AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.3

Forces and elasticity

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**15**
Available paper years	**2008–2025**

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.

4.5.3 Forces and elasticity

Answer 01 · Mark scheme

June 2008 | PHY1AP | Original Q2 | Legacy

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

4.5.3 Forces and elasticity

Answer 02 · Mark scheme

June 2012 | PH2HP | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	**B C**	either order	1
1(a)(ii)	elastic potential (energy)	accept strain for elastic	1
1(b)(i)	measured / recorded the length of the spring (and not extension) extension does not equal zero when force = 0	mark both parts together accept measured **A**–**C** (and not **B**–**C**) accept did not work out/measure the extension accept line should pass through the origin	1 1
1(b)(ii)	point marked at 5.5 (N) up to that point force and extension are (directly) proportional	accept anywhere between 5.0 and 5.6 inclusive accept at the end of the straight part (of the graph line) accept past that point force and extension are no longer (directly) proportional accept the line starts to curve	1 1
1(c)	1.8	allow **1** mark for correct substitution, ie 25 x 0.072 provided no subsequent step shown an answer 1800 gains **1** mark an incorrect conversion from mm to m with a subsequent correct calculation gains **1** mark	2
Total			**8**

4.5.3 Forces and elasticity

Answer 02 · Mark scheme June 2012 | PH2HP | Original Q1 | Legacy

PH2HP

Answer 03 · Mark scheme June 2015 | PH1HP | Original Q5 | Legacy

The full source mark scheme begins on page 30. Follow original question 5 in that document.

4.5.3 Forces and elasticity

Answer 04 · Mark scheme

June 2016 | PH2HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	elastic potential		1	AO1 2.1.5b 2.2.1c
5(b)(i)	line is straight	accept line does not curve	1	AO1 2.1.5c
5(b)(ii)	400 newtons per metre **or** N/m	allow **1** mark for correct substitution of any pair of numbers correctly taken from the graph e.g.160 = k × 0.40 if symbols are used they must be correct	2 1	AO2 2.1.5d AO1 2.1.5d
5(b)(iii)	300	allow **1** mark for correctly obtaining force on 1 spring = 100N	2	AO3 2.3.2l
5(c)	52	allow **2** marks for calculating change in gpe for 1 chin-up as 260 (J) or for 12 chin-ups as 3120 (J) an answer 4.3 gains **2** marks allow **1** mark for correct substitution into gpe equation ie gpe = 65 × 10 × 0.4 (×12) **or** correct use of power equation with an incorrect value for energy transferred	3	AO2 2.2.1e
Total			**10**	

4.5.3 Forces and elasticity

Answer 04 · Mark scheme

June 2016 | PH2HP | Original Q5 | Legacy



4.5.3 Forces and elasticity

Answer 05 · Mark scheme

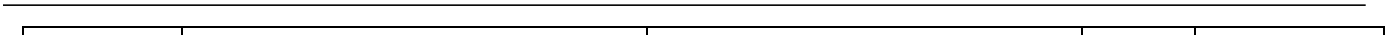
June 2017 | PH3HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	any **two** from: • The number of turns on the coil • The strength of the magnet • The (stiffness of the) elastic bands	do not accept number of coils allow how tightly the turns are wrapped allow distance between the magnet and coil / cone allow strength/elasticity/tension for stiffness ignore references to size of paper cone change direction of current or magnet is insufficient	2	AO3 3.3.1c
1(b)(i)	1.3 (cm)	two values (1.4 and 2.7) correctly taken from the graph scores **1** mark	2	AO2 3.3.1b
1(b)(ii)	any **two** from: • (Below 1A) as the current increases the distance increases • Above 1A the distance does not change (with current) • Between 0.3A and 0.7A the relationship is linear	accept the maximum distance (that the cone can move) is 2.8 cm accept between 0.6 cm and 2.2 cm the relationship is linear ignore references to positive correlation and direct proportionality a description of the shape of the graph is insufficient eg the line levels off after 1A	2	AO3 3.3.1c
Total			**6**	

4.5.3 Forces and elasticity

Answer 05 · Mark scheme

June 2017 | PH3HP | Original Q1 | Legacy



4.5.3 Forces and elasticity

Answer 06 · Mark scheme

June 2018 | 8463/2H | Original Q2

Question	Answers	Mark	AO/ Spec. Ref
02.1	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.5.3
	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 set up a clamp stand with a clamp hang the spring from the clamp use a second clamp and boss to fix a (half) metre ruler alongside the spring record the metre ruler reading that is level with the bottom of the spring hang a 2 N weight from the bottom of the spring record the new position of the bottom of the spring calculate the extension of the spring measure the extension of the spring add further weights to the spring so the force increases 2 N at a time up to 10 N for each new force record the position of the bottom of the spring and calculate / measure the extension **possible source of inaccuracy** not fixing the ruler in position but simply holding the ruler next to the spring not clamping the ruler vertical misjudging the position of the bottom of the spring parallax error allow any other sensible suggestion that could reasonably lead to inaccuracy in the data allow a description that would increase accuracy repeating the measurements is insufficient		

