AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.2

Work done and energy transfer

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**9**
Available paper years	**2018–2025**

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.

6.5.2 Work done and energy transfer

Answer 01 · Mark scheme

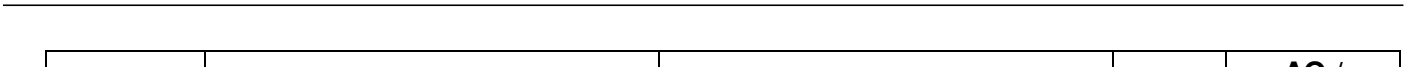
June 2018 | 8464/P/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	equal to		1	AO1 6.5.4.2.3
03.2		an answer of 833 (N) **or** 830 (N) scores **2** marks		AO2 6.5.1.3
	weight = 85 × 9.8		1	
	weight = 833 (N)	allow weight = 830 (N)	1	
03.3		an answer that rounds to 525 (J) scores **2** marks		AO2 6.5.2
	work done = 833 × 0.63	allow their calculated value from question **03.2** × 0.63	1	
	work done = 525 (J)	allow an answer that is consistent with their calculated value from question **03.2**	1	
03.4	work done = 0 (J)		1	AO2 6.5.2
03.5		an answer of 682 (N) **or** 680 (N) scores **2** marks		AO2 6.5.4.2.2
	force = 62 × 11		1	
	force = 682 (N)	allow force = 680 (N)	1	
Total			**8**	

6.5.2 Work done and energy transfer

Answer 01 · Mark scheme

June 2018 | 8464/P/2F | Original Q3



6.5.2 Work done and energy transfer

Answer 02 · Mark scheme June 2019 | 8464/P/2F | Original Q4

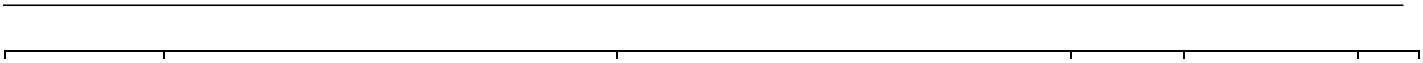
Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	(thinking distance) will double any correct pair of points from graph eg (200,6) and (400,12)	 allow graph shows direct proportionality (after 200 ms) allow **1** mark for thinking distance increases with supporting data.	1 1	AO3 6.5.4.3.2	E
04.2	(most) people cannot react any quicker than 200 ms		1	AO1 6.5.4.3.2	E
04.3	there is variation in the measurements	allow the data is not very precise allow lots of random error ignore references to accuracy / reliability / average	1	AO3 6.5.4.3.2	E
04.4	(258+265+302+248+327) / 5 280 (ms)	an answer of 280 gains **2** marks	1 1	AO2 6.5.4.3.2	E
04.5	8.4 (m)	allow 7.9 (m) to 8.9 (m) allow ecf from **04.4**	1	AO2 6.5.4.3.2	E
04.6	any **two** from: • (material of) road surface • condition of the tyres • speed of the car • wet / icy road surface • gradient of road • mass / weight of the car	 Ignore any reference to brakes	2	AO1 6.5.4.3.3	
04.7	work done = force × distance (along the line of action of the force)	allow W = F s allow any correct re-arrangement	1	AO1 6.5.2	

04.8	F = 6000 N W = 6000 × 75 W = 450 000 (J)	an answer of 450 000 scores 3 marks allow a correct substitution using an incorrectly / not converted value of F allow a correct calculation using an incorrectly / not converted value of F	1 1 1	AO2 6.5.2	
Total			**13**		

6.5.2 Work done and energy transfer

Answer 02 · Mark scheme

June 2019 | 8464/P/2F | Original Q4



6.5.2 Work done and energy transfer

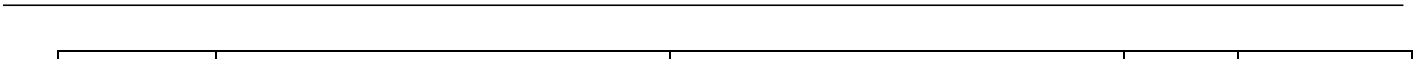
Answer 03 · Mark scheme November 2020 | 8464/P/2F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	gradient = $\frac{250 - 0}{50 - 0}$ speed = 5.0 m/s	allow any correct pair of values substituted allow 5 (m/) allow the use of s = v t	1 1	AO2 6.5.4.1.4
04.2	gravitational force		1	AO1 6.5.1.2
04.3	W = 30 × 250 W = 7500 J		1 1 1	AO2 AO2 AO1 6.5.2
04.4	frictional kinetic chemical		1 1 1	AO1 6.5.2
Total			**9**	

