AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.1.4

Resultant forces

Past-paper questions

Tier	**Higher**
Question groups	**9**
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.

6.5.1.4 Resultant forces

Question 01

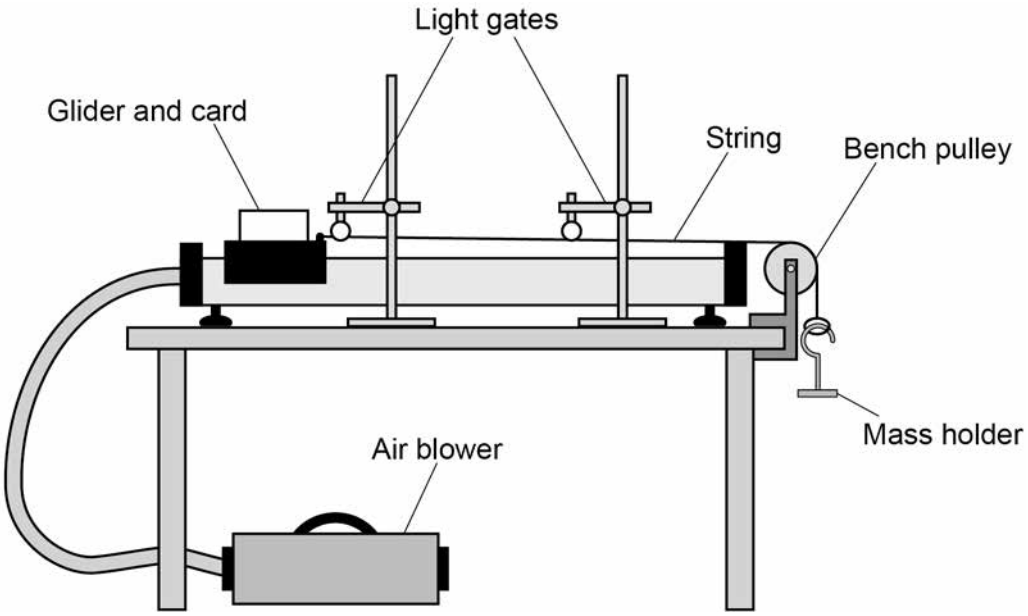
June 2018 | 8464/P/2H | Original Q1

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. ☐

6.5.1.4 Resultant 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

6.5.1.4 Resultant forces

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 _____

_____

6.5.1.4 Resultant 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

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

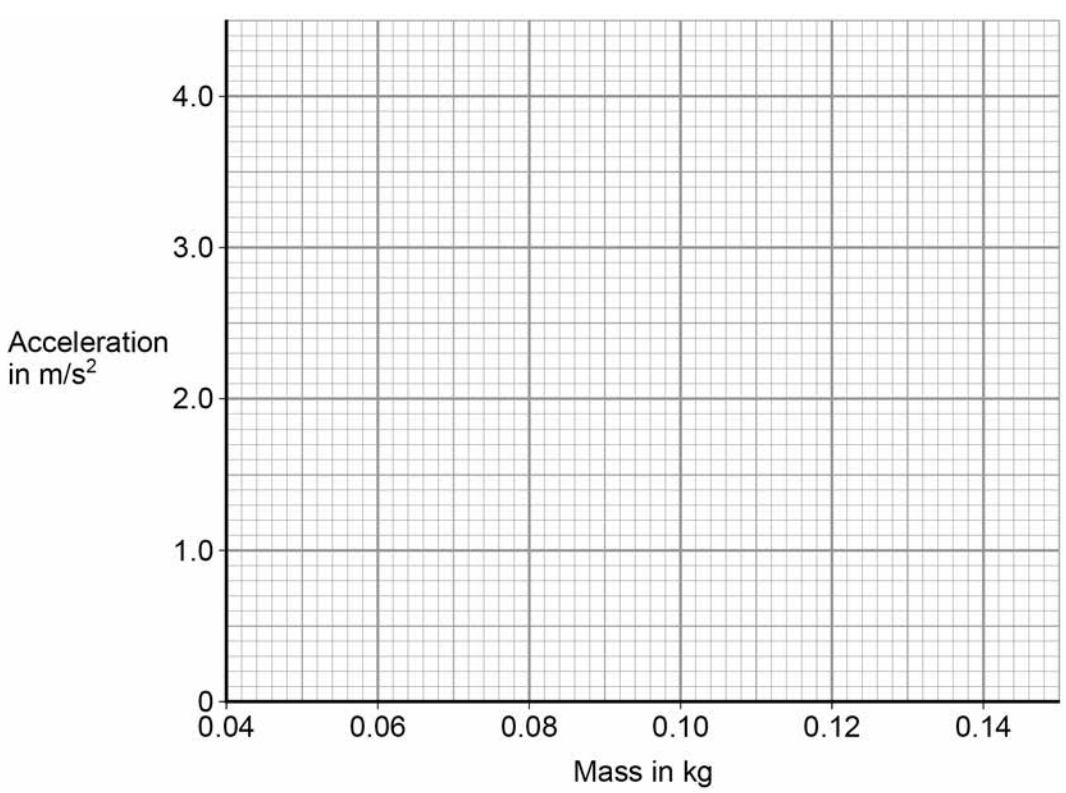
Mass of the glider in kg	Acceleration in m/s^2
0.060	3.5
0.080	2.6
0.10	2.0
0.12	1.7
0.14	1.4

