AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.1.3

Reflection of waves (physics only)

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**18**
Available paper years	**2007–2025**

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.

4.6.1.3 Reflection of waves (physics only)

Answer 01 · Mark scheme

January 2007 | PHY1F | Original Q1 | Legacy

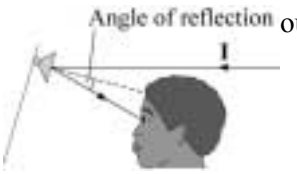
Question 1

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

4.6.1.3 Reflection of waves (physics only)

Answer 02 · Mark scheme

Question 2

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

4.6.1.3 Reflection of waves (physics only)

Answer 02 · Mark scheme January 2008 | PHY3F | Original Q2 | Legacy

PHY3F

Answer 03 · Mark scheme January 2008 | PHY3F | Original Q9 | Legacy

The full source mark scheme begins on page 29. Follow original question 9 in that document.

4.6.1.3 Reflection of waves (physics only)

Question 2

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

4.6.1.3 Reflection of waves (physics only)

Answer 04 · Mark scheme

January 2009 | PHY1F | Original Q2 | Legacy

PHY1F

4.6.1.3 Reflection of waves (physics only)

Answer 05 · Mark scheme

Question 6

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

Question 6 continues on the next page . . .

PHY1F

Question 6 continued . . .

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

4.6.1.3 Reflection of waves (physics only)

Answer 05 · Mark scheme January 2011 | PHY1F | Original Q6 | Legacy

PHY1F

Answer 06 · Mark scheme March 2011 | PHY1BP | Original Q2 | Legacy

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

Answer 07 · Mark scheme March 2011 | PHY1BP | Original Q8 | Legacy

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

4.6.1.3 Reflection of waves (physics only)

Answer 08 · Mark scheme

January 2013 | PH1FP | Original Q4 | Legacy

Question 4

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

4.6.1.3 Reflection of waves (physics only)

Answer 08 · Mark scheme January 2013 | PH1FP | Original Q4 | Legacy

PH1FP

Answer 09 · Mark scheme June 2015 | PH1FP | Original Q1 | Legacy

The full source mark scheme begins on page 39. Follow original question 1 in that document.

Answer 10 · Mark scheme June 2016 | PH1FP | Original Q6 | Legacy

The full source mark scheme begins on page 55. Follow original question 6 in that document.

4.6.1.3 Reflection of waves (physics only)

Answer 11 · Mark scheme

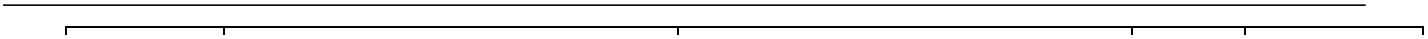
June 2017 | PH1FP | Original Q3 | Legacy

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

4.6.1.3 Reflection of waves (physics only)

Answer 11 · Mark scheme

June 2017 | PH1FP | Original Q3 | Legacy



4.6.1.3 Reflection of waves (physics only)

Answer 12 · Mark scheme June 2017 | PH1FP | Original Q6 | Legacy

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

4.6.1.3 Reflection of waves (physics only)

Answer 12 · Mark scheme

June 2017 | PH1FP | Original Q6 | Legacy



4.6.1.3 Reflection of waves (physics only)

Answer 13 · Mark scheme June 2017 | PH1FP | Original Q8 | Legacy

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

4.6.1.3 Reflection of waves (physics only)

Answer 13 · Mark scheme

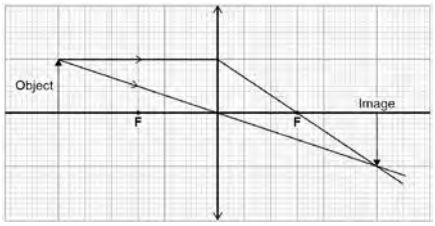
June 2017 | PH1FP | Original Q8 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.

4.6.1.3 Reflection of waves (physics only)

Answer 14 · Mark scheme

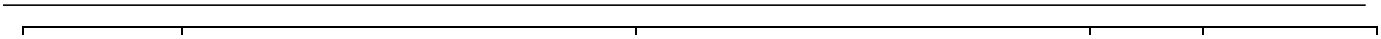
June 2017 | PH3FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	refraction		1	AO1 3.1.3b
5(a)(ii)	real		1	AO1 3.1.3d
5(a)(iii)	1.5	allow **1** mark for correct substitution ie 3/2 provided no subsequent step	2	AO2 3.1.3i
5(b)(i)	**1** mark for each correct ray drawn • straight line through the centre of the lens continues • line parallel to the principal axis passes through focal point to right of lens 	rays should be drawn with a ruler ignore arrows on rays	2	AO2 3.1.3h
5(b)(ii)	Image drawn where the projected rays cross	image should extend from axis to the intersecting rays	1	AO2 3.1.3h
5(b)(iii)	principal focus	accept focal point	1	AO1 3.1.3c
5(c)(i)	**X**	accept **A**	1	AO1 3.1.5a
5(c)(ii)	**B**	do not accept **Y**	1	AO1 3.1.5a
Total			**10**	

