AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.1.2

Contact and non-contact forces

Past-paper questions

Tier	**Higher**
Question groups	**8**
Available paper years	**2018–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

6.5.1.2 Contact and non-contact forces

Question 01

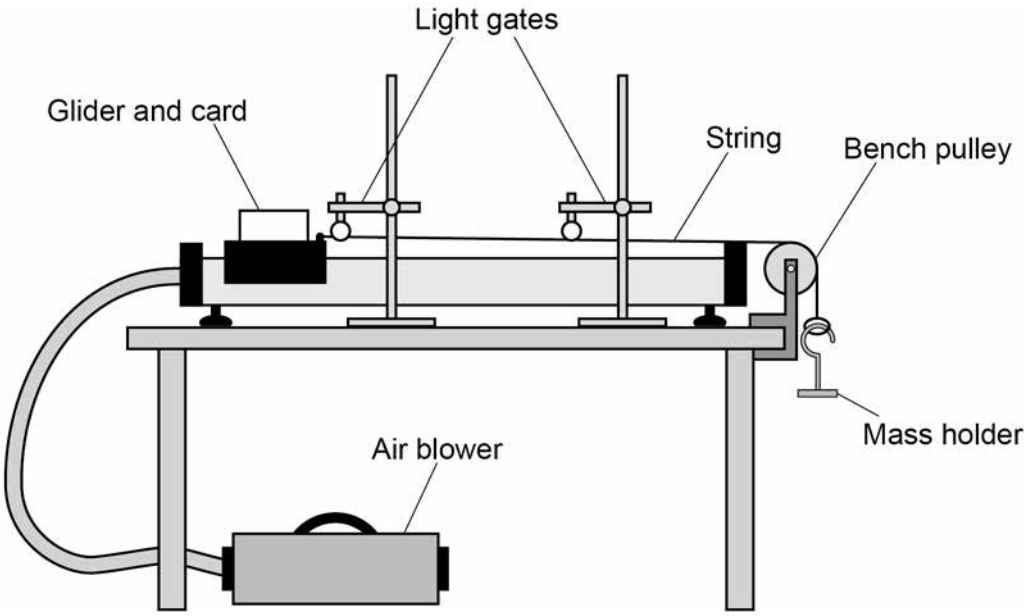
June 2018 | 8464/P/2H | Original Q1

0 1 A student investigated acceleration using gliders, an air track and light gates.

The air track reduces friction between the glider and the track to zero.

Figure 1 shows the apparatus.

Figure 1



The glider was released from rest and moved along the track.

The mass holder hit the ground before the card passed through the second light gate.

0 1 . 1 Which **two** statements describe the effect this would have on the glider?

[2 marks]

Tick **two** boxes.

- Its acceleration would decrease to zero. ☐
- Its acceleration would increase. ☐
- The resultant force on it would decrease to zero. ☐
- The resultant force on it would increase. ☐
- Its speed would increase. ☐

6.5.1.2 Contact and non-contact forces

Question 01 · continued

0 1 . 2 The mass holder should **not** hit the ground before the card passes through the second light gate.

Suggest **one** way that the student could stop this happening.

[1 mark]

Question 1 continues on the next page

Question 01 · continued

The student increased the resultant force acting on the glider by adding more masses to the mass holder.

She calculated the acceleration of the glider for each resultant force.

Each test was done three times.

Table 1 shows the results.

Table 1

Resultant force in N	Acceleration in m/s^2			Mean acceleration in m/s^2
	Test 1	Test 2	Test 3	
0.20	1.3	1.2	1.3	1.26667
0.39	2.6	2.5	2.6	2.6
0.59	3.8	3.8	3.9	3.8
0.78	5.1	5.1	5.1	5.1
0.98	6.4	7.2	6.4	6.7

0 1 . 3 The student made **two** mistakes in the mean acceleration column.

Identify the mistakes the student made.

Suggest how each mistake can be corrected.

