AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.2.3

Properties of electromagnetic waves 2

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**40**
Available paper years	**2004–2024**

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.

4.6.2.3 Properties of electromagnetic waves 2

Answer 01 · Mark scheme June 2004 | 3451H | Original Q2 | Legacy

The full source mark scheme begins on page 34. Follow original question 2 in that document.

Answer 02 · Mark scheme June 2004 | 3451H | Original Q17 | Legacy

The full source mark scheme begins on page 34. Follow original question 17 in that document.

Answer 03 · Mark scheme June 2004 | 3462H3 | Original Q2 | Legacy

The full source mark scheme begins on page 55. Follow original question 2 in that document.

Answer 04 · Mark scheme June 2004 | 3462H3 | Original Q13 | Legacy

The full source mark scheme begins on page 55. Follow original question 13 in that document.

Answer 05 · 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**

4.6.2.3 Properties of electromagnetic waves 2

Answer 06 · 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 07 · 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 08 · Mark scheme

November 2006 | PHY1B | Original Q9 | Legacy

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

4.6.2.3 Properties of electromagnetic waves 2

Answer 08 · Mark scheme

November 2006 | PHY1B | Original Q9 | Legacy

PHY1B (Radiation and the Universe) Higher Tier

Question	Key		
One	**A**	bar	**3**
	B	categoric	**1**
	C	dependent	**2**
	D	reliable	**4**
Two	**A**	current	**3**
	B	energy	**2**
	C	frequency	**4**
	D	substance	**1**

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

4.6.2.3 Properties of electromagnetic waves 2

Answer 09 · Mark scheme

January 2007 | PHY1H | Original Q2 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 10 · Mark scheme

January 2007 | PHY1H | Original Q4 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 11 · Mark scheme

March 2007 | PHY1B | Original Q2 | Legacy

Two	**A**	electron	**1**
	B	nucleus	**4**
	C	neutron	**3**
	D	proton	**2**

Answer 12 · Mark scheme

March 2007 | PHY1B | Original Q5 | Legacy

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

Answer 13 · Mark scheme

March 2007 | PHY1B | Original Q9 | Legacy

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

4.6.2.3 Properties of electromagnetic waves 2

Answer 13 · 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**

4.6.2.3 Properties of electromagnetic waves 2

Answer 14 · Mark scheme June 2007 | PHY1B | Original Q4 | Legacy

Four	**3**	**1**	**1**	**1**

Answer 15 · Mark scheme June 2007 | PHY1B | Original Q6 | Legacy

Six	**4**	**1**	**3**	**1**

Answer 16 · Mark scheme November 2007 | PHY1B | Original Q5 | Legacy

Five	**4**	**2**	**1**	**1**

Answer 17 · Mark scheme November 2007 | PHY1B | Original Q8 | Legacy

Eight	**1**	**4**	**3**	**2**

4.6.2.3 Properties of electromagnetic waves 2

Answer 18 · Mark scheme January 2008 | PHY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
(a) E	C or 0.18 mm		1
(b) E	0.6 m	allow **1** mark for correct transformation and substitution allow **1** mark for changing frequency to Hz answer 600 gains **1** mark	2
(c) E	creates an alternating current with the same frequency as the radio wave **or** it gets hotter	accept 'ac' for alternating current accept alternating voltage accept signal for radio wave	1 1
(d) E	X-rays cannot penetrate the atmosphere **or** X-rays are absorbed *(*by the atmosphere*)*	accept atmosphere stops X-rays do **not** accept atmosphere in the way before reaching Earth ignore explanations	1
total			6

4.6.2.3 Properties of electromagnetic waves 2

Answer 18 · Mark scheme

January 2008 | PHY1H | Original Q5 | Legacy

PHY1H

Answer 19 · Mark scheme

March 2008 | PHY1BP | Original Q9 | Legacy

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

4.6.2.3 Properties of electromagnetic waves 2

Answer 20 · Mark scheme June 2008 | PHY1H | Original Q2 | Legacy

Question 2

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 2 continues on the next page