4.6.1.3 Reflection of waves (physics only)

Answer 14 · Mark scheme

June 2017 | PH3FP | Original Q5 | Legacy



4.6.1.3 Reflection of waves (physics only)

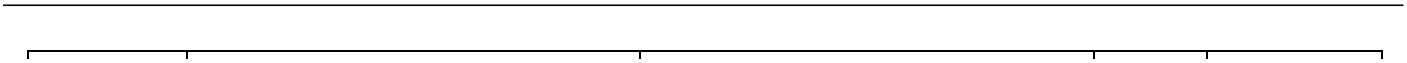
Answer 15 · Mark scheme June 2018 | 8463/2F | Original Q3

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

4.6.1.3 Reflection of waves (physics only)

Answer 15 · Mark scheme

June 2018 | 8463/2F | Original Q3



4.6.1.3 Reflection of waves (physics only)

Answer 16 · Mark scheme

June 2022 | 8463/2F | Original Q9

Question 9

Question	Answers	Mark	AO / Spec. Ref.
09.1	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.6.1.3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content Some indicative content could be indicated within a labelled diagram • 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 80 degrees Methods involving mirrors and reflection score zero		

4.6.1.3 Reflection of waves (physics only)

Answer 16 · Mark scheme

June 2022 | 8463/2F | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	angle of incidence in degrees / ° on *x*-axis **and** angle of refraction in degrees / ° on *y*-axis		1	AO2 4.6.1.3
	all points plotted correctly	allow **1** mark if 3 or 4 points plotted correctly allow tolerance of half a small square	2	
	curved line of best fit	allow line of best fit from their incorrectly plotted points	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	normal drawn at 90° at the point where the incident ray strikes the mirror		1	AO2 4.6.1.3
	straight line drawn with a ruler **and** angle of incidence = angle of reflection	ignore any arrows	1	

4.6.1.3 Reflection of waves (physics only)

Answer 16 · Mark scheme

June 2022 | 8463/2F | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	(the protractor drawn on the paper means you) do not have to move the mirror (to measure the angles)	allow do not have to mark the position of the rays of light allow protractor does not need to be repositioned	1	AO3 4.6.1.3
	(so) more likely to record the correct angle of incidence and/or reflection	allow reducing random error allow more accurate	1	
	ray in method A does not diverge	allow the ray in method A is thin(ner)	1	
	(making it) easier to judge the centre (position) of the ray	allow more accurate if not already awarded allow converse answers in terms of method B being worse than method A	1	

Total Question 9		16

4.6.1.3 Reflection of waves (physics only)

Answer 17 · Mark scheme

June 2024 | 8463/2F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	1 (°)		1	AO3 4.6.1.3 RPA9

Question	Answers	Mark	AO / Spec. Ref.
08.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.6.1.3 RPA9
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content Some indicative content could be indicated within a labelled diagram • 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 60 degrees Methods involving mirrors and reflection score zero		

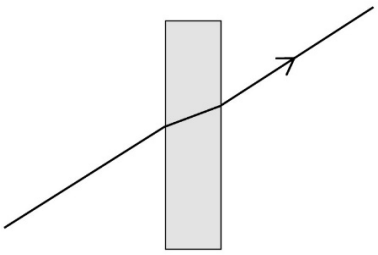
4.6.1.3 Reflection of waves (physics only)

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	points plotted correctly curve drawn passing through points	allow tolerance of ± half a small square allow a line starting at the origin	1 1	AO2 4.6.1.3 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	the line curves	allow the line is not straight allow line does not pass through the origin if consistent with their answer to question **08.3**	1	AO3 4.6.1.3 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	normal drawn ray reflected so i = r	 judge by eye	1 1	AO2 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6			1	AO1 4.6.2.2

Total Question 8	**13**

4.6.1.3 Reflection of waves (physics only)

Answer 18 · Mark scheme

June 2025 | 8463/2F | Original Q1

Question 1

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

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

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

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

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

4.6.1.3 Reflection of waves (physics only)

Answer 18 · Mark scheme

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

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

Total Question 1	13

4.6.1.3 Reflection of waves (physics only)

Version 1.0: 08/02/2008

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Separate Science Physics 4451

