AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.4.1.5

Acceleration

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**14**
Available paper years	**2018–2024**

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.

6.5.4.1.5 Acceleration

Answer 01 · Mark scheme June 2018 | 8464/P/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec Ref.
01.1	its acceleration would decrease to zero the resultant force on it would decrease to zero		1 1	AO3 6.5.4.2.2
01.2	any **one** from: • move the second light gate closer to the first • shorten the string length	allow use a taller table	1	AO3 6.5.4.2.2
01.3		each mistake and its correction may be given in any order		AO3 6.5.4.2.2
	1.26667 (m/s^2) (is wrong)	allow (mean value calculated at) 0.20 (N)	1	
	give value to 2 significant figures	allow give value to 1 decimal place allow 1.3 (m/s^2)	1	
	6.7 (m/s^2) (is wrong)	allow (mean value calculated at) 0.98 (N) allow test 2 for 0.98 (N) or 7.2 is an anomaly	1	
	discard the anomalous result and recalculate the mean	allow repeat the anomalous test result and re-calculate the mean allow 6.4 (m/s^2)	1	
01.4	(resultant) force is directly proportional to acceleration	allow the larger the (resultant) force, the greater the acceleration allow positive correlation between (resultant) force and acceleration allow mass / weight (of the holder) for (resultant) force	1	AO3 6.5.4.2.2

6.5.4.1.5 Acceleration

Answer 01 · Mark scheme

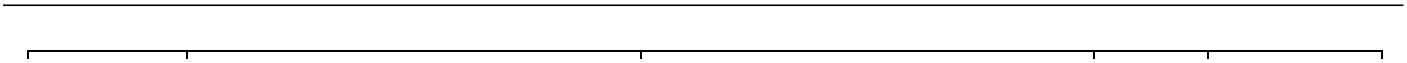
June 2018 | 8464/P/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec Ref.
01.5	all points correctly plotted within ½ small square curved line of best fit	allow **1** mark for 3 or 4 points correctly plotted	2 1	AO2 6.5.4.2.2
01.6	inversely proportional	allow as mass increases, acceleration decreases	1	AO3 6.5.4.2.2
Total			**12**	

6.5.4.1.5 Acceleration

Answer 01 · Mark scheme

June 2018 | 8464/P/2H | Original Q1



6.5.4.1.5 Acceleration

Answer 02 · Mark scheme June 2018 | 8464/P/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	either: 7.5 (m) **and** 12.3 (m) from the graph **or** 15 (m/s) × 0.32 (s) using speed extra distance = 4.8 (m)	an answer between 4.7 (m) and 4.9 (m) scores **2** marks allow 7.5 (m) and between 12.2 (m) and 12.4 (m)	 1 1	AO2 6.5.4.3
06.2	there is a decrease in kinetic energy of the car so this (causes) the internal / thermal energy store of the brakes to increase	allow work is done by friction (on the brakes)	1 1	AO1 6.1.1.1 6.5.4.3.4
06.3	$19^2 - u^2 = 2 \times 2 \times 84$ $u^2 = 19^2 - (2 \times 2 \times 84)$ u = 5 (m/s)	an answer of 5 (m/s) scores **3** marks $u = \sqrt{19^2 - (2 \times 2 \times 84)}$	1 1 1	AO2 6.5.4.1.5

6.5.4.1.5 Acceleration

Answer 02 · Mark scheme

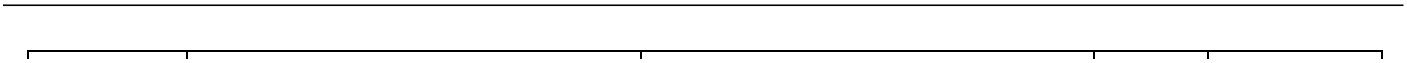
June 2018 | 8464/P/2H | Original Q6

Question	Answers	Mark	AO / Spec. Ref.
06.4	**Level 3:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	5–6	AO3
	Level 2: Scientifically relevant facts, events or processes are identified and their relevance is clear. The account is not fully accurate.	3-4	AO1 AO3
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	AO1
	No relevant content	0	
	Indicative content • use of drugs, alcohol, tiredness and distractions would increase the thinking distance • thinking distance increases with speed • thinking distance is directly proportional to speed • use of drugs, alcohol, tiredness and distractions would increase the gradient of thinking distance • poor brakes, poor tyres, wet / icy roads and mass would increase the braking distance • braking distance increases with speed • braking distance increases at an increasing (accept greater) rate (with speed) • poor brakes, poor tyres, wet/icy roads and mass would increase the gradient of braking distance • braking distance is directly proportional to speed squared • stopping distance = thinking distance + braking distance • factors that increase thinking and / or braking distance would increase the gradient of stopping distance • stopping distance increases at an increasing (accept greater) rate (with speed)		6.5.4.3.1
Total			**13**

