AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.1.4

Resultant forces

Past-paper questions

Tier	**Foundation**
Question groups	**25**
Available paper years	**2008–2025**

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:** _____

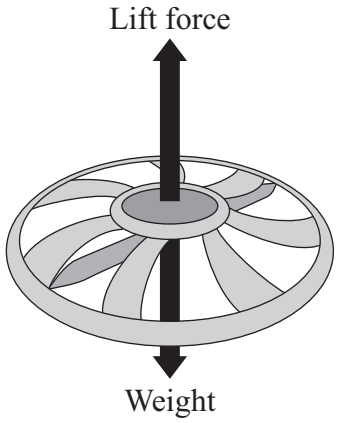
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.1.4 Resultant forces

Question 01

June 2008 | PHY2F | Original Q4 | Legacy

4 The diagram shows the forces on a small, radio-controlled, flying toy.



4 (a) (i) The mass of the toy is 0.06 kg.
Gravitational field strength = 10 N/kg

Use the equation in the box to calculate the weight of the toy.

weight = mass × gravitational field strength

Show clearly how you work out your answer and give the unit.

.....

.....

Weight = ...

(3 marks)

4 (a) (ii) Complete the following sentence by drawing a ring around the correct line in the box.

When the toy is hovering stationary in mid-air, the lift force is

bigger than
the same as
smaller than

the weight of the toy.

(1 mark)

4.5.1.4 Resultant forces

Question 01 · continued

for mark

4 (b) When the motor inside the toy is switched off, the toy starts to *accelerate* downwards.

4 (b) (i) What does the word *accelerate* mean?

.....

(1 mark)

4 (b) (ii) What is the direction of the resultant force on the falling toy?

.....

(1 mark)

4 (b) (iii) Does the momentum of the toy increase, decrease or stay the same?

.....

Give a reason for your answer.

.....

(2 marks)

8

4.5.1.4 Resultant forces

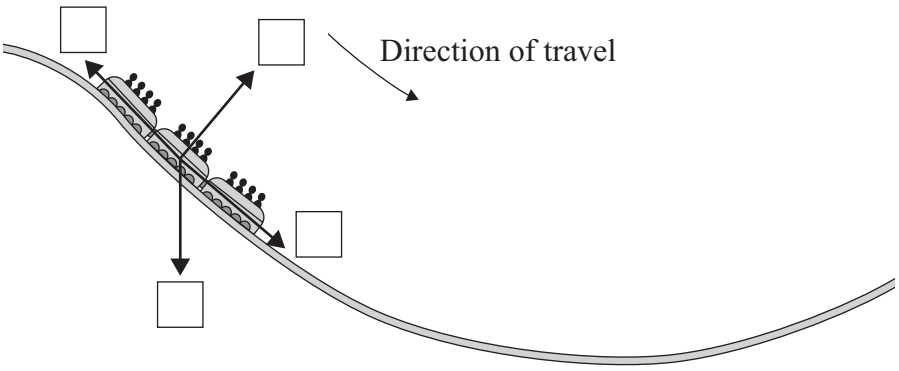
Question 02

January 2009 | PHY2F | Original Q7 | Legacy

7 The diagram shows the passenger train on part of a rollercoaster ride.

7 (a) Which arrow shows the direction of the resultant force acting on the passenger train?

Put a tick (✓) in the box next to your choice.



(1 mark)

7 (b) At the bottom of the slope, the passengers in the train all have the same speed but they each have a different kinetic energy.

Why is the kinetic energy of each passenger different?

.....

.....

(1 mark)

7 (c) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 10 N/kg

7 (c) (i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

.....

.....

Maximum gravitational field strength = ... N/kg

(1 mark)

4.5.1.4 Resultant forces

Question 02 · continued

for mark

7 (c) (ii) One of the passengers has a mass of 80 kg.

Use the equation in the box to calculate the maximum weight this passenger seems to have during the ride.

weight = mass × gravitational field strength

Show clearly how you work out your answer.

.....

.....

Maximum weight = ... N

(2 marks)

5

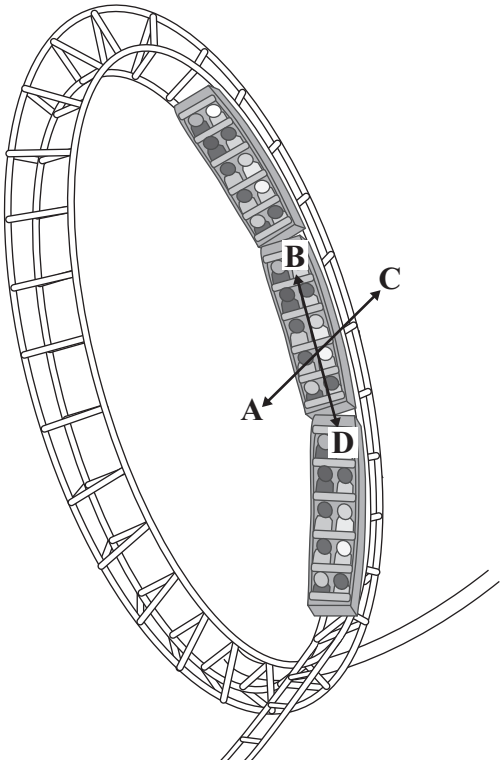
Turn over for the next question

4.5.1.4 Resultant forces

Question 03

June 2009 | PHY3F | Original Q2 | Legacy

2 The drawing shows a set of carriages on a roller coaster.
The carriages are moving upwards in a nearly circular path at a constant speed.



2 (a) Complete the following sentences by drawing a ring around the correct line in each box.

2 (a) (i) The carriages will accelerate because of a change in their

direction
mass
speed

.

(1 mark)

2 (a) (ii) The resultant force which causes the carriages to accelerate is the

circular
centripetal
gravity

force.

(1 mark)

4.5.1.4 Resultant forces

Question 03 · continued

for mark

2 (b) In which direction, **A**, **B**, **C** or **D**, does the resultant force act?

Write your answer in the box. ☐

(1 mark)

2 (c) Complete the following sentence by drawing a ring around the correct line in the box.

The resultant force will need to be greater if the

mass of the passengers is greater
radius of the circle is greater
speed of the carriages is less

.

(1 mark)

4

Turn over for the next question

4.5.1.4 Resultant forces

Question 04

6 A cyclist travelling along a straight level road accelerates at 1.2 m/s^2 for 5 seconds. The mass of the cyclist and the bicycle is 80 kg.

6 (a) Use the equation in the box to calculate the resultant force needed to produce this acceleration.

resultant force = mass × acceleration

Show clearly how you work out your answer and give the unit.

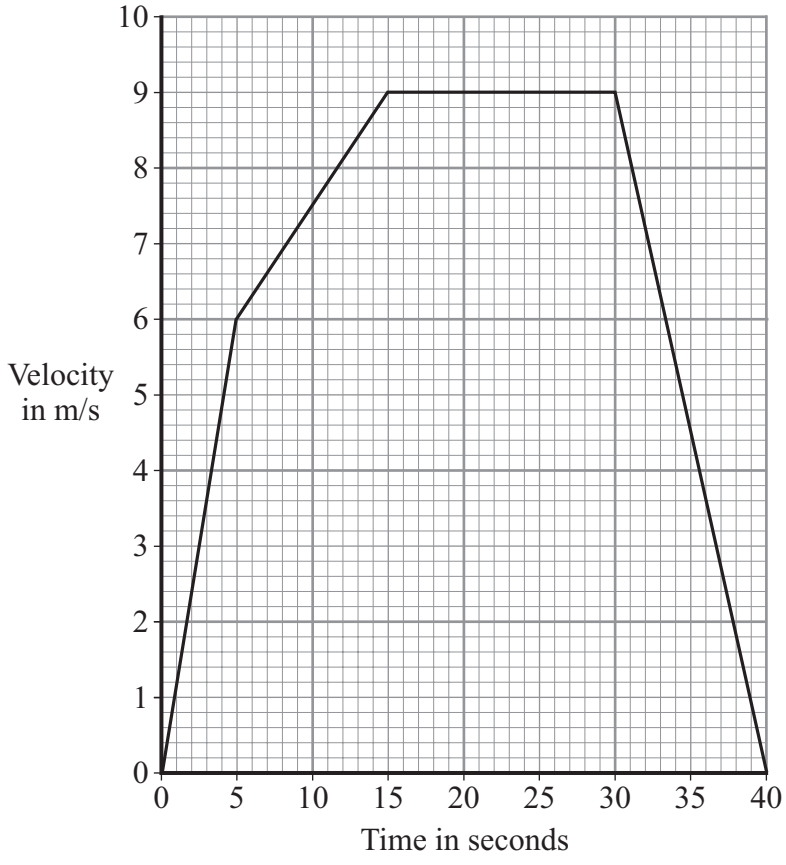
.....

.....

Resultant force = ...

(3 marks)

6 (b) The graph shows how the velocity of the cyclist changes with time.



4.5.1.4 Resultant forces

Question 04 · continued

for mark

6 (b) (i) Complete the following sentence.

The velocity includes both the speed and the ..... of the cyclist.

(1 mark)

6 (b) (ii) Why has the data for the cyclist been shown as a line graph instead of a bar chart?

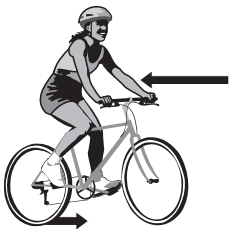
.....

.....

(1 mark)

6 (b) (iii) The diagrams show the horizontal forces acting on the cyclist at three different speeds. The length of an arrow represents the size of the force.

A



B



C



Which **one** of the diagrams, **A**, **B** or **C**, represents the forces acting when the cyclist is travelling at a constant 9 m/s?

.....

Explain the reason for your choice.

.....

.....

.....

.....

.....

.....

(3 marks)

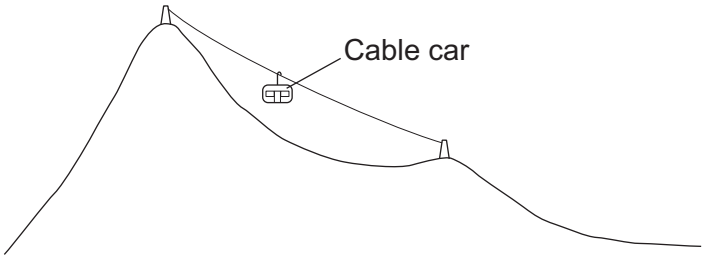
8

4.5.1.4 Resultant forces

Question 05

June 2010 | PHY2F | Original Q6 | Legacy

6 (a) The diagram shows a cable car used to take skiers to the top of a mountain.



6 (a) (i) The total mass of the cable car and skiers is 7500 kg.

Use the equation in the box to calculate the weight of the cable car and skiers.

weight = mass × gravitational field strength

gravitational field strength = 10 N/kg

Show clearly how you work out your answer and give the unit.

.....

.....

Weight = ...

(3 marks)

4.5.1.4 Resultant forces

Question 05 · continued

6 (a) (ii) The cable car moves at a constant speed. It lifts skiers through a vertical height of 800 metres in 7 minutes.

Use the following equation to calculate the work done to lift the cable car and skiers.

work done = force applied × distance moved in the direction of force

Show clearly how you work out your answer.

.....

.....

Work done = ... J

(2 marks)

6 (b) The diagram shows a skier who is accelerating down a steep ski slope.



6 (b) (i) Draw an arrow on the diagram to show the direction of the resultant force acting on the skier.

(1 mark)

6 (b) (ii) How and why does the kinetic energy of the skier change?

.....

.....

.....

.....

(2 marks)

Question 6 continues on the next page

4.5.1.4 Resultant forces

Question 05 · continued

6 (c) Last year, 18 000 skiers suffered a head injury. It is thought that nearly 8000 of these injuries could have been avoided if the skier had been wearing a helmet. However, at present, there are no laws to make skiers wear helmets.

Suggest why skiers should be made aware of the benefits of wearing a helmet.

.....

.....

(1 mark)

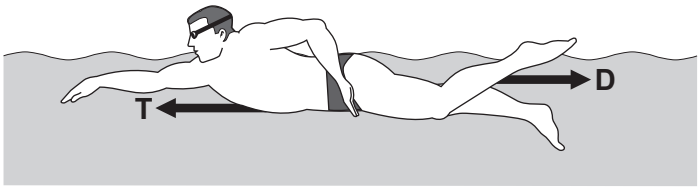
9

4.5.1.4 Resultant forces

Question 06

January 2011 | PHY2F | Original Q7 | Legacy

7 (a) The diagram shows the horizontal forces acting on a swimmer.



7 (a) (i) The swimmer is moving at constant speed.
Force **T** is 120 N.

What is the size of force **D**?

..... N
(1 mark)

7 (a) (ii) By increasing force **T** to 140 N, the swimmer accelerates to a higher speed.

Calculate the size of the initial resultant force acting on the swimmer.

.....

.....

