AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.2.4

Uses and applications of electromagnetic waves

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**163**
Available paper years	**2003–2024**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.6.2.4 Uses and applications of electromagnetic waves

Answer 01 · Mark scheme June 2003 | 3451F | Original Q3 | Legacy

The full source mark scheme begins on page 140. Follow original question 3 in that document.

Answer 02 · Mark scheme June 2003 | 3451F | Original Q14 | Legacy

The full source mark scheme begins on page 140. Follow original question 14 in that document.

Answer 03 · Mark scheme June 2003 | 3462F3 | Original Q3 | Legacy

The full source mark scheme begins on page 162. Follow original question 3 in that document.

Answer 04 · Mark scheme June 2003 | 3462F3 | Original Q12 | Legacy

The full source mark scheme begins on page 162. Follow original question 12 in that document.

Answer 05 · Mark scheme June 2004 | 3451F | Original Q2 | Legacy

The full source mark scheme begins on page 179. Follow original question 2 in that document.

4.6.2.4 Uses and applications of electromagnetic waves

Answer 06 · Mark scheme June 2004 | 3451F | Original Q11 | Legacy

The full source mark scheme begins on page 179. Follow original question 11 in that document.

Answer 07 · Mark scheme June 2004 | 3462F3 | Original Q2 | Legacy

The full source mark scheme begins on page 200. Follow original question 2 in that document.

Answer 08 · Mark scheme June 2004 | 3462F3 | Original Q9 | Legacy

The full source mark scheme begins on page 200. Follow original question 9 in that document.

Answer 09 · Mark scheme June 2005 | 3451 | Original Q3 | Legacy

The full source mark scheme begins on page 217. Follow original question 3 in that document.

Answer 10 · Mark scheme June 2005 | 3462 | Original Q3 | Legacy

The full source mark scheme begins on page 235. Follow original question 3 in that document.

4.6.2.4 Uses and applications of electromagnetic waves

Answer 11 · Mark scheme June 2006 | 3451 | Original Q4 | Legacy

The full source mark scheme begins on page 249. Follow original question 4 in that document.

Answer 12 · Mark scheme June 2006 | 3451 | Original Q9 | Legacy

The full source mark scheme begins on page 249. Follow original question 9 in that document.

Answer 13 · Mark scheme June 2006 | 3462 | Original Q4 | Legacy

The full source mark scheme begins on page 269. Follow original question 4 in that document.

Answer 14 · Mark scheme June 2006 | 3462 | Original Q9 | Legacy

The full source mark scheme begins on page 269. Follow original question 9 in that document.

Answer 15 · Mark scheme November 2006 | PHY1B | Original Q1 | Legacy

One	**A**	infra red rays	**1**
	B	ultraviolet waves	**3**
	C	visible light	**2**
	D	X-rays	**4**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 16 · Mark scheme November 2006 | PHY1B | Original Q2 | Legacy

Two	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**4**
	D	ultraviolet waves	**2**

Answer 17 · Mark scheme November 2006 | PHY1B | Original Q4 | Legacy

Four	**A**	**3**
	B	**2**
	C	**1**
	D	**4**

Answer 18 · Mark scheme November 2006 | PHY1B | Original Q6 | Legacy

Six	**A**	bar	**3**
	B	categoric	**1**
	C	dependent	**2**
	D	reliable	**4**

	A	**B**	**C**	**D**

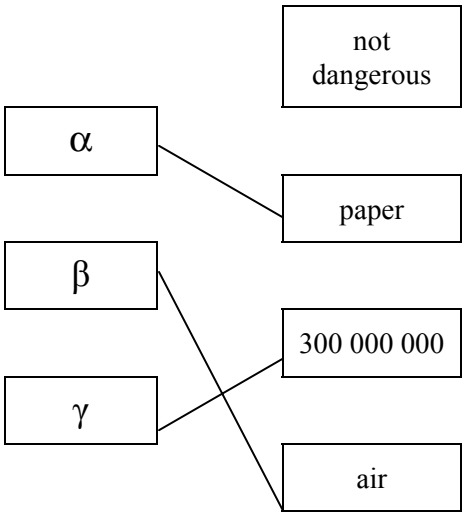
Answer 19 · Mark scheme November 2006 | PHY1B | Original Q7 | Legacy

Seven	**3**	**2**	**4**	**4**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 20 · Mark scheme January 2007 | PHY1F | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
(a)	3 correct lines drawn  	any box in list A with 2 or more lines, all lines for that box do **not** score	3
(b)	radiation damages our cells	accept radiation can cause cancer accept kills cells accept changes DNA / causes mutations accept dangerous / poisonous / harmful / toxic accept so precautions can be taken	1
(c)	it can pass through the human body		1
(d)(i)	6 (hours)	no tolerance	1
(ii)	6 (hours)	accept their (d)(i)	1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

Answer 21 · Mark scheme January 2007 | PHY1F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
(a)(i)	diagram showing only on / off discrete values	'ON' pulses must be equal amplitude	1
(ii)	microwave		1
(b)(i)	identical		1
(ii)	• increased risk of cancerous growth (between ear and brain) • complaints of headaches and tiredness		1 1
(iii)	any **two** from: • tests in a laboratory did not give effects of tiredness or headaches • waves not strong enough to cause long term heat damage to cells • evidence to link mobile phones and ill health is not reliable		2
total			7

4.6.2.4 Uses and applications of electromagnetic waves

Answer 22 · Mark scheme January 2007 | PHY1F | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
(a)(i)	as a source of thermal <u>radiation</u>	accept heat for thermal radiation accept to act as the Sun do **not** accept sunlight alone	1
(ii)	any **one** from: • volume of water • distance between lamp and boiling tube • initial / starting temperature of water • same room temperature	accept amount for volume do **not** accept time or same insulation material	1
(iii)	any **one** from: • greater sensitivity / precision • could link to a computer for (automatic) data analysis • could take more frequent readings • reduces instrument reading error	do **not** accept more reliable (negates mark) accept more accurate do **not** accept easier to use on its own	1
(b)(i)	acts as a control	accept to be able to make a comparison accept to see the difference do **not** accept 'to make it a fair test' OWTTE on its own	1
(ii)	(plastic) <u>foam</u> and aluminium foil		1

Continued on next page

4.6.2.4 Uses and applications of electromagnetic waves

Answer 22 · Mark scheme

question	answers	extra information	mark
(iii)	(aluminium) foil is a poor absorber of thermal radiation **or** (aluminium) foil is a (good) reflector of thermal radiation	accept heat / infra red for thermal radiation do **not** accept 'reflects sunlight' on its own	1
	(plastic) foam traps air which is a (good) insulator	accept (plastic) foam is a poor conductor / (good) insulator do **not** accept 'the material' is a good insulator / poor conductor	1
(c)	particles vibrate with a bigger / stronger amplitude / faster / with more (kinetic) energy	accept particles vibrate more do **not** accept start to vibrate only	1
	energy transferred by collisions with other particles	do **not** accept answers in terms of free/mobile electrons	1
total			9

4.6.2.4 Uses and applications of electromagnetic waves

Answer 23 · Mark scheme March 2007 | PHY1A | Original Q1 | Legacy

Question	Key		
One	**A**	heat	**4**
	B	light	**1**
	C	movement	**2**
	D	sound	**3**

Answer 24 · Mark scheme March 2007 | PHY1B | Original Q1 | Legacy

Question	Key		
One	**A**	infra red	**3**
	B	radio waves	**4**
	C	ultraviolet	**2**
	D	visible light	**1**

Answer 25 · Mark scheme March 2007 | PHY1B | Original Q5 | Legacy

Five	**A**	6	**3**
	B	8	**2**
	C	12	**4**
	D	19	**1**

Answer 26 · Mark scheme March 2007 | PHY1B | Original Q6 | Legacy

Six	**A**	conclusion	**3**
	B	confidentiality	**4**
	C	control	**1**
	D	evidence	**2**

	A	B	C	D

Answer 27 · Mark scheme March 2007 | PHY1B | Original Q7 | Legacy

Seven	**4**	**1**	**1**	**2**

Answer 28 · Mark scheme March 2007 | PHY1B | Original Q9 | Legacy

Nine	**4**	**4**	**3**	**3**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 28 · Mark scheme

March 2007 | PHY1B | Original Q9 | Legacy

PHY1B (Radiation and the Universe) Higher Tier

Question	Key		
One	**A**	conclusion	**3**
	B	confidentiality	**4**
	C	control	**1**
	D	evidence	**2**
Two	**A**	gamma rays	**3**
	B	microwaves	**2**
	C	ultraviolet rays	**1**
	D	X-rays	**4**

	A	B	C	D
Three	**2**	**4**	**1**	**4**
Four	**4**	**4**	**3**	**3**
Five	**1**	**4**	**1**	**4**
Six	**3**	**4**	**4**	**2**
Seven	**2**	**4**	**3**	**4**
Eight	**4**	**1**	**1**	**1**
Nine	**2**	**1**	**3**	**3**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 29 · Mark scheme June 2007 | PHY1B | Original Q1 | Legacy

Question	Key		
One	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	ultraviolet rays	**4**
	D	X-rays	**2**

Answer 30 · Mark scheme June 2007 | PHY1B | Original Q5 | Legacy

Five	**A**	gamma radiation	**4**
	B	X-ray radiation	**3**
	C	alpha radiation	**1**
	D	beta radiation	**2**

Answer 31 · Mark scheme June 2007 | PHY1B | Original Q8 | Legacy

Eight	**1**	**4**	**3**	**1**

Answer 32 · Mark scheme June 2007 | PHY1F | Original Q4 | Legacy

The full source mark scheme begins on page 283. Follow original question 4 in that document.

Answer 33 · Mark scheme June 2007 | PHY1F | Original Q6 | Legacy

The full source mark scheme begins on page 283. Follow original question 6 in that document.

Answer 34 · Mark scheme November 2007 | PHY1B | Original Q1 | Legacy

One	**A**	gamma rays	**2**
	B	infra red rays	**1**
	C	radio waves	**4**
	D	visible light	**3**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 35 · Mark scheme

November 2007 | PHY1B | Original Q5 | Legacy

Five	**A**	0.42	**1**
	B	3	**2**
	C	27.5	**4**
	D	68.5	**3**

Answer 36 · Mark scheme

November 2007 | PHY1B | Original Q6 | Legacy

Six	**A**	analogue electrical signal	**2**
	B	digital light signal	**3**
	C	microwaves	**4**
	D	sound waves	**1**

	A	**B**	**C**	**D**

Answer 37 · Mark scheme

November 2007 | PHY1B | Original Q9 | Legacy

Nine	**4**	**4**	**3**	**3**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 38 · Mark scheme

Question 2

question	answers	extra information	mark
(a)(i)	digital	correct answer only	1
(ii)	(visible) light infra red	answer in either order accept IR	1 1
(b)(i)	25 (%)	do **not** accept ¼	1
(ii)	increases		1
(c)	tick (✓) in top and bottom box	both required	1
(d)	SHINY surfaces are good reflectors of infra-red radiation **or** black surfaces are POOR reflectors of infra-red radiation **or** black surfaces are good EMITTERS of infra-red radiation **or** black surfaces are good ABSORBERS of infra red radiation	accept white for shiny accept bad for poor accept insertion of 'not' before 'good' in statement	1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

Answer 38 · Mark scheme

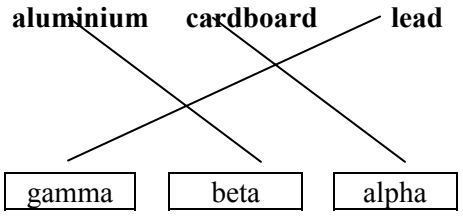
January 2008 | PHY1F | Original Q2 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 39 · Mark scheme January 2008 | PHY1F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
(a)(i)	**P**		1
(ii) A	**Q**		1
(b) G	3 lines correct  	allow **1** mark for 1 correct line two lines drawn from any source or box – both incorrect	2
(c)(i)	**K**		1
(ii)	56	accept 50 – 60 inclusive	1
(iii)	**K**		1
(iv)	to inject... tracer		1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

Answer 39 · Mark scheme

January 2008 | PHY1F | Original Q3 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 40 · Mark scheme

Question 4

question	answers	extra information	mark
(a)	less / no light pollution	accept no / fewer streetlights	1
	less cloud cover / above clouds		1
	less atmospheric pollution	accept air for atmospheric	1
		accept idea of thinner atmosphere	
(b)	microwave	correct answer only	1
(c)	the atmosphere absorbs X-rays		1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

Answer 40 · Mark scheme

January 2008 | PHY1F | Original Q4 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 41 · Mark scheme

Question 5

question	answers	extra information	mark
(a)	top and bottom boxes identified		1
(b)	Medical (treatment) **or** X-rays	answer must be in table accept treatment for medical treatment	1
(c)	15	allow **1** mark for correctly identifying 300 as the average dose	2
total			4

4.6.2.4 Uses and applications of electromagnetic waves

Answer 41 · Mark scheme January 2008 | PHY2F | Original Q5 | Legacy

PHY2F

Answer 42 · Mark scheme March 2008 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	infra red radiation	**3**
	B	gamma radiation	**4**
	C	visible light	**1**
	D	ultraviolet radiation	**2**

Answer 43 · Mark scheme March 2008 | PHY1BP | Original Q3 | Legacy

Three	**A**	SIRTF	**2**
	B	Hubble	**4**
	C	Chandra	**3**
	D	Compton	**1**

Answer 44 · Mark scheme March 2008 | PHY1BP | Original Q4 | Legacy

Four	**A**	alpha	**3**
	B	beta	**2**
	C	gamma	**1**
	D	visible light	**1**

Answer 45 · Mark scheme March 2008 | PHY1BP | Original Q8 | Legacy

Eight	**4**	**1**	**1**	**1**

Answer 46 · Mark scheme March 2008 | PHY1BP | Original Q9 | Legacy

Nine	**4**	**1**	**3**	**4**

Answer 47 · Mark scheme June 2008 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	infra red	**3**
	B	ultraviolet	**2**
	C	visible light	**1**
	D	gamma	**4**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 48 · Mark scheme June 2008 | PHY1BP | Original Q2 | Legacy

Two	**A**	This telescope is used in space and detects light.	**3**
	B	This telescope is used on Earth and detects radio waves.	**1**
	C	This telescope is used on Earth and can be held in the hand.	**2**
	D	This telescope is used on Earth to view distant stars.	**4**

Answer 49 · Mark scheme June 2008 | PHY1BP | Original Q4 | Legacy

Four	**A**	gamma	**1**
	B	infra red	**3**
	C	radio waves	**4**
	D	ultraviolet	**2**

Answer 50 · Mark scheme June 2008 | PHY1BP | Original Q8 | Legacy

Eight	**1**	**4**	**2**	**4**

Answer 51 · Mark scheme June 2008 | PHY1BP | Original Q9 | Legacy

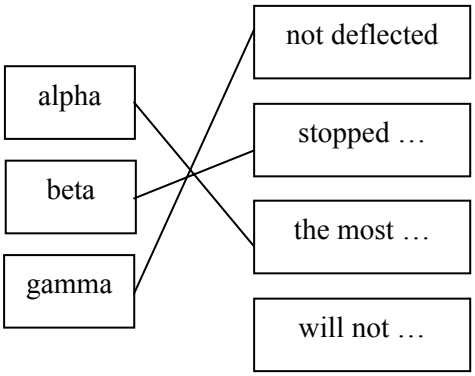
Nine	**4**	**3**	**4**	**3**

GCSE

4.6.2.4 Uses and applications of electromagnetic waves

Answer 52 · Mark scheme June 2008 | PHY1F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
(a)	3 lines correctly drawn  	**1** mark for each correct line if more than one line is drawn from a box in List **A** all lines from that box are wrong	3
(b)	nucleus	accept nuclei do **not** accept nuclear	1
(c)	**Y**	do **not** accept gamma	1
	any **two** from:	do **not** accept other properties of gamma	2
	• least dangerous (inside the body)	do **not** accept not dangerous accept not as harmful as alpha (inside the body)	
	• least ionising		
	• penetrates through the body	do **not** accept can be detected externally	
	• is a gas / can be breathed in	accept it is not a solid (cannot score if **Z** chosen) if **X** chosen can score this gas mark if **Z** chosen can score **both** gamma marks	

Question 3 continues on the next page

PHY1F

Question 3 continued

question	answers	extra information	mark
(d)	any **one** from: • longer shelf life • food can be supplied from around the world • wider market for farmers • cost to consumers (may be) lower • less likely to / will not get food poisoning	do **not** accept kills bacteria accept stays fresh longer / stops it going bad / mouldy accept infection / disease / ill for food poisoning	1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

Answer 52 · Mark scheme June 2008 | PHY1F | Original Q3 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 53 · Mark scheme June 2008 | PHY1F | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
(a)	atmosphere distorts / blocks image	accept clouds block light / global dimming accept because of the atmosphere	1
		accept weather conditions	
	or		
	atmosphere scatters light	accept light pollution	
(b)		do **not** accept answers in terms of mirror size	
	Correct statement related to distance		1
	Sensible comment related to access		1
	eg		
	Hubble telescope is close enough (1) for a spacecraft / astronauts to reach (1)		
	or		
	James Webb is too far away (1) for astronauts to travel to (1)		
		do **not** accept easier to service on it's own	
(c)	To test the design ….		1
(d)	gamma rays	answers in any order	1
	X-rays		1
(e)	Big bang		1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

Answer 53 · Mark scheme June 2008 | PHY1F | Original Q4 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 54 · Mark scheme June 2008 | PHY1F | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
(a)(i)	soil		1
(a)(ii)	type of surface is a categoric (variable)	accept surface is not a continuous (variable) do **not** accept data is discrete	1
(a)(iii)		mark is for a feasible reason linked to either the skier or golfer accept radiation for UV	1
	skier		
	exposed to high(er) level reflected UV **or** less UV absorbed by the atmosphere	accept snow is a good reflector of UV do **not** accept snow reflects UV accept snow is a poor absorber of UV do **not** accept snow absorbs UV	
	golfer		
	out when Sun's intensity is highest **or** larger area of skin / body exposed	accept when Sun is stronger / hotter accept golfer is outside for longer	
(a)(iv)	any **one** from: • (skin) cancer • premature skin ageing	 accept kills / damages cells accept a correct description do **not** accept suntan accept burn (it)	1

Question 6 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

PHY1F

Question 6 continued

question	answers	extra information	mark
(b)(i)	level of UV **transmitted** is very low	accept energy / rays for UV accept answers in terms of absorbed / blocked	1
	for all wavelengths shown / up to 400 nm	only scores if first mark scores accept an answer in terms of cannot support 95 % claim as measurements cannot be taken from the graph **or** an attempted calculation	1
(b)(ii)	glass transmitted most / a lot of UV **or** glass absorbed little UV	accept energy / rays for UV do **not** accept light for UV do **not** accept all UV accept results (almost) same as no absorbing material accept blocks / stops for absorbed do **not** accept no UV	1
(c)(i)	Publicity and education ….		1
(c)(ii)	implication of financial gain	accept to promote the product sunglasses cost a lot of money is insufficient	1
total			9

4.6.2.4 Uses and applications of electromagnetic waves

Answer 54 · Mark scheme June 2008 | PHY1F | Original Q6 | Legacy

PHY1F

Answer 55 · Mark scheme November 2008 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	infra red rays	**4**
	B	visible light	**2**
	C	ultraviolet rays	**3**
	D	X-rays	**1**

Answer 56 · Mark scheme November 2008 | PHY1BP | Original Q2 | Legacy

Two	**A**	gamma rays	**1**
	B	radio waves	**4**
	C	ultraviolet rays	**2**
	D	visible light	**3**

Answer 57 · Mark scheme November 2008 | PHY1BP | Original Q4 | Legacy

Four	**A**	microwaves	**4**
	B	radio waves	**2**
	C	visible light	**1**
	D	X-rays	**3**

Answer 58 · Mark scheme November 2008 | PHY1BP | Original Q5 | Legacy

Five	**A**	alpha radiation	**3**
	B	beta radiation	**4**
	C	gamma radiation	**2**
	D	visible light	**1**

	A	**B**	**C**	**D**

Answer 59 · Mark scheme November 2008 | PHY1BP | Original Q6 | Legacy

Six	**1**	**1**	**3**	**2**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 60 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)(i)	X-rays infra red (rays) radio (waves)	all three in correct order allow **1** mark for **1** correct	2
1(a)(ii)	to kill cancer cells		1
1(a)(iii)	energy		1
Total			**4**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 60 · Mark scheme

January 2009 | PHY1F | Original Q1 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 61 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)(i)	shorter than		1
2(a)(ii)	increase slightly		1
2(b)(i)	go up in the same ratio **or** (directly) proportional **or** as speed (of the tennis ball) increases so does the (difference in) frequency	accept as one goes up, so does the other accept positive correlation	1
2(b)(ii)	20 (m/s)	allow **1** mark for showing correct method on graph (ie horizontal or vertical line anywhere on graph) if indicated by a cross, must be ± half square of correct value)	2
2(b)(iii)	frequency and speed are both continuous variables		1
Total			**6**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 61 · Mark scheme January 2009 | PHY1F | Original Q2 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 62 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)	**C**		1
4(b)	beta	accept gamma if answer alpha can still gain marks for saying why not beta or gamma	1
	any **two** from: • range in air for beta is (at least) 50 cm • count-rate does not drop (much) in first 40 cm • count-rate does not fall much until distance is 60 cm • alphas cannot travel more than 5 cm in air / alphas could not travel 100 cm in air • alphas would not be detected • gammas not absorbed by 100 cm of air	must have at least one quantitative statement to get **2** marks accept alphas cannot travel that far accept gammas not stopped by air accept gammas travel further than alphas and betas strength of source is neutral references to penetrating power is neutral	2
4(c)(i)	increases		1

Question 4 continues on the next page

PHY1F

Question 4 continued

question	answers	extra information	mark
4(c)(ii)	Group **A** think that (even a very small level of exposure) gives some risk Group **B** think that there is no risk (from a very low level of exposure)	accept there is always a risk, no matter how small the level of exposure accept below a certain level of exposure there is no risk no marks for a simple graph description	1 1
Total			**7**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 62 · Mark scheme

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 63 · Mark scheme

Question 1

question	answers	extra information	mark
1	**four** lines correct **List A** the nuclei of two atoms joining together the nucleus of an atom splitting into several pieces an atom losing an electron an electric charge moving through a metal **List B** gamma emission electric current ionisation nuclear fission nuclear fusion	allow **1** mark for each correct line if more than 1 line is drawn from a box in List A, mark each line incorrect	4
Total			**4**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 63 · Mark scheme January 2009 | PHY2F | Original Q1 | Legacy

PHY2F

Answer 64 · Mark scheme March 2009 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	infra red	**4**
	B	visible light	**1**
	C	ultraviolet	**3**
	D	X-rays	**2**

Answer 65 · Mark scheme March 2009 | PHY1BP | Original Q2 | Legacy

Two	**A**	alpha	**2**
	B	beta	**3**
	C	electron	**4**
	D	gamma	**1**

Answer 66 · Mark scheme March 2009 | PHY1BP | Original Q3 | Legacy

Three	**A**	conclusion	**4**
	B	control variable	**2**
	C	prediction	**1**
	D	independent variable	**3**

Answer 67 · Mark scheme March 2009 | PHY1BP | Original Q6 | Legacy

Six	**2**	**1**	**2**	**1**

Answer 68 · Mark scheme March 2009 | PHY1BP | Original Q8 | Legacy

Eight	**1**	**3**	**2**	**1**

Answer 69 · Mark scheme March 2009 | PHY1BP | Original Q9 | Legacy

Nine	**2**	**3**	**2**	**3**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 70 · Mark scheme June 2009 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	infra red	**2**
	B	microwaves	**3**
	C	radio waves	**4**
	D	visible light	**1**

Answer 71 · Mark scheme June 2009 | PHY1BP | Original Q3 | Legacy

Three	**A**	wearing thick, insulating gloves	**4**
	B	leaving the room	**1**
	C	looking through blackened glass	**3**
	D	using sun cream	**2**

Answer 72 · Mark scheme June 2009 | PHY1BP | Original Q4 | Legacy

Four	**A**	8	**4**
	B	12	**3**
	C	30	**2**
	D	60	**1**

Answer 73 · Mark scheme June 2009 | PHY1BP | Original Q5 | Legacy

Five	**A**	microwaves	**3**
	B	X-rays	**1**
	C	visible light	**2**
	D	radio waves	**4**

	A	**B**	**C**	**D**

Answer 74 · Mark scheme June 2009 | PHY1BP | Original Q9 | Legacy

Nine	**1**	**1**	**3**	**4**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 75 · Mark scheme

June 2009 | PHY1F | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	HESS	accept gamma	1
6(a)(ii)	infra red	accept IR accept answers written in table do **not** accept heat	1
6(b)	clearer / more detailed / sharper / less distorted image any **one** from: • no light pollution • light is not scattered by the atmosphere	do **not** accept image is bigger accept no clouds to prevent observations accept light is scattered by the atmosphere (implies William Herschel) accept light does (not have to) pass through the atmosphere accept air for atmosphere do **not** accept answers in terms of distance	1 1

Question 6 continues on the next page . . .

PHY1F

Question 6 continued . . .

question	answers	extra information	mark
6(c)	any **two** from: • <u>microwaves absorbed</u> by water (molecules) • signal strength greater (in dry environment) • more sensitive (in dry environment) • detect weaker signals (in dry environment) • more detailed / clearer image (in dry environment)	accept more microwaves reach telescope accept harder to detect signals in a humid environment accept image contains more information do **not** accept better image	2
6(d)	a fourth / extra galaxy / star	accept a planet / another object / source	1
Total			**7**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 75 · Mark scheme

June 2009 | PHY1F | Original Q6 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 76 · Mark scheme

June 2009 | PHY1F | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	any **one** from: • less (prone to) interference • can be (easily) processed by computers • better (quality) signal • signal can be restored	accept interference causes less / no permanent damage accept no interference accept noise / distortion for interference accept can be processed without an analogue to digital converter accept clearer signal do **not** accept faster / sends more information	1
7(a)(ii)	cooking **or** satellite communication	do **not** accept microwave (oven) accept radar accept (microwave) telescopes accept Wi-Fi do **not** accept radio	1
7(b)(i)	compare (the health of) mobile phone users with non-mobile phone users	must be an implied comparison between users and non-users any idea of doing an experiment negates the mark	1
7(b)(ii)	increase the sample size	accept use more people accept have a large sample size repeat the research / test is neutral	1

Question 7 continues on the next page . . .

