AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.1.3

Gravity

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**6**
Available paper years	**2019–2024**

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.

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Answer 01 · Mark scheme

June 2019 | 8464/P/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	force ∝ extension		1	AO1 6.5.3	A
05.2	F = 0.49 × 1 200 **or** F = 588 (N) 588 = m × 9.8 $m = \frac{588}{9.8}$ m = 60 (kg) **OR** 0.49 = mean mass per spring × 9.8 (1) mean mass per spring = $\frac{0.49}{9.8}$ (1) mean mass per spring = 0.050 (1) m = 0.050 × 1200 = 60 (kg) (1)	an answer of 60 (kg) scores **4** marks allow a correct substitution using an incorrectly calculated value of F allow a correct rearrangement using an incorrectly calculated value of F allow a correct calculation using an incorrectly calculated value of F	1 1 1 1	AO2 6.5.1.3	E
05.3	$0.49 = k \times 3.5 \times 10^{-3}$ $k = \frac{0.49}{3.5 \times 10^{-3}}$ 140 N/m	an answer of 140 scores **3** calculation marks	1 1 1 1	3 x AO2 1 x AO1 6.5.3	E

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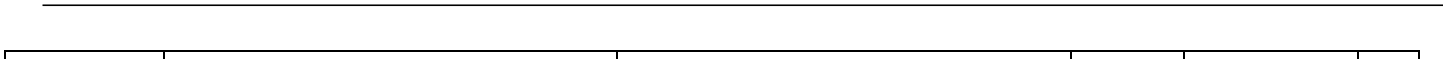
Answer 01 · Mark scheme

05.4	springs with a low spring constant because they can compress by a larger amount (for a given force)	 allow they can compress by the same amount for a smaller force allow low stiffness	1 1	AO3 6.5.3	E
Total			**11**		

6.5.1.3 Gravity

Answer 01 · Mark scheme

June 2019 | 8464/P/2H | Original Q5



6.5.1.3 Gravity

Answer 02 · Mark scheme

November 2020 | 8464/P/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	iron and steel will be attracted (to the magnet) aluminium, copper and tin will not be attracted (to the magnet)	 allow **1** mark is one metal is in the incorrect list, but all the other four are correct if no other mark awarded allow **1** mark for iron and steel are magnetic	1 1	AO1 6.7.1.1
01.2	the paperclip would still be attracted to the magnet because of induced magnetism	 allow the paper clip becomes an induced magnet allow because the paper clip is a temporary magnet allow there is a magnetic field at the south pole	1 1	AO1 6.7.1.1
01.3	weight = mass × gravitational field strength or W = mg	do not accept gravity for gravitational field strength	1	AO1 6.5.1.3
01.4	1.0 g = 0.0010 kg weight of 1 paperclip = 0.0010 × 9.8 Force = 0.0098 x 20 = 0.196 (N)	allow 0.001 (kg) allow 0.0098 (N) allow correct substitution using incorrectly/not converted value of mass of paperclip allow correct calculation using incorrectly/not converted value of mass of paperclip	1 1 1	AO2 6.5.1.3

6.5.1.3 Gravity

Answer 02 · Mark scheme

November 2020 | 8464/P/2H | Original Q1

Total			**8**	

6.5.1.3 Gravity

Answer 03 · Mark scheme

November 2021 | 8464/P/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	solar	allow biofuel / biodiesel allow wave power	1	AO1 6.1.3
03.2	sometimes there is no wind (but the battery can still be charged using the generator) when there is wind less fuel is burned	allow if the generator breaks then the turbine can still generate electricity allow a disadvantage of burning fossil fuel	1 1	AO1 6.1.3
03.3	carbon dioxide increases global warming **OR** sulfur dioxide or NOx emissions (1) increases acid rain (1) **OR** particulates or NOx emissions (1) can harm living organisms (1)	 allow increases the greenhouse effect	1 1	AO1 6.1.3

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Answer 03 · Mark scheme

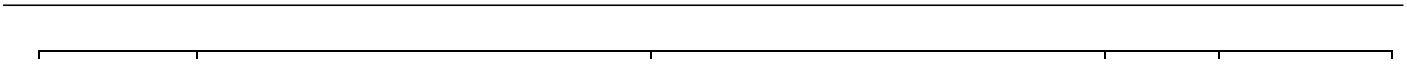
November 2021 | 8464/P/1H | Original Q3

03.4	81 kJ = 81 000 J $81000 = 0.5 \times 8000 \times v^2$ $v = \sqrt{\frac{81\,000}{0.5 \times 8000}}$ v = 4.5 (m/s)	 allow a correct substitution using an incorrectly/not converted value of energy allow a correct re-arrangement using an incorrectly/not converted value of energy allow a correct calculation using an incorrectly/not converted value of energy	1 1 1 1	AO2 6.1.1.2
03.5	$19600 = 8000 \times 9.8 \times \Delta h$ $\Delta h = \frac{19\,600}{8000 \times 9.8}$ $\Delta h = 0.25$ m		1 1 1	AO2 6.1.1.2
Total			**12**	