Plot the results on **Figure 2**

Draw a line of best fit.

[3 marks]

Figure 2



6.5.1.4 Resultant forces

Question 01 · continued

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

[1 mark]

12

Turn over for the next question

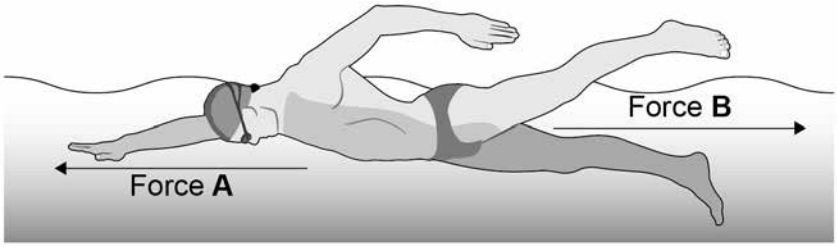
6.5.1.4 Resultant forces

Question 02

June 2018 | 8464/P/2H | Original Q7

0 7 **Figure 10** shows the horizontal forces acting on a man swimming in the sea.

Figure 10



0 7 . 1 Describe the movement of the man when the resultant horizontal force is 0 N

[1 mark]

0 7 . 2 The man increases Force **A**.

Explain what happens to Force **B** and to the movement of the man.

[4 marks]

6.5.1.4 Resultant forces

Question 02 · continued

0 7 . 3 A boat moves through the sea.

There is a 3000 N force to the west on the boat.

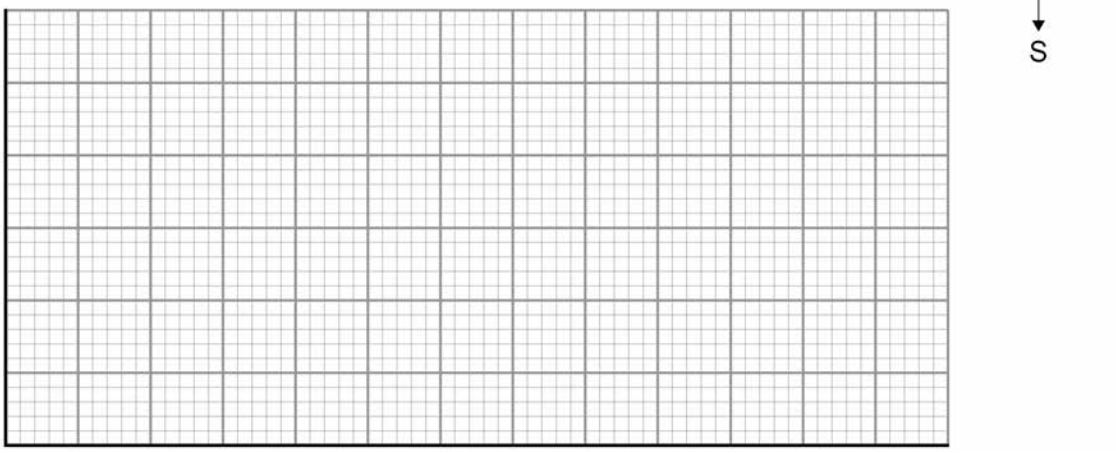
There is a 1000 N force to the south on the boat.