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	to identify any anomalous results **or** to reduce the effect of random error	allow calculate an average for the spring constant allow (more) accurate to obtain an average is insufficient to be able to draw a graph is insufficient	1	AO3 4.5.3
02.3	both points plotted correctly correct line of best fit drawn	 to pass through (0,0) and (10,20)	1 1	AO2 4.5.3
02.4	force = spring constant × extension	allow F = ke	1	AO1 4.5.3
02.5	 extension = 0.2 10 = k × 0.2 $k = \frac{10}{0.2}$ k = 50	an answer of 50 scores **4** marks allow 0.035 / 0.08 / 0.125 / 0.16 force value must match extension this mark may be awarded if e is in cm allow correct transformation of their chosen values this mark may be awarded if e is in cm an answer 0.5 scores **3** marks	 1 1 1 1	 AO2 AO2 AO2 AO2 4.5.3

4.5.3 Forces and elasticity

Answer 06 · Mark scheme

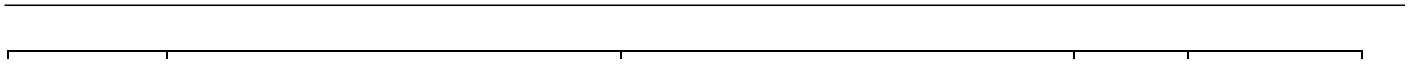
June 2018 | 8463/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	the line is straight and passes through the origin	allow the line does not curve this mark is dependent on scoring the first mark allow a correct description of direct proportionality for **2** marks ignore the line shows they are directly proportional	1 1	AO3 4.5.3
Total			**16**	

4.5.3 Forces and elasticity

Answer 06 · Mark scheme

June 2018 | 8463/2H | Original Q2



Answer 07 · Mark scheme

June 2019 | 8463/2H | Original Q10

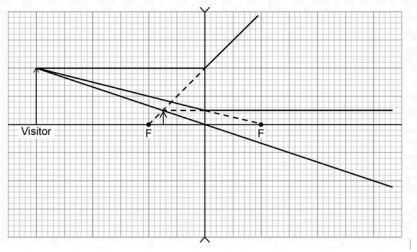
Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	the (perpendicular) distance from the pivot / hinge to (the line of action of) the force is greater so a smaller force is required	allow distance from the rope to the pivot / hinge is greater (than distance between handle and pivot / hinge) this mark is dependent on scoring the 1st mark an answer a smaller force is required at the rope to produce the same moment scores **2** marks	1 1	AO2/1 4.5.4
10.2	 924 = F × 0.15 F = 6160 (N) 6160 = k × 0.25 $k = \frac{6160}{0.25}$ **or** k = 24640 (N/m) $E = \frac{½ \times 6160 \times 0.25 \times 0.25}{0.25}$ E = 770 (J)	an answer of 770 scores **6** marks allow use of E = ½ F e instead of k = F ÷ e and E = ½ × k × e^2 allow their calculated F = k × 0.25 allow a value for k calculated using their calculated F allow E = ½ × their calc. k × 0.25^2 allow an answer consistent with their calculated k	 1 1 1 1 1 1	AO2/1 4.5.4 4.5.3
Total			**8**	

Answer 08 · 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

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**	

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref
02.1	will return to its original shape/length when the force is removed	 allow (when) the child gets off the second mark is dependent on scoring the first mark	1 1	AO2 4.5.3

02.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.5.3
	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 • set up a clamp stand with a clamp • hang the spring from the clamp • use a second clamp and boss to fix a (half) metre rule alongside the spring • record the ruler reading that is level with the bottom of the spring • hang a 1 N / a known weight from the bottom of the spring • record the new position of the bottom of the spring • calculate the extension of the spring • measure the extension of the spring • add further weights to the spring so the force increases 1 N at a time up to 5 N • for each new force record the position of the bottom of the spring and calculate / measure the extension Indicative content continues on the next page…		

	Risk Assessment Hazard: Clamp (stand, boss and masses) might fall off desk Risk: injury to feet Precaution: Use clamp to fix apparatus to the bench **or** Ensure that the slotted masses hang over the base/foot of the stand **or** Ensure that the boss is screwed tightly into the stand and clamp **or** Put (heavy) masses on the base/foot of the stand **or** Stand up so that you can move out of the way Hazard: Spring could break / come loose Risk: damage eye Precaution: Wear safety goggles If a risk assessment / hazard is not given, the answer can still reach level 3, but not full marks. Full marks may be awarded for alternative feasible methods.			

02.3	force = spring constant × extension		1	AO1 4.5.3

02.4	5.00 0.125 $k = \frac{5.00}{0.125}$ k = 40 (N/m)	allow any correct pair of values from the graph allow a misread value(s) from the graph allow a correct calculation using their incorrect value(s)	1 1 1	AO2 4.5.3

02.5	the line is straight and passes through the origin	allow the line does not curve allow a constant gradient	1 1	AO3 4.5.3

02.6	e = 0.20 m $E_e = 0.5 \times 13 \times 0.20^2$ E_e = 0.26 (J)	 allow an incorrectly / not converted value of e use of two incorrectly/not converted values scores a maximum of 1 mark	1 1 1	AO2 4.5.3