4.6.2.3 Properties of electromagnetic waves 2

PHY1H

Question 2 continued

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

4.6.2.3 Properties of electromagnetic waves 2

Answer 20 · Mark scheme June 2008 | PHY1H | Original Q2 | Legacy

PHY1H

4.6.2.3 Properties of electromagnetic waves 2

Answer 21 · Mark scheme June 2008 | PHY2H | Original Q2 | Legacy

Question 2

	answers	extra information	mark
(a)(i)	protons neutrons	answers may be in either order	1 1
(ii)	86		1
(iii)	two **fewer** protons and two **fewer** neutrons **or** 84 protons 134 neutrons	do **not** accept two fewer protons and neutrons do **not** accept 218 protons and neutrons	1
(b)(i)	0.4	accept $\frac{2}{5}$ / accept 40 % for 2 marks allow **1** mark for correct totalling = 1.8 allow **1** mark for a clearly correct method with a clearly incorrect total	2
(ii)	any **one** from: • nuclear weapon testing • nuclear power (stations) • nuclear accidents • medical	 do **not** accept nuclear accept nuclear/ radioactive waste accept X-rays	1
(c)(i)	2	accept 2:1 accept twice as big ignore units	1

Question 2 continues on the next page

4.6.2.3 Properties of electromagnetic waves 2

PHY2H

Question 2 continued

	answers	extra information	mark
(ii)	No with a reasonable reason explained only going for two weeks so **or** even staying for a year		1
	total exposure well under lowest limit for causing cancer **or**	**1** mark is for a time frame **1** mark is for correctly relating to a dose	1
	Yes with a reasonable reason explained all levels of radiation are (potentially) hazardous (1) harm caused by lower doses may not have been recorded (1) **or** evidence may not be complete **or** insufficient research into effect of small doses	accept low doses could still cause cancer accept all levels affect you do **not** accept radiation dose is high(er) do **not** accept level of background radiation is higher in Germany	
total			10

4.6.2.3 Properties of electromagnetic waves 2

Answer 21 · Mark scheme June 2008 | PHY2H | Original Q2 | Legacy

PHY2H

Answer 22 · Mark scheme March 2009 | PHY1BP | Original Q3 | Legacy

Three	**1**	**3**	**2**	**1**

Answer 23 · Mark scheme March 2009 | PHY1BP | Original Q4 | Legacy

Four	**2**	**3**	**2**	**3**

Answer 24 · Mark scheme March 2009 | PHY1BP | Original Q8 | Legacy

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

Answer 25 · Mark scheme June 2009 | PHY1BP | Original Q4 | Legacy

Four	**1**	**1**	**3**	**4**

Answer 26 · Mark scheme June 2009 | PHY1BP | Original Q5 | Legacy

Five	**2**	**3**	**4**	**3**

Answer 27 · Mark scheme June 2009 | PHY1BP | Original Q6 | Legacy

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

Answer 28 · Mark scheme November 2009 | PHY1BP | Original Q3 | Legacy

Three	**2**	**4**	**2**	**2**

Answer 29 · Mark scheme March 2010 | PHY1BP | Original Q5 | Legacy

Five	**4**	**2**	**1**	**1**

4.6.2.3 Properties of electromagnetic waves 2

Answer 30 · Mark scheme

March 2010 | PHY1BP | Original Q9 | Legacy

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

Answer 31 · Mark scheme

June 2010 | PHY1BP | Original Q6 | Legacy

Six	2	2	2	2

Answer 32 · Mark scheme

November 2010 | PHY1BP | Original Q6 | Legacy

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

4.6.2.3 Properties of electromagnetic waves 2

Answer 33 · Mark scheme

January 2011 | PHY2H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	any **one** from: • food / drink • rocks / building materials • cosmic rays / rays from space	accept correctly named example	1
3(a)(ii)	any **one** from: • nuclear power / coal power (stations) • nuclear accidents • nuclear weapons testing	accept nuclear waste accept named accident eg Chernobyl accept named medical procedure which involves a radioactive source accept radiotherapy nuclear activity / radiation is insufficient do **not** accept CT scans	1
3(a)(iii)	different number of / fewer protons **or** different atomic number	accept does not have 86 protons accept only has 84 protons do **not** accept bottom number different reference to mass number negates this mark	1

Question 3 continues on the next page . . .

