AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.1.2

Contact and non-contact forces

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**8**
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.

6.5.1.2 Contact and non-contact forces

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

6.5.1.2 Contact and non-contact forces

Answer 01 · Mark scheme

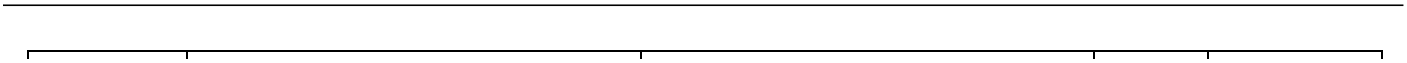
June 2018 | 8464/P/2H | Original Q1

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**	

6.5.1.2 Contact and non-contact forces

Answer 01 · Mark scheme

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



6.5.1.2 Contact and non-contact forces

Answer 02 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	D needs the greatest force to extend the spring the same amount	allow 20 (N) allow fourth (newtonmeter) reason only scores if correct newtonmeter selected	1 1	AO1 6.5.3
04.2	zero (error) any **one** from: • record the value and subtract from readings taken • adjust the newtonmeter to zero	allow systematic (error) allow subtract 1 from all readings	1 1	AO3 6.5.3

Answer 02 · Mark scheme

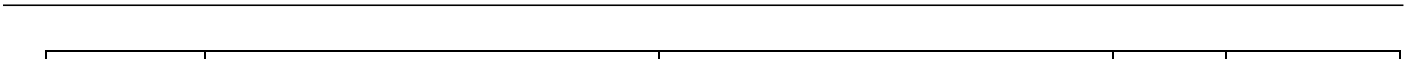
June 2018 | 8464/P/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3		an answer of 0.02 (m) gains **6** marks		AO2 6.5.3
	$4.5 \times 10^{-2} = 0.5 \times 400 \times e^2$	this mark may be awarded if the standard form value is incorrectly converted	1	
	$e = \sqrt{\frac{4.5 \times 10^{-2}}{0.5 \times 400}}$	this mark may be awarded if the standard form value is incorrectly converted allow $e^2 = \frac{4.5 \times 10^{-2}}{0.5 \times 400}$	1	
	e = 0.015 (m)	this answer only	1	
	2.0 = 400 × e		1	
	e = 0.005 (m)	this answer only	1	
	0.015 + 0.005 = 0.02 (m)	allow their initial extension + their additional extension correctly calculated	1	
	or			
	$4.5 \times 10^{-2} = 0.5 \times 400 \times e^2$ (1)	this mark may be awarded if the standard form value is incorrectly converted		
	$e = \sqrt{\frac{4.5 \times 10^{-2}}{0.5 \times 400}}$ (1)	this mark may be awarded if the standard form value is incorrectly converted allow $e^2 = \frac{4.5 \times 10^{-2}}{0.5 \times 400}$		
	e = 0.015 (m) (1)	this answer only		
	F = 400 × 0.015 F = 6 (N) (1)	allow an answer of 400 × their calculated value of e		
	total force = 6 + 2 8 = 400 × e (1)	allow an answer that is consistent with their calculated value of e		
	e = 0.02 (m) (1)			
Total			**10**	

6.5.1.2 Contact and non-contact forces

Answer 02 · Mark scheme

June 2018 | 8464/P/2H | Original Q4



6.5.1.2 Contact and non-contact forces

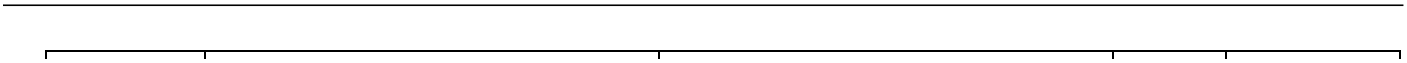
Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	the spring will return to its original length when the force is removed		1	6.5.3 AO1
01.2	measure the original length of the spring **and** the extended length of the spring (with the metre rule) extension = extended length – original length		1 1	6.5.3 AO1
01.3	e = 0.080 m $E_e = 0.5 \times 40 \times (0.080)^2$ $E_e = 0.128$ (J)	 allow a correct substitution using an incorrectly / not converted value of e allow a correct calculation using an incorrectly / not converted value of e	1 1 1	6.5.3 AO2
01.4	force = spring constant × extension **or** F = k e		1	6.5.3 AO1
01.5	300 = k × 0.40 $k = \frac{300}{0.40}$ k = 750 (N/m)		1 1 1	6.5.3 AO2
Total			**10**	