Total			**17**

Answer 10 · Mark scheme

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	$E_e = 0.5 \times 50 \times 0.12^2$		1	AO2 4.1.1.2
	$E_e = 0.36$ (J)		1	
	$0.36 = 0.5 \times 0.020 \times v^2$	allow a correct substitution of their calculated value of E_e	1	
	$v^2 = \frac{0.36}{0.5 \times 0.020}$ **or** $v^2 = 36$	allow a correct rearrangement of their calculated value of E_e	1	
	speed = 6.0	allow an answer consistent with their calculated value of E_e	1	
	m/s **or** metres/second		1	
		Alternative approach: ($F = ke$) ($F = 50 \times 0.12$) (maximum) $F = 6.0$ (N) (1)		
		($F = ma$) ($6.0 = 0.020 \times a$) (maximum) $a = 300$ (m/s^2) (1)		
		mean $a = 150$ (m/s^2) (1)		
		($v^2 - u^2 = 2as$) $v^2 = 2 \times 150 \times 0.12$ (1) **or** $v^2 = 36$		
		$v = 6.0$ (1)		
		m/s (1) **or** metres/second		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	kinetic		1	AO1 4.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	increasing the extension of the spring **or** more elastic potential energy **or** increase the angle of release (to the horizontal by a small amount)	allow other factors that would increase the horizontal distance travelled eg a tail-wind ignore factors without a change specified e.g. extension unqualified would not score ignore changing the spring or changes to the toy aeroplane	1	AO2 4.1.1.1

Total Question 10		**8**

Answer 11 · Mark scheme

June 2022 | 8463/2HR | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	the point from which weight may be considered to act **or** the point where the mass appears to be concentrated	allow the point through which the line of action of the weight acts allow the point at which the mass is concentrated	1	AO1 4.5.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	mass of 5 tomatoes = 0.425 (kg) mass of 1 tomato = 0.085 (kg) $W = (0.085 \times 9.8) = 0.833$ (N)	 allow an incorrect and / or not converted reading correctly divided by 5 allow a correct calculation using their value of mass	1 1 1	AO2 4.5.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	$6.0 = k \times 0.015$ $k = \frac{6.0}{0.015}$ $k = 400$ (N/m)	 allow correct rearrangement using an incorrectly calculated value of e allow a correct calculation using an incorrectly calculated value of e	1 1 1	AO2 4.5.3

4.5.3 Forces and elasticity

Answer 11 · Mark scheme

June 2022 | 8463/2HR | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	deforms elastically (so) will return to its original length / shape (after force is removed) **OR** compression is directly proportional to the force (applied) (1) (so) gives a linear scale (1)	 allow easy to calibrate	1 1	AO3 4.5.3

Total Question 5		**9**

4.5.3 Forces and elasticity

Answer 12 · Mark scheme

June 2023 | 8463/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	spring may become permanently extended **or** extension of the spring may be too great (so the baby's feet are always on the floor)	ignore reference to limit of proportionality allow the harness / spring / chain may break ignore baby may be injured / harmed / may hit doorframe	1	AO3 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(in position **A**) the baby has gravitational potential energy (as the baby moves down this) is transferred to kinetic energy (of the baby) and / then elastic potential energy (of the spring) (in position **B**) all the energy is elastic potential energy	allow E_p for gravitational potential energy allow E_k for kinetic energy allow E_e for elastic potential energy ignore energy dissipated to the surroundings	1 1 1	AO1 4.1.1.1

Answer 12 · Mark scheme

June 2023 | 8463/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	$e = 0.080$ (m)		1	AO2 4.1.1.2
	$4.0 = ½ \times k \times 0.080^2$	allow a correct substitution using an incorrectly / not converted value of *e*	1	
	$k = \dfrac{4.0}{(0.5 \times 0.080^2)}$	allow a correct rearrangement using an incorrectly / not converted value of *e*	1	
	$k = 1250$ (N/m)	allow an answer consistent with their value of *e*	1	

Total Question 7	**8**

Answer 13 · Mark scheme

June 2024 | 8463/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	elastic potential (energy)	*allow E_e / EPE*	1	AO1 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	$E_e = 0.5 \times 735 \times 8.0^2$	allow a correct substitution using k = 1470 (N/m) and e = 8 (m) **or** k = 1470 (N/m) and e = 16 (m) **or** k = 735 (N/m) and e = 16 (m)	1	AO2 4.1.1.2
	$E_e = 23\,520$ (J)	this answer only	1	
	total $E_e = 47\,040$ (J)	this answer only	1	
	$47\,040 = 240 \times 9.8 \times h$	allow a correct substitution of their calculated value of E_e (using $E_e = 0.5ke^2$)	1	
	$h = \dfrac{47\,040}{(240 \times 9.8)}$	allow a correct rearrangement using their calculated value of E_e (using $E_e = 0.5ke^2$)	1	
	$h = 20$ (m)	allow an answer consistent with their value of E_e (using $E_e = 0.5ke^2$)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	air resistance (opposes the motion of the pod upwards)		1	AO3
	(so) not all of the elastic potential energy will be transferred to gravitational potential energy	allow the energy transfer is not 100% efficient allow some energy is transferred to the surroundings allow some energy is dissipated ignore energy is wasted ignore reference to mass of person in pod	1	AO1 4.1.2.1 4.1.2.2

