AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.2.5

Lenses (physics only)

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**23**
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.

4.6.2.5 Lenses (physics only)

Answer 01 · Mark scheme

June 2004 | 3451H | Original Q15 | Legacy

The full source mark scheme begins on page 53. Follow original question 15 in that document.

Answer 02 · Mark scheme

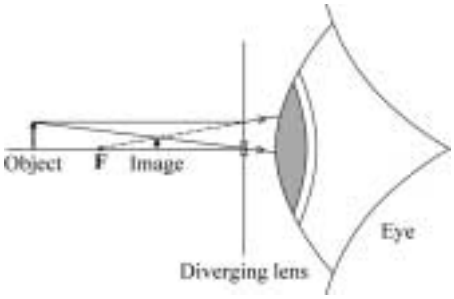
June 2006 | 3451 | Original Q6 | Legacy

The full source mark scheme begins on page 74. Follow original question 6 in that document.

4.6.2.5 Lenses (physics only)

Answer 03 · Mark scheme

Question 4

question	answers	extra information	mark
(a)	straight line from the tip of the object … straight through the centre of the lens (1) … parallel to the axis, then diverges from the lens as if from F (1) image drawn from where **these** lines intersect, vertically to the axis (1)	**example**  	3
(b)	any **two** from: • smaller (than the object) • (both) upright • image is virtual / imaginary (whereas object is real)	no errors carried forward from the candidate's diagram mark first **two** points given	2
total			5

4.6.2.5 Lenses (physics only)

Answer 03 · Mark scheme

January 2008 | PHY3H | Original Q4 | Legacy

PHY3H

4.6.2.5 Lenses (physics only)

Answer 04 · Mark scheme

Question 1

question	answers	extra information	mark
(a)(i)	(angle of) refraction	take care **not** to credit 'angle of reflection'	1
(a)(ii)	normal	do **not** credit 'horizontal'	1
(b)	**either** (photographic) film **or** CCD(s) (charge-coupled device(s)) / CMOS(s) (sensor(s)) / (active) pixel sensor(s)	 accept 'LDR(s)' / 'light dependent resistor(s)' **not** lux meter do **not** accept light sensor(s)	1
(c)(i)	converging	**or** 'convex'	1
(c)(ii)	 **either** (0).35 **or** (0).4(1…)	do **not** give any credit for an answer greater than 1 **or** 7 ÷ 20 for **1** mark **or** clear evidence that appropriate measuring / counting, has been made for **1** mark	2
(d)	otherwise it will have no effect on the light detector **or** otherwise no (real) light will fall on the light detector	**or** 'a virtual / imaginary image will have no effect on the light detector' allow error carried forwards for 'light detector' allow so it can be formed on the film	1
total			7

4.6.2.5 Lenses (physics only)

Answer 04 · Mark scheme June 2008 | PHY3H | Original Q1 | Legacy

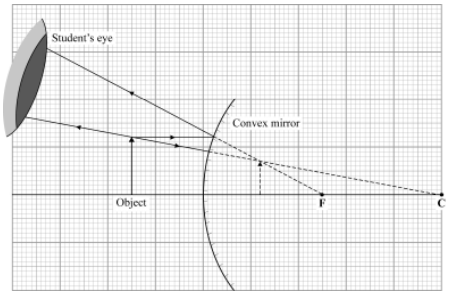
PHY3H

4.6.2.5 Lenses (physics only)

Answer 05 · Mark scheme

January 2009 | PHY3H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	ray from the top of the object in a straight line to **C** (1) ray from the top of the object and parallel to the principal axis reflected from the mirror as if from **F** (1) where these lines intersect vertically to the axis (to form the image) (1) direction of four <u>real</u> rays correctly shown (1)	example  note this mark depends on the first two marks being correct two from the object towards the mirror two towards the student's eye note the rays only need to go towards the eye any arrows shown on 'rays' behind the mirror invalidate this mark	4
4(b)	image is formed by the intersection of virtual/ imaginary rays	**or** the construction lines only show where the image appears to be/where light seems to come from **or** the image is behind the mirror **or** (real) rays do not pass through the image **or** (real) rays do not cross ignore reference to a 'screen'	1
Total			**5**

4.6.2.5 Lenses (physics only)

Answer 05 · Mark scheme

January 2009 | PHY3H | Original Q4 | Legacy

PHY3H

4.6.2.5 Lenses (physics only)

Answer 06 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)(i)	answer in the range 3.0 ↔ 3.1 inclusive	accept for 1 3.6 ÷ 1.2 or 3.7÷1.2 or 36 ÷ 12 or 37÷12 or 18 ÷ 6 or 18.5 ÷ 6 or 10.2 ÷ 3.4 or 102 ÷ 34 or answer in the range but with a unit eg 3 cm	2
2(a)(ii)	(principal) focus / focal (point(s)) / foci / focus	accept 'focusses' accept focals do **not** accept focal length	1
2(a)(iii)	at the intersection of virtual / imaginary rays	**or** 'where virtual / imaginary rays cross' **or** the rays of (real) light do not cross **or** the image on the same side (of the lens) as the object **or** the image is drawn as a dotted line **or** the image is upright do **not** accept 'cannot be put on a screen' do **not** accept any response which refers to reflected rays	1

Question 2 continues on the next page . . .