6.5.2 Work done and energy transfer

Answer 03 · Mark scheme

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



6.5.2 Work done and energy transfer

Answer 04 · Mark scheme November 2021 | 8464/P/2F | Original Q5

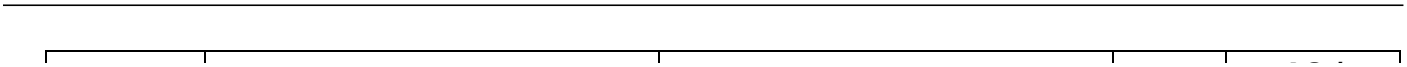
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(air resistance) increases		1	AO1 6.5.4.1.5
05.2	less than		1	AO3 6.5.4.1.5
05.3	s = 35 × 14 s = 490 (m)		1 1	AO2 6.5.4.1.2
05.4	work done = force × distance **or** W = Fs		1	AO1 6.5.2
05.5	54 000 000 = F × 270 $F = \frac{54\,000\,000}{270}$ F = 200 000 (N)		1 1 1	AO2 6.5.2

Question	Answers	Mark	AO / Spec. Ref.
05.6	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	4–6	AO3 6.5.4.1.2
	Level 1: Relevant features are identified and differences noted.	1–3	
	No relevant content	0	
	Indicative content • distance travelled is the same for each aeroplane • time in the air is much greater for jet aeroplane • speed of rocket plane is much greater • speed of rocket plane is 32 times greater • radiation dose each hour greater for rocket aeroplane • radiation dose each hour is 2 times greater for rocket aeroplane • overall radiation dose is less for rocket plane • dose in jet aeroplane is 16 times greater overall • much higher risk in jet aeroplane • increased risk of skin cancer • increased risk of gene mutation and cancer To access level 2, there must be a relevant calculation.		
Total			**14**

6.5.2 Work done and energy transfer

Answer 04 · Mark scheme

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



Answer 05 · Mark scheme

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

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	work done = force × distance (along the line of action of the force) **or** $W = F\ s$		1	AO1 6.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	3 360 000 = F × 42 000 $F = \frac{3\ 360\ 000}{42\ 000}$ F = 80 (N)		1 1 1	AO2 6.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	distance travelled = speed × time		1	AO1 6.5.4.1.5

6.5.2 Work done and energy transfer

Answer 05 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	42 000 = v × 5600 $v = \frac{42\,000}{5600}$ v = 7.5 (m/s)		1 1 1	AO2 6.5.4.1.2

Answer 05 · Mark scheme

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

Question	Answers	Mark	AO / Spec. Ref.
07.5	**Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO3 6.5.4.1.2
	Level 1: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	1–2	
	No relevant content	0	
	Indicative content the effect on speed must be consistent with the cause of the change • competitors accelerate at the start • so speed increases • the road is not flat • so speed increases going downhill and / or speed decreases going uphill • the competitor goes round a bend • so speed decreases • competitors may tire towards the end (so the force they exert decreases) • so they slow down • competitors may sprint during the race • causing speed to increase • may get a puncture • so speed would decrease or they would stop • resistive forces on competitors may increase/decrease • so speed would decrease/increase		

Total Question 7		**12**

Answer 06 · Mark scheme

June 2023 | 8464/P/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	0.30 (m)		1	AO2 6.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	$W = 710 \times 0.30$ $W = 213$ Nm	 allow ecf from question **05.1**	1 1	AO2 6.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	force / weight is greater		1	AO3 6.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	gravitational potential thermal		1 1	AO2 6.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	weight = mass × gravitational field strength **or** $W = mg$		1	AO1 6.5.1.3

6.5.2 Work done and energy transfer

Answer 06 · Mark scheme

June 2023 | 8464/P/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	710 = m × 9.8		1	AO2 6.5.1.3
	$m = \frac{710}{9.8}$		1	
	m = 72.4…		1	
	m = 72 (kg)	this mark can only be awarded if the correct equation is used and a value of m is calculated	1	

