AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.1.2

Properties of waves

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**125**
Available paper years	**2004–2025**

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 2004 | 3451H | Original Q14 | Legacy

The full source mark scheme begins on page 149. Follow original question 14 in that document.

Answer 02 · Mark scheme June 2004 | 3462H3 | Original Q12 | Legacy

The full source mark scheme begins on page 170. Follow original question 12 in that document.

Answer 03 · Mark scheme June 2005 | 3451 | Original Q7 | Legacy

The full source mark scheme begins on page 187. Follow original question 7 in that document.

Answer 04 · Mark scheme June 2005 | 3462 | Original Q5 | Legacy

The full source mark scheme begins on page 205. Follow original question 5 in that document.

Answer 05 · Mark scheme June 2006 | 3451 | Original Q2 | Legacy

The full source mark scheme begins on page 219. Follow original question 2 in that document.

4.6.1.2 Properties of waves

Answer 06 · Mark scheme

June 2006 | 3462 | Original Q2 | Legacy

The full source mark scheme begins on page 239. Follow original question 2 in that document.

Answer 07 · 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 08 · Mark scheme

November 2006 | PHY1B | Original Q3 | Legacy

Three	**A**	10	**1**
	B	15	**3**
	C	60	**2**
	D	200	**4**

Answer 09 · Mark scheme

November 2006 | PHY1B | Original Q8 | Legacy

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

Answer 10 · Mark scheme

January 2007 | PHY1H | Original Q3 | Legacy

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

Answer 11 · Mark scheme

January 2007 | PHY1H | Original Q5 | Legacy

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

4.6.1.2 Properties of waves

Answer 12 · Mark scheme March 2007 | PHY1B | Original Q4 | Legacy

Four	**A**	away from	**2**
	B	beyond	**4**
	C	furthest	**3**
	D	towards	**1**

Answer 13 · Mark scheme March 2007 | PHY1B | Original Q7 | Legacy

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

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

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

4.6.1.2 Properties of waves

Question 4 continued

(ii)	check validity / reliability of the evidence **or** change the theory to match the new evidence	accept comparison of new and old evidence	1
total			8

PHY1H Question 5

	answers	extra information	mark
(a)(i)	a signal that has only two states / only discrete states	accept can only be on or off accept made up of 1 and 0 only accept high and low accept diagram with all amplitudes equal	1
(ii)	400 000 000 **or** correct equivalent	allow **1** mark for correct transformation **and** substitution (of 75) answer 4 000 000 gains **1** mark only	2

Continued on next page

4.6.1.2 Properties of waves

Answer 16 · Mark scheme

June 2007 | PHY1H | Original Q5 | Legacy

Question 5 continued

	answers	extra information	mark
(b)(i)		any mention of alpha, beta, gamma waves scores **0** marks	
	emit / uses / transmit / receive microwaves	accept radiation for microwaves throughout ignore radio waves	1
	some microwave / energy absorbed by / enters the body	ecf for their given electromagnetic wave do **not** accept goes through the body	1
	raises temperature of (body) cells / tissue / water	accept reference to water molecules vibrating faster accept it could cause mutation / harm / kill cells do **not** accept answers in terms of ionisation ignore references to cancer	1
(ii)	any **two** from: • research (may be) biased **or** may have been misled in the past • some research suggests a link • long-term effect not proven / studied • residents may not have seen the research	accept not independent **or** may be lying accept not studied for long enough	2
total			8

4.6.1.2 Properties of waves

Answer 16 · Mark scheme June 2007 | PHY1H | Original Q5 | Legacy

PHY1H Question 6

	answers	extra information	mark
(a)	four calculations correctly shown	200 × 10 – 1800 = £200 100 × 10 – 2400 = –£1400 50 × 10 – 600 = –£100 20 × 10 – 75 = 125 accept four final answers only **or** obvious rejection of solar water heater and underfloor heating, with other two calculations completed any 1 complete calculation correctly shown **or** showing each saving × 10 of all four calculations = **1** mark answers in terms of savings as a percentage of installation cost **may** score savings mark only	2
	hot water boiler	correct answers only	1
(b)	less electricity / energy to be generated / needed from power stations	accept less demand	1
	reduction in (fossil) fuels being burnt	accept correctly named fuel accept answer in terms of: fewer light bulbs required because they last longer (1 mark) less energy used / fuels burnt in production / transport etc. (1 mark) ignore reference to CO_2 or global warming ignore reference to conservation of energy	1
total			5

4.6.1.2 Properties of waves

Answer 17 · Mark scheme

November 2007 | PHY1B | Original Q2 | Legacy

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

Answer 18 · Mark scheme

November 2007 | PHY1B | Original Q5 | Legacy

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

4.6.1.2 Properties of waves

Answer 19 · Mark scheme

Question 5

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

4.6.1.2 Properties of waves

Answer 19 · Mark scheme

January 2008 | PHY1H | Original Q5 | Legacy

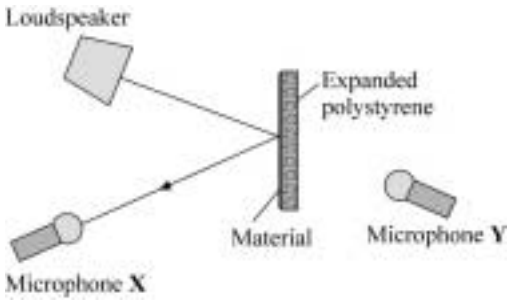
PHY1H

4.6.1.2 Properties of waves

Answer 20 · Mark scheme

January 2008 | PHY3H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
(a)	(mechanical) vibration(s)	**not** just 'particles knocking into each other' not reference to 'sound particles'	1
(b)	K		1
(c)(i)	reflected by the material from loudspeaker to microphone X shown by straight lines with angle of incidence = angle of reflection (by eye) **and** at least one arrow in the correct direction	 do **not** credit if the direction is contradicted by any incorrect arrow may be shown by waves / wavefronts in the direction of straight lines ignore any sound to Y or which 'misses' the material **example**  	1 1
(ii)	any **one** from: • so (the student) can compare results • so only one (independent) variable • to get reliable / accurate results • because (the expanded) polystyrene absorbs some of the sound	do **not** credit just 'so it's a fair test'	1

PHY3H

Question 2 continued

question	answers	extra information	mark
(iii)	**[A]** wood		1
	[B] either 0.25 **or** 1/4 **or** 25 % **or** 15/60 **or** 1: 3	do **not** credit 1 : 4	1
(d)	practical suggestion		1
	appropriate reason / explanation	**example** line / panel the walls with wood / plasterboard / increase the thickness of the plaster (on the walls) (1) (this) will absorb / reflect (back) (most / some of) the sound (1) credit legal suggestions for attempting to limit the noise made by the neighbours **example** ask the neighbours to make less noise (1) by limiting the time(s) music played (1) do **not** credit reference to 'sound particles' for second mark	1
total			9

continued

4.6.1.2 Properties of waves

Answer 20 · Mark scheme January 2008 | PHY3H | Original Q2 | Legacy

PHY3H

Answer 21 · Mark scheme March 2008 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	2	**3**
	B	3	**2**
	C	4	**1**
	D	6	**4**

Answer 22 · Mark scheme March 2008 | PHY1BP | Original Q2 | Legacy

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

	A	B	C	D

Answer 23 · Mark scheme March 2008 | PHY1BP | Original Q6 | Legacy

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

Answer 24 · Mark scheme March 2008 | PHY1BP | Original Q7 | Legacy

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

4.6.1.2 Properties of waves

Answer 25 · Mark scheme

March 2008 | PHY1BP | Original Q9 | Legacy

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

Answer 26 · Mark scheme

June 2008 | PHY1BP | Original Q5 | Legacy

Five	**4**	**2**	**3**	**1**

Answer 27 · Mark scheme

June 2008 | PHY1BP | Original Q8 | Legacy

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

4.6.1.2 Properties of waves

Answer 28 · Mark scheme

June 2008 | PHY1BP | Original Q9 | Legacy

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

4.6.1.2 Properties of waves

Answer 29 · Mark scheme

June 2008 | PHY1H | Original Q2 | Legacy

Question 2

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

Question 2 continues on the next page

4.6.1.2 Properties of waves

PHY1H

Question 2 continued

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

4.6.1.2 Properties of waves

Answer 29 · Mark scheme June 2008 | PHY1H | Original Q2 | Legacy

PHY1H

4.6.1.2 Properties of waves

Answer 30 · Mark scheme June 2008 | PHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
(a)	Hubble telescope is above the (Earth's) atmosphere	accept no / little atmosphere	1
	atmosphere distorts <u>image</u> **or** atmosphere scatters <u>light</u>	do **not** accept light / waves distorted accept picture for image accept no clouds (to block light) accept no light pollution answers in terms of closer to stars neutral	1
(b)	to check it works (correctly) **or** less risk of a fault (once in space)		1
	too far away (for astronauts) to travel to / to fix	accept its difficult to send astronauts to repair / maintain it dangerous / expensive is insufficient	1
(c)	to test the design works	accept idea of fault finding or modifying the design	1
(d)	(visible) light can pass through the atmosphere		1
	X-rays are absorbed by the atmosphere **or** X-rays cannot pass through the atmosphere		1
total			7

4.6.1.2 Properties of waves

Answer 30 · Mark scheme June 2008 | PHY1H | Original Q3 | Legacy

PHY1H

4.6.1.2 Properties of waves

Answer 31 · Mark scheme June 2008 | PHY2H | Original Q4 | Legacy

Question 4

	answers	extra information	mark
(a)	alternates between positive and negative	accept switches accept (constantly) changes accept goes up and down	1 1
(b)	potential difference between the neutral and earth (terminal) **or** potential of the neutral terminal with respect to earth	accept voltage for p.d	1
(c)(i)	0.025 (s)		1
(ii)	40 (Hz)	accept 1 ÷ their (a)(i)	1
total			5

4.6.1.2 Properties of waves

Answer 31 · Mark scheme June 2008 | PHY2H | Original Q4 | Legacy

PHY2H

4.6.1.2 Properties of waves

Answer 32 · Mark scheme

Question 5

question	answers	extra information	mark
(a)	any **two** points: • humans cannot hear ultrasound • it has a very high frequency / pitch • above the (upper) limit for humans / above 20 000 Hz	do **not** credit features which are true of sound in general eg longitudinal waves do **not** credit just 'has a high frequency / pitch'	2
(b)(i)	ultrasound / waves are reflected Pulse **A** indicates / is the crack Pulse **B** *i*ndicates / is the back (of the block or crack)	… are bounced is insufficient, but … echo is acceptable need to mention both A and B to get this mark	1 1
(b)(ii)	90 (mm)	accept any answer in the range 88 – 92 (mm)	1
total			5

4.6.1.2 Properties of waves

Answer 32 · Mark scheme June 2008 | PHY3H | Original Q5 | Legacy

PHY3H

Answer 33 · Mark scheme November 2008 | PHY1BP | Original Q5 | Legacy

Five	**3**	**2**	**1**	**2**

Answer 34 · Mark scheme November 2008 | PHY1BP | Original Q6 | Legacy

Six	**4**	**1**	**3**	**2**

Answer 35 · Mark scheme November 2008 | PHY1BP | Original Q8 | Legacy

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

Answer 36 · Mark scheme November 2008 | PHY1BP | Original Q9 | Legacy

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

4.6.1.2 Properties of waves

Answer 37 · Mark scheme

January 2009 | PHY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	radio(waves)		1
5(a)(ii)	energy	correct answer only	1
5(b)(i)	0.0125 (m)	allow **1** mark for correct transformation and substitution	2
5(b)(ii)	make it hot(ter)	do **not** accept cook it accept (air) particles inside ball will move faster accept water in the ball gets hotter	1
5(b)(iii)	wavelength decreases frequency increases	ignore reference to speed	1 1
5(c)(i)	both variables are continuous	accept the data is continuous	1

Question 5 continues on the next page

PHY1H

Question 5 continued

question	answers	extra information	Mark
5(c)(ii)	digital data can be (easily) processed by a computer **or** digital analogue data cannot (easily) be processed by a computer	both parts needed do **not** accept answers in terms of interference / quality / clearer signals	1
5(c)(iii)	<u>digital</u> a signal that has only two states / discrete values <u>analogue</u> a signal that varies continuously	accept can only be on or off accept made up of 1 and 0 only allow both marks for two correct diagrams correctly labelled digital and analogue allow **1** mark for two correct diagrams but not labelled	1 1
Total			**11**

4.6.1.2 Properties of waves

Answer 38 · Mark scheme January 2009 | PHY3H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	20 000	accept any unambiguous indication	1
1(b)	kilohertz	credit misspellings credit '1000 hertz' or '1000 Hz' accept 1000 oscillations/beats/waves per second	1
1(c)(i)	cleaning (e.g. something delicate such as a watch)	**or** quality control/flaw detection credit any appropriate extra Specification response e.g. sonar	1
1(c)(ii)	pre-natal (scanning)	do **not** credit just 'scanning'/medical scanning credit any appropriate extra Specification response e.g. destruction of (kidney) stones or cleaning teeth	1
1(d)	8 (μs)		1
1(e)	distance (1) between the boundary and the detector (1)	accept 'between the boundary and the source' accept any correct use of speed = distance/time	2

Question 1 continues on the next page

PHY3H

Question 1 continued

question	answers	extra information	mark
1(f)	examples publish/tell doctors/the public (1) ... their evidence/results/ research/data (1) carry out more research/ tests (1) ... to make sure/check reliability (1)	allow a wide variety of appropriate responses valid point (1) appropriate example/ qualification/expansion/etc. (1) allow just 'stop using them/ultrasonic waves' (1) allow using them (only) for industrial purposes (1)	2
Total			**9**

4.6.1.2 Properties of waves

Answer 38 · Mark scheme January 2009 | PHY3H | Original Q1 | Legacy

PHY3H

Answer 39 · Mark scheme March 2009 | PHY1BP | Original Q4 | Legacy

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

Answer 40 · Mark scheme March 2009 | PHY1BP | Original Q5 | Legacy

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

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

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

Answer 42 · Mark scheme March 2009 | PHY1BP | Original Q9 | Legacy

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

Answer 43 · Mark scheme June 2009 | PHY1BP | Original Q1 | Legacy

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

4.6.1.2 Properties of waves

Answer 44 · Mark scheme June 2009 | PHY1BP | Original Q6 | Legacy

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

Answer 45 · Mark scheme June 2009 | PHY1BP | Original Q7 | Legacy

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

Answer 46 · Mark scheme June 2009 | PHY1BP | Original Q8 | Legacy

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

4.6.1.2 Properties of waves

Answer 47 · Mark scheme

June 2009 | PHY1H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	HESS	accept gamma	1
1(a)(ii)	infra red	accept IR accept answers written in table do **not** accept heat	1
1(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 1 continues on the next page . . .