6.5.4.1.5 Acceleration

Answer 02 · Mark scheme

June 2018 | 8464/P/2H | Original Q6



6.5.4.1.5 Acceleration

Answer 03 · Mark scheme

June 2019 | 8464/P/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	(4 - 0) + (10 - 7) **or** 4 + 3 **or** 10 - 3 7 (s)	an answer of 7 (s) gains **2** marks	1 1	AO2 6.5.4.1.5	E
01.2	gradient = $\frac{0-2}{24-14}$ (-)0.2 (m/s^2)	an answer of 0.2 (m/s^2) gains **2** marks allow readings from any two points correctly substituted allow correct use of $a = \frac{\Delta v}{t}$	1 1	AO2 6.5.4.1.5	E
01.3	(there are no wires) to get tangled / disconnected	allow easier to move arms allow wires are inconvenient allow easier to transfer data	1	AO3 6.6.2.4	E
01.4	wave speed = frequency × wavelength	allow v = f λ allow any correct re-arrangement	1	AO1 6.6.1.2	E
01.5	300 000 000 = 2 400 000 000 × λ λ = $\frac{300\,000\,000}{2\,400\,000\,000}$ λ = 0.125 (m)	an answer of 0.125 (m) or 0.13 (m) scores **3** marks allow λ = 0.13 (m)	1 1 1	AO2 6.6.1.2	E
01.6	range is far enough (for most uses) power is not too great so the battery will not drain quickly	allow power not too great so the phone will not overheat allow the range per milliwatt is greatest or 4 metres	1 1	AO3 6.6.2.4	E

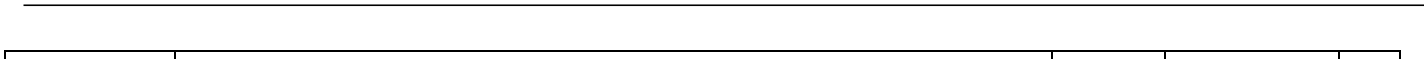
6.5.4.1.5 Acceleration

Total			**11**		

6.5.4.1.5 Acceleration

Answer 03 · Mark scheme

June 2019 | 8464/P/2H | Original Q1



6.5.4.1.5 Acceleration

Answer 04 · Mark scheme

November 2020 | 8464/P/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	AO3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	AO1
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	AO1
	No relevant content	0	6.5.4.2.2 RPA19
	Indicative content **<u>measurements</u>** • place one wooden block under the ramp • vary the height by placing a different number of wooden blocks • measure the height of the ramp using a metre rule • measure the distance travelled using a metre rule • measure time taken using light gates (and computer/datalogger) • measure time taken using a stopclock or ticker timer • release trolley from the same position each time • release the trolley without applying a force **<u>results</u>** • repeat at the same height and calculate a mean • repeat for different heights • calculate acceleration using $a = (v-u)/t$ or $a = \frac{v^2 - u^2}{2s}$		

6.5.4.1.5 Acceleration

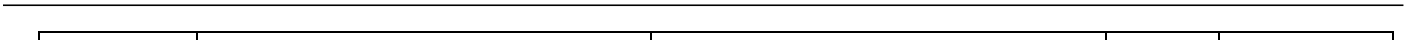
Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	all points plotted correctly height of ramp in metres on x-axis **and** acceleration in m/s^2 on y-axis) correct line of best fit	allow **1** mark for 3 points plotted correctly both quantity and unit required for both axes	2 1 1	AO2 6.5.4.2.2 RPA19
02.3	resultant force = mass × acceleration or F = ma		1	AO1 6.5.4.2.2 RPA19
02.4	0.63 = m × 2.1 $m = \frac{0.63}{2.1}$ m = 0.30 (kg)	 allow 0.3 (kg)	1 1 1	AO2 6.5.4.2.2 RPA19
Total			**14**	

6.5.4.1.5 Acceleration

Answer 04 · Mark scheme

November 2020 | 8464/P/2H | Original Q2



6.5.4.1.5 Acceleration

Answer 05 · Mark scheme

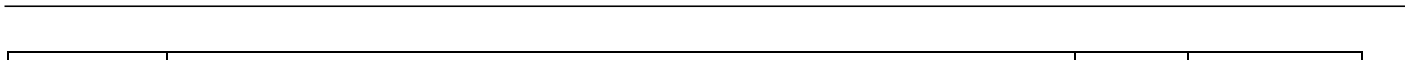
November 2021 | 8464/P/2H | Original Q2

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**	

6.5.4.1.5 Acceleration

Answer 05 · Mark scheme

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



6.5.4.1.5 Acceleration

Answer 06 · Mark scheme

November 2021 | 8464/P/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	different temperatures emit different intensities of infrared which are represented (on the infrared camera) as different shades / colours	 allow wavelength / frequency / amount for intensity throughout	1 1	AO1 AO3 6.6.2.4
05.2	visible light		1	AO3 6.6.2.1
05.3	both ionising radiation so some risk of cancer the whole body is irradiated by gamma rays when an X-ray is taken only part of the body is exposed exposure time for gamma rays is longer		1 1 1 1	AO1 AO3 AO3 AO3 6.6.2.3
05.4	$1.2 \times 10^{-13} = F \times 0.015$ $F = \frac{1.2 \times 10^{-13}}{0.015}$ $F = 8.0 \times 10^{-12}$ N	 allow a correct rearrangement using an incorrectly / not converted value of s allow 8×10^{-12} allow a correct calculation using an incorrectly / not converted value of s	1 1 1	AO2 6.5.2