Total Question 5	**11**

Answer 07 · Mark scheme

June 2024 | 8464/P/1F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	kinetic energy (of the beater / food) internal / thermal energy (of the surroundings / whisk / food)	ignore sound	1 1	AO1 6.2.4.2 6.1.2.1 6.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	power = $\frac{\text{work done}}{\text{time}}$ or $P = \frac{W}{t}$		1	AO1 6.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$92 = \frac{23\,000}{\text{time}}$ $\text{time} = \frac{23\,000}{92}$ 250 (s)		1 1 1	AO2 6.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	$P = I^2 R$		1	AO1 6.2.4.1

6.5.2 Work done and energy transfer

Answer 07 · Mark scheme June 2024 | 8464/P/1F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	I = 0.500 A		1	AO2 6.2.4.1
	$P = 0.500^2 \times 640$	allow a correct substitution of an incorrectly / not converted current	1	
	P = 160 (W)	allow a correct calculation using an incorrectly / not converted current	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	230 (V)		1	AO1 6.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	decreases		1	AO1 6.2.4.1

Total Question 6	**12**

6.5.2 Work done and energy transfer

Answer 08 · Mark scheme June 2024 | 8464/P/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	reaction time of the driver		1	AO1 6.5.4.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	(initial) speed	allow section of road used ignore condition of road without further qualification	1	AO3 6.5.4.3.3

Answer 08 · Mark scheme

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

Question	Answers	Mark	AO / Spec. Ref.
05.3	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	AO3
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	AO3
	Level 1: Relevant points are made. They are not logically linked.	1–2	AO2
	No relevant content	0	
	Indicative content • tyre A braking distance is 30 m on dry road and 31 m on wet road • tyre A has the shortest braking distance on wet road • tyre B braking distance is 42 m on dry road and 43 m on wet road • tyre B has the longest braking distance on both wet and dry road • tyre C braking distance is 29 m on dry road and 40 m on wet road • tyre C has the shortest braking distance on dry road • the difference between braking distance on wet and dry roads for tyre A and tyre B is 1m • the difference between braking distance on wet and dry roads for tyre C is 11m **<u>Judgements</u>** • the shorter the braking distance the safer the tyre • tyre A is 1 m longer on dry road, but is 9 m shorter on wet road than tyre C • tyre A has the shortest combined / average braking distance • overall tyre A is the safest • tyre C is safest on a dry road • tyre B is the least safe tyre • the manufacturer should not choose tyre B allow use of stopping distance for braking distance throughout		6.5.4.3.3

Answer 08 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	work done = force × distance **or** $W = Fs$		1	AO1 6.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	300 000 = 6000 × s $s = \frac{300\,000}{6000}$ s = 50 (m)		1 1 1	AO2 6.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	the greater the force the shorter the braking distance (because) deceleration will be greater **or** (because) the work done to stop the car will be the same		1 1	AO2 6.5.4.3.4 6.5.4.2.2

Total Question 5	**14**

Answer 09 · Mark scheme

June 2025 | 8464/P/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	distance travelled = 3.0 × 20	both marks may be awarded if a length in the range 2.9 to 3.1 cm is used	1	AO3 6.5.4.1.1
	distance travelled = 60 (m)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	weight = 15 × 9.8		1	AO2 6.5.1.3
	weight = 147 (N)	allow weight = 150 (N)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	the line has a constant gradient	allow the line is straight do **not** accept directly proportional	1	AO2 6.5.4.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	distance travelled = $\frac{4500}{250}$		1	AO2 6.5.2
	distance travelled = 18 (m)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	total distance travelled is greater than the displacement		1	AO1 6.5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	distance has magnitude only		1	AO1 6.5.1.1 6.5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	total distance = 158 (km)	allow **1** mark for 56, 40 and 62 read from graph allow **1** mark for a total distance calculated using two correct values and one incorrect value from the bar chart	2	AO3 6.5.4.1.4

Total Question 3	**11**

6.5.2 Work done and energy transfer

Answer 04 · Examiner comments November 2021 | 8464/P/2F | Original Q5

Question 5 (Low demand and standard demand)

05.1 Over 50% of students correctly stated that the air resistance would increase. Of those that didn't, many of them failed to answer the question, and wrote answers such as 'the acceleration will overcome the air resistance'.

