AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.1.2

Properties of waves

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**107**
Available paper years	**2003–2025**

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.

4.6.1.2 Properties of waves

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

The full source mark scheme begins on page 129. Follow original question 3 in that document.

Answer 02 · Mark scheme June 2003 | 3462F3 | Original Q3 | Legacy

The full source mark scheme begins on page 151. Follow original question 3 in that document.

Answer 03 · Mark scheme June 2005 | 3451 | Original Q3 | Legacy

The full source mark scheme begins on page 168. Follow original question 3 in that document.

Answer 04 · Mark scheme June 2005 | 3451 | Original Q17 | Legacy

The full source mark scheme begins on page 168. Follow original question 17 in that document.

Answer 05 · Mark scheme June 2005 | 3462 | Original Q3 | Legacy

The full source mark scheme begins on page 186. Follow original question 3 in that document.

4.6.1.2 Properties of waves

Answer 06 · Mark scheme June 2005 | 3462 | Original Q13 | Legacy

The full source mark scheme begins on page 186. Follow original question 13 in that document.

Answer 07 · Mark scheme June 2006 | 3451 | Original Q13 | Legacy

The full source mark scheme begins on page 200. Follow original question 13 in that document.

Answer 08 · Mark scheme June 2006 | 3462 | Original Q11 | Legacy

The full source mark scheme begins on page 220. Follow original question 11 in that document.

Answer 09 · 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 10 · Mark scheme November 2006 | PHY1B | Original Q8 | Legacy

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

4.6.1.2 Properties of waves

Answer 11 · Mark scheme

Question 1

question	answers	extra information	mark
(a)	B		1
(b)	G		1
(c)	D		1
(d)	A		1
total			4

4.6.1.2 Properties of waves

Answer 12 · Mark scheme

March 2007 | PHY1B | Original Q7 | Legacy

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

Answer 13 · Mark scheme

March 2007 | PHY1B | Original Q9 | Legacy

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

4.6.1.2 Properties of waves

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**

4.6.1.2 Properties of waves

Answer 14 · Mark scheme June 2007 | PHY1B | Original Q7 | Legacy

Seven	**3**	**4**	**1**	**2**

Answer 15 · Mark scheme June 2007 | PHY1F | Original Q4 | Legacy

The full source mark scheme begins on page 234. Follow original question 4 in that document.

Answer 16 · Mark scheme November 2007 | PHY1B | Original Q3 | Legacy

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

Answer 17 · Mark scheme November 2007 | PHY1B | Original Q7 | Legacy

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

4.6.1.2 Properties of waves

Answer 18 · 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

4.6.1.2 Properties of waves

Answer 18 · Mark scheme January 2008 | PHY1F | Original Q4 | Legacy

PHY1F

Answer 19 · Mark scheme January 2008 | PHY3F | Original Q9 | Legacy

The full source mark scheme begins on page 246. Follow original question 9 in that document.

Answer 20 · Mark scheme March 2008 | PHY1BP | Original Q3 | Legacy

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

Answer 21 · Mark scheme March 2008 | PHY1BP | Original Q6 | Legacy

Six	**A**	2	**3**
	B	3	**2**
	C	4	**1**
	D	6	**4**

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

Answer 22 · Mark scheme June 2008 | PHY1BP | Original Q4 | Legacy

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

4.6.1.2 Properties of waves

Answer 23 · 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

4.6.1.2 Properties of waves

Answer 23 · Mark scheme June 2008 | PHY1F | Original Q4 | Legacy

PHY1F

4.6.1.2 Properties of waves

Answer 24 · 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

4.6.1.2 Properties of waves

PHY1F

Question 6 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

4.6.1.2 Properties of waves

Answer 24 · Mark scheme June 2008 | PHY1F | Original Q6 | Legacy

PHY1F

Answer 25 · Mark scheme June 2008 | PHY3F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
(a)(i)	**A**, **C** and **D**	any order but all three required and no others	1
(a)(ii)	**D** and **E**	either order but both required and no others	1
(b)(i)	20000 (Hz) to 20 (Hz) **or** vice-versa	accept '19980 (Hz)'	1
(b)(ii)	frequency (of dog whistle) too high (for humans to hear) / frequency above 20000 Hz	accept 'it is ultrasound' accept 'sound from the whistle is ultrasonic'	1
(c)(i)	substance reflection	correct order essential	1 1
(c)(ii)	detector		1
total			7

Answer 26 · 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 27 · Mark scheme November 2008 | PHY1BP | Original Q6 | Legacy

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

4.6.1.2 Properties of waves

Answer 28 · 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**

4.6.1.2 Properties of waves

Answer 28 · Mark scheme

January 2009 | PHY1F | Original Q1 | Legacy

PHY1F

4.6.1.2 Properties of waves

Answer 29 · Mark scheme January 2009 | PHY1F | Original Q2 | Legacy

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**

4.6.1.2 Properties of waves

Answer 29 · Mark scheme

January 2009 | PHY1F | Original Q2 | Legacy

PHY1F

4.6.1.2 Properties of waves

Answer 30 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)	230 50		1 1
2(b)(i)	has a plastic case **or** does not have a metal case or plastic is an insulator	accept outside is plastic accept cover / handle/ hair dryer is plastic / non-conductor accept is double insulated	1
2(b)(ii)	copper		1
Total			**4**

4.6.1.2 Properties of waves

Answer 30 · Mark scheme January 2009 | PHY2F | Original Q2 | Legacy

PHY2F

Answer 31 · Mark scheme January 2009 | PHY3F | Original Q2 | Legacy

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

Answer 32 · Mark scheme January 2009 | PHY3F | Original Q7 | Legacy

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

Answer 33 · Mark scheme March 2009 | PHY1BP | Original Q6 | Legacy

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

Answer 34 · Mark scheme March 2009 | PHY1BP | Original Q7 | Legacy

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

Answer 35 · Mark scheme March 2009 | PHY1BP | Original Q9 | Legacy

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

Answer 36 · 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**

4.6.1.2 Properties of waves

Answer 37 · Mark scheme

June 2009 | PHY1BP | Original Q7 | Legacy

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

4.6.1.2 Properties of waves

Answer 38 · 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 . . .

4.6.1.2 Properties of waves

Answer 38 · Mark scheme

June 2009 | PHY1F | Original Q6 | Legacy

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**

4.6.1.2 Properties of waves

Answer 38 · Mark scheme

June 2009 | PHY1F | Original Q6 | Legacy

PHY1F

4.6.1.2 Properties of waves

Answer 39 · Mark scheme June 2009 | PHY3F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	(**A** =) a microphone (**B** =) an oscilloscope	correct order essential **or** cathode ray oscilloscope **or** CRO	1 1
3(a)(ii)	the amplitude	accept any unambiguous indication	1
3(a)(iii)	quieter / softer	do **not** accept less (which could refer to the amplitude, frequency or wavelength)	1
3(b)	sound cannot travel through a vacuum / (empty) space / free space (because) there is / are nothing / no particles to vibrate	accept there is no medium for the sound to travel through accept (because) there is / are nothing / no particles between them and the source (of the sound)	1 1
Total			**6**

4.6.1.2 Properties of waves

Answer 39 · Mark scheme June 2009 | PHY3F | Original Q3 | Legacy

PHY3F

Answer 40 · Mark scheme November 2009 | PHY1BP | Original Q2 | Legacy

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

Answer 41 · Mark scheme November 2009 | PHY1BP | Original Q7 | Legacy

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

4.6.1.2 Properties of waves

Answer 42 · 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**

4.6.1.2 Properties of waves

Answer 42 · Mark scheme

January 2010 | PHY1F | Original Q3 | Legacy

PHY1F

4.6.1.2 Properties of waves

Answer 43 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)(i)	bat(s)		1
4(a)(ii)	elephant(s)		1
4(a)(iii)	any example in the inclusive range 5 ↔ 29 Hz / hertz	appropriate number and unit both required	1
4(b)(i)	**B**		1
4(b)(ii)	**F**		1
Total			**5**

4.6.1.2 Properties of waves

Answer 43 · Mark scheme January 2010 | PHY3F | Original Q4 | Legacy

PHY3F

Answer 44 · Mark scheme March 2010 | PHY1BP | Original Q2 | Legacy

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

Answer 45 · Mark scheme March 2010 | PHY1BP | Original Q9 | Legacy

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

Answer 46 · 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 47 · Mark scheme June 2010 | PHY1BP | Original Q8 | Legacy

Eight	3	3	4	2

4.6.1.2 Properties of waves

Answer 48 · 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**

4.6.1.2 Properties of waves

Answer 48 · Mark scheme June 2010 | PHY1F | Original Q2 | Legacy

PHY1F

4.6.1.2 Properties of waves

Answer 49 · Mark scheme

June 2010 | PHY1F | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	any **one** from: • above the atmosphere • no clouds in the way • no light pollution	 accept no atmospheric pollution answers in terms of being closer to space negate answers in terms of looking at the Earth negate	1
5(b)(i)	red-shift		1
5(b)(ii)	expanding		1
5(c)(i)	as one gets bigger the other gets bigger	accept (directly) proportional accept positive correlation	1
5(c)(ii)	**C** it is furthest from the Earth **or** it is furthest away **or** has the largest red-shift **or** it is moving (away) the fastest	 only scores if **C** is chosen	1 1
Total			**6**

4.6.1.2 Properties of waves

Answer 49 · Mark scheme June 2010 | PHY1F | Original Q5 | Legacy

PHY1F

4.6.1.2 Properties of waves

Answer 50 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)(i)	**B**		1
2(a)(ii)	microphone		1
2(b)(i)	frequency		1
2(b)(ii)	amplitude		1
2(c)	electromagnet	do **not** accept just 'magnet' accept solenoid accept coil	1
2(d)(i)	(sound will) get less / get quieter / stop / go silent	accept faint buzzing noise	1
2(d)(ii)	**either** sound cannot travel through a vacuum **or** no particles / molecules to vibrate	 accept sound requires a medium accept fewer particles to transfer the sound accept only the vibration of the wires / parts (will transfer the sound)	1
Total			**7**

4.6.1.2 Properties of waves

Answer 50 · Mark scheme June 2010 | PHY3F | Original Q2 | Legacy

PHY3F

4.6.1.2 Properties of waves

Answer 51 · Mark scheme

June 2010 | PHY3F | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	20 (Hz) to 20 000 (Hz) / 20 kHz	**or** reversed order	1
7(a)(ii)	ultrasound / ultrasonic	do **not** accept sonic	1
7(b)	examples discriminates against (young) people who are not being a nuisance discriminates against young people (just) moves the group to another meeting place discourages young people from shopping distresses babies it's morally / ethically wrong	allow any reasonable response 'it bothers young people' is insufficient ignore reference to animals ignore damages hearing	1
7(c)	(mechanical) vibration	accept vibrations in the air / particles	1
7(d)(i)	the sound intensity gets (much) less the greater the distance from (the source of) the sound correct comparison from the graph eg sound is 100 (w/m²) at 1 (m) but only 20 (w/m²) at 2.5 (m)	allow the closer you are to the machine the more likely it is to damage your hearing accept the graph falls steeply (at first) and then more gently	1 1

Question 7 is continued on the next page . . .