Initial resultant force = ... N
(1 mark)

7 (a) (iii) Even though the swimmer keeps the force **T** constant at 140 N, the resultant force on the swimmer decreases to zero.

Explain why.

.....

.....

.....

.....

.....

.....
(3 marks)

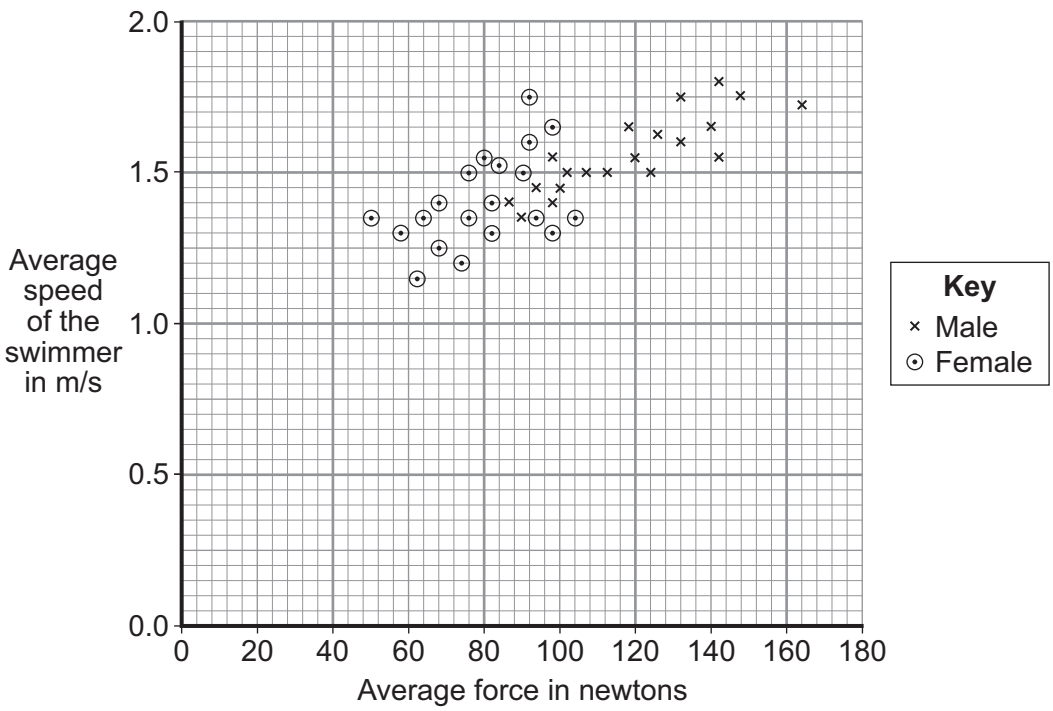
Question 7 continues on the next page

4.5.1.4 Resultant forces

Question 06 · continued

7 (b) A sports scientist investigated how the force exerted by a swimmer's hands against the water affects the swimmer's speed.
The investigation involved 20 males and 20 females swimming a fixed distance.
Sensors placed on each swimmer's hands measured the force 85 times every second over the last 10 metres of the swim.
The measurements were used to calculate an average force.
The average speed of each swimmer over the last 10 metres of the swim was also measured.

The data from the investigation is displayed in the graph.



7 (b) (i) What was the dependent variable in this investigation?

.....

(1 mark)

7 (b) (ii) Explain **one** advantage of measuring the force 85 times every second rather than just once or twice every second.

.....

.....

.....

.....

(2 marks)

4.5.1.4 Resultant forces

Question 06 · continued

7 (b) (iii) Give **one** way in which the data for the male swimmers is different from the data for the female swimmers.

.....

.....

(1 mark)

7 (b) (iv) Considering only the data from this investigation, what advice should a swimming coach give to swimmers who want to increase their average speed?

.....

.....

(1 mark)

10

Turn over for the next question

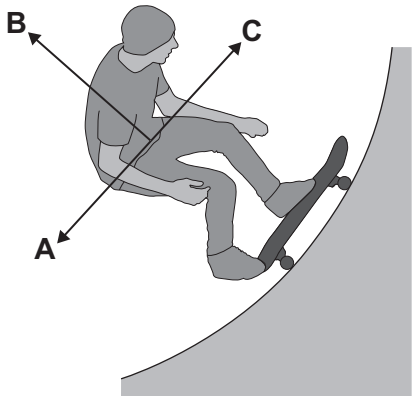
4.5.1.4 Resultant forces

Question 07

January 2011 | PHY3F | Original Q2 | Legacy

2 The drawing shows a skateboarder moving in a circular path.

• Centre of circular path



2 (a) (i) What is the name of the resultant force which allows the skateboarder to move in a circular path?

Draw a ring around your answer.

centripetal force **gravitational force** **weight**

(1 mark)

2 (a) (ii) In which direction, **A**, **B** or **C**, does this resultant force act on the skateboarder?

Write your answer, **A**, **B** or **C**, in the box. ☐

(1 mark)

2 (b) Another skateboarder has a smaller mass.

Complete the following sentences by drawing a ring around the correct line in each box.

2 (b) (i) She uses the same part of the ramp at the same speed.

The force which allows her to move in a circular path will need

to

decrease.
stay the same.
increase.

(1 mark)

4.5.1.4 Resultant forces

Question 07 · continued

2 (b) (ii) If she goes faster, this resultant force will need to

decrease.

stay the same.

increase.

(1 mark)

2 (c) On their website, the managers of a skateboard park give the following information about some of the ramps where skateboarders move in a circular path.

Name of ramp	Inside radius of the ramp in metres
Bull pit	6
Dragon's den	11
Tiger cage	8
Witch's cauldron	7

A skateboarder uses each ramp at the same speed.

Name the ramp where the resultant force on the skateboarder will need to be the greatest.

.....

Explain the reason for your answer.

.....

.....

(2 marks)

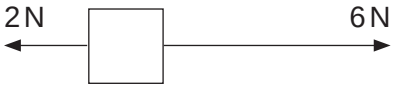
6

4.5.1.4 Resultant forces

Question 08

January 2013 | PH2FP | Original Q1 | Legacy

1 (a) The diagram shows two forces acting on an object.



What is the resultant force acting on the object?

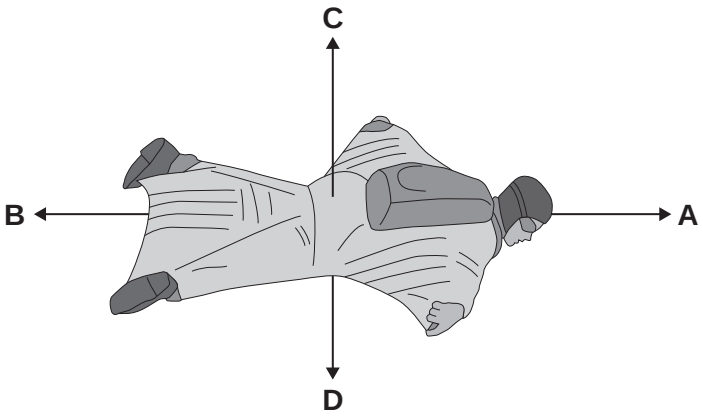
Tick (✓) **one** box.

- 8 N to the right ☐
- 8 N to the left ☐
- 4 N to the right ☐
- 4 N to the left ☐

(1 mark)

1 (b) BASE jumpers jump from very high buildings and mountains for sport.

The diagram shows the forces acting on a BASE jumper in flight.
The BASE jumper is wearing a wingsuit.



4.5.1.4 Resultant forces

Question 08 · continued

1 (b) (i) Draw a ring around the correct answer in the box to complete each sentence.

The BASE jumper accelerates forwards when force **A** is

smaller than
equal to
bigger than

force **B**.

The BASE jumper falls with a constant speed when force **C** is

smaller than
equal to
bigger than

force **D**.

(2 marks)

1 (b) (ii) To land safely the BASE jumper opens a parachute.



What effect does opening the parachute have on the speed of the falling BASE jumper?

.....

Give a reason for your answer.

.....

.....

(2 marks)

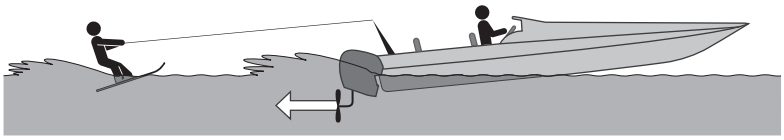
5

4.5.1.4 Resultant forces

Question 09

June 2013 | PH2FP | Original Q7 | Legacy

7 The diagram shows a boat pulling a water skier.



7 (a) The arrow represents the force on the water produced by the engine propeller. This force causes the boat to move.

Explain why.

.....

.....

.....

.....

(2 marks)

7 (b) The boat accelerates at a constant rate in a straight line. This causes the velocity of the water skier to increase from 4.0 m/s to 16.0 m/s in 8.0 seconds.

7 (b) (i) Calculate the acceleration of the water skier and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Acceleration = ...

(3 marks)

4.5.1.4 Resultant forces

Question 09 · continued

7 (b) (ii) The water skier has a mass of 68 kg.

Calculate the resultant force acting on the water skier while accelerating.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Resultant force = ... N

(2 marks)

7 (b) (iii) Draw a ring around the correct answer to complete the sentence.

The force from the boat pulling the water skier forwards

will be | less than / the same as / greater than | the answer to part **(b)(ii)**.

Give the reason for your answer.

.....

.....

(2 marks)

9

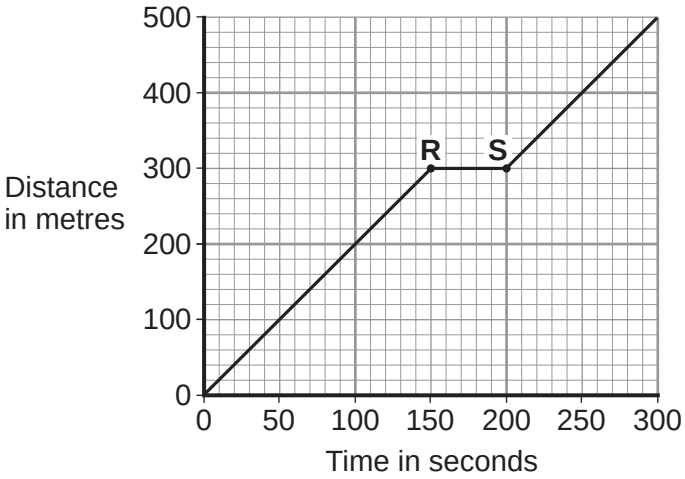
4.5.1.4 Resultant forces

Question 10

June 2014 | PH2FP | Original Q2 | Legacy

2 (a) **Figure 3** shows the distance–time graph for a person walking to a bus stop.

Figure 3



2 (a) (i) Which **one** of the following statements describes the motion of the person between points **R** and **S** on the graph?

Tick (✓) **one** box.

[1 mark]

Not moving ☐

Moving at constant speed ☐

Moving with increasing speed ☐

4.5.1.4 Resultant forces

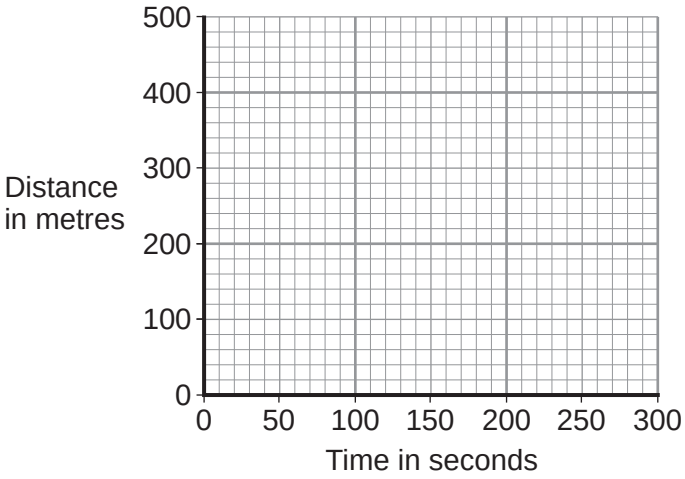
Question 10 · continued

2 (a) (ii) Another person, walking at constant speed, travels the same distance to the bus stop in 200 seconds.

Complete **Figure 4** to show a distance–time graph for this person.

[1 mark]

Figure 4



2 (b) A bus accelerates away from the bus stop at 2.5 m/s^2.

The total mass of the bus and passengers is 14 000 kg.