PHY3F Unit Physics 3

Mark Scheme

2008 examination - January series

4.6.1.3 Reflection of waves (physics only)

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4.6.1.3 Reflection of waves (physics only)

PHY3F

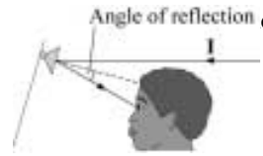
Question 1

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

4.6.1.3 Reflection of waves (physics only)

PHY3F

Question 2

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

4.6.1.3 Reflection of waves (physics only)

PHY3F

Question 3

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

4.6.1.3 Reflection of waves (physics only)

PHY3F

Question 4

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

4.6.1.3 Reflection of waves (physics only)

PHY3F

Question 5

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

4.6.1.3 Reflection of waves (physics only)

PHY3F

Question 6

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

4.6.1.3 Reflection of waves (physics only)

PHY3F

Question 7

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

4.6.1.3 Reflection of waves (physics only)

PHY3F

Question 8

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

4.6.1.3 Reflection of waves (physics only)

AQA

GCSE

Science A / Physics

PH1FP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

4.6.1.3 Reflection of waves (physics only)

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.

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Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.1 Use of chemical symbols / formulae

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

3.2 Marking procedure for calculations

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

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

3.3 Interpretation of 'it'

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

3.4 Errors carried forward

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

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

3.5 Phonetic spelling

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

3.6 Brackets

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

3.2 Ignore / Insufficient / Do not allow

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

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

4. Quality of Communication and levels marking

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

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

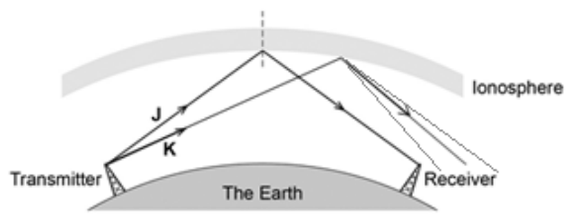
The following general criteria should be used to assign marks to a level:

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

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

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

4.6.1.3 Reflection of waves (physics only)

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

4.6.1.3 Reflection of waves (physics only)

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

4.6.1.3 Reflection of waves (physics only)

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

4.6.1.3 Reflection of waves (physics only)

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

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

Question 5 continues on the next page . . .

Question 5 continued . . .

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

4.6.1.3 Reflection of waves (physics only)

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

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

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

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

4.6.1.3 Reflection of waves (physics only)

Question 7 continued . . .

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

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

Question 8 continues on the next page . . .

4.6.1.3 Reflection of waves (physics only)

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

4.6.1.3 Reflection of waves (physics only)

AQA

GCSE

Science A / Physics

PH1FP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

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Mark Scheme

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The mark scheme for each question shows:

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2. Emboldening

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

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.2 Use of chemical symbols / formulae

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

3.3 Marking procedure for calculations

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

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

3.4 Interpretation of 'it'

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

3.5 Errors carried forward

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

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

3.6 Phonetic spelling

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

3.7 Brackets

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

3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do not allow

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

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

4. Quality of Communication and levels marking

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

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

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

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

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

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

4.6.1.3 Reflection of waves (physics only)

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	geothermal nuclear biofuel		1 1 1	AO1 1.4.1a 1.4.1d
1(b)	gravitational (potential) kinetic sound		1 1 1	AO1 1.3.1a 1.4.1b
1(c)(i)	90% or 0.9(0)	an answer of 0.9(0) with a unit gains **1** mark an answer of 90 with no unit or an incorrect unit gains **1** mark	2	AO2 1.2.1d
1(c)(ii)	60 (MW)	allow 10%	1	AO2 1.2.1b
1(c)(iii)	increased		1	AO1 1.2.1c
Total			**10**	

4.6.1.3 Reflection of waves (physics only)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	46 200	accept 46 000 allow **1** mark for correct substitution ie 0.5 x 4200 x 22 provided no subsequent step	2	AO2 1.1.4d
2(b)	Energy is used to heat the kettle.		1	AO2 1.2.1b
2(c)	9 (pence)	allow **1** mark for correct substitution ie 0.6 x 15 provided no subsequent step	2	AO2 1.3.1d
2(d)(i)	conduction and convection		1	AO1 1.1.3a
2(d)(ii)	any **one** from: • water stays hotter for longer (than a 'conventional' kettle) • water boiled less often • less energy transferred to the surroundings • (new design is) more efficient		1	AO2 1.2
Total			**7**	