6.5.1.2 Contact and non-contact forces

Answer 03 · Mark scheme

November 2021 | 8464/P/2H | Original Q1



6.5.1.2 Contact and non-contact forces

Answer 04 · Mark scheme

June 2022 | 8464/P/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	**Child** gravitational potential energy decreases	ignore descriptions of energy transfers before the child reaches position A	1	AO1 6.1.1.1 6.1.2.1
	kinetic energy increases **and** then decreases (to zero)		1	
	Springs elastic potential energy increases	ignore references to kinetic energy of the springs	1	
	Surroundings internal / thermal store of energy increases	allow energy is dissipated allow (average) kinetic energy of the particles increases	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	**At position A** $4.9 = 0.5 \times k \times 0.056^2$ $k = \frac{2 \times 4.9}{0.056^2} = 3125$ (N/m) **At position B** $8.1 = 0.5 \times 3125 \times e^2$ $e = \sqrt{\left(\frac{2 \times 8.1}{3125}\right)}$ $e = 0.072$ (m)	 allow a correct substitution of an incorrectly calculated value of k using 0.056 m **and** 4.9 J allow $e^2 = 0.005184$ allow a correct re-arrangement using an incorrectly calculated value of k allow an answer consistent with their calculated value of k	1 1 1 1 1	AO2 6.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	the total energy transferred by the child		1	AO1 6.1.1.4

Total Question 3		10

6.5.1.2 Contact and non-contact forces

Answer 05 · Mark scheme

June 2022 | 8464/P/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	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.
02.2	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.
02.3	distance travelled = speed × time		1	AO1 6.5.4.1.5

6.5.1.2 Contact and non-contact forces

Answer 05 · Mark scheme

June 2022 | 8464/P/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	42 000 = v × 5600 $v = \frac{42\,000}{5600}$ v = 7.5 (m/s)		1 1 1	AO2 6.5.4.1.2

6.5.1.2 Contact and non-contact forces

Answer 05 · Mark scheme

June 2022 | 8464/P/2H | Original Q2

Question	Answers	Mark	AO / Spec. Ref.
02.5	**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 2		**12**

Answer 06 · Mark scheme

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

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$W \propto e$		1	AO1 6.5.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	750 = k × 0.060		1	AO2 6.5.3
	$k = \frac{750}{0.060}$	allow a correct rearrangement using an incorrectly / not converted value of *e*	1	
	k = 12 500 N/m	allow a correct calculation using incorrectly / not converted value of *e*	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(an object that is inelastically deformed) will not go back to its original length	allow shape for length	1	AO1 6.5.3
	when the force is removed		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	$1800 = ½ \times 225 \times e^2$		1	AO2 6.5.3
	$e = \sqrt{\frac{2\times1800}{225}}$	allow $e^2 = \frac{2\times1800}{225}$	1	
	e = 4 (m)	allow *e* = 4.0 (m)	1	

6.5.1.2 Contact and non-contact forces

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	$e = \frac{750}{225}$ e = 3.3… (m) the extension will be too great so not suitable for use in the chair **OR** F = 225 x 0.3 (1) F = 67.5 (N) (1) the weight of a person will be too great so (spring is) not suitable for use in the chair (1)	 allow a conclusion consistent with their calculated extension allow the chair would rest on the ground allow the spring will not stretch beyond its elastic limit	1 1 1	AO3 6.5.3

Total Question 5	12

Answer 07 · 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

Answer 08 · Mark scheme

June 2025 | 8464/P/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	distance travelled = speed × time		1	AO1 6.5.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	1 500 000 = v × 670 000 $v = \frac{1\ 500\ 000}{670\ 000}$ V = 2.2… (m/s)		1 1 1	AO2 6.5.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	F = (6 × 370) - 520 F = 1700 (N)	if no other mark awarded allow **1** mark for 370 - 520 = (-)150 (N)	1 1	AO2 6.5.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	speed	allow velocity	1	AO1 6.5.4.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	friction + air resistance = pull of the rope on the sled		1	AO1 6.5.1.4 6.5.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	the force of the sled on the rope		1	AO1 6.5.4.2.3

Total Question 1	**9**

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”.

6.5.1.2 Contact and non-contact forces

Answer 02 · Examiner comments

June 2018 | 8464/P/2H | Original Q4

Question 4 (standard / high & high demand)

04.1 Nearly 70% identified the correct newtonmeter but very few stated that it was the extension being the same for all of the newtonmeters that was the key factor.