Calculate the resultant force needed to accelerate the bus and passengers.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Resultant force = ... N

4

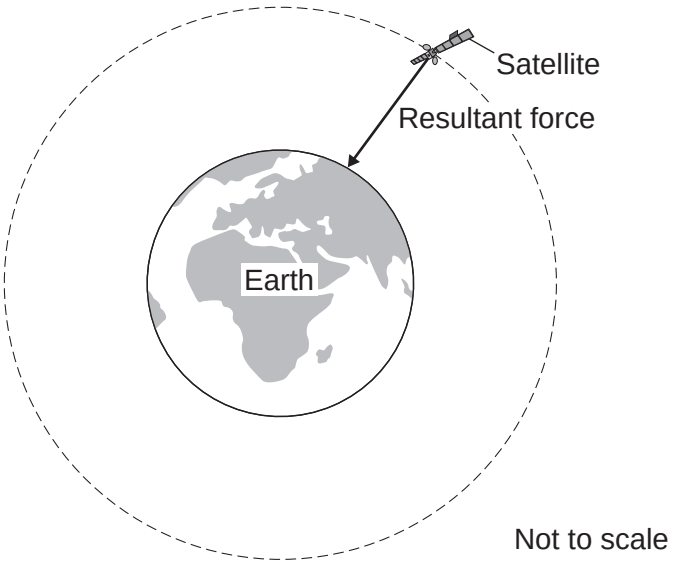
4.5.1.4 Resultant forces

Question 11

June 2014 | PH3FP | Original Q8 | Legacy

8 Man-made satellites can orbit the Earth, as shown in **Figure 14**.

Figure 14



The satellite experiences a resultant force directed towards the centre of the orbit.

The resultant force is called the centripetal force.

8 (a) What provides the centripetal force on the satellite?

[1 mark]

.....

8 (b) State **two** factors that determine the size of the centripetal force on the satellite.

[2 marks]

1 .....

2 .....

4.5.1.4 Resultant forces

Question 11 · continued

8 (c) **Table 4** gives data for five different satellites orbiting the Earth.

Table 4

Satellite	Average height above Earth's surface in kilometres	Time taken to orbit Earth once in minutes	Mass of satellite in kilograms
A	370	93	419 000
B	697	99	280
C	827	103	630
D	5 900	228	400
E	35 800	1440	2 030

8 (c) (i) State the relationship, if any, between the height of the satellite above the Earth's surface and the time taken for the satellite to orbit the Earth once.

[1 mark]

.....

.....

8 (c) (ii) State the relationship, if any, between the time taken for the satellite to orbit the Earth once and the satellite's mass.

[1 mark]

.....

.....

Question 8 continues on the next page

4.5.1.4 Resultant forces

Question 11 · continued

8 (d) Over 300 years ago, the famous scientist Isaac Newton proposed, with a 'thought experiment', the idea of satellites.

Newton suggested that if an object was fired at the right speed from the top of a high mountain, it would circle the Earth.

Why did many people accept Isaac Newton's idea as being possible?

Tick (✓) **one** box.

[1 mark]

Isaac Newton was a respected scientist who had made new discoveries before. ☐

Isaac Newton went to university. ☐

It was a new idea that nobody else had thought of before. ☐

6

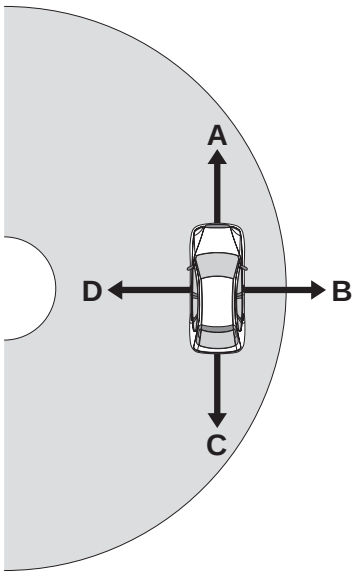
4.5.1.4 Resultant forces

Question 12

June 2015 | PH3FP | Original Q8 | Legacy

8 (a) **Figure 15** shows a car travelling around a bend in the road. The car is travelling at a constant speed.

Figure 15



There is a resultant force acting on the car. This resultant force is called the centripetal force.

8 (a) (i) In which direction, **A**, **B**, **C** or **D**, does the centripetal force act on the car?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

8 (a) (ii) State the name of the force that provides the centripetal force.

[1 mark]

.....

4.5.1.4 Resultant forces

Question 12 · continued

8 (a) (iii) State **two** factors that affect the size of the centripetal force acting on the car.

[2 marks]

1 .....

2 .....

8 (b) **Figure 16** shows a racing car.

Figure 16



The racing car should not roll over when racing.

State **two** features of the car that make it difficult for the car to roll over.

[2 marks]

1 .....

.....

2 .....

.....

6

4.5.1.4 Resultant forces

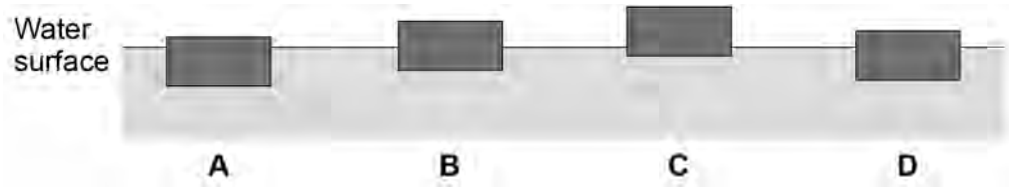
Question 13

June 2018 | 8463/2F | Original Q6

0 6 **Figure 7** shows four blocks of different materials floating on water.

The four blocks are the same volume.

Figure 7



0 6 . 1 Which of the blocks has the smallest weight?

Tick **one** box.

[1 mark]

A ☐ **B** ☐ **C** ☐ **D** ☐

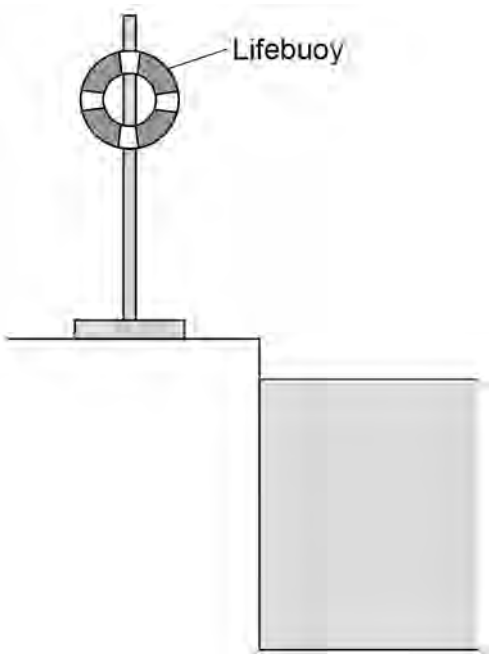
Question 6 continues on the next page

4.5.1.4 Resultant forces

Question 13 · continued

Figure 8 shows a lifebuoy next to a deep swimming pool.

Figure 8



0 6 . 2 The lifebuoy has a mass of 2.5 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the lifebuoy.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

4.5.1.4 Resultant forces

Question 13 · continued

0 6 . 3 When thrown into the water the lifebuoy floats. The two forces acting on the lifebuoy are the weight of the lifebuoy downwards and upthrust upwards.

How big is the upthrust on the lifebuoy compared to the weight of the lifebuoy?

Tick **one** box.

[1 mark]

The upthrust is greater than the weight. ☐

The upthrust is less than the weight. ☐

The upthrust is the same as the weight. ☐

0 6 . 4 Write down the equation which links acceleration, mass and resultant force.

[1 mark]

_____

0 6 . 5 A rope is used to pull the lifebuoy to the side of the swimming pool.

A resultant force of 4.0 N acts on the lifebuoy.

The mass of the lifebuoy is 2.5 kg.

Calculate the acceleration of the lifebuoy.

[3 marks]

_____

_____

_____

_____

Acceleration = _____ m/s^2

8

4.5.1.4 Resultant forces

Question 14

June 2019 | 8463/2F | Original Q6

0 6 The following statements describe parts of a short train journey between two railway stations.

Part A: The train accelerates at a constant rate from 0 m/s to 20 m/s in 40 s

Part B: The train travels at a constant velocity for 260 s

Part C: The train decelerates at a constant rate coming to a stop in 60 s

0 6 . 1 During which part of the journey is the resultant force on the train zero?

[1 mark]

Tick (✓) **one** box.

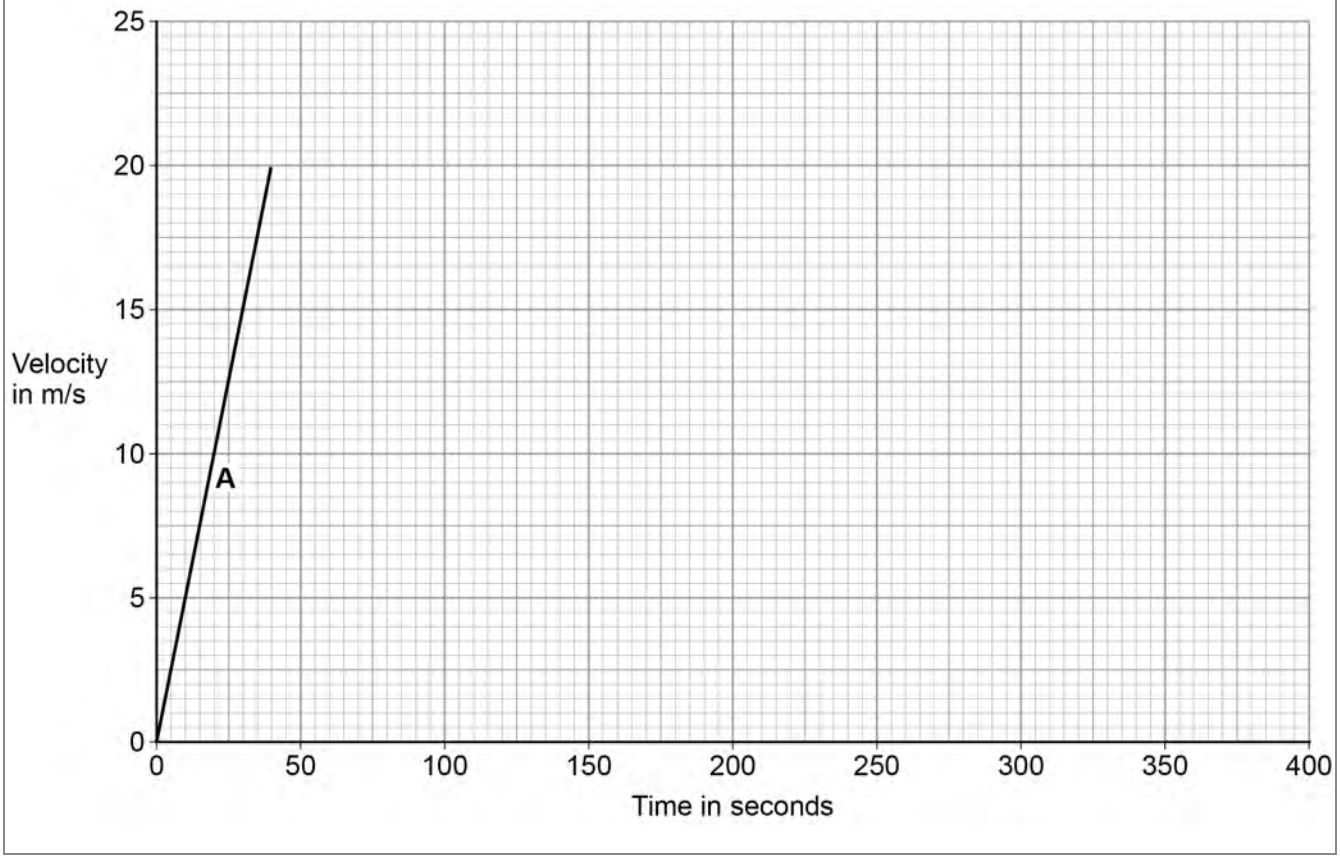
A ☐ **B** ☐ **C** ☐

0 6 . 2 **Figure 16** shows part of the velocity-time graph for the train journey.

Complete **Figure 16** showing part **B** and part **C** of the train journey.

[3 marks]

Figure 16



4.5.1.4 Resultant forces

Question 14 · continued

0 6 . 3 Write down the equation which links acceleration, change in velocity and time taken.

[1 mark]

0 6 . 4 Another train accelerated at 1.15 m/s^2 for 22.0 s

Calculate the increase in velocity of the train.

[3 marks]

Increase in velocity = _____ m/s

8

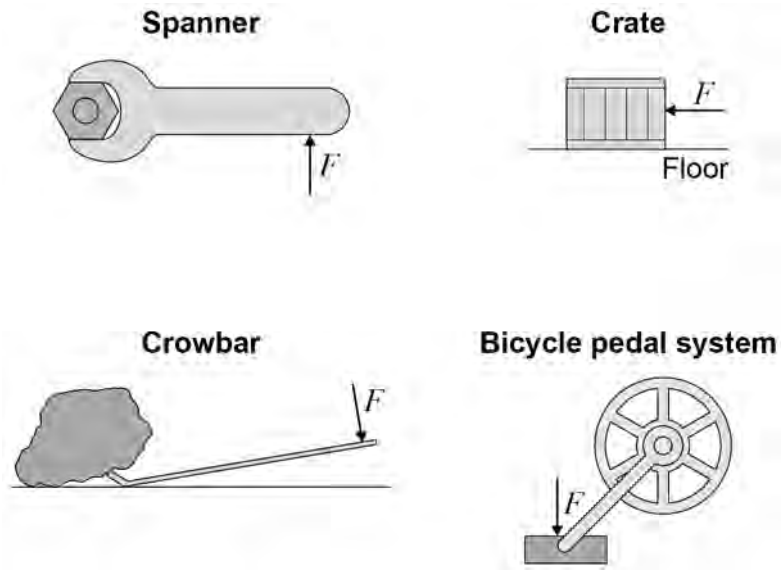
4.5.1.4 Resultant forces

Question 15

June 2019 | 8463/2F | Original Q7

0 7 . 1 **Figure 17** shows four examples of a force causing an object to move.