4.6.1.2 Properties of waves

Answer 51 · Mark scheme

PHY3F

Question 7 continued . . .

question	answers	extra information	mark
7(d)(ii)	any **two** from: • (so) data can be compared • anomalous results can be checked / removed / identified • more than one set of data • intensity / loudness fluctuates	increases reliability is insufficient improves accuracy is insufficient fair test is insufficient	2
Total			**8**

4.6.1.2 Properties of waves

Answer 52 · Mark scheme

November 2010 | PHY1BP | Original Q5 | Legacy

Five	**A** decreased **3** **B** increased **2** **C** shifted **1** **D** not changed **4**			
	A	**B**	**C**	**D**

Answer 53 · Mark scheme

November 2010 | PHY1BP | Original Q7 | Legacy

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

4.6.1.2 Properties of waves

Answer 54 · Mark scheme

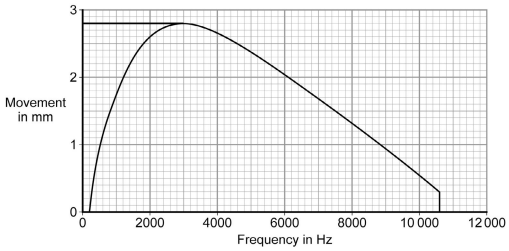
Question 7

question	answers	extra information	mark
7(a)	frequency / pitch decreases	accept wavelength increases accept it / the note becomes deeper / lower it / the note decreases is insufficient quieter is neutral	1
7(b)(i)	Models can help to explain an effect or theory.		1
7(b)(ii)	(moving) loudspeaker represents the (moving) galaxy the decrease in frequency of the sound is like red-shift	accept sound waves represent light waves accept increase in frequency is like blue-shift accept answers in terms of wavelength change accept sound going away from you is like red-shift accept red-shift happens when galaxies / stars move away (from Earth) this accept only scores if first marking point scores	1 1
7(c)	big bang		1
Total			**5**

4.6.1.2 Properties of waves

Answer 55 · Mark scheme

Question 8

question	answers	extra information	mark
8(a)	10 600 (Hz)	accept 10.6 kHz	1
8(b)	3000 (Hz)	allow **1** mark for a line drawn to show greatest movement (allow only if frequency is between 2800 and 3200) accept other indication of correctly using the graph  	2
8(c)	(No)	no marks for just the ticked box reasons can score even if yes is ticked	
	(human hearing) range is 20 – 20 000 (Hz)	accept (most) people hear up to 20 000 (Hz) / 20 kHz	1
	any **one** from: • range on graph is within this range • range on graph starts after 20 Hz • range on graph is from to 200 – 10 600 (Hz) • range on graph finishes before 20 000 Hz		1

Question 8 continues on the next page . . .

4.6.1.2 Properties of waves

PHY3F

Question 8 continued . . .

question	answers	extra information	mark
8(d)	reliability	this answer only	1
8(e)	only 1 variable affects dependent variable / size of movement **or** there is only one independent variable **or** to be able to compare (effect of different frequencies)	accept 'results' for 'size of movement' fair test is insufficient do **not** accept to control the experiment	1
Total			**7**

4.6.1.2 Properties of waves

Answer 56 · 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 57 · Mark scheme

March 2011 | PHY1BP | Original Q8 | Legacy

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

Answer 58 · Mark scheme

March 2011 | PHY1BP | Original Q9 | Legacy

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

4.6.1.2 Properties of waves

Answer 58 · 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**

4.6.1.2 Properties of waves

Answer 59 · Mark scheme June 2011 | PHY1BP | Original Q5 | Legacy

Five	**A** frequency			**2**
	B red-shift			**4**
	C wavelength			**1**
	D wave speed			**3**
	A	**B**	**C**	**D**

Answer 60 · Mark scheme June 2011 | PHY1BP | Original Q9 | Legacy

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

4.6.1.2 Properties of waves

Answer 61 · Mark scheme

June 2011 | PHY3F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	vibrate dirt / muck / grit / rust / dust etc.	allow move more (vigorously) but **not** just move do **not** accept bacteria	1 1
3(b)	any **one** medical use eg • scanning unborn babies • destroying (kidney) stones	ignore incorrect biological detail	1
3(c)(i)	2		1
3(c)(ii)	C		1
Total			**5**

4.6.1.2 Properties of waves

Answer 61 · Mark scheme June 2011 | PHY3F | Original Q3 | Legacy

PHY3F

4.6.1.2 Properties of waves

Answer 62 · Mark scheme

June 2011 | PHY3F | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	microphone		1
7(b)(i)	vertical line from any maxima or minima to axis	do **not** penalise minor errors but do **not** allow unless intention is clear	1
7(b)(ii)	loudness / volume / intensity / energy	do **not** accept noise	1
7(c)	17	this answer only	1
7(d)	the greater the distance, the smaller the amplitude **or** there is a (strong) negative correlation between distance and amplitude **or** there is an inverse square relationship between distance and amplitude	accept volume / intensity / energy / loudness for amplitude do **not** accept distance and amplitude are inversely proportional	1
7(e)	20 Hz 20,000 Hz	either order accept 20 kHz provided unit has been clearly changed	1 1
Total			7

4.6.1.2 Properties of waves

Answer 62 · Mark scheme June 2011 | PHY3F | Original Q7 | Legacy

PHY3F

Answer 63 · 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**

4.6.1.2 Properties of waves

Answer 64 · 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

4.6.1.2 Properties of waves

Answer 64 · Mark scheme

June 2012 | PH1FP | Original Q3 | Legacy

PH1FP

4.6.1.2 Properties of waves

Answer 65 · Mark scheme

June 2012 | PH1FP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	letter C clearly marking a compression	accept C at any point in a compression if more than one letter C marked all must be correct	1
6(b)(i)	straight continuous line drawn from loudspeaker to metal to sound sensor angle I = angle R	judge by eye judge by eye ignore any arrows on lines	1 1
6(b)(ii)	less sound reflected **or** (some) sound passes through the glass	accept energy for sound accept (some) sound absorbed by the glass	1
6(b)(iii)	makes the sound louder		1
6(b)(iv)	340	$v = f \times \lambda$ allow **1** mark for correct substitution ie 850×0.4 provided no subsequent step shown	2
6(c)	echo		1
6(d)(i)	from 250 Hz to 750 Hz		1

Question 6 continues on the next page

PH1FP

Question 6 continued

question	answers	extra information	mark
6(d)(ii)	curtains reduce (percentage of) sound reflected more(than carpet) for all frequencies (shown)	accept curtains absorb more sound (than carpet) accept for both marks an answer in terms of walls having a larger (surface) area to reflect sound and curtains reducing the amount of reflected sound more (than carpet) answers less noisy or walls / curtains have a larger area gain **1** mark only do **not** accept curtains are cheaper	1 1
Total			**11**

4.6.1.2 Properties of waves

Answer 65 · Mark scheme

June 2012 | PH1FP | Original Q6 | Legacy

PH1FP

4.6.1.2 Properties of waves

Answer 66 · Mark scheme

January 2013 | PH1FP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	wavelength	accept frequency accept speed	1
4(a)(ii)	amplitude	accept energy height is insufficient	1
4(a)(iii)	sound		1
4(b)(i)	diffraction	accept diffract a description is insufficient	1
4(b)(ii)	0.12	allow **1** mark for correct substitution, ie 8 × 0.015 provided no subsequent step shown	2
	metre per second **or** m/s **or** metre/second	do **not** accept mps units must be consistent with numerical answers	1
Total			**7**

4.6.1.2 Properties of waves

Answer 66 · Mark scheme

January 2013 | PH1FP | Original Q4 | Legacy

PH1FP

4.6.1.2 Properties of waves

Answer 67 · Mark scheme

Question 7

question	answers	extra information	mark
7(a)(i)	red-shift	accept Doppler (effect)	1
7(a)(ii)	the Universe is expanding		1
7(a)(iii)	N		1
7(b)	Why was the Universe created?		1
Total			**4**

4.6.1.2 Properties of waves

Answer 67 · Mark scheme

January 2013 | PH1FP | Original Q7 | Legacy

PH1FP

4.6.1.2 Properties of waves

Answer 68 · Mark scheme

January 2013 | PH2FP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	50 (Hz)		1
4(a)(ii)	2760 (W)		1
4(b)	12 amps	allow **1** mark for correct substitution, ie 2400/200 **or** allow **1** mark for 2760/230 provided no subsequent step shown	2 1
4(c)	the charge is directly proportional to the time switched on for	accept for **1** mark the longer time (to boil), the greater amount of charge **or** positive correlation **or** they are proportional	2
Total			**7**

4.6.1.2 Properties of waves

Answer 68 · Mark scheme

January 2013 | PH2FP | Original Q4 | Legacy

PH2FP

4.6.1.2 Properties of waves

Answer 69 · 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**

4.6.1.2 Properties of waves

Answer 69 · Mark scheme

June 2013 | PH1FP | Original Q2 | Legacy

PH1FP

4.6.1.2 Properties of waves

Answer 70 · Mark scheme

June 2013 | PH1FP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	vibrate / oscillate	accept a correct description move is insufficient	1
5(a)(ii)	336	allow **1** mark for correct substitution, ie 420 × 0.8(0) provided no subsequent step shown	2
5(b)(i)	frequency		1
5(b)(ii)	longer than 0.8 m		1
5(b)(iii)	Doppler		1
Total			**6**

4.6.1.2 Properties of waves

Answer 70 · Mark scheme

June 2013 | PH1FP | Original Q5 | Legacy

PH1FP

4.6.1.2 Properties of waves

Answer 71 · Mark scheme

June 2013 | PH3FP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	centre of X drawn at centre of pendulum bob	judged by eye accept dot drawn at centre of circle	1
3(b)(i)	2	allow **1** mark for correct substitution, ie $\frac{1}{0.5}$ provided no subsequent step shown	2
3(b)(ii)	30 **or** 60 ÷ their (b)(i) correctly calculated	allow **1** mark for $\frac{60}{2}$ **or** $\frac{60}{\text{their (b)(i)}}$ **or** 0.5 × 60 provided no subsequent step shown	2
3(c)	51.2	allow **1** mark for correct substitution, ie 64 × 0.8 provided no subsequent step shown	2
3(d)	it increases (the moment)	must be comparative accept **1** mark for calculation of the moment = 64 (Nm)	1
Total			**8**