04.2 Fewer than 10% could correctly identify the type of error, with many giving descriptions rather than stating zero error or systematic error. Terms used incorrectly with some frequency included human error.

Over 50% were then able to say how the error could be corrected. Some suggested that the newtonmeter might just be 'sticky' and need to be pulled down and released which, whilst showing practical experience, would not be a solution in all cases.

04.3 Whilst only just over 5% gained all 6 marks, correct solutions, when seen, were clear and well set out. A significant number, nearly 17%, calculated the initial extension, but did not complete the calculation to determine the total extension.

Those managing to do the second part of the question opted in about equal numbers for each of the two expected methods.

Typical errors in the first part included not finding the square root of the answer for the extension and in dividing by 2 twice.

A few candidates realised there were two parts but worked out incorrect values. They were able to gain the final mark by adding the two incorrect extensions correctly.

6.5.1.2 Contact and non-contact forces

Answer 03 · Examiner comments

November 2021 | 8464/P/2H | Original Q1

Question 1 (Standard demand)

01.1 30% of students correctly selected the meaning of elastically deformed.

01.2 Approximately 25% of students scored at least 1 mark on this question for suggesting that the length of the spring should be measured with a ruler. Nearly 15% correct suggested that the initial and final length should be measured, then subtracted.

01.3 85% of students were able to select the correct equation from the physics equations sheet, and substitute the values into the equation. Nearly all these students correctly evaluated the answer and were awarded 2 marks. Around 15% of these students converted 80 mm to metres and scored full marks.

01.4 Approximately 65% of students correctly recalled the equation.

01.5 Approximately 65% of students were able to substitute the numbers into the correctly rearranged equation and evaluate the answer to score full marks.

6.5.1.2 Contact and non-contact forces

Answer 04 · Examiner comments

June 2022 | 8464/P/1H | Original Q3

Question 03 (Standard and standard/high demand)

03.1 Many students struggled with this question, which revealed a number of misconceptions held by students. Around 70% of students gained at least one mark, but very few managed to score all 4 marks.

Many students began by describing energy changes as the child moved from the trampoline to the maximum height. This was ignored, and most of these responses went on to describe what happened as the child then fell downwards.

A lot of students described the forces acting on the child, which did not answer the question, and it was reasonably common to see descriptions of gravitational potential energy being a force which acts on the child. The concept of energy stores continues to be widely misunderstood by students, with some students making statements suggesting that there is a gravitational potential energy store when the child is in the air, for example. Lots of responses to the question described a transfer of gravitational potential energy to kinetic energy as the child descended, which gained the first marking point. Very few students realised that the kinetic energy of the child would decrease after landing on the trampoline.

For the springs, it was common to read descriptions of the springs stretching, rather than descriptions of changes to energy stores. Some students identified that the elastic potential energy of the springs would increase, but added that the chemical energy of the springs would decrease, and therefore did not gain the mark. A fair number of students made statements that elastic energy was used to stretch the springs, which was not credit-worthy.

For the surroundings, a lot of students stated that there was no change to the energy stores, and a lot of students described an increase in sound energy. This is not a store of energy, and was ignored. A fair proportion of students did identify that energy would be dissipated to the surroundings, thus gaining the mark.

6.5.1.2 Contact and non-contact forces

Answer 04 · Examiner comments June 2022 | 8464/P/1H | Original Q3

03.2 This calculation proved to be very challenging, with nearly three quarters of all students failing to gain any marks.

A lot of students calculated the difference between the energies at positions A and B, which is incorrect physics so was unable to gain credit. A lot of students substituted 0.056 m in for the spring constant in position A, and some students forgot to square the extension when using the elastic energy equation.

Students who realised that they needed to use the value of elastic potential energy at position A to calculate the spring constant, tended to do very well in this question, with nearly two thirds of those who gained any credit scoring all 5 marks. A few students arrived at the correct final answer, but then subtracted the original extension to find the change in extension, an approach which scored a maximum of 4 marks.

03.3 Over 60% of students selected the correct definition of work done.

Answer 05 · Examiner comments June 2022 | 8464/P/2H | Original Q2

Question 2 (Standard demand)

02.1 Over 99% of students were able to select the correct equation.

02.2 This was a relatively straight forward calculation, with nearly 90% of students gaining full marks.

02.3 Over 99% of students were able to select the correct equation.

02.4 Over 95% of students gained full marks on this speed calculation.

02.5 30% of students were able write a response that contained logically linked statements. The most common creditworthy responses described competitors getting tired. Of the students that did not get into level 2, most just gave reasons why the speed may change, but did not link this to an increase or decrease in speed.