PHY2H

Question 3 continued . . .

question	answers	extra information	mark
3(b)	168	accept 169 if clear, correct method is shown allow **1** mark for a correct dose ratio involving the spine eg 2:140 etc **or** ratio of days to dose is 1.2 **or** ratio of dose to days is 0.83	2
3(c)(i)	**Group A**: **J M O**; **Group B**: **K L N**	all correct any order within each group	1
3(c)(ii)	similar (number) / same (number) / large (number)	accept the same specific number in each group eg three reference to other factors such as age is neutral	1
3(c)(iii)	how many people in each group developed cancer	a clear comparison is required	1

Question 3 continues on the next page . . .

4.6.2.3 Properties of electromagnetic waves 2

PHY2H

Question 3 continued . . .

question	answers	extra information	mark
3(c)(iv)	**Yes** the benefit of having the scan is greater than the risk **or** the risk is (very) small (compared to the chance from natural causes) **No** no additional risk is acceptable	there are no marks for **Yes** or **No** the mark is for the reason accept the risk is much greater from natural causes	1
Total			**9**

4.6.2.3 Properties of electromagnetic waves 2

Answer 33 · Mark scheme January 2011 | PHY2H | Original Q3 | Legacy

PHY2H

Answer 34 · Mark scheme March 2011 | PHY1BP | Original Q9 | Legacy

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

4.6.2.3 Properties of electromagnetic waves 2

Answer 34 · 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**

4.6.2.3 Properties of electromagnetic waves 2

Answer 35 · Mark scheme November 2011 | PHY1BP | Original Q3 | Legacy

Three	**2**	**1**	**2**	**2**

Answer 36 · Mark scheme November 2011 | PHY1BP | Original Q9 | Legacy

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

The AQA UMS Conversion Calculator can be found at the following web address:

http://www.aqa.org.uk/umsconversion

4.6.2.3 Properties of electromagnetic waves 2

Answer 37 · Mark scheme June 2015 | PH3HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
3(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 3 continues on the next page . . .

4.6.2.3 Properties of electromagnetic waves 2

Answer 37 · Mark scheme

June 2015 | PH3HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(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

4.6.2.3 Properties of electromagnetic waves 2

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**

4.6.2.3 Properties of electromagnetic waves 2

Answer 37 · Mark scheme

June 2015 | PH3HP | Original Q3 | Legacy



4.6.2.3 Properties of electromagnetic waves 2

Answer 38 · Mark scheme June 2016 | PH2HP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(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
2(b)(i)	gamma rays		1	AO1 2.5.2e
2(b)(ii)	loses/gains (one or more) electron(s)		1	AO1 2.5.1d
2(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

4.6.2.3 Properties of electromagnetic waves 2

Answer 38 · Mark scheme

June 2016 | PH2HP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(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

4.6.2.3 Properties of electromagnetic waves 2

Answer 38 · Mark scheme

June 2016 | PH2HP | Original Q2 | Legacy



4.6.2.3 Properties of electromagnetic waves 2

Answer 39 · Mark scheme

June 2019 | 8463/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7.1	The frequency increases and the wave speed in air stays the same		1	AO1/1 4.6.2.1 iso
7.2	pass through soft tissue (but) absorbed by bone	allow penetrate for pass through allow skin/muscle/etc… for soft tissue pass through tissue is insufficient allow do not pass through bone do not accept reflected by bone	1 1	AO1/1 4.6.2.4
7.3	accept a sensible practical suggestion eg • complete the investigation standing up • use (slightly) cooler water • do not touch the hot cube	do not accept use cold water pour water in carefully is insufficient ignore wear safety goggles or gloves	1	AO2/2 4.6.2.2 WS2.4
7.4	distance between each side (of the cube) and the (infrared) detector	allow distance between cube and detector	1	AO1/2 4.6.2.2 WS2.2
7.5	measurements (for each surface) have not been repeated (to show that they cluster closely)	do not accept any answer for measurement should be repeated for any reason other than to show they cluster eg to show accuracy / average / anomalies would be wrong	1	AO3/3b 4.6.2.2 WS3.7
7.6	(the student) could not conclude that black surfaces always emit more (infrared) than a white surface (as) the reading for the matt white and shiny black would both be 66 (°C)	a (matt) white surface (appears to) emit(s) the same amount (of infrared) as a (shiny) black surface the conclusion is wrong is insufficient allow (as) the reading for the matt white and shiny black would be the same	1 1	AO3/1a/2b 4.6.2.2 WS2.2
7.7	0.0	allow 0 allow zero	1	AO1/1 4.6.3.1

