AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.1.2

Contact and non-contact forces

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**22**
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.

4.5.1.2 Contact and non-contact forces

Answer 01 · Mark scheme June 2004 | 3451H | Original Q5 | Legacy

The full source mark scheme begins on page 43. Follow original question 5 in that document.

Answer 02 · Mark scheme June 2004 | 3462H3 | Original Q5 | Legacy

The full source mark scheme begins on page 64. Follow original question 5 in that document.

Answer 03 · Mark scheme November 2007 | PHY1A | Original Q1 | Legacy

One	**A**	gravitational potential energy	**1**
	B	kinetic energy	**2**
	C	light energy	**4**
	D	thermal energy	**3**

4.5.1.2 Contact and non-contact forces

Answer 04 · Mark scheme January 2010 | PHY3H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	distance (from the Sun in millions of km) and time taken for orbit	both required in either order **not** just 'time taken'	1
1(b)(i)	**either** distance (from the Sun in millions of km) **or** time taken for orbit (and) (average) temperature	 **not** just 'time taken' both required in either order	1
1(b)(ii)	(+) 430 / (+) 470 **or** Mercury / Venus		1
1(c)	25 (hours)	do **not** accept 24 (hours)	1
1(d)	...different positions at different times		1
1(e)	…direction…speed gravitational	both and in the correct order	1 1
Total			**7**

4.5.1.2 Contact and non-contact forces

Answer 04 · Mark scheme

January 2010 | PHY3H | Original Q1 | Legacy

PHY3H

4.5.1.2 Contact and non-contact forces

Answer 05 · 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**

4.5.1.2 Contact and non-contact forces

Answer 05 · Mark scheme

June 2012 | PH2HP | Original Q1 | Legacy

PH2HP

4.5.1.2 Contact and non-contact forces

Answer 06 · Mark scheme

June 2012 | PH2HP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	750	allow **1** mark for correct substitution, ie 75 x 10 provided no subsequent steps shown	2
	newton(s) / N	do **not** accept n	1

3(b)				6
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 2, and apply a 'best-fit' approach to the marking.				
0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**	
No relevant content.	There is a brief attempt to explain why the velocity / speed of the parachutist changes. **or** the effect of opening the parachute on velocity/speed is given.	The change in velocity/ speed is clearly explained in terms of force(s) **or** a reasoned argument for the open parachute producing a lower speed.	There is a clear and detailed explanation as to why the parachutist reaches terminal velocity **and** a reasoned argument for the open parachute producing a lower speed	

Question 3 continues on the next page . . .

PH2HP

Question 3 continued

question	answers	extra information	mark
3(b) (cont)	**examples of the physics points made in the response to explain first terminal velocity** • on leaving the plane the only force acting is weight (downwards) • as parachutist falls air resistance acts (upwards) • weight greater than air resistance **or** resultant force downwards • (resultant force downwards) so parachutist accelerates • as velocity / speed increases so does air resistance • terminal velocity reached when air resistance = weight **to explain second lower terminal velocity** • opening parachute increases surface area • opening parachute increases air resistance • air resistance is greater than weight • resultant force acts upwards / opposite direction to motion • parachutist decelerates / slows down • the lower velocity means a reduced air resistance • air resistance and weight become equal but at a lower (terminal) velocity	accept gravity for weight throughout accept drag / friction for air resistance accept terminal velocity reached when forces are balanced	

Question 3 continues on the next page . . .

PH2HP

Question 3 continued

question	answers	extra information	mark
3(c)(i)	any **one** from: • mass/weight of the (modelling) clay • material parachute made from • number / length of strings	 accept size/amount/volume/ shape of clay accept plasticine for (modelling) clay accept same (plastic) bag	1
3(c)(ii)	**C** smallest (area) so falls fastest (so taking least time)	reason only scores if **C** is chosen accept quickest/quicker for fastest if **A** is chosen with the reason given as 'the largest area so falls slowest' this gains **1** mark	1 1
Total			**12**