PHY3H

Question 2 continued . . .

question	answers	extra information	mark
2(b)(i)	another correct observation about relationship between values of **d** (1) (but) not the same relationship between corresponding values for magnification (1)	**example** 15 is three times bigger than 5 but 2.0 is not three times bigger than 1.2	2
2(b)(ii)	when the distance / **d** increases the magnification increases	**or** the converse accept 'there is a (strong) positive correlation' do **not** accept any response in terms of proportion / inverse proportion	1
2(b)(iii)	(student has) no evidence (outside this range)	accept data / results / facts for 'evidence'	1
Total			**8**

4.6.2.5 Lenses (physics only)

Answer 06 · Mark scheme

January 2010 | PHY3H | Original Q2 | Legacy

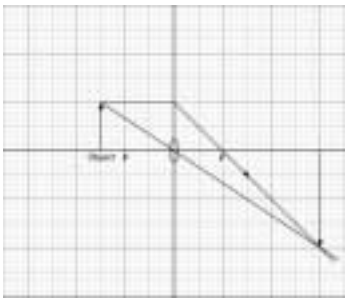
PHY3H

4.6.2.5 Lenses (physics only)

Answer 07 · Mark scheme

June 2010 | PHY3H | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	any **two** for **1** mark each ray from the object's arrowhead • through centre of lens • parallel to the axis then, when it reaches the lens, through F on the right • through F on the left then, when it reaches the lens parallel to the axis	deduct (1) from the first two marks if a ruler has not been used but the intention is clear example of a **4** mark response  if more than two construction lines have been drawn all must be correct to gain **2** marks construction lines drawn as dashed lines do not score credit	2
	image shown as vertical line from axis to where their <u>rays</u> intersect	image need not be marked with an arrowhead but, if it is, it must be correct	1
	ray direction shown	only one correct direction arrow needed but there must not be any contradiction	1
7(b)	any **two** from: • inverted • magnified • real	one correct feature gains **1** mark accept 'upside down' accept 'bigger' accept 'not virtual / not imaginary' ignore any reference to position an incorrect feature negates a correct response	2
Total			**6**

4.6.2.5 Lenses (physics only)

Answer 07 · Mark scheme June 2010 | PHY3H | Original Q7 | Legacy

PHY3H

4.6.2.5 Lenses (physics only)

Answer 08 · Mark scheme

January 2011 | PHY3H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	converging (lens)	accept 'convex (lens)' accept biconvex	1
1(b)	(principal) foci	accept 'focus' / 'focuses' / 'focis' focal point(s)	1
1(c)(i)	formed where (real) rays (of light) intersect / meet / cross	accept ray (of light) pass through the image accept 'image is on the opposite side (of the lens to the object)' accept (construction) lines cross over a response relating to a screen or similar is neutral lines are solid and not dotted is neutral	1
1(c)(ii)	inverted	accept any unambiguous correct indication	1
1(d)(i)	smooth curve which matches the points	judge by eye but do not accept point to point by ruler or otherwise	1
1(d)(ii)	continuous		1

Question 1 continues on the next page . . .

4.6.2.5 Lenses (physics only)

PHY3H

Question 1 continued . . .

question	answers	extra information	mark
1(d)(iii)	as distance increases, magnification decreases	accept negative correlation a statement 'inversely proportional' is incorrect and limits maximum mark for this part question to **1**	1
	further detail eg magnification falls steeply between 40 and 50 cm **or** magnification begins to level out after / at 70 cm		1
Total			**8**

4.6.2.5 Lenses (physics only)

Answer 08 · Mark scheme January 2011 | PHY3H | Original Q1 | Legacy

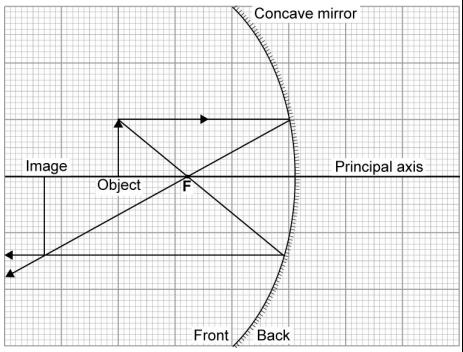
PHY3H

4.6.2.5 Lenses (physics only)

Answer 09 · Mark scheme

January 2011 | PHY3H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6	any **two** from: • straight line from the top of object parallel to principal axis then reflected from the mirror and through **F** • straight line from the top of the object through **F** to the mirror then reflected parallel to the principal axis • straight line from the top of the object to the centre of the mirror reflected so that angle of incidence = angle of reflection real image shown from where their reflected rays intersect and perpendicular to the principal axis	example of correct response  ignore direction of any arrow heads drawn on the lines ignore image orientation if shown	2 1
Total			**3**

4.6.2.5 Lenses (physics only)

Answer 09 · Mark scheme January 2011 | PHY3H | Original Q6 | Legacy

PHY3H

4.6.2.5 Lenses (physics only)

Answer 10 · Mark scheme

June 2011 | PHY3H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	refraction		1
5(b)(i)	converging	accept convex	1
5(b)(ii)	cause the light (rays) to meet on / focus at retina / back of eye	do **not** accept hit the retina only	1
5(c)	silicone is removed from the lens(es) lens(es) thinner in / at the middle (than at the edge) **or** lens(es) became concave / diverging diverges(s) the light which (now) meets / focuses at the retina / back of the eye		1 1 1
Total			**6**