PHY1F

Question 7 continued . . .

question	answers	extra information	mark
7(b)(iii)	ethical		1
7(c)(i)	so the phones can be compared (fairly)	a fair test is insufficient accept different tests (may) give different results do **not** accept to make the results reliable, unless qualified eg all variables are controlled do **not** accept bias unless qualified	1
7(c)(ii)	yes all are below the legal limit / 2 (W/kg) **or** no and any **one** from: • even absorbing a small amount of energy may be harmful • no proof that small amounts of energy are not harmful	 accept microwaves for energy accept emits energy absorbed by head / other parts of body accept because the SAR value is not 0 (W/kg)	1
7(d)	any **one** from: • to get an independent opinion • company scientists may be biased	 accept company scientists may manipulate results	1
Total			**8**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 77 · Mark scheme

November 2009 | PHY1BP | Original Q1 | Legacy

Question			Key
One	**A**	infra red	**2**
	B	microwaves	**1**
	C	ultraviolet	**4**
	D	X-rays	**3**

Answer 78 · Mark scheme

November 2009 | PHY1BP | Original Q2 | Legacy

Two	**A**	gamma	**2**
	B	infra red	**3**
	C	radio	**1**
	D	visible light	**4**

Answer 79 · Mark scheme

November 2009 | PHY1BP | Original Q6 | Legacy

Six	**4**	**2**	**3**	**2**

Answer 80 · Mark scheme

November 2009 | PHY1BP | Original Q8 | Legacy

Eight	**2**	**4**	**2**	**2**

Answer 81 · Mark scheme

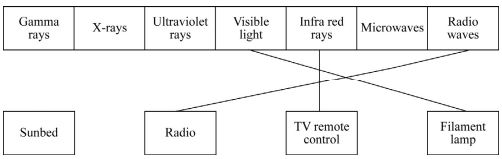
November 2009 | PHY1BP | Original Q9 | Legacy

Nine	**2**	**1**	**2**	**3**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 82 · Mark scheme January 2010 | PHY1F | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	all three lines correct  	allow **1** mark for each correct line if more than one line goes from a device then all lines from that device are wrong	3
1(b)(i)	<u>skin</u> cancer	do **not** accept cancer do **not** accept sunburn correct answer only	1
1(b)(ii)	other factors may be involved	accept may have been in the Sun too long accept (over)-use of sunbeds and (over)-exposure to the Sun (both) give the same symptoms accept any other sensible factor that could lead to doubt do **not** accept irrelevant answers eg may be run over by a car do **not** accept large numbers killed by exposure to the Sun	1
1(b)(iii)	can assess risk **or** make your own decision	answers should be in terms of assessing your own health risk accept so you limit its use / don't use one do **not** accept so you don't get skin cancer do **not** accept so you don't get sunburn	1
Total			**6**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 82 · Mark scheme

January 2010 | PHY1F | Original Q1 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 83 · Mark scheme January 2010 | PHY1F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	85		1
3(b)(i)	thickness (of glass)	accept how thick the glass is do **not** accept light intensity	1
3(b)(ii)	transmits less infra red infra red has a heating effect **or** infra red warms the room	accept radiation / or heat for infra red accept transmits less energy (at all wavelengths) accept (glass **B**) absorbs more infra red accept infra red is the same as heat ignore reference to visible light ignore references to conservatory keeping cool	1 1
3(c)	**Z**		1
Total			**5**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 83 · Mark scheme

January 2010 | PHY1F | Original Q3 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 84 · Mark scheme

Question 5

question	answers	extra information	mark
5(a)(i)	(visible) light		1
5(a)(ii)	any **one** from: • less / no light pollution • less atmospheric distortion / interference • less / no cloud cover • **image / picture** is clearer	 accept no street lights accept less / thinner atmosphere do **not** accept no atmosphere accept less atmospheric pollution do **not** accept less pollution accept above the clouds do **not** accept gives a clearer view / signal	1
5(b)	on a satellite	accept in orbit / space accept in a high altitude balloon accept above the atmosphere do **not** accept on top of a mountain do **not** accept on a plane ignore any reason given correct or otherwise	1
5(c)	The Universe began from a very small point.		1
Total			**4**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 84 · Mark scheme January 2010 | PHY1F | Original Q5 | Legacy

PHY1F

Answer 85 · Mark scheme March 2010 | PHY1BP | Original Q1 | Legacy

Question			Key
One	**A**	microwaves	**4**
	B	ultraviolet rays	**1**
	C	visible light	**2**
	D	X-rays	**3**

Answer 86 · Mark scheme March 2010 | PHY1BP | Original Q2 | Legacy

Two	**A**	gamma	**3**
	B	infra red	**4**
	C	radio	**1**
	D	ultraviolet	**2**

Answer 87 · Mark scheme March 2010 | PHY1BP | Original Q4 | Legacy

Four	**A**	alpha	**3**
	B	beta	**4**
	C	gamma	**2**
	D	X-rays	**1**

Answer 88 · Mark scheme March 2010 | PHY1BP | Original Q6 | Legacy

Six	**1**	**2**	**2**	**1**

Answer 89 · Mark scheme March 2010 | PHY1BP | Original Q9 | Legacy

Nine	**2**	**4**	**2**	**1**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 90 · Mark scheme June 2010 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	gamma rays	**1**
	B	microwaves	**4**
	C	visible light	**3**
	D	X-rays	**2**

Answer 91 · Mark scheme June 2010 | PHY1BP | Original Q2 | Legacy

Two	**A**	alpha	**3**
	B	beta	**2**
	C	gamma	**1**
	D	X-rays	**4**

Answer 92 · Mark scheme June 2010 | PHY1BP | Original Q3 | Legacy

Three	**A**	alpha	**2**
	B	beta	**3**
	C	gamma	**1**
	D	X-rays	**4**

Answer 93 · Mark scheme June 2010 | PHY1BP | Original Q6 | Legacy

Six	4	2	2	1

Answer 94 · Mark scheme June 2010 | PHY1BP | Original Q8 | Legacy

Eight	3	3	4	2

4.6.2.4 Uses and applications of electromagnetic waves

Answer 95 · Mark scheme

June 2010 | PHY1F | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	infra red (rays) **or** radio (waves)	accept IR do **not** accept heat waves do **not** accept TV waves	1
2(a)(ii)	radio (waves)	this answer only	1
2(b)	frequency		1
2(c)(i)	need to know if it is harmful / makes you ill	answer should be in terms of establishing if harmful or not harmful ie trying to clear up any uncertainty do **not** accept answers that assume it is harmful eg Wi-Fi systems will make you ill accept idea that safety issue may worry people accept idea that (more) research may reassure people accept idea of finding out (the truth)	1
2(c)(ii)	an opinion		1
Total			**5**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 95 · Mark scheme June 2010 | PHY1F | Original Q2 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 96 · Mark scheme

June 2010 | PHY1F | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	gamma will pass through the body **or** alpha will not pass through the body	it refers to gamma answers must relate to the body accept skin for body	1
	gamma is only slightly ionising **or** alpha is heavily ionising	accept gamma causes less damage to cells / tissue do **not** accept gamma causes no damage to cells less harmful is insufficient	1
7(b)(i)	(both graphs show an initial) increase in count-rate	accept both show an increase	1
7(b)(ii)	only the right kidney is working correctly		1
	any **two** from: • count-rate / level / line for right kidney decreases (rapidly) • count-rate / level / line for <u>left</u> kidney does not change • radiation is being passed out / into urine - if referring to right kidney • radiation is not being passed out - if referring to the left kidney	if incorrect box chosen maximum of **1** mark can be awarded reference to named kidney can be inferred from the tick box it decreases is insufficient it does not change is insufficient	2

Question 7 continues on the next page . . .

PHY1F

Question 7 continued . . .

question	answers	extra information	mark
7(c)(i)	time taken for number of nuclei to halve **or** time taken for the count-rate to halve		1
7(c)(ii)	short half-life - the level of radiation (in the body) decreases rapidly to a safe / very small level **or** a long half-life - the radiation remains in the body / for a long time level of radiation remains high	it refers to short life isotope answers in terms of damage eg cancer are insufficient	1 1
Total			**9**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 97 · Mark scheme

June 2019 | PHY2F | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	2.5		1
7(a)(ii)	The radiation dose from natural sources is much greater than from artificial sources.		1
7(b)(i)	other factors may be involved	accept a specific suggestion eg they may be exposed to other types of radiation accept cannot be sure (in many cases) that the cause of death is radon (poisoning)	1
7(b)(ii)	any **one** from: • different concentrations in different rooms • to average out daily fluctuations	accept to find an average accept to make the result (more) reliable / valid do **not** accept to make more accurate on its own	1
7(b)(iii)	average level (much) higher (in **C** and **D**) some homes have very high level (in **C** and **D**) **or** maximum level in some homes (in **C** and **D**) is very high	accept converse accept maximum level in **A** and **B** is low accept higher radiation levels (in **C** and **D**) for **1** mark	1 1
Total			**6**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 98 · Mark scheme November 2010 | PHY1AP | Original Q1 | Legacy

Question			Key
One	**A**	conduction	**2**
	B	insulation	**3**
	C	radiation	**1**
	D	reflection	**4**

Answer 99 · Mark scheme November 2010 | PHY1BP | Original Q1 | Legacy

Question			Key
One	**A**	infra red	**1**
	B	ultraviolet	**4**
	C	visible light	**3**
	D	X-rays	**2**

Answer 100 · Mark scheme November 2010 | PHY1BP | Original Q2 | Legacy

Two	**A**	can be used by anyone to view the surface of the moon	**2**
	B	in orbit around the Earth	**3**
	C	built on the top of a mountain and can be used to view planets	**4**
	D	used by scientists to detect radio waves from space	**1**

Answer 101 · Mark scheme November 2010 | PHY1BP | Original Q3 | Legacy

Three	**A**	infra red	**4**
	B	microwaves	**3**
	C	radio waves	**1**
	D	visible light	**2**

Answer 102 · Mark scheme November 2010 | PHY1BP | Original Q4 | Legacy

Four	**A**	gamma	**1**
	B	infra red	**3**
	C	radio	**4**
	D	ultraviolet	**2**

Answer 103 · Mark scheme November 2010 | PHY1BP | Original Q6 | Legacy

Six	**2**	**4**	**3**	**4**

Answer 104 · Mark scheme November 2010 | PHY1BP | Original Q7 | Legacy

Seven	**1**	**1**	**2**	**3**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 105 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)	**1** mark for each correct line **List A** Type of nuclear radiation Alpha Beta Gamma **List B** Property of radiation Has the same mass as an electron Very strongly ionising Passes through 10 cm of aluminium Deflected by a magnetic field but not deflected by an electric field	if more than 1 line is drawn from any box in List **A**, none of those lines gain any credit	3
3(b)(i)	(the detector) reading had gone down	'it' equals detector reading accept the reading in the table is the smallest accept 101 is (much) lower than other readings / a specific value eg 150 do **not** accept this answer if it indicates the readings are the thickness	1
	more beta (particles / radiation) is being absorbed / stopped	accept radiation for beta particles / radiation accept fewer particles being detected	1
3(b)(ii)	six years		1

Question 3 continues on the next page . . .

4.6.2.4 Uses and applications of electromagnetic waves

PHY1F

Question 3 continued . . .

question	answers	extra information	mark
3(b)(iii)	alpha would not penetrate the cardboard	accept the basic property- alpha (particles) cannot pass through paper / card accept alpha (particles) are less penetrating (than beta) range in air is neutral	1
Total			**7**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 105 · Mark scheme January 2011 | PHY1F | Original Q3 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 106 · Mark scheme

January 2011 | PHY1F | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	higher frequency **or** shorter wavelength **or** greater energy	general properties / uses are neutral do **not** accept different frequency / wavelength / energy	1
6(b)	the same (speed)	accept they travel at the speed of light	1
6(c)	pass through / transmitted by the plastic / casing <u>reflected</u> by the metal / plates	 do **not** accept bounce / deflected etc for reflected if neither marking point scores an answer reflected (back to boat / from the device) scores **1** mark	1 1
6(d)(i)	waves are not <u>reflected</u> from the walls **or** only waves (reflected) from the device are detected	accept microwaves / radar for waves do **not** accept bounce / deflected etc for reflected accept to stop reflected waves affecting results	1

Question 6 continues on the next page . . .

PHY1F

Question 6 continued . . .

question	answers	extra information	mark
6(d)(ii)	different types (of device) can be compared	fair test is insufficient accept idea that only one variable is then changed	1
6(d)(iii)	so (measurements / results / scientists) are not biased towards one type / manufacturer of device/s	accept to avoid bias accept so they are not biased	1
6(e)(i)	any **two** from: • (for any angle) **A** values < **B** values • **A** values increase with (increasing) angle • **B** values decrease with (increasing) angle • **A** values do not vary as much (as **B** values)	if temperature is mentioned rather than angle a maximum of **1** mark can be scored **or** converse eg **B** values are higher / better / stronger accept weakest at 0° strongest at 15° values go up is insufficient accept strongest at 0° weakest at 15° values go down is insufficient	2
6(e)(ii)	**D** values are always over 2(.0)	mark is for the reason reason cannot score if **D** is not chosen	1
Total			**10**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 106 · Mark scheme January 2011 | PHY1F | Original Q6 | Legacy

PHY1F

Answer 107 · Mark scheme March 2011 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	infra red	**3**
	B	microwaves	**2**
	C	radio waves	**1**
	D	visible light	**4**

Answer 108 · Mark scheme March 2011 | PHY1BP | Original Q2 | Legacy

Two	**A**	infra red	**3**
	B	microwaves	**2**
	C	visible light	**1**
	D	X-rays	**4**

Answer 109 · Mark scheme March 2011 | PHY1BP | Original Q3 | Legacy

Three	**A**	bacteria	**3**
	B	cells	**2**
	C	isotopes	**1**
	D	particles	**4**

Answer 110 · Mark scheme March 2011 | PHY1BP | Original Q4 | Legacy

Four	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**4**
	D	ultraviolet rays	**2**

Answer 111 · Mark scheme March 2011 | PHY1BP | Original Q7 | Legacy

Seven	**1**	**4**	**1**	**2**

Answer 112 · Mark scheme March 2011 | PHY1BP | Original Q8 | Legacy

Eight	**1**	**3**	**2**	**1**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 113 · Mark scheme

March 2011 | PHY1BP | Original Q9 | Legacy

Nine	**4**	**1**	**2**	**2**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 113 · Mark scheme

March 2011 | PHY1BP | Original Q9 | Legacy

GCSE

SCIENCE A (4461) / PHYSICS (4451)

Objective Test Answer Key

PHY1BP (Radiation and the Universe)

March 2011

Higher Tier

Question	Key		
One	**A**	a belief that science cannot disprove	**1**
	B	a conclusion based on observations of red-shift	**3**
	C	a theory supported by scientific evidence but not direct observations	**4**
	D	a theory that science has disproved	**2**
Two	**A**	Isotope **A**	**4**
	B	Isotope **B**	**1**
	C	Isotope **C**	**3**
	D	Isotope **D**	**2**

	A	**B**	**C**	**D**
Three	**1**	**3**	**2**	**1**
Four	**4**	**1**	**2**	**2**
Five	**4**	**3**	**4**	**3**
Six	**2**	**3**	**2**	**4**
Seven	**1**	**2**	**3**	**4**
Eight	**3**	**2**	**4**	**2**
Nine	**2**	**3**	**4**	**3**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 114 · Mark scheme June 2011 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	infra red	**1**
	B	ultraviolet	**3**
	C	visible light	**2**
	D	X-rays	**4**

Answer 115 · Mark scheme June 2011 | PHY1BP | Original Q2 | Legacy

Two	**A**	alpha	**4**
	B	beta	**1**
	C	gamma	**2**
	D	X-rays	**3**

Answer 116 · Mark scheme June 2011 | PHY1BP | Original Q3 | Legacy

Three	**A**	leaving the room to switch on the equipment	**2**
	B	looking through blackened glass	**1**
	C	wearing thick, insulating gloves	**3**
	D	using remotely controlled equipment	**4**

Answer 117 · Mark scheme June 2011 | PHY1BP | Original Q9 | Legacy

Nine	**2**	**3**	**4**	**1**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 118 · Mark scheme

June 2011 | PHY1F | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	microwave		1
2(a)(ii)	**C**		1
2(a)(iii)	Digital signals are less affected by interference.		1
2(b)(i)	infra red		1
2(b)(ii)	2 or 3 reflections shown	lines are straight and most angles look correct by eye four or more reflections gains **1** mark only ray must touch side of the fibre to qualify as a reflection ray must reach end of the fibre	2
Total			**6**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 118 · Mark scheme June 2011 | PHY1F | Original Q2 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 119 · Mark scheme

June 2011 | PHY1F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	high		1
3(b)(i)	reduce		1
3(b)(ii)	increases (it) less / no vitamin D produced	points may score written in either answer space do **not** accept less sunlight / UV	1 1
Total			**4**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 119 · Mark scheme June 2011 | PHY1F | Original Q3 | Legacy

PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 120 · Mark scheme

June 2011 | PHY1F | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	any **two** from: • light pollution • cloud cover • atmospheric pollution • telescope not powerful enough • distant stars are not bright enough	accept street lights the weather is insufficient do **not** accept very general statements eg 'the weather' or 'the atmosphere' accept a description of atmospheric pollution accept sensible comment regarding zoom of telescope accept lens is not strong enough accept diameter of lens is too small do **not** accept lens is not big enough	2
4(b)	any **one** from: • difficult / expensive / to maintain / repair • expensive to put into space	accept have to go into space to fix it ignore answers in terms of collision with other objects in space	1

Question 4 continues on the next page

4.6.2.4 Uses and applications of electromagnetic waves

PHY1F

Question 4 continued

question	answers	extra information	mark
4(c)(i)	The atmosphere absorbs gamma rays.		1
4(c)(ii)	support the theories that predict WIMPs exist		1
Total			**5**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 120 · Mark scheme June 2011 | PHY1F | Original Q4 | Legacy

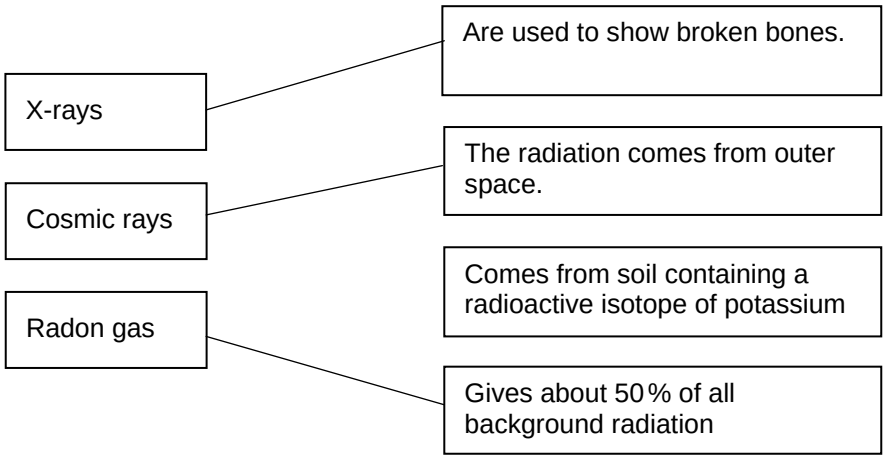
PHY1F

4.6.2.4 Uses and applications of electromagnetic waves

Answer 121 · Mark scheme

June 2011 | PHY2F | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1	**1** mark for each correct line  	If more than 1 line has been drawn from a box in **List A** then all those lines are marked incorrect.	3
Total			**3**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 121 · Mark scheme June 2011 | PHY2F | Original Q1 | Legacy

PHY2F

Answer 122 · Mark scheme November 2011 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**4**
	D	visible light	**2**

Answer 123 · Mark scheme November 2011 | PHY1BP | Original Q2 | Legacy

Two	**A**	alpha particle	**4**
	B	beta particle	**2**
	C	gamma ray	**1**
	D	X-rays	**3**

Answer 124 · Mark scheme November 2011 | PHY1BP | Original Q5 | Legacy

Five	**A**	gamma rays	**1**
	B	infra red rays	**3**
	C	radio waves	**2**
	D	ultraviolet rays	**4**

	A	**B**	**C**	**D**

Answer 125 · Mark scheme November 2011 | PHY1BP | Original Q6 | Legacy

Six	**2**	**2**	**3**	**3**

Answer 126 · Mark scheme November 2011 | PHY1BP | Original Q8 | Legacy

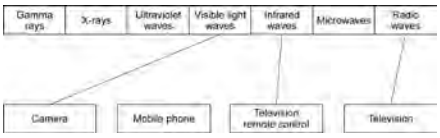
Eight	**2**	**1**	**2**	**2**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 127 · Mark scheme

June 2012 | PH1FP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	3 lines drawn linking: camera to visible light television to radio waves remote control to infrared 	if more than one line is drawn from any device all those lines are incorrect	1 1 1
2(b)	300 000 km/s **or** 300 000 000 m/s	unit required accept the same (as light) accept the speed of light	1
2(c)	a longer wavelength than		1
2(d)(i)	refraction	do **not** allow a misspelling that might be reflection	1
2(d)(ii)	travelling along the normal	accept light is at 90° to the surface / block light is not entering at an angle is insufficient	1
Total			**7**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 127 · Mark scheme

June 2012 | PH1FP | Original Q2 | Legacy

PH1FP

4.6.2.4 Uses and applications of electromagnetic waves

Answer 128 · Mark scheme

June 2012 | PH1FP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	any suitable risk eg being injured by a car	accept a measure to reduce the risk eg stand well away from edge of pavement stay on school grounds / don't go onto the street be aware of the dangers of traffic car travelling at high speed is insufficient	1
3(a)(ii)	increased		1
3(b)(i)	S S		1 1
3(b)(ii)	big bang (theory)		1
3(b)(iii)	CMBR comes from all parts of the Universe		1
3(b)(iv)	At the moment it is the best way of explaining our scientific knowledge		1
Total			7

4.6.2.4 Uses and applications of electromagnetic waves

Answer 128 · Mark scheme

June 2012 | PH1FP | Original Q3 | Legacy

PH1FP

4.6.2.4 Uses and applications of electromagnetic waves

Answer 129 · Mark scheme

June 2012 | PH1FP | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	any **two** from: • black is a good emitter of (infrared radiation) • large surface (area) • matt surfaces are better emitters (than shiny surfaces)	accept heat for radiation ignore reference to absorbing radiation accept matt surfaces are good emitters ignore reference to good conductor	2
7(b)	90 % or 0.9(0)	efficiency = useful energy out / total energy in (×100%) allow **1** mark for correct substitution ie 13.5 / 15 provided no subsequent step shown an answer of 90 scores **1** mark an answer of 90 / 0.90 with a unit scores **1** mark	2
7(c)	(producing) light	allow (producing) sound	1

Question 7 continues on the next page

PH1FP

Question 7 continued

question	answers	extra information	mark
7(d)	any **two** from: • wood is renewable • (using wood) conserves fossil fuels • wood is carbon neutral	 accept wood grows again / quickly accept wood can be replanted accept doesn't use fossil fuels accept a description cheaper / saves money is insufficient	2
7(e)	2 550 000 joules /J	$E = m \times c \times \theta$ allow **1** mark for correct substitution ie $100 \times 510 \times 50$ provided no subsequent step shown answers of 1 020 000, 3 570 000 gain **1** mark accept kJ / MJ do **not** accept j for full credit the unit and numerical answer must be consistent	2 1
Total			**10**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 129 · Mark scheme

June 2012 | PH1FP | Original Q7 | Legacy

PH1FP

4.6.2.4 Uses and applications of electromagnetic waves

Answer 130 · Mark scheme

June 2012 | PH2FP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	on average, cosmic rays produce less background radiation than rocks. having no X-rays reduces a person's radiation dose.		1 1
6(a)(ii)	4	allow **1** mark for 350 / 4 allow **1** mark for an answer 3.5	2
6(b)(i)	(risk) increases		1
6(b)(ii)	C shows a lower risk for low doses (than for zero exposure)	reason only scores if **C** chosen accept risk reduces when you go from low to moderate (doses)	1 1
6(c)(i)	YES fewer mice exposed first to a low dose get cancer (than those only exposed to a high dose) NO the results are for mice (1) and may not be applicable to people (1)	no mark for YES or NO, marks are for the explanation only scores if first marking point scores	1 1
6(c)(ii)	ethical		1
Total			**10**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 130 · Mark scheme

June 2012 | PH2FP | Original Q6 | Legacy

PH2FP

4.6.2.4 Uses and applications of electromagnetic waves

Answer 131 · Mark scheme

Question 5

question	answers	extra information	mark
5(a)	to reflect (the infrared)	accept (shiny surfaces) are good reflectors ignore reference to incorrect type of wave	1
5(b)	black best absorber (of infrared)	 answer should be comparative black absorbs (infrared) is insufficient accept good absorber (of infrared) ignore reference to emitter ignore attracts heat ignore reference to conduction	1 1
5(c)	to reduce energy loss **or** so temperature of water increases faster **or** reduces loss of water (by evaporation)	accept to stop energy loss accept heat for energy accept to stop / reduce convection accept to heat water faster accept cooks food faster	1
5(d)	672 000	 allow **1** mark for correct substitution, ie 2 × 4200 × 80 provided no subsequent step shown	2
Total			**6**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 131 · Mark scheme

January 2013 | PH1FP | Original Q5 | Legacy

PH1FP

4.6.2.4 Uses and applications of electromagnetic waves

Answer 132 · Mark scheme

June 2013 | PH1FP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	(visible) light	accept visible	1
2(a)(ii)	microwaves		1
2(b)	J		1
2(c)(i)	B		1
2(c)(ii)	shorter than		1
2(d)(i)	To find out if using a mobile phone is harmful to health		1
2(d)(ii)	any **two** from: • (X has a) low(er) SAR value • (maximum) energy absorbed (by the head) is less • (if mobiles are harmful) less likely to cause harm	"it" refers to mobile phone accept has a low(er) rate accept energy emitted (by phone) is less accept radiation for energy accept will not cause harm accept it is safer	2
Total			**8**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 132 · Mark scheme

June 2013 | PH1FP | Original Q2 | Legacy

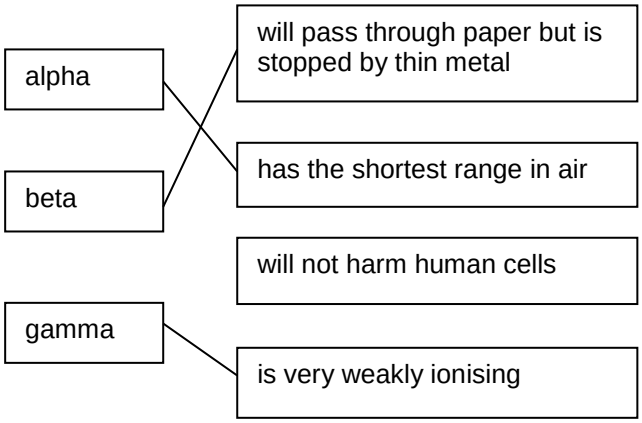
PH1FP

4.6.2.4 Uses and applications of electromagnetic waves

Answer 133 · Mark scheme

June 2013 | PH2FP | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	3 lines correct  	allow **1** mark for each correct line if more than one line is drawn from any type of radiation box then all of those lines are wrong	3
1(b)	Gamma radiation will pass through the body		1
1(c)	half		1
1(d)	protons		1
Total			**6**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 133 · Mark scheme

June 2013 | PH2FP | Original Q1 | Legacy

PH2FP

4.6.2.4 Uses and applications of electromagnetic waves

Answer 134 · Mark scheme

Question 8

question	answers	extra information	mark
8(a)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.		6

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant / correct content.	There is a basic description of either wave **OR** What happens to either wave when they enter the body. However there is little other detail.	There is either: A clear description of BOTH waves **OR** A clear description as to what happens to BOTH waves inside the body **OR** A clear description of ONE of the waves with clear detail as to what happens to either wave inside the body.	There is a detailed description of BOTH of the waves **AND** A detailed description as to what happens to EITHER wave inside the body.