Total Question 6	**9**

Answer 14 · Mark scheme

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	$E_e = 0.5 \times 64 \times 0.075^2$		1	AO2 4.1.1.1
	$E_e = 0.18$ (J)	the equation $E_e = 0.5ke^2$ must have been used to score subsequent calculation marks	1	4.1.1.2
	$0.18 = 0.5 \times 0.052 \times v^2$	allow a correct substitution using their value of E_e	1	
	$v^2 = \dfrac{0.18}{0.5 \times 0.052}$	allow a correct rearrangement using their value of E_e	1	
	$v = 2.631\ldots$ (m/s)	allow a correct calculation using their value of E_e	1	
	$v = 2.6$ (m/s)	allow an answer given to 2 sf using **all** the data in the question alternative approach: ($F = ke$) ($F = 64 \times 0.075$) (maximum) $F = 4.8$ (N) (1) ($F = ma$) ($4.8 = 0.052 \times a$) (maximum) $a = 92.3$ (m/s^2) (1) (mean) $a = 46.2$ (m/s^2) (1) ($v^2 - u^2 = 2as$) $v^2 = 2 \times 46.2 \times 0.075$ (1) **or** $v^2 = 6.923$ $v = 2.631\ldots$ (1) $v = 2.6$ (m/s) (1)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2		ignore comments about energy dissipation allow E_k for kinetic energy allow E_p for gravitational potential energy		AO1 4.1.1.1
	kinetic energy decreases moving from **A** to **B**	allow kinetic energy is transferred to gravitational potential energy while moving from **A** to **B** for MP1 and MP2	1	
	(and) gravitational potential energy increases moving from **A** to **B**		1	
	(then) gravitational potential energy decreases from **B** to **C** and kinetic energy increases	allow gravitational potential energy is transferred to kinetic energy while moving from **B** to **C**	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	length of the toy car		1	AO2 4.1.1.2
	time for toy car to pass the light gate		1	

Total Question 10	**11**

Answer 15 · Mark scheme

June 2025 | 8463/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	force (applied to spring) **or** weight (of the masses)	allow mass (hung from spring)	1	AO1 4.5.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	stand could tip over **and** hurt/hit the student **or** masses could fall off **and** hurt/hit the student		1	AO1 4.5.3 RPA6
	clamp base of stand to desk	allow rotate base/clamp allow place some masses on the base of the clamp stand allow student should stand up allow limit the mass hung on spring allow limit the mass hung on spring	1	
	OR spring could snap **and** hurt the student (1)			
	wear goggles (1)	allow limit the mass hung on spring		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	any **two** from: • ensure the ruler is vertical • clamp the ruler (close to the spring) • attach a pointer to bottom of the spring • use a ruler with a better resolution	allow move ruler so it is in line with spring	2	AO3 4.5.3 RPA6

Answer 15 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	the spring length is not proportional to the force **or** the unstretched/initial length of the spring is not zero	allow student has plotted/measured spring length instead of extension	1	AO3 4.5.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	the spring is inelastically deformed (so) the extension is no longer proportional to the force	allow the spring has reached/passed its limit of proportionality allow no longer obeys Hooke's law	1 1	AO3 4.5.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	force = spring constant × extension		1	AO1 4.5.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	$4.0 = k \times 0.064$ $\frac{4.0}{0.064} = k$ $k = 62.5$ (N/m)	 allow 63 (N/m)	1 1 1	AO2 4.5.3 RPA6

Total Question 2	12

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

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

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

Copyright © 2015 AQA and its licensors. All rights reserved.
AQA retains the copyright on all its publications. However, registered schools/colleges 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 schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

PMT

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

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

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

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

3.1 Use of chemical symbols / formulae

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

3.2 Marking procedure for calculations

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

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

3.3 Interpretation of 'it'

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

3.4 Errors carried forward

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

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

3.5 Phonetic spelling

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

3.6 Brackets

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

3.2 Ignore / Insufficient / Do not allow

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

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

4. Quality of Communication and levels marking

In Question **2a** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

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

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

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

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

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

4.5.3 Forces and elasticity

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

PMT

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

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th><th>ID</th></tr>
<tr><td>2 (a)</td><td colspan="2">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a ‘best-fit’ approach to the marking.</td><td>6</td><td>AO2
AO3
P1.2
HSW</td><td>E</td></tr>
<tr><td>0 marks</td><td>Level 1 (1-2 marks)</td><td>Level 2 (3-4 marks)</td><td colspan="3">Level 3 (5-6 marks)</td></tr>
<tr><td>No relevant information</td><td>There is a relevant statement about an energy saving method</td><td>There is at least one clear comparison of energy saving methods and their cost effectiveness with an appropriate calculation</td><td colspan="3">There is a comparison of energy saving methods and their cost effectiveness with appropriate calculations. Comparison to include further detail.</td></tr>
<tr><td colspan="3">examples of physics points made in the response
examples of relevant statements
• energy efficient boiler saves the most (energy / money) per year
• loft insulation costs the least to install
• double-glazing costs the most to install
examples of statements that include cost effectiveness
• loft insulation is the most cost effective in the long term
• double-glazing is the least cost effective
• loft insulation has the shortest payback time
• double-glazing has the longest payback time
• payback time calculated for any method
examples of further detail
• for cost effectiveness install in the following order: loft, cavity wall, boiler, double-glazing
• for reducing energy use install in the following order: boiler, loft, cavity wall, double glazing
• don’t install double-glazing for insulation purposes
• double-glazing won’t pay for itself in your lifetime
• justified choice of best / worst method</td><td colspan="3">extra information
payback times:
energy efficient boiler: 6.25 years
loft insulation: 2 years
double glazing: 100 years
cavity wall insulation: 2.86 years</td></tr>
</table>

Question 2 continued . . .