4.5.1.2 Contact and non-contact forces

Answer 06 · Mark scheme

June 2012 | PH2HP | Original Q3 | Legacy

PH2HP

Answer 07 · Mark scheme

June 2015 | PH2HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
6(a)(i)	decreases (to zero) resultant force acts in opposite direction to motion	 accept air resistance and weight for resultant force accept resultant force acts downwards do **not** accept air resistance increases	1 1	AO1 2.1.1c/e	**E**
6(a)(ii)	velocity includes direction **or** velocity is a vector (quantity)		1	AO1 2.1.2d	**E**
6(b)(i) mark with 6bii 6biii	3.6	allow **1** mark for correct substitution i.e. ½ x 0.05 x 12^2 provided no subsequent step	2	AO2 2.2.1g	**E**
6(b)(ii) mark with 6bi, 6biii	3.6 **or** their (b)(i)		1	AO1 2.2	**E**
6(b)(iii) mark with 6bi, 6bii	7.2 **or** their (b)(ii) ÷ 0.5 correctly calculated	allow **1** mark for correct substitution i.e. 3.6 or their (b)(ii) = 0.05 x 10 x h	2	AO2 2.2.1f	**E**
6(b)(iv)	**B**		1	AO3 2.1	**A**
6(c)	range increases up to 45° range decreases from 45°	 the range is a maximum at 45° gains both marks for any two angles that add up	1 1	AO3 2.1	**E**

4.5.1.2 Contact and non-contact forces

Answer 07 · Mark scheme

		to 90° the range is the same gains both marks the range increases then decreases gains **1** mark			
Total			**11**		

4.5.1.2 Contact and non-contact forces

Answer 08 · 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**	

4.5.1.2 Contact and non-contact forces

Answer 08 · Mark scheme

June 2016 | PH2HP | Original Q5 | Legacy



4.5.1.2 Contact and non-contact forces

Answer 09 · Mark scheme

June 2018 | 8463/1H | Original Q1

Question	Answers	Extra information	Mark	AO/ Spec. Ref
01.1	transfer of electrons	mention of positive charge moving negates both marks	1	AO1 4.2.5.1
	from the carpet to the student		1	
01.2	three arrows perpendicular to sphere's surface with all arrows directed inwards and distributed evenly around sphere		1	AO1 4.2.5.2
01.3	there is a potential difference between the student and the tap	do **not** accept the tap / sink is charged	1	AO1 4.2.1.2 4.2.1.3
	which causes electrons / charges to transfer from the student **or** which causes electrons / charges to transfer to the tap		1	4.2.5.1
	which earths the charge	allow the tap is earthed	1	
01.4	carpet / copper has a low resistance	allow carpet is a conductor **or** copper is a conductor	1	AO3 4.2.5.1 4.2.1.3
	lower / no build-up of charge (on the student) **or** (so there is a) smaller / no potential difference between student and tap / earth		1	
Total			8	

4.5.1.2 Contact and non-contact forces

Answer 10 · Mark scheme

June 2018 | 8463/1H | Original Q4

Question	Answers	Extra information	Mark	AO/ Spec. Ref
04.1	chemical	in this order only	1	AO1 4.1.1.1
	equal to	allow the same as	1	
04.2	power = $\frac{\text{work done}}{\text{time}}$	allow P = $\frac{W}{t}$	1	AO1 4.1.1.4
04.3		an answer of 360 000 (J) scores **3** marks		AO2 4.1.1.4
	200 = $\frac{W}{1800}$		1	
	W = 200 × 1800		1	
	W = 360 000 (J)		1	
04.4		an answer that rounds to 15.8 (%) scores **2** marks		AO2 4.1.1.1
	11 – 9.5 = 1.5 (m/s)	allow a change in speed between 1.2 and 1.5 (m/s)	1	
	$\left(\frac{1.5}{9.5}\right)$ × 100 = 15.8 (%)	allow an answer consistent with their change in speed	1	
		an answer of 16 (%) scores **2** marks		
04.5	maximum speed is lower		1	AO1 4.1.1.4
	because maximum power output of cyclist is constant	allow maximum force on pedals is constant	1	
	(but) additional work is done (against gravity) **or** gravitational potential energy (of cyclist) is increased	do **not** accept additional work done against friction or air resistance	1	
Total			**11**	