05.2 Only 15% of students correctly identified that the lift force on the wings will be the same as the weight of the rocket aeroplane.

05.3 This low demand calculation was very well answered, with the vast majority of students scoring 2 marks.

05.4 Over 50% of students correctly recalled the equation.

05.5 This standard demand calculation was reasonably well answered. Nearly 75% 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.

05.6 This question was an extended response question that was marked with a level of response mark scheme. Over 10% of students did not attempt the question. Of those that did 35% did not write any relevant content. Nearly all these students failed to include any

Answer 04 · Examiner comments November 2021 | 8464/P/2F | Original Q5

information from the question. Where students are given an additional instruction such as 'Use values from Table 2', they must do so. Of the 35% of students that did score mark the majority made simple statements that the radiation dose for the rocket aeroplane was greater. Very few appreciated that because the rocket aeroplane was much faster, it spent much less time in the air. Only a handful of students wrote level 2 answers.

6.5.2 Work done and energy transfer

Answer 05 · Examiner comments June 2022 | 8464/P/2F | Original Q7

Question 7 (Standard demand)

07.1 Nearly 90% of students were able to write down the correct equation.

07.2 This was a relatively straightforward calculation. However, it was not attempted by nearly 20% of students, and only approximately 50% of students gained full marks.

07.3 Nearly 90% of students were able to select the correct equation.

07.4 This calculation was well answered with 75% of students gaining full marks.

07.5 This extended response question was well answered. 70% of students were able to write responses worth some credit, with most stating that the competitors may get tired. Of the students that did not get into level 2, most gave reasons why the speed may change, but did not link this to an increase or decrease in speed.

Answer 05 · 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 on how students have performed for each question.

Mark Ranges and Award of Grades

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

6.5.2 Work done and energy transfer

Answer 06 · Examiner comments June 2023 | 8464/P/2F | Original Q5

Question 5 (Low demand and standard demand)

05.1 A little over 70% of students were able to convert cm to m.

05.2 80% of students were able to use their value from question 05.1 correctly and calculate the work done. Very few students correctly substituted in the equation and did not calculate the correct value. Of those that did, it was clear that they did not have a calculator.

05.3 Nearly 70% of students correctly stated that the force / weight would increase.

05.4 Approximately 10% of students scored two marks on this question. Despite the question stating that the engineer was stationary, many incorrectly selected kinetic energy.

05.5 This question was well answered with the vast majority of students getting the mark. Students were given the equation sheet, which will have contributed to the overall performance on this question.

05.6 Nearly 75% of students calculated the correct value, and 35% of students were able to correctly give the answer to 2 significant figures.

Answer 07 · Examiner comments

June 2024 | 8464/P/1F | Original Q6

Question 6 (standard demand)