4.6.1.2 Properties of waves

Answer 71 · Mark scheme

June 2013 | PH3FP | Original Q3 | Legacy

PH3FP

4.6.1.2 Properties of waves

Answer 72 · Mark scheme June 2014 | PH1FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO spec ref
2(a)(i)	A		1	AO2 1.5.3b
2(a)(ii)	B		1	AO2 1.5.3b
2(b)	340 metres/second	allow **1** mark for correct substitution ie 850 × 0.4 provided no subsequent step shown accept m/s	2 1	AO1 AO2 1.5.1j
2(c)	higher than shorter than		1 1	AO1 1.5.4a
Total			**7**	

4.6.1.2 Properties of waves

Answer 73 · Mark scheme

June 2014 | PH1FP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO spec ref
6(a)	decreases increases	correct order only	1 1	AO1 1.5.1e
6(b)	absorbed	makes the glass warmer is insufficient (energy) is wasted is insufficient	1	AO3 1.5.1
6(c)(i)	intensity (of transmitted light) depends on thickness **or** to enable a valid comparison **or** it is a control variable	accept absorption depends on thickness it would affect the results is insufficient fair test is insufficient	1	AO3 1.5.1
6(c)(ii)	transmits the least light **or** absorbs the most light	accept very little light is transmitted do **not** accept transmits none of the light do **not** accept absorbs all of the light any reference to heat negates this mark	1	AO3 1.5.1
Total			5	

4.6.1.2 Properties of waves

Answer 74 · Mark scheme

June 2015 | PH1FP | Original Q6 | Legacy

The full source mark scheme begins on page 256. Follow original question 6 in that document.

4.6.1.2 Properties of waves

Answer 75 · Mark scheme

June 2015 | PH3FP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
7(a)	1.25	accept 1.3 for **2** marks allow **1** mark for correct substitution ie $\frac{1}{0.8}$ provided no subsequent step shown	2	AO2 P3.2.1d
7(b)(i)	increasing the length (of the pendulum) decreases the number of oscillations / swings made (in 20 seconds)	accept increasing the length (of the pendulum) increases the time (of 1 oscillation / swing) accept increasing the length (of the pendulum) decreases the speed/frequency (of 1 oscillation / swing) answers must refer to the effect of increasing/decreasing length ignore references to time being proportional to length	1	AO3 P3.2.1e
	changing the mass (of the pendulum bob) does not change the number of oscillations / swings made (in 20 seconds)	accept changing the mass does not change the time/speed/frequency/results accept weight for mass	1	

Question 7 continues on the next page . . .

4.6.1.2 Properties of waves

Answer 75 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. ref.
7(b)(ii)	any **two** suitable improvements: • measure (the number of swings) over a wider range of (pendulum) lengths • measure (the number of swings) over a wider range of (bob) masses • measure the number of swings made over a greater period of time • repeat each measurement & calculate mean / average (number of oscillations in 20 seconds) • measure (the total number of swings &) the fraction of swings made • start the swings at the same height	accept repeat measurements & discard anomalous measurements repeat measurements is insufficient use a computer / datalogger to make measurement (of number of oscillations) is insufficient measuring time period is insufficient using a stop clock with greater resolution is insufficient	2	AO3 P3.2.1
Total			6	

4.6.1.2 Properties of waves

Answer 75 · Mark scheme

June 2015 | PH3FP | Original Q7 | Legacy



4.6.1.2 Properties of waves

Answer 76 · 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 . . .

4.6.1.2 Properties of waves

Answer 76 · 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

4.6.1.2 Properties of waves

Answer 76 · Mark scheme

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**

4.6.1.2 Properties of waves

Answer 77 · Mark scheme June 2016 | PH1FP | Original Q3 | Legacy

The full source mark scheme begins on page 272. Follow original question 3 in that document.

Answer 78 · Mark scheme June 2016 | PH1FP | Original Q6 | Legacy

The full source mark scheme begins on page 272. Follow original question 6 in that document.

4.6.1.2 Properties of waves

Answer 79 · Mark scheme

June 2016 | PH2FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	20		1	AO2 2.4.1b
2(b)	50		1	AO1 2.4.1c
2(c)(i)	115		1	AO2 2.3.2k
2(c)(ii)	230		1	AO1 2.3.2l
2(c)(iii)	if one goes out the other still works **or** brighter	accept power (output) is greater can be switched on/off independently is insufficient	1	AO2 2.3
2(d)	the outside/casing is plastic and plastic is an insulator	there is plastic around the wires is insufficient it is plastic is insufficient an answer the light fitting is double insulated gains both marks	1 1	AO1 2.4.1j
2(e)	(residual current) circuit breaker	accept RCCB accept RCBO accept RCCD accept RCB accept miniature circuit breaker / MCB trip switch is insufficient breaker is insufficient do not accept earth wire	1	AO1 2.4.1i
Total			8	

4.6.1.2 Properties of waves

Answer 79 · Mark scheme

June 2016 | PH2FP | Original Q2 | Legacy



4.6.1.2 Properties of waves

Answer 80 · Mark scheme June 2016 | PH3FP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	X marked in the centre of the sign	 Check position by eye	1	AO1 3.2.1c
4(b)	concentrated		1	AO 1 3.2.1a
4(c)	0.5 (s)	allow **1** mark for correct substitution ie $\frac{1}{2}$ provided no subsequent step	2	AO2 3.2.1d
4(d)	make the cables longer	accept pendulum / sign for cables	1	AO3 3.2.1e
Total			5	

4.6.1.2 Properties of waves

Answer 80 · Mark scheme

June 2016 | PH3FP | Original Q4 | Legacy



4.6.1.2 Properties of waves

Answer 81 · Mark scheme

June 2016 | PH3FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	20 000 Hz		1	AO1 3.1.2a
5(b)	400 (m)	allow **1** mark for correct substitution ie 1600 × 0.25 provided no subsequent steps shown an answer of 200 (m) gains **1** mark	2	AO2 3.1.2c
5(c)	twice		1	AO1 3.1.2b
5(d)	From pulse 1 to pulse 3 the distance (to the sea floor) decreased then (after pulse 3) the distance (to the sea floor) increased	accept the sea got shallower **or** the submarine went deeper for the distance decreased accept the sea got deeper **or** the submarine rose for the distance increased An answer of the distance decreased then increased gains **1** mark	1 1	AO3 3.1.2b
Total			6	

4.6.1.2 Properties of waves

Answer 81 · Mark scheme

June 2016 | PH3FP | Original Q5 | Legacy



4.6.1.2 Properties of waves

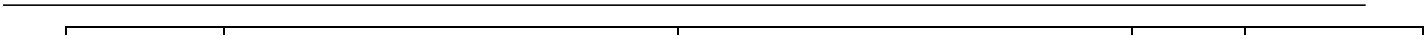
Answer 82 · Mark scheme June 2017 | PH1FP | Original Q3 | Legacy

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**	

4.6.1.2 Properties of waves

Answer 82 · Mark scheme

June 2017 | PH1FP | Original Q3 | Legacy



4.6.1.2 Properties of waves

Answer 83 · Mark scheme

June 2017 | PH1FP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	(the speed of sound is) lower	accept converse	1	AO2 1.5
6(b)	336 m/s	accept 340 allow **1** mark for correct substitution ie 800 x 0.42 provided no subsequent step	2 1	AO1 AO2 1.5.1j
6(c)	less than same as same as		1 1 1	AO1 1.5.3b
6(d)	echo		1	AO1 1.5.3c
6(e)	Sound waves are longitudinal waves. Sound waves transfer energy.		1 1	AO1 1.5 1.1.3c
Total			**10**	

4.6.1.2 Properties of waves

Answer 83 · Mark scheme

June 2017 | PH1FP | Original Q6 | Legacy



4.6.1.2 Properties of waves

Answer 84 · 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**	

4.6.1.2 Properties of waves

Answer 84 · Mark scheme

June 2017 | PH1FP | Original Q8 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.

4.6.1.2 Properties of waves

Answer 85 · Mark scheme

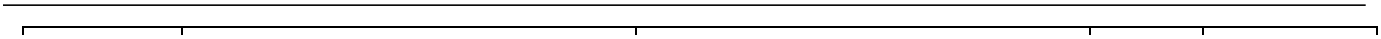
June 2017 | PH3FP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	The turning effect of the force		1	AO1 3.2.2a
1(a)(ii)	equal to		1	AO1 3.3.2c
1(a)(iii)	600 newton-metre / N m	allow **1** mark for a correct substitution ie 400 x1.5 provided no subsequent step do not accept n m	2 1	AO2 AO1 3.2.2b
1(b)	K		1	AO2 3.2.1b
1(c)	2 (s)	allow **1** mark for a correct substitution ie 1/0.5 provided no subsequent step	2	AO2 3.2.1d
Total			**8**	

4.6.1.2 Properties of waves

Answer 85 · Mark scheme

June 2017 | PH3FP | Original Q1 | Legacy



4.6.1.2 Properties of waves

Answer 86 · Mark scheme

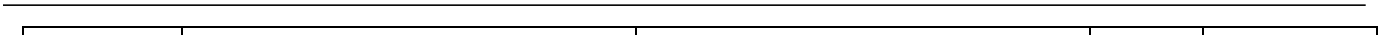
June 2017 | PH3FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	less than		1	AO1 3.3.2f
2(a)(ii)	because there are fewer turns (on the secondary coil)	do not accept coils for turns accept because it is a step down transformer reason only scores if correct answer is chosen in part 2 (a)(i)	1	AO1 3.3.2f
2(b)	(soft) iron		1	3.3.2c
2(c)	A potential difference is induced across the secondary coil.		1	AO1 3.3.2d
2(d)	50 hertz		1	AO1 3.3.2j
2(e)	2 (W)		1	AO1 3.3.2h
Total			6	