4.6.2.5 Lenses (physics only)

Answer 10 · Mark scheme June 2011 | PHY3H | Original Q5 | Legacy

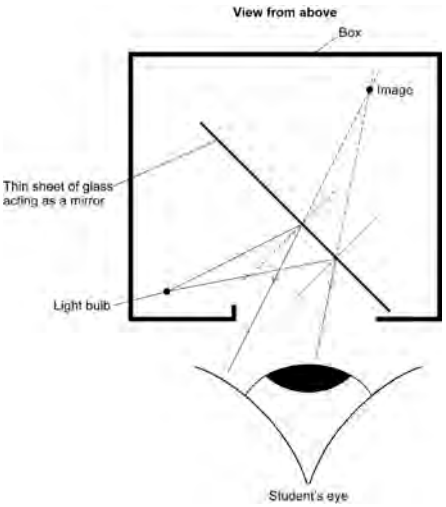
PHY3H

4.6.2.5 Lenses (physics only)

Answer 11 · Mark scheme

June 2012 | PH1HP | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	two rays drawn from the bulb and reflected by the glass	angle **I** = angle **R** judged by eye allow **1** mark for one incident and reflected ray even if angle **I** doesn't equal angle **R**	2
	at least one arrow drawn in correct direction	any conflicting arrows negate this mark ignore any arrows drawn on construction lines behind the glass	1
	position of image correct 	judged by eye	1

Question 7 continues on the next page

PH1HP

Question 7 continued

question	answers	extra information	mark
7(b)	image is formed by virtual / imaginary rays crossing	accept construction lines only show where the light seems to come from accept the image is behind the glass / mirror accept image is seen through the glass / mirror accept (real) rays of light do not pass through the image accept (real) rays do not cross accept the image is a reflection (of the object) accept the image is formed by reflection do **not** accept a virtual image can't be formed on a screen do **not** accept the object / image is reflected	1
Total			**5**

4.6.2.5 Lenses (physics only)

Answer 11 · Mark scheme June 2012 | PH1HP | Original Q7 | Legacy

PH1HP

4.6.2.5 Lenses (physics only)

Answer 12 · Mark scheme

June 2013 | PH1HP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	perpendicular	accept correct description	1
3(a)(ii)	light off – no / slow rotation		1
	light on – fast(er) rotation	accept starts rotating ignore references to energy transfers	1
3(b)	one ray drawn from wrist watch and reflected by mirror	accept solid or dashed lines	1
	two rays drawn from wrist watch and reflected by mirror with i = r for both rays	judge angles by eye	1
	one ray traced back behind mirror	accept solid or dashed lines	1
	image in correct position	judged by eye accept image marked where two reflected rays traced back cross behind the mirror	1
3(c)	cannot be formed on a screen **or** rays of light seem to come from it but do not pass through it	accept image formed behind the mirror	1
Total			**8**

4.6.2.5 Lenses (physics only)

Answer 12 · Mark scheme

June 2013 | PH1HP | Original Q3 | Legacy

PH1HP

4.6.2.5 Lenses (physics only)

Answer 13 · Mark scheme

June 2013 | PH3HP | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	cornea (LHS gap)	must be in correct space	1
	retina (RHS gap)		1
1(b)	iris **or** pupil		1
	to change the shape / curvature (of the surface) of the lens	accept to make the lens thinner / fatter to contract and relax is insufficient	1
	to focus the light (from the object, onto the retina)	accept to refract / change direction of light accept rays for light accept to form / focus an image (on the retina) to focus is insufficient	1
1(c)	the older (a human), the longer the near point (or vice versa) **or** young people have the shortest near point (or vice versa)	answer must be in terms of near point (or a description of), eg become increasingly long sighted as you get older allow near point increases with age do **not** accept eye sight deteriorates as you get older answers must be comparative	1
	the (rate of) change of the near point increases as you get older (or vice versa)	accept near point increases most rapidly after 40 this statement alone gains **2** marks: the (rate of) increase of the near point gets greater as you get older	1

Question 1 continues on the next page . . .

4.6.2.5 Lenses (physics only)

PH3HP

Question 1 continued . . .

question	answers	extra information	mark
1(d)	test / measure / use more people (to increase the range of ages) **or** test / measure / use more people with ages in between (those already measured)	accept test older / younger people accept increase sample size repeat the measurements (of the same people) is insufficient	1
1(e)	2.5	allow **1** mark for correct substitution and conversion to metres, ie $\frac{1}{0.4}$ provided no subsequent step shown an answer of 0.025 gains **1** mark	2
Total			**10**

4.6.2.5 Lenses (physics only)

Answer 13 · Mark scheme

June 2013 | PH3HP | Original Q1 | Legacy

PH3HP

4.6.2.5 Lenses (physics only)

Answer 14 · Mark scheme

June 2013 | PH3HP | Original Q2 | Legacy

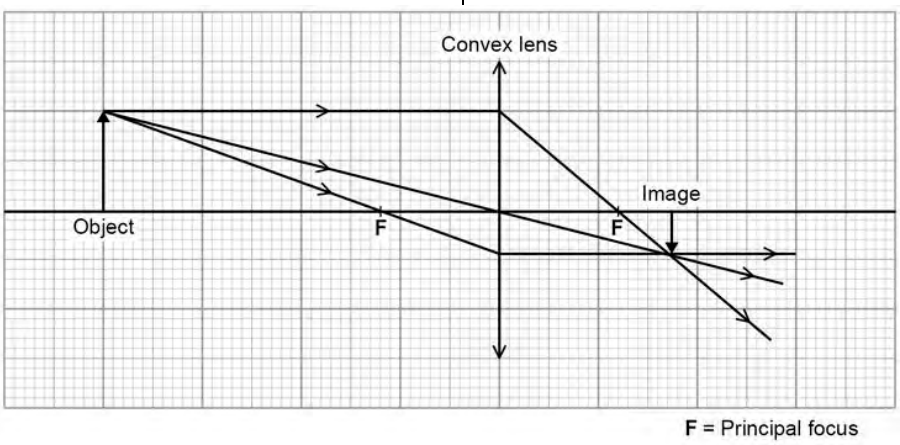
Question 2

question	answers	extra information	mark
2(a)	raft A is more stable	no mark for identifying raft, marks for explanation	
	raft A has the lower centre of gravity / mass	must be direct / implied comparison to the other raft	1
	raft A has the wider base / is the widest	accept the barrels are spread out the most **or** the base / surface area is the largest	1
	OR		
	raft B is less stable		
	raft B has the higher centre of gravity / mass (1)		
	raft B has the narrower base / is the widest (1)		
		if wrong or no raft identified as being most / least stable, **1** mark maximum for BOTH correct explanations of C of G & base width	

Question 2 continues on the next page . . .