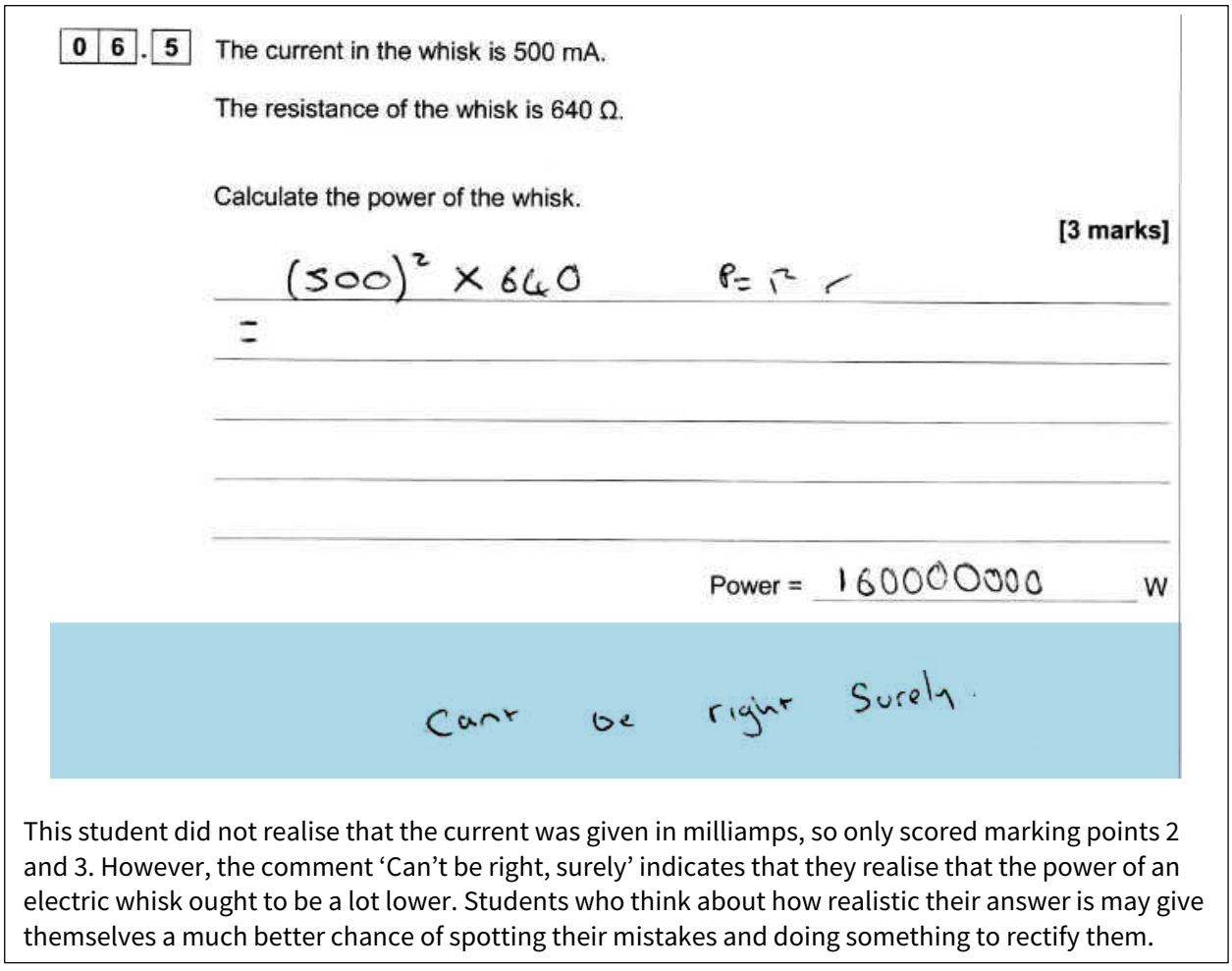
06.1 Roughly two-thirds of students gained at least 1 mark on this question, with about half of these gaining both marks. The most common incorrect answers were an increase in electrical energy and an increase in chemical energy.

06.2 Almost 90% of students wrote the correct equation.

06.3 Over half of all students arrived at the correct final answer, gaining 3 marks.

06.4 Just under 90% of students selected the correct equation.

06.5 For this calculation, very few students correctly converted the current from milliamps into amps. Some students forgot to show that the current should be squared in their substitution. Others showed a valid substitution but forgot to square the current when they entered it in their calculator. Less than 5% scored all 3 marks, but about 65% gained 2 marks on this question.



0 6 . 5 The current in the whisk is 500 mA.

The resistance of the whisk is 640 Ω.

Calculate the power of the whisk.

[3 marks]

$(500)^2 \times 640$ $P = I^2 R$

=

Power = 160000000 W

Can't be right Surely.

This student did not realise that the current was given in milliamps, so only scored marking points 2 and 3. However, the comment 'Can't be right, surely' indicates that they realise that the power of an electric whisk ought to be a lot lower. Students who think about how realistic their answer is may give themselves a much better chance of spotting their mistakes and doing something to rectify them.

06.6 The proportion of students who recalled the potential difference between the live and neutral wires was very low, with less than 15% of students answering correctly.

06.7 Slightly more than half of all students identified that an increase in current would be caused by a decrease in resistance.