4.6.1.2 Properties of waves

Answer 86 · Mark scheme

June 2017 | PH3FP | Original Q2 | Legacy



4.6.1.2 Properties of waves

Answer 87 · Mark scheme

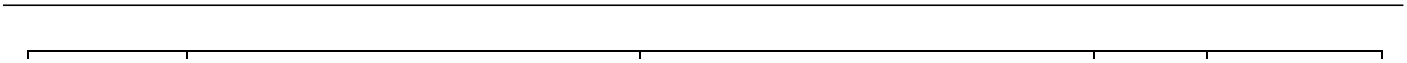
June 2018 | 8463/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	increased		1	AO1 4.6.1.2
03.2	(count) how many waves pass a point		1	AO1 4.6.1.2
	in one second	this is dependent on the first mark point being awarded	1	
	or			
	(count) number of waves that pass a point in a given time **or** (count) number of waves that are produced in a given time (1)	allow a specific time for a given time		
	and divide by that time in seconds (1)	this is dependent on the first mark point being awarded allow an answer in terms of measuring the frequency of the vibrating bar		
03.3	period = $\frac{1}{5}$	an answer of 0.2 scores **2** marks	1	AO2 4.6.1.2
	period = 0.2		1	AO2 4.6.1.2
	seconds / s		1	AO1 4.6.1.2
Total			**6**	

4.6.1.2 Properties of waves

Answer 87 · Mark scheme

June 2018 | 8463/2F | Original Q3



4.6.1.2 Properties of waves

Answer 88 · Mark scheme

June 2018 | 8463/2F | Original Q12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12.1	Regrettably, this part of the question assessed content that we had stipulated would only be assessed on the Higher tier. All students were awarded full marks for this part of the question.		1	
12.2	0.4		1	AO2 4.6.1.2
12.3	wave speed = frequency × wavelength	allow v = f λ	1	AO1 4.6.1.2
12.4	7200 = 0.4 × wavelength wavelength = $\frac{7200}{0.4}$ wavelength = 18 000 (m)	an answer 18 000 scores **3** marks allow up to full marks for ecf using their answer to question **12.2** a method shown as 7200 × 2.5 = 18 000 scores **0** marks	1 1 1	AO2 4.6.1.2
12.5	Regrettably, this part of the question assessed content that we had stipulated would only be assessed on the Higher tier. All students were awarded full marks for this part of the question.		2	
Total			**8**	

4.6.1.2 Properties of waves

Answer 89 · Mark scheme

June 2019 | 8463/2F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2.1	wavelength	allow a correct answer indicated in the box provided the answer space is blank	1	AO1/1 4.8.2 iso
2.2	C		1	AO3/1a 4.8.2
2.3	C		1	AO3/1a 4.8.2
2.4	Very dense and extremely hot		1	AO1/1 4.8.2 iso
2.5	Scientific evidence supports the theory		1	AO1/1 4.8.2 WS1.2
2.6	Z any **one** from • (only one) shows the universe is expanding • (only one) shows the universe began (very) small	 only scores if Z is chosen	1 1	AO3/1b 4.8.2
Total			**7**	

4.6.1.2 Properties of waves

Answer 90 · Mark scheme

June 2019 | 8463/2F | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9.1	metre rule	allow metre ruler allow tape measure do not accept ruler do not accept metre stick	1	AO1/2 4.6.1.2 RPA8
9.2	(wave) speed = frequency × wavelength	allow v = f λ	1	AO1/1 4.6.1.2 RPA8
9.3	 80cm = 0.8m v = 55 × 0.8 v = 44 (m/s)	an answer of 44 (m/s) scores **3** marks this mark may be awarded if wavelength is incorrectly or not converted allow correct calculation using an incorrectly or not converted wavelength an answer of 4400 (m/s) scores **2** marks	 1 1 1	AO2/1 4.6.1.2 RPA8
9.4	move the (wooden) bridge to the right OR change the mass/weight (on the string) scores **1** mark add more masses/weights (to the string) scores both marks	 dependent on 1st mp being scored	1 1	AO2/2 4.6.1.2 RPA8

4.6.1.2 Properties of waves

Answer 90 · Mark scheme

June 2019 | 8463/2F | Original Q9

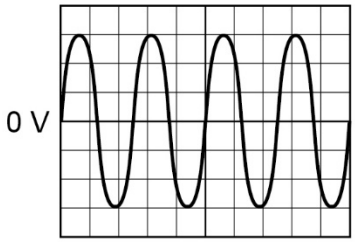
9.5	**Level 2:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	3–4	AO3/3a 4.6.1.2 RPA8
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content add or take away masses from the string (ignore any stated values) adjust frequency using the signal generator and/or move the wooden bridge observe a steady / stationary pattern measure the wavelength calculate wave speed from frequency and wavelength a Level 1 answer should include a way of changing tension a complete Level 2 answer would include either changing frequency and/or moving the bridge		
Total		**11**	

4.6.1.2 Properties of waves

Answer 91 · Mark scheme

November 2020 | 8463/1F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	50 Hz		1	AO1 4.2.3.1
03.2			1	AO1 4.2.3.1
03.3	P = 0.020 × 230 P = 4.6 (W)		1 1	AO2 4.2.4.1
03.4	E = 180 × 230 E = 41 400 (J)		1 1	AO2 4.2.4.2
03.5	Hazard: live wire **or** high potential difference Risk: electric shock **or** electrocution	 ignore current in his body allow (electrical) burn allow death (by electric shock) allow 1 mark for hazard and risk in incorrect order	1 1	AO3 4.2.3.2
Total			**8**	

4.6.1.2 Properties of waves

Answer 92 · Mark scheme

November 2020 | 8463/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	R		1	AO1 4.6.1.2
03.2	S		1	AO1 4.6.1.2
03.3	$T = \frac{1}{0.20}$ T = 5(.0 s)		1 1	AO2 4.6.1.2
03.4	The wavelength decreases		1	AO1 4.6.1.2
03.5	Time taken by the wave to travel the length of the tray		1	AO1 4.6.1.2 RPA8
03.6	Depth of water		1	AO1 4.6.1.2 RPA8
03.7	as the depth increases, the speed increases	allow positive correlation (between speed and depth)	1	AO3 4.6.1.2 RPA8
03.8	0.49 (m/s)		1	AO2 4.6.1.2
Total			**9**	

4.6.1.2 Properties of waves

Answer 93 · Mark scheme

November 2020 | 8463/2F | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(force of) gravity fusion	do **not** allow weight	1 1	AO1 4.8.1.1
09.2	distance = speed × time **or** s = vt	allow a correct re-arrangement do **not** allow d = st	1	AO1 4.5.6.1.2
09.3	$1.5 \times 10^{11} = 3.0 \times 10^{8} \times t$ $t = \frac{1.5 \times 10^{11}}{3.0 \times 10^{8}}$ t = 500 (s)		1 1 1	AO2 4.5.6.1.2

09.4	**Level 3**: Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.		5–6	AO1 4.8.1.2
	Level 2: Scientifically relevant facts, events or processes are identified and their relevance is clear. The account is not fully accurate.		3–4	
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.		1–2	
	No relevant content		0	
	Indicative content: • fusion (processes in stars) produce new elements • cloud of gas / hydrogen **and** dust **OR** nebula • pulled together by gravity • causing increasing temperature (to start the fusion process) • (to become a) protostar • hydrogen nuclei fuse to form helium nuclei • and the star becomes main sequence • hydrogen begins to run out • helium nuclei fuse to make heavier elements • up to iron • the star expands (to become a) • red super giant • (the star collapses rapidly) and explodes • called a supernova • creating elements heavier than iron • and distributing them throughout the universe • leaving behind a neutron star • or a black hole.			
09.5	Temperature		1	AO1 4.6.3.2
Total			**13**	

4.6.1.2 Properties of waves

Answer 94 · Mark scheme

November 2021 | 8463/2F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	transverse		1	AO1 4.6.1.1
01.2	the water at point **X** moves up and down		1	AO2 4.6.1.1
01.3	$v = 2.0 \times 0.032$ $v = 0.064$ (m/s) m/s		1 1 1	AO2 AO2 AO1 4.6.1.2
01.4	energy		1	AO1 4.6
01.5	**D**		1	AO1 4.6.1.2
01.6	**B**		1	AO1 4.6.1.2
Total			**8**	

4.6.1.2 Properties of waves

Answer 95 · 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

4.6.1.2 Properties of waves

Answer 95 · 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

4.6.1.2 Properties of waves

Answer 95 · 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**

4.6.1.2 Properties of waves

Answer 96 · Mark scheme

June 2022 | 8463/2F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	wavelength frequency	this order only	1 1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	parallel		1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	8000 Hz		1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	period = $\frac{1}{8000}$ 0.000125 (s)	allow ecf from question **07.3**	1 1	AO2 4.6.1.2

4.6.1.2 Properties of waves

Answer 96 · Mark scheme

June 2022 | 8463/2F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	$\lambda = \frac{330}{6600}$ $\lambda = 0.050$ m	 allow 0.05	1 1 1	AO2 AO2 AO1 4.5.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	distance (travelled) = speed × time **or** $s = vt$	allow any correct rearrangement	1	AO2 4.5.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	$13.2 = 330 \times t$ $t = \frac{13.2}{330}$ $t = 0.04$ (s)	 allow 0.040 (s)	1 1 1	AO2 4.5.6.1.2

4.6.1.2 Properties of waves

Answer 96 · Mark scheme

June 2022 | 8463/2F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.8	loudspeaker **B** is further from the technician (than speaker **A**) so the sound would take more time to travel (to the technician) so the sound from each speaker arrives at the technician at the same time	'it' means speaker **B**	1 1 1	AO3 4.6.1.2

Total Question 7		**16**

4.6.1.2 Properties of waves

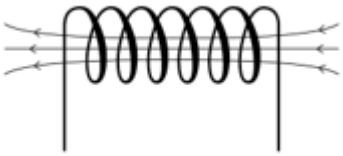
Answer 97 · Mark scheme

June 2023 | 8463/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	direction (of the magnetic field)		1	AO1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	increase the current in the wire		1	AO1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3			1	AO1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	**D A B C**	allow **1** mark for D B A C	2	AO2 4.7.2.1 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	decrease the distance between the electromagnet and the iron arm		1	AO3 4.7.1.2 4.7.2.1

4.6.1.2 Properties of waves

Answer 97 · Mark scheme

June 2023 | 8463/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	period = $\frac{1}{6.25}$ period = 0.16 (s)		1 1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	B		1	AO1 4.6.1.1