6.5.1.2 Contact and non-contact forces

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

Question 5 (standard/high demand and high demand)

05.1 Approximately 70% of students selected the correct relationship.

05.2 90% of students correctly substituted and calculated a spring constant. However, only 35% of students converted the extension to metres and scored three marks. 55% of students did not do the conversion or did it incorrectly and scored two marks.

05.3 Approximately 60% of students knew that an object that is inelastically deformed will not go back to its original length but did not refer to when the force is removed. Only 2% of students were awarded both marks for this question. Many students who scored zero marks wrote vague statements such as the object will not go back to its original form.

05.4 50% of students scored full marks. Many students who scored zero used an incorrect equation despite having the equation sheet. Many students tried to substitute into the correct equation but omitted the squared symbol.

05.5 Many students find evaluate questions challenging, particularly when they have to do a calculation. 30% of students did score at least two marks for a calculation, and 12% went on to draw a sensible conclusion and were awarded all three marks.

Answer 07 · 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.

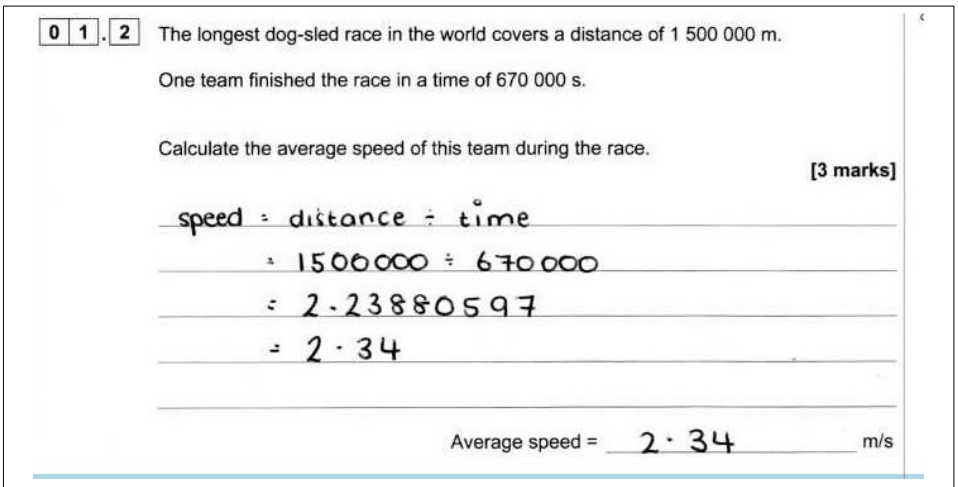
6.5.1.2 Contact and non-contact forces

Answer 08 · Examiner comments June 2025 | 8464/P/2H | Original Q1

Question 1 (Standard demand)

01.1 Almost all students selected the correct equation.

01.2 Almost all students were able to calculate the answer using the relevant equation. Of those who did not, it was surprisingly common to see answers where the student had attempted to round their answer to two significant figures and decided that 2.23 should be rounded to 2.3. This led to an incorrect final answer.



0 1 . 2 The longest dog-sled race in the world covers a distance of 1 500 000 m.

One team finished the race in a time of 670 000 s.

Calculate the average speed of this team during the race.

[3 marks]

speed = distance ÷ time
= 1500000 ÷ 670000
= 2.23880597
= 2.34

Average speed = 2.34 m/s

This student's response shows incorrect rounding after calculating their answer. A small but significant proportion of students made errors such as this.

If this student had left their answer as 2.23880597 they would have scored all three marks, but the incorrect rounding meant that their final answer was incorrect and so only two marks were awarded.