6.5.4.1.5 Acceleration

Answer 06 · Mark scheme

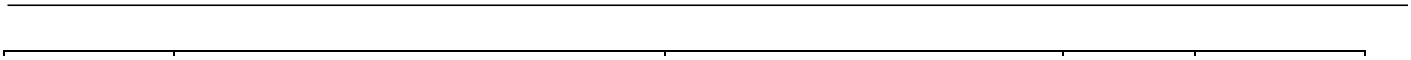
November 2021 | 8464/P/2H | Original Q5

05.5	some of the energy of the electrons causes heating (therefore) increasing the temperature (so using tungsten) allows more electrons to be collided per second than using any other metal	 allow (so using tungsten) enables more energy per second to be transferred than using any other metal	1 1 1	AO1 AO3 AO3 6.5.2
Total			**13**	

6.5.4.1.5 Acceleration

Answer 06 · Mark scheme

November 2021 | 8464/P/2H | Original Q5



6.5.4.1.5 Acceleration

Answer 07 · Mark scheme

November 2021 | 8464/P/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec.
06.1	at maximum power the forward force of the engines is constant		1	AO3
	as it accelerates the air resistance increases		1	AO1
	resultant force = force from engines – air resistance		1	AO1
	therefore resultant force decreases		1	AO3
	acceleration is directly proportional to resultant force		1	AO1
				6.5.1.4 6.5.4.2.2 6.5.4.1.5

6.5.4.1.5 Acceleration

Answer 07 · Mark scheme

06.2	$\Delta v = (25.5 - 5.5) \times 330$	allow 6600 m/s	1	AO2 6.5.4.1.5 6.5.5.1
	$a = \frac{((25.5 \times 330) - (5.5 \times 330))}{300}$	allow a correct substitution using incorrectly / not converted values of u and v	1	
	$a = 22\ m/s^2$	allow a correct calculation using incorrectly / not converted values of u and v $a = \Delta v / t$ must have been used to score subsequent marks	1	
	$m = 630\ 000 / 22$	allow a correct substitution using an incorrectly calculated value of a	1	
	$m = 28636.36$ (kg)	allow a correct calculation using an incorrectly calculated value of a	1	
	$m = 29000$ (kg)	this mark can only be awarded for a calculation using the correct equations	1	
Total			**11**	

6.5.4.1.5 Acceleration

Answer 08 · Mark scheme

June 2022 | 8464/P/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	two vertical arrows in opposite directions away from point **X**	allow if the upwards arrow starts from the stem ignore any labels	1	AO1 6.5.4.2.1
	both arrows the same length	dependent on MP1	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	$9.8 = \frac{\Delta v}{0.5}$		1	AO2 6.5.4.1.5
	$\Delta v = 9.8 \times 0.5$		1	
	final velocity = Δv = 4.9 (m/s)		1	
	$4.9^2 - 0^2 = 2 \times 9.8 \times s$	allow a correct substitution of an incorrectly calculated value of final velocity	1	
	$s = \frac{4.9^2}{2 \times 9.8}$	allow a correct rearrangement of an incorrectly calculated value of final velocity	1	
	s = 1.2 m	allow 1.23 or 1.225 do **not** accept 1.22 allow a correct calculation using an incorrectly calculated value of final velocity	1	

6.5.4.1.5 Acceleration

Answer 08 · Mark scheme

June 2022 | 8464/P/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	as the apple falls / accelerates air resistance increases	allow there is air resistance acting on the apple as it falls	1	AO1 6.5.4.1
	so resultant force decreases		1	
	so acceleration will decrease	MP3 dependent on MP1 or MP2 being awarded	1	
	acceleration will not be constant, so not a good assumption	MP4 dependent on MP1 or MP2 being awarded	1	
	OR			
	the apple only falls for a short time/distance (1)			
	air resistance is negligible (1)			
	so resultant force is constant (1)	MP3 dependent on MP1 or MP2 being awarded		
	therefore acceleration is constant, so good assumption (1)	MP4 dependent on MP1 or MP2 being awarded		