Total Question 3	9

4.6.1.2 Properties of waves

Answer 98 · 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**

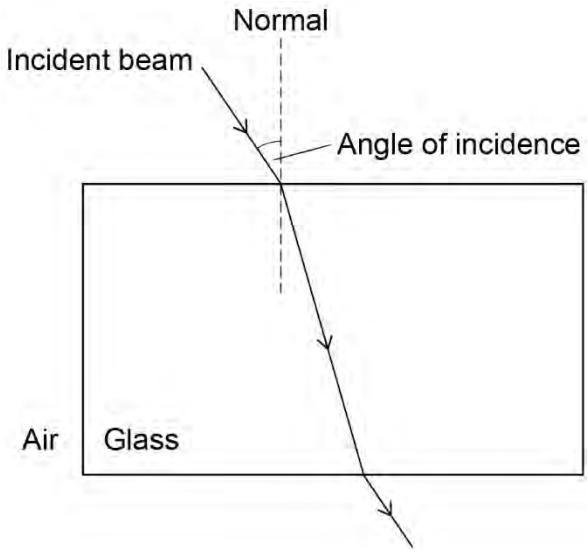
4.6.1.2 Properties of waves

Answer 99 · Mark scheme

June 2023 | 8463/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	it is harder to judge where the centre of the beam is		1	AO3 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	ray shown refracted to the right of the normal as it enters the glass block refraction towards the normal emergent ray parallel to incident ray  	 do **not** accept a continuation of the incident ray through the glass block ignore arrows	1 1 1	AO1 4.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	1 degree		1	AO2 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	33 (°)		1	AO2 4.6.1.3

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	wave speed = frequency × wavelength **or** $v = f\lambda$	allow correct re-arrangement	1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	$3.0 \times 10^8 = 4.0 \times 10^{14} \times \lambda$ $\lambda = \frac{3.0 \times 10^8}{4.0 \times 10^{14}}$ $\lambda = 7.5 \times 10^{-7}$ (m)	 allow 0.000 000 75 (m)	1 1 1	AO2 4.6.1.2

Total Question 6	11

4.6.1.2 Properties of waves

Answer 100 · Mark scheme

June 2023 | 8463/2F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	a satellite		1	AO1 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	arrow drawn towards the centre of the Earth from the Hubble Space Telescope		1	AO1 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	any correct change in distance with the correct change in time	e.g. 38 (km) and 5 (s)	1	AO2 4.5.6.1.4
	a correct substitution of a correct pair of values	e.g. $v = \frac{38}{5}$	1	
	a correctly calculated answer	e.g. v = 7.6 (km/s)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	galaxy **C**		1	AO3 4.8.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	galaxy **C**		1	AO3 4.8.2

4.6.1.2 Properties of waves

Answer 100 · Mark scheme

June 2023 | 8463/2F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	to check the observations are correct		1	AO1 4.8.2

Total Question 7	**8**

4.6.1.2 Properties of waves

Answer 101 · Mark scheme

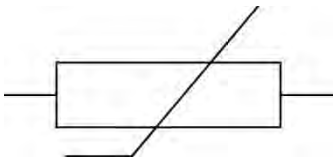
June 2024 | 8463/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	50 hertz		1	AO1 4.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	230 volts		1	AO1 4.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	resistance = $\frac{0.45}{0.75}$ resistance = 0.60 (Ω)		1 1	AO2 4.2.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4			1	AO1 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	pd across battery - pd across thermistor		1	AO3 4.2.2

4.6.1.2 Properties of waves

Answer 101 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	1.5 V (thermistor has the) same resistance as resistor **or** both (components) have a resistance of 200 (Ω)	 MP2 dependent on scoring MP1 allow pd shared equally (between components of equal resistance) allow pd will be half (of the total pd)	1 1	AO3 4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	resistance at 15 °C = 200 (Ω) change in resistance = 400 (Ω)	 allow a correct change in resistance from a misread resistance within the range 180 to 220 Ω	1 1	AO2 4.2.1.4

Total Question 2	10

4.6.1.2 Properties of waves

Answer 102 · Mark scheme

June 2024 | 8463/1F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	the volume decreased		1	AO1 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	the distance decreased		1	AO1 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	the frequency of collisions increased		1	AO1 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	the air pressure increased		1	AO1 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	the mean speed of the particles increases		1	AO1 4.3.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	$0.0130 = 2.60\times10^{-8} \times 1010 \times \Delta\theta$ $\Delta\theta = \dfrac{0.0130}{(2.60 \times 10^{-8} \times 1010)}$ $\Delta\theta = 495$ (°C)	 allow a correct answer given to more than 3 s.f.	1 1 1	AO2 4.1.1.3 4.3.2.2

Total Question 5	8

4.6.1.2 Properties of waves

Answer 103 · Mark scheme

June 2024 | 8463/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec.
04.1	C		1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec.
04.2	B		1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec.
04.3	period = $\frac{1}{5000}$ period = 0.0002 (s)		1 1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec.
04.4	any named electromagnetic wave	allow electromagnetic (wave)	1	AO1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec.
04.5	F		1	AO1 4.6.1.1

Question	Answers	Extra information	Mark	AO / Spec.
04.6	wavelength = $\frac{330}{750}$ = 0.44 (m)		1 1	AO2 4.6.1.2

4.6.1.2 Properties of waves

Answer 103 · Mark scheme

June 2024 | 8463/2F | Original Q4

Question	Answers	Mark	AO / Spec. Ref.
04.7	**Level 2:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	3–4	AO1 4.6.1.2
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content **method of making sound** eg cymbals, wooden blocks, starting pistol **measuring distance** • measuring distance between sound source and detector eg distance to wall, distance along track, distance between microphones • use of measuring instrument eg tape measure, trundle wheel, metre rule **measuring time** • timing started when sound made and timing stopped when sound heard • use of measuring instrument eg stopwatch, oscilloscope, data logger **extra detail** • dividing time by 2 or multiply distance by 2 for echo method • use of equation speed = $\frac{\text{distance}}{\text{time}}$		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.8	increases		1	AO3 4.6.1.2

Total Question 4	13

Answer 104 · 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**

4.6.1.2 Properties of waves

Answer 105 · Mark scheme

June 2025 | 8463/2F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	protractor		1	AO1 4.6.1.3 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	angle **B** in degrees / ° on y-axis		1	AO2 4.6.1.3 RPA9
	all points correctly plotted	allow a tolerance of $\pm \frac{1}{2}$ small square allow **1** mark for 3 plotted correctly	2	
	straight line of best fit drawn	allow a line of best fit from their plotted points	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	angle **A** is directly proportional to angle **B**		1	AO3 4.6.1.3 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	A		1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	D		1	AO1 4.6.1.2

4.6.1.2 Properties of waves

Answer 105 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	$\lambda = \frac{0.125}{2.5}$ 0.050 m	 allow 5.0 cm	1 1 1	AO2 AO2 AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	$T = \frac{1}{2.5}$ 0.40 (s)	 allow 0.4 (s)	1 1	AO2 4.6.1.2

Total Question 1	13

4.6.1.2 Properties of waves

Answer 106 · Mark scheme

June 2025 | 8463/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	moon star	this order only	1 1	AO1 4.8.1.1

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	it will become a black dwarf		1	AO1 4.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	a very distant galaxy moves faster		1	AO1 4.8.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	red-shift		1	AO1 4.8.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	hot		1	AO1 4.8.2

4.6.1.2 Properties of waves

Answer 106 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	the universe is getting bigger		1	AO1 4.8.2

Total Question 3	**8**

4.6.1.2 Properties of waves

Answer 107 · Mark scheme

June 2025 | 8463/2F | Original Q8

Question 8

Question	Answers	Mark	AO / Spec. Ref.
08.1	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account	4–6	AO1 4.6.1.1 4.6.2.1
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear	1–3	
	No relevant content	0	
	Indicative content **Differences** • sound waves are mechanical whereas visible light waves are electromagnetic waves • sound waves require a medium to travel through whereas visible light waves can travel through a vacuum • sound waves are longitudinal whereas visible light waves are transverse • sound waves travel slower (in air) than visible light waves • sound waves travel faster in solids than in air whereas visible light waves travel slower in solids than in air • sound waves have longer wavelengths than visible light • sound waves have a lower frequency than visible light waves **Similarities** • both types of waves can be reflected • both types of waves can be refracted • both types of waves can be diffracted • both types of wave transfer energy		

4.6.1.2 Properties of waves

Answer 107 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	speed = $\frac{\text{distance}}{\text{time}}$		1	AO1 4.5.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	$330 = \frac{13\,200}{t}$ **or** $13\,200 = 330 \times t$ $t = \frac{13\,200}{330}$ 40 (s)		1 1 1	AO2 4.5.6.1.2

Total Question 8	10

4.6.1.2 Properties of waves

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Mark scheme June 2003

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4.6.1.2 Properties of 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

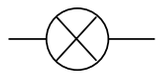
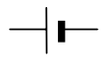
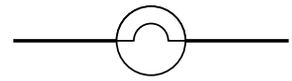
(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

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.

4.6.1.2 Properties of waves

3451/F Q1

question	answers	extra information	mark
(a)	circuit symbol for a lamp correct   circuit symbol for a cell correct	accept  accept any standard of drawing providing circuit would work	1 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

4.6.1.2 Properties of waves

3451/F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time	accept fuel available all the time	1
	wind generator can only produce when the wind is strong enough	accept it's not always windy	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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

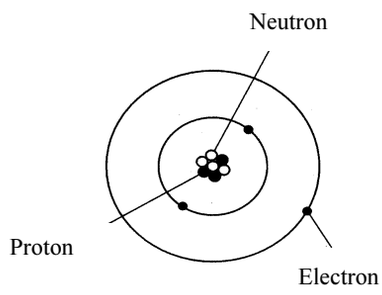
4.6.1.2 Properties of waves

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

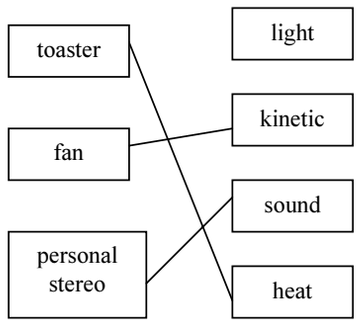
4.6.1.2 Properties of waves

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

4.6.1.2 Properties of 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

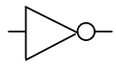
4.6.1.2 Properties of waves

3451/F Q8

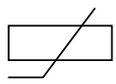
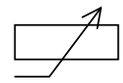
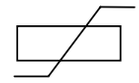
question	answers	extra information	mark
(a)(i)	point where the rays cross	do not credit if ambiguous	1
(ii)	converging (lens)	do **not** accept convex	1
(b)(i)	point where the rays appear to diverge from	this should appear to be within 10mm in front of the back of the arrows on the approximate centre 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

4.6.1.2 Properties of 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

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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of waves

3451/F Q13

question	answers	extra information	mark
(a)	silver is a (good) reflector of heat (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

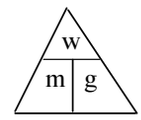
4.6.1.2 Properties of waves

3451/F Q14

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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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*

4.6.1.2 Properties of 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:

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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.