PH3HP

Question 2 continued . . .

question	answers	extra information	mark
2(b)	any **two** correct construction lines: • line passing straight through centre of lens (& out other side) • line travelling parallel to principal axis & then being refracted through principal focus (on RHS) • line travelling through principal focus (on LHS) & then being refracted to be parallel to principal axis (on RHS)	if more than 2 construction lines treat as a list	2
	<u>inverted</u> image drawn (with arrow) in correct location		1
	one arrowhead from object to image on any construction ray	conflicting arrowheads negate this mark	1
			
2(c)	any **two** from: • inverted • real • diminished / smaller	accept upside down allow ecf if ray diagram wrongly drawn but descriptions must relate to **their image** a converse negates mark, eg real and virtual scores zero	2
Total			**8**

4.6.2.5 Lenses (physics only)

Answer 14 · Mark scheme

June 2013 | PH3HP | Original Q2 | Legacy

PH3HP

4.6.2.5 Lenses (physics only)

Answer 15 · Mark scheme

June 2014 | PH3HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO spec ref
5(a)	CCD / charged coupled device pupil	ignore sensor do **not** allow film do **not** allow iris	1 1	AO1 3.1.4d
5(b)	the eye(ball) being too short the (eye) lens being unable to focus (an image at the retina) **or** the (ciliary) muscles being unable to change the shape of the lens sufficiently	 accept cornea / lens is not curved enough accept lens is not powerful enough **or** too weak accept lens being unable to accommodate	1 1	AO1 3.1.4b
5(c)	0.31(25)	 allow **1** mark for correct substitution, ie $\frac{1}{3.2}$	2	AO2 3.1.4c
5(d)(i)	1.4	 allow **2** marks for $\frac{0.5}{0.358}$ allow **2** marks for 1.39 an answer of 0.72 gains **2** marks allow **1** mark for correct substitution, ie $\frac{\sin 30°}{\sin 21°}$ allow **1** mark for both sine values correctly calculated ie 0.5 and 0.358 ignore any units	3	AO2 3.1.3c

Question 5 continues on the next page . . .

4.6.2.5 Lenses (physics only)

Question 5 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
5(d)(ii)	the lenses can be made thinner	allow the lenses / spectacles/ glasses are lighter allow uses less glass	1	
Total			10	

4.6.2.5 Lenses (physics only)

Answer 16 · Mark scheme

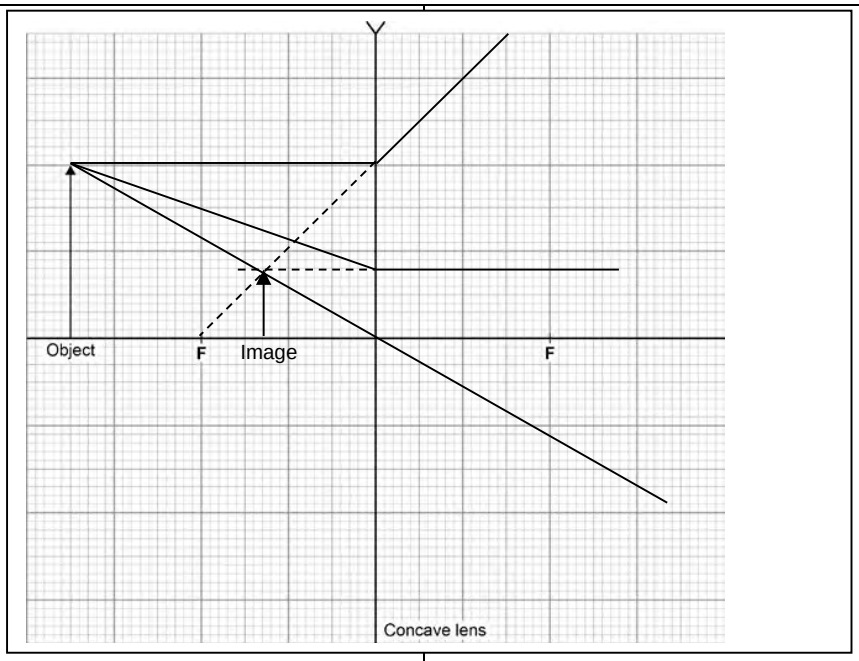
June 2015 | PH3HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(a)	**A** = suspensory ligament **B** = retina		1 1	AO1 P3.1.4a
4(b)	to control the amount of light entering the eye **or** to control the amount of light incident on the retina	allow change the size of the pupil	1	AO1 P3.1.4a
4(c)(i)	short sight **or** myopia	accept near sight	1	AO1 P3.1.4b

4.6.2.5 Lenses (physics only)

Answer 16 · Mark scheme

June 2015 | PH3HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(c)(ii)				AO1 AO2 P3.1.3h
	any 2 correct construction lines:	construction lines may be dotted or solid construction lines must pass correctly through the lens treat more than 2 construction lines as a list for marking	2	
	upright image drawn at correct location.	image must be to the left of the lens upright orientation of image must be clear the image line can be dotted or solid ignore any arrows on construction rays	1	

Question 4 continues on the next page . . .