Total Question 7		12

6.5.4.1.5 Acceleration

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02.1	**Level 3:** The plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.5.4.2.2
	Level 2: The plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The 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 **method of varying force** • clamp a pulley onto the edge of the desk • attach a string to the trolley and place the string over the pulley • attach a mass holder to the string **or** • vary the height of the runway • use wooden blocks **measurements** • place a slotted mass on the mass holder • use $W = mg$ to calculate the force • mark the starting and finishing points of the trolley on the runway • measure the distance between the two marks with a metre rule • time how long it takes to travel between the two marks with a stopclock / timer • use $v = \frac{s}{t}$ and $a = \frac{\Delta v}{t}$ **or** • use light gate(s) to determine time and / or speed • computer calculates acceleration • repeat for different numbers of slotted masses allow a description of a method using a ticker timer		

6.5.4.1.5 Acceleration

Answer 09 · Mark scheme

June 2023 | 8464/P/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	second law		1	AO1 6.5.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	$\frac{3.6}{1.2} = 3$ $1.6 \times 3 = 4.8$ (m/s^2) **OR** (use of $F = ma$) $m = \frac{1.2}{1.6} = 0.75$ (1) $a = \frac{3.6}{0.75} = 4.8$ (m/s^2) (1)		1 1	AO3 6.5.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	resultant force = mass × acceleration **or** $F = ma$		1	AO1 6.5.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	$0.42 = m \times 1.2$ $m = \frac{0.42}{1.2}$ $m = 0.35$ kg		1 1 1	AO2 6.5.4.2.2

Total Question 2	13

6.5.4.1.5 Acceleration

Answer 10 · Mark scheme

June 2023 | 8464/P/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	inertia		1	AO1 6.5.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2			1	AO2 6.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	increase the current so that the (resultant) force increases	allow use a stronger magnet	1 1	AO1 6.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	bring the (same end of the) iron bar close to each pole / end of the permanent magnet any repulsion shows the iron bar is a permanent magnet **or** if one end of the iron bar is attracted to both poles it is not a permanent magnet	allow bring each end of the iron bar to the same pole of the magnet	1 1	AO3 6.7.1.1

6.5.4.1.5 Acceleration

Answer 10 · Mark scheme

June 2023 | 8464/P/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	the compass (needle always) points in the same direction because it aligns itself with the Earth's magnetic field	allow the compass (needle always) points north dependent on MP1	1 1	AO1 6.7.1.2

Total Question 4	8

6.5.4.1.5 Acceleration

Answer 11 · Mark scheme

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$v^2 - 3.1^2 = 2 \times 9.8 \times 6.3$		1	AO2 6.5.4.1.5
	$v = \sqrt{(3.1^2 + (2 \times 9.8 \times 6.3))}$	allow $v^2 = 3.1^2 + (2 \times 9.8 \times 6.3)$	1	
	$v = 11.5\ldots$		1	
	$v = 12$ (m/s)	this mark can only be awarded if the correct equation is used and a value of v is calculated	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(magnitude) increases (uniformly)		1	AO2
	direction remains constant		1	AO3 6.5.1.1 6.5.4.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3		allow resistive / frictional force for drag throughout		AO3 6.5.4.1.5
	drag is greater than weight	allow upward force is greater than downward force	1	
	(so) there is a resultant force acting in the opposite direction to the velocity (causing deceleration)		1	
	as velocity decreases the drag decreases		1	
	(until) drag is equal to weight (so velocity is constant)	allow until the resultant force is zero ignore upthrust	1	

Total Question 6	10

6.5.4.1.5 Acceleration

Answer 12 · Mark scheme

June 2023 | 8464/P/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	$a = \frac{26 - 0}{5.25 - 2.0}$	allow any pair of correct points substituted allow ± half a small square for reading of time	1	AO2 6.5.4.1.5
	$a = 8$	allow 8.0 allow a correct calculation using their acceptable values from the graph ignore any minus sign	1	
	m/s^2		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2		allow ecf for acceleration and initial velocity from question **07.1**		
	thinking distance			
	$s = 26 \times 0.75$	to award MP1 and MP2 a time of 0.75 must have been used	1	AO3
	$s = 19.5$ (m)		1	AO2
	braking distance			
	$s = \frac{(5.25 - 2.0) \times 26}{2}$ **or** $s = \frac{26^2 - 0^2}{2 \times 8.0}$	allow a range of 5.2 to 5.3 for final time	1	AO3
	$s = 42.25$ (m)		1	AO2
		marks for thinking distance and braking distance may be awarded independently		
	stopping distance			
	$s = 19.5 + 42.25 = 61.75$ (m)	for this mark to be awarded both the thinking distance and braking distance must have been calculated using correct equations allow an answer correctly rounded to 2 or 3 sig figs	1	AO2 6.5.4.1.5