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Answer 03 · Mark scheme

November 2021 | 8464/P/1H | Original Q3



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Answer 04 · Mark scheme

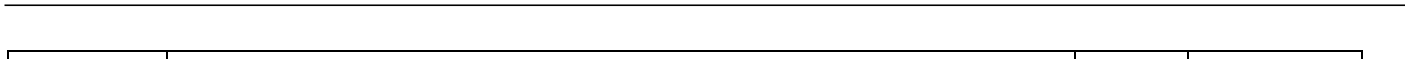
November 2021 | 8464/P/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	a quantity with both magnitude and direction		1	AO1 6.5.1.1
02.2	displacement		1	AO1 6.5.4.1.1
02.3	gradient = $\frac{(4 - 0)}{(1.6 - 0)}$ acceleration = 2.5 m/s^2	 allow use of a = Δv / t	1 1	AO2 6.5.4.1.5
02.4	constant deceleration	allow large deceleration allow decelerates to a stop	1	AO2 6.5.4.1.5
02.5	resultant force = mass × acceleration **or** F = ma	allow force = mass × acceleration	1	AO1 6.5.4.2.2
02.6	1800 = m × 25 m = $\frac{1800}{25}$ m = 72 (kg)		1 1 1	AO2 6.5.4.2.2
02.7	performance can be monitored during the game	allow do not have to wait until the end of the game to download data	1	AO3 6.6.2.4
Total			**10**	

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Answer 04 · Mark scheme

November 2021 | 8464/P/2H | Original Q2



Answer 05 · Mark scheme

June 2023 | 8464/P/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	the measurement will be more accurate	allow parallax error is reduced	1	AO3
	because (in position B) the eye is level with (the maximum height of) the toy		1	AO1 6.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	64 cm = 0.64 m		1	AO2 6.1.1.2
	$0.049 = m \times 9.8 \times 0.64$	allow a correct substitution using an incorrectly / not converted height	1	
	$m = \frac{0.049}{9.8 \times 0.64}$	allow a correct rearrangement using their incorrectly / not converted height	1	
	$m = 0.0078125$ (kg)	allow an answer consistent with their incorrectly / not converted height	1	
	$m = 0.0078$ (kg)	this mark can only be scored if the equation $E_p = m\ g\ h$ has been used	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	energy from the toy is dissipated (to the surroundings / air)	allow energy from the toy is transferred to the surroundings / air	1	AO1 6.1.2.1 6.1.1.1
	(but) in a closed system the total energy remains constant		1	

Total Question 5	9

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Answer 06 · Mark scheme

June 2024 | 8464/P/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	chemical store of energy decreases gravitational potential energy of the drone increases		1 1	AO2 6.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	$3920 = 2.5 \times 9.8 \times \Delta h$ $\Delta h = \frac{3920}{2.5 \times 9.8}$ $\Delta h = 160$ (m) $(840 - 160) = 680$ (m) **OR** Initial $E_p = 2.5 \times 9.8 \times 840$ (1) Final $E_p (= 20580 - 3920) = 16660$ (1) $h = \frac{16660}{2.5 \times 9.8}$ (1) = 680 (m) (1)	 allow an answer consistent with their calculated value of Δh using the correct equation allow initial $E_p = 20580$ allow correct use of an incorrectly calculated value of E_p using the gravitational potential energy equation allow a correct substitution and rearrangement using their calculated value of E_p using the gravitational potential energy equation allow an answer consistent with their calculated value of E_p using the gravitational potential energy equation	1 1 1 1	AO2 6.1.1.2

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Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	max E_k = 3920 + 150 (= 4070 J)	allow max E_k = 4070 J	1	AO2 6.1.1.2
	$4070 = 0.5 \times 2.5 \times v^2$	allow a substitution using their value for kinetic energy	1	
	$v = \sqrt{\frac{4070}{0.5 \times 2.5}}$	allow a correct re-arrangement using their value for kinetic energy allow $v^2 = \frac{4070}{0.5 \times 2.5}$	1	
	v = 57.06… (m/s)	allow v = 57 (m/s)	1	
	v = 0.057… (km/s)	allow an answer consistent with their calculated value for v using the kinetic energy equation	1	

Total Question 4	**11**

6.5.1.3 Gravity

Answer 03 · Examiner comments — November 2021 | 8464/P/1H | Original Q3

Question 03 (Standard/high demand)

03.1 Slightly over half of students answered correctly. The most common incorrect answer was to suggest that the boat could utilise tidal power.

03.2 It appeared that some students did not assimilate all of the information in the question, with answers stating that the boat can move using the generator. It was also fairly common for students to describe why using wind power is beneficial, but not to give reasons why it is useful to have both a wind turbine and a generator. Approximately 15% of students gained both marks, with nearly 60% gaining at least 1 mark.

03.3 This question proved to be accessible to all students, and differentiated well between them. Approximately a third of students gained both marks, a third gained one mark, and a third of students gained no marks.

03.4 Many students did not convert 81 kJ into J. Re-arranging the kinetic energy equation to give *v* also caused problems for a fair proportion of students. Roughly one in four students gained at least 3 marks. Over half the students gained no marks at all.