4.6.1.2 Properties of waves

Answer 47 · Mark scheme

June 2009 | PHY1H | Original Q1 | Legacy

PHY1H

Question 1 continued . . .

question	answers	extra information	mark
1(c)	any **two** from: • microwaves absorbed 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
1(d)	a fourth / extra galaxy / star	accept a planet / another object / source	1
Total			**7**

4.6.1.2 Properties of waves

Answer 47 · Mark scheme

June 2009 | PHY1H | Original Q1 | Legacy

PHY1H

4.6.1.2 Properties of waves

Answer 48 · Mark scheme

June 2009 | PHY2H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	0.0046	accept 4.6 mA allow **1** mark for correct substitution and transformation i.e. current = $\frac{230}{50\,000}$ an answer of 4.6 gains **1** mark	2
6(a)(ii)	• increases overall resistance • (in event of a shock) gives a smaller current	 accept gives smaller shock do **not** accept no shock/current	1 1
6(b)(i)	50 (hertz)	ignore units	1
6(b)(ii)	NO has the lowest current at which people cannot let go **or** YES changing the frequency changes the current by only a small amount	answer and reason needed accept a sensible reason in terms of their answer to (b) (i)	1

Question 6 continues on the next page . . .

4.6.1.2 Properties of waves

Answer 48 · Mark scheme

June 2009 | PHY2H | Original Q6 | Legacy

PHY2H

Question 6 continued . . .

question	answers	extra information	mark
6(c)	a current flows through from the live wire/metal case to the earth wire	accept a current flows from live to earth do **not** accept on its own if the current is too high	1
	this current causes the fuse to melt	accept blow for melt	1
Total			**8**

4.6.1.2 Properties of waves

Answer 49 · Mark scheme

Question 5

question	answers	extra information	mark
5(a)(i)	same frequency / period / pitch / wavelength	ignore references to amplitude	1
5(a)(ii)	differences in waveform / shape / quality	accept the diagrams are not identical	1
5(b)(i)	20 000 Hz / hertz **or** 20 kHz / kilohertz	in both cases, if the **symbol** rather than the name is used, it must be correct in every detail	1
5(b)(ii)	material(s) / substance(s) (through which sound travels)		1
5(b)(iii)	is absorbed is transmitted	accept (some) sound (energy) is transformed / transferred as heat / thermal energy accept is refracted accept changes speed accept changes velocity do **not** accept is diffracted do **not** accept is diffused do **not** accept is dissipated	1 1
Total			**6**

4.6.1.2 Properties of waves

Answer 49 · Mark scheme June 2009 | PHY3H | Original Q5 | Legacy

PHY3H

Answer 50 · Mark scheme November 2009 | PHY1BP | Original Q5 | Legacy

Five	**3**	**2**	**3**	**1**

Answer 51 · Mark scheme November 2009 | PHY1BP | Original Q6 | Legacy

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

Answer 52 · Mark scheme November 2009 | PHY1BP | Original Q7 | Legacy

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

4.6.1.2 Properties of waves

Answer 53 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)(i)	microwaves		1
3(a)(ii)	can pass through the ionosphere	accept travels in a straight line accept atmosphere for ionosphere do **not** accept air for ionosphere	1
3(b)	any **two** from: • analogue is continuously varying • digital has only discrete values • digital is less prone to interference (than analogue) • digital can be processed more easily (than analogue) by a computer	 do **not** accept analogue has many values accept digital is on or off accept digital is 1 or 0 accept digital is binary accept digital is easier to restore	2
3(c)	higher the frequency, further the wave travels (into the atmosphere before reflection)		1
3(d)	15 000	allow **1** mark for correct transformation and substitution ie $\frac{300\,000\,000}{20}$ an answer of 15 000 000 only gains **1** mark allow both marks for an answer of 15 MHz (unit must be changed) an answer of 15 gains no credit	2
Total			**7**

4.6.1.2 Properties of waves

Answer 53 · Mark scheme January 2010 | PHY1H | Original Q3 | Legacy

PHY1H

Answer 54 · Mark scheme March 2010 | PHY1BP | Original Q4 | Legacy

Four	**2**	**4**	**2**	**1**

Answer 55 · Mark scheme March 2010 | PHY1BP | Original Q6 | Legacy

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

Answer 56 · Mark scheme March 2010 | PHY1BP | Original Q7 | Legacy

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

Answer 57 · Mark scheme March 2010 | PHY1BP | Original Q8 | Legacy

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

Answer 58 · Mark scheme March 2010 | PHY1BP | Original Q9 | Legacy

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

Answer 59 · Mark scheme June 2010 | PHY1BP | Original Q3 | Legacy

Three	3	3	4	2

Answer 60 · Mark scheme June 2010 | PHY1BP | Original Q6 | Legacy

Six	2	2	2	2

4.6.1.2 Properties of waves

Answer 61 · Mark scheme

June 2010 | PHY1BP | Original Q9 | Legacy

Nine	2	4	4	2

4.6.1.2 Properties of waves

Answer 62 · Mark scheme

June 2010 | PHY1H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	any **two** from: • travel at the same speed (through a vacuum) • can travel through a vacuum / space • transfer energy • can be reflected • can be refracted • can be diffracted • can be absorbed • can be transmitted • transverse	 accept travel at the speed of light accept air for vacuum do **not** accept air for vacuum accept any other property common to electromagnetic waves accept travel at the same speed through a vacuum for both marks do **not** accept both radiated from the Sun	2
4(a)(ii)	infra red radio(waves)	**both** required for the mark accept IR for infra red	1

Question 4 continues on the next page . . .

4.6.1.2 Properties of waves

PHY1H

Question 4 continued . . .

question	answers	extra information	mark
4(b)	2400000000	correct transformation and substitution gains **1** mark ie $\frac{300000000}{0.125}$ **or** $\frac{300000000}{12.5}$ an answer of 24000000 gains **1** mark **either** 2400000 kHz **or** 2400 MHz scores **3** marks but the symbol only scores the 3rd mark if it is correct in every detail	2
	hertz	accept Hz do **not** accept hz	1
4(c)(i)	presented (scientific) evidence / data	do an experiment / investigation is insufficient	1
4(c)(ii)	to find out if there is a hazard (or not)	accept to find out if it is safe accept not enough evidence to make a decision not enough evidence is insufficient	1
Total			**8**

4.6.1.2 Properties of waves

Answer 62 · Mark scheme June 2010 | PHY1H | Original Q4 | Legacy

PHY1H

4.6.1.2 Properties of waves

Answer 63 · Mark scheme

June 2010 | PHY1H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	wavelength (of light appears to) increase	accept frequency (appears to) decrease accept light moves to the red end of the spectrum do **not** accept it moves to the red end of the spectrum do **not** accept light becomes redder	1
6(b)(i)	**M** is closer (to the Earth) than **N** **M** is moving (away from the Earth) slower than **N**		1 1
6(b)(ii)	520	an answer between 510 and 530 inclusive gains **1** mark	2
6(b)(iii)	more recent data more reliable **or** improved equipment / techniques **or** data obtained from more (distant) galaxies	no mark for this but must be given to gain reason mark accept data is more accurate more technology is insufficient accept a wider range of data accept data closer to the line of best fit **or** data less scattered accept no anomalous result(s) accept all data fits the pattern	 1
6(c)	wavelength is decreased frequency is increased		1 1
Total			**8**

4.6.1.2 Properties of waves

Answer 64 · Mark scheme

June 2010 | PHY2H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	125	allow **1** mark for obtaining time period = 0.008 (s) **or** frequency = 1 / time period (or their calculated time period)	2
	hertz **or** Hz	do **not** accept hz	1
6(b)	50 (hertz)		1
Total			**4**

4.6.1.2 Properties of waves

Answer 64 · Mark scheme June 2010 | PHY2H | Original Q6 | Legacy

PHY2H

4.6.1.2 Properties of waves

Answer 65 · Mark scheme

June 2010 | PHY3H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	20 (Hz) to 20 000 (Hz) / 20 kHz	**or** reversed order	1
2(a)(ii)	ultrasound / ultrasonic	do **not** accept sonic	1
2(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
2(c)	(mechanical) vibration	accept vibrations in the air / particles	1
2(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 2 is continued on the next page . . .

4.6.1.2 Properties of waves

PHY3H

Question 2 continued . . .

question	answers	extra information	mark
2(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 65 · Mark scheme June 2010 | PHY3H | Original Q2 | Legacy

PHY3H

Answer 66 · Mark scheme November 2010 | PHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	decreased	**3**
	B	increased	**2**
	C	shifted	**1**
	D	not changed	**4**

Answer 67 · Mark scheme November 2010 | PHY1BP | Original Q5 | Legacy

Five	**3**	**3**	**1**	**4**

Answer 68 · Mark scheme November 2010 | PHY1BP | Original Q6 | Legacy

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

Answer 69 · Mark scheme November 2010 | PHY1BP | Original Q9 | Legacy

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

4.6.1.2 Properties of waves

Answer 70 · Mark scheme

Question 1

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

Question 1 continues on the next page . . .

PHY1H

Question 1 continued . . .

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

4.6.1.2 Properties of waves

Answer 70 · Mark scheme January 2011 | PHY1H | Original Q1 | Legacy

PHY1H

4.6.1.2 Properties of waves

Answer 71 · Mark scheme

January 2011 | PHY1H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	frequency / pitch decreases	accept wavelength increases accept it / the note becomes deeper / lower it / the note decreases is insufficient quieter is neutral	1
2(b)(i)	Models can help to explain an effect or theory.		1
2(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
2(c)	big bang		1
Total			**5**

4.6.1.2 Properties of waves

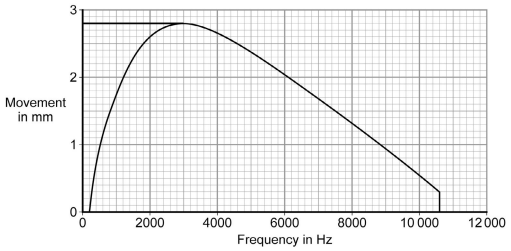
Answer 71 · Mark scheme January 2011 | PHY1H | Original Q2 | Legacy

PHY1H

4.6.1.2 Properties of waves

Answer 72 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)	10 600 (Hz)	accept 10.6 kHz	1
2(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
2(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 / less than 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 2 continues on the next page . . .

4.6.1.2 Properties of waves

PHY3H

Question 2 continued . . .

question	answers	extra information	mark
2(d)	reliability	this answer only	1
2(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 72 · Mark scheme January 2011 | PHY3H | Original Q2 | Legacy

PHY3H

Answer 73 · Mark scheme March 2011 | PHY1BP | Original Q3 | Legacy

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

Answer 74 · 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 75 · Mark scheme March 2011 | PHY1BP | Original Q7 | Legacy

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

Answer 76 · Mark scheme June 2011 | PHY1BP | Original Q1 | Legacy

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

Answer 77 · Mark scheme June 2011 | PHY1BP | Original Q4 | Legacy

Four	**2**	**3**	**4**	**1**

Answer 78 · Mark scheme June 2011 | PHY1BP | Original Q5 | Legacy

Five	**1**	**4**	**2**	**3**

4.6.1.2 Properties of waves

Answer 79 · Mark scheme

June 2011 | PHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	microwave(s)		1
3(a)(ii)	has discrete values only **or** has only 2 states	accept can only be on or off accept made up of 1 and 0 only accept has high and low (values only) accept a diagram with discrete levels do **not** accept can be switched on and off	1
3(a)(iii)	any **one** from: • less (prone to) interference • can be (easily) processed by computers • better quality (signal) • digital signals can be restored • information / data can be compressed	it refers to signal accept no interference accept interference causes less / no permanent damage accept noise / distortion for interference accept can be processed without an analogue to digital converter better on its own is insufficient accept can send more information in same time do **not** accept faster	1

Question 3 continues on the next page

4.6.1.2 Properties of waves

Answer 79 · Mark scheme

PHY1H

Question 3 continued

question	answers	extra information	mark
3(b)	2 000 000 000	allow **1** mark for correct transformation and substitution ie $\frac{300\,000\,000}{0.15}$ or $\frac{300\,000\,000}{15}$	2
	hertz	accept Hz do **not** accept hz accept kHz / MHz / GHz **but** for full credit the answer and unit must be consistent eg answers 2 GHz; 2000 MHz; 2 000 000 kHz gain **3** marks	1
3(c)(i)	infra red (radiation)	accept IR ignore reference to light	1
3(c)(ii)	travel a shorter distance	do **not** accept faster	1
Total			**8**

4.6.1.2 Properties of waves

Answer 79 · Mark scheme June 2011 | PHY1H | Original Q3 | Legacy

PHY1H

4.6.1.2 Properties of waves

Answer 80 · Mark scheme

June 2011 | PHY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	radio waves pass through the atmosphere	accept it is cheaper / easier to maintain	1
5(a)(ii)	computers process digital signals (more easily)	accept read for process accept computers cannot (easily) process analogue signals ignore references to interference	1
5(b)(i)	wavelength (of waves appears to) increase **or** wavelength moves to longer / red end of spectrum	accept answers in terms of frequency decrease accept wavelength stretched but not just wave is stretched answers involving planets negates mark	1
5(b)(ii)	can measure change 20 times smaller	accept can measure (much) smaller change accept detects with greater precision accept can show more detail / stars accept can detect weaker signals can see things more clearly is insufficient	1

Question 5 continues on the next page

PHY1H

Question 5 continued

question	answers	extra information	mark
5(b)(iii)	Universe had a start point Universe is (still) changing / expanding	mention of Earth / planets etc exploding / expanding negates answer	1 1
5(c)	any **one** from: • share ideas • can justify large development costs • makes new investigations possible	accept cost shared saves money is insufficient accept any sensible suggestion	1
Total			**7**

4.6.1.2 Properties of waves

Answer 80 · Mark scheme June 2011 | PHY1H | Original Q5 | Legacy

PHY1H

4.6.1.2 Properties of waves

Answer 81 · Mark scheme

June 2011 | PHY3H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	microphone		1
1(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
1(b)(ii)	loudness / volume / intensity / energy	do **not** accept noise	1
1(c)	17	this answer only	1
1(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
1(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 81 · Mark scheme June 2011 | PHY3H | Original Q1 | Legacy

PHY3H

Answer 82 · Mark scheme November 2011 | PHY1BP | Original Q1 | Legacy

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

Answer 83 · Mark scheme November 2011 | PHY1BP | Original Q8 | Legacy

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

Answer 84 · Mark scheme November 2011 | PHY1BP | Original Q9 | Legacy

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

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

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

4.6.1.2 Properties of waves

Answer 85 · Mark scheme

June 2012 | PH1HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	any **two** from: • travel (at same speed) through a vacuum / space • transverse • transfer energy • can be reflected • can be refracted • can be diffracted • can be absorbed • travel in straight lines	do **not** accept air for vacuum	2
5(b)	can pass through the ionosphere	accept atmosphere for ionosphere do **not** accept air for ionosphere accept travel in straight lines accept not refracted / reflected / absorbed by the ionosphere	1
5(c)	diffraction (of waves around hills) wavelength needs to be similar size to the obstacle / gap radio has a long enough wavelength **or** TV doesn't have a long enough wavelength	an answer TV (waves / signals) have short wavelengths so do not diffract (around the hill) scores **2** marks	1 1 1