Question 8 continues on the next page . . .

PH3FP

Question 8 continued . . .

Examples of the points made in the response: **<u>Description of an X-ray</u>** • X-rays are electromagnetic waves / part of the electromagnetic spectrum • X-rays are (very) high frequency (waves) • X-rays are (very) high energy (waves) • X-rays have a (very) short wavelength • Wavelength (of X-rays) is of a similar size to (the diameter of) an atom • X-rays are a transverse wave • X-rays are ionising radiation **<u>Description of ultrasound</u>** • ultrasound has a <u>frequency</u> above 20 000 (hertz) **OR** ultra sound is above 20 000 hertz • ultrasound is above / beyond the human (upper) limit (of hearing) • ultrasound is a longitudinal wave **<u>Statement(s) as to what happens to X-rays inside the human body:</u>** • X-rays are absorbed by bone • X-rays travel through / are transmitted by tissue / skin **<u>Statement as to what happens to ultrasound inside body:</u>** • ultrasound is (partially) reflected at / when it meets a boundary between two different media • travel at different speeds through different media	do **not** allow a description of a property – eg X-rays travel through a vacuum / at the speed of light correct description acceptable – oscillations / vibrations are perpendicular (at 90°) to direction of energy transfer accept ultrasound cannot be heard by humans correct description acceptable – oscillations / vibrations (of particles) are parallel (in same direction) to direction of energy transfer	

Question 8 continues on the next page . . .

PH3FP

Question 8 continued . . .

question	answers	extra information	mark
8(b)	(because the X-rays) are ionising	accept a description of what ionising is	1
	(they will) damage cells **or** mutate cells / cause mutations / increase chances of mutations **or** turn cells cancerous / produce abnormal growths / produce rapidly growing cells **or** kill cells	instead of cell, any of these words can be used: DNA / genes / chromosomes / nucleus do **not** accept they can be dangerous (to human health) do **not** accept damage to soft tissue	1
8(c)	any **one** from: • removal / destruction of kidney / gall stones		1
	• repair of damaged tissue / muscle	accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation accept physiotherapy accept curing prostate cancer **or** killing prostate cancer cells	
	• removing plaque from teeth	cleaning teeth is insufficient	
Total			**9**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

4.6.2.4 Uses and applications of electromagnetic waves

Answer 135 · Mark scheme June 2014 | PH3FP | Original Q1 | Legacy

The full source mark scheme begins on page 295. Follow original question 1 in that document.

Answer 136 · Mark scheme June 2014 | PH3FP | Original Q7 | Legacy

The full source mark scheme begins on page 295. Follow original question 7 in that document.

Answer 137 · Mark scheme June 2015 | PH1FP | Original Q4 | Legacy

The full source mark scheme begins on page 312. Follow original question 4 in that document.

Answer 138 · Mark scheme June 2015 | PH1FP | Original Q6 | Legacy

The full source mark scheme begins on page 312. Follow original question 6 in that document.

Answer 139 · Mark scheme June 2015 | PH2FP | Original Q6 | Legacy

The full source mark scheme begins on page 328. Follow original question 6 in that document.

4.6.2.4 Uses and applications of electromagnetic waves

Answer 140 · Mark scheme June 2015 | PH3FP | Original Q9 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
9(a)	20,000	accept 20 kilo **or** 20 k **or** 20 001	1	AO1 P3.1.2a
	an atom		1	AO1 P3.1.1a

Question 9 continues on the next page . . .

4.6.2.4 Uses and applications of electromagnetic waves

Answer 140 · Mark scheme

June 2015 | PH3FP | Original Q9 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(b)			6	AO1 P3.1 P3.1.1c

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a 'best-fit' approach to the marking.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
no relevant content	At least one relevant statement is given for either type of wave	**either** a use, risk and precaution is given for one type of wave **or** A medical use is given for both types of wave **plus** a risk or precaution for one type of wave	At least one medical use is given for both types of wave linked to the risks and any precautions necessary

examples of the points made in the response	extra information
<u>Medical use of X-rays</u> Any one from: • Detecting bone fractures • Detecting dental problems • Killing cancer cells • CT scanning	Ignore details about how X-rays/ultrasound work accept any specific use of X-rays, eg • detecting heart/lung disorders (with chest X-rays) • mammograms / breast cancer detection • detecting stones / bowel disease (with abdominal X-rays)
<u>Risks with X-rays</u> X-rays pose a risk / danger / hazard	accept are harmful
X-rays cause ionisation / damage to cells **or** mutate cells / cause mutations / increase chances of mutations **or** turn cells cancerous / produce abnormal growths / produce rapidly growing cells **or** kill cells	accept a description of what ionising is instead of cell, any of these words can be used: DNA / genes / chromosomes / nucleus accept (may) cause cancer

Operator precautions with X-rays The X-ray operator should go behind a (metal / glass) screen / leave the room when making an X-ray / wear a lead lined apron	accept appropriate precautions for the patient e.g. limit the total exposure/dose (in one year) wear a radiation badge is insufficient	
Medical use of ultrasound Any one from: • Pre-natal scanning • Imaging (a named body part). • removal / destruction of kidney / gall stones • removing plaque from teeth • repair of damaged tissue / muscle	cleaning teeth is insufficient accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation accept physiotherapy accept curing prostate cancer **or** killing prostate cancer cells	
Risks with ultrasound Ultrasound poses no risk / danger / hazard (to the user / patient). Ultrasound is not ionising **or** Ultrasound does not damage (human) cells	accept ultrasound is safer than using X-rays	
Precautions with ultrasound The operator needs to take no precautions when making an ultrasound scan.	this can be assumed if it is stated that ultrasound is harmless or it is safer than using x-rays or it is non-ionising	

Total		**8**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 141 · Mark scheme June 2016 | PH1FP | Original Q3 | Legacy

The full source mark scheme begins on page 343. Follow original question 3 in that document.

Answer 142 · Mark scheme June 2016 | PH1FP | Original Q8 | Legacy

The full source mark scheme begins on page 343. Follow original question 8 in that document.

4.6.2.4 Uses and applications of electromagnetic waves

Answer 143 · Mark scheme

June 2016 | PH2FP | Original Q9 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(a)	2 protons and 2 neutrons	accept 2p and 2 n accept (the same as a) helium nucleus symbol is insufficient do not accept 2 protons and neutrons	1	AO1 2.5.2c
9(b)(i)	gamma rays		1	AO1 2.5.2e
9(b)(ii)	loses/gains (one or more) electron(s)		1	AO1 2.5.1d
9(c)	any **one** from: • wear protective clothing • work behind lead/concrete/glass shielding • limit time of exposure • use remote handling	accept wear mask/gloves wear goggles is insufficient wear protective equipment/gear is insufficient accept wear a film badge accept handle with (long) tongs accept maintain a safe distance accept avoid direct contact	1	AO2 2.5

4.6.2.4 Uses and applications of electromagnetic waves

Answer 143 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(d)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a 'best-fit' approach to the marking.		6	AO1 2.5.2e 2.5.2f

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	There is a description of at least one type of radiation in terms of one or more properties.	There is a description of at least two types of radiation in terms of some properties **or** a full description of one type of radiation in terms of all three properties **or** the same property is described for all three radiations	There is a description of all three types of radiation in terms of at least two of their properties **or** a full description of two types of radiation in terms of all three properties.

examples of physics points made in the response	extra information
alpha particles • are least penetrating • are stopped by paper / card • have the shortest range • can travel (about) 5cm in air • are (slightly) deflected by a magnetic field • alpha particles are deflected in the opposite direction to beta particles by a magnetic field	
beta particles • (some are) stopped by (about) 2mm (or more) of aluminium/metal • can travel (about) 1 metre in air • are deflected by a magnetic field • beta particles are deflected in the opposite direction to alpha particles by a magnetic field	accept (some are) stopped by aluminium foil
gamma rays • are the most penetrating • are stopped by (about) 10cm of lead • have the longest range • can travel at least 1 km in air • are not deflected by a magnetic field	

Total			10

4.6.2.4 Uses and applications of electromagnetic waves

Answer 144 · Mark scheme

June 2016 | PH3FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	electromagnetic	accept e.m.	1	AO1 3.1.1a
2(b)(i)	2.2 (arbitrary units)	allow an answer between 2.1 and 2.3	1	AO2 3.1.1a
2(b)(ii)	the thicker the tissue the lower the intensity the relationship is not linear	accept more intensity is needed to pass through thicker tissue accept the line is not straight allow for **1** mark it still goes through with thicker tissue **or** intensity does not reach zero **or** at 5cm X rays still pass through	1 1	AO2 3.1.1a
2(b)(iii)	Both variables are continuous		1	AO3 3.1.1a
2(c)	(they are) absorbed	accept (they are) stopped	1	AO1 3.1.1a
2(d)	With a charge-coupled device (CCD).		1	AO1 3.1.1b
2(e)(i)	X-rays are ionising		1	AO1 3.1.1a
2(e)(ii)	stand behind a (protective) screen	accept leave the room accept wear a lead apron	1	AO1 3.1.1c
Total			9	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 144 · Mark scheme

June 2016 | PH3FP | Original Q2 | Legacy



4.6.2.4 Uses and applications of electromagnetic waves

Answer 145 · Mark scheme

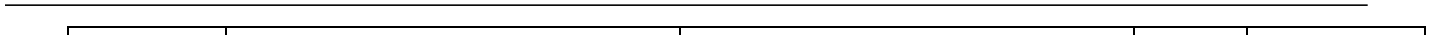
June 2017 | PH1FP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	wavelength = N		1	AO1 1.5.1i
3(a)(ii)	amplitude = L		1	AO1 1.5.1i
3(b)	B		1	AO1 1.5.1e
3(c)(i)	equal to	accept the same as	1	AO1 1.5.2b
3(c)(ii)	the laser light is absorbed (by burglar's clothing) **or** the laser light is reflected (in a different direction)		1	AO2 1.5.1g
Total			**5**	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 145 · Mark scheme

June 2017 | PH1FP | Original Q3 | Legacy



4.6.2.4 Uses and applications of electromagnetic waves

Answer 146 · Mark scheme

June 2017 | PH1FP | Original Q8 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	Doppler		1	AO1 1.5.4a
8(b)(i)	A frequency has increased	 accept frequency is higher (compared to the emitted frequency) accept wavelength has decreased reason only scores if A is chosen	1 1	AO2 AO3 1.5.4a
8(b)(ii)	C greater change in frequency	 accept greater change in wavelength reason only scores if C chosen	1 1	AO2 AO3 1.5.4a
Total			**5**	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 146 · Mark scheme

June 2017 | PH1FP | Original Q8 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.

4.6.2.4 Uses and applications of electromagnetic waves

Answer 147 · Mark scheme

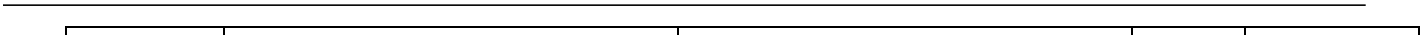
June 2017 | PH2FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	it must have an earth wire as the case / outside is metal **or** to reduce the risk of electrocution/shock	 accept as the microwave is not double insulated makes it safer is insufficient	1 1	AO1 2.4 2.4.1j
5(b)(i)	13 A the fuse (rating) must be higher than the current (drawn from the mains) **or** the other two (fuses) would melt	the reason only scores if 13 A is chosen the fuse has to be bigger than the current is insufficient accept it is the only one that will not melt accept 'blow' for 'melt' do not accept explode/break for fuse melts the other fuses would overheat is insufficient	1 1	AO1 2.4.1h 2.4.2c
5(b)(ii)	750	allow **1** mark for correct substitution ie $P = \frac{225000}{300}$ provided no subsequent step	2	AO2 2.4.2b
Total			**6**	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 147 · Mark scheme

June 2017 | PH2FP | Original Q5 | Legacy



4.6.2.4 Uses and applications of electromagnetic waves

Answer 148 · Mark scheme

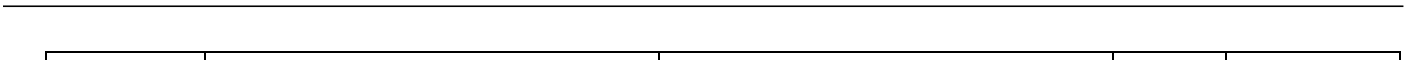
June 2018 | 8463/1F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	nucleus neutron gamma rays	in this order only	1 1 1	AO1 4.4.4.1
06.2	$\frac{25\,000\,000}{2\,400\,000}$ 11	an answer of 11 scores **2** marks an answer of 10.4 with no working scores **1** mark	1 1	AO2 4.1.3
06.3	any **two** from: • waste is radioactive • waste has a long half-life • waste is toxic • waste needs to be buried • risk of catastrophic accidents • fuel is non-renewable	allow nuclear waste allow waste remains dangerous for a long time allow waste is difficult to dispose of allow named accident eg Fukushima, Chernobyl, Three Mile Island	2	AO1 4.1.3
06.4	**similarity:** (carbon dioxide concentration and global temperature have) both increased **difference:** the carbon dioxide (concentration) continues to increase whereas temperature (increase) levels off	allow they both show a positive correlation allow carbon dioxide (concentration) increases more quickly than temperature (increase)	1 1	AO3 4.1.3
Total			9	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 148 · Mark scheme

June 2018 | 8463/1F | Original Q6



4.6.2.4 Uses and applications of electromagnetic waves

Answer 149 · Mark scheme

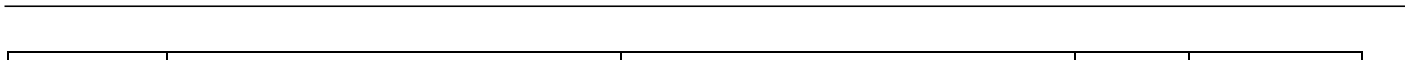
June 2018 | 8463/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	glass vase		1	AO2 4.6.2.6
05.2	transmit		1	AO1 4.6.2.6
05.3	the T-shirt reflects all wavelengths / colours of light (equally)	allow T-shirt reflects (white / all) light	1	AO1 4.6.2.6
05.4	changes from red to black as the cap absorbs (all) the (blue) light **or** as the cap does not reflect the (blue) light	it appears black it is darker is insufficient	1 1	AO2 4.6.2.6
05.5	C —— distance D ✕ the I time	all 3 lines correct allow **1** mark for 1 line correct if more than one line drawn from a variable all of those lines do not score	2	AO2 4.6.2.2
05.6	the (infrared) heater	allow infrared (radiation) do **not** accept answers where burning yourself is given as the hazard	1	AO2 4.6.2.2
05.7	answer must be a comparison, eg the matt / black surface is the better absorber (of infrared radiation)	matt black is a good absorber is insufficient	1	AO3 4.6.2.2
Total			**9**	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 149 · Mark scheme

June 2018 | 8463/2F | Original Q5



4.6.2.4 Uses and applications of electromagnetic waves

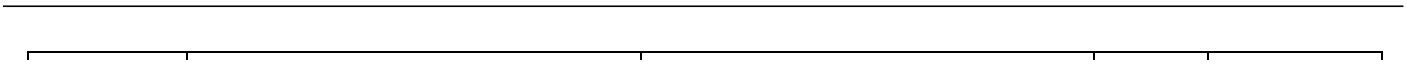
Answer 150 · Mark scheme June 2018 | 8463/2F | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	C		1	AO1 4.6.2.1
08.2	radio waves have a longer wavelength than ultraviolet		1	AO1 4.6.2.1
08.3	(risk of) skin cancer **or** (prematurely) ageing skin	cancer is insufficient skin damage is insufficient ignore kills skin cells	1	AO1 4.6.2.3
08.4	risk is higher (for X-ray of uds than X-ray of chest) by a factor of 50 **or** risk calculated for each type of X-ray chest X-ray = 1:200 000 (1) uds = 1:4000 (1)		1 1	AO2 4.6.2.3
Total			**5**	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 150 · Mark scheme

June 2018 | 8463/2F | Original Q8



4.6.2.4 Uses and applications of electromagnetic waves

Answer 151 · Mark scheme

June 2019 | 8463/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4.1	B		1	AO1/1 4.6.2.1
4.2	electrical heating		1	AO1/1 4.6.2.4
4.3	orange	allow a correct answer indicated in the box provided the answer space is blank	1	AO3/1a 4.6.2.4 WS3.5
4.4	becomes (more) red	allow changes from mainly orange to mainly red	1	AO3/2a 4.6.2.4 WS3.5
4.5	the independent	allow a correct answer indicated in the box provided the answer space is blank	1	AO2/2 4.6.2.2 WS2.2
4.6	pour (hot) water into the (hollow metal) cube point the IR detector at each / a side and take a reading keep the detector the same distance from each surface	 allow point the IR detector at the cube and take a reading allow IR detector touching the surface and take a reading allow take the temperature for take a reading	1 1 1	AO1/2 4.6.2.2 WS2.2
4.7	0.1 °C		1	AO2/2 4.6.2.2 WS2.3
4.8	one bar drawn to 68.0 (°C) one bar drawn to 28.0 (°C) tallest bar labelled Matt black and shortest bar labelled Shiny silver	ignore the position of the bars on the x-axis	1 1 1	AO2/2 4.6.2.2 WS3.1

4.6.2.4 Uses and applications of electromagnetic waves

Answer 151 · Mark scheme

4.9	any **one** from: • (matt) black is the best emitter • shiny silver is the worst emitter	 allow matt white and shiny black are (almost) the same at emitting allow black is a good emitter allow silver is a poor emitter allow an answer in terms of highest / lowest temperature ignore any reference to absorption / reflection	1	AO3/2b 4.6.2.2 WS3.5
Total			**13**	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 152 · Mark scheme

November 2020 | 8463/1F | Original Q5

Question 5

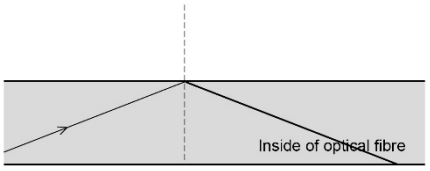
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	radiotherapy		1	AO1 4.4.3.1
05.2	a neutron energy gamma rays	energy and gamma rays can score in reverse order	1 1 1	AO1 4.4.4.1
05.3	An alpha particle is the same as a helium nucleus.		1	AO1 4.4.2.2
05.4	24 000 (years)	allow an answer between 24 000 and 24 500 (years) inclusive	1	AO2 4.4.2.3
05.5	24 000 (years) **or** their **05.4**		1	AO1 4.4.2.3
05.6	Any **one** from: • irradiation • cancer • genetic damage • mutations to DNA / genes • radiation sickness / poisoning		1	AO3 4.4.3.3
Total			**8**	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 153 · Mark scheme

November 2020 | 8463/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	Microwaves Radio waves		1 1	AO1 4.6.2.4
04.2	normal		1	AO1 4.6.1.3
04.3	reflected ray drawn to the right of the normal correct ray of light drawn using a ruler with i = r	ignore arrows 	1 1	AO2 4.6.1.3
04.4	they need to be flexible	ignore bendy / ductile / malleable / elastic	1	AO3 4.6.2.4
04.5	transmitted absorbed absorbed		1 1 1	AO1 4.6.2.6
Total			**9**	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 154 · Mark scheme

November 2020 | 8463/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	D		1	AO1 4.6.2.1
06.2	Any **one** from: • mutation (of genes/DNA/ chromosomes) • cancer/tumour • cell death	allow can damage OR destroy genes/DNA/chromosomes ignore damage/destroy cells/ tissues/organs ignore mutates cells allow kills cells	1	AO1 4.6.2.1
06.3	the risk of harm is lower from the X-ray by a factor of 60		1 1	AO3 4.6.2.3
06.4	0.0060 sieverts		1	AO1 4.6.2.3
06.5	$\frac{0.1}{2.5} \times 100$ 4 (%)	 allow 0.04 for **1** mark	1 1	AO2 4.6.2.3
Total			**7**	

4.6.2.4 Uses and applications of electromagnetic waves

Answer 155 · Mark scheme

November 2021 | 8463/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	**B**		1	AO1 4.6.2.1
03.2	a control		1	AO1 4.6.2.2 RPA10
03.3	record the initial temperature of the two thermometers in each flask switch the infrared heater on and start the stop clock (at the same time) after five minutes record the (final) temperature from both flasks see / check if the temperature inside the flasks had increased by different amounts	allow initial temperature is a control variable **or** ensure initial temperature is the same in both flasks allow switch on the power supply for switch on the heater allow calculate the temperature increase / change after five minutes	1 1 1 1	AO1 4.6.2.2 RPA10
03.4	27 (°C)	allow 27 (°C) identified on the table allow test 3	1	AO3 4.6.2.2 RPA10
03.5	ignore (the result)	allow repeat (the result)	1	AO1 4.6.2.2 RPA10
03.6	(33/3 =) 11		1	AO2 4.6.2.2 RPA10

4.6.2.4 Uses and applications of electromagnetic waves

Answer 155 · Mark scheme

03.7	the black flask absorbed the most infrared during the five minutes		1	AO3 4.6.2.2 RPA10

Total			**10**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 156 · Mark scheme

June 2022 | 8463/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	2 protons and 2 neutrons		1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	an electron		1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	$^{85}_{36}Kr \longrightarrow {}^{85}_{37}Rb + {}^{0}_{-1}e$		1	AO1 4.4.2.2

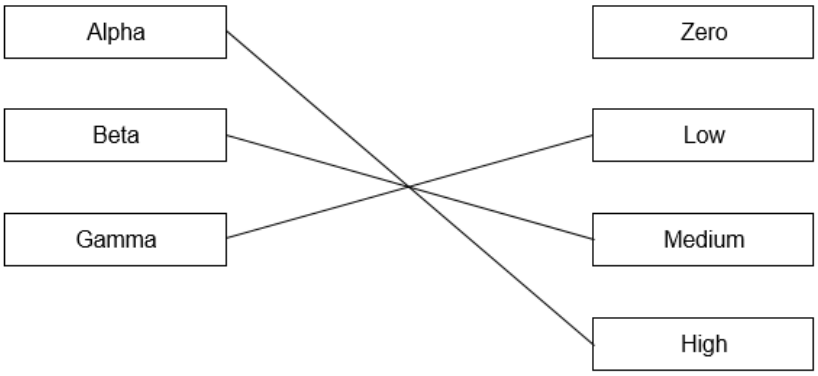
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4			3	AO1 4.4.2.1

Type of radiation	Most radiation is stopped by:		
	the sheet of paper	the sheet of aluminium	the block of lead
Alpha	Yes	Yes	Yes
Beta	No	Yes	Yes
Gamma	No	No	Yes

1 mark for each correct row
allow ticks and crosses in place of yes and no
any incorrect answer on a row negates the mark for the row

4.6.2.4 Uses and applications of electromagnetic waves

Answer 156 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	 **1** mark for each correct line if more than one line drawn from radiation type list principle applies		1 1 1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	nuclear accidents		1	AO1 4.4.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	number = $\frac{2.0}{0.005}$ number = 400		1 1	AO2 4.4.3.1

Total Question 4		12

Answer 157 · Mark scheme

June 2022 | 8463/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	ultraviolet travels at the same speed as visible light		1	AO1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	D C	this order only	1 1	AO1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	A 400 – 315 = 85 (nm) B 315 – 280 = 35 (nm) C 280 – 100 = 180 (nm) (ultraviolet) C (UVC)	three calculations correct 2 marks one or two calculations correct 1 mark mark dependent on all three calculations being made	2 1	AO2 4.6.2.1

4.6.2.4 Uses and applications of electromagnetic waves

Answer 157 · Mark scheme

June 2022 | 8463/2F | Original Q5

Question	Answers	Mark	AO / Spec. Ref.
05.4	**Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO3 4.6.2.3
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content.	0	
	Indicative content: • ozone absorbs all of the UVC • UVC is the most dangerous • ozone absorbs nearly all (95%) of the UVB • UVB has a medium risk • ozone does not absorb any UVA • ozone does not reduce risk from UVA • UVA is the least dangerous • the greater the ionising power the greater the absorption by ozone • the greater the ionising power the greater the risk • UV damages skin cells • can lead to skin cancer • can cause sunburn • UV can damage eyes • leads to problems with eyesight		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	our eyes detect visible light	allow it would be dark all the time allow specific effect ie plants couldn't grow	1	AO1 4.6.2.1

4.6.2.4 Uses and applications of electromagnetic waves

Answer 157 · Mark scheme

June 2022 | 8463/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	transmitted absorbed	this order only	1 1	AO1 4.6.2.6

Total Question 5		**13**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 158 · Mark scheme

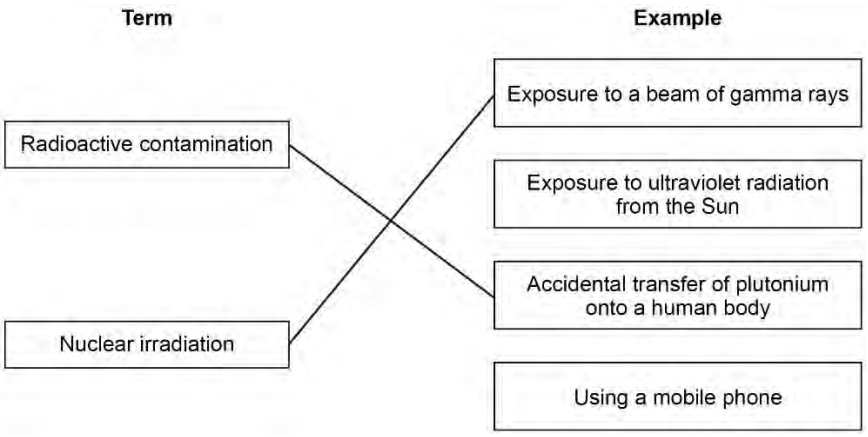
June 2023 | 8463/1F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	protons neutrons	this order only	1 1	AO1 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	the time taken for half the nuclei in a sample to decay		1	AO1 4.4.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	carbon-18		1	AO3 4.4.2.3

Question	Answers	Mark	AO / Spec. Ref.
03.4	 1 mark for each correct line additional line from a box on the left negates the mark for that box	1 1	AO1 4.4.2.4

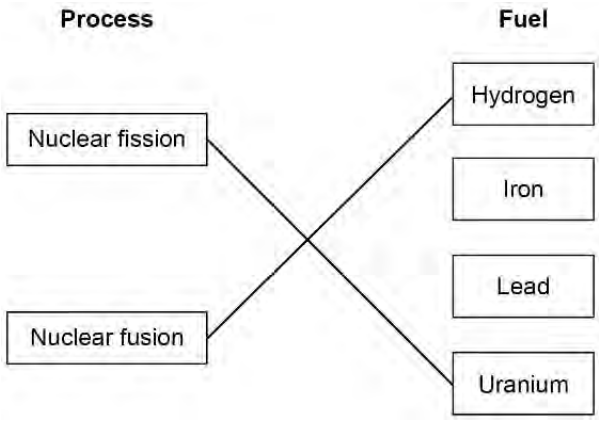
4.6.2.4 Uses and applications of electromagnetic waves