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

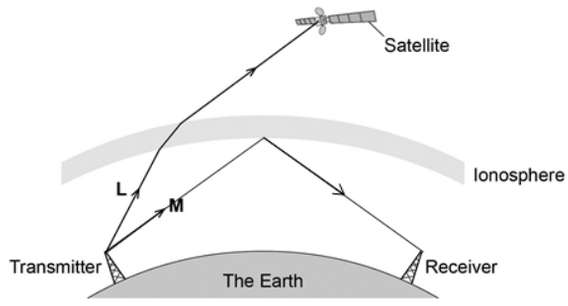
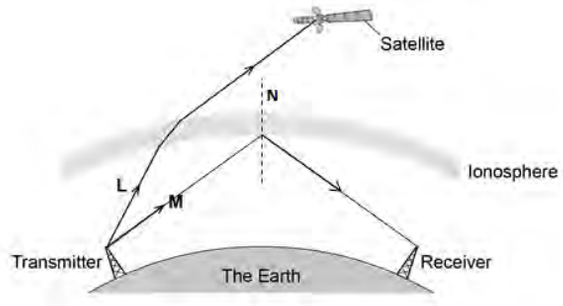
Question	Answers	Extra information	Mark	AO / Spec. ref.
3(a)(i)	0.5 °C		1	AO3 P1.1
3(a)(ii)	data is continuous **or** both variables are continuous **or** independent variable is continuous **or** time is continuous	accept results / measurements for data accept data is not categoric one variable is continuous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

Question 3 continues on the next page . . .

PMT

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

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

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

Question 4 continues on the next page. . .

Question 4 continued…

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

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

Question 5 continues on the next page . . .

PMT

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

Question 5 continued . . .

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

4.5.3 Forces and elasticity

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

4.5.3 Forces and elasticity

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

Answer 06 · Examiner comments

June 2018 | 8463/2H | Original Q2

Question 2 (Standard demand)

02.1 Almost all students made a good attempt at describing this investigation but many omitted one of the necessary actions such as adding 2N weights up to 10N or a method of ensuring accuracy. Most of the students drew a diagram of the apparatus which, although often in sketch form, was generally enough to show what was intended. However having done this there was no need to write a lengthy description of the diagram. Most students were aware of the need to determine the extension of the spring, and many described in detail how to do this. Many students quoted a correct range of weights. Students were more likely to describe how to ensure accuracy, rather than pointing out inaccuracies. Most frequent answers included; clamping the ruler vertically, using a pointer on the end of the spring and marking the original length of the spring on the ruler with a piece of tape. All of these were worthy of credit.

02.2 Fewer than 40% of students scored the mark. The most common correct answer was in terms of improving accuracy, the idea of identifying anomalous results was rare.

02.3 Nearly all students plotted the two data points accurately. However some students did not draw the line with adequate precision and so scored only one mark.

02.4 Just over 75% of students correctly recalled the equation.

02.5 For those students who correctly recalled the equation in question 02.4, most scored at least 3 marks here. About 35% converted centimetres to metres to score all 4 marks.

02.6 Those students who used the graph to answer this question usually wrote that it was a straight line, but generally failed to write that the line went through the origin. Some students explained that the line would curve if the spring was overstretched. Those students that attempted to answer this in terms of direct proportionality often simply stated that as the force increased, the extension increased. This answer scored zero.
Only a small minority correctly explained what is meant by two quantities being directly proportional.

Question 3 (Standard demand)

4.5.3 Forces and elasticity

Answer 07 · Examiner comments

June 2019 | 8463/2H | Original Q10

Question 10 (Standard/high and high demand)

10.1 There were a number of good answers here, though some students referred to momentum instead of moment, or work done = force × distance. A few students wrote about the distance between the rope and the spring (or the ramp) instead of the pivot.

10.2 Almost a third of the students scored all 6 marks and showed their working in a clear and logical sequence. Where students did not score all 6 marks, the equation for elastic potential energy was often correctly selected, but they did not appear to know how to use the other quantities given to find the spring constant correctly. Most students were able to use the moment and distance to calculate the force.

Answer 07 · Examiner comments

June 2019 | 8463/2H | Original Q10

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.

4.5.3 Forces and elasticity

Answer 08 · 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.

Answer 09 · Examiner comments November 2021 | 8463/2H | Original Q2

Question 2 (Common Question)
Students seemed unfamiliar with the term 'elastically deformed' and in **02.1** described an object that was 'inelastically deformed'. When describing a method to obtain given results, students must include what measuring instruments are used, how each quantity is obtained and the interval and range of the given results. Most of the students understood the term 'risk assessment'. Answers to part **02.5** that simply stated 'positive correlation' or 'extension increases with force' were insufficient to gain credit. A minority of the students gave a very succinct answer worth two marks. In part **02.6** the most common errors were a failure to convert 20 cm to metres or failing to square the extension.

Answer 12 · Examiner comments — June 2023 | 8463/1H | Original Q7

Question 7 (Standard/high Demand)

07.1 64% of students scored the mark. 'Over extend was insufficient', but 'exceed elastic limit' was allowed as it is correct but not on the specification.