4.6.2.5 Lenses (physics only)

Answer 16 · Mark scheme

June 2015 | PH3HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(d)	to focus light from objects at different distances	accept can see objects (clearly) at different distances. to focus light on the retina is insufficient	1	AO1 P3.1.4e
4(e)(i)	0.5 metre(s) / m	the unit is **not** an independent mark an answer 0.5 without a unit or with an incorrect unit scores **1** mark **or** a substitution 2 = 1/f with the unit metre(s)/m scores **1** mark	2	AO1 AO2 P3.1.4e
4(e)(ii)	10 to 30 decreases linearly or at a constant rate 50 to 70 falls less rapidly after 60 years 10 to 30 decrease is less than 50 to 70	accept from 10 to 30 the decrease is 2.6/2.7(D) accept it decreases at a decreasing rate accept from 50 to 70 the decrease is 3.3/3.4(D)	1 1 1	AO3 P3.1.4c
4(e)(iii)	0.8 (D)	accept answers in the range of 0.6 to 1.0 (D) inclusive	1	AO3 P3.1.4c
Total			14	

4.6.2.5 Lenses (physics only)

Answer 16 · Mark scheme

June 2015 | PH3HP | Original Q4 | Legacy



4.6.2.5 Lenses (physics only)

Answer 17 · Mark scheme

June 2016 | PH3HP | Original Q7 | Legacy

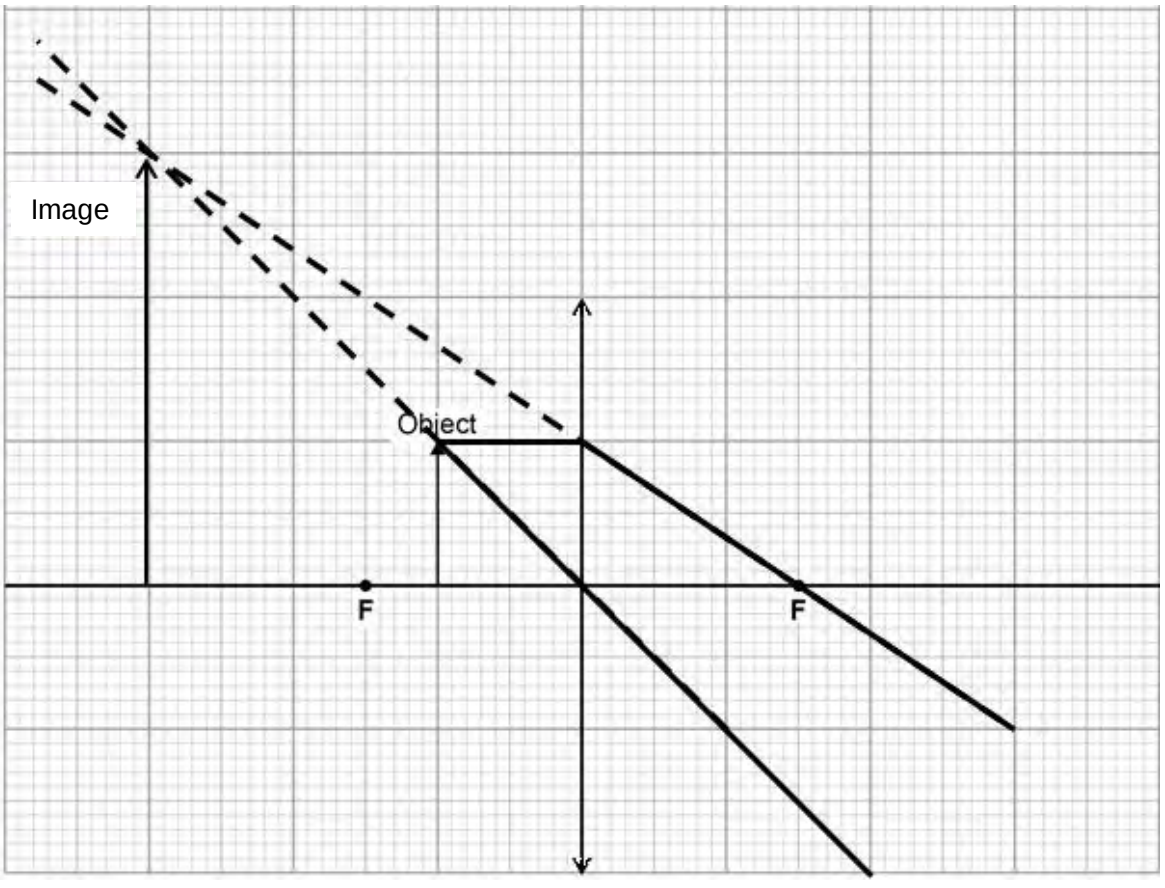
Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)(i)	the eyeball is too short **or** the lens is too weak/thin	accept the light is focussed behind the retina accept the lens is unable to focus accept the cornea is not curved enough old age / inherited is insufficient	1	AO1 3.1.4b
7(a)(ii)	a laser		1	AO1 3.1.5c
7(b)	the image would decrease in size the image would change (from virtual) to real the image would change (from non-inverted) to inverted	 accept that the image (of bulb M) can be projected on to a screen 	1 1 1	AO1 3.1.3d

Question 7 continues on the next page . . .

4.6.2.5 Lenses (physics only)

Answer 17 · Mark scheme

7(c)	a ray through the centre of the lens	rays should be drawn with a ruler ignore arrows	1	AO2 3.1.3h
	a ray parallel to the principal axis and passing through the principal focus to the right of lens	accept solid or dashed lines accept a ray drawn as if from the principal focus to the left of the lens, emerging parallel to the principal axis	1	
	image drawn where rays cross	image should be to left of the lens	1	



Question 7 continues on the next page . . .