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Answer 08 · Examiner comments

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

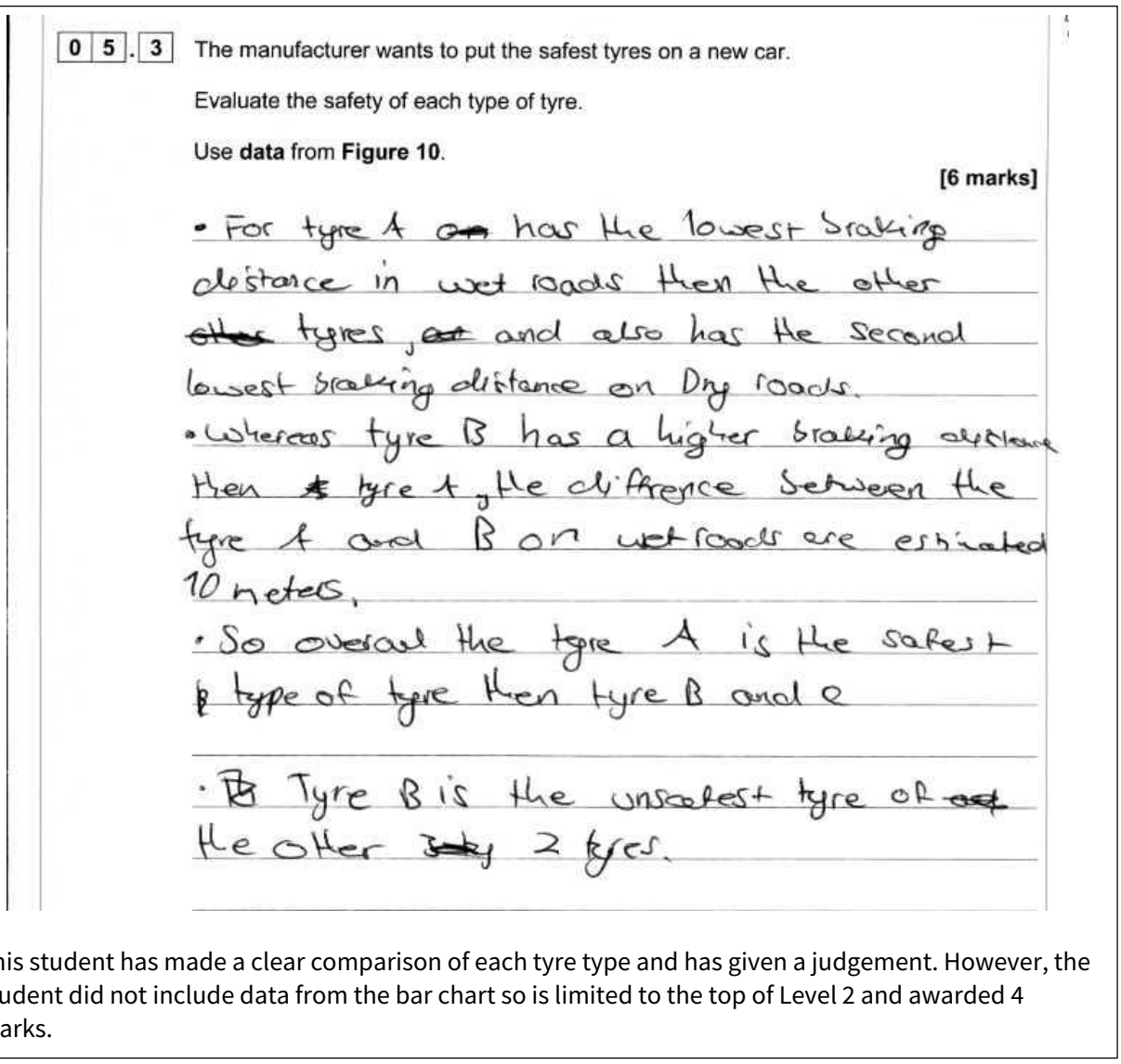
Question 5 (low & standard demand)

05.1 This question was well answered with the vast majority of students able to identify that the reaction time affects the thinking distance.

05.2 30% of students were able to correctly give a variable that should be kept the same. Many students wrote incorrect answers such as 'same driver'.

05.3 Most students attempted this extended response evaluation, with two-thirds gaining marks in Level 2 and a quarter reaching Level 3.

To access Level 3, students needed to give a judgement and support it with data from the bar chart. The majority of students that wrote Level 2 answers did not get into Level 3 because even though they clearly evaluated the data correctly, they did not include data in support of their arguments.



0 5 . 3 The manufacturer wants to put the safest tyres on a new car.

Evaluate the safety of each type of tyre.

Use **data** from **Figure 10**.