07.2 The second marking point was for the idea that the baby had kinetic energy at some point in the movement and the spring had some elastic potential energy. So, the following ways of wording this would be creditworthy:
The baby's kinetic energy is transferred to the spring's elastic potential energy.
As the baby's kinetic energy decreases, the spring's elastic potential energy increases.
For the third marking point, the mark was given for saying that at position B all the energy is elastic potential energy as the baby is stationary. But if a student said that all the energy is elastic potential energy, apart from some energy dissipated / transferred to the surroundings, this would still score the mark. An answer indicating that the final elastic potential energy is equal to the initial gravitational potential energy would be acceptable for this marking point. 'Gravitational potential energy is transferred to kinetic energy then

Answer 12 · Examiner comments — June 2023 | 8463/1H | Original Q7

elastic potential energy' would score 2 marks, as the student hasn't stated that all the energy was elastic potential. 'Gravitational potential energy in position **A** is transferred to elastic potential energy in position **B**' would score 1 mark.
Abbreviations like KE, GPE and EPE were creditworthy. If types of energy were written in words, 'potential' must be included, i.e. not just 'gravitational energy' or 'elastic energy'.
3% of students scored 3 marks, while 32 % scored 2 marks and 39 % scored 1 mark.

07.3 45% of students scored 4 marks, while 36% of students scored 3 marks. Most students either mis-converted or did not convert the extension into metres.

Answer 13 · Examiner comments — June 2024 | 8463/1H | Original Q6

Question 6 (High Demand)

06.1 90% of students scored this mark, for identifying that the elastic potential energy store increases as the bungee cords are stretched.

06.2 A challenging grade 8-9 calculation question. A common incorrect answer was '10' which scored 5 marks because the only mistake the student made was not doubling the elastic potential energy calculated for one bungee cord. Due to the various ways students approached the question it discriminated well between different abilities. 14% of students scored 6 marks, while 34% scored 5 marks and 28% scored 4 marks. As long as a student had used the elastic potential energy equation calculating a value of E_e using a value of k and e^2 they could score the marks for using the E_p equation.

06.3 12% of students scored 2 marks, while 46% of students scored 1 mark, in this question for identifying the ways in which energy was dissipated.

Answer 14 · Examiner comments June 2025 | 8463/1H | Original Q10

10.1

Many students were successful with this multi-step calculation question. Nearly 60% of the students scored 6 marks, while almost 10 % scored 5 marks. A significant number of students tried to answer the question using equations from paper 2, which was creditworthy, but virtually no students arrived at the correct answer using this method. Some students scored the significant figures mark by completing an incorrect calculation using all the data provided in the question. The most common mistake was not squaring the extension in the elastic potential energy equation. Ensuring that students substitute first before rearranging is a good way of scoring method marks in calculations, even if the final answer is incorrect.

10.2

Students who stated the names of energy stores didn't score any marks unless they stated how the amount of energy changed or stated that kinetic energy was transferred to gravitational potential energy, for example. Mention of elastic potential energy from the spring in Q10.1 was ignored for this question. E_k and *KE* were acceptable abbreviations for kinetic energy; E_p and *GPE* were acceptable abbreviations for gravitational potential energy. Just over 60 % of the students scored 3 marks, while just over 10% scored 2 marks and just fewer than 10 % scored 1 mark.

10.3

Only about 25 % of the students scored 2 marks for identifying the correct measurements needed to determine the speed of the car at the end of the track. Nearly 75% of the students scored 1 mark. The most common incorrect choice was the length of the track.

Answer 14 · Examiner comments

Mark Ranges and Award of Grades

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

4.5.3 Forces and elasticity

Answer 15 · Examiner comments June 2025 | 8463/2H | Original Q2

2.1

Most of the students could identify the independent variable in the investigation.

2.2

Most students were able to identify potential hazards in the investigation. However it was not always appreciated that a weight falling, for example, only becomes a risk of harm when it is clearly linked to what the falling weight could do to cause harm. The subsequent safety precaution should then have been linked to something that might be expected to be achievable in a school science laboratory. The wearing of steel toe capped boots is a precaution not normally associated with school science laboratories.

2.3

There were many good responses relating to improving the arrangement of the apparatus. These included using a ruler with a better resolution. A large number of the students suggested making the ruler "straight", which was insufficient, given that rulers are straight. Those who expressed this as vertical, parallel to the spring or similar were awarded the mark. Clamping the ruler was often quoted in relation to making sure the zero-mark lined up with either the top or bottom of the spring. Some of the students did not appreciate that this question was asking about the arrangement of the apparatus, as shown in the diagram. These students wrote answers in terms of taking repeat measurements and calculating a mean.

2.4

Most of the students were able to express the idea that the spring must have some length even when there is no force. A few noted that the variable measured was length not extension and others discussed proportionality. A small proportion mistakenly discussed the whole graph and the upward curve rather than why the line does not pass through the origin.

2.5

4.5.3 Forces and elasticity

Answer 15 · Examiner comments June 2025 | 8463/2H | Original Q2

Less than 30 % of the students gained both marks for identifying why the extension of the spring starts to increase at a greater rate. There were many quotations of Hooke's Law and discussions regarding the limit of proportionality. Answers referring to elastic limit were acceptable, but the terms were not always used correctly. It is essential that students learn correct terminology. Most were able to describe inelastic deformation with many writing that the spring would not return to its original size when unloaded. However, a few incorrectly referred to elastic deformation.

2.6

Almost all of the students correctly identified the equation linking extension, force and spring constant.

2.7

The vast majority of the students were able to answer this question correctly. A few wrote the division upside down leading to an incorrect final answer. Students should be reminded of the need to show working even if done on a calculator. Showing working also helps to determine the appropriate mark when numbers are difficult to read.