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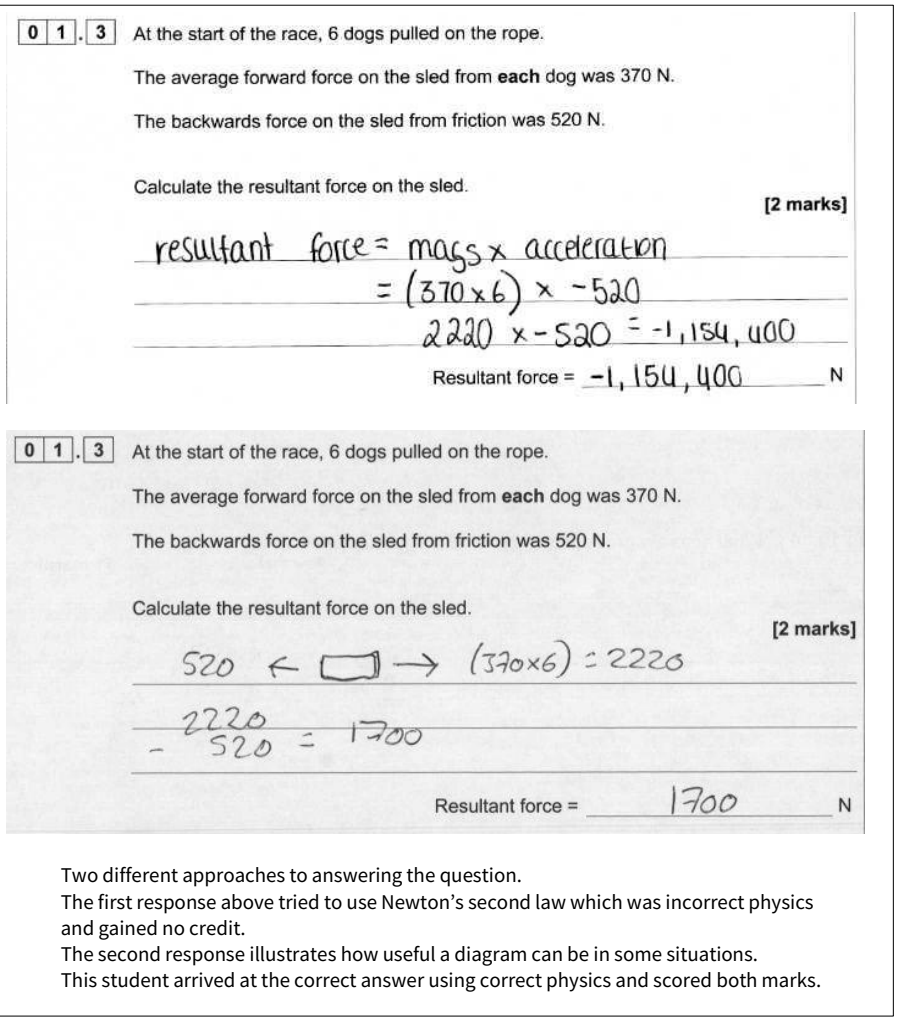
6.5.1.2 Contact and non-contact forces

Answer 08 · Examiner comments June 2025 | 8464/P/2H | Original Q1

01.3 Slightly more than 60% of students answered this question correctly, with another fifth scoring 1 mark. The instruction to 'Calculate the resultant force…' had many students attempting to use $F = ma$ which was not possible given the information provided. Some students drew sketch diagrams to help them answer, which tended to lead them along the right lines.



0 1 . 3 At the start of the race, 6 dogs pulled on the rope.

The average forward force on the sled from **each** dog was 370 N.

The backwards force on the sled from friction was 520 N.

Calculate the resultant force on the sled.

[2 marks]

resultant force = mass x acceleration
= (370 x 6) x -520
2220 x -520 = -1,154,400

Resultant force = -1,154,400 N

0 1 . 3 At the start of the race, 6 dogs pulled on the rope.

The average forward force on the sled from **each** dog was 370 N.

The backwards force on the sled from friction was 520 N.

Calculate the resultant force on the sled.

[2 marks]

520 ← □ → (370×6) = 2220

2220
- 520 = 1700

Resultant force = 1700 N

Two different approaches to answering the question.
The first response above tried to use Newton's second law which was incorrect physics and gained no credit.
The second response illustrates how useful a diagram can be in some situations.
This student arrived at the correct answer using correct physics and scored both marks.

01.4 Fewer than half the students were able to recall that the gradient of a distance-time graph represents speed. Many responses gave descriptions of the distance increasing with time, or the steepness of the line. A description of the trend shown in the graph is not the same as what the gradient represents, so these answers did not gain any credit. Other common incorrect answers included suggestions that the gradient shows the average speed of the sled.

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6.5.1.2 Contact and non-contact forces

Answer 08 · Examiner comments

June 2025 | 8464/P/2H | Original Q1

01.5 Just under three quarters recalled that at a constant speed the resultant force is zero and therefore selected the correct option.

01.6 Only about four in ten students were able to identify the Newton's third law pair to the force of the rope on the sled.

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