[6 marks]

- For tyre A ~~on~~ has the lowest braking distance in wet roads then the other ~~other~~ tyres, ~~on~~ and also has the second lowest braking distance on Dry roads.
- Whereas tyre B has a higher braking distance then ~~the~~ tyre A, the difference between the tyre A and B on wet roads are estimated 10 meters.
- So overall the tyre A is the safest ~~type~~ type of tyre then tyre B and C
- ~~The~~ Tyre B is the unsafest tyre of ~~out~~ the other ~~two~~ 2 tyres.

This student has made a clear comparison of each tyre type and has given a judgement. However, the student did not include data from the bar chart so is limited to the top of Level 2 and awarded 4 marks.

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6.5.2 Work done and energy transfer

Answer 08 · Examiner comments June 2024 | 8464/P/2F | Original Q5

0 5 . 3 The manufacturer wants to put the safest tyres on a new car.

Evaluate the safety of each type of tyre.

Use **data** from **Figure 10**.

[6 marks]

Tyre A looks to be the safest on wet ~~car~~ roads as it has a ~~breaking~~ braking distance of 31 metres and it has the ~~B~~ second best braking distance ~~g~~ on ~~dry~~ dry roads with ~~B~~ a breaking distance of 30 metres. Tyre C is the ~~sy~~ safest on ~~wet~~ dry ~~ro~~ roads with a braking distance of 29 metres, however on wet roads it has a braking distance of 40 metres. Tyre B ~~is~~ the least safest tyres with ~~bra~~ braking distances in the low 40s for both wet and dry ~~roa~~ roads. Tyre A seems to be the most reliable and safest because it has a good braking distance for both wet and dry roads with low 30s.

This student has made a clear comparison of each tyre type, using data from the bar chart. The student has included an overall judgement. This is a Level 3 response and was awarded 6 marks.

05.4 This question was well answered with 89% of students writing the correct equation.

05.5 To calculate the braking distance of the car, 70% of students were able to rearrange the equation correctly and score full marks.

05.6 This question proved extremely challenging, with 30% of students gaining a mark. and very few gaining both marks. Most students wrote vague responses about braking.

6.5.2 Work done and energy transfer

Answer 09 · Examiner comments June 2025 | 8464/P/2F | Original Q3

Question 3 (Low demand)

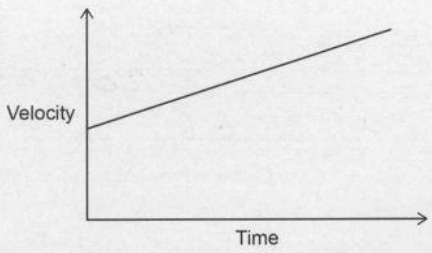
03.1 Almost two thirds of students were able to interpret the scale on the diagram and arrive at a correct answer.
Some students calculated the correct distance but then contradicted this by multiplying their answer by 20, which prevented them from scoring any marks.

03.2 The majority of students answered this calculation correctly. A small proportion of students decided that the unit for mass should be grams and ended up with an answer that was too large by a factor of a thousand, so were unable to gain one of the marks.

03.3 Only about 4 in 10 students were able to state that gradient was constant or that the line was straight, to gain the mark. Some students struggled to express the idea of a constant gradient, giving answers such as 'the line is straight and moves at a constant speed', or just giving a description of acceleration instead of referring to the graph.

0 3 . 3 **Figure 6** shows a velocity–time graph for a downhill part of the journey.

Figure 6



The gradient of the graph represents acceleration.

How does **Figure 6** show that the acceleration was constant?

[1 mark]

A straight line with a constant velocity

A proportion of incorrect answers were contradictory, by stating that the straight line had a constant velocity or a constant speed.

03.4 About 90% of students correctly calculated the distance travelled.

03.5 Nearly two thirds of students were able to identify how distance compared with displacement for the cyclist.

03.6 Only about a third of students selected the correct reason for distance being a scalar quantity.

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6.5.2 Work done and energy transfer

Answer 09 · Examiner comments

June 2025 | 8464/P/2F | Original Q3

3.7 About three quarters of students correctly determined the total distance travelled by the cyclist. Incorrect answers were often caused by misinterpreting the scale on the graph and reading, for example, 53 km instead of 56 km for the distance travelled on the Monday.