4.5.3 Forces and elasticity

AQA

GCSE
PHYSICS

8463/1H: Paper 1 (Higher tier)
Report on the Examination

8463
June 2022

Version: 1.0

4.5.3 Forces and elasticity

Further copies of this Report are available from aqa.org.uk

Copyright © 2022 AQA and its licensors. All rights reserved.
AQA retains the copyright on all its publications. However, registered schools/colleges 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 schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

General

Grade 4-5 calculation questions ask for students to recall an equation, before using it in a subsequent calculation. In the 2022 series, students were given an Equations Sheet which had all the equations printed on it. Subsequently, the performance on the more straightforward calculations has improved on previous years.

The multistep calculations targeted at candidates working at grades 8-9, questions **09.1** and **10.1**, were well attempted with many students answering correctly. Of these two questions, students were slightly more successful on question **09.1** with about 55% of students scoring full marks, whereas for question **10.1** approximately 45% of students scored full marks.

Question **02.1** was generally well attempted and students who had carried out the density required practical had an advantage over those who hadn't. For this question, about 35% of students scored 6 marks and approximately 25% of students scored 5 marks.

Handwriting continues to be a problem for a number of students, making it very difficult for examiners to read what has been written. Students who have handwriting that is difficult to read may benefit from a scribe or from word processing their answers in exams.

Question 11

Due to incorrect Advance Information guidance being issued for this question, and to avoid students being disadvantaged, Question 11 was discounted and all students were awarded full (9) marks.

Levels of demand

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

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

Question 1 (Standard demand)

01.1 About 55% of students scored 2 marks. The unit conversion caused a problem for many students and powers of 10 errors were frequently seen. A correct calculation using an incorrectly or not converted value for power would score 1 mark.

01.2 Students were generally successful at answering this question with approximately 40% scoring 2 marks and about 50% scoring 1 mark. Most students wrote variations of the first and third bullet points in the markscheme. A number of students wrote that the turbines may be broken, which was enough to score a mark for the idea of maintenance.

01.3 'Turbine will rotate faster' was insufficient to score a mark. 'Rotate more smoothly' was not enough to score the 'less friction' mark. Students who stated that 'no energy was wasted' did not score the second marking point. Approximately 35% of students scored 3 marks, 35% of students scored 2 marks and 20% of students scored 1 mark.

01.4 About 30% of students scored 2 marks, while approximately 50% of students scored 1 mark. Many students answered in terms of 'saving energy' which was insufficient. Other students answered in terms of absolute statements which did not score, 'energy efficient appliances waste no energy' for example.

Question 2 (Standard demand)

02.1 Generally very well answered with about 35% of students gaining 6 marks and 25% scoring 5 marks. Students were told that this required practical would appear in the 2022 series via the Advance Information. A number of students quoted the density equation incorrectly, although this was given on the Equations Sheet for the 2022 series. There were extremely few students who didn't attempt the question and less than 1% of students who attempted the question scored zero.

02.2 Approximately 85% of students answered this question correctly. Of the incorrect answers seen, a significant proportion gave the maximum and minimum values the wrong way round. Another common mistake was to write maximum: 2.55 and minimum 0.10, which showed a clear misunderstanding of expressing an uncertainty.

02.3 About 95% of students answered this question correctly.

02.4 Approximately 45% of students scored 2 marks and 40% scored 1 mark. 'In case an error / mistake was made the first time' was insufficient. 'To check the repeatability of the data' was ignored, as this wouldn't improve the accuracy of the data. 'Get rid of anomalies' was assumed to mean 'remove anomalies', but 'stops anomalies from occurring' did not score. Likewise 'stops random errors' did not score.

Question 3 (Standard demand)

03.1 Over 99% of students answered this question correctly as they had all the Physics equations on the Equations Sheet for the 2022 series.

03.2 Nearly 95% of students answered this question correctly. In this series all students were given all the equations on the Equations Sheet. The first mark is for the substitution into the equation as it appears on the equations sheet. Some students failed to score any marks by incorrectly rearranging the equation, then substituting into the incorrectly rearranged equation.

03.3 Over 99% of students answered this question correctly as they had all the Physics equations on the Equations Sheet for the 2022 series.

03.4 95% of students answered this question correctly. In this series all students were given all the equations on the Equations Sheet. The first mark is for the substitution into the equation as it appears on the Equations Sheet. Some students failed to score any marks by incorrectly rearranging the equation, then substituting into the incorrectly rearranged equation.

Question 4 (Standard/High demand)

04.1 A large number of students found it difficult to identify the independent and dependent variables in the investigation that was described. Control variables appeared often in students' answers. 'Temperature change' seemed to be the most common incorrect answer for the dependent variable. About 50% of students scored 2 marks and approximately 35% of students scored 1 mark.

04.2 65% of students answered correctly. The most common incorrect answer was 87.4 °C.

04.3 About 35% of students answered this question correctly. Common incorrect answers referred to the resolution, or just repeated the question and said 'difficult to read' which was insufficient.

04.4 Approximately 75% of students scored 3 marks and about 10% of students scored 2 marks. Power of 10 errors were common and usually resulted in 2 marks being scored for an incorrectly or not converted value of energy.

04.5 Many students found relating the time for the temperature to decrease to thermal conductivity difficult. About 15% of students scored 2 marks, while 40% scored 1 mark. Answers in terms of good / bad insulators were insufficient to score a mark.