6.5.4.1.5 Acceleration

Answer 12 · Mark scheme

June 2023 | 8464/P/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	the brakes can overheat (so) the brakes will not work properly **OR** can lead to loss of control (1) (because) the tyres lose traction / grip (1) **OR** the greater the deceleration the greater the force (1) (and) large forces can cause injury (1)	 dependent on MP1 allow the car may skid dependent on MP1 dependent on MP1 ignore accidents and crashes throughout	1 1	AO1 6.5.4.3.4

Total Question 7	10

6.5.4.1.5 Acceleration

Answer 13 · Mark scheme

June 2024 | 8464/P/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$5.8 = \frac{\Delta v}{2.5}$ $\Delta v = 5.8 \times 2.5$ $\Delta v = 14.5$ $v = (20 - 14.5) = 5.5$ (m/s)	 allow use of an incorrectly calculated Δv if the correct equation has been used	1 1 1 1	AO2 6.5.4.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	multiply the speed of the car by the reaction time		1	AO3 6.5.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	braking distance $\propto$ speed^2		1	AO3 6.5.4.3.4

6.5.4.1.5 Acceleration

Answer 13 · Mark scheme

June 2024 | 8464/P/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	6250 = m × 5.0		1	AO2 6.5.4.2.2
	$m = \frac{6250}{5.0}$		1	6.5.5.1
	m = 1250 (kg)		1	
	v = 12 (m/s)		1	
	p = 1250 × 12	allow a substitution using a value of v in the range 11.8 to 12.2 allow a correct substitution using their incorrectly calculated value for m using the correct equation	1	
	p = 15 000 (kgm/s)	allow a calculation using a value of v in the range 11.8 to 12.2 allow a correct calculation using their incorrectly calculated value for m using the correct equation	1	

Total Question 5	12

6.5.4.1.5 Acceleration

Answer 14 · Mark scheme

June 2024 | 8464/P/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	s = 40 000		1	AO2 6.5.4.1.5
	v^2 (- 0^2) = 2 × 6.48 × 40 000	allow v^2 = 518 400 allow a correct substitution using an incorrectly / not converted value of height	1	
	$v = \sqrt{(2 \times 6.48 \times 40\,000)}$	allow a correct rearrangement using an incorrectly / not converted value of height	1	
	v = 720 (m/s)	allow a correct calculation using an incorrectly / not converted value of height	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	weight depends on mass and gravitational field strength	allow weight = mass × gravitational field strength allow $W = mg$	1	AO1
	mass decreases (as fuel is burned) **or** gravitational field strength decreases		1	AO3 AO3
	therefore the weight decreases	dependent on MP2 if no other marks are awarded allow **1** mark for the weight decreases because the fuel is used	1	6.5.1.3

6.5.4.1.5 Acceleration

Answer 14 · Mark scheme

	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	gravitational force acts on the rocket (in the opposite direction to the motion of the rocket) (and) there are no forces in the direction that the rocket is moving (so) resultant force is towards the Earth	allow air resistance acts on the rocket (in the opposite direction to the motion of the rocket) allow so the rocket decelerates if MP1 or MP2 awarded	1 1 1	AO1 AO2 AO2 6.5.5.1 6.5.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	parachutes increase the effective area (so) there is the same air resistance at a lower speed (so) resultant force is zero at a lower speed (with the parachutes open)	 allow air resistance is equal to weight at a lower speed (with the parachutes open)	1 1 1	AO3 AO1 AO1 6.5.1.2 6.5.4.1.5

Total Question 6	13

6.5.4.1.5 Acceleration

Answer 01 · Examiner comments

June 2018 | 8464/P/2H | Original Q1

Question 1 (standard demand)

01.1 This was generally well answered with nearly 40% scoring both marks. The most common incorrect responses were that acceleration and the resultant force would increase.

01.2 Many students did not realise that it was distance that was important and a significant number spoke of needing to have less weight so that the glider moved more slowly. About 40% scored this mark. Correct responses of raising the table and shortening the string were given fairly equally.

01.3 Many students were not clear about how means were calculated and spoke of the mode being used instead at 0.59 N. There was widespread misunderstanding about accuracy with many stating that the more decimal places, the more accurate a result.

There were many references to recurring decimals. Those who scored in this question often did so by the 'decimal point' route rather than the 'significant figure' route.

Nearly 40% scored 2 marks, with a fairly even spread between those who identified one error and corrected it, or for identifying the 2 errors but not adequately describing how they would correct them.

01.4 This was well done with over 80% scoring the mark, but common errors were to refer to 'faster' or 'quicker' acceleration. A few made reference to the investigation not being a fair test.

01.5 46% scored all 3 marks. The quality of the plotting was generally good, but lines of best fit were often mistakenly given as straight lines, 50% gaining 2 marks. Where a curve was drawn these were generally of a credit worthy standard.

01.6 This was well done, with 73% gaining the mark, but a common error was to refer to “slower” acceleration. There were a number of answers which were insufficient, for example “negative correlation”.