[4 marks]

Mistake _____

_____

Correction _____

_____

Mistake _____

_____

Correction _____

_____

6.5.1.2 Contact and non-contact forces

Question 01 · continued

0 1 . 4 Write a conclusion for this investigation.

Use the data in **Table 1**

[1 mark]

Question 1 continues on the next page

Question 01 · continued

0 1 . 5 The student used a constant resultant force to accelerate the glider.

The student changed the mass of the glider and calculated the new acceleration.

She repeated this for different masses of the glider, keeping the resultant force constant.

The results are shown in **Table 2**

Table 2

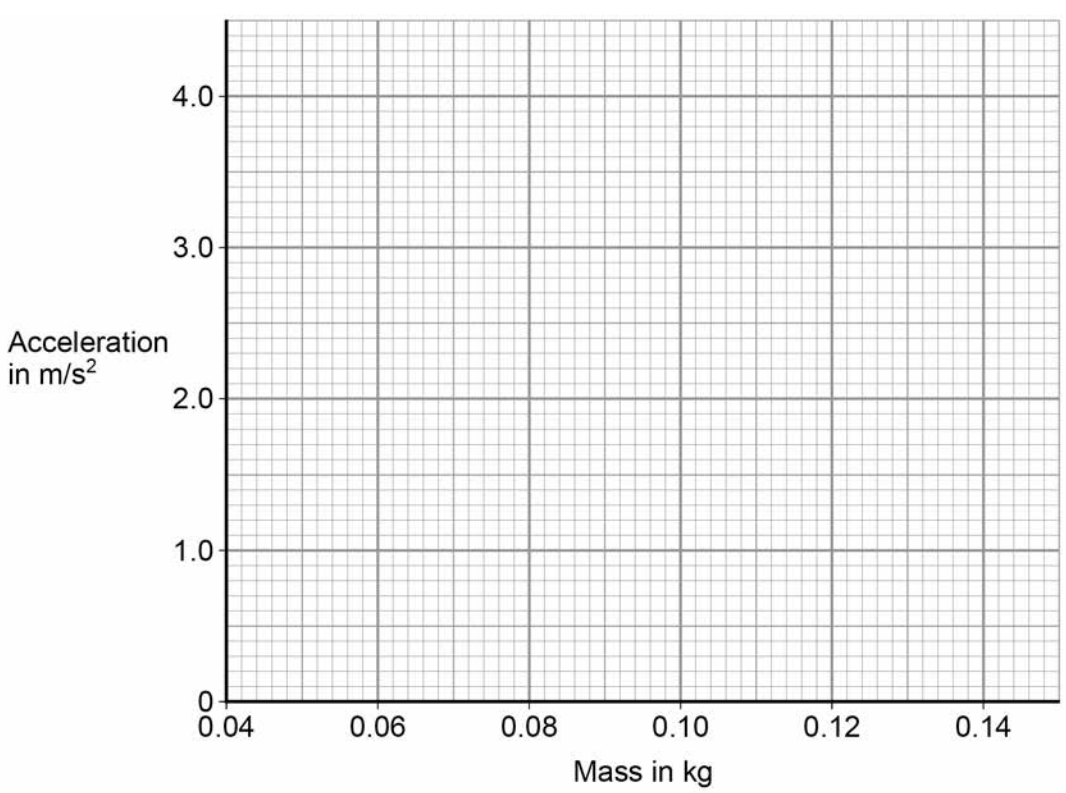
Mass of the glider in kg	Acceleration in m/s^2
0.060	3.5
0.080	2.6
0.10	2.0
0.12	1.7
0.14	1.4

Plot the results on **Figure 2**

Draw a line of best fit.

[3 marks]

Figure 2



6.5.1.2 Contact and non-contact forces

Question 01 · continued

0 1 . 6 Describe the relationship between mass and acceleration.