Figure 17



Which object is **not** likely to rotate?

[1 mark]

Tick (✓) **one** box.

- Bicycle pedal system ☐
- Crate ☐
- Crowbar ☐
- Spanner ☐

Question 7 continues on the next page

4.5.1.4 Resultant forces

Question 15 · continued

Figure 18 shows a simple device that can be used as a weighing scale.

Figure 19 shows the device being used to measure a quantity of rice.

The weight of the device is balanced by the weight of the rice and basket.

Figure 18

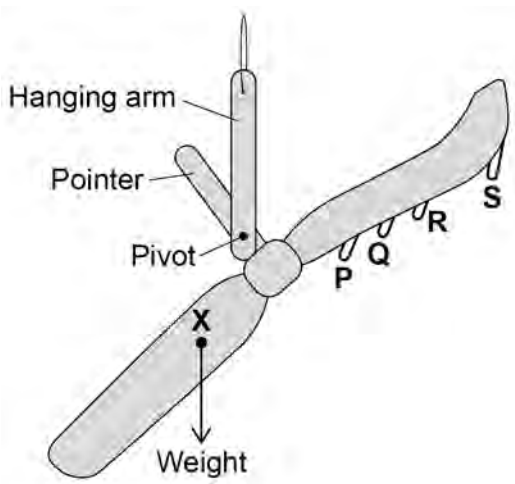
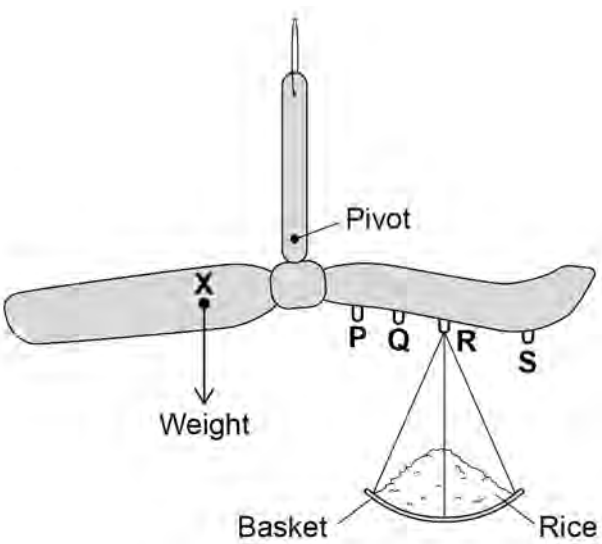


Figure 19



0 7 . 2 The weight of the device acts through the point labelled **X**.

What is point **X** called?

[1 mark]

Tick (✓) **one** box.

Centre of balance ☐

Centre of mass ☐

Centre of weight ☐

4.5.1.4 Resultant forces

Question 15 · continued

0 7 . 3 How does **Figure 19** show that the weight of the device is balanced by the weight of the rice and basket?

[1 mark]

0 7 . 4 The basket can hang from different points on the device.

Where should the basket hang to measure the largest quantity of rice?

[1 mark]

Tick (✓) **one** box.

P ☐ **Q** ☐ **R** ☐ **S** ☐

0 7 . 5 Write down the equation which links distance, force and moment of a force.

[1 mark]

0 7 . 6 In **Figure 19**, the weight of the device causes an anticlockwise moment of 0.15 Nm about the pivot.

The weight of the rice and basket acts 0.06 m from the pivot.

Calculate the weight of the rice and basket.

[3 marks]

Weight of rice and basket = _____ N

4.5.1.4 Resultant forces

Question 15 · continued

0 7 . 7 Write down the equation which links gravitational field strength, mass and weight.

[1 mark]

0 7 . 8 The basket has a mass of 0.04 kg

gravitational field strength = 9.8 N/kg

Calculate the mass of rice in the basket.

[3 marks]

Mass = _____ kg

12

4.5.1.4 Resultant forces

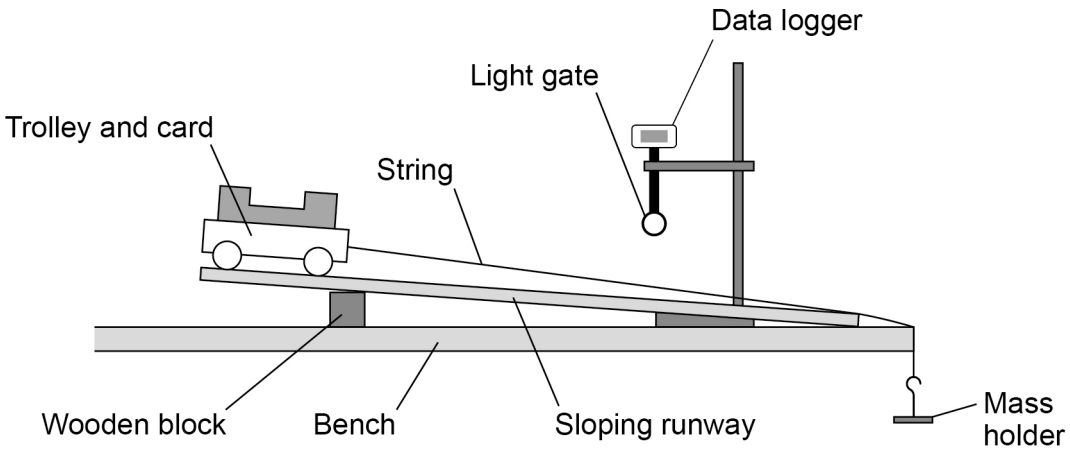
Question 16

November 2020 | 8463/2F | Original Q8

0 8 A student investigated the acceleration of a trolley.

Figure 13 shows how the student set up the apparatus.

Figure 13



0 8 . 1 Before attaching the mass holder the student placed the trolley at the top of the runway. The trolley rolled down the runway without being pushed.

What change to the apparatus in **Figure 13** could be made to prevent the trolley from starting to roll down the runway?

[1 mark]

Tick (✓) **one** box.

Move the wooden block to the left. ☐

Shorten the length of the runway. ☐

Use a taller wooden block. ☐

0 8 . 2 The student attached the mass holder to the string.

The string rubbed along the edge of the bench as the mass holder fell to the floor.

Suggest what the student could do to prevent the string from rubbing.

[1 mark]

4.5.1.4 Resultant forces

Question 16 · continued

The light gate and data logger were used to determine the acceleration of the trolley.

The student increased the resultant force on the trolley and recorded the acceleration of the trolley.

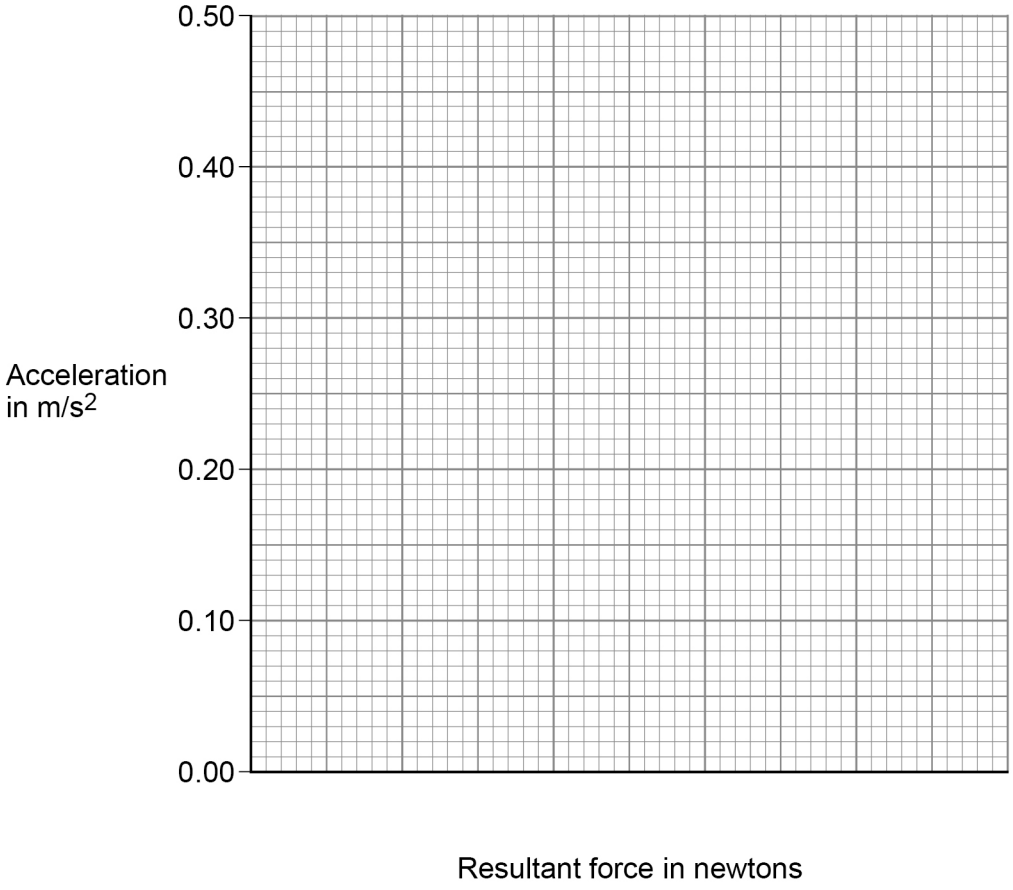
Table 4 shows the results.

Table 4

Resultant force in newtons	Acceleration in m/s²
0.05	0.08
0.10	0.18
0.15	0.25
0.20	0.32
0.25	0.41

Figure 14 is an incomplete graph of the results.

Figure 14



0 8 . 3 Complete **Figure 14**.

- Choose a suitable scale for the x-axis.
- Plot the results.
- Draw a line of best fit.

[4 marks]

4.5.1.4 Resultant forces

Question 16 · continued

0 8 . 4 Describe the relationship between the resultant force on the trolley and the acceleration of the trolley.

[1 mark]

0 8 . 5 Describe how the investigation could be improved to reduce the effect of random errors.

[2 marks]

0 8 . 6 Write down the equation that links acceleration (*a*), mass (*m*) and resultant force (*F*).

[1 mark]

0 8 . 7 The resultant force on the trolley was 0.375 N.

The mass of the trolley was 0.60 kg.

Calculate the acceleration of the trolley.

Give your answer to 2 significant figures.

[4 marks]

Acceleration (2 significant figures) = _____ m/s^2

14

4.5.1.4 Resultant forces

Question 17

November 2021 | 8463/2F | Original Q8

0 8 The thinking distance and braking distance for a car vary with the speed of the car.

0 8 . 1 Explain the effect of **two** other factors on the **braking** distance of a car.

Do **not** refer to speed in your answer.

[4 marks]

Question 8 continues on the next page

4.5.1.4 Resultant forces

Question 17 · continued

0 8 . 2 Which equation links acceleration (a), mass (m) and resultant force (F).

[1 mark]

Tick (✓) **one** box.

resultant force = mass × acceleration ☐

resultant force = mass × acceleration^2 ☐

resultant force = $\frac{\text{mass}}{\text{acceleration}^2}$ ☐

resultant force = $\frac{\text{mass}}{\text{acceleration}}$ ☐

0 8 . 3 The mean braking force on a car is 7200 N.

The car has a mass of 1600 kg.

Calculate the deceleration of the car.