Determine the magnitude and direction of the resultant force on the boat.

Draw a vector diagram of these forces to scale on **Figure 11**

[3 marks]

Figure 11



Magnitude of resultant force = _____ N

Direction of resultant force = _____ °

0 7 . 4 The force to the south on the boat increases.

What effect does this have on the resultant force on the boat?

[2 marks]

_____

_____

_____

_____

6.5.1.4 Resultant forces

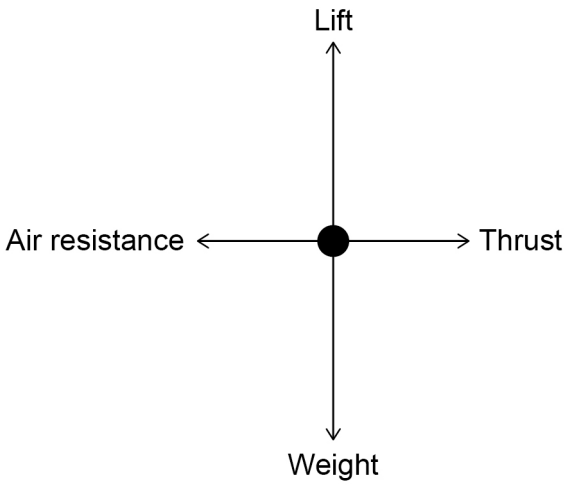
Question 03

June 2019 | 8464/P/2H | Original Q6

0 6 **Figure 9** shows a free body diagram for an aeroplane flying at a constant speed and at a constant height.

The speed of the aeroplane is much greater than the speed at which the aeroplane lands.

Figure 9



0 6 . 1 Explain how the forces need to change so the aeroplane can land.

[4 marks]

Question 6 continues on the next page

6.5.1.4 Resultant forces

Question 03 · continued

0 6 . 2 The aeroplane lands at a speed of 80 m/s

After landing, the aeroplane takes 28 s to decelerate to a speed of 10 m/s

The mean resultant force on the aeroplane as it decelerates is 750 000 N

Calculate the mass of the aeroplane.

[5 marks]

Mass = _____ kg

9

6.5.1.4 Resultant forces

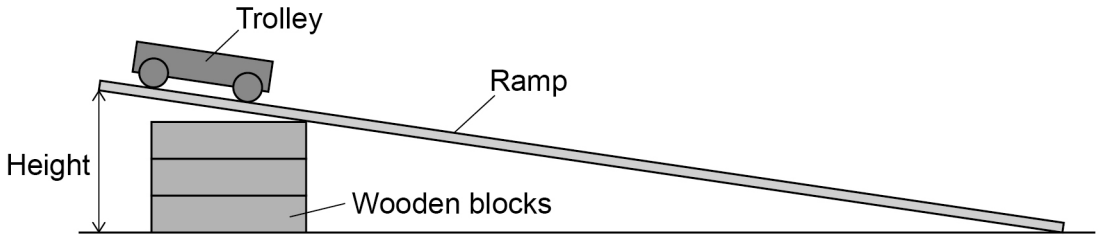
Question 04

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

0 2 A student investigated how the height of a ramp affects the acceleration of a trolley down the ramp.

Figure 3 shows some of the equipment used.

Figure 3



0 2 . 1 Plan an investigation to determine how the height of the ramp affects the acceleration of the trolley.

[6 marks]