Question 5 continues on the next page

4.6.1.2 Properties of waves

Answer 85 · Mark scheme

June 2012 | PH1HP | Original Q5 | Legacy

PH1HP

Question 5 continued

question	answers	extra information	mark
5(d)		$v = f \times \lambda$	
	1.2×10^6 / 1200 000	allow **1** mark for correct substitution ie $3.0 \times 10^8 = f \times 2.5 \times 10^2$	2
	hertz / Hz	do **not** accept hz **or** HZ accept kHz **or** MHz answers 1.2 MHz **or** 1200 kHz gain all **3** marks for full credit the unit and numerical value must be consistent	1
Total			**9**

4.6.1.2 Properties of waves

Answer 85 · Mark scheme June 2012 | PH1HP | Original Q5 | Legacy

PH1HP

4.6.1.2 Properties of waves

Answer 86 · Mark scheme

June 2012 | PH1HP | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)	any **three** from: • red-shift shows galaxies are moving away (from each other / the Earth) • more distant galaxies show bigger red-shift **or** more distant galaxies show a greater increase in wavelength • (in all directions) more distant galaxies are moving away faster • suggests single point of origin (of the universe)	accept correct reference to frequency in place of wavelength accept (suggests) universe is expanding	3
8(b)(i)	(radiation produced shortly after) 'Big Bang'	accept beginning of time / beginning of the universe for 'Big Bang'	1
8(b)(ii)	any **one** from: • can only be explained by 'Big Bang' • existence predicted by 'Big Bang' • provides (further) evidence for 'Big Bang'	ignore proves 'Big Bang' (theory) ignore reference to red-shift	1

Question 8 continues on the next page

4.6.1.2 Properties of waves

Answer 86 · Mark scheme

June 2012 | PH1HP | Original Q8 | Legacy

PH1HP

Question 8 continued

question	answers	extra information	mark
8(b)(iii)	increase universe continues to accelerate outwards **or** greater red-shift	accept becomes radio waves accept as universe continues to expand	1 1
Total			**7**

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

4.6.1.2 Properties of waves

Answer 87 · Mark scheme

January 2013 | PH1HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	gamma	accept correct symbol	1
5(a)(ii)	any **one** from: • (ultraviolet has a) higher frequency • (ultraviolet has a) greater energy • (ultraviolet has a) shorter wavelength	ultraviolet cannot be seen is insufficient ignore ultraviolet causes cancer etc	1
5(b)	1.2×10^7 / 12 000 000 hertz / Hz / kHz / MHz	allow **1** mark for correct substitution, ie $3 \times 10^8 = f \times 25$ do **not** accept hz **or** HZ answers 12 000 kHz **or** 12 MHz gain **3** marks for full credit the numerical answer and unit must be consistent	2 1
5(c)(i)	away (from each other)	accept away (from the Earth) accept receding	1
5(c)(ii)	distance (from the Earth) speed galaxy is moving	accept how far away (it is)	1 1
5(c)(iii)	(Universe is) expanding		1
Total			**9**

4.6.1.2 Properties of waves

Answer 87 · Mark scheme

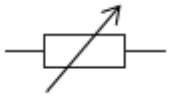
January 2013 | PH1HP | Original Q5 | Legacy

PH1HP

4.6.1.2 Properties of waves

Answer 88 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)(i)	symbol for a diode 	accept 	1
	symbol for a variable resistor 		1
4(a)(ii)	voltmeter is in series **or** voltmeter is not in parallel		1
	ammeter is in parallel **or** ammeter is not in series	accept an answer in terms of how the circuit should be corrected voltmeter and ammeter are wrong way around is insufficient	1
4(b)(i)	0.2 (V)	accept any value between 0.20 and 0.21 inclusive	1
4(b)(ii)	37.5	allow **1** mark for I = 0.008 **or** allow **2** marks for correct substitution, ie 0.3 = 0.008 × R **or** allow **1** mark for a correct substitution using I = 0.8 **or** I = 0.08 **or** I = 0.009 **or** allow **2** marks for answers of 0.375 **or** 3.75 **or** 33(.3)	3

Question 4 continues on the next page . . .

PH2HP

Question 4 continued . . .

question	answers	extra information	mark
4(c)(i)	25	allow **1** mark for obtaining period = 0.04(s)	2
4(c)(ii)	diode has large resistance in reverse / one direction so stops current flow in that / one direction	 allow diodes only let current flow one way / direction allow **1** mark for the diode has half-rectified the (a.c. power) supply	1 1
Total			**12**

4.6.1.2 Properties of waves

Answer 88 · Mark scheme

January 2013 | PH2HP | Original Q4 | Legacy

PH2HP

4.6.1.2 Properties of waves

Answer 89 · Mark scheme

Question 6

question	answers	extra information	mark
6(a)(i)	50(Hz)	ignore any unit given	1
6(a)(ii)	any **two** from: • (some) current flows to Earth • current flows through copper braid • RCCB detects difference between current in live and neutral wire	 accept ground for Earth accept current flows through the earth wire accept electricity for current in either the first or second marking point but not both	2
6(a)(iii)	can be reset **or** faster acting	accept does not need replacing accept switches circuit off faster	1
6(b)(i)	79 200 coulombs / C	allow **1** mark for correct substitution, ie $11 = \frac{Q}{2 \times 3600}$ an answer 22 gains **1** mark do **not** accept c	2 1
6(b)(ii)	18 216 000 **or** 230 × their (b)(i) correctly calculated	accept for **2** marks 18 216 kJ **or** 18.216 MJ allow **1** mark for correct substitution, ie 230 × their (b)(i) **or** allow **1** mark for power calculated as 2530(W)	2

Question 6 continues on the next page . . .

4.6.1.2 Properties of waves

PH2HP

Question 6 continued . . .

question	answers	extra information	mark
6(c)	increases temperature of thermistor changes resistance (of thermistor)	 do **not** accept increases resistance (of thermistor) an answer decreases resistance (of thermistor) gains **2** marks	1 1
Total			**11**

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

4.6.1.2 Properties of waves

Answer 90 · Mark scheme

June 2013 | PH1HP | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	10^{-15} metres to 10^{4} metres		1
7(b)(i)	any **one** from: • (TV / video / DVD) remote controls • (short range) data transmission • optical fibre (signals)	mobile phones is insufficient accept specific example, eg linking computer peripherals do **not** accept Bluetooth	1
7(b)(ii)	0.17	an answer 17 cm gains **3** marks an answer given to more than 2 significant figures that rounds to 0.17 gains **2** marks allow **1** mark for correct substitution, ie $3 \times 10^{8} = 1.8 \times 10^{9} \times \lambda$	3
7(c)	(maybe) other factors involved	accept a named 'sensible' factor, eg higher stress / sedentary lifestyle / overweight / smoking more / diet / hot office / age not testing enough people is insufficient unreliable data is insufficient	1
Total			**6**

4.6.1.2 Properties of waves

Answer 90 · Mark scheme

June 2013 | PH1HP | Original Q7 | Legacy

PH1HP

4.6.1.2 Properties of waves

Answer 91 · Mark scheme

June 2013 | PH1HP | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)(i)	origin of the Universe	accept (why) the Universe is expanding do **not** accept origin of the Earth	1
8(a)(ii)	provided more evidence to support the 'Big Bang' theory		1
8(b)(i)	red-shift	accept Doppler (shift)	1
8(b)(ii)	(at the point in time shown the observed spectrum from) star A (shows it) is moving away from the Earth light from star B shows a decrease in wavelength so star B is moving towards Earth	accept star A is moving away star A shows red-shift is insufficient accept light from star B shows blue-shift accept light from star B shows an increase in frequency	1 1 1
Total			**6**

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

4.6.1.2 Properties of waves

Answer 92 · Mark scheme

June 2013 | PH3HP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	60	allow **1** mark for correct substitution (with d in metres), ie 36 = F × 0.6 an answer of 0.6 **or** 6 gains **1** mark	2
6(b)	the line of action of the weight lies outside the base / bottom (of the bag)	accept line of action of the weight acts through the side accept the weight (of the bag) acts outside the base / bottom (of the bag)	1
	a resultant / overall / unbalanced moment acts (on the bag)	accept the bag is not in equilibrium do **not** accept the bag is unbalanced	1
6(c)	0.0625	allow **1** mark for correct substitution, ie $16 = \frac{1}{f}$ an answer of 0.00625 gains **1** mark	2
	hertz / Hz	do **not** accept HZ **or** hz	1
Total			**7**

4.6.1.2 Properties of waves

Answer 92 · Mark scheme June 2013 | PH3HP | Original Q6 | Legacy

PH3HP

4.6.1.2 Properties of waves

Answer 93 · Mark scheme

June 2014 | PH1HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO spec ref
4(a)(i)	440 (sound) waves produced in one second	accept vibrations / oscillations for waves	1	AO1 1.5.1i
4(a)(ii)	0.773 (metres)	allow **2** marks for an answer that rounds to 0.773 allow **2** marks for an answer of 0.77̇2̇ allow **2** marks for an answer of 0.772 allow **1** mark for correct substitution ie 340 = 440 × λ	3	AO2 1.5.1j
4(b)	(sound is) louder as amplitude is larger higher pitch/frequency as more waves are seen	do **not** accept the converse waves are taller is insufficient reference to wavelengths alone is insufficient waves are closer together is insufficient	1 1 1 1	AO1 AO3 1.5.3b
Total			**8**	

4.6.1.2 Properties of waves

Answer 94 · Mark scheme

June 2014 | PH3HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO spec ref
7(a)	because the angle of incidence is greater than critical angle	accept the light is totally internally reflected	1	AO1 3.1.5a
7(b)	41.8	allow **1** mark for correct substitution, eg $1.5 = \frac{1}{\sin c}$ **or** $\sin c = \frac{1}{1.5}$ **or** $c = \sin^{-1}\frac{1}{1.5}$	2	AO2 3.1.5a
7(c)	(for both fibres) increasing the wavelength of light decreases and then increases the percentage / amount of light transmitted	accept for **1** mark: (for both fibres) increasing the wavelength (of light) to 5 (x 10^{-7} metres), decreases the (percentage) transmission	1	AO3 4.5.3
	(for both fibres) the minimum transmission happens at 5 (x 10^{-7} metres) **or** maximum transmission occurs at 6.5 (x 10^{-7} metres)	accept for a further **1** mark: (for both fibres) increasing the wavelength of the light from 5 (x 10^{-7} metres) increases the amount of light transmitted increasing wavelength (of light), decreases the percentage transmitted is insufficient on its own	1	
	the shorter fibre transmits a greater percentage of light (at the same wavelength)	accept for **1** mark: Any statement that correctly processes data to compare the fibres	1	
Total			**6**	

4.6.1.2 Properties of waves

Answer 95 · Mark scheme

June 2015 | PH1HP | Original Q6 | Legacy

The full source mark scheme begins on page 253. Follow original question 6 in that document.

4.6.1.2 Properties of waves

Answer 96 · Mark scheme

June 2015 | PH3HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
1(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
1(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 1 continues on the next page . . .

4.6.1.2 Properties of waves

Answer 96 · Mark scheme

June 2015 | PH3HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
1(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 96 · Mark scheme

June 2015 | PH3HP | Original Q1 | Legacy



4.6.1.2 Properties of waves

Answer 97 · Mark scheme

June 2015 | PH3HP | Original Q3 | Legacy

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

Question 3 continues on the next page . . .

4.6.1.2 Properties of waves

Answer 97 · Mark scheme

June 2015 | PH3HP | Original Q3 | Legacy

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

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

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

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

Answer 97 · Mark scheme

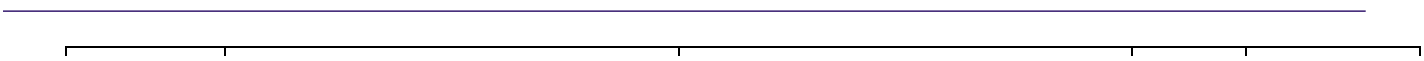
Operator precautions with X-rays The X-ray operator should go behind a (metal / glass) screen / leave the room when making an X-ray / wear a lead lined apron	accept appropriate precautions for the patient e.g. limit the total exposure/dose (in one year) wear a radiation badge is insufficient	
Medical 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 97 · Mark scheme

June 2015 | PH3HP | Original Q3 | Legacy



4.6.1.2 Properties of waves

Answer 98 · Mark scheme

June 2015 | PH3HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
5(a)(i)	(closing the switch makes) a current (through the wire) (the current flowing) creates a magnetic field (around the wire) this field interacts with the permanent magnetic field	 accept links / crosses attracts / repels is insufficient	1 1 1	AO1 P3.3.1a, b
5(a)(ii)	arrow drawn showing upwards force on XY	judge vertical by eye the arrow must be on or close to the wire XY	1	AO2 P3.3.1e
5(a)(iii)	motor	accept catapult	1	AO1 P3.3.1b
5(b)(i)	the wire moves up and down or the wire vibrates	 back and forth or side to side is insufficient for vibrate	1	AO2 P3.3.1e
5(b)(ii)	the force (continually) changes direction (from upwards to downwards, on the wire)	accept the direction of the magnetic field (of the wire) changes	1	AO1 P3.3.1e
Total			7	

4.6.1.2 Properties of waves

Answer 98 · Mark scheme

June 2015 | PH3HP | Original Q5 | Legacy



Answer 99 · Mark scheme

June 2016 | PH1HP | Original Q1 | Legacy

The full source mark scheme begins on page 269. Follow original question 1 in that document.

4.6.1.2 Properties of waves

Answer 100 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	ultrasound is not ionising	allow ultrasound does not harm the (unborn) baby	1	AO1 3.1
	but X-rays are ionising		1	
	so X-rays increase the health risk to the (unborn) baby	accept specific examples of health risks, eg cancer, stunted growth, impaired brain function etc X-rays are dangerous is insufficient	1	
3(b)	ultrasound/waves are partially reflected (when they meet a boundary) (between two different media / substances / tissues)	must be clear that not all of the wave is reflected	1	AO1 3.1.2b
	the time taken is measured (and is used to determine distances)		1	
3(c)	1600 (m/s)	800 (m/s) gains **2** marks 160 000 (m/s) gains **2** marks 0.0016 (m/s) gains **2** marks allow **2** marks for $\frac{0.04}{25 \times 10^{-6}}$ or $\frac{0.08}{50 \times 10^{-6}}$ 80 000 (m/s) gains **1** mark 0.0008 (m/s) gains **1** mark allow **1** mark for $\frac{0.04}{25}$ or $\frac{0.08}{50}$ allow **1** mark for evidence of doubling the distance or halving the time	3	AO2 3.1.2c

Question 3 continues on the next page . . .

4.6.1.2 Properties of waves

Answer 100 · Mark scheme

June 2016 | PH3HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(d)(i)	they are absorbed by bone	allow stopped for absorbed X-rays are reflected negates this mark	1	AO1 3.1.1a
	they are transmitted by soft tissue	allow pass through for transmitted allow flesh / muscle / fat accept less (optically) dense material for soft tissue	1	
	(the transmitted) X-rays are detected		1	
3(d)(ii)	short	accept small	1	AO1 3.1.1a
Total			12	

4.6.1.2 Properties of waves

Answer 100 · Mark scheme

June 2016 | PH3HP | Original Q3 | Legacy



4.6.1.2 Properties of waves

Answer 101 · Mark scheme

June 2017 | PH1HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	transverse		1	AO1 1.5.1c
1(b)	4.6×10^{14} (Hz)	an answer that rounds to 4.6×10^{14} scores 2 marks allow **1** mark for correct substitution ie $3.0 \times 10^{8} = f \times 6.5 \times 10^{-7}$	3	AO2 1.5.1j
1(c)	10^{-15} to 10^{4}		1	AO1 1.5.1e
Total			**5**	

4.6.1.2 Properties of waves

Answer 101 · Mark scheme

June 2017 | PH1HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.