[1 mark]

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Turn over for the next question

6.5.1.2 Contact and non-contact forces

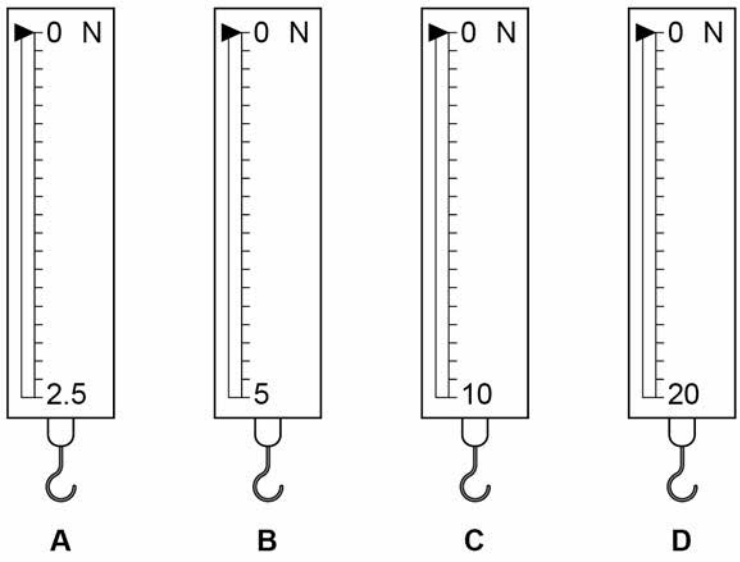
Question 02

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

0 4 . 1 **Figure 6** shows four newtonmeters.

Each newtonmeter contains a spring.

Figure 6



Which newtonmeter has the spring with the greatest spring constant?

Give a reason for your answer.

[2 marks]

Newtonmeter _____

Reason _____

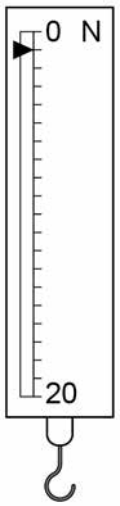
_____

6.5.1.2 Contact and non-contact forces

Question 02 · continued

0 4 . 2 The newtonmeter in **Figure 7** will give an error when used to make a measurement.

Figure 7



Name the type of error.

Describe how this error can be corrected.

[2 marks]

Type of error _____

Correction _____

_____

Question 4 continues on the next page

6.5.1.2 Contact and non-contact forces

Question 02 · continued

0 4 . 3 A student hangs a weight on a newtonmeter.

The energy now stored in the spring in the newtonmeter is 4.5×10^{-2} J

The student then increases the weight on the newtonmeter by 2.0 N

Calculate the total extension of the spring.

Spring constant = 400 N/m

[6 marks]

Total extension = _____ m

10

6.5.1.2 Contact and non-contact forces

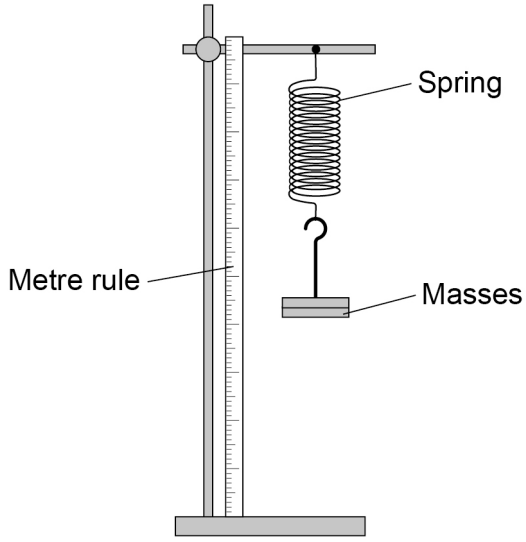
Question 03

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

0 1 **Figure 1** shows a stretched spring.

The spring is elastically deformed.

Figure 1



0 1 . 1 What is meant by 'elastically deformed'?

[1 mark]

Tick (✓) **one** box.