Answer 158 · Mark scheme

June 2023 | 8463/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	to remove radioactive dust from their shoes		1	AO3 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	number of days = $\frac{0.072}{0.00050}$ number of days = 144		1 1	AO2 4.4.3.1

Question	Answers	Mark	AO / Spec. Ref.
03.7	 1 mark for each correct line additional line from a box on the left negates the mark for that box	1 1	AO1 4.4.4.1 4.4.4.2

Total Question 3	11

4.6.2.4 Uses and applications of electromagnetic waves

Answer 159 · Mark scheme

June 2023 | 8463/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	wavelength = Q		1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	amplitude = $\frac{R}{2}$		1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	radio waves		1	AO1 4.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	s = 300 000 000 × 0.000009 s = 2700 (m)		1 1	AO2 4.5.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	satellite communications **or** cooking /heating food	allow WiFi	1	AO1 4.6.2.4

Total Question 5	**6**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	perpendicular		1	AO1 4.6.1.1

Question	Answers	Mark	AO / Spec. Ref.
09.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5-6	AO3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3-4	AO1
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2	AO1
	No relevant content	0	
	Indicative content **Method:** • heat the water / kettle • add an equal volume of (hot) water to each flask • insert a thermometer into each flask • record the initial temperature from both flasks OR • place an IR detector near each flask • the distance between the IR detector and the flask should be the same each time • record initial reading from IR detectors • (and) start a stop clock • record the temperatures / readings after 10 minutes from both flasks • calculate the change in temperatures / readings during the 10 minutes • compare the results to test the hypothesis to access level 3 the method must allow the correct consideration of a temperature decrease for both flasks or the correct comparison of IR detected from both flasks		4.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	during the 1st minute there is the greatest temperature difference (between the hot water and the surroundings)	 allow highest temperature or hottest MP 2 dependent on scoring MP1	1 1	AO2 AO1 4.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	the temperature (increase / change after 10 minutes)	allow the final temperature do not allow temperature decrease	1	AO1 4.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	black surfaces absorb more (infrared than white surfaces) matt surfaces absorb more (infrared) than shiny surfaces of the same colour	allow black surfaces have a greater temperature increase (than white surfaces) allow matt surfaces have a greater temperature increase than shiny surfaces of the same colour if no other marks scored, allow 1 mark for matt black surface is the best absorber and shiny white surface is the worst absorber if no other marks scored, allow 1 mark for matt black has the greatest temperature increase and shiny white has the smallest temperature increase	1 1	AO3 4.6.2.2 4.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	pressure = $\frac{\text{force}}{\text{area}}$		1	AO1 4.5.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.7	area of base = 0.0144 (m^2)	do not allow this or subsequent marks unless base area is used	1	AO2 4.5.5.1.1
	$1500 = \frac{F}{0.0144}$	this mark may be awarded if base area is incorrectly calculated	1	
	$F = 1500 \times 0.0144$	this mark may be awarded if base area is incorrectly calculated	1	
	$F = 21.6$ (N)	this mark may be awarded if base area is incorrectly calculated allow 22 (N)	1	

Total Question 9	**17**

4.6.2.4 Uses and applications of electromagnetic waves

Answer 161 · Mark scheme

June 2024 | 8463/1F | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	nuclei neutrons gamma rays	this order only	1 1 1	AO1 4.4.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	energy = power × time **or** $E = P \times t$		1	AO1 4.2.4.2 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	P = 500 000 000 (W) E = 500 000 000 × 3600 E = 1 800 000 000 000 (J) **or** $E = 1.8 \times 10^{12}$ (J)	 allow a correct substitution of an incorrectly / not converted value of P allow an answer consistent with an incorrectly / not converted value of P	1 1 1	AO2 4.2.4.2 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	any **one** from: • bury the radioactive waste • put the radioactive waste in cooling ponds • transport the radioactive waste in secure vessels • store the radioactive waste in metal containers • cover the radioactive waste in concrete	allow store it for (at least) one half-life ignore references to high / medium / low level waste ignore label the waste as hazardous	1	AO3 4.4.2.4

4.6.2.4 Uses and applications of electromagnetic waves

Answer 161 · Mark scheme

June 2024 | 8463/1F | Original Q10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.5	number of days = $\frac{92}{100} \times 365$		1	AO2 4.1.3
	number of days = 335.8	allow answers of 335 and 336 days allow an answer of 29.2 (days) for 1 mark	1	

Total Question 10	10

4.6.2.4 Uses and applications of electromagnetic waves

Answer 162 · Mark scheme

June 2024 | 8463/2F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	Milky Way		1	AO1 4.8.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	dust and gas		1	AO1 4.8.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	gravitational force		1	AO1 4.8.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	fusion		1	AO1 4.8.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	visible light takes the same time as infrared radiation		1	AO1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	greater		1	AO1 4.6.2.1

4.6.2.4 Uses and applications of electromagnetic waves

Answer 162 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	greater rate than the Earth the Sun is at a higher temperature	 allow the Sun has a greater surface area MP2 is dependent on MP1	1 1	AO3 4.6.3.1

Total Question 1	**8**

Answer 163 · Mark scheme

June 2024 | 8463/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	infrared camera	allow thermometer, thermal imaging camera, night vision goggles	1	AO3 4.6.2.4 4.6.3.2 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	690 nm		1	AO3 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	bees cannot detect all the colours (a human can) bees can detect UV radiation (but humans can't)	allow bees cannot detect red (light but humans can)	1 1	AO3 4.6.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	reflected absorbed	this order only	1 1	AO1 4.6.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	black		1	AO1 4.6.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	diffuse		1	AO1 4.6.2.6

Total Question 6	**8**

4.6.2.4 Uses and applications of electromagnetic waves

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCSE

Physics

3451

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4.6.2.4 Uses and applications of electromagnetic waves

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

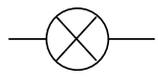
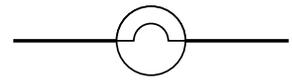
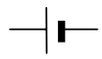
(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q1

question	answers	extra information	mark
(a)	circuit symbol for a lamp correct 	accept  accept any standard of drawing providing circuit would work	1
	circuit symbol for a cell correct 		1
	2 lamps drawn in parallel with 3 cells	polarity of cells must be correct (+ to –) but cells may be either way around	1
(b)	4.5		1
(c)	the same as	accept any clear indication of the correct answer	1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time wind generator can only produce when the wind is strong enough	accept fuel available all the time accept it's not always windy	1 1
(c)	no fuel is burnt **or** no fuel is used **or** uses only energy from wind **or** does not emit harmful gases / soot / smoke	do **not** accept wind is natural / environmentally friendly / renewable answer must be in terms of wind, **not** negative of fuel burning specific examples of gases CO_2, SO_2, acid rain and greenhouse gases can be accepted ozone negates credit	1
total			4

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q3

question	answers	extra information	mark
(a)(i)	microwaves		1
(ii)	infra red		1
(iii)	ultrasonic		1
(b)(i)	B		1
(ii)	A		1
(c)	disturbance / vibration / movement direction	accept motion / force do **not** accept energy	1 1
(d)	sound wave	accept any clear indication of the correct answer	1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q4

question	answers	extra information	mark
(a)(i)	heat		1
(ii)	temperature increases **or** (cause) convection (currents)	accept gets warmer accept gets hotter	1
(iii)	60% **or** 0.6	60 without % scores **1** mark 0.6 with a unit scores **1** mark 60 with incorrect unit scores **1** mark **or** correct substitution $\frac{120}{200}$ for **1** mark	2
(b)	street more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest	 can only score this mark if first mark scored all efficiencies calculated correctly score 2nd mark point	1 1
total			6

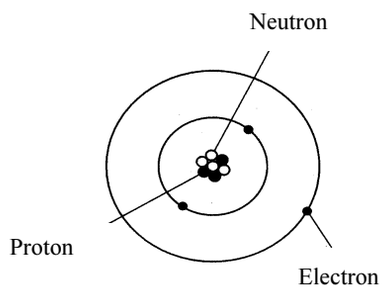
4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q5

question	answers	extra information	mark
(a)	MN	accept 5.8, 8 seconds must include unit	1
(b)	LM	accept 0.8, 5.8 seconds must include unit	1
(c)(i)	0.8		1
(ii)	drinking alcohol		1
(d)	straight (by eye) line starting at 0.8 seconds line drawn steeper than LM starting before L	 ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating	1 1
total			6

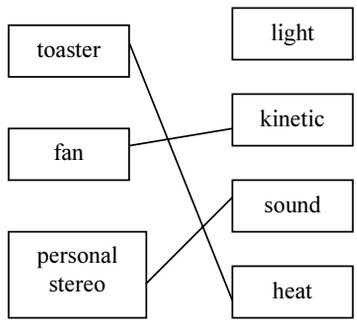
4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q6

question	answers	extra information	mark
(a)(i)	each correct label scores 1 mark  		3
(ii)	neutron		1
(iii)	7 number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus	 accept number of particles in the centre only if first answer = 7	1 1
(b)(i)	50 ± 5		1
(ii)	50 ± 5	accept their (b)(i)	1
(iii)	less	accept any way of indicating the correct answer	1
total			9

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q7

question	answers	extra information	mark
(a)	each correct line scores 1 mark  	if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines	3
(b)	toaster	accept 1.2 kW	1
(c)(i)	400		1
(ii)	£24 **or** 2400p	full credit for their (c)(i) × 6p for full credit the correct numerical answer must have the correct unit an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark (c)(i) × 6 incorrectly evaluated scores **1** mark	2
(d)	6	allow 6000 for **1** mark allow 3 × 2 for **1** mark	2
total			9

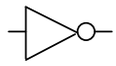
4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q8

question	answers	extra information	mark
(a)(i)	point where the rays cross	do not credit if ambiguous	1
(ii)	converging (lens)	do **not** accept convex	1
(b)(i)	point where the rays appear to diverge from	this should appear to be within 10mm in front of the back of the arrows on the approximate centre line need not be accurately constructed using a ruler	1
(ii)	diverging (lens)	do **not** accept concave	1
(c)	converging film smaller than nearer to	accept any clear indication of the correct response e.g. ticking, ringing, writing in after a mistake	1 1 1 1
(d)(i)	(image) bigger than object / enlarge	accept just 'made bigger'	1
(ii)	it / real image can be put on a screen **or** real image on the opposite side of the lens to the object	accept 'not an imaginary or virtual image' assume 'it' refers to a real image do **not** credit 'it can be seen'	1
(e)	**either** (the converging lens is) thick in the middle thin(ner) at the edge **or** (both) sides bend outwards (1) in the middle (1) **or** one side bends in the middle (1) more than the other side bends inwards (in the middle) (1)	thickest in the middle gains **2** marks convex gains **2** marks suitable diagrams gains **2** marks	1 1
total			12

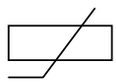
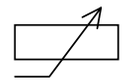
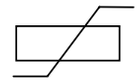
4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q9

question	answers	extra information	mark
(a)(i)	off off on	all correct	1
(ii)	AND (gate)	accept and (gate)	1
(iii)	on on on	all correct	1
(iv)	OR (gate)	accept or (gate)	1
(b)(i)	1 0 **or** 0 1 0 1 1 0	do **not** credit on / off responses	1
(ii)		accept mirror image accept  accept with either or both parts shaded accept line through as shading	1
(c)		accept off for 0 and on for 1 throughout	
	0 0	both correct	1
	0 1	both correct	1
	1 1	both correct	1
	1 1	both correct	1

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q9 continued

(d)(i)		accept mirror image **or** inverted do **not** credit  **or**  or similar	1
(ii)	resistance decreases / increases / changes current (through it) increases / decreases / changes **or** temperature changes / increases / decreases (1) resistance changes / decreases / increases (1) (NTC thermistor) both marks independent but must be compatible to score **2** marks	accept 'voltage across it decreases' for **2** marks but only if it is made clear that this refers to a thermistor in series	1 1
total			13

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q10

question	answers	extra information	mark
(a)(i)	friction	accept any way of indicating the correct answer	1
(ii)	gravity	accept any way of indicating the correct answer	1
(b)(i)	accelerates **or** speed / velocity increases	accept faster and faster (**1** mark) do **not** accept faster pace / falls faster or suggestions of a greater but constant speed	1
	downwards / falls	accept towards the Earth / ground this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts	1
(ii)	constant speed / velocity **or** terminal velocity / speed **or** zero acceleration	stays in the same place negates credit	1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q11

question	answers	extra information	mark
(a)(i)	X – mantle		1
	Y – inner core	do **not** accept solid core	1
(ii)	different to the crust **or** contains a lot of (heavy) metals	accept iron and nickel for metals	1
	higher (average) density **or** denser	density higher than 5500 (kg/m^3) gets **2** marks	1
(b)	animals were able to move from one continent to the other		1
	(when bridge broke) animals evolved differently	accept animals adapted differently	1
(c)(i)	earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other		1
	there are no plate boundaries running through Britain	accept Britain is not near the edge of a plate	1
(ii)	convection currents (in the mantle) **or** heat released by (natural) radioactive processes		1
total			9

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q12

question	answers	extra information	mark
(a)(i)	outside the Earth **or** not from the Earth	accept alien accept life from / on another planet / space accept our planet for Earth	1
(ii)	radio telescope(s)	do **not** accept telescopes do **not** accept satellite dishes do **not** accept radio receivers **or** transmitters	1
(b)(i)	galaxies	do **not** accept stars	1
(ii)	any **one** from: the pulses were regular pulses from space are usually random (scientists) thought technology had been used to produce the pulses neutron stars were unknown signals from a single point	 accept signals / beats for pulses accept noise for random pulses idea of regular but not continuous	1
(iii)	neutron star is (the matter / mass) left behind after a star / red giant explodes (as a super nova)	 accept after a super nova (explosion) neutron star causing super nova gets no credit	1 1
(c)(i)	carried on the balloon / equipment	accept carried by a rocket / aircraft / satellite birds negates credit	1
(ii)	on comets or meteors	accept meteorites / shooting stars accept returning space craft accept solar wind ignore asteroids accept ufo do **not** accept solar flares do **not** accept satellites	1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q13

question	answers	extra information	mark
(a)	silver is a (good) reflector of <u>heat</u> (radiation) **or** silver reflects the heat (radiation)	fact heat = infra red ignore references to light accept shiny for silver good radiator negates the mark ignore references to good conductor do **not** accept bounce back	1
	less heat is lost through the board **or** more heat is retained by the shirt	explanation accept both sides of shirt heated reflects heat back up gets **1** mark only ignore mention of friction	1
(b)	metal soleplate	accept soleplate / bottom / metal do **not** accept outside / case	1
(c)	plastic **or** rubber	accept any named plastic do **not** accept wood	1
	it is a (good) insulator **or** it is a poor conductor	ignore mention of heat if in conjunction with electricity	1
(d)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*	*Maximum of **2** marks if ideas not well expressed.*	
	pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger	answers in terms of charges attracting or repelling gain no credit	1
	plunger pushed / moved to the right (by spring) **or** plunger released		1
	push switch opens / goes to off / goes to right	accept circuit is broken for maximum credit the points must follow a logical sequence 3 correct points but incorrect sequence scores **2** marks only ignore reset action	1
total			8

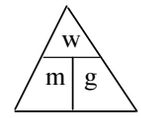
4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q14

question	answers	extra information	mark
(a)(i)	any **one** from: the ground the air radon (gas) building materials buildings rocks / granite food cosmic rays **or** solar rays X-rays nuclear weapons testing nuclear power stations / accidents	 do **not** accept mobile phones accept from outer space accept sun but **not** sunlight accept medical uses	1
(ii)	2	allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120 for **1** mark	2
(b)	 alpha: the count rate is (greatly) reduced by the card **or** the card absorbs alphas but not betas beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source) gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or** a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal	answers must be comparative accept converse answers throughout accept paper for the card accept aluminium for the metal accept aluminium for the metal accept lead / aluminium for the metal	 1 1 1
total			6

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q15

question	answers	extra information	mark
(a)(i)	weight = mass × g.f.s.	accept w = m × g accept gravity for gfs accept  provided subsequent use of Δ correct do **not** accept N = kg × N/kg	1
(ii)	675	75 × 9 for **1** mark	2
(iii)	g.(f.s.) is higher (on Earth than Venus)	accept gravity for g.f.s. do **not** accept g.f.s. is lower unless answer states on Venus	1
(iv)	orbit time for Jupiter is <u>longer</u> / longest (than for the other planets)	do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s.	1
(b)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **two** from: dust <u>and</u> gas **or** remnants of a super nova pulled together by (force of) <u>gravity</u> nuclear fusion starts	*Maximum of **1** mark if ideas not well expressed.* accept hydrogen for dust and gas do **not** accept hydrogen burns although candidates may include more detail these points are essential to score the credit	2
total			7

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q16

question	answers	extra information	mark
(a)(i)	upright with the contacts at the bottom and still in place and unbent	no need for labels but incorrect label(s) cancel the mark accept a freehand drawing no need for details such as correct dimensions	1
	one blob of mercury touching <u>both</u> contacts	do **not** award mark if contacts bent to touch	1
(b)(i)	(X is a) battery	do **not** credit cell accept (set of) cells accept power supply do **not** accept power pack	1
	(Y is a) LED	**or** light emitting diode	1
(ii)	longer (time)	do **not** accept 'slower time'	1
(iii)	any **two** from: current less (so) rate of flow of charge less **or** less coulombs per second (so) discharge is slower	 do **not** accept current slower accept capacitor has charge for longer **or** charge lasts longer **or** (so total of) electrons take longer to travel round circuit	2
(c)	4200	translation correct (= 4000) but percentage addition incorrect gains **1** mark translation incorrect but 5% addition is correct gains **1** mark accept 422.1 **or** 42.2 **or** 6.3 for **1** mark	2
	ohms **or** Ω	4.2 kilohms **or** 4.2 kΩ gains all **3** marks	1
total			10

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q17

question	answers	extra information	mark
(a)	point at which its mass (seems to) act **or** point at which gravity (seems to) act	accept …its weight acts accept correct statements if the intent is clear e.g. … if suspended, the centre of gravity will be directly under the point of suspension e.g. … (if the object is symmetrical), the centre of gravity is on the **or** an axis (of symmetry) do **not** credit just 'it is a point'	1
(b)	**Quality of written communication** *The answer to this question requires good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **five** from: clamp (steel) rod (horizontally) hang plastic / sheet by rod through (one) hole hang plumb line from rod mark ends of plumb line on the sheet and use the ruler to draw a straight line repeat with other hole centre of mass is where the lines cross check by balancing at this point	*maximum of **4** marks if ideas not well expressed* **no** marks if method quite unworkable maximum of **3** marks if no 'repeat with other hole'	5
(c)(i)	(turning) effect **or** moment force distance	all three correct accept weight accept length	1
(ii)	17.6 Nm **or** newton metre(s)	allow 44 × 0.4 **or** 0.4 × 44 for **1** mark do **not** accept N/m **or** N/cm 1760 Ncm gains all **3** marks	2 1
total			10

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCSE

Science: Double Award Co-ordinated

3462

Paper 3F

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Kathleen Tattersall: *Director General*

4.6.2.4 Uses and applications of electromagnetic waves

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

4.6.2.4 Uses and applications of electromagnetic waves

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

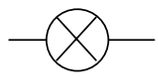
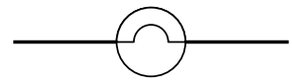
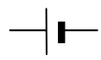
3.10 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.6.2.4 Uses and applications of electromagnetic waves

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	circuit symbol for a lamp correct 	accept  accept any standard of drawing providing circuit would work	1
	circuit symbol for a cell correct 		1
	2 lamps drawn in parallel with 3 cells	polarity of cells must be correct (+ to –) but cells may be either way around	1
(b)	4.5		1
(c)	the same as	accept any clear indication of the correct answer	1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time wind generator can only produce when the wind is strong enough	accept fuel available all the time accept it's not always windy	1 1
(c)	no fuel is burnt **or** no fuel is used **or** uses only energy from wind **or** does not emit harmful gases / soot / smoke	do **not** accept wind is natural / environmentally friendly / renewable answer must be in terms of wind, **not** negative of fuel burning specific examples of gases CO_2, SO_2, acid rain and greenhouse gases can be accepted ozone negates credit	1
total			4

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q3

question	answers	extra information	mark
(a)(i)	microwaves		1
(ii)	infra red		1
(iii)	ultrasonic		1
(b)(i)	B		1
(ii)	A		1
(c)	disturbance / vibration / movement direction	accept motion / force do **not** accept energy	1 1
(d)	sound wave	accept any clear indication of the correct answer	1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q4

question	answers	extra information	mark
(a)(i)	heat		1
(ii)	temperature increases **or** (cause) convection (currents)	accept gets warmer accept gets hotter	1
(iii)	60% **or** 0.6	60 without % scores **1** mark 0.6 with a unit scores **1** mark 60 with incorrect unit scores **1** mark **or** correct substitution $\frac{120}{200}$ for **1** mark	2
(b)	street more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest	 can only score this mark if first mark scored all efficiencies calculated correctly score 2nd mark point	1 1
total			6

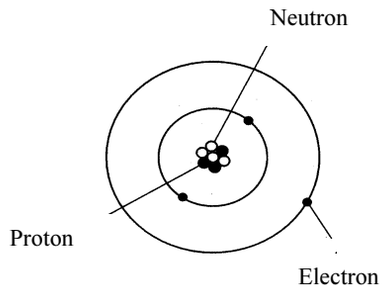
4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q5

question	answers	extra information	mark
(a)	MN	accept 5.8, 8 seconds must include unit	1
(b)	LM	accept 0.8, 5.8 seconds must include unit	1
(c)(i)	0.8		1
(ii)	drinking alcohol		1
(d)	straight (by eye) line starting at 0.8 seconds line drawn steeper than LM starting before L	 ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating	1 1
total			6

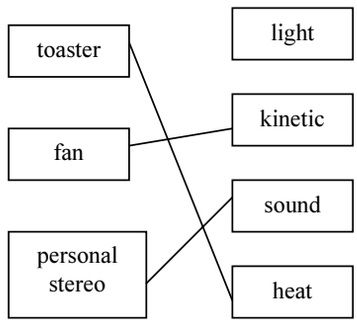
4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q6

question	answers	extra information	mark
(a)(i)	each correct label scores 1 mark  		3
(ii)	neutron		1
(iii)	7 number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus	 accept number of particles in the centre only if first answer = 7	1 1
(b)(i)	50 ± 5		1
(ii)	50 ± 5	accept their (b)(i)	1
(iii)	less	accept any way of indicating the correct answer	1
total			9

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q7

question	answers	extra information	mark
(a)	each correct line scores 1 mark  	if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines	3
(b)	toaster	accept 1.2 kW	1
(c)(i)	400		1
(ii)	£24 **or** 2400p	full credit for their (c)(i) × 6p for full credit the correct numerical answer must have the correct unit an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark (c)(i) × 6 incorrectly evaluated scores **1** mark	2
(d)	6	allow 6000 for **1** mark allow 3 × 2 for **1** mark	2
total			9

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q8

question	answers	extra information	mark
(a)(i)	friction	accept any way of indicating the correct answer	1
(ii)	gravity	accept any way of indicating the correct answer	1
(b)(i)	accelerates **or** speed / velocity increases	accept faster and faster (**1** mark) do **not** accept faster pace / falls faster or suggestions of a greater but constant speed	1
	downwards / falls	accept towards the Earth / ground this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts	1
(ii)	constant speed / velocity **or** terminal velocity / speed **or** zero acceleration	stays in the same place negates credit	1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q9

question	answers	extra information	mark
(a)(i)	X – mantle		1
	Y – inner core	do **not** accept solid core	1
(ii)	different to the crust **or** contains a lot of (heavy) metals	accept iron and nickel for metals	1
	higher (average) density **or** denser	density higher than 5500 (kg/m^3) gets **2** marks	1
(b)	animals were able to move from one continent to the other		1
	(when bridge broke) animals evolved differently	accept animals adapted differently	1
(c)(i)	earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other		1
	there are no plate boundaries running through Britain	accept Britain is not near the edge of a plate	1
(ii)	convection currents (in the mantle) **or** heat released by (natural) radioactive processes		1
total			9

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q10

question	answers	extra information	mark
(a)(i)	outside the Earth **or** not from the Earth	accept alien accept life from / on another planet / space accept our planet for Earth	1
(ii)	radio telescope(s)	do **not** accept telescopes do **not** accept satellite dishes do **not** accept radio receivers **or** transmitters	1
(b)(i)	galaxies	do **not** accept stars	1
(ii)	any **one** from: the pulses were regular pulses from space are usually random (scientists) thought technology had been used to produce the pulses neutron stars were unknown signals from a single point	 accept signals / beats for pulses accept noise for random pulses idea of regular but not continuous	1
(iii)	neutron star is (the matter / mass) left behind after a star / red giant explodes (as a super nova)	 accept after a super nova (explosion) neutron star causing super nova gets no credit	1 1
(c)(i)	carried on the balloon / equipment	accept carried by a rocket / aircraft / satellite birds negates credit	1
(ii)	on comets or meteors	accept meteorites / shooting stars accept returning space craft accept solar wind ignore asteroids accept ufo do **not** accept solar flares do **not** accept satellites	1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q11

question	answers	extra information	mark
(a)	silver is a (good) reflector of <u>heat</u> (radiation) **or** silver reflects the heat (radiation)	fact heat = infra red ignore references to light accept shiny for silver good radiator negates the mark ignore references to good conductor do **not** accept bounce back	1
	less heat is lost through the board **or** more heat is retained by the shirt	explanation accept both sides of shirt heated reflects heat back up gets **1** mark only ignore mention of friction	1
(b)	metal soleplate	accept soleplate / bottom / metal do **not** accept outside / case	1
(c)	plastic **or** rubber	accept any named plastic do **not** accept wood	1
	it is a (good) insulator **or** it is a poor conductor	ignore mention of heat if in conjunction with electricity	1
(d)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*	*Maximum of **2** marks if ideas not well expressed.*	
	pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger	answers in terms of charges attracting or repelling gain no credit	1
	plunger pushed / moved to the right (by spring) **or** plunger released		1
	push switch opens / goes to off / goes to right	accept circuit is broken for maximum credit the points must follow a logical sequence 3 correct points but incorrect sequence scores **2** marks only ignore reset action	1
total			8

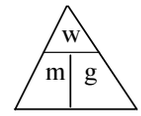
4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q12

question	answers	extra information	mark
(a)(i)	any **one** from:		1
	the ground	do **not** accept mobile phones	
	the air		
	radon (gas)		
	building materials		
	buildings		
	rocks / granite		
	food		
	cosmic rays **or** solar rays	accept from outer space accept sun but **not** sunlight	
	X-rays	accept medical uses	
	nuclear weapons testing		
	nuclear power stations / accidents		
(ii)	2	allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120 for **1** mark	2
(b)		answers must be comparative accept converse answers throughout	
	alpha: the count rate is (greatly) reduced by the card **or** the card absorbs alphas but not betas	accept paper for the card	1
	beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source)	accept aluminium for the metal	1
	gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or** a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal	accept aluminium for the metal accept lead / aluminium for the metal	1
total			6

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q13

question	answers	extra information	mark
(a)(i)	weight = mass × g.f.s.	accept w = m × g accept gravity for gfs accept  provided subsequent use of Δ correct do **not** accept N = kg × N/kg	1
(ii)	675	75 × 9 for **1** mark	2
(iii)	g.(f.s.) is higher (on Earth than Venus)	accept gravity for g.f.s. do **not** accept g.f.s. is lower unless answer states on Venus	1
(iv)	orbit time for Jupiter is <u>longer</u> / longest (than for the other planets)	do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s.	1
(b)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **two** from: dust <u>and</u> gas **or** remnants of a super nova pulled together by (force of) <u>gravity</u> nuclear fusion starts	*Maximum of **1** mark if ideas not well expressed.* accept hydrogen for dust and gas do **not** accept hydrogen burns although candidates may include more detail these points are essential to score the credit	2
total			7

GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics Specification B
3451/F

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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4.6.2.4 Uses and applications of electromagnetic waves

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4.6.2.4 Uses and applications of electromagnetic waves

GCSE PHYSICS

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.
On the script, the QoWC tick should be identified by a 'q' written next to it.