4.6.2.5 Lenses (physics only)

Answer 17 · Mark scheme

June 2016 | PH3HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(d)(i)	(because the glass in) lens A has a greater refractive index	accept lens A is more powerful accept lens A has a shorter focal length	1	AO3 3.1.3f
7(d)(ii)	when the magnification increases by 1, the image distance increases by 10 cm	accept for **1** mark it is a linear pattern or as the image distance increases, the magnification increases do **not** accept directly proportional	2	AO3 3.1.3i
7(d)(iii)	diagram showing the surfaces of a convex lens C having greater curvature than lens B	the size of the lens drawn is not important	1	AO1 3.1.4f
Total			12	

4.6.2.5 Lenses (physics only)

Answer 18 · Mark scheme

June 2017 | PH3HP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	any **one** from: • They don't need replacing if your eyesight changes • They don't need an optician/specialist to prescribe them	accept they can be adjusted to see near or far objects allow only need one pair of glasses can be re-used by other people is insufficient ignore they are cheaper than traditional glasses they focus on objects at different distances is insufficient	1	AO3 3.1.4b

2(b)			6	AO1 AO3 3.1.4b 3.1.4a

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

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant comments	Describes how an image is formed by the eye **or** Identifies that the lens changes shape to focus light **or** Gives the reason why long **or** short sight gives a blurred image	Explains how an image is formed by the eye **and** **either** Identifies that the lens changes shape to focus light from objects at different distances **or** Gives the reason why long **or** short sight gives a blurred image	Clearly explains how an image is formed by the eye **and** **either** Explains how the lens changes shape to focus light from objects at different distances **or** Correctly identifies that in long sight the image is focused behind the retina **and** for short sight it is focused in front of the retina

4.6.2.5 Lenses (physics only)

Answer 18 · Mark scheme

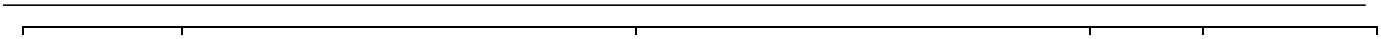
Examples of the points made in the response Explain how a normal eye forms an image:- • Light enters the eye through the pupil • Light is refracted at the cornea • Light is focused by the lens and the cornea • The image should be focused on the retina • The image is inverted, real and diminished Explain how light from objects at different distances forms an image:- • For objects at different distances the lens changes shape • The ciliary muscles pull the suspensory ligaments changing the shape of the lens • For distant objects the lens becomes less powerful • For nearby objects the lens becomes more powerful Explain why long and short sight cause blurred images:- • In long and short sight the (focused) image does not form on the retina • In long sight, the image forms behind the retina • In short sight, the image forms in front of the retina	**extra information** For distant objects the lens becomes thinner For nearby objects the lens becomes fatter In long sight the eyeball is too short In short sight the eyeball is too long	

Total			**7**

4.6.2.5 Lenses (physics only)

Answer 18 · Mark scheme

June 2017 | PH3HP | Original Q2 | Legacy



4.6.2.5 Lenses (physics only)

Answer 19 · Mark scheme

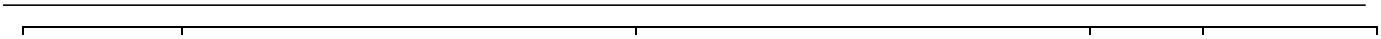
June 2017 | PH3HP | Original Q4 | Legacy

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**	

4.6.2.5 Lenses (physics only)

Answer 19 · Mark scheme

June 2017 | PH3HP | Original Q4 | Legacy



4.6.2.5 Lenses (physics only)

Answer 20 · Mark scheme

June 2019 | 8463/2H | Original Q1

Question 1

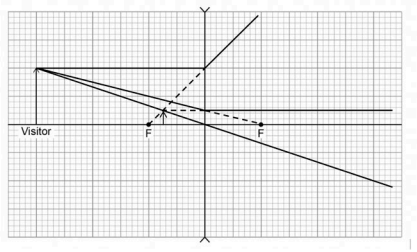
Question	Answers	Extra information	Mark	AO / Spec. Ref.
1.1	focal length	this answer only	1	AO1/1 4.6.2.5
1.2	one correct line drawn from the top of the object, passing through the lens and crossing or meeting given line inverted image drawn at the correct position and length	ignore any arrow drawn on the line if two lines are drawn, both must be correct arrowhead required	1 1	AO2/2 4.6.2.5
1.3	similarity (both are) diminished difference concave is <u>virtual</u> and convex is <u>real</u> **or** concave is upright and convex is inverted	 allow smaller for diminished a comparison must be made ignore reference to positions of images	1 1	AO3/2a 4.6.2.5
1.4	 $6.0 = \frac{9.0}{\text{object height}}$ $\text{object height} = \frac{9.0}{6.0}$ object height = 1.5 (mm)	an answer of 1.5 (mm) scores **3** marks provided working can be seen, an attempt to convert 9.0 mm to cm or m with all other steps correct scores **2** marks	 1 1 1	AO2/1 4.6.2.5
Total			**8**	

4.6.2.5 Lenses (physics only)

Answer 21 · Mark scheme

November 2020 | 8463/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	any **two** correct lines drawn from the top of the visitor and passing through the lens image drawn at the correct position and with the correct orientation	allow construction lines that are not dashed mark only scores if first two marks scored. a convex lens diagram scores **0** marks 	2 1	AO2 4.6.2.5
04.2	Decreases		1	AO3 4.6.2.5
04.3	Iron		1	AO1 4.7.2.1
04.4	there is a current in the solenoid / circuit creating a magnetic field attracting the bolt	allow a charge flows through the solenoid / circuit allow the solenoid / coil is magnetised	1 1 1	AO1 4.7.2.1