6.5.1.4 Resultant forces

Question 04 · continued

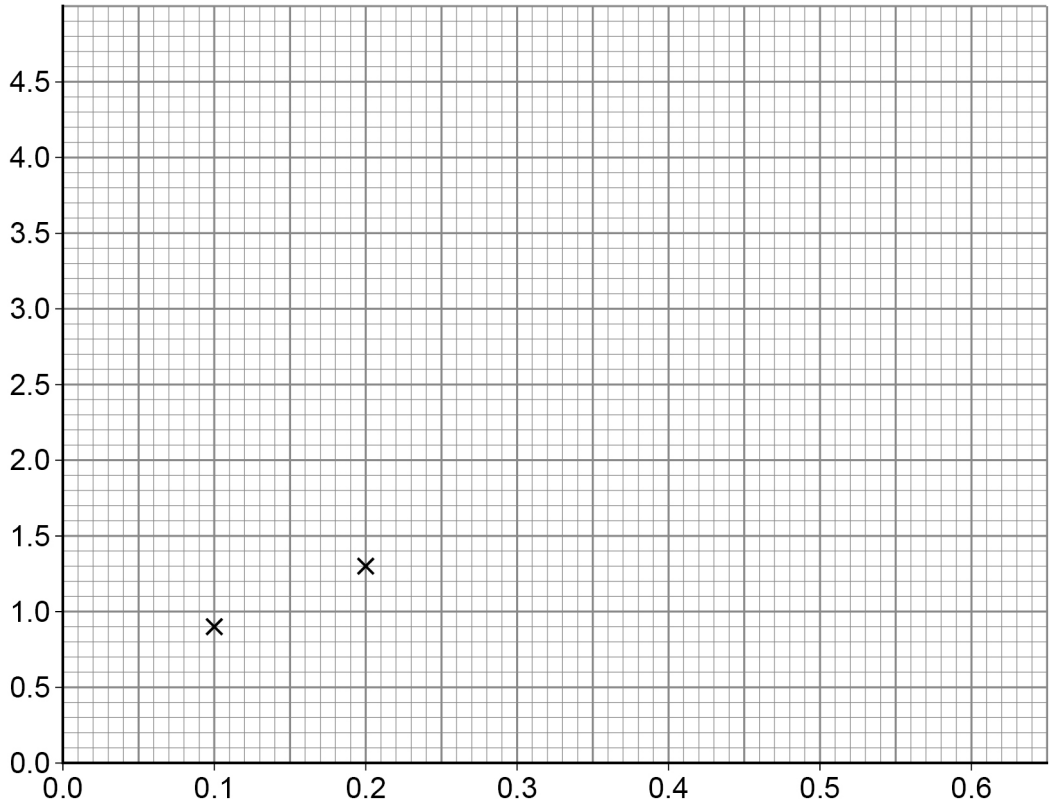
Table 1 shows the results.

Table 1

Height of ramp in metres	0.1	0.2	0.3	0.4	0.5	0.6
Acceleration in m/s^2	0.9	1.3	2.1	3.2	3.9	4.3

The first two results have been plotted on **Figure 4**.

Figure 4



0 2 . 2 Complete **Figure 4**.

You should:

- label the axes
- plot the remaining results from **Table 1**
- draw a line of best fit.

[4 marks]

Question 2 continues on the next page

6.5.1.4 Resultant forces

Question 04 · continued

0 2 . 3 Write down the equation that links acceleration (*a*), mass (*m*) and resultant force (*F*).

[1 mark]

0 2 . 4 When the resultant force on the trolley was 0.63 N the acceleration of the trolley was 2.1 m/s^2

Calculate the mass of the trolley.

[3 marks]

Mass of trolley = _____ kg

14

6.5.1.4 Resultant forces

Question 05

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

0 2 Professional rugby players wear a tracking device that measures their velocity and acceleration.

Figure 2 shows a player wearing a tracking device.

The player is tackling another player who is running with the ball.

Figure 2



0 2 . 1 Velocity and acceleration are both vector quantities.

What is a vector quantity?

[1 mark]

Tick (✓) **one** box.

- A quantity with both magnitude and direction ☐
- A quantity with direction only ☐
- A quantity with magnitude only ☐

6.5.1.4 Resultant forces

Question 05 · continued

0 2 . 2 Which of the following is a vector quantity?

[1 mark]

Tick (✓) **one** box.