4.5.1.2 Contact and non-contact forces

Answer 11 · Mark scheme

June 2018 | 8463/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	uniform acceleration	allow constant / steady acceleration allow velocity / speed increasing at a constant rate ignore reference to direction acceleration scores **1** mark **or** velocity / speed is increasing scores **1** mark do **not** accept acceleration increases	2	AO1 4.5.6.1.5
01.2	up(wards)		1	AO1 4.5.6.1.5
01.3	a group of objects that interact		1	AO1 4.1.1.1
01.4	velocity just after bounce is less than just before bounce **or** the height at the top of the bounce is less than the height from which it was dropped	allow velocity is less / decreases allow speed for velocity velocity decreases to zero – on its own scores zero	1	AO3 4.5.6.1.5
	so the ball has lost energy		1	AO1 4.1.1.2
	correct reference to (loss of) ke or (reduced) gpe		1	AO1 4.1.2.1
	total energy of ball and Earth / ground is constant	allow 'a system' for ball and Earth allow energy is conserved	1	AO1 4.1.2.1
Total			**8**	

4.5.1.2 Contact and non-contact forces

Answer 12 · 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		

4.5.1.2 Contact and non-contact forces

Answer 12 · Mark scheme

June 2018 | 8463/2H | Original Q2

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

4.5.1.2 Contact and non-contact forces

Answer 12 · Mark scheme

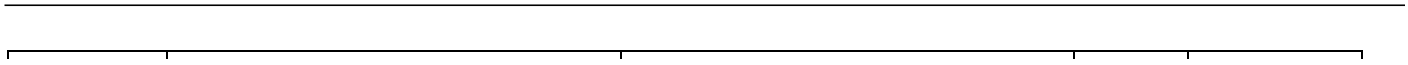
June 2018 | 8463/2H | Original Q2

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**	

4.5.1.2 Contact and non-contact forces

Answer 12 · Mark scheme

June 2018 | 8463/2H | Original Q2



4.5.1.2 Contact and non-contact forces

Answer 13 · Mark scheme June 2018 | 8463/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	arrow of equal size pointing vertically upwards	judged by eye ignore horizontal arrows if equal and opposite horizontal arrows of unequal length negates this mark	1	AO2 4.5.1.4
	labelled 'upthrust'	ignore buoyancy ignore 25 kN	1	AO1 4.5.5.1.2
06.2		an answer of 2600 scores **4** marks		
	weight = 25 kN	allow 24 to 25 kN inclusive	1	AO3
	25 000 = mass x 9.8 **or** $m = \frac{25\,000}{9.8}$	allow their W correctly converted and substituted	1	AO2
	m = 2551 kg	allow correctly calculated value using their converted W allow a value correctly calculated with W in kN	1	AO2
	m = 2600 kg	allow a calculated answer correctly rounded to 2 significant figures	1	AO2 4.5.1.1 4.5.1.3
06.3	Newton's 3rd law (of motion)		1	AO1 4.5.6.2.3

4.5.1.2 Contact and non-contact forces

Answer 13 · Mark scheme

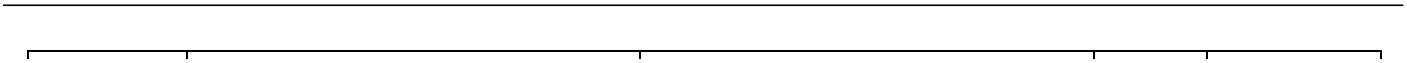
June 2018 | 8463/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	vertical force (50 N) drawn **and** horizontal force (150 N) drawn to the same scale		1	AO2 4.5.1.4
	resultant tension force in the correct direction	shown by an arrowhead	1	
	value of the tension force in the range 156 N–160 N	allow a calculated value of 158	1	
	value of direction in the range 18°–20° (from the horizontal)	allow 70° to 72° (from the vertical) allow a bearing in the range 288 to 290	1	
Total			**11**	

4.5.1.2 Contact and non-contact forces

Answer 13 · Mark scheme

June 2018 | 8463/2H | Original Q6



4.5.1.2 Contact and non-contact forces

Answer 14 · Mark scheme

June 2019 | 8463/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2.1	metre rule	allow metre ruler allow tape measure do not accept ruler do not accept metre stick	1	AO1/2 4.6.1.2 RPA8
2.2	(wave) speed = frequency × wavelength	allow v = f λ	1	AO1/1 4.6.1.2 RPA8
2.3	 80cm = 0.8m v = 55 × 0.8 v = 44 (m/s)	an answer of 44 (m/s) scores **3** marks this mark may be awarded if wavelength is incorrectly or not converted allow correct calculation using an incorrectly or not converted wavelength an answer of 4400 (m/s) scores **2** marks	 1 1 1	AO2/1 4.6.1.2 RPA8
2.4	move the (wooden) bridge to the right OR change the mass/weight (on the string) scores **1** mark add more masses/weights (to the string) scores both marks	 dependent on 1st mp being scored	1 1	AO2/2 4.6.1.2 RPA8