6.5.4.1.5 Acceleration

Answer 02 · Examiner comments

June 2018 | 8464/P/2H | Original Q6

Question 6 (standard / high & high demand)

06.1 About 30% gained both marks, with fewer than 1% gaining just one mark. There was widespread misreading of the graph, in some cases misreading the scale but in a very large proportion there was little attempt to read between the grid lines.

Those who were successful adopted one of three routes: reading the distance off the graph between the given times; finding the time interval from the data given and reading that off the graph from the origin; using the data from the graph along with distance = speed x time to find the extra distance.

06.2 This was not answered well, with many students simply talking about heat energy, and many of those who referred to kinetic energy talking about kinetic energy in the brakes.

Many students overcomplicated their responses to this question. Over three quarters of students gained no marks.

06.3 This calculation was fairly well done with just over 42% gaining full marks. There were not many able to score compensation marks and so 40% scored zero.

The major problem was the inability to rearrange the equation, and substitution marks were rare as students were trying to substitute into an incorrect equation. A significant minority divided rather than subtracted when moving v^2 from one side of the equation to the other.

06.4 Many students did not grasp that a specific requirement of the question was to include factors that would affect the gradient and only a minority talked about the gradient being altered by factors rather than simply describing the graphs presented.

Lower attaining students described the graphs, often saying that “everyone has stopped by 112 km/h” as this was seen as an end point. Many mentioned factors that would affect each of the distances but the factors were not always attributed to the correct distance. A significant number of students cited factors that affected the stopping distance in their own right.

Fewer than 6% of responses achieved level three.

6.5.4.1.5 Acceleration

Answer 05 · 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 06 · Examiner comments — November 2021 | 8464/P/2H | Original Q5

Question 5 (standard/high demand and high demand)

05.1 Only 10% of students scored marks on this question. At high demand it is expected that where a question follows a figure, students should use information from the figure. Very few students linked the amount of infra-red radiation to temperature, or stated that different temperatures are displayed at different colours, despite that information being given in Figure 8.

05.2 This was a demanding question - students had to compare wavelengths given in nm and mm and in standard form. They then had to use their understanding of the electromagnetic spectrum. Less than 30% of students answered this question correctly.

05.3 The vast majority of the 40% of students that scored marks on this question only scored 1 mark, and that was mostly for saying that there is some risk of cancer with both.

05.4 This question performed as expected with 30% of students scoring 2 marks. Only 8% of students included the conversion to gain full marks.

6.5.4.1.5 Acceleration

Answer 06 · Examiner comments November 2021 | 8464/P/2H | Original Q5

05.5 20% of students gained at least 1 mark. Most of those stated that the energy from the electrons would cause heating and increase the temperature. Some went on to say that tungsten could be heated to a higher temperature than any other metal. No student scored full marks for explaining this meant that more electrons could be collided.

6.5.4.1.5 Acceleration

Answer 07 · Examiner comments

November 2021 | 8464/P/2H | Original Q6

Question 6 (high demand)

06.1 Very few answers to this question were well structured or contained anything creditworthy. Many did not contain any scientific terminology, and most that did used it incorrectly. There were lots of incidences of students describing acceleration as being equal to air resistance, or stating that because speed is increasing acceleration can't be constant.

06.2 Nearly 30% of students scored some marks on this question. 10% were able to convert the change in velocity to m/s and score 1 mark. Only 10% of students scored 5 or 6 marks. The answer line now reminds students to give their answer to 2 significant figures, however, some students still did not do this.

6.5.4.1.5 Acceleration

Mark Ranges and Award of Grades

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

6.5.4.1.5 Acceleration

Answer 08 · Examiner comments

June 2022 | 8464/P/2H | Original Q7

Question 7 (Standard/high and high demand)

07.1 20% of students scored both marks on this question. Incorrect answers often had arrows that did not point up or down, or were drawn on the apple. Many incorrect answers had labelled the diagram rather than drawn force arrows. 5% of students gained 1 mark, for two correct arrows that were not the same length.

07.2 This question was well answered with over 40% of students arriving at the correct final answer and scoring 6 marks. Approximately 15% of students were able to correctly work out the change in velocity, but then failed to use that the determine the distance, most of these students scored 3 marks. Students should always show their working out for extended calculations.

07.3 20% of students gained at least 1 mark, and approximately 10% gained more than one mark. A small number of students scored all 4 marks. Incorrect answers usually demonstrated a poor understanding of acceleration, with a significant number stating that the apple would accelerate more and more, so the acceleration would increase.

6.5.4.1.5 Acceleration

Answer 08 · Examiner comments

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.

6.5.4.1.5 Acceleration

Answer 09 · Examiner comments June 2023 | 8464/P/2H | Original Q2

Question 2 (standard demand)

02.1 Students found describing the method for this investigation very challenging even on the higher tier paper. This is a required practical, but fewer than 10% of students wrote a level 3 response that would lead to a valid outcome. About 25% of students suggested a valid way of varying the force and described taking measurements, so wrote a level 2 response. Approximately 50% of students just suggested some measurements that could be taken, such as timing with a stopwatch or measuring the length of the runway with a ruler, so wrote a level 1 response.