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

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Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.
However:

- if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

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3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Interpretation of marginal points

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

3.11 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

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4.6.2.4 Uses and applications of electromagnetic waves

GCSE Physics
Foundation Tier 3451/F

3451F Q1

question	answers	extra information	mark
(a)	comet	correct order only	1
	elliptical		1
	Milky Way		1
	Universe		1
(b)(i)	D A C B	allow **2** marks for two letters in the correct place allow **1** mark for one letter in the correct place	3
(ii)	A		1
total			8

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4.6.2.4 Uses and applications of electromagnetic waves

3451F Q2

question	answers	extra information	mark
(a)	95		1
(b)	alpha	accept correct symbol	1
(c)	any **two** from: • radiation is outside the body • radiation will not reach (living) cells • radiation absorbed by the air	 accept detector is on ceiling or high up the wall accept radiation cannot pass through the body / skin accept cannot pass through the plastic casing do **not** accept because it is alpha radiation – unless qualified do **not** accept does not give off harmful substance do **not** accept cannot pass through building materials etc.	2
(d)	less (than)		1
total			5

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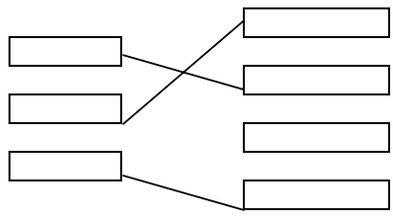
4.6.2.4 Uses and applications of electromagnetic waves

3451F Q3

question	answers	extra information	mark
(a)	generator	accept dynamo accept alternator	1
(b)(i)	1400	ignore units	1
(ii)	0.3 or 30%	any incorrect unit penalise **1** mark allow **1** mark for the correct use of 600 **or** 0.3% **or** 30	2
(c)	**1** mark for each correct link 	if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect	3
(d)(i)	110	no tolerance	1
(ii)	12	no tolerance	1
(iii)	wind speed may be too low to operate the generator	accept wind may not always blow accept power depends on wind speed accept does not generate if wind speed is too high accept does not generate if wind speed is above 12 (m/s) accept does not generate if wind speed is below 1.6 (m/s) accept it is unreliable do **not** accept answers referring to cost only	1
total			10

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4.6.2.4 Uses and applications of electromagnetic waves

3451F Q4

question	answers	extra information	mark
(a)	B E A D	allow **1** mark for each letter in the correct place, to a maximum of **3** marks	3
(b)	(a spark) may cause the (petrol vapour) to explode / ignite	accept petrol for (petrol vapour) accept catch fire for explode	1
	connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept ground for earth	1
(c)	**Quality of written communication**	for a logical sequence	1
	any **two** from:		2
	• when current greater than fuse rating / value	accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity	
	• fuse (becomes hot and) melts / burns out	accept fuse blows / breaks	
	• circuit is broken	accept circuit switched off this cannot score credit on its own	
total			8

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4.6.2.4 Uses and applications of electromagnetic waves

3451F Q5

question	answers	extra information	mark
(a)(i)	crust		1
(ii)	inner core is <u>solid</u> outer core is liquid	do **not** accept just rock inner core is denser / hotter than outer core gets **2** marks accept one is solid and one is liquid for **1** mark accept they are different densities for **1** mark wrong way round = **0** marks	1 1
(b)	seismograph		1
(c)	difficult to measure (slow) movement (1) of plates (1) dependent mark **or** difficult to measure friction / forces (1) between plates (1) dependent mark		1 1
(d)	geothermal		1
(e)(i)	5000		1
(ii)	2500		1
total			9

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4.6.2.4 Uses and applications of electromagnetic waves

3451F Q6

	answers	extra information	mark
(a)	converging image object image object shorter		1 1 1 1 1 1
(b)(i)	(Earth's) gravity	accept centripetal accept minor misspellings, however, do **not** credit any response which could be 'centrifugal'	1
(ii)	to(wards) (the centre of the) Earth	allow inwards do **not** accept downwards	1
(c)(i)	**either** friction (force) **or** centripetal force between the tyres / wheels and (the surface of) the road	 allow grip allow on the tyres / wheels **or** towards the centre of the bend / arc / circle	 1 1
(ii)	mass **or** speed **or** momentum radius / diameter	allow weight allow velocity do **not** credit 'curvature' or 'circumference'	1 1
(d)	centripetal	accept minor misspellings (see above)	1
total			13

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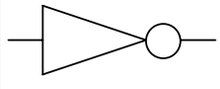
4.6.2.4 Uses and applications of electromagnetic waves

3451F Q7

	answers	extra information	mark
(a)(i)	two switches in series **and** circuit complete	ignore small imperfections	1
(ii)	two switches in parallel **and** circuit complete	ignore small imperfections	1
(iii)	one switch in parallel with the cell / lamp (but **not** both)	ignore small imperfections	1
(iv)	(i) AND (ii) OR (iii) NOT	accept 'and' accept 'or' accept 'not'	1 1 1
(b)(i)	when it is light the sensor sends on / high / 1 signal to the gate off / low / 0 sent to the lamp **or** when it is dark the sensor sends off / low / 0 signal to the gate (1) on / high / 1 sent to the lamp (1)		1 1
(ii)	any suitable application	e.g. to switch a security light on (and off) e.g. to switch a light on when it is dark do **not** credit just '… to switch a light on / off'	1
(c)(i)		accept shading-in of either or both parts end connections are not required accept any orientation	1
(ii)	1 0 **or** 0 1 0 1 1 0	all correct	1
(iii)	truth (table)		1
total			12

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4.6.2.4 Uses and applications of electromagnetic waves

3451F Q8

question	answers	extra information	mark
(a)	60		1
(b)	$5\frac{1}{2}$ hours	must include unit	1
(c)	30		1
(d)	30 minutes or $\frac{1}{2}$ hour	must include unit	1
(e)	D **and** E least steep part of the graph	accept finish for E accept correct numbers from axes with units accept covers smallest distance in a set time accept only moves 5 km in $1\frac{1}{2}$ hours (accept anything between 5 and 6) ignore horse is tired	1 1
total			6

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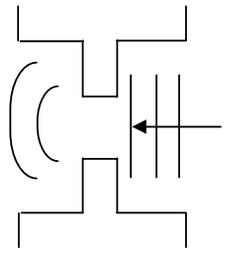
4.6.2.4 Uses and applications of electromagnetic waves

3451F Q9

question	answers	extra information	mark
(a)(i)	any **one** from: • (doctors) to see inside a patients body **or** endoscope • telephone cables • optical fibre / fibre optic lamps **or** (artificial) Christmas trees • data transfer **or** internet connection	 accept keyhole surgery do **not** accept flex **or** wires for cable accept decorative / ornamental lighting accept any feasible practical suggestion for taking light to a difficult to access place do **not** accept lighting unqualified do **not** accept lamp unqualified do **not** accept communications unless clarified	1
(ii)	(incident) ray angle greater than critical angle total internal reflection occurs	either order accept (incident) ray greater than 42° accept TIR do **not** accept just description of TIR	1 1
(b)(i)	waves shown diffracting in the correct direction 	ignore wavelength	1
(ii)	diffraction	accept diffract / diffracted	1
total			5

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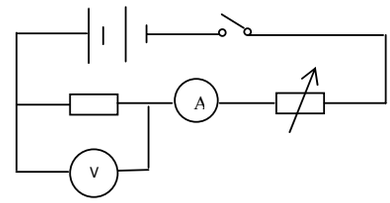
4.6.2.4 Uses and applications of electromagnetic waves

3451F Q10

question	answers	extra information	mark
(a)	all symbols correct	 accept push switch symbol switch may be open or closed any lines through symbols = **0** marks	1
	correct circuit drawn voltmeter must be across resistor only	polarity of cells not relevant provided they are joined correctly two cells are required in the diagram ignore the order of the components allow small gaps in circuit omission of any component = **0** marks	1
(b)(i)	potential difference = current × resistance	accept voltage or p.d. for potential difference accept $V = I \times R$ accept  provided subsequent use correct do **not** accept C for current	1
(ii)	2	 allow **1** mark for correct substitution wrong working loses both marks	2
(iii)	straight line drawn <u>through the origin</u> straight line passes through $I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0	judge by eye this mark may be awarded if all points shown including these points are correct even if no line is drawn N.B. a curve scores **0** marks	1 1 dep
(c)	temperature <u>increases</u>	accept filament lamp / it gets <u>hotter</u> allow heat for temperature	1
total			8

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4.6.2.4 Uses and applications of electromagnetic waves

3451F Q11

question	answers	extra information	mark
(a)(i)	gamma rays	accept gamma accept correct symbol	1
(ii)	infra red	accept IR	1
(b)	ultraviolet <u>absorbed</u> by ink (energy) given out as light	 accept glows / luminous accept for **both** marks the ink is fluorescent do **not** accept answers in terms of uv being reflected	1 1
(c)	any **two** from: • UV can damage / kill / ionise / alter (normal) cells • change DNA structure **or** mutate • (normal) cells may become cancerous	 do **not** accept attacks cells **or** burns skin accept may cause (skin) cancer accept abnormal cell multiplication	2
(d)(i)	microwaves **and** infra red	both answers needed in either order do **not** accept heat for IR	1
(ii)	0.9	allow **1** mark for the <u>correct</u> use of 1.8 (kW) ($1.8 \times \frac{1}{2}$ or 1.8×30) i.e. adding the correct 2 power values	2
total			9

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4.6.2.4 Uses and applications of electromagnetic waves

3451F Q12

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration increases	accept velocity / speed increases more rapidly do **not** accept velocity / speed increases	1
(b)(i)	$\text{acceleration} = \frac{\text{change in velocity}}{\text{time (taken)}}$	accept $a = \frac{v - u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ do **not** accept velocity for change in velocity do **not** accept change in speed do **not** accept $a = \frac{v}{t}$	1
(ii)	15	allow **1** mark for an answer of 900 **or** for correct use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between shuttle and Earth) plus correct orbital speed (makes shuttle move in a curve)	accept gravitational pull if used correctly accept forward motion **or** constant speed for orbital speed accept it is travelling fast enough accept for **2** marks the force of gravity provides the centripetal force	1 1
(d)	black is a good emitter of radiation **or** to limit the temperature rise inside the shuttle	accept heat for radiation accept the tiles are good insulation do **not** accept black absorbs heat on its own do **not** accept tiles are heat proof	1
total			9

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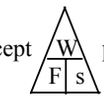
4.6.2.4 Uses and applications of electromagnetic waves

3451F Q13

question	answers	extra information	mark
(a)(i)	work (done) = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	240 000 joules	allow **1** mark for correct substitution **or** correct use of 1200 (N) accept J do **not** accept j / Nm	2 1
(b)	800 (watts)	accept 0.8 kW accept their (a)(ii) ÷ 300 correctly evaluated for **2** marks allow **1** mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for **1** mark	2
(c)(i)	any **one** from: • needs to raise the chair / lift • lifting more than one chair • energy transfer to the surroundings correctly qualified	 allow lifting more than 2 people implication of a heavier weight accept loss for transfer do **not** accept motor inefficient do **not** accept motor gets hot do **not** accept friction unless the location is specified as external to the motor	1
(ii)	electrical potential	accept electric **both** answers required for the mark	1
total			8

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4.6.2.4 Uses and applications of electromagnetic waves

3451F Q14

	answers	extra information	mark
(a)(i)	current		1
(ii)	resistance decreases	 accept 'the flow of electrons / current (through it) increases' for **1** mark do **not** credit just '… it will get warmer'	1 1
(b)	input sensor → controlled by the processor processor → detects changes in the environment output device → decides what action is needed	all pairs correct one pair correct for **1** mark	2
(c)(i)	potential divider	accept voltage divider	1
(ii)	4 (volts)	$6 \times \frac{30}{45}$ for **1** mark	2
(iii)	across the new resistor…(will) increase across R_2 … (will) decrease	 N.B. independent marks	1 1
total			10

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4.6.2.4 Uses and applications of electromagnetic waves

3451F Q15

	answers	extra information	mark
(a)	relay (normally open) (switch)	each mark is independent	1
	… switch on a (larger) current (in another circuit) **or** switch on a higher voltage circuit	do **not** accept switch on another circuit **or** smaller / equal current	1
	light emitting diode / LED	do **not** credit LDR	1
	… in one / direct / certain direction **or** from left to right	**or** when the cathode is connected to the negative terminal / side **or** when the left-hand side is connected to the positive terminal / side do **not** credit just '… is big enough' do **not** accept 'positive direction'	1
	AND gate	accept 'and' gate	1
	… (both) inputs are on / high / 1 **or** current flows in both inputs	do **not** accept numerical values unless expanded	1
(b)	**Quality of written communication**	If in a sensible order which clearly indicates advantages or disadvantages, including answers in the form of a table **or** as bullet points Q ✓ Q X	1
	any **three** from: • advantage of mobile phones • drawback of mobile phones • benefit of the Internet • drawback of the Internet	 e.g. more convenient for service engineers e.g. calls can be received away from base e.g. privacy can be more easily invaded e.g. drivers can be distracted e.g. microwaves / radio waves can / may cause damage to the brain e.g. access to educational material e.g. some material is salacious e.g. spam (on external e-mail) these are examples candidates may be credited for a variety of responses	3
total			10

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4.6.2.4 Uses and applications of electromagnetic waves

3451F Q16

question	answers	extra information	mark
(a)	**Y** and **Z** they have the same number of protons **or** same atomic number	 accept they have the same number of electrons **or** same number of protons **and** electrons allow only different in number of neutrons N.B. independent marks	1 1
(b)	**Quality of written communication** A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus B – alpha particle <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> by the (positive) <u>nucleus</u> C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards	for correct use of terms underlined in B **or** C Q ✓ Q X describes 3 tracks correctly for **2** marks describes 2 or 1 track correctly for **1** mark do **not** accept hits the nucleus do **not** accept answers referring to refraction do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion mention of difference in charge on nucleus negates that track	1 max 2
total			5

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GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Science: Double Award
Specification B (Co-ordinated)
3462/3F

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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4.6.2.4 Uses and applications of electromagnetic waves

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4.6.2.4 Uses and applications of electromagnetic waves

SCIENCE: DOUBLE AWARD CO-ORDINATED

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.
On the script, the QoWC tick should be identified by a 'q' written next to it.

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

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4.6.2.4 Uses and applications of electromagnetic waves

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.
However:

- if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

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3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Interpretation of marginal points

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

3.11 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

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4.6.2.4 Uses and applications of electromagnetic waves

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	comet	correct order only	1
	elliptical		1
	Milky Way		1
	Universe		1
(b)(i)	D A C B	allow **2** marks for two letters in the correct place allow **1** mark for one letter in the correct place	3
(ii)	A		1
total			8

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4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q2

question	answers	extra information	mark
(a)	95		1
(b)	alpha	accept correct symbol	1
(c)	any **two** from: • radiation is outside the body • radiation will not reach (living) cells • radiation absorbed by the air	 accept detector is on ceiling or high up the wall accept radiation cannot pass through the body / skin accept cannot pass through the plastic casing do **not** accept because it is alpha radiation – unless qualified do **not** accept does not give off harmful substance do **not** accept cannot pass through building materials etc.	2
(d)	less (than)		1
total			5

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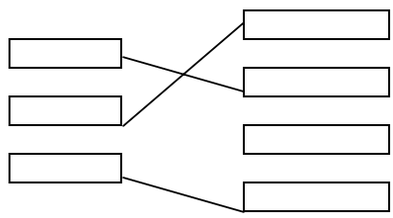
4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q3

question	answers	extra information	mark
(a)	generator	accept dynamo accept alternator	1
(b)(i)	1400	ignore units	1
(ii)	0.3 or 30%	any incorrect unit penalise **1** mark allow **1** mark for the correct use of 600 **or** 0.3% **or** 30	2
(c)	**1** mark for each correct link 	if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect	3
(d)(i)	110	no tolerance	1
(ii)	12	no tolerance	1
(iii)	wind speed may be too low to operate the generator	accept wind may not always blow accept power depends on wind speed accept does not generate if wind speed is too high accept does not generate if wind speed is above 12 (m/s) accept does not generate if wind speed is below 1.6 (m/s) accept it is unreliable do **not** accept answers referring to cost only	1
total			10

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4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q4

question	answers	extra information	mark
(a)	B E A D	allow **1** mark for each letter in the correct place, to a maximum of **3** marks	3
(b)	(a spark) may cause the (petrol vapour) to explode / ignite	accept petrol for (petrol vapour) accept catch fire for explode	1
	connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept ground for earth	1
(c)	**Quality of written communication**	for a logical sequence	1
	any **two** from:		2
	• when current greater than fuse rating / value	accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity	
	• fuse (becomes hot and) melts / burns out	accept fuse blows / breaks	
	• circuit is broken	accept circuit switched off this cannot score credit on its own	
total			8

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4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q5

question	answers	extra information	mark
(a)(i)	crust		1
(ii)	inner core is <u>solid</u> outer core is liquid	do **not** accept just rock inner core is denser / hotter than outer core gets **2** marks accept one is solid and one is liquid for **1** mark accept they are different densities for **1** mark wrong way round = **0** marks	1 1
(b)	seismograph		1
(c)	difficult to measure (slow) movement (1) of plates (1) dependent mark **or** difficult to measure friction / forces (1) between plates (1) dependent mark		1 1
(d)	geothermal		1
(e)(i)	5000		1
(ii)	2500		1
total			9

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4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q6

question	answers	extra information	mark
(a)	60		1
(b)	$5\frac{1}{2}$ hours	must include unit	1
(c)	30		1
(d)	30 minutes or $\frac{1}{2}$ hour	must include unit	1
(e)	D **and** E least steep part of the graph	accept finish for E accept correct numbers from axes with units accept covers smallest distance in a set time accept only moves 5 km in $1\frac{1}{2}$ hours (accept anything between 5 and 6) ignore horse is tired	1 1
total			6

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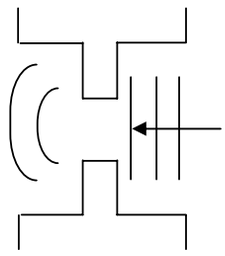
4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q7

question	answers	extra information	mark
(a)(i)	any **one** from: • (doctors) to see inside a patients body **or** endoscope • telephone cables • optical fibre / fibre optic lamps **or** (artificial) Christmas trees • data transfer **or** internet connection	 accept keyhole surgery do **not** accept flex **or** wires for cable accept decorative / ornamental lighting accept any feasible practical suggestion for taking light to a difficult to access place do **not** accept lighting unqualified do **not** accept lamp unqualified do **not** accept communications unless clarified	1
(ii)	(incident) ray angle greater than critical angle total internal reflection occurs	either order accept (incident) ray greater than 42° accept TIR do **not** accept just description of TIR	1 1
(b)(i)	waves shown diffracting in the correct direction 	ignore wavelength	1
(ii)	diffraction	accept diffract / diffracted	1
total			5

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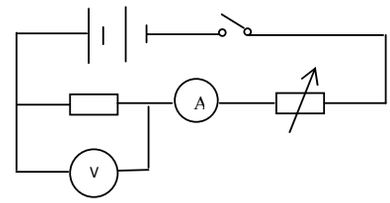
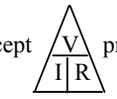
4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q8

question	answers	extra information	mark
(a)	all symbols correct	 accept push switch symbol switch may be open or closed any lines through symbols = **0** marks	1
	correct circuit drawn voltmeter must be across resistor only	polarity of cells not relevant provided they are joined correctly two cells are required in the diagram ignore the order of the components allow small gaps in circuit omission of any component = **0** marks	1
(b)(i)	potential difference = current × resistance	accept voltage or p.d. for potential difference accept $V = I \times R$ accept  provided subsequent use correct do **not** accept C for current	1
(ii)	2	 allow **1** mark for correct substitution wrong working loses both marks	2
(iii)	straight line drawn <u>through the origin</u> straight line passes through $I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0	judge by eye this mark may be awarded if all points shown including these points are correct even if no line is drawn N.B. a curve scores **0** marks	1 1 dep
(c)	temperature <u>increases</u>	accept filament lamp / it gets <u>hotter</u> allow heat for temperature	1
total			8

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4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q9

question	answers	extra information	mark
(a)(i)	gamma rays	accept gamma accept correct symbol	1
(ii)	infra red	accept IR	1
(b)	ultraviolet absorbed by ink (energy) given out as light	 accept glows / luminous accept for **both** marks the ink is fluorescent do **not** accept answers in terms of uv being reflected	1 1
(c)	any **two** from: • UV can damage / kill / ionise / alter (normal) cells • change DNA structure **or** mutate • (normal) cells may become cancerous	 do **not** accept attacks cells **or** burns skin accept may cause (skin) cancer accept abnormal cell multiplication	2
(d)(i)	microwaves **and** infra red	both answers needed in either order do **not** accept heat for IR	1
(ii)	0.9	 allow **1** mark for the correct use of 1.8 (kW) $(1.8 \times \frac{1}{2}$ or $1.8 \times 30)$ i.e. adding the correct 2 power values	2
total			9

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4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q10

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration increases	accept velocity / speed increases more rapidly do **not** accept velocity / speed increases	1
(b)(i)	$\text{acceleration} = \frac{\text{change in velocity}}{\text{time (taken)}}$	accept $a = \frac{v - u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ do **not** accept velocity for change in velocity do **not** accept change in speed do **not** accept $a = \frac{v}{t}$	1
(ii)	15	allow **1** mark for an answer of 900 **or** for correct use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between shuttle and Earth) plus correct orbital speed (makes shuttle move in a curve)	accept gravitational pull if used correctly accept forward motion **or** constant speed for orbital speed accept it is travelling fast enough accept for **2** marks the force of gravity provides the centripetal force	1 1
(d)	black is a good emitter of radiation **or** to limit the temperature rise inside the shuttle	accept heat for radiation accept the tiles are good insulation do **not** accept black absorbs heat on its own do **not** accept tiles are heat proof	1
total			9

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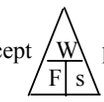
4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q11

question	answers	extra information	mark
(a)(i)	work (done) = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	240 000 joules	allow **1** mark for correct substitution **or** correct use of 1200 (N) accept J do **not** accept j / Nm	2 1
(b)	800 (watts)	accept 0.8 kW accept their (a)(ii) ÷ 300 correctly evaluated for **2** marks allow **1** mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for **1** mark	2
(c)(i)	any **one** from: • needs to raise the chair / lift • lifting more than one chair • energy transfer to the surroundings correctly qualified	 allow lifting more than 2 people implication of a heavier weight accept loss for transfer do **not** accept motor inefficient do **not** accept motor gets hot do **not** accept friction unless the location is specified as external to the motor	1
(ii)	electrical potential	accept electric **both** answers required for the mark	1
total			8

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4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q12

question	answers	extra information	mark
(a)	**Y** and **Z**		1
	they have the same number of protons **or** same atomic number	accept they have the same number of electrons **or** same number of protons **and** electrons allow only different in number of neutrons N.B. independent marks	1
(b)	**Quality of written communication**	for correct use of terms underlined in B **or** C Q ✓ Q X	1
	A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus B – alpha particle deflected / repelled / repulsed by the (positive) nucleus C – alpha particle heading straight for the nucleus is deflected / repelled / repulsed backwards	describes 3 tracks correctly for **2** marks describes 2 or 1 track correctly for **1** mark do **not** accept hits the nucleus do **not** accept answers referring to refraction do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion mention of difference in charge on nucleus negates that track	max 2
total			5

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2005 examination – June series

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Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

question	answers	extra information	mark
(a)(i)	less than	accept any correct indication	1
(ii)	more than	accept any correct indication	1
(b)	any **two** from: stays above the same place above the equator one orbit takes 24 hours	 do **not** accept stays in the same place do **not** accept goes around equator unless qualified do **not** accept orbit at same speed as Earth do **not** accept orbit at a constant speed accept has same angular speed / velocity as Earth	2
total			4

3451/F Q2

question	answers	extra information	mark
(a)	comet		1
(b)	large group / number / collection of stars	ignore reference to planets accept millions of stars do **not** accept thousands of stars do **not** accept loads of stars	1
(c)	giant supernova neutron		1 1 1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q3

question	answers	extra information	mark
(a)(i)	radio		1
(ii)	gamma	accept microwave accept infrared	1
(iii)	ultra violet		1
(iv)	microwaves		1
(b)	the same as		1
(c)	X-rays do not go through lead	references to gamma rays are incorrect accept lead protects them from the X-rays accept not exposed to X-rays	1
	lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u>	accept X-rays (may) cause cancer accept organs for cell do **not** accept references to electric shock do **not** accept stops bones of people showing on X-ray answers involving the horse wearing an apron are incorrect	1
	Quality of written communication	award for a sensible sequence of **two** points	1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q4

question	answers	extra information	mark
(a)	light electrical		1 1
(b)	15% **or** 0.15	correct substitution gains **1** mark only an answer of 15 with no unit **or** an incorrect unit gains **1** mark an answer of 0.15 given with a unit gains **1** mark	2
(c)	the ticket machine is a long way from other electricity supplies		1
(d)	any figure between 5 and 10 inclusive	unit not required but if given must match numerical answer	1
total			6