4.5.1.2 Contact and non-contact forces

Answer 14 · Mark scheme

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

Answer 15 · Mark scheme

November 2021 | 8463/2H | Original Q2

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…		

Answer 15 · Mark scheme

November 2021 | 8463/2H | Original Q2

	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

4.5.1.2 Contact and non-contact forces

Answer 15 · Mark scheme

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**

4.5.1.2 Contact and non-contact forces

Answer 16 · Mark scheme

June 2022 | 8463/1H | Original Q10

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		

4.5.1.2 Contact and non-contact forces

Answer 16 · Mark scheme

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**

4.5.1.2 Contact and non-contact forces

Answer 17 · Mark scheme

June 2022 | 8463/2HR | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any **two** from: • capacity of the battery • speed • mass / weight • uphill / downhill • stopping at traffic lights • condition of the road • (air) temperature • (incorrect) tyre pressure • streamlining of the car	allow energy/charge stored in battery allow efficiency of battery ignore size of battery allow terrain ignore 'the road' only ignore 'weather' only allow efficiency of engine allow anything that would use charge from the battery **or** anything that will reduce the energy stored	2	AO3 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	acceleration = change in velocity/time (taken) **or** $a = \frac{\Delta v}{t}$	allow any correct rearrangement allow $a = \frac{v - u}{t}$ do **not** accept $a = \frac{v}{t}$	1	AO1 4.5.6.1.5

4.5.1.2 Contact and non-contact forces

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$20 = \frac{28}{t}$ $t = \frac{28}{20}$ 1.4 (s)		1 1 1	AO2 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	v^2 (- 0^2) = 2 × 10 × 605 v^2 = 12 100 v = 110 (m/s)		1 1 1	AO2 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	work done = force × distance **or** $W = Fs$	allow any correct rearrangement	1	AO1 4.5.2

4.5.1.2 Contact and non-contact forces

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	*s* = 7500 (m)		1	AO2 4.5.2
	W = 4000 × 7500	allow correct substitution using incorrectly / not converted value of s	1	
	W = 30 000 000 (J)	allow correct calculation using incorrectly / not converted value of s	1	

Total Question 1		13

4.5.1.2 Contact and non-contact forces

Answer 18 · 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

4.5.1.2 Contact and non-contact forces

Answer 18 · 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	
	$k = \frac{4.0}{(0.5 \times 0.080^2)}$	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

4.5.1.2 Contact and non-contact forces

Answer 19 · Mark scheme

June 2023 | 8463/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	7.1 (cm) 497 (m)	allow 7.0 to 7.3 (cm) allow 70 × their incorrect measurement of displacement	1 1	AO2 4.5.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	0 (N)		1	AO2 4.5.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	constant velocity	allow constant speed (in a straight line) do **not** accept stationary allow constant acceleration if a **mathematical error** in 02.2 gives a non-zero value for resultant force	1	AO1 4.5.6.2.1

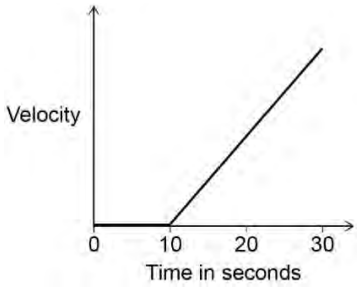
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **one** from: • tension • normal contact (force) • upthrust	allow lift, thrust and water resistance allow normal reaction (force) ignore drag	1	AO1 4.5.1.2

4.5.1.2 Contact and non-contact forces

Answer 19 · Mark scheme

June 2023 | 8463/2H | Original Q2

Question	Answers		Mark	AO / Spec. Ref.
02.5	horizontal line drawn to 10s along the *x*-axis		1	AO3 4.5.6.1.4
	line with a positive gradient starting from 10 s	allow an upward curving line with increasing gradient starting from 10 s	1	



Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	line of best fit drawn and extrapolated to 10 km	do **not** accept a straight line	1	AO2 4.5.5.2
	28 (kPa)	allow 26 to 32 (kPa) allow a value correctly extrapolated from their line allow 2 marks for a correct mathematically extrapolated value	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	the average density of the air above the aeroplane decreases		1	AO3 4.5.5.2

Total Question 2	10

Answer 20 · 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 21 · 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	
	$v^2 = \frac{0.18}{0.5 \times 0.052}$	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	

Answer 21 · Mark scheme

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**

4.5.1.2 Contact and non-contact forces

Answer 22 · 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 22 · 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

GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics Specification B
3451/F

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

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

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4.5.1.2 Contact and non-contact forces

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4.5.1.2 Contact and non-contact forces

GCSE PHYSICS

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

3. Marking points

3.1 Marking of Quality of Written Communication

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

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

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

3.2 Marking of lists

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

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

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

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

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

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

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

3.3 Use of chemical symbols/formulae

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

3.4 The marking of quantitative relationships

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

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

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

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

3.5 Marking procedure for calculations

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

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

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

3.6 Interpretation of 'it'

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

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3.7 Errors carried forward

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

Examples

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

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

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

3.8 Phonetic spelling

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

3.9 Brackets

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

3.10 Interpretation of marginal points

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

3.11 Unexpected Correct Answers not in the Mark Scheme

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

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4.5.1.2 Contact and non-contact forces

GCSE Physics
Foundation Tier 3451/F

3451F Q1

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

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4.5.1.2 Contact and non-contact forces

3451F Q2

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

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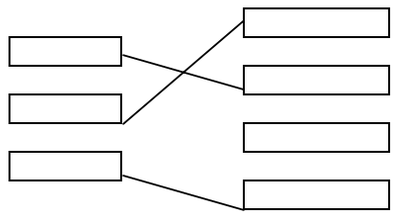
4.5.1.2 Contact and non-contact forces

3451F Q3

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

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4.5.1.2 Contact and non-contact forces

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 connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept petrol for (petrol vapour) accept catch fire for explode accept ground for earth	1 1
(c)	**Quality of written communication** any **two** from: • when current greater than fuse rating / value • fuse (becomes hot and) melts / burns out • circuit is broken	for a logical sequence accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity accept fuse blows / breaks accept circuit switched off this cannot score credit on its own	1 2
total			8

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4.5.1.2 Contact and non-contact forces

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

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4.5.1.2 Contact and non-contact forces

3451F Q6

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

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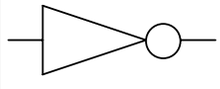
4.5.1.2 Contact and non-contact forces

3451F Q7

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

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4.5.1.2 Contact and non-contact forces

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

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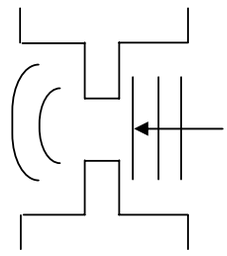
4.5.1.2 Contact and non-contact forces

3451F Q9

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

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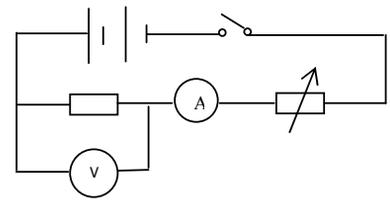
4.5.1.2 Contact and non-contact forces

3451F Q10

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

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4.5.1.2 Contact and non-contact forces

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

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4.5.1.2 Contact and non-contact forces

3451F Q12

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

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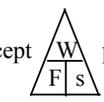
4.5.1.2 Contact and non-contact forces

3451F Q13

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

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4.5.1.2 Contact and non-contact forces

3451F Q14

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

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4.5.1.2 Contact and non-contact forces

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	1
	… (both) inputs are on / high / 1 **or** current flows in both inputs	do **not** accept numerical values unless expanded	1
(b)	**Quality of written communication**	If in a sensible order which clearly indicates advantages or disadvantages, including answers in the form of a table **or** as bullet points Q ✓ Q X	1
	any **three** from: • advantage of mobile phones • drawback of mobile phones • benefit of the Internet • drawback of the Internet	 e.g. more convenient for service engineers e.g. calls can be received away from base e.g. privacy can be more easily invaded e.g. drivers can be distracted e.g. microwaves / radio waves can / may cause damage to the brain e.g. access to educational material e.g. some material is salacious e.g. spam (on external e-mail) these are examples candidates may be credited for a variety of responses	3
total			10