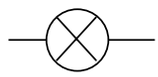
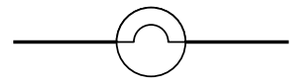
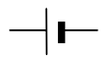
3.10 Unexpected Correct Answers not in the Mark Scheme

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.

4.6.1.2 Properties of 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

4.6.1.2 Properties of waves

3462/3F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time	accept fuel available all the time	1
	wind generator can only produce when the wind is strong enough	accept it's not always windy	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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

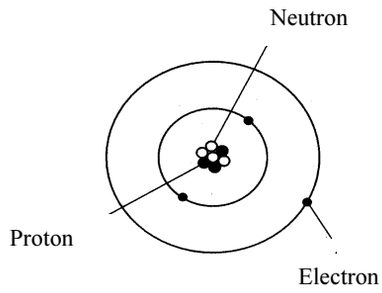
4.6.1.2 Properties of waves

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

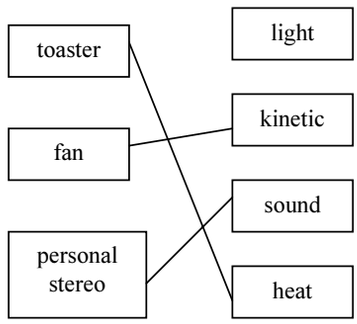
4.6.1.2 Properties of waves

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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of waves

3462/3F Q11

question	answers	extra information	mark
(a)	silver is a (good) reflector of heat (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

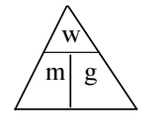
4.6.1.2 Properties of waves

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

4.6.1.2 Properties of 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

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

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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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

4.6.1.2 Properties of 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

4.6.1.2 Properties of waves

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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of waves

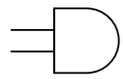
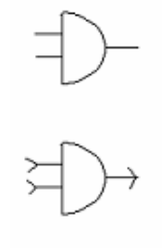
Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q9

question	answers	extra information	mark
(a)	capacitor LDR relay (normally open)	accept condenser **or** light dependent resistor accept 'ldr', 'Ldr' etc. do **not** accept 'relay normally closed'	1 1 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…

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

4.6.1.2 Properties of waves

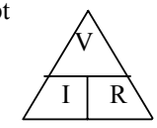
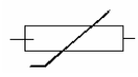
Physics B – AQA GCSE Mark Scheme, 2005 June series

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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of waves

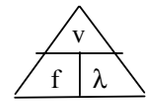
3451/F Q16

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

4.6.1.2 Properties of waves

Physics B – AQA GCSE Mark Scheme, 2005 June series

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

Version 1.0: *27092005*

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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of waves

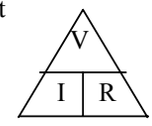
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

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

4.6.1.2 Properties of waves

3462/3F Q9

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$ $A_4 = 0.5$	ignore any units allow **1** mark for $A_1 = A_4 \neq 0.5$	1 1
(ii)	the resistance of **P** is more than 20 Ω a smaller current goes through P / A_2 (than 20 Ω)	 dependent on getting 1st mark correct accept converse	1 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  resistance goes down (as temperature of thermistor goes up)	accept correct circuit symbol allow phonetic spelling 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 1
total			10

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

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…

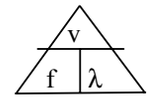
3462/3F Q12 cont…

(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 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 <u>increase</u> award **1** mark only	3
total			13

4.6.1.2 Properties of 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

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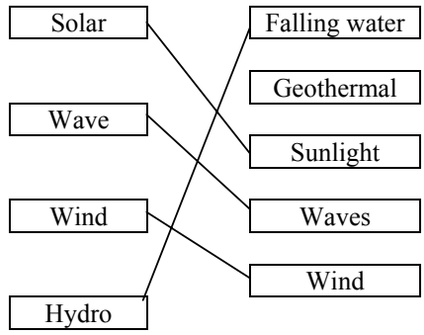
Physics (Specification B)
Foundation Tier 3451/F

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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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>

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of waves

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

4.6.1.2 Properties of waves

3451/F Q13

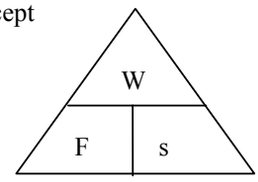
question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	1
(b)	any **one** from: • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope	 do **not** 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

4.6.1.2 Properties of 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 <u>increases</u> / is <u>longer</u> **or** thinking distance <u>increases</u>	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it <u>increases</u>	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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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>

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
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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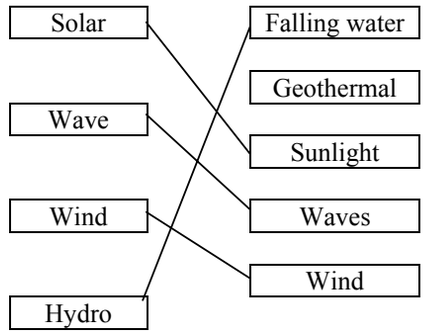
4.6.1.2 Properties of waves

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

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

4.6.1.2 Properties of 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 <u>and</u> time in hours or seconds	2
total			5

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of waves

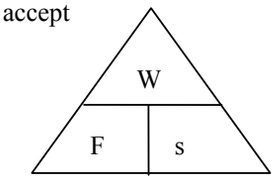
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

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

4.6.1.2 Properties of 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 <u>increases</u> / is <u>longer</u> **or** thinking distance <u>increases</u>	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it <u>increases</u>	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

4.6.1.2 Properties of 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

4.6.1.2 Properties of waves

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Dr Michael Cresswell, Director General.

4.6.1.2 Properties of 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.

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.

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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 greater 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

4.6.1.2 Properties of 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

Version 1.0: 08/02/2008

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Separate Science Physics 4451

PHY3F Unit Physics 3

Mark Scheme

2008 examination - January series

4.6.1.2 Properties of 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.

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Dr Michael Cresswell Director Genera

4.6.1.2 Properties of waves

PHY3F

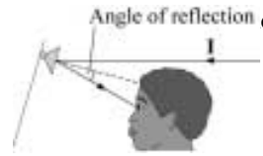
Question 1

question	answers	extra information	mark
(a)	centre of X at the point where the axes cross	to within 1 mm in any direction	1
(b)(i)	(at / in the) centre (of the tyre)	**or** unambiguously shown on the diagram	1
(ii)	(this is) where axes of symmetry (of the tyre) cross / intersect / meet	**or** point at which the mass of the tyre seems to be (concentrated)	1
total			3

4.6.1.2 Properties of waves

PHY3F

Question 2

question	answers	extra information	mark
(a)(i)	I correct r correct	only credit if unambiguously correct  ously correct	1 1
(ii)	(the) normal	do **not** credit 'perpendicular' / 'vertical'	1
(b)	both lines correctly connected one line correctly connected gains **1** mark	 if two lines from any in list A to any in list B then both incorrect	2
total			5

4.6.1.2 Properties of waves

PHY3F

Question 3

question	answers	extra information	mark
(a)	tension	accept any unambiguous method of indication eg it's underlined **or** ticked	1
(b)(i)	speed of the ball is increased		1
(b)(ii)	the direction of the ball		1
(c)	centripetal	accept any unambiguous method of indication eg it's underlined **or** ticked	1
total			4

4.6.1.2 Properties of waves

PHY3F

Question 4

question	answers	extra information	mark
(a)(i)	more than	accept any clear indication eg the other two lines crossed out	1
(ii)	less than	accept any clear indication eg the other two lines crossed out	1
(b)	any **two** from: • above the equator • takes / period of 24 hours • (remains) above the same point	**or** 'rotates with the Earth' do **not** credit 'stays in the same place' but accept 'appears to stay in the same place' do **not** credit just 'one like satellite X's'	2
(c)	low polar		1
total			5

4.6.1.2 Properties of waves

PHY3F

Question 5

question	answers	extra information	mark
(a)	Venus	accept Mercury	1
(b)	any negative number or range in the range –75 to –150 inclusive	do **not** credit any positive number or positive range	1
(c)	**either** … increases … increases **or** … decreases … decreases	**both** required for the mark	1
(d)	Today's …… about Mars.	accept any unambiguous method of indication for the correct answer eg it's underlined or ticked	1
total			4

4.6.1.2 Properties of waves

PHY3F

Question 6

question	answers	extra information	mark
(a)	increase the current (1)	credit increase the p.d./voltage credit reduce the resistance credit have thicker wiring credit add extra / more cells	1
	increase the magnetic field (strength) (1)	credit 'have stronger magnet(s) do **not** credit 'bigger magnets'	1
		either order	
(b)	**either** reverse polarity **or** connect the battery the other way round		1
	either reverse direction of the magnetic field **or** put the magnet the other way round / reverse the magnet	do **not** give any credit to a response in which both are done at the same time	1
		either order	
(c)	**either** conductor parallel to the magnetic field **or** lines of magnetic force and path of electricity do not cross		1
total			5

4.6.1.2 Properties of waves

PHY3F

Question 7

question	answers	extra information	mark
(a)	converging **or** convex		1
(b)	(principal) focus **or** focal point		1
(c)	**either** (×)1.5 **or** (×)1½ **or** 150%	unambiguous evidence of appropriate measurements for **1** mark only eg 4 and 6 **or** 8 and 12 **or** 0.8 and 1.2	2
(d)	real rays cross to form it / formed at the intersection of real rays	accept 'image on the opposite side of the lens to the object' accept 'can be put onto a screen'	1
total			5

4.6.1.2 Properties of waves

PHY3F

Question 8

question	answers	extra information	mark
(a)	moment	**or** torque do **not** credit 'leverage'	1
(b)	4 (2)	**either** 0.20 × 20 (1) **or** allow '400' (1)	2
(c)	use a longer spanner **or** 'fit a pipe over the (end of the) spanner (to lengthen it)' use a greater force / pull	**or** increases the perpendicular distance / length note 'lever' refers to 'spanner' note change the . . . (0) ignore references to wider / larger nut **either order**	1 1
total			5

4.6.1.2 Properties of waves

AQA

GCSE

Science A / Physics

PH1FP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

4.6.1.2 Properties of 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.

PMT

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:

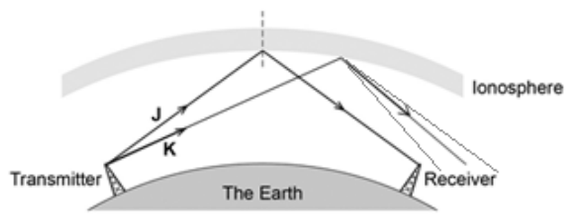
Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

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

4.6.1.2 Properties of 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	

4.6.1.2 Properties of 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**	

4.6.1.2 Properties of 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**	

4.6.1.2 Properties of 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**	

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**	

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**	

4.6.1.2 Properties of waves

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

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>7 (a)</td><td colspan="2">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.</td><td>6</td><td rowspan="4">AO2
AO3
P1.2
HSW</td></tr>
<tr><td>0 marks</td><td>Level 1 (1-2 marks)</td><td>Level 2 (3-4 marks)</td><td>Level 3 (5-6 marks)</td></tr>
<tr><td>No relevant information</td><td>There is a relevant statement about an energy saving method</td><td>There is at least one clear comparison of energy saving methods and their cost effectiveness with an appropriate calculation</td><td>There is a comparison of energy saving methods and their cost effectiveness with appropriate calculations. Comparison to include further detail.</td></tr>
<tr><td colspan="2">examples of physics points made in the response
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
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</td><td colspan="2">extra information
payback times:
energy efficient boiler: 6.25 years
loft insulation: 2 years
double glazing: 100 years
cavity wall insulation: 2.86 years</td></tr>
</table>

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**	

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 . . .