4.6.2.5 Lenses (physics only)

Answer 21 · Mark scheme

November 2020 | 8463/2H | Original Q4

04.5	1.50 cm = 0.015 m 2.88 = k × 0.015 k = 2.88 / 0.015 k = 192 (N/m)	 this mark may be awarded if distance is incorrectly/not converted this mark may be awarded if distance is incorrectly/not converted allow a correctly calculated answer using an incorrectly/not converted distance	1 1 1 1	AO2 4.5.3

04.6	Any **two** from: • increase the current (in the solenoid / circuit) • add more turns to the solenoid • use a spring with a lower spring constant	 allow any sensible suggestion for increasing the current such as increasing the p.d. / power of the battery **OR** using lower resistance wire in the solenoid do **not** allow increase the number of coils allow use a weaker spring	2	AO3 4.7.2.1
Total			**14**	

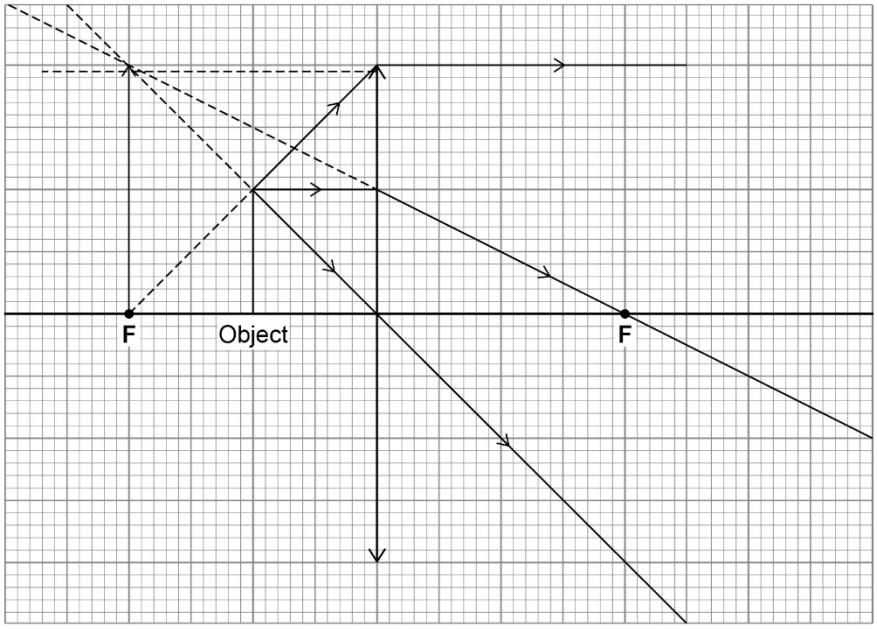
4.6.2.5 Lenses (physics only)

Answer 22 · Mark scheme

November 2021 | 8463/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref
04.1	**both** answers correct virtual diminished	answers may be in either order allow a description of diminished (eg smaller / reduced)	1	AO3 4.6.2.5
04.2	any **two** correct lines drawn from the top of the object, passing through the lens and traced backwards image drawn in the correct position and with the correct orientation	allow construction lines that are not dashed allow 1 mark for **two** correct lines drawn from the top of the object, passing through the lens BUT not traced backwards mark only scores if first two marks score	2 1	AO2 4.6.2.5



04.3	(increasing the object distance) decreases the image distance more rapidly at small (object) distances / more gradually at larger (object) distances	do **not** accept inversely proportional	1	AO3 4.6.2.5
04.4	$\frac{(2.2 - 1.4)}{2}$ uncertainty = (±) 0.4 (cm)	 allow $\frac{1.9 + 1.7 + 2.2 + 1.4}{4} = 1.8$ (1) (2.2 – 1.8 =) (±) 0.4 (cm) (1)	1 1	AO3 4.6.2.5
04.5	only red is transmitted by the filter red is absorbed by the (blue) object (so) no light is reflected by the (blue) object		1 1 1	AO1 4.6.2.6
Total			**10**	

4.6.2.5 Lenses (physics only)

Answer 23 · 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

4.6.2.5 Lenses (physics only)

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.

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

Further copies of this Mark Scheme are available from:

Publications Department, Aldon House, 39, Heald Grove, Rusholme, Manchester, M14 4NA
Tel: 0161 953 1170

or

download from the AQA website: www.aqa.org.uk

Copyright © 2004 AQA and its licensors

COPYRIGHT
AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester. M15 6EX. *Dr Michael Cresswell Director General*

4.6.2.5 Lenses (physics only)

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'.

Copyright © 2004 AQA and its licensors

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.

Copyright © 2004 AQA and its licensors

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.

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

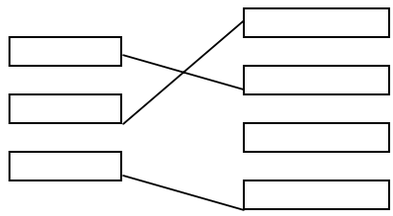
3451F Q2

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

3451F Q5

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

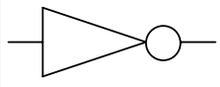
3451F Q6

	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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

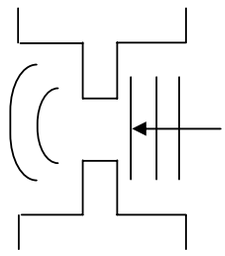
3451F Q8

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	accept finish for E accept correct numbers from axes with units	1
	least steep part of the graph	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
total			6