4.6.1.2 Properties of waves

Answer 102 · Mark scheme

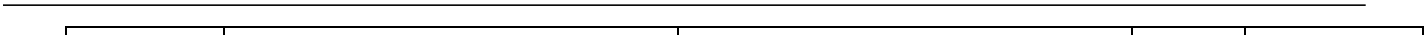
June 2017 | PH1HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	Doppler		1	AO1 1.5.4a
4(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
4(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 102 · Mark scheme

June 2017 | PH1HP | Original Q4 | Legacy



4.6.1.2 Properties of waves

Answer 103 · Mark scheme

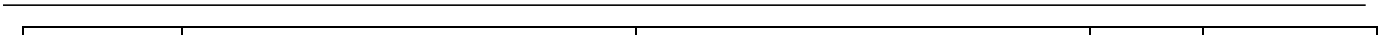
June 2017 | PH3HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	CCD (charge coupled device)	accept CMOS	1	AO1 3.1.4d
4(b)	Converging – both real and virtual images Diverging – virtual image only		1 1	AO1 3.1.3g
4(c)	The refractive index of the converging lens is greater (for all frequencies) The refractive index of the converging lens increases more than that of the diverging lens The refractive index of the converging lens reaches a maximum at a lower frequency than that of the diverging lens	use of data without comparison is insufficient	1 1 1	AO2 3.1.3c
4(d)	An answer that rounds to 12	allow **2** marks for $r = \sin^{-1}(0.21)$ allow **1** mark for correct substitution ie $1.6 = \sin(20)/\sin(r)$ allow **1** mark for $r = \sin^{-1}(\sin(20)/1.6)$ allow **1** mark for 0.21	3	AO2 3.1.3c
4(e)	− 2.5 dioptres / D	allow **1** mark for − 0.025 allow **1** mark for (+) 2.5	2 1	AO2 AO1 3.1.4e
4(f)	curvature refractive index	allow shape allow material it is made from ignore references to density	1 1	AO1 3.1.3g
Total			**14**	

4.6.1.2 Properties of waves

Answer 103 · Mark scheme

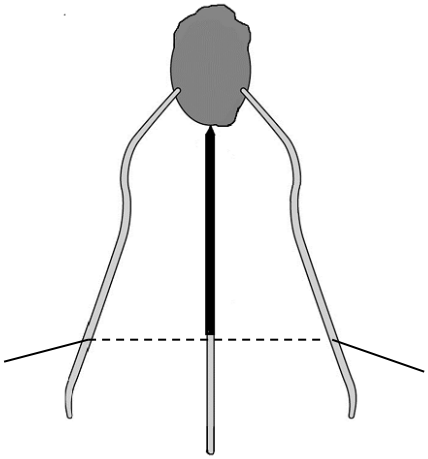
June 2017 | PH3HP | Original Q4 | Legacy



4.6.1.2 Properties of waves

Answer 104 · Mark scheme

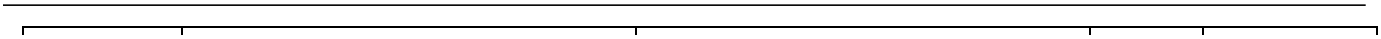
June 2017 | PH3HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	A cross marked on the knife between the tip of the knife and a line drawn between the two fork labels as shown by the darker shading below 		1	AO1 3.2.1b
6(a)(ii)	The point where the mass is (thought to be) concentrated		1	AO1 3.2.1a
6(b)	1.25 Hz	allow **1** mark for correct substitution and re-arrangement ie 1/0.8 an answer of 2.5 scores **1** mark	2	AO2 3.2.1d
Total			**4**	

4.6.1.2 Properties of waves

Answer 104 · Mark scheme

June 2017 | PH3HP | Original Q6 | Legacy



4.6.1.2 Properties of waves

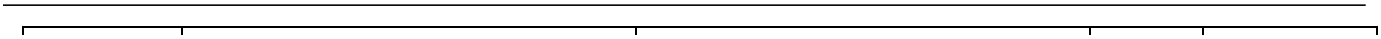
Answer 105 · Mark scheme June 2017 | PH3HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	20 001 hertz / Hz	accept 20 000 hertz	1	AO1 3.1.2a
7(b)(i)	The time (taken for the pulse to travel to the crack and back)	accept how long it takes (for the pulse to travel to the crack and back)	1	AO1 3.1.2c
7(b)(ii)	The speed (of ultrasound in the wing)		1	AO1 3.1.2c
7(b)(iii)	Partially reflected and partially transmitted	accept it is reflected and transmitted for **2** marks	1 1	AO2 3.1.2b
7(c)	If a fault is missed on an inspection it will still be safe (until the next inspection)	accept there is a far lower risk of the fault being missed and becoming dangerous	1	AO3 3.1.2
Total			**6**	

4.6.1.2 Properties of waves

Answer 105 · Mark scheme

June 2017 | PH3HP | Original Q7 | Legacy



4.6.1.2 Properties of waves

Answer 106 · Mark scheme

June 2018 | 8463/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	P-waves are longitudinal and S-waves are transverse		1	AO1 4.6.1.5
03.2	0.4		1	AO2 4.6.1.2
03.3	wave speed = frequency × wavelength	allow v = f λ	1	AO1 4.6.1.2
03.4	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 **03.2** a method shown as 7200 × 2.5 = 18 000 scores **0** marks	1 1 1	AO2 4.6.1.2
03.5	because S-waves cannot travel through a liquid and S-waves do not travel through the (outer) core	allow some (seismic) waves cannot travel through a liquid and do not go through the core for **1** mark	1 1	AO1 4.6.1.5
03.6	magnetic field around the coil changes **or** the magnetic field (lines) cut by the coil	allow the generator effect	1	4.7.3.1 AO2

4.6.1.2 Properties of waves

Answer 106 · Mark scheme

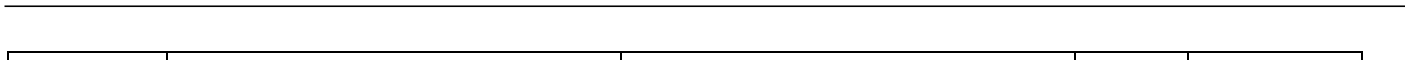
June 2018 | 8463/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	because the magnet changes direction		1	4.7.3.1 AO2
03.8	stationary		1	4.7.3.1 AO2
03.9	any **two** from: • stronger magnetic field • more turns on the coil • turns pushed closer together • spring with a lower spring constant	 allow stronger magnet allow heavier magnet bigger magnet is insufficient bigger coil is insufficient do **not** accept more coils of wire allow less stiff spring allow weaker spring do **not** accept add an iron core	2	4.7.3.1 AO2
Total			**13**	

4.6.1.2 Properties of waves

Answer 106 · Mark scheme

June 2018 | 8463/2H | Original Q3



4.6.1.2 Properties of waves

Answer 107 · Mark scheme

June 2018 | 8463/2H | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	an idea used to explain observations and data		1	AO1 key ideas
09.2	different models may be appropriate in different situations	allow one particular model may not be able to explain all observations	1	AO1 key ideas
09.3	new (experimental) evidence / data		1	AO1 key ideas
	evidence cannot be explained using an existing model **or** predictions made using old model are shown to be incorrect	allow old model based on data now shown to be incorrect	1	
	new model explains new evidence **or** predictions made with new model are shown to be correct		1	
	a suitable example given eg nuclear model of the atom replacing the plum pudding model	allow tectonic plates replacing static land masses	1	
	big bang theory replacing other theories for the creation of the universe	allow heliocentric model of solar system replacing geocentric model		
09.4	velocity / speed is slower in shallow water		1	AO2 4.6.2.2
	so edge of wave (front) entering shallow water slows down		1	
	but the part of the wave (front) in deeper water continues at a higher speed (leading to a change in direction of the wave fronts)	allow one part of the wave (front) changes speed before other parts allow an answer in terms of wave (front) travelling from shallow to deep water	1	

4.6.1.2 Properties of waves

Answer 107 · Mark scheme

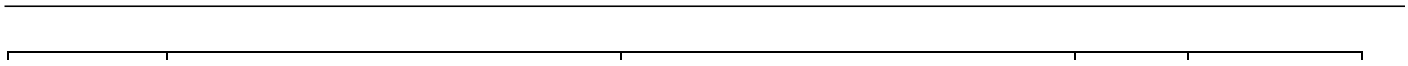
June 2018 | 8463/2H | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	every point on the wave (front) enters / hits the shallow water at the same time and so every point slows down at the same time	 allow changes speed for slows down allow an answer in terms of wave (front) travelling from shallow to deep water	1 1	AO2 4.6.2.2
Total			11	

4.6.1.2 Properties of waves

Answer 107 · Mark scheme

June 2018 | 8463/2H | Original Q9



4.6.1.2 Properties of waves

Answer 108 · Mark scheme

June 2019 | 8463/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6.1	50 Hz / hertz	 allow Hertz	1 1	4.2.3.1 AO1
6.2	(both) switches need to be closed / on to complete the series circuit **or** to allow charge to flow **or** so there is a current in the circuit		1 1	4.2.2 AO1
6.3	 $1800 = I^2 \times 32$ $I^2 = \frac{1800}{32}$ **or** $I^2 = 56.25$ $I = 7.5$ (A)	an answer of 7.5 (A) scores **3** marks an answer of 0.237(A) scores **2** marks this mark may be awarded if P is incorrectly or not converted this mark may be awarded if P is incorrectly or not converted this answer only	 1 1 1	4.2.4.1 AO2
6.4	 $1500 = \frac{450\ 000}{t}$ $t = \frac{450\ 000}{1500}$ $t = 300$ (s)	an answer of 300 (s) scores **3** marks an answer of 300 000 (s) scores **2** marks this mark may be awarded if P is incorrectly or not converted this mark may be awarded if P is incorrectly or not converted this answer only	 1 1 1	4.1.1.4 AO2
Total			**10**	

4.6.1.2 Properties of waves

Answer 109 · Mark scheme

June 2019 | 8463/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2.1	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
2.2	(wave) speed = frequency × wavelength	allow v = f λ	1	AO1/1 4.6.1.2 RPA8
2.3	 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
2.4	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 109 · Mark scheme

June 2019 | 8463/2H | Original Q2

2.5	**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 110 · Mark scheme

June 2019 | 8463/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5.1	wavelength	this answer only	1	AO1 4.8.2 iso
5.2	(extremely) hot and dense	ignore very small	1	AO1/1 4.8.2 iso
5.3	(directly) proportional	allow a correct description of direct proportionality ignore positive correlation	1	AO3/2b 4.8.2
5.4	6×10^{24}		1	AO2/2 4.8.2 WS4.4
5.5	the furthest galaxies are moving the fastest (this suggests) the universe is expanding (from a very small region)		1 1	AO1/1 4.8.2
5.6	expanding at (an ever) greater rate	allow expanding faster	1	AO3/1a 4.8.2
5.7	any **one** from: • detects false claims • detects inaccurate data • detects bias • verifies new data • provides a consensus (of opinion)	 allow provides credibility allow detects mistakes allow removes bias allow checks validity ignore shows data is accurate ignore proves a theory	1	AO1/1 4.8.2 WS 1.6
5.8	wavelength (seems to have) decreased frequency (seems to have) increased		1 1	AO2/1 4.8.2
Total			**10**	

4.6.1.2 Properties of waves

Answer 111 · Mark scheme

November 2020 | 8463/1H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	$5.75 = I \times 230$ $I = \frac{5.75}{230}$ $I = 0.025$ (A) $230 = 0.025 \times R$ **or** $R = \frac{230}{0.025}$ $R = 9200$ (Ω)	allow a correct substitution using an incorrect value of I **or** allow a correct rearrangement using incorrect value of I allow a correct calculation of resistance using an incorrect value of I alternative approach for 4th and 5th marks: $5.75 = 0.025^2 \times R$ (1) **or** $R = \frac{5.75}{0.025^2}$ $R = 9200$ (Ω) (1) alternative approach: $5.75 = \frac{230^2}{R}$ (3) $R = \frac{230^2}{5.75}$ (1) $R = 9200$ (Ω) (1)	1 1 1 1 1	AO2 4.2.4.1 4.2.1.3

4.6.1.2 Properties of waves

Answer 111 · Mark scheme

November 2020 | 8463/1H | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	one wire in the switch is live	allow the switch / circuit is live allow one wire is at a potential of 230 V	1	AO1 4.2.3.2
	the electrician is earthed **or** the electrician is at earth potential		1	
	(so) there will be a (large) potential difference between the live wire and the electrician / earth (if the electrician touched the wire)		1	
09.3	50 Hz has the lowest (maximum) let-go current		1	AO3 4.2.3.1
	a higher / lower / different frequency would allow people to let go at a greater current	allow a specific numerical example as opposed to a trend	1	
Total			**10**	

4.6.1.2 Properties of waves

Answer 112 · Mark scheme

November 2020 | 8463/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(force of) gravity fusion	do **not** allow weight	1 1	AO1 4.8.1.1
02.2	distance = speed × time **or** s = vt	allow a correct re-arrangement do **not** allow d = st	1	AO1 4.5.6.1.2
02.3	$1.5 \times 10^{11} = 3.0 \times 10^{8} \times t$ $t = \frac{1.5 \times 10^{11}}{3.0 \times 10^{8}}$ t = 500 (s)		1 1 1	AO2 4.5.6.1.2

02.4	**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.			
02.5	Temperature		1	AO1 4.6.3.2
Total			**13**	

4.6.1.2 Properties of waves

Answer 113 · Mark scheme

November 2020 | 8463/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	it is harder to judge where the centre of a wider ray is		1	AO3 4.6.1.3 RPA9
	causing a larger uncertainty (in the measurements)	allow increasing random errors (in the measurements)	1	
03.2	line of best fit drawn and extrapolated to 80 degrees		1	AO3 4.6.1.3 RPA9
	41 (degrees)	allow 40 to 43 (degrees)	1	
03.3	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		5–6	AO1 4.6.1.3 RPA9
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.		3–4	
	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: • place a glass block on a piece of paper • draw around the glass block • use the ray box to shine a ray of light through the glass block • mark the ray of light entering the glass block • mark the ray of light emerging from the glass block • join the points to show the path of the complete ray through the block • and draw a normal line at 90 degrees to the surface • use a protractor to measure the angle of incidence • use a protractor to measure the angle of refraction • use a ray box to shine a ray of light at a range of different angles (of incidence) • increase the angle of incidence in 10 degree intervals • from an angle of incidence of 10 degrees to an angle of incidence of 70 degrees. allow use of optical pins instead of a ray box			