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**	

AQA

GCSE

Science A / Physics

PH1FP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

4.6.1.2 Properties of 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.

4.6.1.2 Properties of waves

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**	

4.6.1.2 Properties of 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**	

4.6.1.2 Properties of 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**	

4.6.1.2 Properties of waves

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**	

4.6.1.2 Properties of 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**	

4.6.1.2 Properties of 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**	

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 . . .

4.6.1.2 Properties of waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

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)	accept carbon neutral
• both have very small (allow 'no') running costs	accept no greenhouse gases
• no carbon dioxide produced	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

4.6.1.2 Properties of 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**	

4.6.1.2 Properties of waves

Answer 87 · Examiner comments

June 2018 | 8463/2F | Original Q3

Question 3 (Low demand)

03.1 94% of the students gave the correct answer.

03.2 This was poorly answered with just over 50% of the students scoring zero. There was a lot of confusion between wavelength and frequency, with many students stating that frequency is the distance between two adjacent waves. Those students scoring one mark understood the need to count the number of waves passing a point in a given time but not in one second.

03.3 Most of the students were able to correctly substitute the given value for frequency into the equation and calculate the period. 24% of the students knew that the period is measured in seconds; the majority giving metres/second.

Answer 88 · Examiner comments

June 2018 | 8463/2F | Original Q12

Question 12 (Standard demand)

12.1 Regrettably, this part of the question assessed content that we had stipulated would only be assessed on the Higher tier. All students were awarded full marks for this part of the question.

12.2 Only just over 6% of the students were able to use the information presented in Figure 16 to calculate the frequency of the wave.

12.3 34% of the students were able to give this equation.

12.4 Those students that could recall the correct equation generally scored all three marks. Most of the students that scored zero did so because they either substituted the values into an incorrect equation or did not use the frequency calculated for question 12.2. It was common to see a frequency of 10 Hz being used instead.

12.5 Regrettably, this part of the question assessed content that we had stipulated would only be assessed on the Higher tier. All students were awarded full marks for this part of the question.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

Answer 89 · Examiner comments

June 2019 | 8463/2F | Original Q2

Question 2 (Low demand)

02.1 Just over 50% of the students gave the correct answer, wavelength. Most of the other students wrote frequency.

02.2 Just under 60% of the students gave the correct answer.

02.3 Nearly 73% of the students made the correct choice.

02.4 Only just over half of the students scored this mark. The most common incorrect answers included the idea of the universe being very big when it began.

02.5 Just over 85% of the students appreciated that scientific evidence supports the Big Bang theory.

02.6 Although 57% of the students scored both marks the idea that graph Z is the only one to show the universe expanding was often not well expressed.

4.6.1.2 Properties of waves

Answer 90 · Examiner comments — June 2019 | 8463/2F | Original Q9

Question 9 (Standard demand)

09.1 This question was successfully completed by 29% of the students. Both 'ruler' and 'metre stick' were common unacceptable answers. There were numerous other answers such as ammeter, oscilloscope and timer.

09.2 This equation was not well known with only 33% of the students scoring the mark.

09.3 Just over 60% of the students scored zero or did not attempt this question. A mark was awarded for converting the distance into metres, however this was rarely done.

09.4 Students could answer this in one of two ways, either with reference to the wooden bridge or with altering the mass hanging from string. Just over 23% of the students scored both marks, mainly for adding more masses as opposed to indicating which way the wooden bridge should be moved.

09.5 Nearly 20% of the students did not attempt this question. Many of those that did attempt the question gave a detailed written description of the apparatus shown in the diagram; this was not worth any marks. Those students that scored some marks identified the need to alter the mass on the string to adjust the tension. Some students correctly identified the need to measure the wavelength and then multiply this by the frequency as the way to determine the wave speed. However many students simply stated they would 'measure' the wave speed which was not creditworthy. Less than 1% of the students identified the need to move the bridge or adjust the frequency in order to see a wave pattern.

Answer 95 · 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.

4.6.1.2 Properties of waves

Answer 96 · Examiner comments

June 2022 | 8463/2F | Original Q7

Question 7 (Low and standard demand)

07.1 Most of the students scored at least 1 mark with the majority scoring both.

07.2 The answers were split 50/50 between parallel and perpendicular.

07.3 About three quarters of the students chose the correct answer.

07.4 Very few of the students appeared to see the link between part 07.3 and 07.4. Those choosing the correct answer in 07.3 often went on to use the value 8 rather than 8000 and so scored zero. The students scoring both marks often did so for choosing the wrong answer ‘8’ in part 07.3 but then using it in this calculation.

07.5 About 30% of the students failed to score 3 marks as they were unable to give the correct unit of wavelength.

07.6 Almost all the students were able to use the equations sheet to give the correct equation. A few students only wrote the three symbols inside a triangle - this is not an equation and so scored zero.

07.7 A significant minority of the students were unable to rearrange the equation correctly and thus ended up with an incorrect answer. Over half of the students scored all 3 marks.

07.8 Very few of the answers given linked the three marking points together in a logical, well written sequence. The idea that the sound from speaker B would take more time to reach the technician was often omitted. Approximately 15% of the students did not attempt the question.

4.6.1.2 Properties of waves

Answer 97 · Examiner comments June 2023 | 8463/2F | Original Q3

03.1

Many students confused the arrows with the direction of current.

03.2

Almost 88% of students knew that increasing the current in the wire would increase the strength of the magnetic field.

03.3

62% identified the correct magnetic field pattern for a solenoid.

03.4

Most students identified the correct sequence, or got a mark for identifying the first and last letters correctly.

03.6

Most students calculated the period correctly.

03.7

75% of students recognised an area of compression in a longitudinal wave.

Answer 98 · 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.

4.6.1.2 Properties of waves

Answer 99 · Examiner comments June 2023 | 8463/2F | Original Q6

06.1

50% of students knew that a wide beam of light makes it more difficult to judge where the centre of the beam is.

06.2

Many students found completing the path taken by the ray through the block very difficult very difficult, with many scoring no marks. Some treated the normal line as mirror and drew a reflected ray either inside the block or against the edge of it.

06.3

21% of students were able to identify the resolution of the protractor.

06.4

The vast majority of students were able to calculate the mean.

06.5

Only 25% of students gave the correct word ‘absorbed’. Common incorrect answers included blocked, emitted, filtered, reflected and refracted.

06.6

The vast majority of students gave the correct equation. For those few that didn’t score, it was most frequently because they did not attempt the question, in spite of having the formula sheet.

06.7

A significant number of students scored 2 marks because they could not calculate the powers of ten correctly, giving an answer of 7.5×10^{21}. A number of students scored no marks because they showed an incorrect rearrangement but omitted to show the substitution step first.

Answer 100 · Examiner comments June 2023 | 8463/2F | Original Q7

07.1

75% of students knew that satellite is the name given to an object that orbits a planet.

07.2

A significant number of students did not attempt this question. This is common when students are asked to complete a diagram. Many did show an arrow from the Hubble Space Telescope to Earth. Some drew multiple arrows. A lack of precision from where the arrow started prevented some students from scoring the mark.

07.3

53% of students scored full marks on this calculation of speed from a distance–time graph. The most obvious way of doing this was to use the full gradient which gives 38km in 5 seconds, which was the most common method used by the students. However, many students took different intervals along the line and provided they used the correct numbers the calculation was accepted. This meant a range of velocities could be derived. Common ones were 15km in 2s, 4km in 0.5s,

4.6.1.2 Properties of waves

Answer 100 · Examiner comments June 2023 | 8463/2F | Original Q7

23km in 3s. 8% scored one mark for correctly identifying a change in distance with the corresponding change in time.

07.4

65% of students could identify the galaxy moving away from Earth the fastest from the light spectra.

07.5

77% of students could identify the galaxy furthest away from Earth from the light spectra.

07.6

74% of students understood why it is important that scientific observations are peer reviewed.

Answer 101 · Examiner comments June 2024 | 8463/1F | Original Q2

Question 2 (Low demand)

02.1 48% of students were able to recall the frequency of the UK mains electricity supply.

02.2 75% of students were able to recall the potential difference of the UK mains electricity supply.

02.3 94% of students scored 2 marks for this calculation question. For low demand calculations the equation is provided in the rearrangement needed to answer the question.

02.4 91% of students correctly identified the circuit symbol for a thermistor.

02.5 Only 24% of students chose the correct answer for this question, which tested how the potential difference is shared between components in a series circuit.

02.6 The question discriminated well between students. 12% of students scored 2 marks, while 33% scored 1 mark. The question tested whether students knew how the potential difference was shared between components with equal resistance. 'Because it's a series circuit' was insufficient to score the 2nd marking point.

02.7 80% of students scored 2 marks for this question, by calculating the change in resistance between two values of temperature.

4.6.1.2 Properties of waves

Answer 102 · Examiner comments June 2024 | 8463/1F | Original Q5

Question 5 (Low / Standard demand)

05.1 48% of students understood that the volume of air in the syringe decreased.

05.2 83% of students understood that the distance between the particles decreased.

05.3 85% of students understood that the frequency of collisions increased.

05.4 86% of students understood that the air pressure increased.

05.5 85% of students answered this question correctly, linking temperature increase to the mean speed of gas particles.

05.6 A standard demand calculation of temperature change, which was a good discriminator between students who could or could not rearrange an equation. 35% of students scored 3 marks, while 45% of students scored no marks.

Answer 103 · Examiner comments June 2024 | 8463/2F | Original Q4

04.1
Only 28% of students identified the amplitude of the wave correctly. The most common incorrect response was option A, which was double the amplitude.