Displacement ☐

Distance ☐

Time ☐

Work done ☐

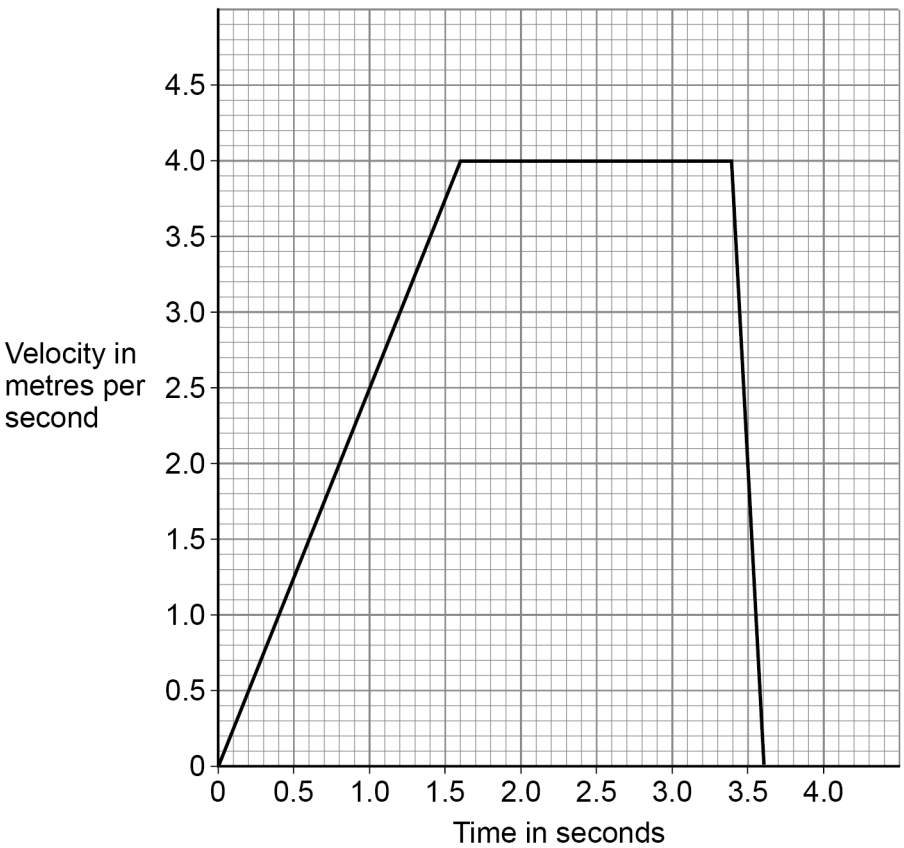
Question 2 continues on the next page

6.5.1.4 Resultant forces

Question 05 · continued

Figure 3 shows a velocity–time graph for the player running with the ball.

Figure 3



0 2 . 3 Determine the acceleration of the player between 0 and 1.6 s.

[2 marks]

Acceleration = _____ m/s^2

0 2 . 4 Describe the motion of the player between 3.4 s and 3.6 s.

[1 mark]

6.5.1.4 Resultant forces

Question 05 · continued

The force exerted on the player when she is tackled causes her to accelerate.

0 2 . 5 Write down the equation which links acceleration (*a*), mass (*m*) and resultant force (*F*).

[1 mark]

0 2 . 6 The player accelerates at 25 m/s^2 when a resultant force of 1800 N acts on her.

Calculate the mass of the player.

[3 marks]

Mass = _____ kg

0 2 . 7 The tracking device sends data to a computer during the game.

Suggest **one** advantage of the data being sent during the game.

[1 mark]

10

6.5.1.4 Resultant forces

Question 06

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

0 6 Scientists are developing a hypersonic aeroplane that will travel much faster than normal aeroplanes.

0 6 . 1 An aeroplane accelerates from a low speed to a high speed with the engines at maximum power.

Explain why the acceleration is **not** constant.

[5 marks]

Question 6 continues on the next page

6.5.1.4 Resultant forces

Question 06 · continued

0 6 . 2 The hypersonic aeroplane will have jet engines and a rocket engine.

The speed of aeroplanes can be measured on a uniform scale called the Mach scale.

Mach 1 = 330 m/s

The jet engines will accelerate the aeroplane to Mach 5.5.

The rocket engine will accelerate the aeroplane from Mach 5.5 to Mach 25.5 in 300 s.

The average resultant force on the aeroplane when the rocket engine is used will be 630 000 N.

Calculate the mass of the hypersonic aeroplane.

Give your answer to 2 significant figures.