02.2 Approximately 60% of students knew that Newton's second law predicts that the acceleration of the trolley is proportional to the resultant force on the trolley.

02.3 75% of students calculated the correct acceleration. A variety of methods were seen, and any that used ratios and gave the correct answer were given credit. A small percentage of students scored one mark for calculating the mass, but did not then continue with the calculation.

02.4 Over 99% of students gained the mark. Students were given the equation sheet, which will have contributed to the overall performance on this question.

02.5 Just over 90% of students substituted into the correctly rearranged equation and then calculated correctly. Approximately 3% of students were able to substitute, but then did not rearrange the equation correctly.

Answer 10 · Examiner comments June 2023 | 8464/P/2H | Original Q4

Question 4 (standard demand and standard/high demand)

04.1 Fewer than 20% of students correctly answered inertia.

04.2 Just over 50% of students gave the correct direction for the acceleration.

6.5.4.1.5 Acceleration

Answer 10 · Examiner comments June 2023 | 8464/P/2H | Original Q4

04.3 Approximately 50% of students gained one mark on this question. Most of those that did suggested increasing the current or the strength of the magnet. Very few went on to explain that this would increase the force on the copper rod.

04.4 Approximately 20% scored two marks on this question. Of the 20% that scored 1 mark, most suggested bringing both sides of the magnet close to the iron bar (or vice versa) but then incorrectly stated that any attraction proves it is a magnet.

04.5 Approximately 40% of students gained at least one mark on this question. Even the credit worthy responses mostly contained simple statements like 'it always points north'. Only a small percentage explained that this was because the magnet aligns itself with the Earth's magnetic field.

Answer 11 · Examiner comments June 2023 | 8464/P/2H | Original Q6

Question 6 (high demand)

06.1 45% of students did the calculation correctly and 35% gave the answer correctly to two significant figures. Of the 45% that scored either no marks or one mark, a significant number rearranged the equation incorrectly and subtracted u^2 from $2as$.

06.2 Despite being clued into the fact that velocity is a vector, very few students referred to the direction of the stone. 55% of students scored one mark for referring to the magnitude, with most making simple statements like the velocity increases. Only 3% of students scored 2 marks for adding that the direction does not change.

06.3 This was an extremely challenging question. 85% of students scored zero marks, and of those that did score the vast majority scored one mark. The question asked students to explain why the stone slows to a constant velocity, but most students just explained why it travelled at a constant velocity. Most students that did score a mark stated that the resultant force on the stone was zero when the velocity was constant.

6.5.4.1.5 Acceleration

Answer 12 · Examiner comments

June 2023 | 8464/P/2H | Original Q7

Question 7 (high demand)

07.1 25% of students gained three marks on this question. 20% of students correctly determined the gradient but could not recall the unit for acceleration. A significant number of students knew to calculate the gradient but mis-read the graph and used an initial velocity of 25 m/s.

07.2 5% of students gained full marks on this question. 20% of students gained two marks for correctly calculating the thinking distance. Of the 65% of students that scored zero marks the majority neither attempted to determine the area under the graph or used a correct equation.

07.3 15% of students scored a mark on this question. Most of those that did score a mark wrote that large decelerations could lead to a loss of control.

6.5.4.1.5 Acceleration

Answer 12 · 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.

6.5.4.1.5 Acceleration

Answer 13 · Examiner comments

Question 5 (standard/high & high demand)

05.1 This calculation was the most demanding on the paper, with 80% of students not gaining any marks. Most students used an incorrect equation and substituted the value of acceleration as the displacement. Of the approximately 20% of students that did use the correct equation, the vast majority gained full marks.

05.2 This question was not well answered, with less than 10% of students gaining the mark. It is common for students when answering questions on this topic to not make the distinction that reaction time is a time and thinking distance is a distance.

05.3 Approximately 33% of students identified the correct relationship between speed and braking distance. Inversely proportional was a more popular response.

05.4 Nearly 50% of students were able to calculate the mass of the car and achieve the first 3 marks. Of the 20% of students that did not gain any further marks, most did not use the graph to determine the speed from the given braking distance, despite being instructed to use it in the question, and so could not go on to calculate the momentum.