Answer 03 · Examiner comments — November 2021 | 8464/P/1H | Original Q3

03.5 This calculation was carried out correctly by just over a third of students, with about 50% of students gaining no marks.

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Answer 04 · Examiner comments November 2021 | 8464/P/2H | Original Q2

Question 2 (standard demand)

02.1 85% of students knew that a vector was a quantity with both magnitude and direction.

02.2 50% of students knew that displacement was the vector.

02.3 Approximately 40% of students were able to determine the acceleration from the graph.

02.4 Just over 35% of students were able to describe the motion of the player. Of those that were unable to and scored no marks, most wrote answers such as 'the motion decreased'.

02.5 Just under 80% of students correctly recalled the equation.

02.6 This standard demand calculation was very well answered. Over 85% were able to substitute into the correctly rearranged equation, and the vast majority of those went on to correctly evaluate the answer and score full marks.

02.7 Nearly 25% of students wrote a reasonable suggestion that the data could be analysed during the game. Many of the incorrect answers suggested that the data could be analysed after the game.

Answer 05 · Examiner comments June 2023 | 8464/P/1H | Original Q5

Question 05 (Standard/high and high demand)

05.1 Around half of students gained at least 1 mark on this question. There were many acceptable ways to describe the toy being at eye level in position B. A fair number of students suggested that in position B the student could push down harder on the toy so that it would reach a greater height, which missed the point of the question and tended to score no marks.

05.2 About 85% of students gained at least 1 mark for this calculation, with about 20% scoring full marks, about 25% on 4 marks and about 15% on 3 marks. Most students did not attempt to convert the height into metres. Many students struggled to give the answer to 2 significant figures, perhaps caused by students not understanding how their calculators were giving the answer in standard form. So, for example, 7.8125×10^{-3} as an answer might have been rounded to 7.8 without any power of 10 shown.

Answer 05 · Examiner comments June 2023 | 8464/P/1H | Original Q5

05.3 Approximately a quarter of students scored at least 1 mark, with many not knowing how the specification defines a closed system.

Answer 06 · Examiner comments

June 2024 | 8464/P/1H | Original Q4

Question 4 (standard/high & high demand)

04.1 Many students just named energy stores and did not describe how the stores changed. A fair proportion of students stated that the kinetic energy of the drone would remain constant, which is not an incorrect statement, but is not a change to a store of energy so did not gain any credit. A small proportion of students referred to the chemical store of energy decreasing.

Approximately two-thirds of students gained at least 1 mark, although only about 10% of students scored both marks.

04.2 There were two routes that students could use to answer this question. Many students who took the first route got as far as the third marking point but then did not subtract their answer from 840 m.

Just under a third of students gained full credit, with slightly over half gaining 3 marks.

04.3 Most students omitted the first step in this calculation and did not add the 3920 J to the initial kinetic energy of the drone. However, marking point 2 could still be scored using any energy value when substituting into the kinetic energy equation. The most common approach was to use 150 J as the maximum kinetic energy.

A noticeable minority of students converted 2.5 kg into grams.

Some students forgot to square the speed when substituting into the equation. Other students struggled to re-arrange the equation. One relatively common mistake was to correctly rearrange the equation for v^2 (eg $v^2 = \frac{4070}{05 \times 2.5}$) but then square this value to determine v (eg $v = \left(\frac{4070}{0.5 \times 2.5}\right)^2$) rather than determining the square root.

A minority of students remembered to convert their final answer into km/s.

Almost 60% of students scored 2 marks, with only the highest-attaining students managing to gain 4 or 5 marks.

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6.5.1.3 Gravity

Answer 06 · Examiner comments June 2024 | 8464/P/1H | Original Q4

0 4 . 3 When the motor was switched off, the kinetic energy of the drone was 150 J.

Calculate the maximum possible speed of the drone when the motor was switched back on.

Use the Physics Equations Sheet.

Give your answer in km/s.

[5 marks]

Kinetic energy = 0.5 × mass × (speed)^2

150 = 0.5 × 2.5 × (speed)^2

2.5 × 100 = 250

150 = 0.5 × 250 × (speed)^2

0.5 × 250 = 125

150 ÷ 125 = 1.2

1.2^2 = 1.44

Maximum possible speed of drone = 1.2 km/s

This student has tried to use the kinetic energy equation but has made several errors along the way and, as a result, does not gain any marks.

The student used an incorrect value for the maximum kinetic energy, so does not score marking point 1.

Although a correct substitution of 150 J into the kinetic energy equation is shown in line 2 of the answer, the student has multiplied the mass by 100 in line 3 and then used the equation with the mass multiplied by 100 (line 4). It is the equation on line 4 that ultimately leads to the student's final answer. As an incorrect value for mass is used here, this is an incorrect substitution, so marking point 2 is not awarded.

On line 6, the student has rearranged the equation to give a value of 1.2, but the answer line demonstrates that the student thinks this is the maximum possible speed of the drone rather than a value for v^2, so marking point 3 is not scored.

The common mistake of squaring the calculated value of v^2 can be seen on line 7, but the student has chosen to ignore this line of reasoning when giving the final answer. The student has not attempted to convert the calculated speed of 1.2 m/s to km/s.

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