3451/F Q5

question	answers	extra information	mark
(a)(i)	radon (gas)	do **not** accept gas	1
(ii)	background		1
(b)	bigger	accept any word which means bigger	1
(c)	**Z** alpha will not pass through aluminium or lead	if Z is not given, the reason does not score accept alpha cannot go through metals / dense material accept there is nothing to stop the radiation accept alpha will not pass through aluminium do **not** accept alpha will not pass through lead do **not** accept alpha stopped by air	1 1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q6

question	answers	extra information	mark
(a)	loses negative charge / electrons	do **not** accept positive charge transfers to the comb do **not** accept friction	1
(b)	**A** attract		1
	B repel		1
	C attract		1
(c)	**F A D E**	allow **2** marks for 2 letters in the correct place allow **1** mark for 1 letter in the correct place	3
total			7

4.6.2.4 Uses and applications of electromagnetic waves

Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q7

question	answers	extra information	mark
(a)	all points correctly plotted	tolerance ± $\frac{1}{2}$ square on y axis only allow **1** mark for 3 correctly plotted points	2
	attempt made to draw a smooth curve	do **not** accept dot-to-dot line	1
(b)(i)	3 days ± 0.2 **or** any value correctly obtained using their graph line	if no line drawn in (a), answer must be exactly 3	1
(ii)	3 days or their (b)(i)		1
(c)	radon-222	accept radon **or** 222 accept alpha or 3.8 correct isotope required for reason to score	1
	has the shortest half-life	accept the others have longer half-lives	1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q8

question	answers	extra information	mark
(a)	fossils of Cynognathus are found in Africa and South America		1
	the shapes ……. almost fit together	only two boxes should be ticked deduct **1** mark for each additional box to a minimum mark of **0**	1
(b)	continental		1
	crust		1
	tectonic		1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

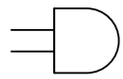
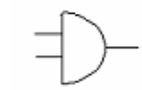
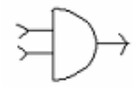
3451/F Q9

question	answers	extra information	mark
(a)	capacitor	accept condenser	1
	LDR	**or** light dependent resistor accept 'ldr', 'Ldr' etc.	1
	relay (normally open)	do **not** accept 'relay normally closed'	1
(b)(i)	battery	accept '(battery of) cells' do **not** accept 'battery / cell'	1
(ii)	LED	**or** light emitting diode accept 'led' or 'Led' do **not** accept just 'diode'	1
(iii)	B will light (but C will not)	accept '(only) B will work' accept 'one is on the other is off' do **not** accept 'C is on and B is off'	1
(iv)	any **one** from: B is connected the right way round (and C is not) a (light emitting) diode only allows (a significant) current to flow in one direction B's anode is connected to the positive side of the supply B's cathode is connected to the negative terminal	N.B. the candidate's answer to part (b)(iii) may include this mark but do **not** credit if the response to part (b)(iii) is incorrect or there is any other contradiction if (iv) is completely consistent with (iii) which is wrong, allow **1** mark	1
(c)(i)	first input / second input / output 0 / 0 / **0** 1 / 0 / **0** 0 / 1 / **0** 1 / 1 / **1**	**all** correct allow: OFF NO OFF NO OFF NO ON YES	1
(ii)	truth (table)		1

cont…

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q9 cont…

(iii)		a Roman upper case D in any orientation without contacts is acceptable but if contacts are shown do **not** give the mark if there is any ambiguity or contradiction allow  	1
(d)	light sensor	**or** light dependent resistor **or** LDR accept 'ldr', Ldr' etc allow solar cell, photo cell	1
	NOT gate	accept 'Not gate' **or** 'not gate' if both correct but in the wrong order credit with **1** mark	1
total			12

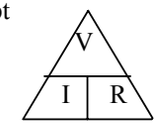
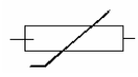
4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q10

question	answers	extra information	mark
(a)(i)	rays continued to meet on the right hand side of the lens and beyond	must be straight lines from the right hand side of the lens ignore details through the lens allow if no arrows	1
	meet exactly on the axis	negate mark if contradictory arrow(s) added do not need to go beyond the focus for this mark	1
(ii)	(principal) focus	**or** focal (point)	1
(iii)	converging	**or** convex	1
(b)(i)	**A**		1
(ii)	rays seem to come from this point	**or** words to this effect **or** shows this on the diagram	1
(iii)	diverging	**or** concave	1
(c)	film	accept any unambiguous method of showing the correct response	1
	smaller than		1
	further away from		1
(d)	any **three** from: • real image can be put on a screen • virtual image cannot be put on a screen / film • virtual image is imaginary • real image is formed where (real) rays cross / converge • virtual image is where virtual / imaginary rays (seem to) come from • virtual image formed where virtual rays intersect / cross	allow film allow real image has light travelling through it **or** virtual image is where rays seem to come from	3
total			13

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q11

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$	ignore any units	1
	$A_4 = 0.5$	allow **1** mark for $A_1 = A_4 \neq 0.5$	1
(ii)	the resistance of **P** is more than 20 Ω		1
	a smaller current goes through P / A_2 (than 20 Ω)	dependent on getting 1st mark correct accept converse	1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	thermistor or 	accept correct circuit symbol allow phonetic spelling	1
	resistance goes down (as temperature of thermistor goes up)	do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1
total			10

4.6.2.4 Uses and applications of electromagnetic waves

Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q12

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun' answer in terms of greenhouse effect only, scores **0** marks	1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q13

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator **or** air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or low<u>est</u> cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q14

question	answers	extra information	mark
(a)(i)	constant speed	do **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = change in velocity / time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** $a = \frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept no friction	1

cont…

3451/F Q14 cont…

(d)	any **three** from: • <u>increased</u> speed • <u>reduced</u> braking force • <u>slower</u> (driver) reactions • <u>poor</u> vehicle maintenance • <u>increased</u> mass / weight of vehicle • <u>poor</u> road surface • <u>more</u> streamlined	do **not** accept night time / poor vision N.B. specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only	3
total			13

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q15

question	answers	extra information	mark
(a)(i)	arrow from centre of the ball **and** at right angles to the string **and** in the correct direction	arrow should point to the student's belt accept free-hand 'straight' line do **not** accept curved line	1
(ii)	increase increase increase	accept 'be stronger / bigger' accept 'be stronger / bigger' accept 'be stronger / bigger'	1 1 1
(b)	speed velocity direction	all **three** correct any two correct for **1** mark otherwise **0** marks	2
(c)(i)	centripetal	accept 'centripedal' and other minor misspellings do **not** accept anything which could be 'centrifugal'	1
(ii)	gravity	accept 'weight' accept 'force of attraction due to mass(es) (of the Moon and the Earth)'	1
(iii)	electron(s)		1
(iv)	electrostatic	accept 'electrical' do **not** accept just 'centripetal'	1
total			10

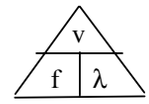
4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q16

question	answers	extra information	mark
(a)(i)	**X** at the centre of the lifebelt	measuring from the centre of **X**, allow 2 mm tolerance in any direction	1
(ii)	any **two** from: below the point of suspension at the centre (of the lifebelt) (because) the lifebelt / it is symmetrical	if X is on vertical line below the hanger (but not at centre) can gain the first point only accept '(vertically) below **Y**' accept 'in the middle' **or** (because) the mass / weight is evenly distributed	2
(b)	Nm **or** newton metre(s) 750	accept Newton metre(s) do **not** accept any ambiguity in the symbol ie NM, nM or nm (moment) = force × (perpendicular) distance (between line of action and pivot) **or** (moment) = 500 × 1.5 gains **1** mark	1 2
(c)	**Quality of written communication**: any **three** connected points from: low(er) <u>centre of mass / gravity</u> (more) <u>stable</u> less likely to fall over the <u>turning effect / moment</u> (of the weight of case) is less so the pull on her arm is less	for **2** of the underlined terms used in the correct context **or** <u>centre of mass / gravity</u> will be close(r) to the wheels / axle / ground **or** less <u>unstable</u> accept 'less likely to overturn' do **not** accept 'will not fall over' **or** so less effort is needed to hold the case ignore references to pulling the case	1 3
total			10

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q17

question	answers	extra information	mark
(a)	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing **Quality of written communication**	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark all emboldened terms in candidate's answer used correctly	2 1
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept $v = f \times \lambda$ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	3
total			8

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
Specification B (Co-ordinated)

Mark Scheme

2005 examination - June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)(i)	less than	accept any correct indication	1
(ii)	more than	accept any correct indication	1
(b)	any **two** from: stays above the same place above the equator one orbit takes 24 hours	 do **not** accept stays in the same place do **not** accept goes around equator unless qualified do **not** accept orbit at same speed as Earth do **not** accept orbit at a constant speed accept has same angular speed / velocity as Earth	2
total			4

3462/ 3F Q2

question	answers	extra information	mark
(a)	comet		1
(b)	large group / number / collection of stars	ignore reference to planets accept millions of stars do **not** accept thousands of stars do **not** accept loads of stars	1
(c)	giant supernova neutron		1 1 1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q3

question	answers	extra information	mark
(a)(i)	radio		1
(ii)	gamma	accept microwave accept infrared	1
(iii)	ultra violet		1
(iv)	microwaves		1
(b)	the same as		1
(c)	**Quality of written communication**	award for a sensible sequence of **two** points	1
	X-rays do not go through lead	accept lead protects them from the X-rays accept not exposed to X-rays	1
	lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u>	accept X-rays (may) cause cancer accept organs for cell do **not** accept references to electric shock do **not** accept stops bones of people showing on X-ray answers involving the horse wearing an apron are incorrect references to gamma rays are incorrect	1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q4

question	answers	extra information	mark
(a)	light electrical		1 1
(b)	15% **or** 0.15	correct substitution gains **1** mark only an answer of 15 with no unit **or** an incorrect unit gains **1** mark an answer of 0.15 given with a unit gains **1** mark	2
(c)	the ticket machine is a long way from other electricity supplies		1
(d)	any figure between 5 and 10 inclusive	unit not required but if given must match numerical answer	1
total			6

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q5

question	answers	extra information	mark
(a)(i)	radon (gas)	do **not** accept gas	1
(ii)	background		1
(b)	bigger	accept any word which means bigger	1
(c)	**Z** alpha will not pass through aluminium or lead	if Z is not given, the reason does not score accept alpha cannot go through metals / dense material accept there is nothing to stop the radiation accept alpha will not pass through aluminium do **not** accept alpha will not pass through lead do **not** accept alpha stopped by air	1 1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q6

question	answers	extra information	mark
(a)	loses negative charge / electrons	do **not** accept positive charge transfers to the comb do **not** accept friction	1
(b)	**A** attract		1
	B repel		1
	C attract		1
(c)	**F A D E**	allow **2** marks for 2 letters in the correct place allow **1** mark for 1 letter in the correct place	3
total			7

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q7

question	answers	extra information	mark
(a)	all points correctly plotted	tolerance ± $\frac{1}{2}$ square on y axis only allow **1** mark for 3 correctly plotted points	2
	attempt made to draw a smooth curve	do **not** accept dot-to-dot line	1
(b)(i)	3 days ± 0.2 **or** any value correctly obtained using their graph line	if no line drawn in (a), answer must be exactly 3	1
(ii)	3 days or their (b)(i)		1
(c)	radon-222	accept radon **or** 222 accept alpha or 3.8 correct isotope required for reason to score	1
	has the shortest <u>half-life</u>	accept the others have longer <u>half-lives</u>	1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

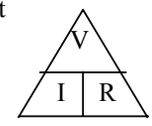
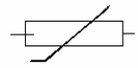
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q8

question	answers	extra information	mark
(a)	fossils of Cynognathus are found in Africa and South America		1
	the shapes ……. almost fit together	only two boxes should be ticked deduct **1** mark for each additional box to a minimum mark of **0**	1
(b)	continental		1
	crust		1
	tectonic		1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q9

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$	ignore any units	1
	$A_4 = 0.5$	allow **1** mark for $A_1 = A_4 \neq 0.5$	1
(ii)	the resistance of **P** is more than 20 Ω		1
	a smaller current goes through P / A_2 (than 20 Ω)	dependent on getting 1st mark correct accept converse	1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	thermistor or 	accept correct circuit symbol allow phonetic spelling	1
	resistance goes down (as temperature of thermistor goes up)	do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1
total			10

4.6.2.4 Uses and applications of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q10

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun' answer in terms of greenhouse effect only, scores **0** marks	1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q11

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator **or** air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or lowest cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q12

question	answers	extra information	mark
(a)(i)	constant speed	do **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = change in velocity / time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** $a = \frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept no friction	1

cont…

4.6.2.4 Uses and applications of electromagnetic waves

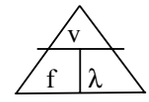
3462/3F Q12 cont…

(d)	any **three** from: • increased speed • reduced braking force • slower (driver) reactions • poor vehicle maintenance • increased mass / weight of vehicle • poor road surface • more streamlined	do **not** accept night time / poor vision NB specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to increase award **1** mark only	3
total			13

4.6.2.4 Uses and applications of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q13

question	answers	extra information	mark
(a)	**Quality of written communication**	all emboldened terms in candidate's answer used correctly	1
	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark	2
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept $v = f \times \lambda$ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	3
total			8

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2006 examination - June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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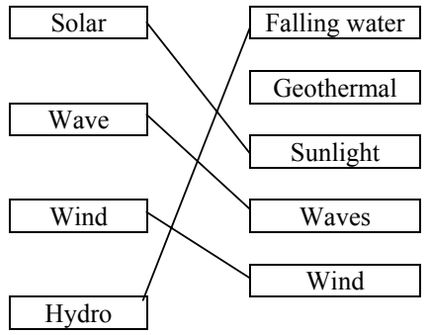
4.6.2.4 Uses and applications of electromagnetic waves

Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

question	answers	extra information	mark
(a)	4 correct lines drawn  	**1** mark for each correct line if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines	4
(b)	4		1
(c)(i)	nuclear		1
(ii)	(natural) gas	do **not** accept natural	1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q2

question	answers	extra information	mark
(a)(i)	ultra violet		1
(ii)	kill the cells	accept destroys the cells accept makes cells cancerous accept damage cells accept harms cells accept changes DNA accept cause cells to mutate accept skin cells for cells accept cause cancer do **not** accept skin for cells do **not** accept burns the cells	1
(b)(i)	the sunbed uses an alternating current (a.c.) supply		1
(ii)	10.8	accept **1** mark for correct substitution of power in W or kW and time in hours or seconds	2
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q3

question	answers	extra information	mark
(a)(i)	M		1
(ii)	K		1
(iii)	J		1
(iv)	O		1
(b)(i)	billions of years		1
(ii)	red giant	any answer in terms of explosion or supernova is **incorrect**	1
	contracts / shrinks to	incorrect reference to black hole negates **1** mark	1
	white dwarf		1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q4

question	answers	extra information	mark
(a)(i)	A and C	**both** answers must be correct in either order	1
(ii)	A and B	**both** answers must be correct in either order	1
(iii)	same number of protons plus neutrons **or** same number of nucleons	accept number of particles in nucleus the same do **not** accept they add up to 6 unless qualified	1
(b)(i)	any **two** from: • boron - 12 • carbon - 14 • oxygen - 15 • lead - 209	**both** required both name **and** number must be given	1
(ii)	any **two** from: • boron - 11 • carbon - 12 • oxygen - 16 • lead - 207	**both** required both name **and** number must be given	1
(c)	alpha		1
total			6

4.6.2.4 Uses and applications of electromagnetic waves

Physics B – AQA GCSE Mark Scheme, 2006 June series

3451/F Q5

question	answers	extra information	mark
(a)	(good) insulator	accept does not conduct (electricity) accept does not conduct heat or electricity do **not** accept does not conduct heat outside is tough is insufficient	1
(b)	fuse		1
(c)	connect the green and yellow / earth wire	accept wires must be connected to screws	1
	swap the brown and blue wires round		1
total			4

3451/F Q6

question	answers	extra information	mark
(a)	fossils	answers can be in either order	1
	water		1
(b)	increased		1
(c)	radio telescope		1
total			4

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q7

question	answers	extra information	mark
(a)(i)	electrical		1
	kinetic	accept movement	1
(ii)	heat	answers can be in either order	1
	sound		1
(b)(i)	360	accept **1** mark for correct substitution	2
(ii)	watt		1
(c)	the stairlift is not moving the stairlift is moving at constant speed	**both** answers are required for the mark	1
total			8

3451/F Q8

question	answers	extra information	mark
(a)(i)	(up) further **or** (up) faster	any reference to downwards movement loses credit accept <u>with</u> more force accept motion would increase	1
(ii)	down	accept the opposite way accept drop	1
(b)(i)	direct current		1
(ii)	Z		1
total			4

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q9

question	answers	extra information	mark
(a)	level of radiation (detected) will not change	ignore reference to particles	1
	if thickness of aluminium changes	accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same. accept for **1** mark gamma will pass through aluminium	1
	QoWC for 2 points in a sensible sequence		1
(b)	S W T V	all in correct order accept **2** marks for 2 correct accept **1** mark for 1 correct	3
total			6

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q10

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>thermistor(s)
LDR(s)
switch(es)
LED(s)
buzzer(s)
motor(s)</td><td>1 mark each
or light dependent resistor(s)
or light emitting diode(s)</td><td>6</td></tr>
<tr><td>(b)(i)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Input</th><th>Output</th></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table></td><td>both correct</td><td>1</td></tr>
<tr><td>(iii)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(c)(i)</td><td></td><td>do not credit any attempt which could equally well be a poorly drawn attempt at the symbol for a cell</td><td>1</td></tr>
<tr><td>(ii)</td><td>charge

increases</td><td>accept ‘electrons’
accept ‘energy
or gets bigger/larger</td><td>1

1</td></tr>
<tr><td>total</td><td></td><td></td><td>12</td></tr>
</table>

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q11

question	answers	extra information	mark
(a)(i)	A		1
(ii)	B		1
(iii)	mass is larger	credit if the response is clear by some other means e.g. it is ringed	1
	wire is shorter	credit if the response is clear by some other means e.g. it is ringed	1
(b)	moment		1
	distance		1
(c)(i)	1		1
(ii)	5		1
(iii)	any **two** from • remove slotted mass(es) • slide (slotted) masses / weights nearer pivot • slide forcemeter away from the pivot • slide rod to the left	 **or** ….. to the left **or** ….. to the right **or** …. so that the slotted masses side is shorter **or** …. so that the forcemeter side is longer	2
(d)	centre of the rectangle	accept *2*mm tolerance any direction	1
	centre of the circle	accept *2*mm tolerance any direction	1
	on centre line and 10mm above base	accept *2*mm tolerance any direction	1
total			13

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q12

question	answers	extra information	mark
(a)	0.05 (A)	ignore incorrect units if given accept 'the same' / 'the same as K' / 'the same as the other ammeter' do **not** accept 'same as the other meter'	1
(b)(i)	any **two** from: • two cells are joined + to +	answers in terms of current gain no marks accept one cell in the wrong way accept two cells are joined back-to-back accept two cells are joined – to – accept battery for cell do **not** accept answers in terms of all the cells or in terms of energy only	2
	• some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components	accept voltage for pd do **not** accept using up pd	
	• the other components have a resistance	accept a named component / components / wire has a resistance	
	• cells not fully charged **or** cells partially run down	do **not** accept voltage of cells is less than 1.5 unless explained do **not** accept cells are not as powerful unless explained	
	• cells have an internal resistance		
(ii)	the diode has a (very) high resistance (in the reverse direction)		1
	a diode only conducts / allows current to flow in one direction	accept little / no current flows do **not** accept blocks / cuts flow	1

Continued

4.6.2.4 Uses and applications of electromagnetic waves

Physics B – AQA GCSE Mark Scheme, 2006 June series

3451/F Q12

question	answers	extra information	mark
(c)	**QoWC** for the use of the word resistance	annotate Q✓ Q✗ accept resistant	1
	accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral		
	as the pd / current increases / changes	accept voltage for pd must be correctly linked to at least one of the following points accept	1
	the temperature of the filament increases / changes	lamp / bulb for filament accept filament becomes hotter	1
	increasing / changing the **resistance** of the lamp		1
		accept for **1** mark only the filament lamp does not obey Ohm's law	
total			9

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q13

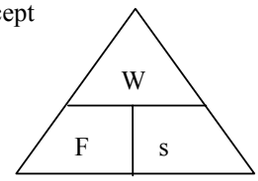
question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	1
(b)	any **one** from: • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope	 do **not** accept seismic waves / earthquake do **not** accept slinky unless clearly described	1
(c)	transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel	accept a correctly labelled diagram	1
	longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram part explanation of the difference between transverse **and** longitudinal gains **1** mark	1
(d)(i)	TIR shown	needs to stay inside water jet ignore number of reflections **or** arrow heads lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q14

question	answers	extra information	mark
(a)	W		1
	has only two states **or** is either on or off	accept discrete values only do **not** credit answer purely in terms of shape	1
(b)	any **one** from:		1
	• higher quality	accept clearer do **not** accept easier to read ignore faster accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength do **not** accept no distortion / weakening on its own	
	• increased carrying capacity	accept more information can be sent **or** more channels	
	• errors can be rectified		
total			3

3451/F Q15

question	answers	extra information	mark
(a)(i)	all points plotted accurately	accept **1** mark for 5 correct plots ± ½ small square on stopping distance	2
	line of best fit must be continuous	accept attempt at a reasonable curve does not need to go through 0 0 do **not** accept a straight line do **not** accept dot-to-dot	1
(ii)	4 to 6 (metres)	accept ecf from (a)(i) accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown	2
(b)(i)	0.7 (s)	incorrect unit = 0 marks	1
(ii)	constant speed / velocity	accept (continued as) 30mph accept did not change / stayed the same accept no acceleration	1
(iii)	3.3(s)	penalise incorrect unit once only	1
(iv)	reaction time increases / is longer **or** thinking distance increases	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it increases	do **not** accept travels at constant speed for longer	1
(c)(i)	work done = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1

Continued

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q15

question	answers	extra information	mark
(ii) **E**	2100	accept 2.1 kilo accept **1** mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q16

question	answers	extra information	mark
(a)(i)	refraction		1
(ii)	it changes speed **or** change in density	accept it speeds up do **not** accept it slows down do **not** accept air is more dense than glass	1
(b)(i)	sound / waves <u>diffract</u> through the gap (in the wall) **or** over the wall **or** because the gate is open	do **not** accept reflection this only scores if first marking point is given accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates if diagram is labelled as diffraction both marks can be scored	1 1
(ii)	less diffraction	accept no diffraction accept gates <u>absorb</u> sound / noise / waves accept gates <u>reflect</u> sound / noise / waves do **not** accept rebounds / stops / blocks out	1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q17

question	answers	extra information	mark
(a)	both rays brought to a focus at F on the right	do **not** have to be continued beyond F	1
	lines have been drawn **accurately** with a ruler	only credit if 1st mark credited do **not** credit if contradictory arrow(s) added	1
(b)	rays seem to come from a focus at G on the left and continued to the right of the lens	this mark is for the current idea of divergence	1
	lines have been drawn **accurately** with a ruler	only credit if 1st mark credited do **not** credit if contradictory arrow(s) added	1
(c)	…lens… …image… …object… …image… ...object… …lens…	lens as 1st and 6th words (1) image and object in the correct order 2nd and 3rd words (1) image and object in correct order 4th and 5th words (1)	max 3
(d)(i)	correct statement about real image real rays intersect / cross to form a real image **or** a real image can be formed on a screen **or** real image is (always) on the opposite side (of the lens) **or** real image is (always) upside down (to the object)	may be credited from a correct diagram	1
	correct statement about virtual / imaginary image virtual / imaginary rays intersect / cross to form a virtual image **or** a virtual / imaginary image cannot **or** virtual / imaginary image is (always) on the same side (of the lens) **or** virtual / imaginary image is (always) same way up (as the object)	may be credited from a correct diagram	1

Continued

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q17

question	answers	extra information	mark
(ii)	**either** image needs to fall on / affect the film **or** image needs to fall on / affect the light sensors / charged coupled devices (CCDs) (in a digital camera / mobile phone) **or** image needs to cause a chemical reaction (in / on the film)		1
total			10

4.6.2.4 Uses and applications of electromagnetic waves

3451/F Q18

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>AND (gate)

OR (gate)

NOT (gate)

LED or light emitting diode</td><td>accept ‘and’

accept ‘or’

accept ‘not’ or invert gate

accept ‘led’</td><td>1

1

1

1</td></tr>
<tr><td>(b)(i)</td><td>NOT (gate) and AND (gate)</td><td>both in either order or ‘(the) gates’

any additions lose the mark</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Switch for fire</th><th>Tilt switch</th><th>Signal to relay</th></tr><tr><td>0</td><td>0</td><td>…0…</td></tr><tr><td>0</td><td>1</td><td>…0…</td></tr><tr><td>1</td><td>0</td><td>…1…</td></tr><tr><td>1</td><td>1</td><td>…0…</td></tr></table></td><td>all correct

allow off or no
off no
on yes
off no</td><td>1</td></tr>
<tr><td>(iii)</td><td>(relay) acts as / is a switch

either
small current from the electronic / control circuit / system (1)

large current through the output / (electric) fire (1)

or

full current through electronic control system (1)

may damage components / lead to overheating / electric shock (1)

QoWC for correct use of the scientific term ‘current’</td><td>accept implication that it works as a switch e.g. ‘turns on fire’

or ‘small current through the coil (of the relay)’

do not accept small current is turned into a large current

annotate Q✓ Q×

if answer in terms of voltage isolation / voltage/ p.d. accept QoWC mark for correct use</td><td>1

1

1

1</td></tr>
<tr><td>total</td><td></td><td></td><td>10</td></tr>
</table>

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
Specification B

Mark Scheme

2006 examination - June series

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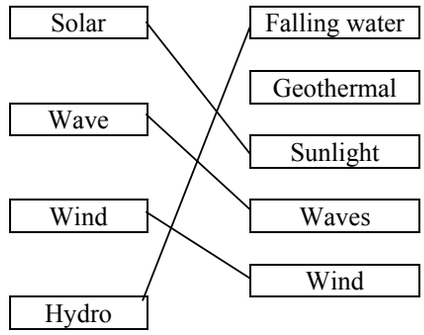
Double Award (Co-ordinated)
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	4 correct lines drawn  	**1** mark for each correct line if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines	4
(b)	4		1
(c)(i)	nuclear		1
(ii)	(natural) gas	do **not** accept natural	1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q2

question	answers	extra information	mark
(a)(i)	ultra violet		1
(ii)	kill the cells	accept destroys the cells accept makes cells cancerous accept damage cells accept harms cells accept changes DNA accept cause cells to mutate accept skin cells for cells accept cause cancer do **not** accept skin for cells do **not** accept burns the cells	1
(b)(i)	the sunbed uses an alternating current (a.c.) supply		1
(ii)	10.8	accept **1** mark for correct substitution of power in W or kW and time in hours or seconds	2
total			5