4.6.2.3 Properties of electromagnetic waves 2

Answer 39 · Mark scheme

June 2019 | 8463/2H | Original Q7

7.8	at night, more radiation is emitted from the Earth than absorbed from space cloud reflects radiation (towards the Earth) at A, (there is no cloud cover so) a larger proportion of radiation will be emitted into space	 allow solar radiation for radiation 	1 1 1	AO1/1 4.6.3.2
Total			**12**	

4.6.2.3 Properties of electromagnetic waves 2

Answer 40 · Mark scheme

June 2024 | 8463/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	any **three** from: • they travel at the same speed (in a vacuum / air) • they can travel through a vacuum • they are transverse (waves) • they are electromagnetic (waves)	allow they travel at the speed of light allow they do not need a medium (to travel) ignore they can be reflected / refracted / absorbed / transmitted / diffracted.	3	AO1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	any **one** from: • (medical) imaging • (medical) treatments	allow correctly named method eg PET scan, tracer, gamma camera do not accept ultrasound, CT scan, X-rays, MRI scan allow correctly named treatment eg radiotherapy, brachiotherapy, gamma knife do not accept chemotherapy allow sterilising medical equipment	1	AO1 4.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	gamma rays are (weakly) ionising but radio waves are <u>not</u> (ionising) (so gamma rays) can cause mutations in genes / DNA **or** (so gamma rays) can increase the risk of cancers	 allow can cause cancer allow damages / kills cells	1 1	AO1 4.6.2.3

4.6.2.3 Properties of electromagnetic waves 2

Answer 40 · Mark scheme

June 2024 | 8463/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(radio waves are produced by) oscillations in electrical circuits (of the scanner)	allow (radio waves are produced by) alternating current allow (radio waves are produced by) oscillating electrons (in an aerial)	1	AO1 4.6.2.3
	the radio waves have the same frequency as the oscillations	MP2 dependent on MP1	1	

Total Question 6	8

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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4.6.2.3 Properties of electromagnetic waves 2

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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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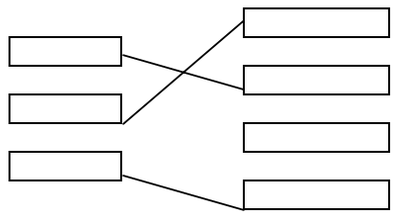
4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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 connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept petrol for (petrol vapour) accept catch fire for explode accept ground for earth	1 1
(c)	**Quality of written communication** any **two** from: • when current greater than fuse rating / value • fuse (becomes hot and) melts / burns out • circuit is broken	for a logical sequence accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity accept fuse blows / breaks accept circuit switched off this cannot score credit on its own	1 2
total			8

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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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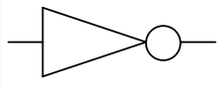
4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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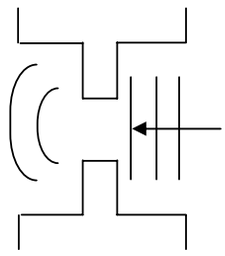
4.6.2.3 Properties of electromagnetic waves 2

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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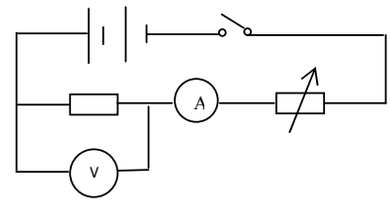
4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

3451F Q12

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration <u>increases</u>	accept velocity / speed increases <u>more</u> 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 <u>correct</u> use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between <u>shuttle</u> and Earth) plus correct orbital speed (makes <u>shuttle</u> 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 <u>centripetal</u> 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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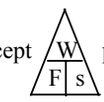
4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

3451F Q16

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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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.

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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4.6.2.3 Properties of electromagnetic waves 2

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4.6.2.3 Properties of electromagnetic waves 2

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.)

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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.