4.6.1.3 Reflection of waves (physics only)

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	any **one** from: • (visible) light • UV / ultra violet • X-ray • gamma / γ-ray		1	AO1 1.5.1e
3(a)(ii)	less than less than the same as		1 1 1	AO1 1.5.1d 1.5.1e
3(b)(i)	(the) Big Bang (theory)		1	AO1 1.5.4e
3(b)(ii)	the red-shift of light from distant galaxies		1	AO1 1.5.4c
Total			**6**	

4.6.1.3 Reflection of waves (physics only)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	dependent		1	AO3 1.1.3b
4(b)	The equipment has a better resolution.		1	AO3 1.1.3
4(c)	(probe) C largest difference between reading and actual temperature	allow 103.2 reason only scores if C chosen accept larger it is 3.2 greater is insufficient comparing C with only one other probe is insufficient	1 1	AO3 1.1.3
4(d)(i)	12(°C)	accept a value between 12.0 and 12.2 inclusive	1	AO2 1.1.3d
4(d)(ii)	140 (seconds) <u>temperature</u> starts to rise	accept an answer between 130 and 150 inclusive only scores if time mark awarded accept the <u>temperature</u> was lowest (at this time)	1 1	AO2 AO3 1.1.3b
4(d)(iii)	increase	accept faster (rate)	1	AO1 1.1.3b
Total			**8**	

4.6.1.3 Reflection of waves (physics only)

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	it would decrease the time		1	AO3 1.2.1a
5(b)	720 (J)	allow **1** mark for correct substitution ie 12 x 60 provided no subsequent step	2	AO2 1.3.1c
5(c)	<u>dense</u> rises falls	 accept equivalent words accept equivalent words	1 1 1	AO1 1.1.3a
5(d)	 decreases decreases decreases	more than one tick in any row negates the mark	 1 1 1	AO3 1.1.3c 1.1.3d
Total			**9**	

4.6.1.3 Reflection of waves (physics only)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	frequency		1	AO1 1.5.3b
6(b)	echo(es)		1	AO1 1.5.3c
6(c)	spreading (out) equal to	changing direction is insufficient moving apart is insufficient bending is insufficient accept: similar to same (order of magnitude) as slightly smaller than slightly larger than	1 1	AO1 1.5.1g
6(d)	340 (m/s)	allow **1** mark for correct substitution ie 25 000 x 0.0136 provided no subsequent step or allow 1 mark for a correct calculation showing an incorrect value from conversion to hertz x 0.0136 an answer of 0.34 gains **1** mark	2	AO2 1.5.1j
6(e)	(a wave where the) oscillations are parallel to the direction of energy transfer causing (areas of) compression and rarefaction	both marking points may appear as labels on a diagram accept vibrations for oscillations accept in same direction as for parallel to allow direction of wave (motion) for direction of energy transfer accept correct description in terms of particles mechanical wave is insufficient needs a medium to travel through is insufficient	1 1	AO1 1.5.1b
Total			**8**	

4.6.1.3 Reflection of waves (physics only)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	any **one** from: • high cost of installing overhead power lines or underground cables or pylons • high cost as (very) long cables needed • amount of electricity required is too low	allow not enough (surplus) electricity would be generated	1	AO1 1.4.1e

Question 7 continues on the next page . . .

4.6.1.3 Reflection of waves (physics only)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7 (b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.		6	3 AO1 2 AO2 1 AO3 1.4.1b

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	at least **one** advantage **or one** disadvantage of either method	at least **one** advantage **and one** disadvantage is stated for **one** method **and** a different advantage **or** disadvantage is stated for the other method	clear comparison of advantages **and** disadvantages of **each** method

examples of physics points made in the response	extra information
Advantages of both methods: • both renewable sources of energy • both have no fuel (cost) • both have very small (allow 'no') running costs • no carbon dioxide produced	 accept carbon neutral accept no greenhouse gases accept doesn't contribute to global warming
Advantages of wind: • higher average power output	 produces more energy is insufficient
Advantages of hydroelectric: • constant / reliable power (output) • lower (installation) cost	
Disadvantages of wind: • higher (installation) cost • variable / unreliable power output • (may) kill birds / bats	
Disadvantages of hydroelectric: • lower power output • (may) kill fish or (may) damage habitats • more difficult to set up (within river)	
Disadvantages of both methods • (may be) noisy • visual pollution	 ignore payback time unless no other relevant points made ignore time to build for both