[3 marks]

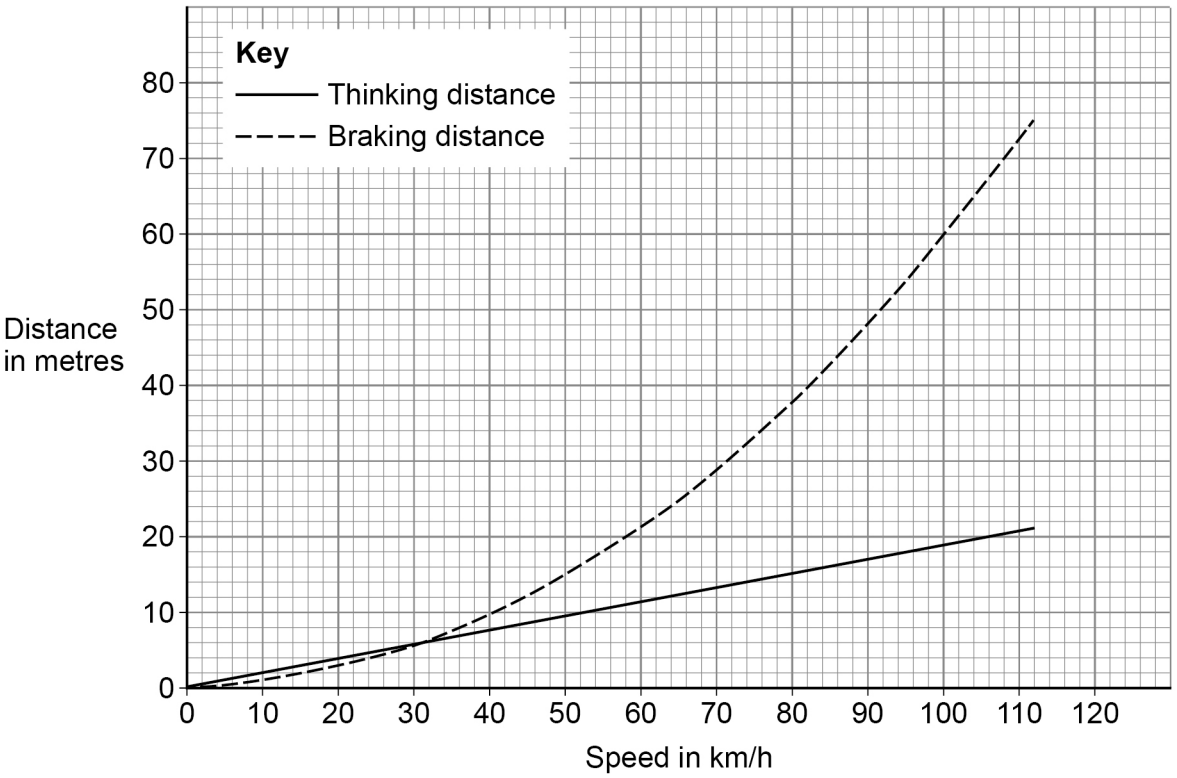
Deceleration = _____ m/s^2

4.5.1.4 Resultant forces

Question 17 · continued

0 8 . 4 **Figure 18** shows how the thinking distance and braking distance for a car vary with the speed of the car.

Figure 18



Determine the stopping distance when the car is travelling at 80 km/h.

[2 marks]

Stopping distance = _____ m

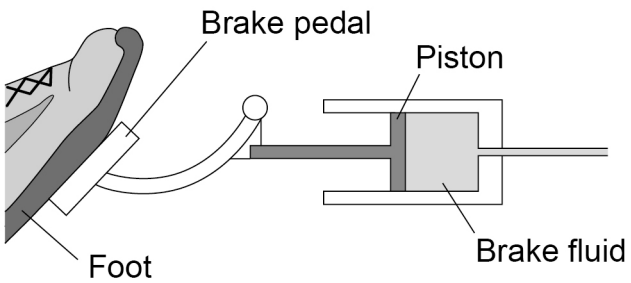
Question 8 continues on the next page

4.5.1.4 Resultant forces

Question 17 · continued

Figure 19 shows part of the braking system for a car.

Figure 19



0 8 . 5 Which equation links area of a surface (A), the force normal to that surface (F) and pressure (p)?

[1 mark]

Tick (✓) **one** box.

$p = F \times A$ ☐

$p = F \times A^2$ ☐

$p = \frac{F}{A}$ ☐

$p = \frac{A}{F}$ ☐

4.5.1.4 Resultant forces

Question 17 · continued

0 8 . 6 When the brake pedal is pressed, a force of 60 N is applied to the piston.

The pressure in the brake fluid is 120 000 Pa.

Calculate the surface area of the piston.

Give your answer in standard form.

Give the unit.

[5 marks]

Surface area (in standard form) = _____ Unit _____

16

4.5.1.4 Resultant forces

Question 18

0 2 Hailstones are small balls of ice. Hailstones form in clouds and fall to the ground.

Figure 3 shows different-sized hailstones.

Figure 3



0 2 . 1 Which force causes the hailstones to fall to the ground?

[1 mark]

Tick (✓) **one** box.

- Air resistance ☐
- Gravitational force ☐
- Magnetic force ☐
- Tension ☐

4.5.1.4 Resultant forces

Question 18 · continued

0 2 . 2 As the hailstones begin to fall they accelerate.

Which force increases as the hailstones accelerate?

[1 mark]

Tick (✓) **one** box.

- Air resistance ☐
- Gravitational force ☐
- Magnetic force ☐
- Tension ☐

0 2 . 3 After a short time hailstones fall at terminal velocity.

Which of the following statements is true at terminal velocity?

[1 mark]

Tick (✓) **one** box.

- The hailstones begin to slow down. ☐
- The mass of the hailstones increases. ☐
- The resultant force on the hailstones is zero. ☐

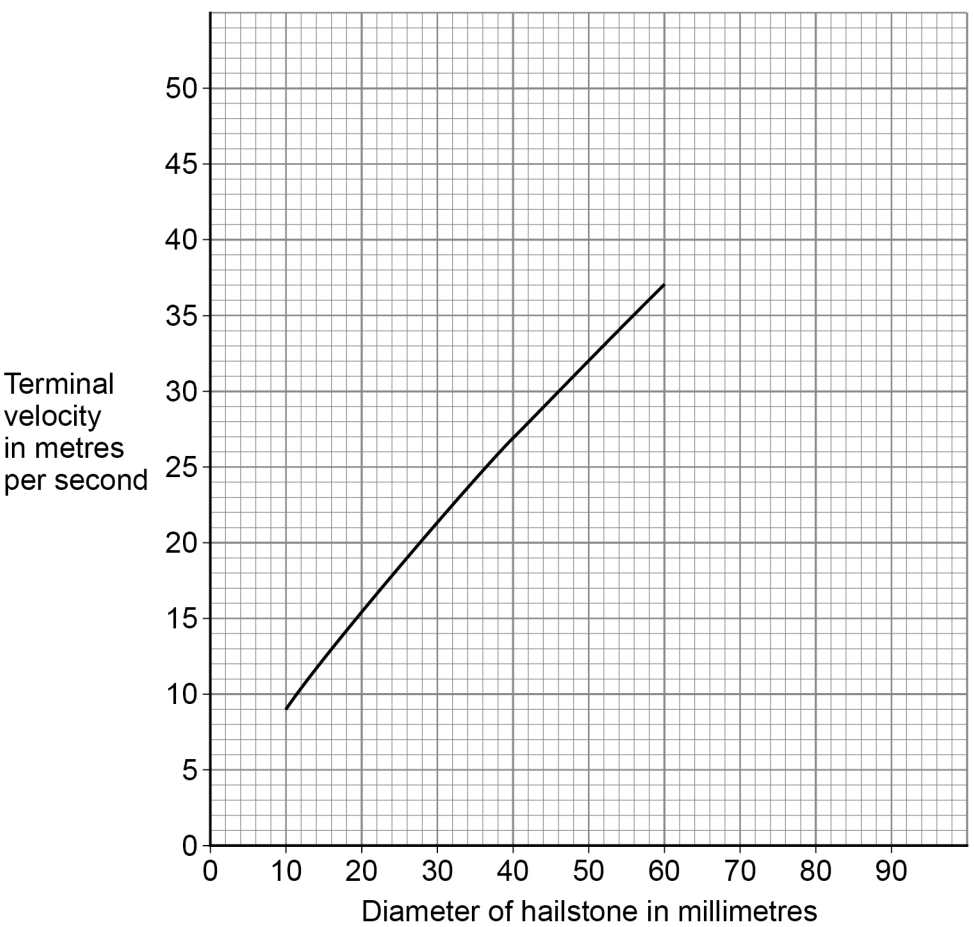
Question 2 continues on the next page

Question 18 · continued

A scientist investigated how the terminal velocity of hailstones varies with their diameter.

Figure 4 shows the results.

Figure 4



0 2 . 4 Estimate the terminal velocity for a hailstone with a diameter of 80 mm.

Show how you obtain your answer.

[2 marks]

Terminal velocity = _____ m/s

4.5.1.4 Resultant forces

Question 18 · continued

0 2 . 5 Give **one** reason why a hailstone with a large diameter has a greater terminal velocity than a hailstone with a smaller diameter.

[1 mark]

Tick (✓) **one** box.

It has a greater power. ☐

It has a greater pressure. ☐

It has a greater temperature. ☐

It has a greater weight. ☐

Question 2 continues on the next page

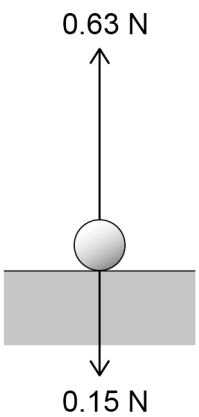
4.5.1.4 Resultant forces

Question 18 · continued

After falling, the hailstone hits the ground.

Figure 5 shows the forces acting on the hailstone at the moment it hits the ground.

Figure 5



0 2 . 6 What is the magnitude of the resultant force on the hailstone in **Figure 5**?

[1 mark]

Tick (✓) **one** box.

- 0.15 N ☐
- 0.48 N ☐
- 0.63 N ☐
- 0.78 N ☐

0 2 . 7 What is the direction of the resultant force on the hailstone in **Figure 5**?

[1 mark]

8

4.5.1.4 Resultant forces

Question 19

June 2023 | 8463/2F | Original Q2

0 2 The stopping distance of a car is the braking distance added to the thinking distance.

0 2 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**electrostatic**	**kinetic**
nuclear		**thermal**

A driver applies the brakes to a moving car.

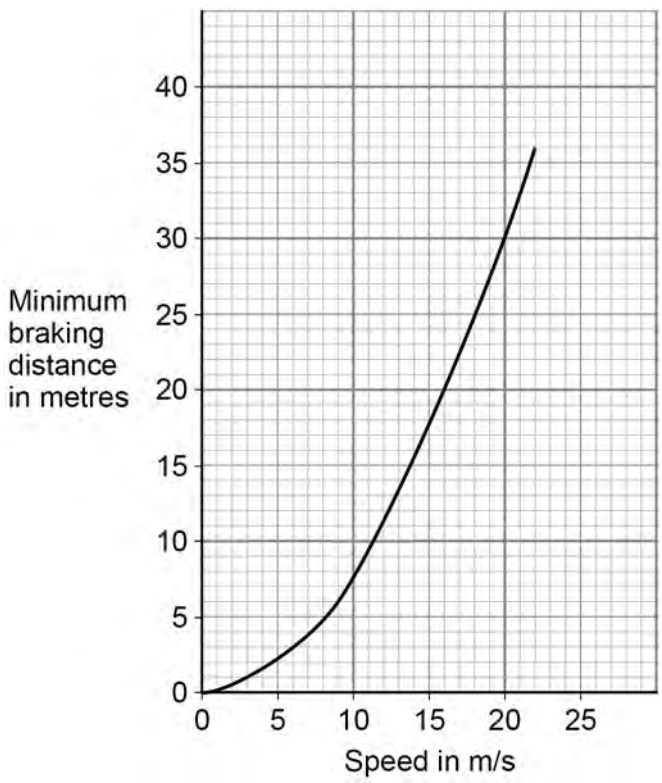
As the car slows down, there is a decrease in the _____ energy of the car.

The work done by friction causes an increase in the _____ energy store of the brakes.

Question 2 continues on the next page

0 2 . 2 **Figure 3** shows how the speed of the car affects the minimum braking distance of the car.

Figure 3



Describe the relationship between the speed of the car and the minimum braking distance of the car.

[1 mark]

0 2 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

When the road becomes icy, the braking distance _____ .

4.5.1.4 Resultant forces

Question 19 · continued

A car driver applies the brakes to decelerate the car as it approaches a road junction.

The car decelerates at 0.25 m/s^2.

mass of the car = 1600 kg

0 2 . 4 Calculate the time taken for the velocity of the car to decrease from 12.5 m/s to 5.0 m/s.

Use the equation:

$$\text{time taken} = \frac{\text{change in velocity}}{\text{deceleration}}$$

[3 marks]

Time taken = _____ s

0 2 . 5 Calculate the resultant force causing the car to decelerate.

Use the equation:

$$\text{resultant force} = \text{mass} \times \text{deceleration}$$

[2 marks]

Resultant force = _____ N

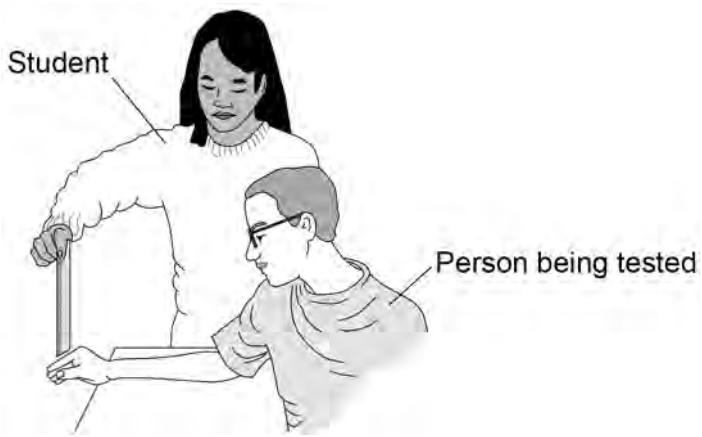
4.5.1.4 Resultant forces

Question 19 · continued

Thinking distance is affected by the reaction time of the driver.