4.6.1.2 Properties of waves

Answer 113 · Mark scheme

November 2020 | 8463/2H | Original Q3

03.4	$\frac{(28 + 25 + 22)}{3} = 25$ 3 (degrees)	 allow alternative method 28 – 22 = 6 (1) = 3 (degrees) (1)	1 1	AO3 4.6.1.3
03.5	Velocity		1	AO1 4.6.2.2
Total			**13**	

4.6.1.2 Properties of waves

Answer 114 · Mark scheme

November 2020 | 8463/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	320 MHz = 3.2×10^8 Hz	allow 320 000 000	1	AO2
	$3.0 \times 10^8 = 3.2 \times 10^8 \times \lambda$	this mark may be awarded if frequency is incorrectly/not converted	1	AO2
	$\lambda = \frac{3.0 \times 10^8}{3.2 \times 10^8}$	this mark may be awarded if frequency is incorrectly/not converted	1	AO2
	wavelength = 0.9375	allow correct calculation using an incorrectly/not converted frequency allow an answer that rounds to 0.94	1	AO2
	metres **or** m		1	AO1 4.6.1.2
06.2	(alternating) current <u>induced</u> (in the electrical circuit)	allow <u>electrons</u> vibrate / oscillate (in the electrical circuit)	1	AO1 4.6.2.3
	with the same frequency as the radio wave		1	
06.3	Any **two** from: • (radio waves are) transverse	allow sound waves are longitudinal allow a description of transverse/longitudinal waves	2	AO1 4.6.1.1 4.6.1.2
	• (radio waves) travel at a higher speed • (radio waves) don't need a medium • (radio waves are) electromagnetic	allow (only) radio waves travel through a vacuum allow sound waves are mechanical		
06.4	accelerating	allow speeding up	1	AO3 4.5.6.1.4

4.6.1.2 Properties of waves

Answer 114 · Mark scheme

November 2020 | 8463/2H | Original Q6

06.5	appropriate tangent drawn correct reading from graph for change in distance and change in time (eg 5.6 (m) and 20 (s)) gradient of tangent shown (eg 5.6/20) 0.28 (m/s)	 allow correct reading from their tangent for change in distance and change in time allow correct gradient from their tangent this answer only allow 0.25 to 0.30 (m/s) if the tangent is appropriate allow 2.8 / 20 = 0.14 (m/s) for **1** mark	1 1 1 1	AO2 4.5.6.1.4
06.6	$0.52^2 - 0.12^2 = 2 \times 0.04 \times s$ $s = \frac{0.52^2 - 0.12^2}{2 \times 0.04}$ s = 3.2 (m) 0.48 = F x 3.2 $F = \frac{0.48}{3.2}$ F = 0.15 (N) **OR**	 this mark may be awarded if the displacement is incorrectly calculated this mark may be awarded if the displacement is incorrectly calculated allow a correctly calculated F using an incorrectly calculated displacement	1 1 1 1 1 1	AO2 4.5.2 4.5.6.1.5

4.6.1.2 Properties of waves

Answer 114 · Mark scheme

November 2020 | 8463/2H | Original Q6

	Alternative method 1 $t = \frac{0.52 - 0.12}{0.04}$ (1) t = 10 (s) (1) s = 0.32 × 10 = 3.2 (m) (1) 0.48 = F x 3.2 (1) $F = \frac{0.48}{3.2}$ (1) F = 0.15 (N) (1) **OR** Alternative method 2 $0.48 = (0.5 \times m \times 0.52^2) - (0.5 \times m \times 0.12^2)$ (1) 0.48 = 0.1352m – 0.0072m (1) 0.48 = 0.128m (1) m = 3.75 (1) F = 3.75 x 0.040 (1) F = 0.15 (N) (1)	allow a correctly calculated displacement from an incorrectly calculated t this mark may be awarded if the displacement is incorrectly calculated this mark may be awarded if the displacement is incorrectly calculated allow a correctly calculated F from incorrectly calculated values for displacement and / or t allow their calculated m allow correctly calculated F using an incorrectly calculated m		

4.6.1.2 Properties of waves

Answer 114 · Mark scheme

November 2020 | 8463/2H | Original Q6

06.7	there is a maximum forward force (provided by the motor) as the speed of the car increases air resistance increases until air resistance is equal in size to forward force so the car can no longer accelerate	allow driving force for forward force - throughout the car has a maximum acceleration is insufficient allow friction / drag for air resistance - throughout allow (until) the resultant force is zero allow forces are in equilibrium / balanced allow the car travels at terminal velocity	1 1 1 1	AO1 4.5.6.1.5
Total			**24**	

4.6.1.2 Properties of waves

Answer 115 · Mark scheme

November 2021 | 8463/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	gravitational force inwards and forces as a result of fusion reactions outwards are in equilibrium / balanced	allow fusion energy for fusion reactions outwards allow radiation pressure for fusion reactions outwards dependant on scoring 1st mark point allow for **1** mark forces are in equilibrium	1 1	AO1 4.8.1.1
03.2	(the star will) expand to become a red giant (the star will) collapse to become a white dwarf (the star will) cool to become a black dwarf	the answers must be in the correct sequence to score all **3** marks allowed outer layers ejected for collapsed if no other marks score, allow red giant, white dwarf, black dwarf in the correct order for **1** mark	1 1 1	AO1 4.8.1.2
03.3	**A** it is (moving away from Earth) the slowest or it is the closest (to the Earth)	 reason only scores if A is chosen	1 1	AO3 4.8.2
Total			**7**	

4.6.1.2 Properties of waves

Answer 116 · Mark scheme

November 2021 | 8463/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **one** from: • (sun) tan • energy efficient lamps	allow • (invisible) security coding • detecting forged bank notes • kill microbes • attract insects • sterilise (surgical) equipment • cause the body to produce vitamin D • increasing the growth rate of plants • water purification	1	AO1 4.6.2.4
05.2	3×10^{-7} m		1	AO1 4.6.2.1
05.3	$3.0 \times 10^{8} = \text{frequency} \times 3 \times 10^{-7}$ $\text{frequency} = \frac{3.0 \times 10^{8}}{3 \times 10^{-7}}$ $\text{frequency} = 1 \times 10^{15}$ (Hz)	allow ecf from question **05.2**	1 1 1	AO2 4.6.1.2
05.4	**Wave** / **Name** Wave E – Infrared Wave F – Visible light Wave G – X-rays all three lines correct for **1** mark		1	AO3 4.6.2.1

4.6.1.2 Properties of waves

Answer 116 · Mark scheme

November 2021 | 8463/2H | Original Q5

05.5	in a transverse wave, the oscillations / vibrations are perpendicular to the direction of energy transfer in a longitudinal wave, the oscillations / vibrations are parallel to the direction of energy transfer	allow direction of wave travel for direction of energy transfer	1 1	AO1 4.6.1.1

Total			**8**

4.6.1.2 Properties of waves

Answer 117 · Mark scheme

November 2021 | 8463/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	to reduce the effect of random errors	allow gives a more accurate mean ignore reference to anomalous results ignore measurements are more accurate	1	AO1 4.6.1.2
06.2	$\frac{(8.4+7.8+8.1)}{3}$ = 8.1 (s)		1	AO2 4.6.1.2
	$\frac{8.1}{10}$ = 0.81 (s)		1	
	frequency = $\frac{1}{0.81}$	allow a correct substitution of an incorrectly calculated value for time	1	
	frequency = 1.2345…	this mark may be awarded if the time is incorrectly calculated	1	
	frequency = 1.2 (Hz)	allow a calculated value correctly rounded to 2 sig figs	1	
06.3	measure the distance travelled by a wave using a metre rule	allow measure the length of the (ripple) tank using a metre rule	1	AO1 4.6.1.2
	measure the time taken (for the wave to travel the measured distance) with a timer / stopwatch		1	
	divide the distance by the time	dependant on scoring the first two mark points	1	
Total			**9**	

4.6.1.2 Properties of waves

Answer 118 · Mark scheme

November 2021 | 8463/2H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	motor (effect)		1	AO1 4.7.2.4
08.2	current creates a magnetic field (around the coil) (which) interacts with the permanent magnet field producing a (resultant) force causing the coil/cone to move (when the) direction of the current reverses, the direction of the (resultant) force reverses (producing a sound wave)	 allow coil/cone for force allow backwards for reverses	1 1 1 1	AO1 4.7.2.4
08.3	the student changed two variables at the same time (so) it is not possible to know the effect of each variable	allow only one variable should be changed at a time	1 1	AO3 4.6.1.2
Total			**7**	

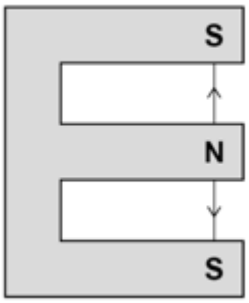
4.6.1.2 Properties of waves

Answer 119 · Mark scheme

June 2023 | 8463/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	current **or** potential difference	allow charge flow	1	AO1 4.7.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2			1	AO1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	an induced magnet is a material that becomes a magnet when it is placed in a magnetic field **or** an induced magnet loses most / all of its magnetism (quickly) when removed from a magnetic field	allow 'when close to another magnet' for 'when it is placed in a magnetic field' allow 'no magnets are nearby' for 'removed from a magnetic field' 'temporary magnet' alone is insufficient	1	AO1 4.7.1.1

4.6.1.2 Properties of waves

Answer 119 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	motor effect		1	AO1 4.7.2.2 4.7.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	16 mA = 0.016 A	allow 1.6×10^{-2} (A)	1	AO2 4.7.2.2
	$0.013 = B \times 0.016 \times 6.5$	allow correct substitution using incorrectly / not converted current	1	
	$B = \frac{0.013}{0.016 \times 6.5}$	allow correct re-arrangement using incorrectly / not converted current	1	
	$B = 0.125$ (T)	allow correct calculation using incorrectly / not converted current allow 0.13 (T)	1	

4.6.1.2 Properties of waves

Answer 119 · Mark scheme

June 2023 | 8463/2H | Original Q4

Question	Answers	Mark	AO / Spec. Ref.
04.6	**Level 2**: Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3-4	AO3 4.6.1.4
	Level 1: Relevant features are identified and differences noted.	1-2	
	No relevant content	0	
	Indicative content: • for all three people, the minimum sound level that can be heard increases as frequency increases **Age** • the minimum sound level that can be heard increases with age • between 2000 and 3000 Hz the minimum sound level that can be heard increases more in **B** compared to **C** • **C** has very little variation in the minimum sound level that can be heard at all frequencies **Working in a loud environment:** • increases the minimum sound level that can be heard at all frequencies above 2000 Hz compared to working in a quiet environment • the minimum sound level that can be heard increases more as frequency increases from 2000 to 4000 Hz compared to working in a quiet environment • doesn't affect the minimum sound level that can be heard at 2000 Hz to access **level 2** the answer must include at least **one** comparison for age **and one** comparison for working in a loud environment, using supporting data/information from the graph		

Total Question 4	**12**

4.6.1.2 Properties of waves

Answer 120 · Mark scheme

June 2023 | 8463/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	satellite	allow moon	1	AO1 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	12.5 cm = 0.125 m		1	AO2 4.6.1.2
	$3 \times 10^8 = f \times 0.125$	this mark may be awarded for an incorrectly / not converted value for wavelength	1	
	$f = \frac{3 \times 10^8}{0.125}$	this mark may be awarded for an incorrectly / not converted value for wavelength	1	
	$f = 2\,400\,000\,000$ (Hz)	this mark may be awarded for an incorrectly / not converted value for wavelength	1	
	$f = 2.4 \times 10^9$ (Hz)	this mark may be awarded for an incorrectly calculated value for frequency in standard form using the given data	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	gravitational force causes the Hubble Space Telescope to accelerate towards the Earth		1	AO1 4.5.1.1 4.5.6.1.3 4.8.1.3
	this changes the direction of motion (but not the speed)		1	
	so changes the velocity of the Hubble Space Telescope	if no other marks awarded, allow 1 mark for gravitational force maintains circular orbit	1	

4.6.1.2 Properties of waves

Answer 120 · Mark scheme

June 2023 | 8463/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	galaxy A has the greater red shift (so) A is travelling (away from us) faster (than B) (because) A is further away (from us than B)	if no other marks awarded, allow 1 mark for galaxy A and galaxy B are moving away from us	1 1 1	AO3 4.8.2

Total Question 6	12

4.6.1.2 Properties of waves

Answer 121 · Mark scheme

June 2024 | 8463/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	50 (Hz) 230 (V)	this order only	1 1	AO1 4.2.3.1

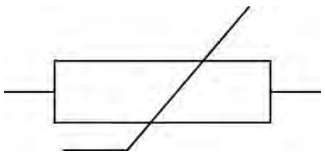
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	340 mW = 0.34 W $0.34 = 0.75^2 \times R$ $R = \frac{0.34}{0.75^2}$ $R = 0.60$ (Ω)	 allow a correct substitution of an incorrectly / not converted value of *P* allow a correct rearrangement of an incorrectly / not converted value of *P* allow an answer consistent with an incorrectly / not converted value of *P* allow a correct answer given to more than 2 sf	1 1 1 1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	the dirt changes the (measured) resistance of the coin **or** the (measured) resistance is different from the expected resistance (of the coin)	 allow the measured resistance does not match the resistance of a known coin allow dirt stops charge flow (through the coin) allow dirt stops the current (in the coin)	1	AO3 4.2.1.3

4.6.1.2 Properties of waves

Answer 121 · Mark scheme

June 2024 | 8463/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4			1	AO1 4.2.1.1

4.6.1.2 Properties of waves

Answer 121 · Mark scheme

June 2024 | 8463/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	R_{Total} = 400 + 80 (= 480 Ω)		1	AO2 4.2.1.3 4.2.2
	12 = I × 480 **or** $I = \frac{12}{480}$	allow a correct substitution / rearrangement with R_{Total} in range 470 - 490 Ω	1	
	I = 0.025 (A)	allow a correct calculation using R_{Total} in range 470 - 490 Ω	1	
	V = 0.025 × 80	allow a correct substitution using their calculated value of I (using $V = IR$) and R_{Th} in range 70 - 90 Ω	1	
	V = 2.0 (V)	allow a correct calculation using their calculated value of I (using $V = IR$) and R_{Th} in range 70 - 90 Ω	1	
	OR			
	total R = 400 + 80 (= 480) (1)			
	ratio (Th:R) = 80:480 (1)	allow a range of R_{Th} between 70 and 90 Ω		
	ratio = 1:6 (1)	allow a correct ratio using a value of R_{Th} between 70 and 90 Ω		
	$V = \frac{1}{6} \times 12$ (1)	allow a correct substitution using a value of R_{Th} between 70 and 90 Ω		
	V = 2.0 (V) (1)	allow an answer in the range 1.8 (V) to 2.2 (V)		