4.6.2.4 Uses and applications of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q3

question	answers	extra information	mark
(a)(i)	M		1
(ii)	K		1
(iii)	J		1
(iv)	O		1
(b)(i)	billions of years		1
(ii)	red giant	any answer in terms of explosion or supernova is **incorrect**	1
	contracts / shrinks to	incorrect reference to black hole negates **1** mark	1
	white dwarf		1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q4

question	answers	extra information	mark
(a)(i)	A and C	**both** answers must be correct in either order	1
(ii)	A and B	**both** answers must be correct in either order	1
(iii)	same number of protons plus neutrons **or** same number of nucleons	accept number of particles in nucleus the same do **not** accept they add up to 6 unless qualified	1
(b)(i)	any **two** from: • boron - 12 • carbon - 14 • oxygen - 15 • lead - 209	**both** required both name **and** number must be given	1
(ii)	any **two** from: • boron - 11 • carbon - 12 • oxygen - 16 • lead - 207	**both** required both name **and** number must be given	1
(c)	alpha		1
total			6

4.6.2.4 Uses and applications of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q5

question	answers	extra information	mark
(a)	(good) insulator	accept does not conduct (electricity) accept does not conduct heat or electricity do **not** accept does not conduct heat outside is tough is insufficient	1
(b)	fuse		1
(c)	connect the green and yellow / earth wire	accept wires must be connected to screws	1
	swap the brown and blue wires round		1
total			4

3462/3F Q6

question	answers	extra information	mark
(a)	fossils	answers can be in either order	1
	water		1
(b)	increased		1
(c)	radio telescope		1
total			4

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q7

question	answers	extra information	mark
(a)(i)	electrical		1
	kinetic	accept movement	1
(ii)	heat	answers can be in either order	1
	sound		1
(b)(i)	360	accept **1** mark for correct substitution	2
(ii)	watt		1
(c)	the stairlift is not moving the stairlift is moving at constant speed	**both** answers are required for the mark	1
total			8

3462/3F Q8

question	answers	extra information	mark
(a)(i)	(up) further **or** (up) faster	any reference to downwards movement loses credit accept <u>with</u> more force accept motion would increase	1
(ii)	down	accept the opposite way accept drop	1
(b)(i)	direct current		1
(ii)	Z		1
total			4

4.6.2.4 Uses and applications of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q9

question	answers	extra information	mark
(a)	level of radiation (detected) will not change	ignore reference to particles	1
	if thickness of aluminium changes	accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same. accept for **1** mark gamma will pass through aluminium	1
	QoWC for 2 points in a sensible sequence		1
(b)	S W T V	all in correct order accept **2** marks for 2 correct accept **1** mark for 1 correct	3
total			6

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q10

question	answers	extra information	mark
(a)	0.05 (A)	ignore incorrect units if given accept 'the same' / 'the same as K' / 'the same as the other ammeter' do **not** accept 'same as the other meter'	1
(b)(i)	any **two** from: • two cells are joined + to +	answers in terms of current gain no marks accept one cell in the wrong way accept two cells are joined back-to-back accept two cells are joined – to – accept battery for cell do **not** accept answers in terms of all the cells or in terms of energy only	2
	• some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components	accept voltage for pd do **not** accept using up pd	
	• the other components have a resistance	accept a named component / components / wire has a resistance	
	• cells not fully charged **or** cells partially run down	do **not** accept voltage of cells is less than 1.5 unless explained do **not** accept cells are not as powerful unless explained	
	• cells have an internal resistance		
(ii)	the diode has a (very) high resistance (in the reverse direction)		1
	a diode only conducts / allows current to flow in one direction	accept little / no current flows do **not** accept blocks / cuts flow	1

Continued

4.6.2.4 Uses and applications of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q10

question	answers	extra information	mark
(c)	**QoWC** for the use of the word resistance	annotate Q✓ Q✗ accept resistant	1
	accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral		
	as the pd / current increases / changes	accept voltage for pd must be correctly linked to at least one of the following points accept	1
	the temperature of the filament increases / changes	lamp / bulb for filament accept filament becomes hotter	1
	increasing / changing the **resistance** of the lamp	accept for **1** mark only the filament lamp does not obey Ohm's law	1
total			9

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q11

question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	1
(b)	any **one** from: • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope	 do **not** accept seismic waves / earthquake do **not** accept slinky unless clearly described	1
(c)	transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel	accept a correctly labelled diagram	1
	longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram part explanation of the difference between transverse **and** longitudinal gains **1** mark	1
(d)(i)	TIR shown	needs to stay inside water jet ignore number of reflections **or** arrow heads lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

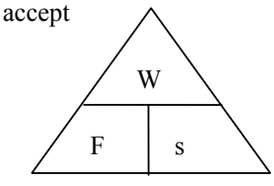
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q12

question	answers	extra information	mark
(a)	W		1
	has only two states **or** is either on or off	accept discrete values only do **not** credit answer purely in terms of shape	1
(b)	any **one** from:		1
	• higher quality	accept clearer do **not** accept easier to read ignore faster accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength do **not** accept no distortion / weakening on its own	
	• increased carrying capacity	accept more information can be sent **or** more channels	
	• errors can be rectified		
total			3

4.6.2.4 Uses and applications of electromagnetic waves

3462/3F Q13

question	answers	extra information	mark
(a)(i)	all points plotted accurately	accept **1** mark for 5 correct plots ± ½ small square on stopping distance	2
	line of best fit must be continuous	accept attempt at a reasonable curve does not need to go through 0 0 do **not** accept a straight line do **not** accept dot-to-dot	1
(ii)	4 to 6 (metres)	accept ecf from (a)(i) accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown	2
(b)(i)	0.7 (s)	incorrect unit = 0 marks	1
(ii)	constant speed / velocity	accept (continued as) 30mph accept did not change / stayed the same accept no acceleration	1
(iii)	3.3(s)	penalise incorrect unit once only	1
(iv)	reaction time increases / is longer **or** thinking distance increases	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it increases	do **not** accept travels at constant speed for longer	1
(c)(i)	work done = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	2100	accept 2.1 kilo accept **1** mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

4.6.2.4 Uses and applications of electromagnetic waves

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q14

question	answers	extra information	mark
(a)(i)	refraction		1
(ii)	it changes speed **or** change in density	accept it speeds up do **not** accept it slows down do **not** accept air is more dense than glass	1
(b)(i)	sound / waves <u>diffract</u> through the gap (in the wall) **or** over the wall **or** because the gate is open	do **not** accept reflection this only scores if first marking point is given accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates if diagram is labelled as diffraction both marks can be scored	1 1
(ii)	less diffraction	accept no diffraction accept gates <u>absorb</u> sound / noise / waves accept gates <u>reflect</u> sound / noise / waves do **not** accept rebounds / stops / blocks out	1
total			5

Version 1.0: 0707

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science B 4462 / Physics 4451

PHY1F Unit Physics 1

Mark Scheme

2007 examination - June series

4.6.2.4 Uses and applications of electromagnetic waves

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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Dr Michael Cresswell, Director General.

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

4.6.2.4 Uses and applications of electromagnetic waves

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.6.2.4 Uses and applications of electromagnetic waves

PHY1F Question 1

	answers	extra information	mark
(a)(i)	grid	accept any way of indicating correct answer	1
(ii)	increases voltage	accept any way of indicating correct answer	1
(iii)	230 V	accept any way of indicating correct answer	1
(iv)	reduce	accept any way of indicating correct answer	1
(b)(i)	increases the temperature	accept make it hotter / heat goes into the air accept convection currents accept sensible comment eg sound energy / it buzzes ignore pollutes the air	1
(ii)	less than 100%		1
total			6

4.6.2.4 Uses and applications of electromagnetic waves

PHY1F Question 2

	answers	extra information	mark
(a)	coal		1
(b)	fossil fuels can be used to generate electricity at any time a few large power stations can generate the electricity for a million homes	if more than 2 boxes ticked, mark incorrect boxes first	1 1
(c)(i)	no fuel is burnt	accept a named fuel accept nothing is burnt accept does not use (fossil) fuel	1
(ii)	kinetic		1
(iii)	any **two** from: • cause <u>noise</u> pollution • cause <u>visual</u> pollution • need concrete for bases • new roads / infrastructure needed • may interfere with TV / radio / mobile phone signals • dangerous to birds • do not generate all of the time • need a lot of generators • high <u>initial</u> / <u>capital</u> costs • reduces house prices	accept causes pollution for **1** mark accept generates <u>only</u> when the wind blows do **not** accept 'generate when the wind blows' do **not** accept 'take up a lot of space / land'	2
total			7

4.6.2.4 Uses and applications of electromagnetic waves

PHY1F Question 3

	answers	extra information	mark
(a)(i)	7pm	accept 19.00 / 1900	1
(ii)	8pm	accept 20.00 / 2000	1
	temperature drops more slowly	accept heat for temperature accept line is less steep	1
(b)	insulator		1
	conduction*	*answers can be either way around	1
	convection*		1
(c)(i)	4 (years)		1
(ii)	it is the cheapest / cheaper / cheap	do **not** accept answers in terms of heat rising or DIY	1
	has the shortest / shorter payback time	do **not** accept short payback time	1
total			9

4.6.2.4 Uses and applications of electromagnetic waves

PHY1F Question 4

	answers	extra information	mark
(a)(i)	any **one** from: • gamma • X-rays • infra red • microwaves • radio	 accept correct symbol accept IR do **not** accept heat do **not** accept TV	1
(ii)	all the waves travel at the same speed		1
(b)(i)	(skin) cancer / melanoma	accept damage eyesight accept sunburn do **not** accept sun tan do **not** accept sunstroke	1
(ii)	higher levels of UV <u>greater</u> risk to health / risk of skin cancer / (more) protection needed / most likely to get burnt / damage skin	accept UV at its strongest / sun's rays are strongest ignore 'sun is at its hottest' ignore 'sun is at its highest' accept greater damage to / easier to damage cells / mutate cells ignore just 'affect your health' must be idea of greater adverse effect on health	1 1
total			5

4.6.2.4 Uses and applications of electromagnetic waves

PHY1F Question 5

	answers	extra information	mark
(a)	C		1
(b)(i)	easy to maintain / access **or** (currently) cheaper than a space telescope **or** can modify (easily) an existing telescope **or** telescopes can be larger **or** can test new types of telescope (easily)	do **not** accept 'easier to use' do **not** accept easier to supply with power	1
(ii)	atmosphere does not block / distort the image	accept picture / data for image accept 'more detailed / clearer image / data / picture accept 'no light pollution' accept 'can look at the Earth' do **not** accept 'can see further' do **not** accept 'better view' do **not** accept 'clear view' do **not** accept 'can see more clearly'	1
total			3

4.6.2.4 Uses and applications of electromagnetic waves

PHY1F Question 6

	answers	extra information	mark
(a)(i)	electromagnetic (wave / radiation)	accept em (wave / radiation) ignore reference to frequency	1
(ii)	gamma can penetrate the crate / box / packaging	accept converse (but must relate to both alpha and beta) ignore just gamma radiation kills bacteria accept can get through to food	1
(iii)	neutrons		1
(b)(i)	absorb gamma / radiation	accept it stops / reduces the radiation	1
(ii)	any **one** from: • slow down the conveyor belt • food does more than one circuit • stay on the conveyor belt longer • food closer to the source / radiation	ignore larger doses / use more of the source ignore thinner packaging	1

Continued on next page

4.6.2.4 Uses and applications of electromagnetic waves

Question 6 continued

	answers	extra information	mark
(c)(i)	idea of testing food on humans / animals		1
	no (measured) ill effects **or** monitor their health	accept monitor people that have eaten the food accept a measurement / comparison for **1** mark eg measure the amount of radiation in treated food comparison plus a reason for the comparison would get **2** marks eg idea of measuring level of radiation in treated food **with** no measurable increase in level = **2** marks **or** comparing it to untreated food = **2** marks	1
(ii)	so can make own decision about eating or not eating treated food	accept may be against their religious / moral views accept some people prefer food that hasn't been tampered with ignore in case they don't like the idea of eating treated food accept don't want to eat treated food ignore might be allergic to the food eg think it will give them cancer = **0** marks think it will give you cancer so I need to know so that I can choose = **1** mark	1
total			8

4.6.2.4 Uses and applications of electromagnetic waves

PHY1F Question 7

	answers	extra information	mark
(a)	the outside colour of the cans		1
(b)(i)	18 (°C) **or** 88 to 70	ignore negative sign	1
(ii)	8 (°C) **or** 70 to 62	ignore negative sign	1
(c)	greater temperature difference between water and surroundings (at start)	must mention temperature difference ignore just water hotter accept energy used to heat cans initially	1
(d)	black		1
	temperature falls the fastest (in L)	accept (can L) loses more heat / cools quicker accept heat for temperature	1
	black is a good / the best / better emitter (of heat / radiation)	accept converse ignore black is best absorber	1
total			7

4.6.2.4 Uses and applications of electromagnetic waves

GCSE
PHYSICS
PH3FP
Mark scheme

4403
June 2014

Version: 1.0 Final

4.6.2.4 Uses and applications of electromagnetic waves

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Information to Examiners

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- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

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2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

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3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Quality of Written Communication and levels marking

In Question 9(a) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE Physics – PH3FP – June 2014

Question	Answers	Extra information	Mark	AO spec ref
1(a)	transmits absorbs	correct order	1 1	AO1 3.1.1b
1(b)	light	allow ultra violet **or** UV **or** infrared **or** IR **or** gamma	1	AO1 3.1.1b
1(c)	20	allow **1** mark for correct working, ie $\frac{60}{3}$ provided no subsequent step	2	AO2 3.1.1b
1(d)	Killing cancer cells		1	AO1 3.1.1b
Total			**6**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO spec ref
2(a)	3000	allow **1** mark for correct substitution, ie 600 × 5 provided no subsequent step	2	AO2 3.2.2b
2(b)	anticlockwise moment	must be both words	1	AO1 3.2.2c
2(c)(i)	3400	allow 3.4 kilo (newtons)	1	AO2 3.2.2c
2(c)(ii)	as the distance (of the girl from point A) increases, force F increases	allow gets bigger for increases force is (directly) proportional to distance will negate any correct response	1	AO3 4.5.3
Total			**5**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO spec ref
3(a)	<table><tr><th></th><th>Digital Camera</th><th>Eye</th></tr><tr><td>Cornea</td><td></td><td>✓</td></tr><tr><td>Lens</td><td>✓</td><td>✓</td></tr><tr><td>Pupil</td><td></td><td>✓</td></tr><tr><td>CCD</td><td>✓</td><td></td></tr></table>	ignore shaded row each correct row = **1** mark	3	AO1 3.1.4a, d
3(b)	long		1	AO1 3.1.4b
3(c)	lens A it is a concave / diverging lens	 this mark is only gained if lens A is stated any reference to lens material or mass of lens negates this mark allow it will focus light onto the retina	1 1	AO1 3.1, 3.1.4b
3(d)	The refractive index of the lens material		1	AO1 3.1.4f
3(e)	4	ignore any signs allow **1** mark for correct substitution, ie $\frac{1}{0.25}$ provided no subsequent step	2	AO2 3.1.4e

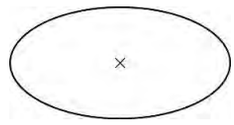
Question 3 continues on the next page . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question 3 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
3(f)	Cauterising open blood vessels		1	AO1 3.1.5f
3(g)	5	allow **1** mark for correct substitution, ie $\frac{70}{14}$ provided no subsequent step	2	AO2 3.1.3i
Total			**12**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO spec ref
4(a)	concentrated		1	AO1 3.2.1a
4(b)		judge by eye	1	AO2 3.2.1c
4(c)	C A D	3 correct = **2** marks 1 or 2 correct = **1** mark	2	AO1 3.2.1a
4(d)	Lower the athlete's seating position Move the wheels further apart		1 1	AO2 3.2
Total			**6**	

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE Physics – PH3FP – June 2014

Question	Answers	Extra information	Mark	AO spec ref
5(a)	hydraulic		1	AO1 3.2.3
5(b)	9	allow **1** mark for a correct substitution, ie $\frac{1800}{200}$ provided no subsequent step	2	AO2 3.2.3c
5(c)	an environmental		1	AO3 SALoSE
Total			**4**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO spec ref
6(a)(i)	increase		1	AO3 3.3.1a, 4.5.4
6(a)(ii)	A and B and B and C	both required for the mark either order	1	AO3 3.3.1a, 4.5.4
6(a)(iii)	any **two** from: • size of nail **or** nail material • current • (size of) paper clip • length of wire	 allow (same) nail allow (same) cell allow p.d. same amount of electricity is insufficient accept type/thickness of wire	2	AO3 4.1b
6(b)	4 B picks up the same number as C, so this electromagnet would pick up the same number as A **or** direction of current does not affect the strength of the electromagnet	 allow it has got the same number of turns as A	1 1	AO3 3.3.1a, 4.5.4
6(c)	2	allow 1 or 3	1	AO3 3.3.1a, 4.5.4
Total			**7**	

Question	Answers	Extra information	Mark	AO spec ref
7(a)	(sound waves) which have a frequency higher than the upper limit of hearing for humans **or** a (sound) wave (of frequency) above 20 000 Hz	sound waves that cannot be heard is insufficient a wave of frequency 20 000 Hz is insufficient	1	AO1 3.1.2a
7(b)	640	an answer of 1280 gains **2** marks allow **2** marks for the correct substitution ie 1600 × 0.40 provided no subsequent step allow **2** marks for the substitution $\frac{1600 \times 0.80}{2}$ provided no subsequent step allow **1** mark for the substitution 1600 × 0.80 provided no subsequent step allow **1** mark for the identification that time (boat to bed) is 0.4	3	AO2 3.1.2c
7(c)	any **one** from: • pre-natal scanning / imaging • imaging of a named organ (that is not surrounded by bone), eg stomach, bladder, testicles • Doppler scanning blood flow	accept heart do **not** allow brain **or** lungs (either of these negates a correct answer)	1	AO1 3.1.2d

Question 7 continues on the next page . . .

Question 7 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
7(d)	advantage any **one** from: • (images are) high quality or detailed or high resolution • (scan) produces a slice through the body • image can be viewed from any direction • an image can be made of <u>any</u> part (inside the body) • easier to diagnose **or** see a problem (on the image) disadvantage any **one** from: • (the X-rays used **or** scans) are <u>ionising</u> • mutate cells **or** cause mutations **or** increase chances of mutations • turn cells cancerous **or** produce abnormal growths **or** produce rapidly growing cells • kill cells • shielding is needed	clearer / better image is sufficient allow images are (always) 3D / 360° allow whole body can be scanned allow a description of what ionising is allow for cells: DNA / genes / chromosomes / nucleus / tissue damage cells is insufficient can be dangerous (to human health) unqualified, is insufficient	1 1	AO1 3.1
Total			**7**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO spec ref
8(a)	gravitational attraction (between the satellite and the Earth)	allow gravity allow weight of the satellite	1	AO1 3.2.4b
8(b)	any **two** from: • mass of satellite • speed / velocity (of satellite) • radius of orbit / circle	allow height above the Earth radius / height alone is insufficient	2	AO1 3.2.4c
8(c)(i)	increasing the height (above the Earth's surface) increases the time (for one orbit)	allow a positive correlation allow as one gets bigger, the other gets bigger, or vice versa ignore they are directly proportional	1	AO3 4.5.3
8(c)(ii)	there is no relationship / correlation		1	AO3 4.5.3
8(d)	Isaac Newton was a respected scientist who had made new discoveries before		1	AO3 3.2.4, SALoSE
Total			**6**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.			Mark	AO spec ref
9(a)				6	
0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**		AO1 3.3.2
No relevant / correct content.	**Either** there is an attempt at a description of the construction of a transformer **or** a correct statement of the effect of one type of transformer on the input p.d.	There is a description of the construction of a transformer **and** a correct statement of the effect of one type of transformer on the input p.d.	There is a clear description of the construction of a transformer **and** there is a correct description of how transformers affect the input p.d.		

details of construction:	extra information
a (laminated) core	
core is made from a magnetic material / iron	
2 coils	
the coils are made from an electrical conductor / copper	
the coils are covered in plastic / insulation	
the coils are (usually) on opposite sides	
step-up transformer has more turns on secondary coil than (its) primary (or vice versa)	
step-down transformer has less turns on secondary coil than (its) primary (or vice versa)	
effect on input p.d. :	
step-up transformer, the output p.d. is greater (than the input p.d.)	accept voltage for p.d.
step-down transformer, the output p.d. is lower (than the input p.d.)	

Question 9 continues on the next page . . .

Question 9 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
9(b)	switch mode (transformer)		1	AO1 3.3.2j
Total			7	

4.6.2.4 Uses and applications of electromagnetic waves

AQA

GCSE

Science A / Physics

PH1FP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

4.6.2.4 Uses and applications of electromagnetic waves

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE Science A / Physics – PH1FP – June 15

Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.1 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.2 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.3 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.4 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.5 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.6 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.2 Ignore / Insufficient / Do not allow

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4. Quality of Communication and levels marking

In Question **7a** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

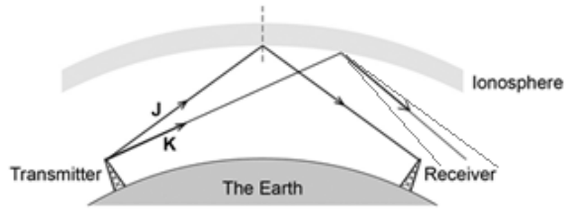
Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec. ref.
1(a)(i)	reflection of wave **K** at or within the ionosphere angle i = angle r  	allow dashed lines 'judge by eye' tolerance for the reflected ray is between the first e and last r ignore arrows a reflected ray to the receiver doesn't score 2nd mark additional rays shown doesn't score 2nd mark	1 1	AO2 P1.5.2b
1(a)(ii)	normal		1	AO1 P1.5.2a
1(b)(i)	microwave		1	AO1 P1.5.1k
1(b)(ii)	refraction		1	AO1 P1.5.1g
1(c)	All electromagnetic waves are transverse. All electromagnetic waves have the same speed in a vacuum.		1 1	AO1 P1.5.1b, c, d
Total			7	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. ref.
2(a)	chemical kinetic sound	correct order only	1 1 1	AO1 P1.2.1a
2(b)	48% or 0.48	an answer of 0.48 with a unit gains **1** mark an answer of 0.48% gains **1** mark an answer of 48 with or without a unit gains **1** mark	2	AO2 P1.2.1d
Total			**5**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. ref.
3(a)(i)	because they contain free electrons		1	AO1 P1.1.3a
3(a)(ii)	because they are good absorbers of infrared radiation		1	AO1 P1.1.1c
3(b)(i)	insulators		1	AO1 P1.1.3a
3(b)(ii)	the rate of energy transfer would be lower.		1	AO1 P1.1.3c
3(c)	power time	allow the temperature (of the oven) watts or wattage is insufficient	1 1	AO1 P1.3.1b
3(d)	it can be switched on / off remotely	accept sensible suggestions about remote operation eg can be turned on / off from work **or** food can be cooked before you get home	1	AO3 P1.1
Total			**7**	

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(a)	20 790 (J)	an answer of 21 000 (J) (2 s.f.) gains **2** marks allow **1** mark for correct substitution: ie E = 0.33 x 4200 x 15 provided no subsequent step shown	2	AO2 P1.1.4d
4(b)	temperature		1	AO1 P1.1.4d
4(c)	(top pan) balance	accept scales do **not** accept a scale do **not** accept weighing scales do **not** accept newtonmeter do **not** accept spring balance	1	AO1 P1.1.4d
4(d)	dark / black / (dark) grey convection	 correct order only	1 1	AO1 P1.1.1c P1.1.3c
4(e)(i)	created	accept made	1	AO1 P1.2.1a
4(e)(ii)	increases		1	AO1 P1.2.1c
Total			**8**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO/Spec. ref.
5(a)(i)	high levels of infrared radiation (from the Sun)	allow lots of (solar) energy (available) do **not** accept 'heat' for infrared 'it is hot' is insufficient 'lots of sunlight' is insufficient	1	AO2 P1.4.1a
5(a)(ii)	reflected		1	AO1 P1.5.1g
5(a)(iii)	boiler turbine transformer	correct order only	1 1 1	AO1 P1.4.1a
5(b)	2 100 000 (kWh)	allow **1** mark for correct substitution i.e. 140 000 x 15 provided no subsequent step	2	AO2 P1.3.1c
5(c)(i)	only 1 wind turbine was considered **or** other wind turbines may have generated more electricity only 1 week's weather was reported on **or** wind speed varies from one week to another	accept only one location is considered accept insufficient sample size 'wind speed varies' is insufficient	1 1	AO3 P1.4
5(c)(ii)	any **one** from: • wind speed is too high / low • wind is unreliable	allow no wind allow too windy allow wind is variable	1	AO1 P1.4

Question 5 continues on the next page . . .

Question 5 continued . . .

Question	Answers	Extra information	Mark	AO/Spec. ref.
5(c)(iii)	any **one** from: • wind is a renewable energy source • do not use fuel • energy source is free • do not release carbon dioxide • do not release greenhouse gases • do not release sulfur dioxide • do not cause acid rain • do not cause climate change • do not cause global warming • do not cause global dimming	answer must be an advantage of wind, converse answers in terms of fossil fuels are insufficient accept do not release pollutant gases 'no pollution' is insufficient	1	AO1 P1.4.1f
Total			**11**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. ref.
6(a)(i)	C		1	AO2 P1.5.4a
6(a)(ii)	The speed of star **B** is less than the speed of star **D**.		1	AO3 P1.5.4b
6(b)	300 000 000 m/s	allow **1** mark for correct substitution ie 200 000 x 1500 provided no subsequent step shown allow unit correctly indicated in list if not written in answer space	2 1	AO2 AO1 P1.5.1j
Total			**5**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7 (a)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a 'best-fit' approach to the marking.		6	AO2 AO3 P1.2 HSW

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	There is a relevant statement about an energy saving method	There is at least one clear comparison of energy saving methods and their cost effectiveness with an appropriate calculation	There is a comparison of energy saving methods and their cost effectiveness with appropriate calculations. Comparison to include further detail.

examples of physics points made in the response	extra information
examples of relevant statements • energy efficient boiler saves the most (energy / money) per year • loft insulation costs the least to install • double-glazing costs the most to install	
examples of statements that include cost effectiveness • loft insulation is the most cost effective in the long term • double-glazing is the least cost effective • loft insulation has the shortest payback time • double-glazing has the longest payback time • payback time calculated for any method	payback times: energy efficient boiler: 6.25 years loft insulation: 2 years double glazing: 100 years cavity wall insulation: 2.86 years
examples of further detail • for cost effectiveness install in the following order: loft, cavity wall, boiler, double-glazing • for reducing energy use install in the following order: boiler, loft, cavity wall, double glazing • don't install double-glazing for insulation purposes • double-glazing won't pay for itself in your lifetime • justified choice of best / worst method	

4.6.2.4 Uses and applications of electromagnetic waves

Question 7 continued . . .