Figure 4 shows how a student tested a person's reaction time.

Figure 4



The student held a ruler and then released it.

The person being tested closed his hand to catch the ruler as quickly as possible.

The further the ruler fell the greater the person's reaction time.

0 2 . 6 The student wanted to test the reaction time of the people in her class.

Which of the following could have been a control variable in this investigation?

[1 mark]

Tick (✓) **one** box.

Distance fallen by the ruler before being caught ☐

Initial height of the ruler above the person's hand ☐

Reaction time of the person being tested ☐

4.5.1.4 Resultant forces

Question 19 · continued

0 2 . 7 The student tested three people in her class.

The mean distance that the ruler fell before being caught was 18.2 cm.

If all of the people in her class were tested, the mean distance may not be 18.2 cm.

Suggest why.

[1 mark]

0 2 . 8 Describe how this investigation could be changed to find out how listening to music affects reaction time.

[2 marks]

13

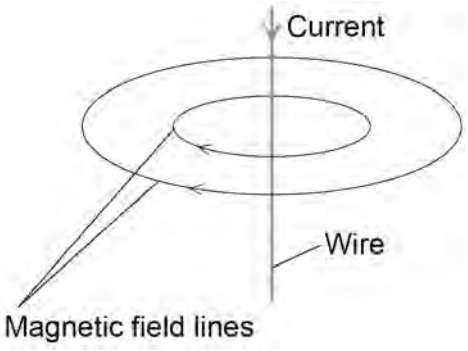
4.5.1.4 Resultant forces

Question 20

June 2023 | 8463/2F | Original Q3

0 3 **Figure 5** shows the magnetic field pattern produced when there is a current in a wire.

Figure 5



0 3 . 1 What do the arrows on the magnetic field lines represent?

[1 mark]

0 3 . 2 How could the strength of the magnetic field be increased?

[1 mark]

Tick (✓) **one** box.

Change the direction of the current in the wire ☐

Increase the current in the wire ☐

Increase the temperature of the wire ☐

4.5.1.4 Resultant forces

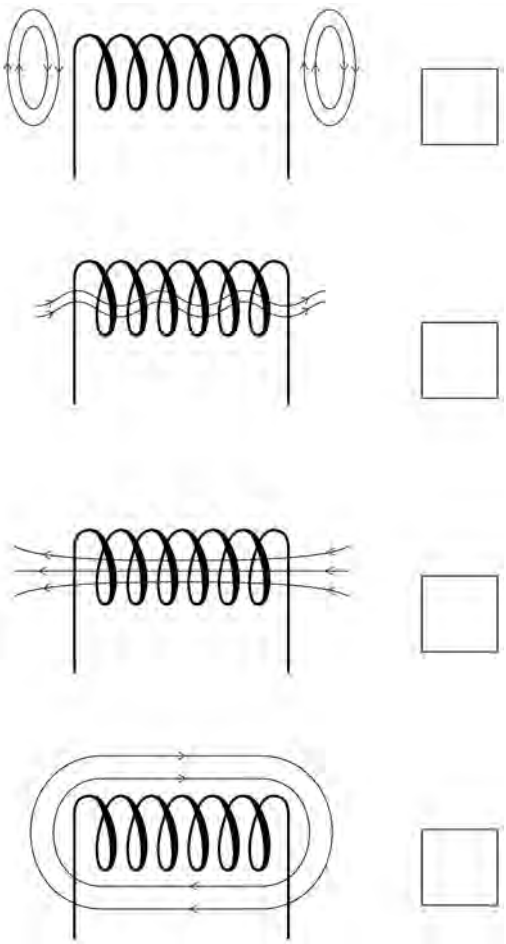
Question 20 · continued

0 3 . 3 The wire is coiled to make a solenoid.

Which diagram in **Figure 6** shows the magnetic field pattern produced when there is a current in the solenoid?

[1 mark]

Figure 6



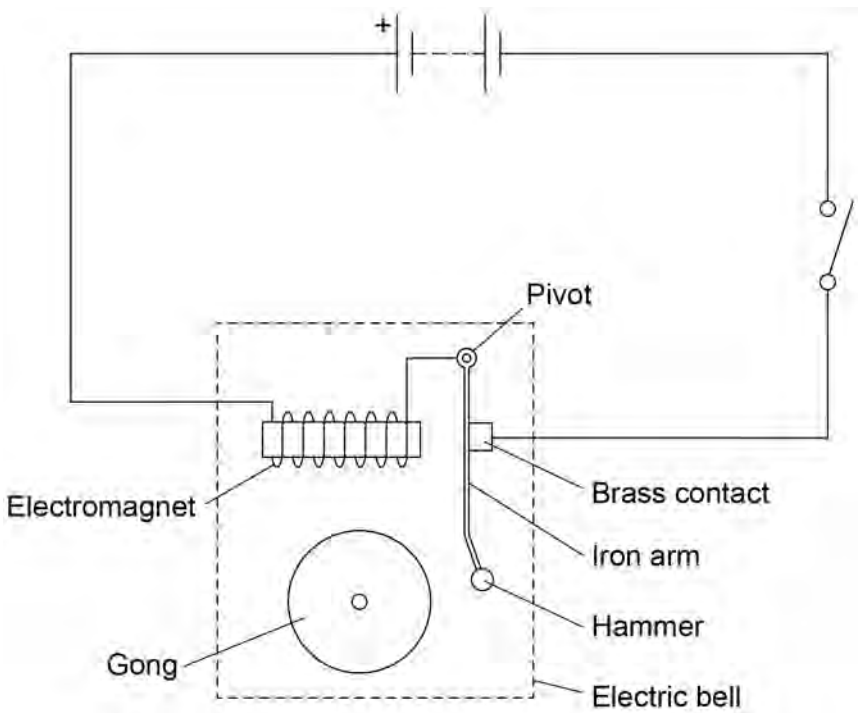
Question 3 continues on the next page

4.5.1.4 Resultant forces

Question 20 · continued

Figure 7 shows the parts of an electric bell.

Figure 7

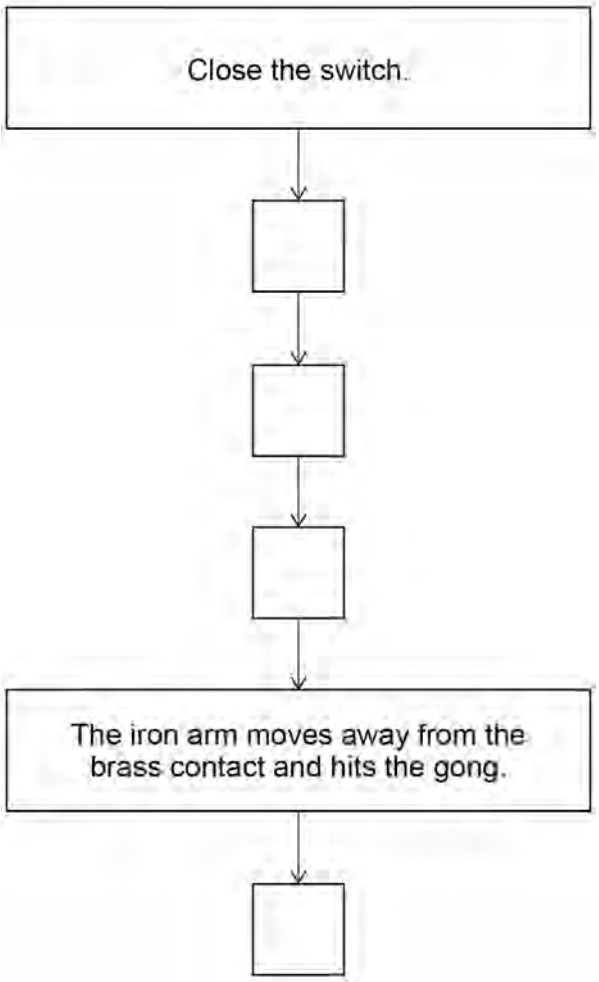


4.5.1.4 Resultant forces

Question 20 · continued

0 3 . 4 **Figure 8** shows an incomplete sequence of how the bell works.

Figure 8



Write **one** letter in each box to show the correct sequence.

Use each letter once.

[2 marks]

A A magnetic field is created around the electromagnet.

B A resultant force acts on the iron arm causing it to move towards the electromagnet.

C The iron arm returns to its original position.

D There is a current in the circuit.

4.5.1.4 Resultant forces

Question 20 · continued

0 3 . 5 Which of the following would increase the resultant force on the iron arm?

[1 mark]

Tick (✓) **one** box.

Decrease the distance between the electromagnet and the iron arm ☐

Decrease the number of cells in the circuit ☐

Decrease the number of turns on the electromagnet ☐

0 3 . 6 The iron arm of the bell vibrates with a frequency of 6.25 Hz.

Calculate the period of the iron arm.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

[2 marks]

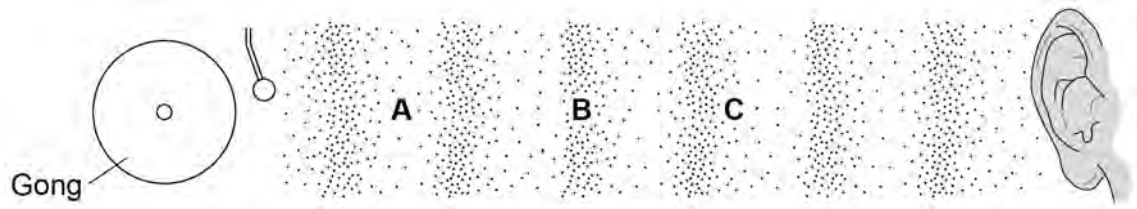
Period = _____ s

Question 20 · continued

0 3 . 7 The sound waves produced by the bell are longitudinal waves.

Figure 9 shows the position of the air particles at one point in time as the sound waves travel through the air.

Figure 9



Which letter represents an area of compression?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

9

Turn over for the next question

4.5.1.4 Resultant forces

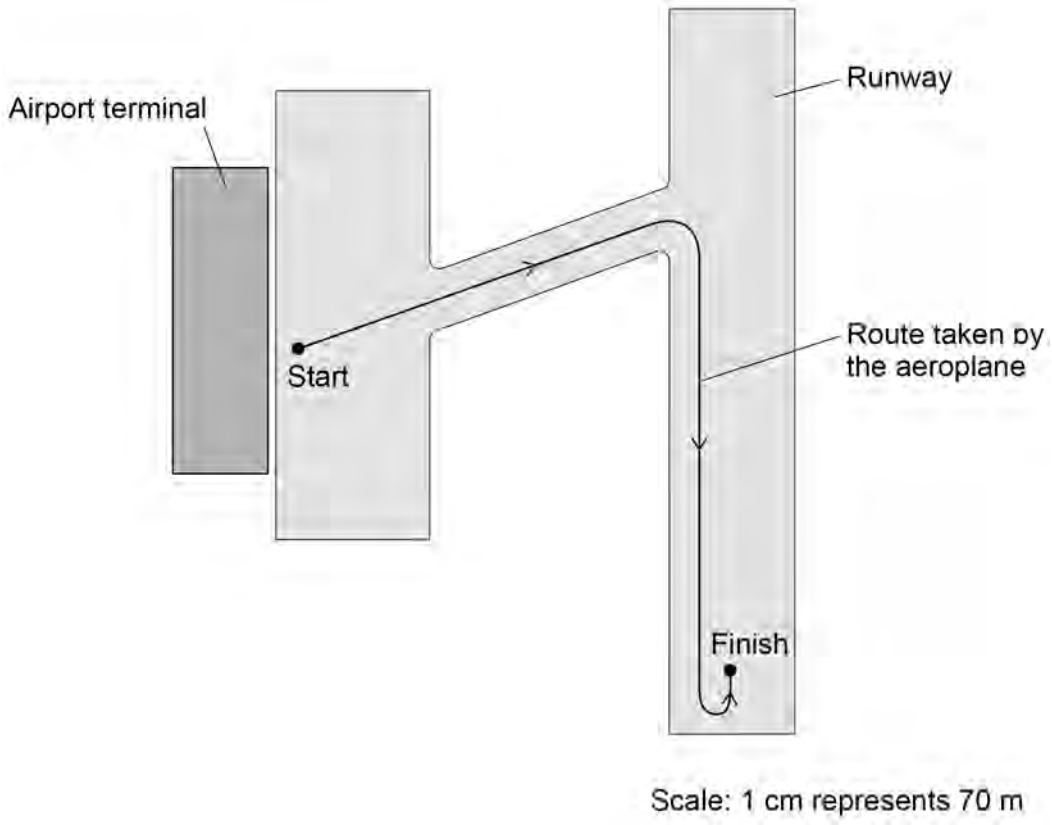
Question 21

June 2023 | 8463/2F | Original Q10

1 0 **Figure 25** shows the route an aeroplane takes as it travels from an airport terminal to the runway.