[6 marks]

Mass (2 significant figures) = _____ kg

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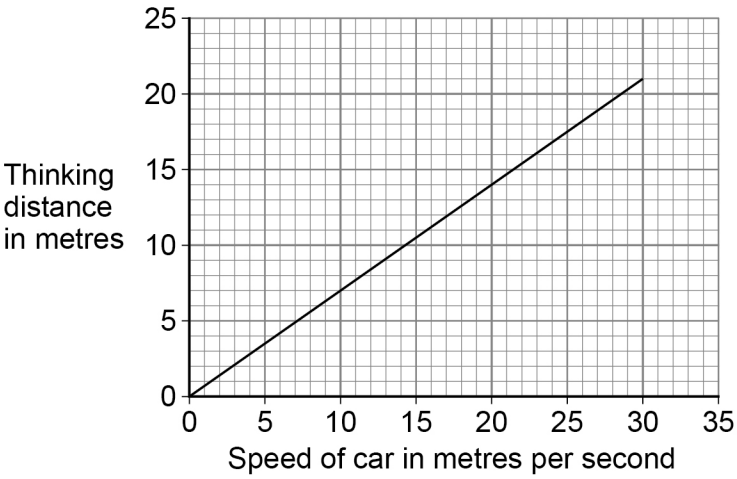
6.5.1.4 Resultant forces

Question 07

0 6 The distance a car travels during the driver's reaction time is called the thinking distance.

0 6 . 1 **Figure 9** shows how thinking distance depends on speed for a car.

Figure 9



Determine the driver's reaction time.

Use the Physics Equations Sheet.

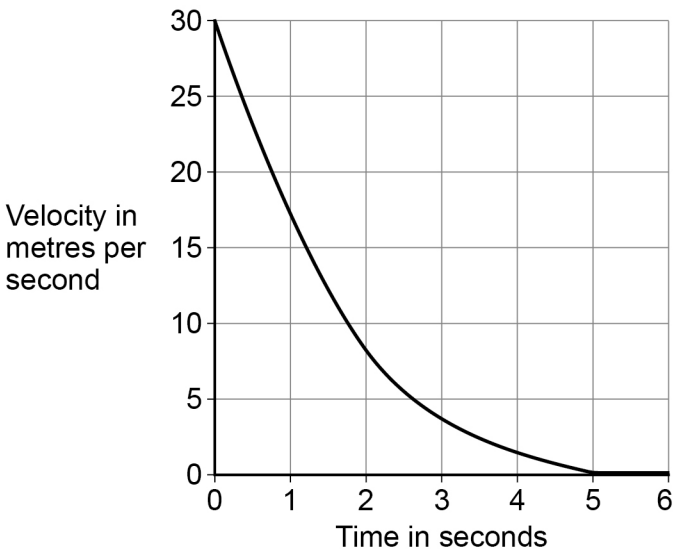
[3 marks]

Reaction time = _____ s

Question 6 continues on the next page

0 6 . 2 **Figure 10** shows how the velocity of a car changes during braking.

Figure 10



Determine the braking distance of the car.

[3 marks]

Braking distance = _____ m

6.5.1.4 Resultant forces

Question 07 · continued

0 6 . 3 Explain how the gradient of the line on **Figure 10** shows that the resultant force on the car was **not** constant.

[3 marks]

9

Turn over for the next question

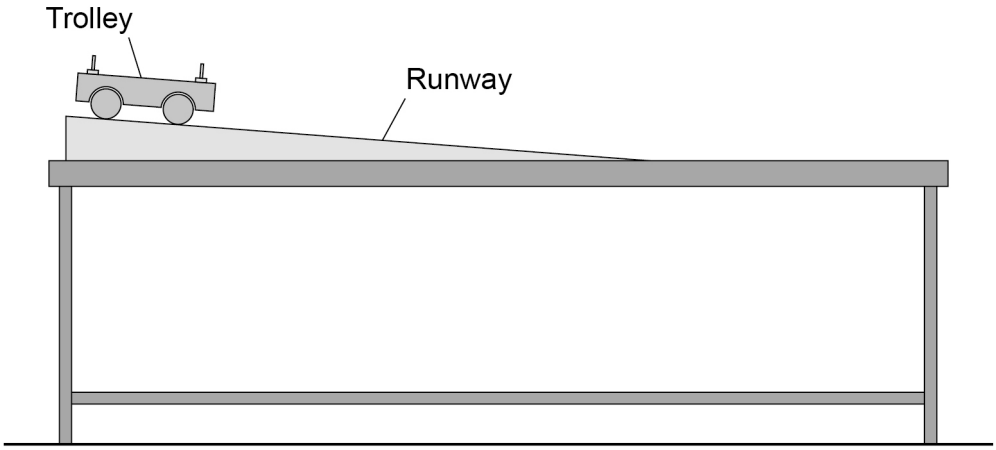
6.5.1.4 Resultant forces

Question 08

0 2 A student investigated how the acceleration of a trolley is affected by the force acting on the trolley.