Question	Answers	Extra information	Mark	AO / Spec. ref.
7(b)(i)	how effective a material is as an insulator	accept 'heat' for energy accept how effective a material is at keeping energy in accept the lower the U-value the better the insulator accept the lower the U-value the lower the rate of energy transfer	1	AO1 P1.1.4a
7(b)(ii)	(the U-value) decreases		1	AO1 P1.1.4b
Total			**8**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. ref.
8(a)(i)	0.5 °C		1	AO3 P1.1
8(a)(ii)	data is continuous **or** both variables are continuous **or** independent variable is continuous **or** time is continuous	accept results / measurements for data accept data is not categoric one variable is continuous is insufficient air temperature is continuous is insufficient	1	AO3 P1.1
8(b)(i)	20.5 (°C)		1	AO2 P1.1
8(b)(ii)	60 (minutes)	accept 1 hour	1	AO2 P1.1
8(c)(i)	so a comparison can be made **or** outside temperature is a control variable	accept: (outside) temperature would affect energy required (to maintain temperature of the house) **or** (outside) temperature would affect internal temperature (of the house) **or** heat loss will be faster on a cold day outside temperature will affect the results is insufficient fair test is insufficient	1	AO3 P1.1

Question 8 continues on the next page . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. ref.
8(c)(ii)	the cost is equal to the number of kWh x the cost per kWh calculation 0.8 / 8.0 = 0.1 or 10%	accept (heating) bill depends on (number of) kWh used accept energy for kWh allow 7.2 / 8.0 = 0.9 or 90%	1 1	AO3 AO2 P1.1
8(c)(iii)	heating is on for more / less time (than anticipated) because some days it is cooler / warmer (than anticipated)	 accept other sensible suggestions an answer giving two sensible situations gains **2** marks possible examples: • some houses have different amounts of insulation • there are different styles of house temperature (inside / outside) is always changing is insufficient	1 1	AO3 P1.1
Total			**9**	

4.6.2.4 Uses and applications of electromagnetic waves

GCSE

Additional Science / Physics

PH2FP

Mark scheme

4408/4403
June 2015

Version/Stage: 1.0: Final

4.6.2.4 Uses and applications of electromagnetic waves

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Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do not allow

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4. Quality of Communication and levels marking

In Question **8c** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE ADDITIONAL SCIENCE / PHYSICS – PH2FP– JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
1(a)	increases	accept reaches highest value do **not** accept increases and decreases	1	AO2 2.3.2	E
1(b)(i)	increases		1	AO1 2.3.2m	A
1(b)(ii)	increases		1	AO1 2.3.2m	A
1(c)	18 watt	allow **1** mark for correct substitution i.e. 12 x 1.5 provided no subsequent step accept W answer may be indicated in the list	2 1	AO2 2.4.2c AO1 2.4.2c	E
Total			6		

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE ADDITIONAL SCIENCE / PHYSICS – PH2FP– JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
2(a)	inside the Sun		1	AO1 2.6.2b	A
2(b)	fusion		1	AO1 2.6.2a	G
2(c)	energy		1	AO1 2.6.2f	A
Total			3		

4.6.2.4 Uses and applications of electromagnetic waves

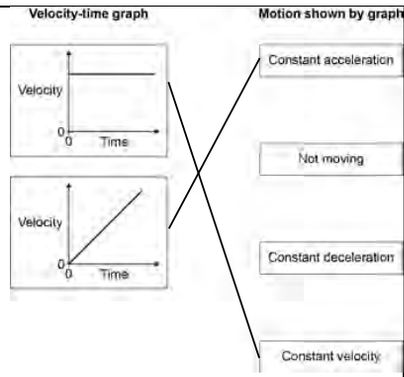
Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
3(a)	3 (.0)	allow **1** mark for correct substitution i.e. 25 x 0.12 provided no subsequent step	2	AO2 2.1.5d	**E**
3(b)(i)	elastic potential kinetic	correct order only	1 1	AO1 2.1.5c 2.2	**G**
3(b)(ii)	increases to 80(mm) (or more)	 accept any number greater than 75 an answer 'it (more than) doubles' gains both marks	1 1	AO3 2.1.5a	**E**
3(c)(i)	weight		1	AO1 2.1	**A**
3(c)(ii)	Downward speed increases		1	AO1 2.1.1e	**A**
Total			**8**		

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
4(a)(i)	(3-pin) plug	do **not** accept plug socket	1	AO1 2.4.1d	**E**
4(a)(ii)	live and neutral		1	AO1 2.4.1e	**A**
4(a)(iii)	double		1	AO1 2.4.1j	**G**
4(b)	Direct current (d.c.) only		1	AO1 2.4.1a	**A**
4(c)(i)	live		1	AO1 2.4.1g	**G**
4(c)(ii)	too great a current flows	accept a surge of current accept too great a power accept an electrical fault do **not** accept voltage / energy / electricity too high	1	AO1 2.4.1g	**E**
4(c)(iii)	can be reset (disconnects circuit) faster	accept does not need replacing cheaper is insufficient does not melt is insufficient quicker to fix / replace is insufficient	1 1	AO2 2.4	**E**
Total			**8**		

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE ADDITIONAL SCIENCE / PHYSICS – PH2FP– JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
5(a)		if more than one line is drawn from a graph then all those lines are wrong allow **1** mark for 1 correct line	2	AO1 2.1.2f	**G**
5(b)	speed		1	AO1 2.1.2d	**G**
5(c)(i)	2.25	allow **1** mark for correct substitution i.e. $a = \frac{9-0}{4}$ or $a = \frac{9}{4}$ provided no subsequent step	2	AO2 2.1.2e	**E**
5(c)(ii)	The air resistance increases		1	AO1 2.1.4a	**A**
5(d)	2000 J mass is half **or** kinetic energy depends on mass	 do **not** accept weight for mass	1 1	AO2 2.2.1g	**E**
Total			**8**		

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE ADDITIONAL SCIENCE / PHYSICS – PH2FP– JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
6(a)	cell damage *or* cancer	accept kills/mutates cells radiation poisoning is insufficient ionising is insufficient	1	AO3 2.5.2g	**E**
6(b)(i)	any **one** from: • use tongs to pick up source • wear gloves • use (lead) shielding • minimise time (of exposure) • maximise distance (between source and teacher)	accept any other sensible and practical suggestion ignore reference to increasing / decreasing the number / thickness of lead sheets	1	AO3 2.5	**E**
6(b)(ii)	background		1	AO1 2.5.2b	**E**
6(c)(i)	curve drawn *from point 2,160*	do **not** accept straight lines drawn from dot to dot	1	AO2 2.5	**E**
6(c)(ii)	(also) increases	less radiation passes through is insufficient	1	AO3 2.5	**E**
6(c)(iii)	50	accept any value from 40 to 56 inclusive	1	AO3 2.5	**E**
6(d)	gamma only gamma (radiation) can pass through lead	 accept alpha **and** beta cannot pass through lead a general property of gamma radiation is insufficient	1 1	AO2 2.5.2e	**E**
Total			**8**		

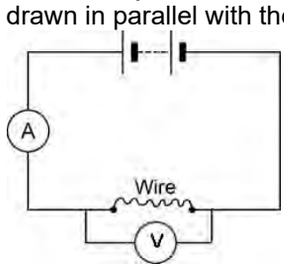
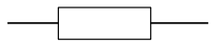
4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE ADDITIONAL SCIENCE / PHYSICS – PH2FP– JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
7(a)(i)	p.d. is (directly) proportional to current **or** gradient/slope is constant ***or*** the lines show constant resistance	accept lines are straight / diagonal	1	AO2 2.3.2d/e/g	**E**
7(a)(ii)	C for the same p.d. the current is the smallest	reason only scores if C is chosen accept lowest gradient **and** the gradient = 1/R	1 1	AO2 2.3.2i	**E**
7(b)(i) clip with table 1	ohm	accept correct symbol Ω accept an answer written in Table 1 if not given in answer space	1	AO1 2.3.2h	**E**
7(b)(ii)	K and L only length varies	reason only scores if both K and L are chosen accept type of metal and the diameter are the same	1 1	AO3 2.3.2	**E**
7(b)(iii)	measure the resistance of more wires made from different metals	accept test more (types of) metals measure the resistance of more wires is insufficient they only use two metals is insufficient	1	AO3 2.3.2	**E**

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE ADDITIONAL SCIENCE / PHYSICS – PH2FP– JUNE 2015

7(c)(i)	voltmeter symbol correct and drawn in parallel with the wire 	accept voltmeter symbol correct and drawn in parallel with the battery	1	AO1 2.3.2c/f	**E**
7(c)(ii)	correct symbol drawn 	symbol must be rectangular	1	AO1 2.3.2c	**E**
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
8(a)	(an equal amount of) positive charge	do **not** accept charge on the atom / nucleus is positive	1	AO3 2.5.1	**E**
8(b)(i)	a (significant) number of alpha particles were scattered by more than 4° **or** alpha particles deflected backwards measurements / results could not be explained by 'plum pudding' model **or** measurements / results did not support predictions	accept (some) measurements / results were unexpected can be explained by the nuclear model is insufficient accept measurements / results did not support hypothesis	1 1	AO1 2.5 AO1	**E**
8(b)(ii)	many/(over)100 000 measurements / results taken	accept Rutherford(and Marsden) were respected scientists **or** scientists were respected accept measurements / results taken over several months the experiment was repeated many times is insufficient	1	AO3 2.5	**E**

4.6.2.4 Uses and applications of electromagnetic waves

Question 8 continues on the next page . . .

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
8(c)			6	AO1 2.5.1a/b/c	**E**

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
no relevant content	A brief description is given with some particles correctly named	A description is given with all three particles named **plus either** the polarity of charge associated with the three particles **or** the relative mass of the three particles **or** the relative mass for one particle and the relative charge for one particle given	A more detailed description is given, naming the particles and polarity of charge **and either** the relative mass is given for at least two particles **or** the relative charge is given for at least two particles

examples of the points made in the response	extra information		
brief description contains protons, neutrons and electrons protons are positive electrons are negative neutrons are uncharged has a nucleus **relative charge** proton +1 electron – 1 neutron 0 **relative mass** proton 1 neutron 1 electron (about) 1/2000 **more detailed description** protons and neutrons make up the nucleus electrons orbit the nucleus electrons are in shells most of the atom is empty space nucleus occupies a very small fraction of the volume of the atom electrons orbit at a relatively large distance from the nucleus most of the mass of the atom is contained in the nucleus the nucleus as a whole is positively charged total number of protons in the nucleus equals the total number of electrons orbiting it in an atom	accept protons and neutrons have the same mass accept electrons have tiny / negligible mass zero mass is neutral		

Total		**10**

4.6.2.4 Uses and applications of electromagnetic waves

AQA

GCSE

Science A / Physics

PH1FP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

4.6.2.4 Uses and applications of electromagnetic waves

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do not allow

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4. Quality of Communication and levels marking

In Question **7(b)** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	geothermal nuclear biofuel		1 1 1	AO1 1.4.1a 1.4.1d
1(b)	gravitational (potential) kinetic sound		1 1 1	AO1 1.3.1a 1.4.1b
1(c)(i)	90% or 0.9(0)	an answer of 0.9(0) with a unit gains **1** mark an answer of 90 with no unit or an incorrect unit gains **1** mark	2	AO2 1.2.1d
1(c)(ii)	60 (MW)	allow 10%	1	AO2 1.2.1b
1(c)(iii)	increased		1	AO1 1.2.1c
Total			**10**	

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	46 200	accept 46 000 allow **1** mark for correct substitution ie 0.5 x 4200 x 22 provided no subsequent step	2	AO2 1.1.4d
2(b)	Energy is used to heat the kettle.		1	AO2 1.2.1b
2(c)	9 (pence)	allow **1** mark for correct substitution ie 0.6 x 15 provided no subsequent step	2	AO2 1.3.1d
2(d)(i)	conduction and convection		1	AO1 1.1.3a
2(d)(ii)	any **one** from: • water stays hotter for longer (than a 'conventional' kettle) • water boiled less often • less energy transferred to the surroundings • (new design is) more efficient		1	AO2 1.2
Total			**7**	

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	any **one** from: • (visible) light • UV / ultra violet • X-ray • gamma / γ-ray		1	AO1 1.5.1e
3(a)(ii)	less than less than the same as		1 1 1	AO1 1.5.1d 1.5.1e
3(b)(i)	(the) Big Bang (theory)		1	AO1 1.5.4e
3(b)(ii)	the red-shift of light from distant galaxies		1	AO1 1.5.4c
Total			**6**	

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	dependent		1	AO3 1.1.3b
4(b)	The equipment has a better resolution.		1	AO3 1.1.3
4(c)	(probe) C largest difference between reading and actual temperature	allow 103.2 reason only scores if C chosen accept larger it is 3.2 greater is insufficient comparing C with only one other probe is insufficient	1 1	AO3 1.1.3
4(d)(i)	12(°C)	accept a value between 12.0 and 12.2 inclusive	1	AO2 1.1.3d
4(d)(ii)	140 (seconds) <u>temperature</u> starts to rise	accept an answer between 130 and 150 inclusive only scores if time mark awarded accept the <u>temperature</u> was lowest (at this time)	1 1	AO2 AO3 1.1.3b
4(d)(iii)	increase	accept faster (rate)	1	AO1 1.1.3b
Total			**8**	

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	it would decrease the time		1	AO3 1.2.1a
5(b)	720 (J)	allow **1** mark for correct substitution ie 12 x 60 provided no subsequent step	2	AO2 1.3.1c
5(c)	<u>dense</u> rises falls	 accept equivalent words accept equivalent words	1 1 1	AO1 1.1.3a
5(d)	 decreases decreases decreases	more than one tick in any row negates the mark	 1 1 1	AO3 1.1.3c 1.1.3d
Total			**9**	

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	frequency		1	AO1 1.5.3b
6(b)	echo(es)		1	AO1 1.5.3c
6(c)	spreading (out) equal to	changing direction is insufficient moving apart is insufficient bending is insufficient accept: similar to same (order of magnitude) as slightly smaller than slightly larger than	1 1	AO1 1.5.1g
6(d)	340 (m/s)	allow **1** mark for correct substitution ie 25 000 x 0.0136 provided no subsequent step or allow 1 mark for a correct calculation showing an incorrect value from conversion to hertz x 0.0136 an answer of 0.34 gains **1** mark	2	AO2 1.5.1j
6(e)	(a wave where the) oscillations are parallel to the direction of energy transfer causing (areas of) compression and rarefaction	both marking points may appear as labels on a diagram accept vibrations for oscillations accept in same direction as for parallel to allow direction of wave (motion) for direction of energy transfer accept correct description in terms of particles mechanical wave is insufficient needs a medium to travel through is insufficient	1 1	AO1 1.5.1b
Total			**8**	

4.6.2.4 Uses and applications of electromagnetic waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	any **one** from: • high cost of installing overhead power lines or underground cables or pylons • high cost as (very) long cables needed • amount of electricity required is too low	allow not enough (surplus) electricity would be generated	1	AO1 1.4.1e

Question 7 continues on the next page . . .

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7 (b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.		6	3 AO1 2 AO2 1 AO3 1.4.1b

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	at least **one** advantage **or one** disadvantage of either method	at least **one** advantage **and one** disadvantage is stated for **one** method **and** a different advantage **or** disadvantage is stated for the other method	clear comparison of advantages **and** disadvantages of **each** method

examples of physics points made in the response	extra information
Advantages of both methods: • both renewable sources of energy • both have no fuel (cost) • both have very small (allow 'no') running costs • no carbon dioxide produced	 accept carbon neutral accept no greenhouse gases accept doesn't contribute to global warming
Advantages of wind: • higher average power output	 produces more energy is insufficient
Advantages of hydroelectric: • constant / reliable power (output) • lower (installation) cost	
Disadvantages of wind: • higher (installation) cost • variable / unreliable power output • (may) kill birds / bats	
Disadvantages of hydroelectric: • lower power output • (may) kill fish or (may) damage habitats • more difficult to set up (within river)	
Disadvantages of both methods • (may be) noisy • visual pollution	 ignore payback time unless no other relevant points made ignore time to build for both

Total			7

4.6.2.4 Uses and applications of electromagnetic waves

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	a proportion / percentage of the energy is wasted	allow heat for energy allow some energy is wasted	1	AO2 1.2.1b 1.2.1c
	(wasted) energy is transferred to surroundings **or** energy is needed to heat pan (before food is heated)		1	
8(b)	(fins have a) large(r) surface area	accept fins increase the surface area	1	AO1 1.1.1c 1.1.1e 1.1.3c
	(black metal surface is a) good / better absorber of infrared radiation	allow 'heat' or 'energy' for infrared radiation ignore good emitter of infrared radiation not a good reflector is insufficient	1	
8(c)	the higher the temperature (of the saucepan) the greater the rate at which infrared radiation is emitted	accept converse answer allow the higher the temperature the more infrared radiation is emitted allow there is a positive correlation	1	AO2 1.1.1b
Total			**5**	

Answer 149 · Examiner comments

June 2018 | 8463/2F | Original Q5

Question 5 (Low demand)

05.1 96% of students scored this mark.

05.2 Answers were split almost equally between the three options.

05.3 Many students seemed confused about the fact that white is not in itself a colour but is made up of the colours of the spectrum. It was common to see answers such as 'the T-shirt absorbs all the colours but reflects white'. The terms reflection, absorption, transmission and emission were often used incorrectly and many students confused their answers with comments such as 'the white light reflected the T-shirt'. Vague answers such as 'It looks white because it is white' were commonly seen.

05.4 About 25% of the students realised that the red cap would absorb the blue light. Of those only 3% said the cap would look black, most of the students suggested that the red and blue would mix to give purple or dark blue.

05.5 46% of students scored both marks, with a further 32% scoring one mark.

Answer 149 · Examiner comments

June 2018 | 8463/2F | Original Q5

05.6 The difficulty in this question was distinguishing between the main hazard in the investigation and the risk that the hazard presented. The acceptable hazards were the heater, the infrared radiation and the hot metal surface. Over half of the students only stated the risk and so scored zero.

05.7 The majority of the students were able to correctly compare the absorption of infra-red radiation by a matt black and a shiny silvered surface. Common misconceptions are that the matt black surface attracted the infra-red radiation better and that it is a better conductor.

Answer 150 · Examiner comments

June 2018 | 8463/2F | Original Q8

Question 8 (Low and Standard demand)

08.1 Position ‘C’ was the most popular answer with 65% of the students scoring the mark.

08.2 The direction in which the wavelength and the frequency change in the electromagnetic spectrum was less well known, with 45 % of the students choosing the correct answer,

08.3 Of the students that scored this mark (44%) most responded with ‘skin cancer’, fewer referred to ‘premature aging of the skin’**.** The majority of the students gave responses that were too general and often not related to the skin. The most common was to state that the radiation causes cancer, rather than specifying skin cancer.

08.4 78% scored at least one mark for recognising that the risk of developing cancer increased with increased radiation dose. Fewer were able to quantify that it was fifty times more likely. Some of the students assumed that having an X-ray on a part of the body would mean that the cancer would be in the same part of the body.

Answer 151 · Examiner comments

June 2019 | 8463/2F | Original Q4

Question 4 (Low demand)

04.1 Just over 50% of the students scored this mark.

04.2 Only 40% of the students knew that infrared is used for electrical heating. The incorrect answers were equally represented.

04.3 Nearly 90% of the students picked the correct colour.

04.4 About 75% of the students answered this correctly. Common incorrect answers indicated a colour change to yellow with some changes to blue or green.

04.5 Just over half of the students identified the type of surface as the independent variable.

04.6 Nearly 9% of the students did not attempt this question with only 10% of the students scoring three marks. About 60% of the students realised that the first thing to do was pour the hot water into the cube. However beyond this, the procedure was often inaccurately described eg the ruler being used to measure the height of the hot water in the cube or used to measure the area of each side of the cube. Most of the students did not realise that the distance from each side of the cube to the infra-red detector needed to be the same. Many students incorrectly completed their answer by describing the amount of radiation given off from each of the different surfaces, possibly having looked at **04.7**.

04.7 About 50% of the students correctly identified the resolution.

04.8 This question was well answered with nearly 85% of the students scoring full marks. Students not gaining full marks usually did not label one of the bars.

04.9 About half of the students gave an acceptable conclusion. Common errors were to give answers in terms of conduction of heat or absorption of radiation, however, the question needed an explanation of emission.

4.6.2.4 Uses and applications of electromagnetic waves

Answer 156 · Examiner comments

June 2022 | 8463/1F | Original Q4

Question 4 (Low demand)

04.1 About 50% of students correctly identified what an alpha particle consists of.

04.2 Approximately 40% of students correctly identified what a beta particle is.

04.3 About 45% of students chose the correct equation for the decay.

04.4 This question discriminated well with a good spread of marks. A quarter of students scored 3 marks, 40% of students scored 2 marks or more and 70% of students gained 1 mark or more.

04.5 This question discriminated well with a good spread of marks. About 30% of students scored 3 marks, approcimately 40% of students scored 2 marks or more and about 80% of students scored 1 mark or more.

04.6 About 75% of students correctly identified the man-made source of background radiation.

Please note there is no reference to 04.7

4.6.2.4 Uses and applications of electromagnetic waves

Answer 157 · Examiner comments June 2022 | 8463/2F | Original Q5

Question 5 (Low and standard demand)

05.1 Very few of the students seemed to know that all electromagnetic waves travel at the same speed in a vacuum.

05.2 The order of the waves in the electromagnetic spectrum was not well known with only about 40% of the students scoring both marks.

05.3 The majority of the students demonstrated an understanding of 'range'. About 10% of students did not attempt the question.

05.4 Very few of the students related the information in Table 4 and Figure 10 to the relative risk of harm to people. Few of the students scored more than 1 mark with about 13% of the students not attempting the question. Most of the students that scored 1 mark did so for giving a general trend or stating that UV can cause skin cancer.

05.5 Many of the students tried to give a more complex answer than required, which were commonly incorrect. The most common correct answers involved being able to see or the idea that if light did not get through it would be dark all the time.

05.6 Nearly three quarters of the students scored at least one mark, often for completing the second blank space correctly.

Answer 158 · Examiner comments June 2023 | 8463/1F | Original Q3

Question 3 (Low and Standard Demand)

03.1 29% of students scored 2 marks, while 27 % of students scored 1 mark for this question about isotopes..

03.2 51% of students knew what half-life means.

03.3 77 % of students correctly identified the least stable isoptope.

03.4 Students found this question difficult with only 38% scoring 2 marks and 21% scoring 1 mark for this question about irradiation and contamination.

03.5 68% of students identified the purpose of the sticky floor.

03.6 72% of students scored 2 marks on this calculation question.

03.7 This question discriminated well with 46 % of students scoring 2 marks and 20 % of students scoring 1 mark for this question about fission and fusion

4.6.2.4 Uses and applications of electromagnetic waves

Answer 159 · Examiner comments June 2023 | 8463/2F | Original Q5

05.1

48% of students recognised the wavelength of a transverse wave.

05.2

47% of students recognised the correct amplitude of a transverse wave.

05.3

93% of students knew that radio waves are used for communication.,

05.4

The majority of students calculated the distance correctly

05.5

The majority of students scored this mark. The most common correct answer was heating food. Common incorrect answers included TV and computers.

Answer 160 · Examiner comments June 2023 | 8463/2F | Original Q9

09.1

12% of students gave the answer perpendicular or a correct description of perpendicular. Common incorrect responses included parallel, opposite, and proportional.

09.2

29% of responses were level 1 and 45% were level 2. Very few students explained the need to calculate the temperature change or to compare the readings on infrared detectors. A number of students suggested using cold water, or even described a different practical. Students were not penalised for using tiny volumes of water, but many students have no concept of how much 50 ml is, for example.

Answer 160 · Examiner comments June 2023 | 8463/2F | Original Q9

09.3

Many students scored zero as they had selected the incorrect box. The reason had to state greatest/highest temperature, or the liquid was the hottest. A higher temperature or hotter liquid was insufficient to gain this mark. 21% of students scored both marks.

09.4

31% of students gained this mark. There seemed to be confusion as to which variable was the dependent variable. The majority of students gave control variables or the independent variable as their answer.

09.5

The most common response related to the matt black surface and the shiny white surface. This was awarded 1 mark. Some students did mention that black was the best absorber but failed to adequately describe the relative absorbance of matt versus shiny surfaces, as they did not explain this only applied for the same colour surface. Some students gave their response in terms of emission or reflection of IR radiation, both of which scored zero. Only 2% of students were able to give two meaningful conclusions.

09.6

90% of students correctly identified the formula for calculating pressure.

09.7

47% of students achieved full marks in this calculation. Many scored zero, as they calculated the total surface area, the volume or used the length of the cube.

Answer 161 · Examiner comments June 2024 | 8463/1F | Original Q10

Question 10 (Standard demand)

10.1 15 % of students scored 3 marks, 39% scored 2 marks and 30% scored 1 mark. The most common mark to score was either ‘nuclei’ or ‘gamma rays’.

10.2 In this exam series all equations were provided for the students on the Physics Equations Sheet. 94% of students scored the mark.

10.3 67% of students scored 2 marks for multiplying the power by the time, whether they had converted the power or not. Most attempts to convert the power were incorrect. Only 3% of students scored all 3 marks for this calculation of energy.

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4.6.2.4 Uses and applications of electromagnetic waves

Answer 161 · Examiner comments June 2024 | 8463/1F | Original Q10

10.4 13% of students scored a mark. 'Wear protective clothing' or 'hazmat suits' were common incorrect answers. Any idea of burying the radioactive waste was credited, so 'bury it in a field' was ok, as was 'bury it in landfill', which from a student's perspective is equivalent to burying it underground. 'Keeping it away from people' was insufficient.

10.5 74% of students scored 2 marks, while 3% scored 1 mark. The answer of 29.2 days was worth 1 mark as this could only have been calculated by doing the correct calculation and then subtracting the result from 365.

Answer 162 · Examiner comments June 2024 | 8463/2F | Original Q1

01.1
98% of students could name our galaxy correctly.

01.2
This question was well answered with 80% of students knowing what the Sun was formed from.

01.3
70% of students were able to name a force involved in the formation of the Sun.

01.4
There was some confusion about the process which releases energy in stars, with only 56% choosing fusion. The most common wrong answer was combustion. Very few students did not attempt this question.

01.5
This question proved more challenging, with only 15% of students understanding that all types of electromagnetic radiation travel at the same speed in a vacuum or space.

01.6
53% of students knew that infrared radiation has a greater frequency than visible light.

01.7
This question was well answered with 49 % of students scoring one mark for knowing that the Sun emits infrared radiation at a greater rate than Earth and a further 34% of students scoring both marks because they could give a reason why.

4.6.2.4 Uses and applications of electromagnetic waves

Answer 163 · Examiner comments June 2024 | 8463/2F | Original Q6

06.1
Many responses for this question were too vague. The questions asked for equipment that can be used to detect infrared waves, so responses that involved emitters of IR waves were incorrect. A significant number focussed on the word radiation and gave their response as a Geiger counter.

06.2
23% of students interpreted the information correctly and chose the correct wavelength.

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Answer 163 · Examiner comments June 2024 | 8463/2F | Original Q6

06.3
A correct response required the use of the information given to identify differences between the sight of bees and humans. Simply quoting wavelengths that could and could not be detected was not sufficient. A minority of students gained marks.

06.4
This question was about white light shining onto a coloured flower. A significant number of students chose the correct words but not always in the incorrect order.

06.5
60% of students were aware of the affect a filter has on the appearance of a coloured object.

06.6
Less than 2% of students were able to name diffuse reflection.