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

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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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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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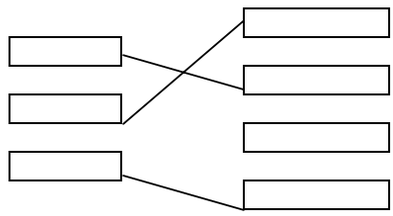
4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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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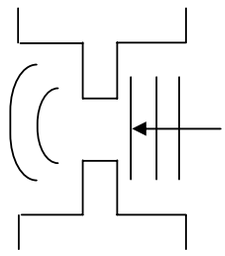
4.6.2.3 Properties of electromagnetic waves 2

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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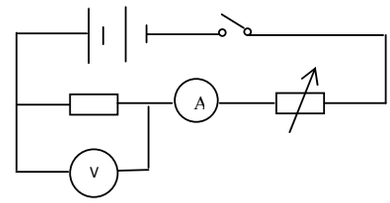
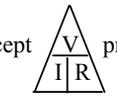
4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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 <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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4.6.2.3 Properties of electromagnetic waves 2

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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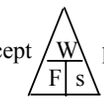
4.6.2.3 Properties of electromagnetic waves 2

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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4.6.2.3 Properties of electromagnetic waves 2

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 <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> by the (positive) <u>nucleus</u>	describes 3 tracks correctly for **2** marks describes 2 or 1 track correctly for **1** mark	max 2
	C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards	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	
total			5

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4.6.2.3 Properties of electromagnetic waves 2

Answer 39 · Examiner comments

June 2019 | 8463/2H | Original Q7

Question 7 (Standard and standard/high and high demand)

07.1 Around 42% of the students scored this mark. Many students seem to think that the wave speed changes.

07.2 About 35% of the students scored both marks. Some students did not specify 'soft' tissue or a named soft tissue, which was required as bone is a tissue. Many students incorrectly described bones as reflecting X-rays rather than absorbing them. Some students appeared to confuse X-rays with gamma rays or even alpha particles.

07.3 A large number of the students failed to appreciate that the hot cube was the main hazard rather than the kettle. The majority gave an answer in terms of 'wear safety goggles and/or

Answer 39 · Examiner comments

June 2019 | 8463/2H | Original Q7

gloves. Less than a quarter of the students gave a correct answer, these appeared to be evenly distributed across the alternatives given in the mark scheme.

07.4 Only a quarter of the students scored this mark, with most incorrect answers giving the temperature or volume of the water as the control variable.

07.5 There appeared to be some confusion of the term precise with either accuracy or resolution. The lack of repeat readings was sometimes given but then incorrectly linked to the idea of calculating a mean or identifying anomalies. About 10% of the students scored this mark.

07.6 About 64% of the students realised that two of the surfaces would give the same temperature reading and therefore undermine the conclusion. However most of these students then simply wrote that the conclusion would not be valid without then going on to explain why.

07.7 Just over 70% of the students gave the correct answer.

07.8 Only a small number of the students scored any marks on this question. Those that did usually scored the mark for 'clouds reflect radiation'. Virtually no students related their answer to night time. Marking points 1 and 3 were rarely awarded. Many of the students wrote about insulation with a few mentioning the cloud as a 'blanket' keeping the ground warm. These answers did not score any marks.

4.6.2.3 Properties of electromagnetic waves 2

Answer 40 · Examiner comments June 2024 | 8463/2H | Original Q6

06.1
Some students displayed a good factual knowledge in answering this item, although a good number thought electromagnetic waves are both transverse and longitudinal. Some students tried to answer this question in terms of the uses of the waves rather than their properties and scored few marks as a result.

06.2
72% of students (scored the mark for this item, displaying a good factual knowledge in giving a wide range of medical uses for gamma rays. However, there were students who did not focus on gamma rays, incorrectly giving MRI scans, X-ray imaging or ultrasound as their response and hence failing to score the mark.

06.3
Only 20% of students scored both marks on this question, comparing the dangers of gamma rays compared with radio waves. The most common errors were not stating that radio waves are not ionising, saying gamma rays are more ionising than radio waves or that gamma rays are highly ionising. Many stated that gamma rays cause cancer or kill cells, but those who mentioned mutations did not always link them to genes / DNA.

06.4
Many students could not explain how radio waves of a specific frequency are produced. Students that achieved the first mark point usually mentioned alternating current. Only 15% scored any marks here.