Figure 25 has been drawn to scale.

Figure 25



1 0 . 1 Determine the magnitude of the aeroplane's displacement from the start point to the finish point on **Figure 25**.

[2 marks]

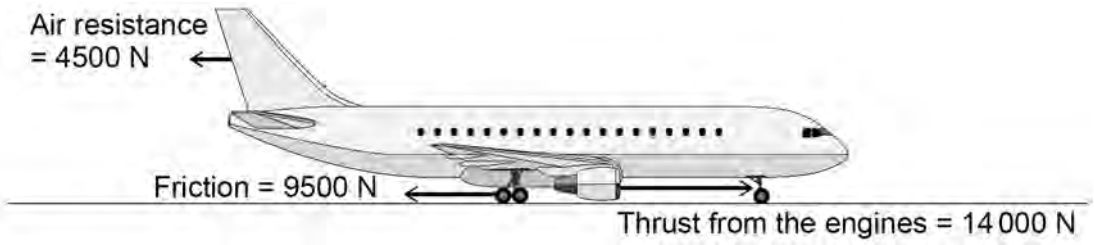
Displacement = _____ m

4.5.1.4 Resultant forces

Question 21 · continued

Figure 26 shows the direction of the horizontal forces acting on the aeroplane as it moves in a straight line towards the runway.

Figure 26



10.2 Determine the magnitude of the resultant horizontal force on the aeroplane.

[1 mark]

Resultant horizontal force = _____ N

10.3 Describe the motion of the aeroplane as it moves towards the runway.

[1 mark]

10.4 Air resistance and friction are contact forces.

Give **one** other example of a contact force.

[1 mark]

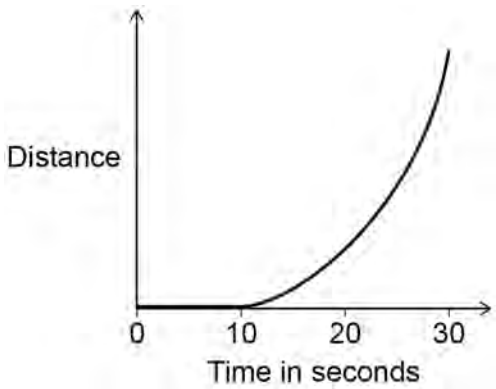
4.5.1.4 Resultant forces

Question 21 · continued

1 0 . 5 The aeroplane stops for a short time and then accelerates along the runway.

Figure 27 shows a distance–time sketch-graph for this stage of the journey.

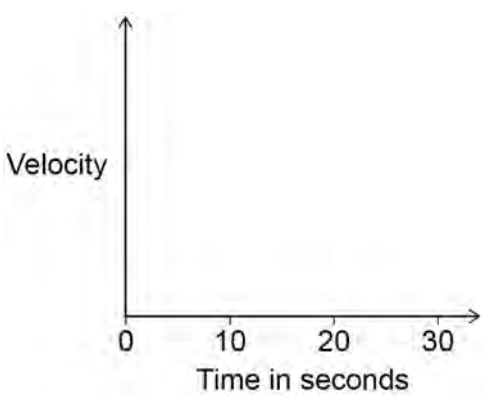
Figure 27



Draw the velocity–time sketch-graph for this stage of the journey on **Figure 28**.

[2 marks]

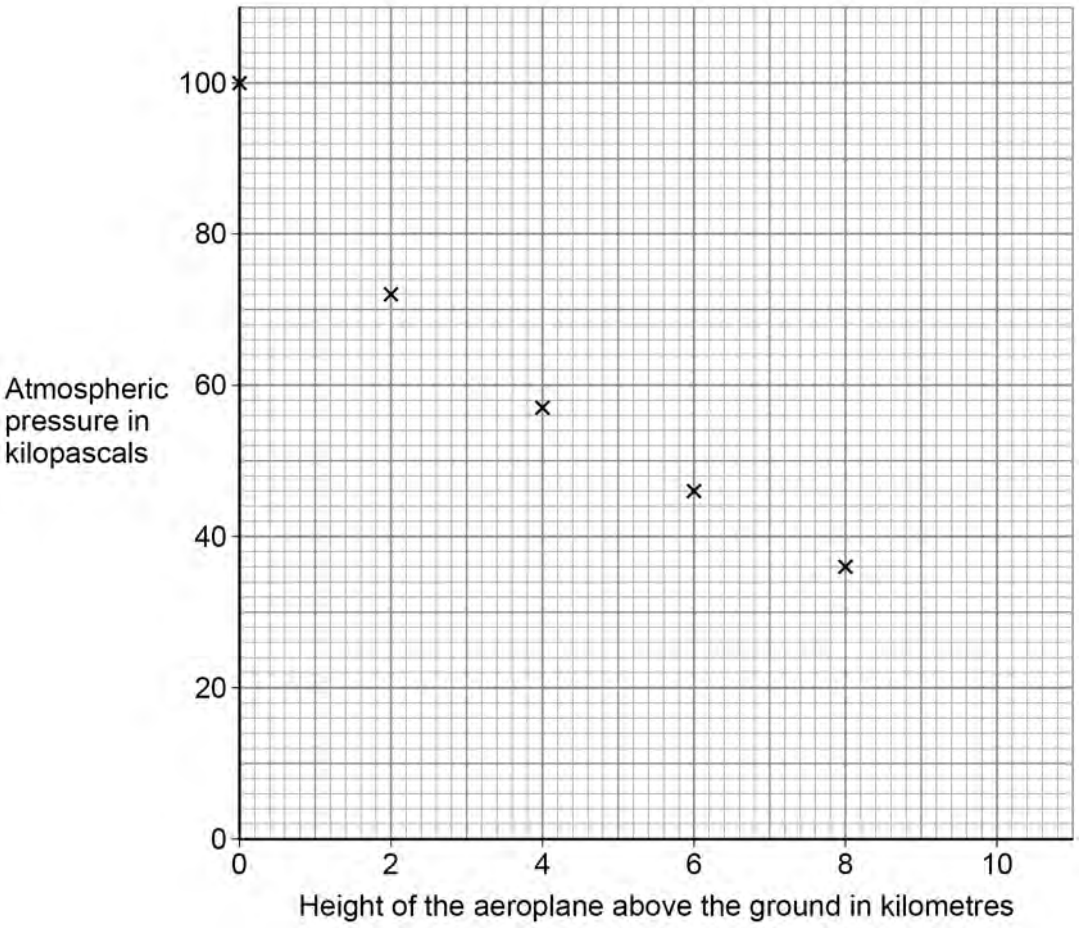
Figure 28



1 0 . 6 The aeroplane takes off from the runway, so its height above the ground increases.

Figure 29 shows how atmospheric pressure varies with the height of the aeroplane above the ground.

Figure 29



Estimate the atmospheric pressure when the height of the aeroplane above the ground is 10 km.

[2 marks]

Atmospheric pressure = _____ kPa

Question 10 continues on the next page

4.5.1.4 Resultant forces

Question 21 · continued

June 2023 | 8463/2F | Original Q10

10.7 What happens to the air surrounding the aeroplane as the height of the aeroplane above the ground increases?

[1 mark]

Tick (✓) **one** box.

- The average density of the air above the aeroplane decreases. ☐
- The mass of air above the aeroplane increases. ☐
- The temperature of the air increases. ☐
- The volume of air below the aeroplane decreases. ☐

10

4.5.1.4 Resultant forces

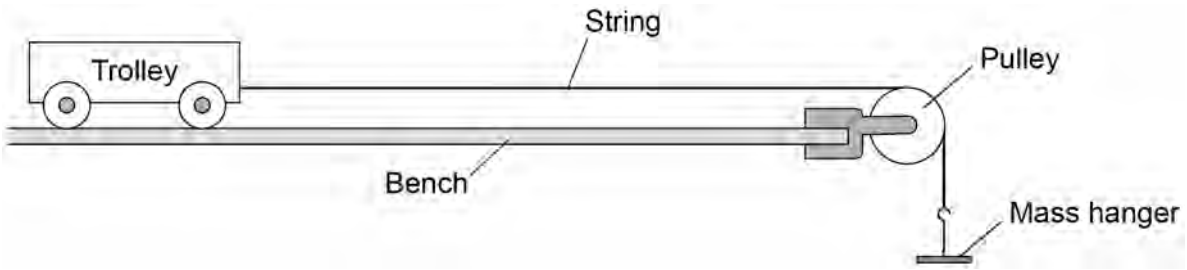
Question 22

June 2024 | 8463/2F | Original Q3

0 3 A student investigated how changing the mass of a trolley affects the acceleration of the trolley.

Figure 5 shows some of the equipment used.

Figure 5



0 3 . 1 The trolley in **Figure 5** is not moving.

Which force prevents the trolley from moving?

[1 mark]

Tick (✓) **one** box.

Friction ☐

Tension ☐

Weight ☐

4.5.1.4 Resultant forces

Question 22 · continued

The force pulling on the trolley was increased so that the trolley accelerated.

The force was then kept constant and different masses were put on the trolley.

For each different mass the acceleration of the trolley was measured.

0 3 . 2 Draw **one** line from each variable to the correct quantity.

[2 marks]

Variable	Quantity
	Acceleration of the trolley
Independent variable	Length of the bench
	Total mass of the trolley
Dependent variable	Force pulling on the trolley

0 3 . 3 For one of the masses put on the trolley, the student recorded three values of acceleration.

1.58 m/s^2 1.53 m/s^2 1.54 m/s^2

Calculate the mean acceleration of the trolley.

[2 marks]

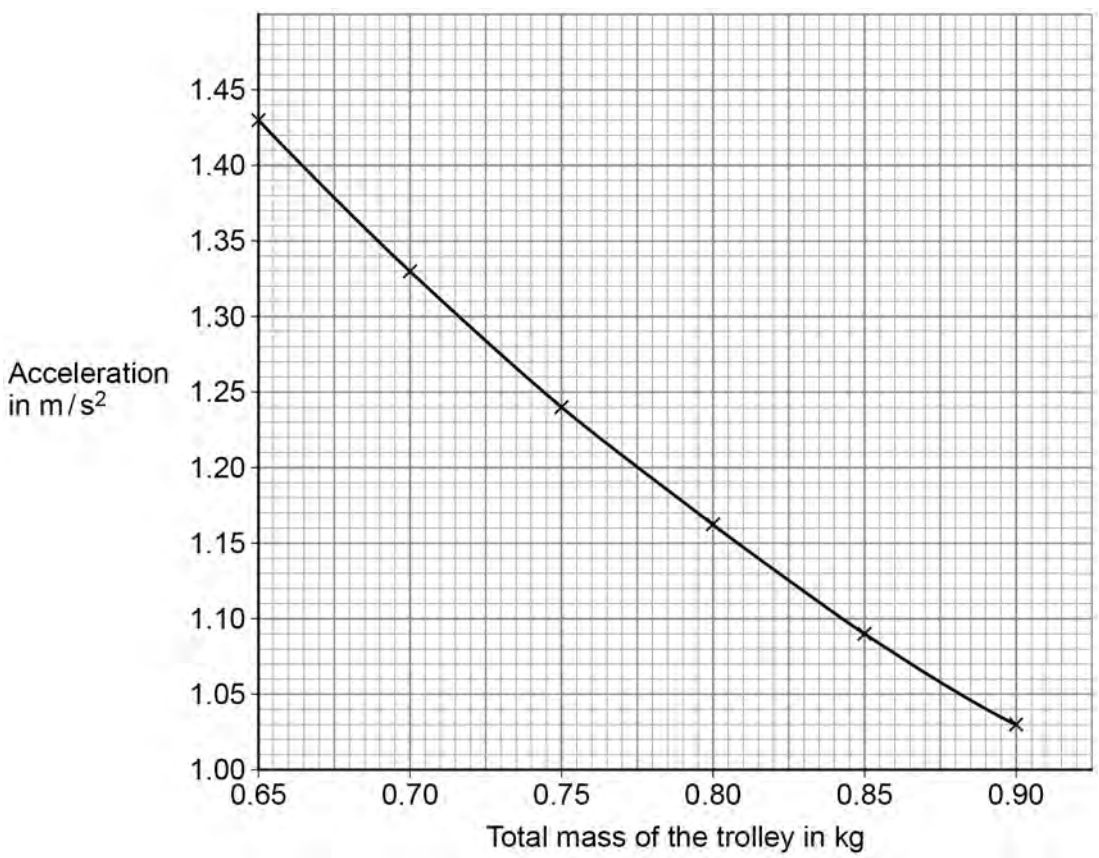
Mean acceleration = _____ m/s^2

4.5.1.4 Resultant forces

Question 22 · continued

Figure 6 shows some of the results.