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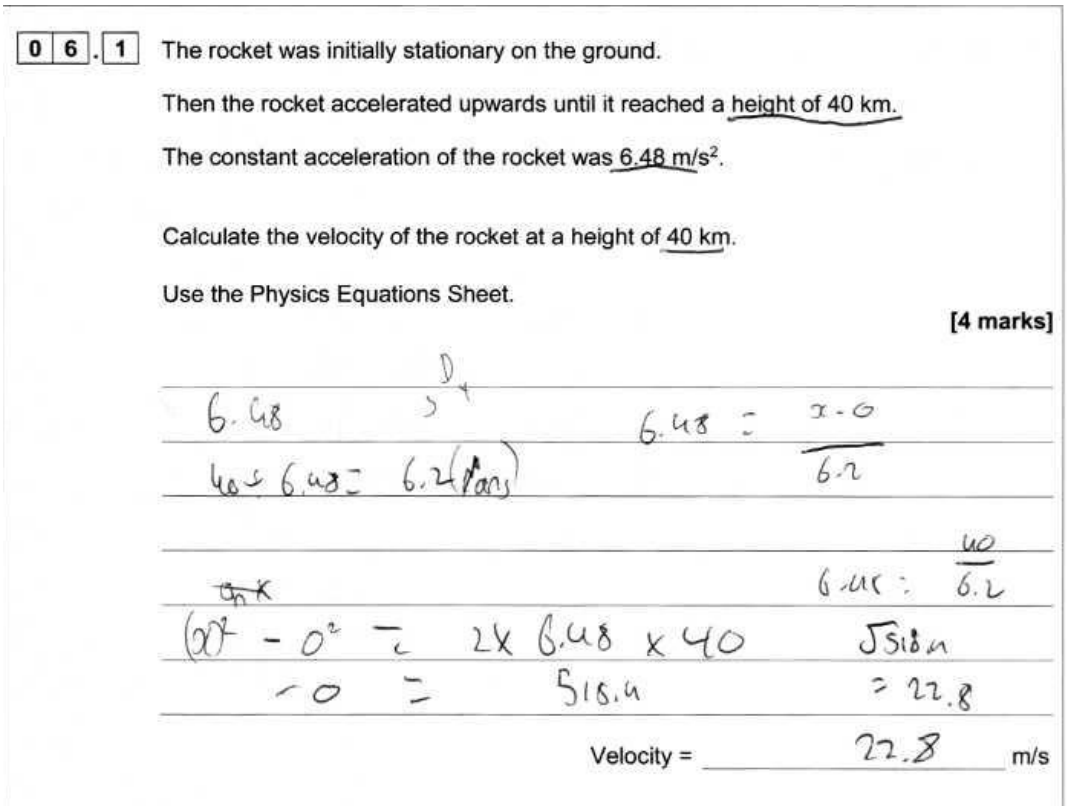
6.5.4.1.5 Acceleration

Answer 14 · Examiner comments

June 2024 | 8464/P/2H | Original Q6

Question 6 (standard/high & high demand)

06.1 Nearly 60% of students gained at least 1 mark in this question, for substituting into a correct equation or converting the distance from kilometres to metres. About 15% of students were awarded 3 marks for using the equation correctly but not converting the distance, and 20% gained full marks.



0 6 . 1 The rocket was initially stationary on the ground.

Then the rocket accelerated upwards until it reached a height of 40 km.

The constant acceleration of the rocket was 6.48 m/s^2.

Calculate the velocity of the rocket at a height of 40 km.

Use the Physics Equations Sheet.

[4 marks]

6.48 D_y

40 ÷ 6.48 = 6.2 (Ans)

6.48 = $\frac{x - 0}{6.2}$

6.48 = $\frac{40}{6.2}$

$(x)^2 - 0^2 = 2 \times 6.48 \times 40$

$-0 = 518.4$

$\sqrt{518.4} = 22.8$

Velocity = 22.8 m/s

This example shows a student that has not converted the distance from kilometres to metres so does not gain marking point 1 but has carried out the rest of the calculation correctly to gain 3 marks. There is some rough working at the top, but this is ignored and the working that supports the final answer is marked.

06.2 Nearly 40% of students were able to gain 1 or more marks on this question, 20% gained 2 marks and 5% all 3 marks. Most of the students that did get a mark correctly stated that the gravitational field strength decreased. Most students who understood that weight depends on mass and gravitational field strength gained full marks. Some students incorrectly stated that the rocket would have no weight.

06.3 Of the 25% of students that gained marks for this question most received 1 mark for either describing the lack of a forward force or stating that air resistance or gravity acts. There were many misconceptions demonstrated about momentum and acceleration.

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6.5.4.1.5 Acceleration

Answer 14 · Examiner comments June 2024 | 8464/P/2H | Original Q6

06.4 This was the most demanding question on the paper, with 75% not being able to give a creditworthy response and less than 1% able to achieve more than 1 mark. There was one more accessible mark (marking point 1: increase of surface area), and 25% of students gained this. Much imprecise language was also seen in this question: when students are asked to compare two things they should make their answer comparative and use for example 'larger' not just 'large'.

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6.5.4.1.5 Acceleration

Contact us

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

Tel: 01483 477756
Email: gcsescience@aqa.org.uk

aqa.org.uk

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