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4.5.1.2 Contact and non-contact forces

3451F Q16

question	answers	extra information	mark
(a)	**Y** and **Z**		1
	they have the same number of protons **or** same atomic number	accept they have the same number of electrons **or** same number of protons **and** electrons allow only different in number of neutrons N.B. independent marks	1
(b)	**Quality of written communication**	for correct use of terms underlined in B **or** C Q ✓ Q X	1
	A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus B – alpha particle <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> by the (positive) <u>nucleus</u> C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards	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	max 2
total			5

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GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

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

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

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

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4.5.1.2 Contact and non-contact forces

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4.5.1.2 Contact and non-contact forces

SCIENCE: DOUBLE AWARD CO-ORDINATED

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

3. Marking points

3.1 Marking of Quality of Written Communication

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

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

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

3.2 Marking of lists

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

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

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

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

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

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

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

3.3 Use of chemical symbols/formulae

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

3.4 The marking of quantitative relationships

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

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

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

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

3.5 Marking procedure for calculations

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

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

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

3.6 Interpretation of 'it'

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

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4.5.1.2 Contact and non-contact forces

3.7 Errors carried forward

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

Examples

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

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

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

3.8 Phonetic spelling

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

3.9 Brackets

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

3.10 Interpretation of marginal points

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

3.11 Unexpected Correct Answers not in the Mark Scheme

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

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4.5.1.2 Contact and non-contact forces

Double Award
Foundation Tier 3462/3F

3462/3F Q1

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

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4.5.1.2 Contact and non-contact forces

3462/3F Q2

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

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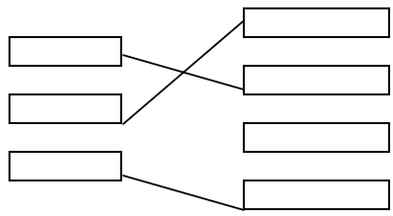
4.5.1.2 Contact and non-contact forces

3462/3F Q3

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

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4.5.1.2 Contact and non-contact forces

3462/3F Q4

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

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4.5.1.2 Contact and non-contact forces

3462/3F Q5

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

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4.5.1.2 Contact and non-contact forces

3462/3F Q6

question	answers	extra information	mark
(a)	60		1
(b)	$5\frac{1}{2}$ hours	must include unit	1
(c)	30		1
(d)	30 minutes or $\frac{1}{2}$ hour	must include unit	1
(e)	D **and** E	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

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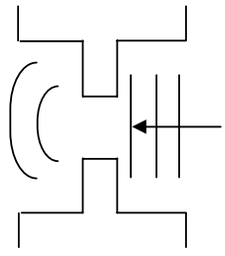
4.5.1.2 Contact and non-contact forces

3462/3F Q7

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

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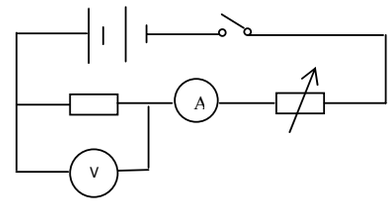
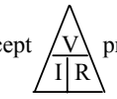
4.5.1.2 Contact and non-contact forces

3462/3F Q8

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

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4.5.1.2 Contact and non-contact forces

3462/3F Q9

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

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4.5.1.2 Contact and non-contact forces

3462/3F Q10

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

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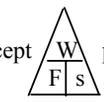
4.5.1.2 Contact and non-contact forces

3462/3F Q11

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

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4.5.1.2 Contact and non-contact forces

3462/3F Q12

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

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4.5.1.2 Contact and non-contact forces

Answer 11 · Examiner comments

June 2018 | 8463/2H | Original Q1

Question 1 (Standard demand)

01.1 Most of the students realised that the falling ball was accelerating or speeding up, but few wrote that the ball was accelerating at a constant rate. Some students did try to explain this, however they were often unable to express this uniform acceleration clearly. Phrases such as “accelerating at a constant speed” were common and did not score any marks.