Question 5 (Standard/High demand)

05.1 Approximately 45% of students scored 1 mark, with about 5% of students scored 3 marks. Around 30% of students scored no marks. The first marking point of this explanation was most likely to score, the third marking point was least likely to score.

05.2 About 30% of students scored all 3 marks for this explanation. 10% of students scored 2 marks and 10% scored 1 mark. A lot of student answers were not creditworthy, with mixed up descriptions of ion transfer, electron transfer, proton transfer, protons weighing more than electrons and transfer of electrons increasing the mass of the rod on the balance. As a result about 50% of students scored zero.

05.3 Approximately 60% of students scored the mark. Some students evidently did not know what a zero error was. Answers like 'it means there is no error' being a good example of this. Some answers were insufficient, 'the actual mass of the rod is not required' being not enough to score the mark. 'Weight' was allowed for 'mass' when used correctly as the reading on the balance does depend on the weight of the object. An answer of 'only the change in weight was needed' would have scored the mark.

05.4 Some very good explanations were seen and about 10% of students scored all 3 marks. The first marking point was least likely to score. The third marking point needed to be linked to the second marking point before it could be scored.

Question 6 (Standard/High demand)

06.1 This question discriminated well between students. About 15% scored 4 marks with 20% gaining 3 marks. The first two marking points were most commonly scored. Students who said that 'no energy was lost' as a consequence of the step-up transformer's effect did not score the third marking point.

06.2 Approximately 55% of students scored 2 marks, while 15% of students scored 1 mark. Students who scored no marks usually confused the quantity that was decreased (pd) with the quantity that increased (current). Some student answers lacked technical accuracy referring to energy, power or charge incorrectly.

06.3 Two thirds of students scored 4 marks for this calculation, whereas about 20% of students scored 3 marks. A common mistake was to try to multiply the answer by the number of seconds in a day, which would probably only score the significant figure mark if correct, as the Physics equations were applied incorrectly.
Common mistakes were to round the answer to 1 400 000 000 C, which would score 3 marks if the full s.f. answer was seen, or round the answer to 141, which would score 3 marks for the supporting calculations if seen. A common error was to miscount the number of zeroes, so would only score 3 marks.

Question 7 (Standard/High demand)

07.1 54% of students could state what an alpha particle consists of. The list principle was applied when students wrote '2 protons and 2 neutrons – a helium atom', which did not score.

07.2 65% of students completed the nuclear equation correctly, scoring 2 marks, whereas 24% scored just 1 mark.

07.3 Students generally made good attempts to answer this question and marking points 1, 2 and 4 were seen most often. To score the 5th marking point students need to make a comparative statement, internal versus external damage. The third marking point was least likely to score, as students rarely referred to dose or the living cells / tissues / organs inside the body. Some students incorrectly thought that ionisation was a process that happened to cells, rather than atoms, so often didn't score the fifth marking point for this reason. Very few students scored 5 marks and the question discriminated well between students of differing ability.

Question 8 (Standard/High demand)

08.1 About 90% of students gave the correct measuring instrument. While it wasn't seen often, an answer of a 'volumetric pipette' was also creditworthy. 'Pipette' was insufficient.

08.2 Around 90% of students correctly identified the hazard in the investigation.

08.3 For this calculation, about 45% of students scored 5 marks and 20% of students scored 4 marks. A common mistake was to calculate *L* using one of the masses given in the question, rather than the change in mass. The resulting numerical answer would score zero as the equation was not being used correctly.

08.4 About 15% of students scored 2 marks for this explanation and 10% of students scored 1 mark. Many students reached incorrect conclusions and many students simply reworded the information given in the question.

08.5 7% of students scored 2 marks and 3% of students scored 1 mark. Many students reached incorrect conclusions and many students reworded the information given in the question without adding to it.

Question 9 (High demand)

09.1 Approximately 55% of students scored 5 marks, but in the 2022 series students were provided with an Equations Sheet with all the equations. A commonly seen answer was 73 500, which scored 4 marks for not converting the height into metres.

09.2 5% scored 2 marks and about 30% scored 1 mark. Many students failed to score a mark by pointing to the 'inaccuracy of the measured mass / height / gravitational field strength', or referring to the measurements as being 'low resolution'. 'Mass may have been greater than 60 kg' or 'time may have been longer / shorter than 1.40 seconds' were other common incorrect answers.

09.3 About 75% of students identified the correct conclusion.

Question 10 (High demand)

10.1 About 45% of students scored 6 marks for this extended calculation, but in the 2022 series students were provided with an Equations Sheet with all the equations. Therefore, students were supported when it came to attempting this question. With an alternative approach using equations from paper 2, students' answers were marked on whichever approach brought them closest to the correct final answer. An answer of 6 m/s with no supporting working did not score full marks as students could achieve this answer by multiplying the spring constant and the extension together, which would give them the maximum force acting on the toy aeroplane.

10.2 About 65% of students scored the mark. The most common incorrect answers seen were gravitational potential or elastic potential.

10.3 Approximately 20% of students scored a mark. Many students failed to score a mark because they gave a factor without a specific change e.g. 'extension of spring', rather than 'increase the extension of the spring'.

Question 11 (High demand)

Due to incorrect Advance Information guidance being issued for this question, and to avoid students being disadvantaged, Question 11 was discounted and all students were awarded full (9) marks.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account of 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.