AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.5.1

Momentum is a property of moving objects

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**5**
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.

6.5.5.1 Momentum is a property of moving objects

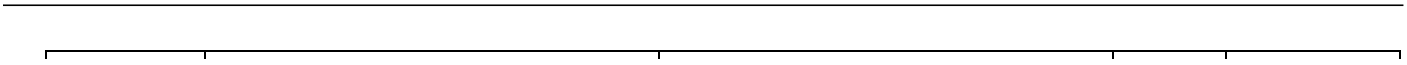
Answer 01 · Mark scheme June 2018 | 8464/P/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	momentum = mass × velocity	allow p = mv	1	AO1 6.5.5.1
03.2	200 = m × 3.2 $m = \frac{200}{3.2}$ m = 63 (kg)	an answer of 63 (kg) scores **3** marks allow 62.5 (kg)	 1 1 1	AO2 6.5.5.1
03.3	(total) momentum before (collision) = (total) momentum after (collision) **either** momentum of skater A decreases and momentum of skater B increases velocity of skater A decreases and velocity of Skater B increases **or** momentum of skater A decreases and so velocity of skater A decreases (1) momentum of skater B increases and so velocity of skater B increases (1)	 allow (total) momentum is shared between skater A and skater B	1 1 1	AO1 6.5.5.2
Total			**7**	

6.5.5.1 Momentum is a property of moving objects

Answer 01 · Mark scheme

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6.5.5.1 Momentum is a property of moving objects

Answer 02 · Mark scheme

June 2019 | 8464/P/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	distance speed		1 1	AO1 6.5.4.1.3	A
03.2	(both have magnitude) only a vector has direction	allow scalar does not have a direction	1	AO1 6.5.1.1	E
03.3	any **two** from: • mass • velocity • friction • power of the motor	 allow weight allow speed or direction allow air resistance or drag	2	AO1 6.5.5.2	E

6.5.5.1 Momentum is a property of moving objects

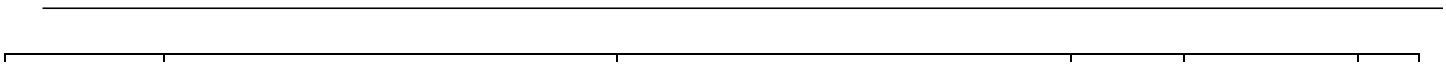
Answer 02 · Mark scheme

03.4	total momentum is zero after the collision (because the bumper cars are stationary) because the momentum of each car before the collision was equal (in magnitude) and opposite (in direction) so the total momentum of the bumper cars was zero before the collision and momentum is conserved **OR** total momentum is zero after the collision (because the bumper cars are stationary) (1) because the momentum of each car before the collision was equal (in magnitude) and opposite (in direction) (1) both cars exert an equal and opposite force on each other (for equal periods of time) (1) so the cars accelerate (in opposite directions) (1)		1 1 1 1	AO3 5.5.5.2	E
Total			**9**		

6.5.5.1 Momentum is a property of moving objects

Answer 02 · Mark scheme

June 2019 | 8464/P/2H | Original Q3



6.5.5.1 Momentum is a property of moving objects

Answer 03 · Mark scheme

November 2020 | 8464/P/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(vector quantity) has magnitude and a direction (scalar quantity) has magnitude only		1 1	AO1 6.5.4.1.3
04.2	resistive force acts on the ball so (resultant) force in opposite direction to velocity **or** so work is done on the ball	allow friction or air resistance	1 1	AO2 6.5.4.2.1
04.3	momentum = mass × velocity or p = mv		1	AO2 6.5.5.1
04.4	26 = m × 5.0 $m = \frac{26}{5.0}$ 5.2 (kg)		1 1 1	AO2 6.5.5.1
04.5	momentum is conserved in the collision (assuming no external forces) momentum of the pin increases therefore the momentum of the ball must decrease.	if no other mark is awarded, allow **1** mark for when the ball exerts a force on the pin, the pin	1 1 1	AO1 6.5.5.2

6.5.5.1 Momentum is a property of moving objects

Answer 03 · Mark scheme

November 2020 | 8464/P/2H | Original Q4

		exerts an equal and opposite force on the ball		
Total			**11**	

6.5.5.1 Momentum is a property of moving objects

Answer 04 · Mark scheme

June 2022 | 8464/P/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	m = 0.180		1	AO2 6.5.5.1
	0.216 = 0.180 × v	allow a correct substitution using an incorrectly / not converted value of m	1	
	$v = \frac{0.216}{0.180}$	allow a correct rearrangement using an incorrectly / not converted value of m	1	
	v = 1.2 (m/s)	allow a correct calculation using an incorrectly / not converted value of m	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(total) momentum is conserved in the collision	allow (total) momentum before collision = (total) momentum after collision	1	AO1 6.5.5.1
	during the collision the momentum of carriage increases		1	
	so the momentum of train decreases		1	
	since momentum = mass × velocity, velocity (of train) decreases	allow since mass (of train) is constant, velocity (of train) decreases	1	

Total Question 3		8

6.5.5.1 Momentum is a property of moving objects

Answer 05 · 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

6.5.5.1 Momentum is a property of moving objects

Answer 05 · Mark scheme

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

6.5.5.1 Momentum is a property of moving objects

Answer 01 · Examiner comments June 2018 | 8464/P/2H | Original Q3

Question 3 (standard & standard / high demand)

03.1 82% scored this mark, with many giving the equation in the form mass = momentum ÷ velocity.

03.2 86% were able to gain 3 marks in this question and only a very small number multiplied the two numerical values.

03.3 Fewer than 2% scored full marks for this question. Very few attempted to describe what happened to the velocity of the skaters, in spite of the very clear lead in the stem of the question. Whilst many realised that the velocity of the two skaters was the same after collision, they talked of velocity being 'shared' rather than saying what had happened to each skater.

A significant number did gain a mark for saying that the momentum before the collision was equal to that after, although many missed this mark, simply repeating the stem of the question.

Answer 04 · Examiner comments June 2022 | 8464/P/2H | Original Q3

Question 3 (Standard and standard/high demand)

03.1 This question was very well answered. Nearly 60% of students used the equation correctly and carried out the conversion to kg and scored full marks. Approximately 30% of students used the equation correctly but did not carry out the conversion and so scored 3 marks.

03.2 Only about 5% of students scored more than 2 marks. 40% of students were able to score 1 mark for either stating that momentum is conserved in the collision or for stating that the momentum of the stationary carriage increased. A significant number of students did not mention momentum at all in their answer.

6.5.5.1 Momentum is a property of moving objects

Answer 05 · Examiner comments

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

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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