Figure 6



0 3 . 4 Describe the relationship shown in **Figure 6**.

[1 mark]

4.5.1.4 Resultant forces

Question 22 · continued

0 3 . 5 When the total mass of the trolley was 1.5 kg, the acceleration of the trolley was 0.62 m/s^2.

Calculate the resultant force acting on the trolley.

Use the equation:

resultant force = mass × acceleration

[2 marks]

Resultant force = _____ N

8

Turn over for the next question

4.5.1.4 Resultant forces

Question 23

June 2024 | 8463/2F | Original Q9

0 9 **Figure 17** shows a young child using a baby walker.

Figure 17



0 9 . 1 The child is standing still.

What is the resultant **vertical** force on the child?

Give a reason for your answer.

[2 marks]

Resultant vertical force = _____ N

Reason _____

_____

4.5.1.4 Resultant forces

Question 23 · continued

Use the Physics Equations Sheet to answer questions **09.2** and **09.3**.

0 9 . 2 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 9 . 3 The child pushed the baby walker 2.8 m across a horizontal floor.

The work done by the child was 35 J.

Calculate the horizontal force the child applied to the baby walker.

[3 marks]

Horizontal force = _____ N

0 9 . 4 The child pushed the baby walker from a carpet onto a hard floor.

The child applied the same horizontal force to the baby walker.

Explain why the speed of the baby walker increased.

[2 marks]

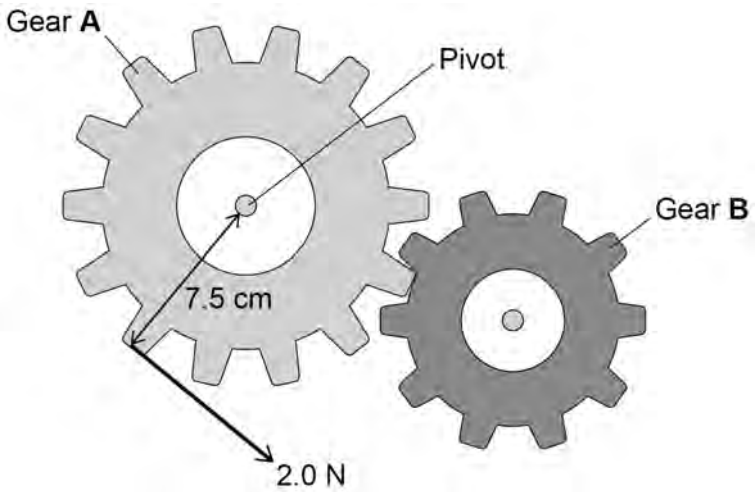
4.5.1.4 Resultant forces

Question 23 · continued

There are some toy gears on the front of the baby walker.

Figure 18 shows the gears.

Figure 18



The child applies a force to gear **A**.

This causes a moment about the pivot, so gear **A** rotates.

4.5.1.4 Resultant forces

Question 23 · continued

Use the Physics Equations Sheet to answer questions **09.5** and **09.6**.

0 9 . 5 Write down the equation which links distance (*d*), force (*F*) and moment of a force (*M*).

[1 mark]

0 9 . 6 The child applies a force of 2.0 N on gear **A**.

The perpendicular distance between the force and the pivot is 7.5 cm.

Calculate the moment of the force about the pivot.

[3 marks]

Moment of force = _____ N m

0 9 . 7 Explain what happens to gear **B** when the child applies the force to gear **A**.

[2 marks]

14

4.5.1.4 Resultant forces

Question 24

June 2025 | 8463/2F | Original Q4

0 4 Car **X** and car **Y** have engines that produce the same maximum forward force.

The cars are the same shape, but car **X** has a greater mass than car **Y**.

0 4 . 1 How does the maximum acceleration of car **X** and car **Y** compare?

[1 mark]

Tick (✓) **one** box.

Car **X** has a greater maximum acceleration. ☐

Car **X** and car **Y** have the same maximum acceleration. ☐

Car **X** has a smaller maximum acceleration. ☐

0 4 . 2 Car **Y** has a mass of 900 kg.

Car **Y** accelerates at 2.5 m/s^2.

Calculate the resultant force on car **Y**.

Use the equation:

resultant force = mass × acceleration

[2 marks]

Resultant force = _____ N

Question 4 continues on the next page

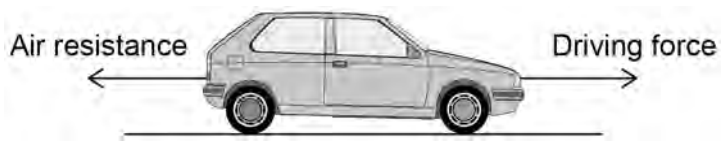
4.5.1.4 Resultant forces

Question 24 · continued

0 4 . 3 A car moves at a constant speed on a level road.

Figure 4 shows the horizontal forces on the car.

Figure 4



The driver makes the car accelerate until the car reaches its maximum speed.

Explain how the horizontal forces on the car change as the car accelerates to its maximum speed.

[4 marks]

4.5.1.4 Resultant forces

Question 24 · continued

To pass a driving test, drivers need to understand the difference between thinking distance and braking distance.

0 4 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

force	length	time

The thinking distance is affected by the driver's reaction _____.

0 4 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

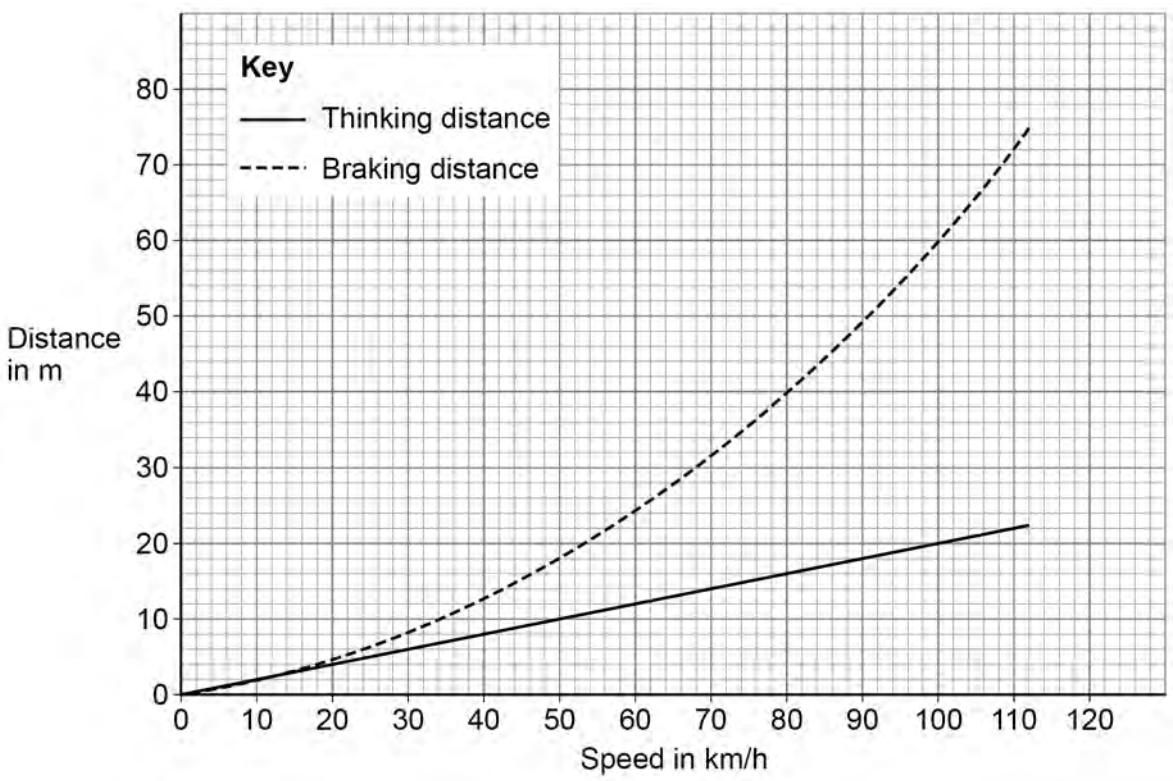
force	length	time

The braking distance is the distance travelled by the car under the braking _____.

Question 4 continues on the next page

0 4 . 6 **Figure 5** shows how speed affects the thinking distance and braking distance of a car.

Figure 5



The car is moving at a speed of 100 km/h.

Calculate the stopping distance of the car.

Use **Figure 5**.

[3 marks]

Stopping distance = _____ m

4.5.1.4 Resultant forces

Question 24 · continued

0 4 . 7 Which **two** of the following would **increase** the stopping distance of a car?

[2 marks]

Tick (✓) **two** boxes.

- Fitting new brakes to the car ☐
- Fitting new tyres to the car ☐
- The driver becoming tired ☐
- Driving uphill ☐
- Driving on a wet road ☐

14

Turn over for the next question

4.5.1.4 Resultant forces

Question 25

June 2025 | 8463/2F | Original Q7

0 7 A 'number balance' is used to help children understand addition.

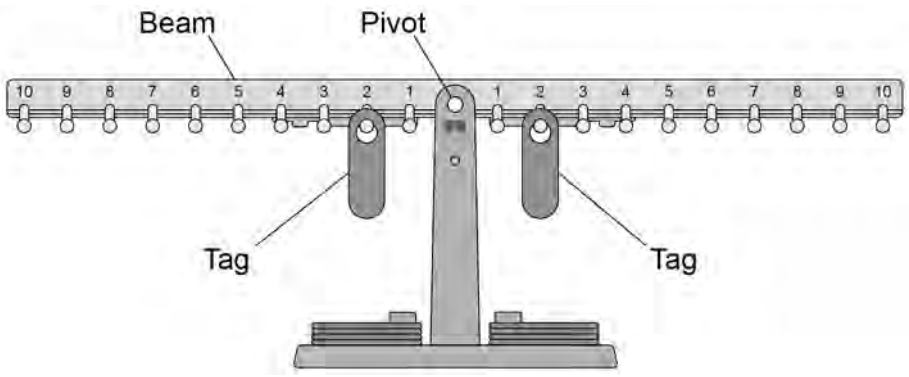
A number balance has a beam that can rotate around a pivot.

Small tags can be hung from the pegs on the beam.

Each tag has the same weight.

Figure 11 shows a number balance. The balance is in equilibrium.

Figure 11



0 7 . 1 The weight of each tag on the beam in **Figure 11** causes a moment about the pivot.

What is meant by the 'moment' of a force?

[1 mark]

Tick (✓) **one** box.

The direction of the force ☐

The magnitude of the force ☐

The turning effect of the force ☐

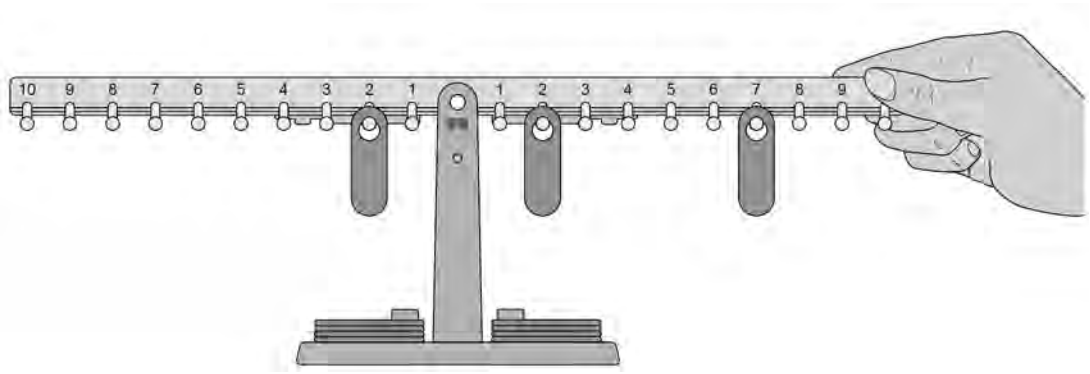
4.5.1.4 Resultant forces

Question 25 · continued

A student holds the beam in a horizontal position and adds a tag to position 7 to the right of the pivot.

Figure 12 shows the new arrangement.

Figure 12



0 7 . 2 The student lets go of the beam.

Which of the following describes the resultant moment on the beam?

[1 mark]

Tick (✓) **one** box.

The resultant moment is anti-clockwise. ☐

The resultant moment is clockwise. ☐

The resultant moment is zero. ☐

0 7 . 3 Explain where the student should add another tag to make the beam in **Figure 12** balance.

[2 marks]

4.5.1.4 Resultant forces

Question 25 · continued

Use the Physics Equations Sheet to answer questions **07.4** and **07.5**.

0 7 . 4 Write down the equation which links distance (*d*), force (*F*) and moment of a force (*M*).

[1 mark]

0 7 . 5 One tag causes a moment about the pivot of 1.8 N cm.

The weight of the tag is 0.15 N.

Calculate the distance between the pivot and the tag.

Give your answer in cm.

[3 marks]

Distance = _____ cm

8