Total Question 5	13

4.6.1.2 Properties of waves

Answer 122 · Mark scheme

June 2024 | 8463/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	the height of the (column of) water above the submarine increases	allow volume / mass for height	1	AO1 4.5.5.1.2
	which increases the force / weight (of the water) acting on the submarine so pressure increases	allow $p = \rho gh$ and ρ and g remain constant so pressure increases	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	p = 110 000 000 Pa		1	AO2 4.5.5.1.2
	110 000 000 = 1026 × 9.8 × Δh	allow a correct substitution of an incorrectly / not converted value for p	1	
	$\Delta h = \frac{110\,000\,000}{1026 \times 9.8}$	allow a correct re-arrangement using an incorrectly / not converted value for p	1	
	Δh = 10 940 (m)	allow a correct calculation from using an incorrectly / not converted value for p allow 11 000 (m) if correct working shown	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	P-waves are longitudinal and S-waves are transverse		1	AO1 4.6.1.5

4.6.1.2 Properties of waves

Answer 122 · Mark scheme

June 2024 | 8463/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	D only P-waves can travel through liquids	 allow only P-waves can travel through the outer core allow S waves cannot travel through liquids allow S waves cannot travel through the outer core MP2 dependent on MP1	1 1	AO3 4.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	$4500 = 3.6 \times \lambda$ $\lambda = \frac{4500}{3.6}$ $\lambda = 1250$ (m)	allow a correct substitution of an incorrectly / not converted value for v allow a correct re-arrangement using an incorrectly / not converted value for v allow 1300 (m) only allow an answer consistent with a correctly converted value for v	1 1 1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	the distance is (directly) proportional to the time between the two waves arriving (at the seismometer)	allow they are (directly) proportional allow a greater distance means a greater time for **1** mark allow there is a positive correlation for **1** mark	2	AO3 4.5.6.1.2

Total Question 4	14

4.6.1.2 Properties of waves

Answer 123 · Mark scheme

June 2024 | 8463/2H | Original Q6

Question 6

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

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

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

4.6.1.2 Properties of waves

Answer 123 · Mark scheme

June 2024 | 8463/2H | Original Q6

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

Total Question 6	8

4.6.1.2 Properties of waves

Answer 124 · Mark scheme

June 2025 | 8463/2H | Original Q1

Question 1

Question	Answers	Mark	AO / Spec. Ref.
01.1	**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 124 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$330 = \frac{13\,200}{t}$ **or** $13\,200 = 330 \times t$ $t = \frac{13\,200}{330}$ 40 (s)		1 1 1	AO2 4.5.6.1.2

Total Question 1	10

4.6.1.2 Properties of waves

Answer 125 · Mark scheme

June 2025 | 8463/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	convex	allow converging	1	AO1 4.6.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(the parallel) rays converging rays meeting/crossing at the principal focus		1 1	AO2 4.6.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	0.60 μm = 0.6 × 10^{-6} m $3.0 \times 10^8 = f \times 0.6 \times 10^{-6}$ $f = \frac{3.0 \times 10^8}{0.6 \times 10^{-6}}$ $f = 5.0 \times 10^{14}$ (Hz)	allow 0.60 μm = 0.000 000 6 m all subsequent marks may be awarded if wavelength is incorrectly / not converted	1 1 1 1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	wavelength		1	AO1 4.8.2

Answer 125 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	distant galaxies are moving away from our galaxy		1	AO1 4.8.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	the distance to this galaxy is greater than any previously observed galaxies		1	AO3 4.8.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	a gravitational / centripetal / resultant force acts on the satellite		1	AO1 4.8.1.3
	(so) the satellite accelerates (towards the centre of the orbit)	do **not** accept acceleration causes a change in speed	1	
	(so) the direction changes (which changes the velocity)		1	

Total Question 4	**13**

GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics Specification B
3451/F

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

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

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4.6.1.2 Properties of waves

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4.6.1.2 Properties of waves

GCSE PHYSICS

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

3. Marking points

3.1 Marking of Quality of Written Communication

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

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

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

3.2 Marking of lists

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

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

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

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

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

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

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

3.3 Use of chemical symbols/formulae

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

3.4 The marking of quantitative relationships

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

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

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

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

3.5 Marking procedure for calculations

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

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

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

3.6 Interpretation of 'it'

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

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4.6.1.2 Properties of waves

3.7 Errors carried forward

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

Examples

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

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

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

3.8 Phonetic spelling

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

3.9 Brackets

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

3.10 Interpretation of marginal points

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

3.11 Unexpected Correct Answers not in the Mark Scheme

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

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4.6.1.2 Properties of waves

GCSE Physics
Foundation Tier 3451/F

3451F Q1

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

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4.6.1.2 Properties of waves

3451F Q2

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

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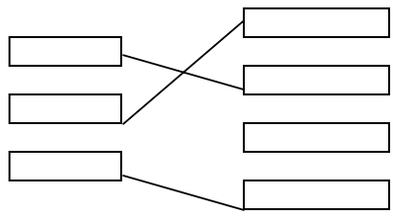
4.6.1.2 Properties of waves

3451F Q3

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

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4.6.1.2 Properties of waves

3451F Q4

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

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4.6.1.2 Properties of waves

3451F Q5

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

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4.6.1.2 Properties of waves

3451F Q6

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

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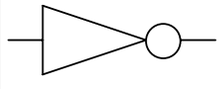
4.6.1.2 Properties of waves

3451F Q7

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

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4.6.1.2 Properties of waves

3451F Q8

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

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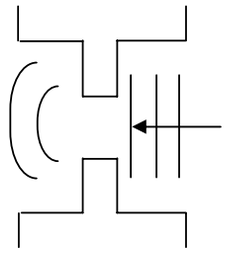
4.6.1.2 Properties of waves

3451F Q9

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

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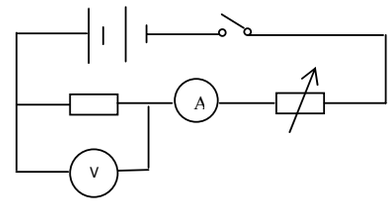
4.6.1.2 Properties of waves

3451F Q10

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

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4.6.1.2 Properties of waves

3451F Q11

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

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4.6.1.2 Properties of waves

3451F Q12

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

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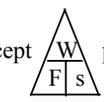
4.6.1.2 Properties of waves

3451F Q13

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

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4.6.1.2 Properties of waves

3451F Q14

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

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4.6.1.2 Properties of waves

3451F Q15

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

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4.6.1.2 Properties of waves

3451F Q16

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

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GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

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

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

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

Further copies of this Mark Scheme are available from:

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4.6.1.2 Properties of waves

SCIENCE: DOUBLE AWARD CO-ORDINATED

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

3. Marking points

3.1 Marking of Quality of Written Communication

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

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

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

3.2 Marking of lists

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

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

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

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

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

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

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

3.3 Use of chemical symbols/formulae

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

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- named units;
- physical quantities;
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3.6 Interpretation of 'it'

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

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4.6.1.2 Properties of waves

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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.

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

3.11 Unexpected Correct Answers not in the Mark Scheme

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

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4.6.1.2 Properties of waves

Double Award
Foundation Tier 3462/3F

3462/3F Q1

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

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4.6.1.2 Properties of waves

3462/3F Q2

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

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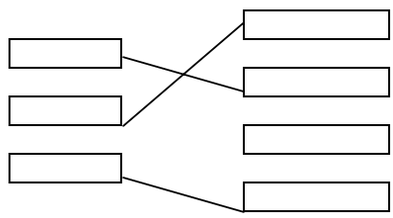
4.6.1.2 Properties of waves

3462/3F Q3

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

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4.6.1.2 Properties of waves

3462/3F Q4

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

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4.6.1.2 Properties of waves

3462/3F Q5

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

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4.6.1.2 Properties of waves

3462/3F Q6

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

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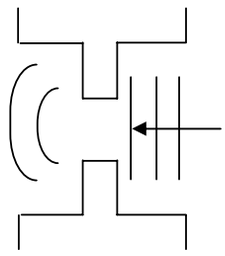
4.6.1.2 Properties of waves

3462/3F Q7

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

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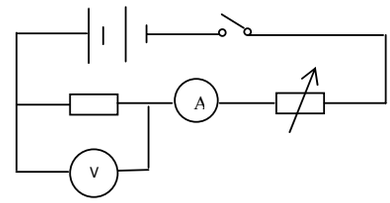
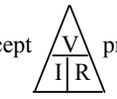
4.6.1.2 Properties of waves

3462/3F Q8

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

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4.6.1.2 Properties of waves

3462/3F Q9

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

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4.6.1.2 Properties of waves

3462/3F Q10

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

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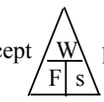
4.6.1.2 Properties of waves

3462/3F Q11

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

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4.6.1.2 Properties of waves

3462/3F Q12

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

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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

Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q4

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

3451/F Q5

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

4.6.1.2 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

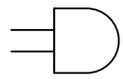
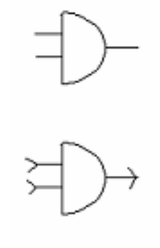
3451/F Q9

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…

4.6.1.2 Properties of waves

3451/F Q9 cont…

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

4.6.1.2 Properties of waves

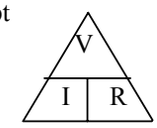
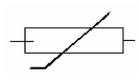
Physics B – AQA GCSE Mark Scheme, 2005 June series

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…

4.6.1.2 Properties of waves

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

Physics B – AQA GCSE Mark Scheme, 2005 June series

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

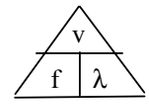
3451/F Q16

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.

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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

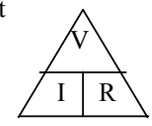
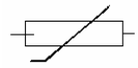
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

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…

4.6.1.2 Properties of waves

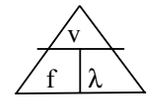
3462/3F Q12 cont…

(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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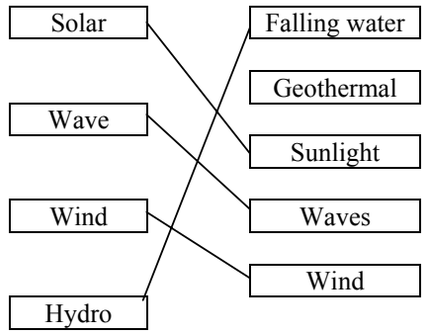
4.6.1.2 Properties of waves

Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

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

4.6.1.2 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

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

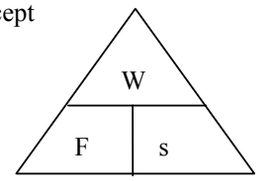
4.6.1.2 Properties of waves

Physics B – AQA GCSE Mark Scheme, 2006 June series

3451/F Q14

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

3451/F Q15

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

Continued

4.6.1.2 Properties of waves

Physics B – AQA GCSE Mark Scheme, 2006 June series

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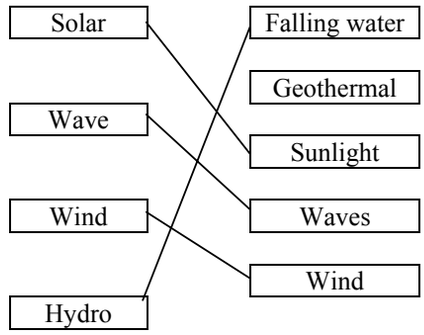
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

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

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

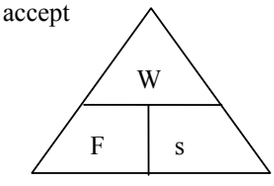
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

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 increases / is longer **or** thinking distance increases	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it increases	do **not** accept travels at constant speed for longer	1
(c)(i)	work done = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	2100	accept 2.1 kilo accept **1** mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

4.6.1.2 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

4.6.1.2 Properties of waves

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

4.6.1.2 Properties of waves

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

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PMT

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.1 Use of chemical symbols / formulae

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

3.2 Marking procedure for calculations

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

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

3.3 Interpretation of 'it'

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

3.4 Errors carried forward

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

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

3.5 Phonetic spelling

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

3.6 Brackets

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

3.2 Ignore / Insufficient / Do not allow

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

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

4. Quality of Communication and levels marking

In Question **2a** 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)	chemical kinetic sound	correct order only	1 1 1	AO1 P1.2.1a
1(b)	37.5% or 0.375	an answer rounded to 0.38 or 38% scores both marks an answer of 0.375 with a unit gains **1** mark an answer of 0.375% gains **1** mark an answer of 37.5 with or without a unit gains **1** mark allow **1** mark for an answer 3/8 3/8 with a unit scores 0	2	AO2 P1.2.1d
Total			**5**	

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

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

examples of physics points made in the response	extra information
examples of relevant statements • energy efficient boiler saves the most (energy / money) per year • loft insulation costs the least to install • double-glazing costs the most to install **examples of statements that include cost effectiveness** • loft insulation is the most cost effective in the long term • double-glazing is the least cost effective • loft insulation has the shortest payback time • double-glazing has the longest payback time • payback time calculated for any method **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	payback times: energy efficient boiler: 6.25 years loft insulation: 2 years double glazing: 100 years cavity wall insulation: 2.86 years

Question 2 continued . . .

Question	Answers	Extra information	Mark	AO / Spec. ref.
2(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
2(b)(ii)	(the U-value) decreases		1	AO1 P1.1.4b
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. ref.
3(a)(i)	0.5 °C		1	AO3 P1.1
3(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
3(b)(i)	20.5 (°C)		1	AO2 P1.1
3(b)(ii)	60 (minutes)	accept 1 hour	1	AO2 P1.1
3(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

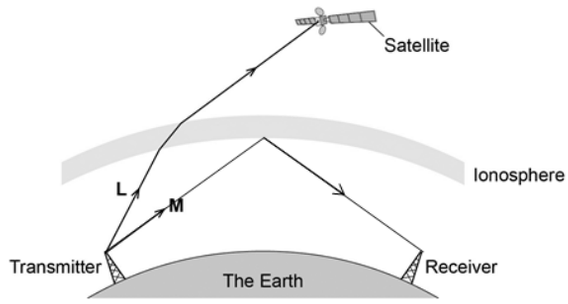
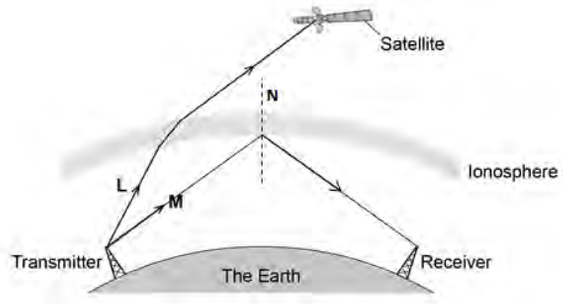
Question 3 continues on the next page . . .

PMT

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec. ref.
3(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
3(c)(iii)	heating is on for more / less time (than anticipated) because some days it is cooler / warmer (than anticipated)	 accept other sensible suggestions an answer giving two sensible situations gains **2** marks possible examples: • some houses have different amounts of insulation • there are different styles of house temperature (inside / outside) is always changing is insufficient	1 1	AO3 P1.1
Total			**9**	

4.6.1.2 Properties of waves

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(a)(i)	microwave		1	AO1 P1.5.1k
4(a)(ii)	refraction		1	AO1 P1.5.1g
4(b)(i)	wave M continues as a straight line to the ionosphere and shown reflected correctly reflected wave shown as a straight line reaching the top of the receiver  	accept reflection at or within the ionosphere if more than 2 rays shown 1 mark maximum ignore arrows	1 1	AO2 P1.5.2b
4(b)(ii)	normal drawn at point where their **M** meets the ionosphere  		1	AO1 P1.5.2a

Question 4 continues on the next page. . .