As the force on the spring increases the length of the spring increases. ☐

Only a very small force is needed to stretch the spring. ☐

The force on the spring causes it to change shape. ☐

The spring will return to its original length when the force is removed. ☐

6.5.1.2 Contact and non-contact forces

Question 03 · continued

0 1 . 2 Describe a method to determine the extension of the spring.

[2 marks]

0 1 . 3 The extension of the spring is 80 mm.

spring constant = 40 N/m

Calculate the elastic potential energy of the spring.

Use the Physics Equations Sheet.

[3 marks]

Elastic potential energy = _____ J

Question 1 continues on the next page

6.5.1.2 Contact and non-contact forces

Question 03 · continued

0 1 . 4 Write down the equation which links extension (*e*), force (*F*) and spring constant (*k*).

[1 mark]

0 1 . 5 A force of 300 N acts on a different spring.

The force causes the spring to extend by 0.40 m.

Calculate the spring constant of the spring.

[3 marks]

Spring constant = _____ N/m

10

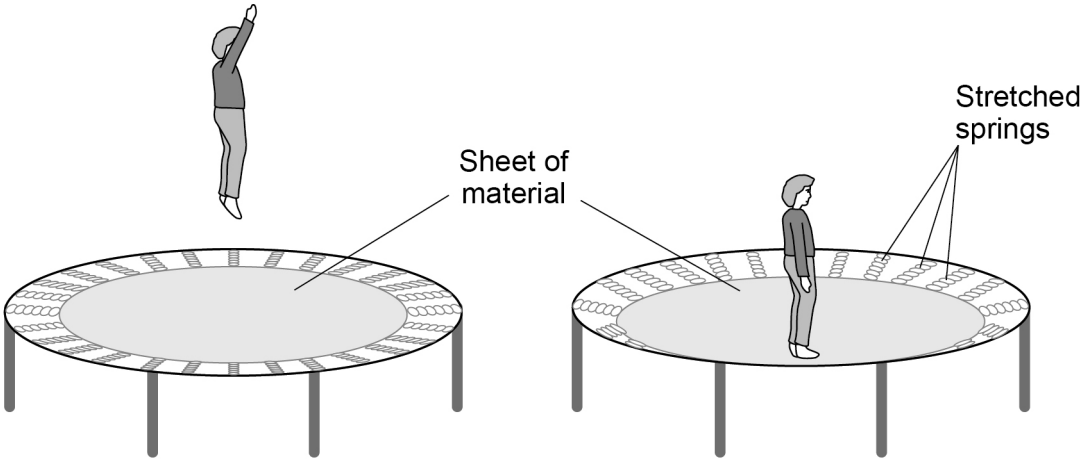
6.5.1.2 Contact and non-contact forces

Question 04

0 3 A trampoline is made from a sheet of material held in place by stretched springs.

Figure 5 shows a child on a trampoline.

Figure 5



6.5.1.2 Contact and non-contact forces

Question 04 · continued

0 3 . 1 Position **A** shows the child's maximum height above the trampoline.

Position **B** shows the lowest position reached by the child when landing on the trampoline.

Describe the changes to the stores of energy of the:

- child
- springs
- surroundings

as the child moves from position **A** to position **B**.

[4 marks]

Child _____

Springs _____

Surroundings _____

Question 3 continues on the next page

Question 04 · continued

0 3 . 2 When the child is at position **A**, each trampoline spring is stretched by 0.056 m

The elastic potential energy of each spring is 4.9 J

When the child is at position **B**, the elastic potential energy of each spring increases to 8.1 J

Calculate the extension of each spring when the child is at position **B**.

Use the Physics Equations Sheet.

[5 marks]

Extension = _____ m

0 3 . 3 As the child bounces on the trampoline the child does work.

What is the work done by the child equal to?

[1 mark]

Tick (✓) **one** box.