01.2 Just over 70% of the students understood that the ball would be moving upwards.

01.3 Most of the students understood what is meant by ‘a system’ with nearly 90% choosing the correct answer.

01.4 Only about half of the students realised that the velocity of the ball was reduced after the bounce or that the ball would not reach the height it was dropped from. If this was written it was generally followed by a statement that repeated the stem of the question; the energy was transferred to the ground. Those students that did state that energy was lost from the ball did often refer to this as kinetic energy. Students often stated that as the velocity became more and more negative, the ball was continuing to slow down.

4.5.1.2 Contact and non-contact forces

Answer 12 · 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)

4.5.1.2 Contact and non-contact forces

Answer 13 · Examiner comments

June 2018 | 8463/2H | Original Q6

Question 6 (Standard/**high** demand)

06.1 Most students knew there should be two arrows in opposite directions and there was evidence of attempts by most to use a ruler and to make the arrows the same length. Most put arrow heads on their lines. A small number of students did not know that the arrows should start from the same point and drew them on a diagram of the boat. Most students added a label but only 50% of the students used 'upthrust'. Incorrect labels included gravity, water resistance, buoyancy, air resistance, drag and upward pressure.

06.2 Many students used the values 24, 24.5 or 25 kN and so knew how to use the scale correctly. A common incorrect value was 5 kN. A wide variety of marks were given for values not in the range but correctly used. In general the conversion to newtons was done correctly, but a significant number of students did not do the conversion. A number of students were unable to re-arrange W = mg correctly.

06.3 Just over 64% of the students identified the correct law.

06.4 9% of the students scored all four marks. Most drew two lines to scale, usually with the 150N horizontal, but sometimes vertical. Many lines did not have arrows to indicate the direction of the forces and it was rare for the resultant force to have an arrow drawn. Values for the tension force were often obtained by calculation rather than scale drawing. Few students measured the direction of the force from the diagram and gave vague compass directions with no numerical angle.

Answer 14 · Examiner comments

June 2019 | 8463/2H | Original Q2

Question 2 (Standard demand)

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

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

4.5.1.2 Contact and non-contact forces

Answer 14 · Examiner comments June 2019 | 8463/2H | Original Q2

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

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

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

Answer 15 · 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.

4.5.1.2 Contact and non-contact forces

Answer 18 · 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 18 · 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.

4.5.1.2 Contact and non-contact forces

Answer 19 · Examiner comments

June 2023 | 8463/2H | Original Q2

02.1

58% of students calculated the displacement correctly. Those who did not gain the mark simply measured the route taken by the aircraft and scaled that distance up, showing that many students do not appreciate the difference between displacement and distance.

02.2

82% of students successfully calculated the resultant force to be zero.

02.3

Having successfully calculated the resultant force to be zero, few students stated that the plane was moving at a constant speed. Many said it was stationary or accelerating, not appreciating the lack of resultant force.

02.4

Students did not appear to understand the concept of a contact force, often quoting gravity as one. In addition, they gave forces already quoted in the question as answers.

02.5

This was successfully done by the majority of students, with 64% correctly linking distance and velocity and drawing correct graphs.

02.6

The minority attempted to draw a smooth curve and extrapolate this to the 10km line. Those who did generally used the graph correctly, with 44% of students gaining both marks. A number of students misread the scale on the graph and quoted incorrect values from their line. It was common to see a straight line, which often allowed the award of 1 mark for a correct reading of the value.

02.7

84% of students knew that as the height of the aeroplane above the ground increased, the average density of the air decreased.

4.5.1.2 Contact and non-contact forces

Answer 20 · 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.

4.5.1.2 Contact and non-contact forces

Answer 21 · 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.

4.5.1.2 Contact and non-contact forces

Answer 21 · 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.

4.5.1.2 Contact and non-contact forces

Answer 22 · 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

4.5.1.2 Contact and non-contact forces

Answer 22 · 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.

4.5.1.2 Contact and non-contact forces

AQA

GCSE
PHYSICS

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

8463
June 2022

Version: 1.0

4.5.1.2 Contact and non-contact forces

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4.5.1.2 Contact and non-contact forces

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.

4.5.1.2 Contact and non-contact forces

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.

4.5.1.2 Contact and non-contact forces

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.