Total			7

4.6.1.3 Reflection of waves (physics only)

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	a proportion / percentage of the energy is wasted	allow heat for energy allow some energy is wasted	1	AO2 1.2.1b 1.2.1c
	(wasted) energy is transferred to surroundings **or** energy is needed to heat pan (before food is heated)		1	
8(b)	(fins have a) large(r) surface area	accept fins increase the surface area	1	AO1 1.1.1c 1.1.1e 1.1.3c
	(black metal surface is a) good / better absorber of infrared radiation	allow 'heat' or 'energy' for infrared radiation ignore good emitter of infrared radiation not a good reflector is insufficient	1	
8(c)	the higher the temperature (of the saucepan) the greater the rate at which infrared radiation is emitted	accept converse answer allow the higher the temperature the more infrared radiation is emitted allow there is a positive correlation	1	AO2 1.1.1b
Total			**5**	

4.6.1.3 Reflection of waves (physics only)

Answer 15 · Examiner comments

June 2018 | 8463/2F | Original Q3

Question 3 (Low demand)

03.1 94% of the students gave the correct answer.

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

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

4.6.1.3 Reflection of waves (physics only)

Answer 16 · Examiner comments

June 2022 | 8463/2F | Original Q9

Question 9 (Standard demand)

09.1 Many of the students did not appear to know which experiment to describe. A significant number described a reflection experiment using a mirror whilst others described how the data would be displayed rather than how it would be obtained. Approximately 30% of the students did not attempt the question.

09.2 Many students failed to label the axes and / or draw a line of best fit. Students should also be aware that lines of best fit are not always straight.

09.3 Many of the students did not appear to have a protractor or chose not to use one. A less common error was to show the incident ray being refracted by the mirror. The normal line was often not drawn.

09.4 Most of the students that scored 1 mark did so for realising that Method A would give more accurate results. However, few of the students were able to link ideas to give clear explanations. The more common correct responses were in terms of the protractor not having to be moved and the laser producing a thinner ray of light. The idea of the mirror not having to be moved or repositioned was rarely seen.

4.6.1.3 Reflection of waves (physics only)

Answer 16 · Examiner comments

June 2022 | 8463/2F | Original Q9

Use of statistics

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

Mark Ranges and Award of Grades

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

4.6.1.3 Reflection of waves (physics only)

Answer 17 · Examiner comments June 2024 | 8463/2F | Original Q8

08.2
Only 41% of students gained any marks for this description of a practical investigation about the refraction of light. There was confusion, or lack of detail, when describing the angles to measure. Many forgot to include a normal line. A small number of students had not read the question carefully and described reflection by a mirror.

08.3
47% of students plotted points on the graph correctly, and drew a curve, to show the relationship between the angles of incidence and refraction. 40% of students drew a straight line of best fit. This is connected to the misconception that a line of best fit is always straight.

08.4
Many students stated that the line was curved even though they drew a straight line in **08.3** or said that the points don't go through the line of best fit. This was incorrect, but was because they had drawn an incorrect line of best fit.

08.5
Many students tried to draw the path of the reflected ray of light by eye rather than using a protractor to measure the required angles. Very few drew the normal line, as directed in the question, those that did tended to do it correctly. 9% of students scored both marks and 23% gained 1 mark.

08.6
50% of students were able to identify the correct pathway for a ray of light being refracted through a denser medium.

4.6.1.3 Reflection of waves (physics only)

Questions matter

GCSE
Physics
8463/2F

Report on the examination

Version: 1.0
June 2025

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4.6.1.3 Reflection of waves (physics only)

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

General comments

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

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

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

Levels of demand

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

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

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

01.1

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

01.2

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

01.3

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

01.4

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

01.5

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

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4.6.1.3 Reflection of waves (physics only)

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01.6

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

01.7

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

02.1

Most of the students correctly calculated the weight of coal.

02.2

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

02.3

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

02.4

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

02.5

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

02.6

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

03.1

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

03.2

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

03.3

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4.6.1.3 Reflection of waves (physics only)

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

03.4

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

03.5

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

03.6

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

03.7

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

04.1

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

04.2

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

04.3

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

04.4

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

04.5

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

04.6

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

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4.6.1.3 Reflection of waves (physics only)

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04.7

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

05.1

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

05.2

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

05.3

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

05.4

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

05.5

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

05.6

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

05.7

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

06.1

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

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4.6.1.3 Reflection of waves (physics only)

06.2

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

06.3

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

06.4

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

06.5

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

07.1

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

07.2

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

07.3

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

07.4

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

07.5

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

08.1

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

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

08.2

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

08.3

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

09.1

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

09.2

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

09.3

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

09.4

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

09.5

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

09.6

Over 90 % of the students selected the correct equation.

09.7

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

10.1

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

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4.6.1.3 Reflection of waves (physics only)

10.2

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

10.3

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

10.4

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

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Mark Ranges and Award of Grades

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