- The average force applied by the child ☐
- The maximum force applied by the child ☐
- The total energy store of the child ☐
- The total energy transferred by the child ☐

10

6.5.1.2 Contact and non-contact forces

Question 05

0 2 **Figure 3** shows competitors in the wheelchair race at the London Marathon.

The distance of the London Marathon is 42 000 m

Figure 3



6.5.1.2 Contact and non-contact forces

Question 05 · continued

Use the Physics Equations Sheet to answer questions **02.1** and **02.2**.

0 2 . 1 Write down the equation that links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 2 . 2 During the race competitors work against air resistance.

The work done against air resistance by the winner of the race was 3 360 000 J

Calculate the average air resistance acting on the winner of the race.

[3 marks]

Average air resistance = _____ N

Question 2 continues on the next page

6.5.1.2 Contact and non-contact forces

Question 05 · continued

Use the Physics Equations Sheet to answer questions **02.3** and **02.4**.

0 2 . 3 Which equation links distance travelled, speed and time?

[1 mark]

Tick (✓) **one** box.

distance travelled = speed × time ☐

time = distance travelled × speed ☐

speed = distance travelled × time ☐

0 2 . 4 The distance of the London Marathon is 42 000 m

The winning time for the race was 5600 seconds.

Calculate the average speed of the winner of the race.

[3 marks]

Average speed = _____ m/s

6.5.1.2 Contact and non-contact forces

Question 05 · continued

0 2 . 5 Explain why the speed of a competitor changes during the race.

[4 marks]

12

Turn over for the next question

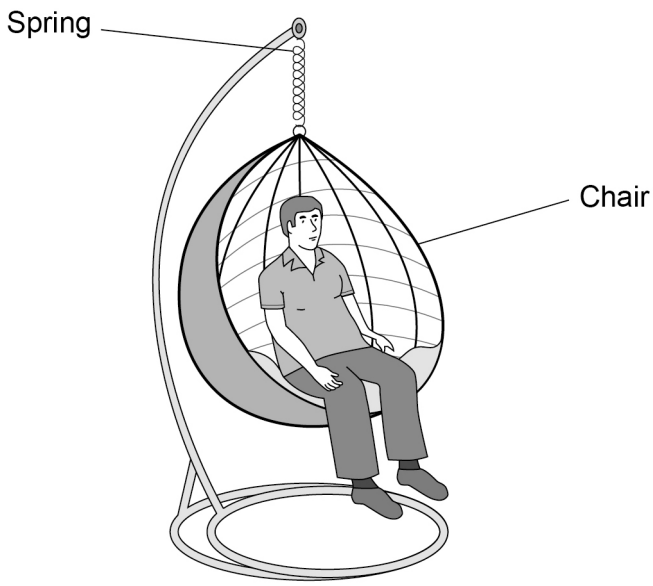
6.5.1.2 Contact and non-contact forces

Question 06

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

0 5 **Figure 8** shows a garden chair hanging from a spring.

Figure 8



0 5 . 1 Which of the following describes the relationship between the weight (W) acting on the spring and the extension (e) of the spring?

[1 mark]

Tick (✓) **one** box.

$W = e$ ☐

$W \propto e$ ☐

$W \sim e$ ☐

$W < e$ ☐

6.5.1.2 Contact and non-contact forces

Question 06 · continued

0 5 . 2 The person in **Figure 8** has a weight of 750 N.

The person's weight causes the spring to extend by 60 mm.

Calculate the spring constant of the spring.

Use the Physics Equations Sheet.

[3 marks]

Spring constant = _____ N/m

Question 5 continues on the next page

6.5.1.2 Contact and non-contact forces

Question 06 · continued

The manufacturer of the chair tests a new spring to see if it is suitable to hang the chair.

The spring can store a maximum of 1800 J of elastic potential energy before it becomes inelastically deformed.

0 5 . 3 Describe what is meant by 'inelastically deformed'.

[2 marks]

0 5 . 4 Calculate the maximum extension of the spring before the spring becomes inelastically deformed.

spring constant = 225 N/m

Use the Physics Equations Sheet.