Question 4 continued…

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(c)	any **two** from: • transverse • same speed (through air) • can be reflected • can be refracted • can be diffracted • can be absorbed • transfer energy • can travel through a vacuum • can be polarised • show interference	 accept speed of light **or** 3×10^8 m/s an answer travel at the same speed though a vacuum scores **2** marks travel in straight lines is insufficient	2	AO1 P1.5.1a,bc, d,g
Total			**7**	

Question	Answers	Extra information	Mark	AO / Spec. ref.
5(a)(i)	infrared (radiation)	accept IR (radiation)	1	AO1 P1.1.1b
5(a)(ii)	(heated) water turns to steam steam turns a turbine turbine turns a generator	ignore reference to fossil fuels do **not** accept water evaporates to steam accept turbine connected to a generator	1 1 1	AO1 P1.4.1a
5(b)(i)	(so the molten salts) can store large amounts of energy	accept there is a small temperature change for a large energy transfer accept heat for energy	1	AO2 P1.1.4d
5(b)(ii)	16 (hours)	an answer that rounds to 16 gains **2** marks eg 15.71 allow **1** mark for a correct substitution ie 2 200 000 = 140 000 x t	3	AO2 AO1 P1.3.1c
5(b)(iii)	the number of daylight hours varies the (mean) power (received from the Sun per square metre) varies	less sunlight is insufficient accept an answer in terms of maximum possible electrical output only possible during Summer for **1** mark	1 1	AO2 AO3 P1.4

Question 5 continues on the next page . . .

4.6.1.2 Properties of waves

Question 5 continued . . .

Question	Answers	Extra information	Mark	AO / Spec. ref.
5(c)(i)	non-renewable power stations have higher Capacity Factors than renewable power stations		1	AO1 AO3 P1.4
	fuel (for non-renewable power stations) is always available	reference to non-renewable power stations operating all the time is insufficient non-renewable energy sources are reliable is insufficient	1	
	(most) renewable energy sources are unpredictable / unreliable	accept (most) renewable energy sources depend on the weather	1	
5(c)(ii)	the (proportion of) time that solar storage power stations can generate electricity is greater (than for other renewable energy sources)		1	AO1 P1.4
Total			**14**	

4.6.1.2 Properties of waves

Question	Answers	Extra information	Mark	AO/Spec ref.
6(a)	Doppler (effect)		1	AO1 P1.5.4a
6(b)	(reflected microwaves) wavelength decreased (reflected microwaves) frequency increased (reflected microwaves) have same speed		1 1 1	AO1 P1.5.4a P1.5.1d
Total			4	

Question	Answers	Extra information	Mark	AO / Spec. ref.
7(a)	4200	allow **2** marks for correct substitution ie 6930 = 0.330 x c x 5.0 answers of 1050 **or** 840 **or** correctly calculated answer from correct substitution of incorrect temperature change **or** identification of temperature change ie 5 ˚C gain **1** mark	3	AO2 AO1 P1.1.4d
	J/kg˚C	accept J/kg K	1	
7(b)	(in a metal) free electrons	to gain full credit the answer must be in terms of free electrons	1	AO1 P1.1.3a
	gain kinetic energy	accept move faster	1	
	(free electrons) transfer energy to other electrons / ions / atoms	do **not** accept particles	1	
	by collision		1	
		allow a maximum of **2** marks for answers in terms of atoms / ions / particles • gaining kinetic energy or vibrating faster / more • transferring energy by collisions		
7(c)	(air) particles spread out		1	AO1 P1.1.3a
	(which causes the) air to become less dense / expand	do **not** accept particles become less dense	1	
	(so the) warm air rises	do **not** accept heat rises particles rise is insufficient	1	
7(d)	large surface area	ignore references to type of metal or external conditions	1	AO1 P1.1.3c
	black / dark (colour)		1	
Total			**13**	

4.6.1.2 Properties of waves

AQA

GCSE

Science A / Physics

PH1HP

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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PMT

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

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 **2(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

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	frequency		1	AO1 1.5.3b
1(b)	echo(es)		1	AO1 1.5.3c
1(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
1(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
1(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.
2(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 2 continues on the next page . . .

4.6.1.2 Properties of waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

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

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	**use of infrared:** remote controls fibre optic (communications) **use of microwaves:** mobile/cell phones satellite (communications/TV) wi-fi Bluetooth	 accept mobiles accept phone signals	1 1	AO1 1.5.1k
4(a)(ii)	any **two** from • same speed **or** travel at the speed of light (in a vacuum) • transverse • transfer energy (from one place to another) • can be reflected • can be refracted • can be diffracted • can be absorbed / transmitted • can travel through a vacuum/space • can be polarised	 accept a full description of a transverse wave travels in straight lines is insufficient	2	AO1 1.5.1c 1.5.1d 1.5.1e 1.5.1g
4(b)(i)	Cosmic Microwave Background (Radiation)	accept CMBR	1	AO1 1.5.4d
4(b)(ii)	 the Big Bang (theory) predicted the existence of CMBR **or** only the Big Bang (theory) supports the existence of CMBR	allow microwave radiation for CMBR throughout allow it supports / proves the Big Bang (theory) accept CMBR disproved other theories, eg steady state	 1	AO1 1.5.4e
Total			**6**	

4.6.1.2 Properties of waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	no particles (in a vacuum) (so) no / reduced conduction and no / reduced convection	 both energy transfer methods needed for the mark	1 1	AO1 1.1.3a
5(b)(i)	78 (°C)	allow **2** marks for correct temperature change ie 22 ˚C allow **1** mark for correct substitution ie 46 200 = 0.5 x 4200 x θ **or** $\frac{46200}{0.5\times4200}=\theta$	3	AO2 1.1.4d
5(b)(ii)	6.4 (W)	allow **2** marks for an answer that rounds to 6.4 allow **1** mark for correct substitution ie 46 200 = P x 7200 an answer of 23 000 or 23 100 or 385 gains 1 mark	2	AO2 1.3.1c
Total			**7**	

4.6.1.2 Properties of waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	any **two** from: • cost per kWh is lower (than all other energy resources) • infrastructure for nuclear power already exists • more reliable (than renewable energy resources)	allow it is cheaper ignore fuel cost ignore energy released per kg of nuclear fuel accept cost of setting up renewable energy resources is high accept many renewable power stations would be needed to replace one nuclear power station accept (France in 2011 already had a) surplus of nuclear energy, so less need to develop more renewable capacity for increased demand in the future accept France benefits economically from selling electricity accept (nuclear) fuel is readily available ignore destruction of habitats for renewables	2	AO1 AO2 1.4
6(b)	any **two** from: • non-renewable • high decommissioning costs • produces radioactive / nuclear waste • long start-up time • nuclear accidents have widespread implications	allow nuclear fuel is running out accept high commissioning costs allow waste has a long half-life allow for nuclear accident a named nuclear accident eg Fukushima, Chernobyl ignore visual pollution	2	AO1 1.4.1f

Question 6 continues on the next page . . .

4.6.1.2 Properties of waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(c)	0.48 (kW)	allow **1** mark for correct substitution ie 0.15 = P / 3.2 an answer of 480 W gains **2** marks an answer of 48 or 480 scores **1** mark	2	AO2 1.2.1d
6(d)	the higher the efficiency, the higher the cost (per m^2 to manufacture)	accept a specific numerical example	1	AO2 AO3 1.4.1c
	more electricity could be generated for the same (manufacturing) cost using lower efficiency solar panels **or** (reducing the cost) allows more solar panels to be bought	accept a specific numerical example	1	
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	surface area **or** duration of experiment	accept shape of beaker size of beaker is insufficient	1	AO3 1.1.3b
7(b)	any **two** from: • takes readings automatically • takes readings more frequently • reduces / no instrument reading error • higher resolution • don't need to remove probe to take reading • more accurate	ignore easier **or** takes readings for you ignore human error allow better resolution	2	AO3 1.1.3
7(c)(i)	0.07 (°C/s)	allow **1** mark for obtaining a temperature drop of 7(ºC) allow **1** mark for an answer between 0.068 and 0.069 (°C/s)	2	AO2 1.1.3d
7(c)(ii)	rate of temperature change is greater at the start **or** rate of temperature change decreases	accept rate of evaporation is greater at the start allow rate of evaporation decreases allow temperature decreases faster at the start	1	AO3 1.1.3b

Question 7 continues on the next page . . .

4.6.1.2 Properties of waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(c)(iii)	A lower temperature decrease (over 200 seconds)	reason only scores if A is chosen accept lower gradient	 1	AO3 1.1.3b
7(c)(iv)	no effect (as rate of evaporation is unchanged)	allow larger temperature change (per second as mass of liquid is lower)	1	AO3 1.1.3b
7(d)	particles with more energy leave the (surface of the) liquid (which) reduces the average (kinetic) energy (of the remaining particles)	accept particles with higher speeds allow reference to the total energy of the liquid reducing	1 1 1	AO1 1.1.3b
Total			**11**	

4.6.1.2 Properties of waves

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	any **two** factors: • surface area (of mug in contact with cup warmer) • thickness of mug • temperature of heater / coffee • power of the heater	 accept temperature difference (between heater and coffee) accept power of the laptop ignore efficiency of the heater	2	AO3 1.1.3c
8(b)	atoms (gain kinetic energy and) vibrate faster / more energy is passed on from atom to atom by collision	allow particles / molecules for atoms allow bigger / faster vibrations do not accept start to vibrate accept vibrations for energy an answer in terms of free electrons scores zero	1 1	AO1 1.1.3a
8(c)	the particles spread out (so) coffee becomes less dense (so) the heated coffee rises (and) cooler / denser coffee falls	allow fluid / liquid / water for coffee throughout answer allow particles move further apart allow (coffee) expands particles rise is insufficient particles fall is insufficient	1 1 1 1	AO1 1.1.3a
Total			**8**	

4.6.1.2 Properties of waves

Answer 106 · Examiner comments

June 2018 | 8463/2H | Original Q3

Question 3 (Standard demand)

03.1 Just over 50% of the students scored this mark

03.2 Only 30% of students were able to use the information in Figure 3 to calculate the frequency of the wave.

03.3 Just over 75% of the students were able to write the correct equation.

03.4 Nearly 70% of the students who could recall the equation calculated the wavelength correctly.

03.5 This is a topic new to this specification. 19% of the students knew that S-waves do not travel through a liquid and could relate this to the Earth having a liquid (outer) core.

03.6 23% of the students scored the mark, generally for simply stating ‘generator effect’.

Answer 106 · Examiner comments

June 2018 | 8463/2H | Original Q3

03.7 37% of students realised that this was to do with the movement of the magnet.

03.8 This was well answered with just over 76% of students choosing the correct answer.

03.9 Just over half of the students scored zero. Answers such as ‘bigger magnet’ or ‘more coils’ were too vague to gain credit.

4.6.1.2 Properties of waves

Answer 107 · Examiner comments June 2018 | 8463/2H | Original Q9

Question 9 (Standard/high and High demand)

09.1 Nearly 80% of the students chose the correct description for a model.

09.2 This part was not answered well. Some students appeared to answer the question 'why do scientists use models?'.

09.3 Most students scored either one or two marks. The idea of new evidence or data was often expressed although not always very clearly. When giving an example many students did describe a model and what replaced it but a significant number only mentioned one of the models.

09.4 Nearly 80% of the students scored zero on this question. Some students were aware that the waves changed speed but did not state what the change was. There were many answers in terms of the refraction of light at a boundary and references to water having different density depending on its depth.

09.5 80% of students scored zero. Many answers were simply descriptions of Figure 17.
A common error was to state that the wavefronts did not cross the boundary.

Answer 109 · Examiner comments June 2019 | 8463/2H | Original Q2

Question 2 (Standard demand)

02.1 Most of the students did suggest using a piece of apparatus that was, recognisably, one that could be thought of as having been designed to measure a length. Many, however, failed to describe it with sufficient clarity to be given the mark. The most common answers that did not gain a mark were 'ruler' and 'metre stick'. A minority of the students opted for pieces of equipment from Figure 4, such as 'signal generator'. Only 57% of the students gave a correct answer.

02.2 Just over 81% of the students knew this equation.

4.6.1.2 Properties of waves

Answer 109 · Examiner comments June 2019 | 8463/2H | Original Q2

02.3 Some students failed to convert 80 cm to 0.8 m but they were usually able to substitute values into the correct equation and calculate the answer. There were a number of students who used 50 Hz in their calculation despite 55 Hz appearing in the stem of this part question and in Figure 4. There were only a few answers that involved the use of an incorrect value for wavelength.

02.4 Nearly 80% of the students scored at least one mark with half of these scoring both marks. Moving the bridge was a more popular correct answer than changing mass. Some students gave both movement of the bridge and changing the mass but contradicted themselves by, for example, moving the bridge to the right and decreasing mass. References to shortening the string suggested that the students understood what was required but did not describe how to adjust the apparatus to change the length. Similarly, some answers mentioned changing tension but gave no indication of how this could be achieved.

02.5 The majority of the students were able to describe how to vary the tension in the string by changing the masses. Most were able to continue to describe measuring the wavelength and some then described how to calculate wave speed. The aspect that was missing, from all but a few of the answers, was a description of how to obtain a new wave pattern on the string, by moving the bridge or adjusting the frequency.

Answer 110 · Examiner comments June 2019 | 8463/2H | Original Q5

Question 5 (Standard and standard/high demand)

05.1 Half of the students were able to answer this correctly. Distance, amount, speed and frequency were common incorrect answers.

05.2 Around 18% of the students scored this mark. The life cycle of stars was often confused with the Big Bang theory. Other incorrect answers gave one but not both of the required pieces of information, usually the ‘dense’ idea which was sometimes linked to small, but rarely the ‘hot’ idea.

05.3 ‘Further away is faster’ was a common incomplete answer; a large number of correct responses had directly proportional rather than just proportional. If this phrase were not used, very few could describe directly proportional correctly. A significant number of responses just said positive correlation or linear relationships. 36% of the students scored this mark.

05.4 Approximately 47% of the students scored this mark.

4.6.1.2 Properties of waves

Answer 110 · Examiner comments June 2019 | 8463/2H | Original Q5

05.5 This was not well answered; there seemed to be a lot of confusion over the graph, with some students appearing to be under the impression that it charted the speed of one particular galaxy over time as it moved away from its original location at the position of the Earth. The response 'directly proportional' required for **05.3** occurred frequently.

05.6 Many answers had 'expanding' but very few qualified this with 'faster' or 'at an increasing rate'. Quite a number of answers wrote about gravity getting less or running out. A fifth of the students scored this mark.

05.7 The reason for peer review was understood with around 72% of the students scoring this mark. Correct answers mainly addressed the bias and finding mistakes ideas. Incorrect responses included comments about proving the theory and there were vague statements about accuracy, repeatability and reliability.

05.8 Nearly half of the students scored both marks. Where students did not score both marks, it was often because they had not appreciated that the speed of light would be the same so if one factor increased, the other decreased. The inability to express answers coherently was evident in responses that referred to longer frequency or faster frequency or compressed waves.