Figure 3 shows some of the equipment used.

Figure 3



6.5.1.4 Resultant forces

Question 08 · continued

0 2 . 1 Describe a method the student could use.

Your answer should include any extra equipment needed.

[6 marks]

Question 2 continues on the next page

Table 1 shows one set of results for a similar investigation.

Table 1

Resultant force in newtons	Acceleration in m/s^2
1.2	1.6

0 2 . 2 Which of Newton's laws predicts that the acceleration of the trolley is proportional to the resultant force on the trolley?

[1 mark]

Tick (✓) **one** box.

First law ☐

Second law ☐

Third law ☐

0 2 . 3 Determine the acceleration of the trolley when the resultant force is 3.6 N.

Use **Table 1**.

[2 marks]

Acceleration = _____ m/s^2

6.5.1.4 Resultant forces

Question 08 · continued

Use the Physics Equations Sheet to answer questions **02.4** and **02.5**.

0 2 . 4 Write down the equation that links acceleration (*a*), mass (*m*) and resultant force (*F*).

[1 mark]

0 2 . 5 A resultant force of 0.42 N acts on a different trolley.

The acceleration of the trolley is 1.2 m/s^2.

Calculate the mass of the trolley.

[3 marks]

Mass of trolley = _____ kg

13

6.5.1.4 Resultant forces

Question 09

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

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 ☐

6.5.1.4 Resultant forces

Question 09 · 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

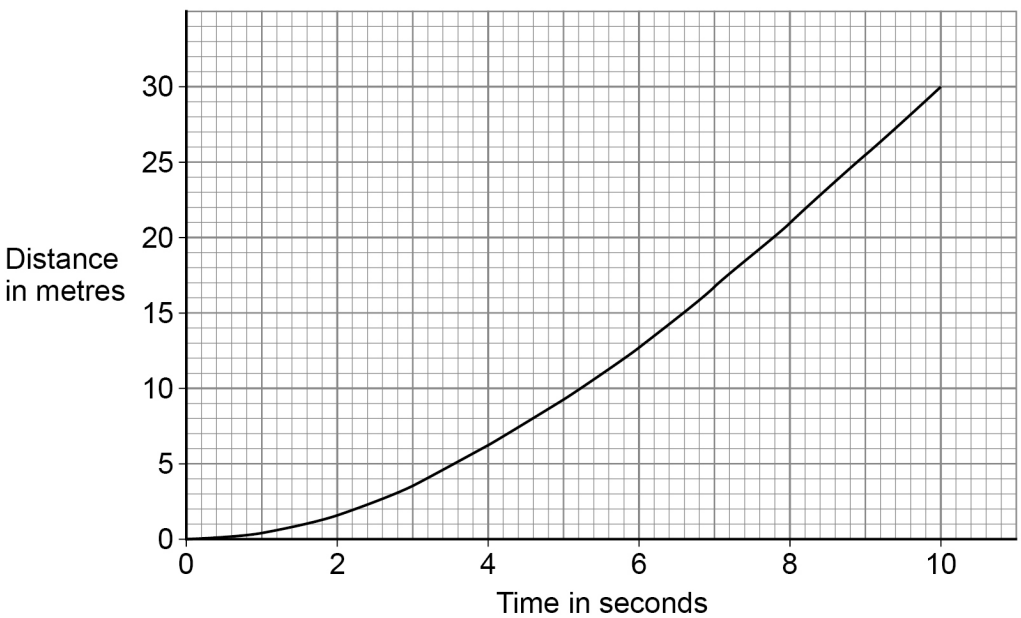
Question 1 continues on the next page

6.5.1.4 Resultant forces

Question 09 · 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]

6.5.1.4 Resultant forces

Question 09 · 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