[3 marks]

Maximum extension = _____ m

6.5.1.2 Contact and non-contact forces

Question 06 · continued

0 5 . 5 Evaluate the suitability of the new spring to hang the chair.

maximum elastic potential energy = 1800 J

spring constant = 225 N/m

weight of person = 750 N

distance between the bottom of the chair and the ground = 30 cm

Include a calculation in your answer.

Use the Physics Equations Sheet.

[3 marks]

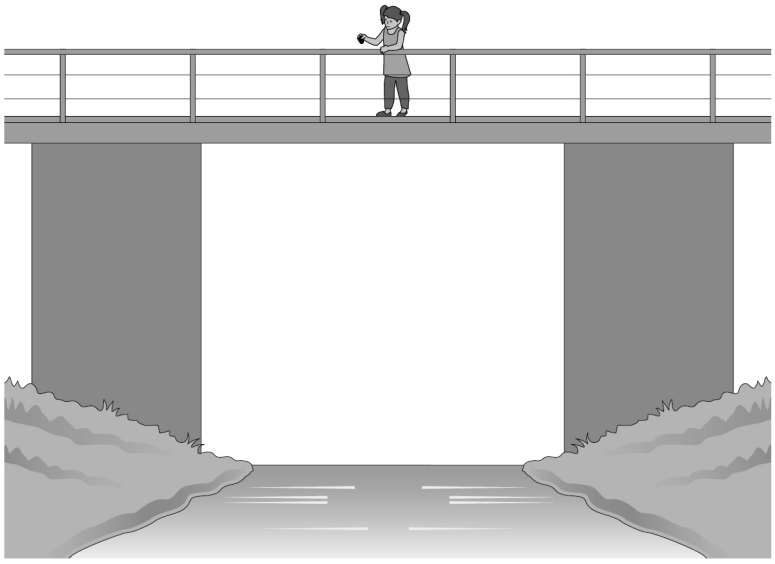
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6.5.1.2 Contact and non-contact forces

Question 07

0 6 **Figure 9** shows a child dropping a stone into water.

Figure 9



0 6 . 1 When the child drops the stone it passes the child's feet with a velocity of 3.1 m/s.

The child's feet are 6.3 m above the water.

acceleration due to gravity = 9.8 m/s^2

Calculate the velocity of the stone as it hits the water.

Use the Physics Equations Sheet.

Give your answer to 2 significant figures.

[4 marks]

Velocity (2 significant figures) = _____ m/s

6.5.1.2 Contact and non-contact forces

Question 07 · continued

0 6 . 2 Velocity is a vector.

Describe the velocity of the stone as it falls through the air.

Assume there is no air resistance.

[2 marks]

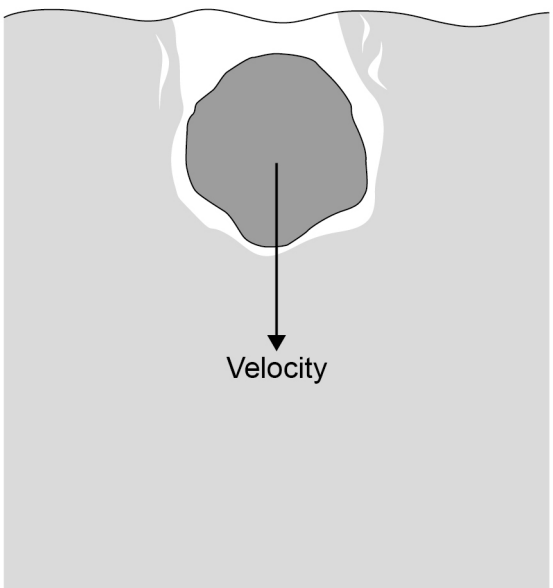
Question 6 continues on the next page

6.5.1.2 Contact and non-contact forces

Question 07 · continued

0 6 . 3 **Figure 10** shows the stone just after it has entered the water.