Answer 111 · Examiner comments November 2020 | 8463/1H | Original Q9

Question 9 (High demand)

09.1 53% of students scored 5 marks on this multi-step calculation. Lower-scoring students didn't score marks for stating and trying to use incorrect physics equations or rearranging correct equations incorrectly. The main reasons for not scoring full marks included: knowing one form of an equation correctly, but re-arranging it incorrectly, eg stating $P = I\,V$ then re-arranging it to $I = V/P$, mixing up two half-known equations eg $P = I^2\,V$, not realising that the 5 marks for this question warranted more than using one basic equation, eg stating $R = V/I$ and substituting the given value of power for I.

09.2 Students often didn't score the third mark because of their technical inaccuracies referring to potential difference of the live wire or the electrician instead of potential. Many students mixed up quantities like potential difference with current and charge in confused answers. The question discriminated well between students with 15% of students scoring 3 marks, 15% of students scoring 2 marks and 35% of students scoring 1 mark.

09.3 18% of students scored 2 marks, while 44% of students scored 1 mark. A good proportion of students appeared to understand what the graph was showing, but often had difficulty in expressing their ideas clearly. A number of students thought that a higher current would be a disadvantage, so stated either that the current was lower at frequencies other than 50Hz, or 're-wrote' the question to answer why 50Hz was the safest frequency. Simply reading off values from the graph was insufficient without an explanation of what the implications were.

4.6.1.2 Properties of waves

Answer 112 · Examiner comments — November 2020 | 8463/2H | Original Q2

Question 2 (Standard demand)

02.1 The most common error was to give ‘fission’ as the answer in the second space.

02.2 Just under 70% of students were able to recall this equation.

02.3 This calculation was generally well done. There were errors made with the standard form and in the rearranging of the equation.

02.4 The lifecycle of stars was well known. However many students limited the mark they scored by not giving any relevant detail beyond the stages the star goes through.

02.5 About 50% of students correctly identified the property of the star.

Answer 113 · Examiner comments — November 2020 | 8463/2H | Original Q3

Question 3 (Standard demand)

03.1 Slightly over 78% of students missed the point of the question, that with a wider ray it would be more difficult to determine the centre of the ray. Many of the students simply repeated, albeit in slightly different words the stem of the question.

03.2 Those students scoring zero generally either failed to draw a line of best fit or failed to extrapolate it. This then gave an answer outside of the permitted range. 30% of students scored both marks.

03.3 There were few complete answers given. Some of the students gave a good practical description but failed to finish the description by including obtaining the range of results given in the table. A small minority of the students described an investigation into reflection rather than refraction

03.4 Just over 55% of students were able to estimate the uncertainty.

03.5 61% of students identified the property of the light wave.

4.6.1.2 Properties of waves

Answer 114 · Examiner comments November 2020 | 8463/2H | Original Q6

Question 6 (Standard and standard/high and high demand)

06.1 The majority of the students were able to convert MHz to Hz correctly. A large number of the students did not know the unit of wavelength with the symbol 'λ' being a common incorrect answer.

06.2 Only 3% of students were able to write a complete answer to this question. Many of the students described the final movement of the car rather than what happens in the electrical circuit. A significant number of the students thought that absorbing radio waves would result in sound being produced. Some of the students realised that there would be a current in the aerial but used terms such as 'produce a current' and 'produce an electrical signal' which were insufficient for credit to be awarded.

06.3 The most frequent correct answer was to state that radio waves are transverse and sound waves are longitudinal. Another popular correct answer was the idea of radio waves being able to travel through a vacuum / space. Comparisons of wavelength / frequency did not gain any marks due to the overlapping range of wavelength and frequency of radio waves and sound waves.

06.4 83% of students correctly described the motion of the car during the first 30 seconds.

06.5 The majority of the students knew how to calculate velocity from a straight line graph but failed to realise the significance of the curved line. Those few students that drew an appropriate tangent to the line at 20s generally went on to score all four marks.

06.6 Whilst 25% of the students gained all six marks for this calculation, a significant number of the remaining students gained partial credit for clearly showing the working out, part of which was correct.

06.7 There were very few complete and correct answers to this question. A significant number of the students correctly referred to air resistance increasing with speed but then went on to state that air resistance becomes equal to speed. It was common for answers to be in terms of real cars, the effect of speed on braking distances or the likely increase in accidents.

Answer 115 · Examiner comments November 2021 | 8463/2H | Original Q3

Question 3

This question was poorly answered. Few of the students knew which forces act during the main sequence stage or what happens to a star after the main sequence ends. To gain full marks it was not sufficient to simply state the names of the subsequent stages correctly. A significant number of the students gave answers that referred to both stars of the same size and mass of the Sun (the required answer) and to stars much larger than the Sun. These answers scored no marks as the

4.6.1.2 Properties of waves

Answer 115 · Examiner comments November 2021 | 8463/2H | Original Q3

students had produced a list without indicating which of the options presented was correct. In part **03.3** the correct choice (option A) needed to be accompanied by a comparative reason to score both marks. Simply stating something like 'it has a low speed' was insufficient.

Answer 116 · Examiner comments November 2021 | 8463/2H | Original Q5

Question 5
Although a number of correct uses were given for ultraviolet a number of the students appeared to confuse UV with ultrasound. The meaning of the prefix 'nano' was not well known. However the students that knew the correct equation for part **05.3** (about 35% did not) did go on to use the value chosen in **05.2** to calculate a correct answer. Only about half of the students could use the data presented in Table 1 to correctly answer part **05.4.** Most of the students scored no marks for part **05.5**, with many either simply giving an example of each type of wave, or failing to link the direction of oscillation to either direction of energy transfer or direction of wave travel.

Answer 117 · Examiner comments November 2021 | 8463/2H | Original Q6

Question 6
Although it was frequently seen, an answer only in terms of removing anomalous results was insufficient. The reason being that the question asked not only the advantage of repeating but also taking a mean. Very few of the students gave a precise answer in terms of reducing the effect of random errors. The calculation produced a full range of marks with most of the students scoring 2 or less. For part **06.3** there were a number of very good answers covering all three marking points. However, most of the students failed to answer the question asked as they simply described a way that the teacher could have measured the wavelength.

Answer 118 · Examiner comments November 2021 | 8463/2H | Original Q8

Question 8
Very few of the students had any idea how a moving-coil loudspeaker works to produce a sound. Generally answers were partially explaining how electric motors, generators or microphones worked. In part **08.3** few of the students scored both marks with 60% scoring no marks. The most frequently seen incorrect answers were to do with lack of data, no repeats or loudness being in arbitrary units.

4.6.1.2 Properties of waves

Answer 119 · Examiner comments — June 2023 | 8463/2H | Original Q4

04.1

31% of students gained this mark. Many students responded with a selection of random Physics terms.

04.2

74% of students recognised the direction of the magnetic field.

Answer 119 · Examiner comments — June 2023 | 8463/2H | Original Q4

04.3

51% of students knew what an induced magnet is. Responses sometimes confused magnets and magnetic materials. Most correct answers were to do with placing a material into a field to become a magnet, compared with removing the material from the field.

04.4

88% of students knew that it is the motor effect that causes the coil to move..

04.5

46% of students scored all 4 marks for this calculation. There were a wide variety of incorrect conversions of mA, which gained 3 out of the 4 marks.

04.6

Most students were able to make generic statements about how age and environment affect hearing. 35% of students were able to use the data in the graph to support their statements. Some responses just gave information about person A, B and C, without any comparisons. Students did not use the patterns in the graph to back up conclusions. There was some confusion over sensitivity, and a number tried to explain the variables to the extent that the response became incorrect. Examples of this included saying that a higher minimum sound level shows better hearing.
A proportion of the responses mentioned ideas about being "used to a loud sound" so "could hear loud sounds better" and younger people not having had the experience of a full range of frequencies due to their age. Alternatively, the idea that being in a quiet environment means you can only hear quiet sounds was another misunderstanding which was often seen.

4.6.1.2 Properties of waves

Answer 120 · Examiner comments June 2023 | 8463/2H | Original Q6

06.1

88% of students scored this mark. The vast majority of responses seen said ‘satellite’, with a small number giving the alternative ‘moon’.

06.2

61% of students were able to achieve full marks for this calculation. Those that did not, didn't convert the wavelength into metres, or converted incorrectly. Most students were able to give their answer in standard form.

06.3

Many students only scored the compensation mark and it was rare to see answers where acceleration towards Earth was included. Few students linked a change in direction to a change in velocity, with some describing the converse.

06.4

6% of students gained full marks for this explanation. students scored a mark for the 2nd or 3rd marking point, and it was unusual to have to consider the award of the compensation mark. A significant number of students thought that galaxies A and B were emitting radiation with a greater wavelength than that emitted by the Sun.

Answer 121 · Examiner comments June 2024 | 8463/1H | Original Q5

Question 5 (Standard/High Demand)

05.1 72% of students scored 2 marks, while 15% of students scored 1 mark. A number of students thought mains p.d. was 240 V. It was officially changed to 230 V in 1987 and this is the value given in the specification. However, it was more common for students to get the p.d. correct and the frequency incorrect.

05.2 A grade 6-7 calculation of resistance, which discriminated well between students. The conversion of milliwatts to watts proved a problem for the vast majority of students. 53% scored all 4 marks, while 36% scored 3 marks.

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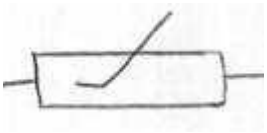
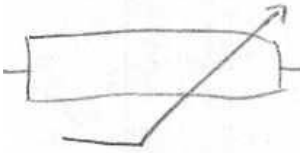
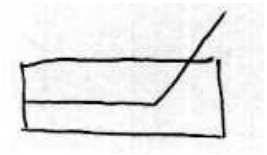
4.6.1.2 Properties of waves

Answer 121 · Examiner comments June 2024 | 8463/1H | Original Q5

05.3 64% of students scored a mark for suggesting why dirty coins are not recognised by the machine. Answers which were insufficient, but ignored, included 'Can't measure resistance' and 'Dirt is an insulator'..

05.4 63% of students scored a mark for drawing the thermistor symbol. Answers that were not acceptable included the following examples.

05.5 This grade 8-9 calculation, worth 5 marks, question discriminated well between students of different abilities. If a student did not calculate the total resistance and then use that value to calculate the current in the circuit, then they didn't score the first 3 marks. If a student calculated the current in the circuit using just the 400 Ω resistor, then they could use that value to score the 4th and 5th marks for the calculation of the p.d. across the thermistor, using $V = IR$.
Answers with a p.d. greater 12 V usually scored zero marks, due to fundamental Physics errors.
18% of students scored 5 marks, while 31% of students scored 2 marks. 46% of students scored 0 marks. In this exam series all equations were provided for the students on the Physics Equations Sheet.

4.6.1.2 Properties of waves

Answer 122 · Examiner comments June 2024 | 8463/2H | Original Q4

04.1
This question asked students to explain the effect of increasing depth on the pressure on a submarine. A common error was repeating the question stem “as depth increases” rather than referring to increasing height (volume or mass) of water above the submarine.

04.2
Quite a well answered question with over 72% of students gaining all 4 marks for calculating the depth of the Mariana Trench. Another 20% did not convert the pressure, or converted incorrectly.

04.3
75% of students knew what types of waves P and S-waves are.

04.4
68% of students selected the position where only P-waves are detected following an earthquake. However, the reasons often referred to “it was in a straight line” or “it was below the earthquake”. A number of students just referred to the core without specifying the inner or outer core. Others confused which layers are liquid and which are solid, even though this information was given in the diagram.

04.5
95% of students gained at least 2 marks in this calculation of wavelength. Converting was sometimes unclear, often being done at the end rather than the beginning of the working, preventing students gaining all 3 marks. .

04.6
This question was about the relationship between the distance an earthquake is from a seismometer, and the time difference between P and S-waves arriving at it. 15% of students gained both marks and 30% gained 1 mark. Those who didn’t score had misunderstood the question stem. A small number had identified that greater distance meant a greater time difference, but then called this inversely proportional.

4.6.1.2 Properties of waves

Answer 123 · Examiner comments June 2024 | 8463/2H | Original Q6

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

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

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

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

Answer 124 · Examiner comments June 2025 | 8463/2H | Original Q1

1.1

Almost all responses gained marks, with the majority being awarded 2 or 3 marks.

The most common differences were for a comparison of speed, transverse and longitudinal, and whether each type of wave could travel through a vacuum.

Students struggled giving a completely correct definition of transverse and longitudinal, but this wasn't needed if they had already stated whether each was transverse or longitudinal. Some did get these the wrong way round, but they knew the terms.

A few quoted the speeds of each type of wave correctly. Again, this wasn't required if they had given the correct comparison of speed.

Whilst a lot of students knew that light was an electromagnetic wave, very few knew that sound was mechanical. Stating that sound is not an electromagnetic wave or that light is was enough to be counted as a comparison.

Approximately 50 % of the students scored 3 marks or less because they did not identify any similarity and so gave a level 1 response, regardless of giving many differences.

4.6.1.2 Properties of waves

Answer 124 · Examiner comments June 2025 | 8463/2H | Original Q1

The most common similarity given was that both transferred energy; however some students did include the extra similarities of both waves being reflected, refracted, transmitted and absorbed.
Simply stating that light can be seen and sound heard was insufficient.
A number of responses included other information about how each type of wave was detected and how each could be used medically, which was not the focus of the question.

1.2

Almost all of the students identified the correct equation linking distance, speed and time.

1.3

A straightforward substitution, rearrangement and evaluation to calculate the time was completed successfully by almost all of the students. A few examples of incorrect rearrangement resulted in an answer of 0.025. Many students adopted good practice and showed both the substitution and rearrangement stages.

Answer 125 · Examiner comments June 2025 | 8463/2H | Original Q4

4.1

This question was answered well. The majority of the students correctly stated 'convex' as the type of lens. 'Converging' was occasionally used.

4.2

4.6.1.2 Properties of waves

Answer 125 · Examiner comments June 2025 | 8463/2H | Original Q4

Almost three quarters of the students scored both marks for completing the ray diagram. However a significant number of the others tried adding objects, images or additional incorrect lines.

4.3

Approximately half of the students failed to convert the wavelength correctly. Some of the students struggled with the rearrangement, but there were also numerous examples of mathematical errors for example 3.0/0.6 = 0.5 or 3.0/6.0 = 5. There was also a notable lack of understanding regarding the use of standard form. Students also need to understand that answers given in standard form are perfectly acceptable.

4.4

Only just over half of the students knew that when radiation is red-shifted there is an increase in wavelength. Incorrect answers such as 'frequency' and 'wave speed' were commonly seen.

4.5

Over 93 % of students knew why radiation from distant galaxies is red-shifted.

4.6

This question tested awareness of what red-shift tells us. Just fewer than 60% of the students gained this mark. Many of the students knew how red-shift related to speed but not the relationship between greatest red-shift and greatest distance away.

4.7

The James Webb Telescope orbits the Sun and those students who read the question carefully answered in terms of the Sun, but sometimes focussed on the different speeds at different points of an elliptical orbit. The majority of the students did not understand the Physics of circular orbits but were able to state that to stay in a circle the direction had to be constantly changing.