04.2
Most students knew which arrow represented the wavelength of the wave.

04.3
Most students got full marks for this calculation of period, and expressed the answer as a decimal or in standard form. A significant number tried to convert from standard form into a decimal value and were unable to do so correctly

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4.6.1.2 Properties of waves

Answer 103 · Examiner comments June 2024 | 8463/2F | Original Q4

04.4
39% of students correctly answered, giving an electromagnetic wave. The most common incorrect answer was sound.

04.5
50 % of students identified the rarefaction in a longitudinal wave correctly.

04.6
49% scored both marks for this calculation of wavelength. Those that didn't often substituted the numbers the wrong way round.

04.7
There were a wide range of answers, with a minority of students providing a valid method to determine the speed of sound and reaching level 2. Most students got the idea of making a sound, the better responses had a way of making a short sharp sound. Many were unsure of the distance required for the experiment to work, and descriptions of how the timings will occur were often vague. The better responses indicated when the stopwatch would be started and when it would be stopped.

04.8
Most attempted this question, but a minority concluded that when going from air to water the wavelength of a sound wave increases.

Answer 104 · 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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4.6.1.2 Properties of waves

Answer 104 · 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.

Questions matter

GCSE
Physics
8463/2F

Report on the examination

Version: 1.0
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4.6.1.2 Properties of waves

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Report on the examination – GCSE - Physics – 8463/2H – June 2025

General comments

Students should pay attention to the number of options that need to be ticked when doing multiple choice questions. They should make sure they cross out wrong options when they change their minds, as marks cannot be awarded where there are multiple ticks instead of one.

Many students demonstrated good maths skills, although there are always issues with rearrangements. Formula triangles are not always helpful. Students who had correctly written down an equation in a previous question and then tried to use a formula triangle often scored no marks, because they don't understand how to use them. If they had substituted into the equation from the equations sheet they would have scored the 1st mark.

Students had access to the equations sheet for this examination series. A minority of the students however did not use them to find the appropriate equation.

Levels of demand

Questions are set at two levels of demand on this paper:

- Low demand questions are targeted at students working at grades 1–3.
- Standard demand questions are targeted at students working at grades 4–5.

A student's final grade, however, is based on their attainment across the qualification, not just on questions that may have been targeted at the level at which they are working.

01.1

Over 90 % of the students knew that a protractor is used to measure angles. The phonetic spelling of protractor was allowed.

01.2

Almost 70% of the students scored all four marks for completing the graph. Despite a clear instruction a significant number did not label the y-axis. A number of the students did not use a ruler to draw the line of best fit.

01.3

Most of the students correctly identified the relationship between the angle of incidence and the angle of reflection.

01.4

Half of the students knew which measurement was the amplitude of a wave. Most of the others thought the vertical distance between a peak and a trough was the amplitude.

01.5

About 80 % of the students knew which line showed the wavelength of the wave. The most common incorrect answer was the distance showing half the wavelength.

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4.6.1.2 Properties of waves

Report on the examination – GCSE - Physics – 8463/2H – June 2025

01.6

Over 90 % of the students correctly calculated the wavelength. Those who did not achieve full marks mainly did so by not choosing the correct unit for wavelength, with Pa being a popular incorrect choice.

01.7

This was well answered, with most of the students scoring both marks. A few inverted the equation and thus calculated the period incorrectly.

02.1

Most of the students correctly calculated the weight of coal.

02.2

Just over 90% of the students were able to use the work done equation correctly. Those that did not get full marks tended to put an additional step into the calculation by dividing the answer 68 000 000 by 4; the number of engines in total.
Occasionally a student would attempt to convert the number calculated into standard form. Whilst not being penalised, this was not required.

02.3

Well answered by most students. As with part 02.2, occasionally a student would attempt to convert the number calculated into standard form.

02.4

Nearly 90% of the students could identify that friction was a contact force.

02.5

Most of the students identified the correct distance-time graph for constant speed.

02.6

This was the 1st calculation that was more challenging for many students. A common error was to use only one of the quoted velocities to calculate the acceleration rather than using the difference between the velocities. However just over 80 % did score full marks, with 10 % scoring zero or not attempting the question.

03.1

Approximately 60% of the students scored both marks. Often students did not know the correct word for a natural satellite. However, many correctly identified ‘star’ for the second word.

03.2

Most of the students knew that we are part of the Milky Way galaxy.

03.3

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Only about 40 % of the students knew that the Sun will eventually become a black dwarf. The most popular wrong answer was that it would become a black hole.

03.4

Just fewer than 40 % of the students knew that a very distant galaxy moves faster than a nearer galaxy.

03.5

About 70 % of the students knew that an increase in the wavelength of light from a distant galaxy is called red-shift.

03.6

About 60 % of the students selected the correct word to describe the beginning of the universe.

03.7

Almost 80 % of the students knew that the universe is expanding.

04.1

Just over 70 % of the students were able to make the connection between the mass of a vehicle and how it would affect the maximum acceleration.

04.2

Over 90 % of the students scored full marks for calculating the resultant force using F = ma. However, some of the students thought that the value of acceleration needed to be squared and then multiplied by mass.

04.3

This level of response question proved too challenging for many. Only just over 1 % of the students scored full marks. Most identified that the driving force would increase, but fewer recognised that as this happened the air resistance would also increase, with many stating that the air resistance would decrease as the cars speed increased.

04.4

Most of the students knew that the thinking distance is affected by the driver's reaction time.

04.5

Just fewer than 70 % of the students were aware that the braking distance is the distance travelled under the braking force.

04.6

Only just over 20 % of the students scored full marks for using the graph of distance against speed to find the stopping distance. The correct distances were often identified from the graph. However, these were then either subtracted from each other, divided or multiplied rather than added.

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4.6.1.2 Properties of waves

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04.7

Nearly 80 % of the students identified factors that would increase the stopping distance of a car. Despite two being emboldened twice in the question, some students only ticked one box.

05.1

The principal focus was correctly identified by just over 60 % of the students.

05.2

About 80 % of the students knew that the change in direction of light as it enters a lens is called refraction.

05.3

Nearly 70 % the students recognised the shape of a convex lens.

05.4

Under a half of the students managed to correctly measure the object height and image height. This may have been due to a lack of skill or a lack of equipment.

05.5

This was much more successfully answered than part 05.4 with nearly 90 % of the students scoring both marks. These students used their values from part 05.4 to calculate magnification.

05.6

Just fewer than 50 % of the students knew that magnification is a ratio, but almost the same number thought it is a power.

05.7

This was a challenging question. Most of the students that did score a mark were awarded only the first mark point. This was for explaining that white light is transmitted through colourless glass. A lot of the students think of white light as an entity in itself rather than the result of the colours of the visible light combined. Few used the word transmitted but rather described it as passing through or goes through.
For the 2nd and 3rd mark points many of the students decided that white light was reflected or refracted, reinforcing the misconception that white light is a single entity rather than being made up of a combination of wavelengths. The idea that filters would absorb different wavelengths of light seemed to be difficult for the students to express, with very few achieving the third mark.

06.1

Only just over 30 % of the students could identify two magnetic materials from the list, with about 60 % being able to identify one. Again, a number of students ticked just one box or more than two boxes.

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06.2

Just over 70 % of the students correctly named the iron nails as induced magnets.

06.3

Just fewer than 40 % of the students knew the direction of the magnetic field.

06.4

Nearly 80 % of the students recognised the shape of the magnetic field around a current carrying wire.

06.5

Very few of the students could give two changes that would increase the magnetic field strength. 'Increasing the current' was a common correct response. Many of the students answered 'increasing the number of coils' as such they were implying the wire was already coiled and not answering the question asked, which was about the straight wire shown in Figure 10.

07.1

Nearly 60 % of the students understood what is meant by the moment of a force. The most common incorrect option was 'The direction of the force.'

07.2

The correct resultant moment was selected by just over 80 % of the students.

07.3

Students generally answered this well, identifying position 7 and on which side of the balance the tag should be placed. Some indicated this on the diagram which was an accepted alternative response, provided what was written did not contradict it.

07.4

Some students wrote the equation for the moment of a force in words and then in symbols. This risks not gaining the mark if either is incorrect. Also, correct use of symbols should be stressed, especially when they are given in the question. It was surprising that some of the students scored zero or did not attempt to write down an equation despite having the equations sheet.

07.5

Almost three quarters of the students were able to rearrange the equation and then calculate the distance between the pivot and the tag on the balance.

08.1

Most of the students found this level of response question difficult to answer. Only just over 1 % gave a level 2 answer. Many of the students scored 2, 1 or 0 marks. Of those that scored a mark the most common response was light travels faster than sound. Many also tried to describe light and sound as transverse and longitudinal waves, with the majority getting this

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confused. Very few identified acceptable similarities. Common answers that did not gain credit included light travels at the speed of light, sound travels at the speed of sound, light can be seen and sound cannot be seen.

08.2

Just fewer than 80 % of the students choose the correct equation for calculating speed.

08.3

This question required students to rearrange the equation. About three quarters of the students scored all three marks.

09.1

About 65 % of the students correctly stated the independent variable in this investigation.

09.2

Just over 40 % of the students scored both marks for identifying a risk of harm and a suitable safety precaution to reduce the risk. Too few students connected a hazard, such as a falling weight, becoming a risk of harm when it hit or hurt the student.

09.3

Students were expected to clearly describe two improvements to the arrangement shown that would improve the accuracy of the results. Many had difficulty describing their ideas clearly and answers were often too vague to gain credit.

09.4

Almost 40 % of the students scored this mark usually by explaining that the spring length was not 0 cm rather than describing the relationship between spring length and force.

09.5

This was not successfully answered, with only about 2 % of the students scoring both marks and a further 13 % scoring one mark. The 1st mark point was for stating or giving a clear description of inelastic deformation. Of those who were awarded marks most of them described how the spring had reached or passed its limit of proportionality.

09.6

Over 90 % of the students selected the correct equation.

09.7

Nearly 80 % of the students scored all three marks. Those that did not often rearranged the equation incorrectly.

10.1

Only about 5% of the students correctly calculated the uncertainty correctly from either the range or the mean.

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4.6.1.2 Properties of waves

10.2

Just over 40 % of the students identified that a random error had caused the variation in this investigation. A greater proportion of the students thought there was a systematic error but this would not have accounted for the variation in the results.

10.3

This mark was awarded for a clear description of variation in the way the ball was dropped. For example, through different heights, at different speeds, or a different delay each time. Common answers giving reaction time or human error were too vague, to be awarded marks unless qualified.

10.4

Just fewer than 30 % of the students scored all three marks. Many of the students took only one value from the graph rather than a corresponding pair of values and so scored 0. Those that used a pair of correct values often then used them the wrong way round when calculating the gradient.

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Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

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