Figure 10



As the stone moves through the water, the stone slows to a constant velocity.

Explain why.

[4 marks]

10

6.5.1.2 Contact and non-contact forces

Question 08

0 1 In a dog-sled race, a team of dogs pull on a rope attached to a sled.

Figure 1 shows a dog-sled team.

Figure 1



Use the Physics Equations Sheet to answer questions **01.1** and **01.2**.

0 1 . 1 What equation links distance travelled, speed and time?

[1 mark]

Tick (✓) **one** box.

distance travelled = speed × time ☐

speed = time × distance travelled ☐

time = distance travelled × speed ☐

6.5.1.2 Contact and non-contact forces

Question 08 · continued

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]

Average speed = _____ m/s

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 = _____ N

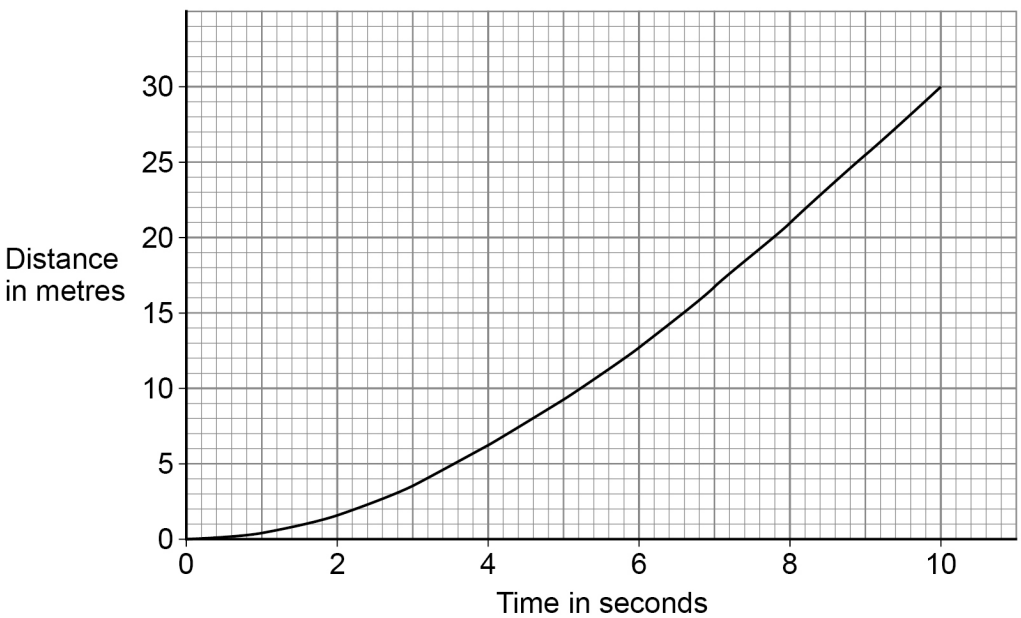
Question 1 continues on the next page

6.5.1.2 Contact and non-contact forces

Question 08 · continued

Figure 2 shows a distance–time graph for the sled at the start of the race.

Figure 2



0 1 . 4 What does the gradient of the graph in **Figure 2** represent?

[1 mark]

6.5.1.2 Contact and non-contact forces

Question 08 · continued

0 1 . 5 Later in the race, the sled moved at a constant speed along a flat, horizontal path.

What was the relationship between the size of the horizontal forces acting when the sled moved at a constant speed?

[1 mark]

Tick (✓) **one** box.

friction + air resistance < pull of the rope on the sled ☐

friction + air resistance = pull of the rope on the sled ☐

friction + air resistance > pull of the rope on the sled ☐

0 1 . 6 The rope exerted a force on the sled when the sled was moving.

What is the Newton's Third Law pair to the force of the rope on the sled?

[1 mark]

Tick (✓) **one** box.

The force of friction on the sled ☐

The force of the dogs on the rope ☐

The force of the sled on the rope ☐

9