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

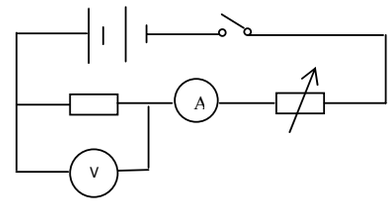
3451F Q9

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

3451F Q11

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

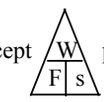
3451F Q12

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

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

Copyright © 2004 AQA and its licensors

4.6.2.5 Lenses (physics only)

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

Copyright © 2004 AQA and its licensors

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2006 examination - June series

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

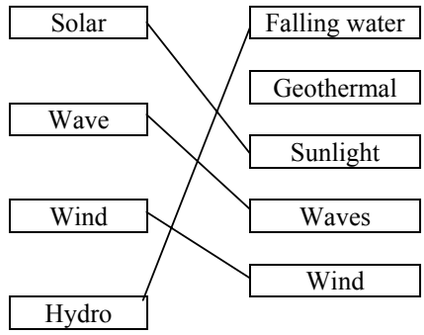
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment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

Copyright © 2006 AQA and its licensors. All rights reserved.

4.6.2.5 Lenses (physics only)

Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

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

4.6.2.5 Lenses (physics only)

3451/F Q2

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

4.6.2.5 Lenses (physics only)

3451/F Q3

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

4.6.2.5 Lenses (physics only)

3451/F Q4

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

4.6.2.5 Lenses (physics only)

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 swap the brown and blue wires round	accept wires must be connected to screws	1 1
total			4

3451/F Q6

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

4.6.2.5 Lenses (physics only)

3451/F Q7

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

3451/F Q8

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

4.6.2.5 Lenses (physics only)

3451/F Q9

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

4.6.2.5 Lenses (physics only)

3451/F Q10

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

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

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

4.6.2.5 Lenses (physics only)

3451/F Q11

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

4.6.2.5 Lenses (physics only)

3451/F Q12

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

Continued

4.6.2.5 Lenses (physics only)

3451/F Q12

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

4.6.2.5 Lenses (physics only)

3451/F Q13

question	answers	extra information	mark
(a)	0.5 hertz	 accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	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 longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram accept a correctly labelled diagram part explanation of the difference between transverse **and** longitudinal gains **1** mark	1 1
(d)(i)	TIR shown	needs to stay inside water jet ignore number of reflections **or** arrow heads lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

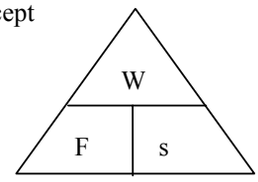
4.6.2.5 Lenses (physics only)

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

4.6.2.5 Lenses (physics only)

3451/F Q15

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

Continued

4.6.2.5 Lenses (physics only)

3451/F Q15

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

4.6.2.5 Lenses (physics only)

3451/F Q16

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

4.6.2.5 Lenses (physics only)

3451/F Q17

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

Continued

4.6.2.5 Lenses (physics only)

3451/F Q17

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

4.6.2.5 Lenses (physics only)

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>

4.6.2.5 Lenses (physics only)

Answer 20 · Examiner comments June 2019 | 8463/2H | Original Q1

Question 1 (Standard demand)

01.1 Less than half of the students were able to the distance as the focal length.

01.2 Nearly half of the students showed themselves to be familiar with drawing ray diagrams and scored both marks. Most correctly drew one line and usually chose to draw a line passing through the centre of the lens without deviation. A significant number of those students that drew a second line did so incorrectly. About 20% of the students that drew a line correctly did not go on to draw an arrow to show the position and inverted nature of the image.

01.3 About 50% of the students scored zero, most of these simply described similarities or differences in the diagrams eg 'ray goes through centre of both lenses'. Students were not always confident in the use of the term 'virtual' to describe an image and instead wrote 'not real'. A number of answers simply referred to Figure 1 or Figure 2 rather than the type of lens.

01.4 Almost 90% of the students were able to complete the calculation and obtain the correct answer. The most popular wrong answer was '9 x 6 = 54'

Answer 21 · Examiner comments November 2020 | 8463/2H | Original Q4

Question 4 (Standard and standard/high demand)

04.1 This part was poorly answered. Many students drew the ray diagram for a convex lens.

04.2 75% of students correctly identified how the image changed.

04.3 80% of students knew that the bolt should be made from iron.

04.4 There were some good, clear and logical explanations given. However some of the students failed to link the switch closing to a current in the circuit. The final marking point was missed by a significant number of the students who failed to give an ‘action’ acting on the bolt i.e. attraction or pulling etc.

04.5 There were many correct answers given with the working out clearly shown. A significant number of the students failed to score all 4 marks as the attempt to convert to metres was incorrect. A smaller proportion of the students tried calculating energy stored. Some of those scored 1 mark for showing a correct conversion from 1.50cm to 0.015m.

04.6 It was not always clear if the students were writing about the spring or the solenoid. The most common way of scoring one mark was for ‘increasing the current’ or a correct description of how this could be achieved. Answers simply in terms of ‘increasing the magnetic field’ were insufficient for credit to be awarded.

4.6.2.5 Lenses (physics only)

Answer 22 · Examiner comments November 2021 | 8463/2H | Original Q4

Question 4

Few of the students showed knowledge of lenses, were able to describe a trend in detail, the meaning of uncertainty in measurements or why objects appear different colours. In part **04.1** few students could describe the image shown. Answers such as ‘not real’ and ‘fake image’ are not acceptable for the term ‘virtual’. In **04.2** the ray diagram was not completed well by most students. Some of the students drew a correct diagram for a concave lens, however, this did not answer the question asked so did not gain credit.

Answer 23 · 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

4.6.2.5 Lenses (physics only)

Answer 23 · 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.