AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.1.4

Resultant forces

Past-paper questions

Tier	**Higher**
Question groups	**22**
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:** _____

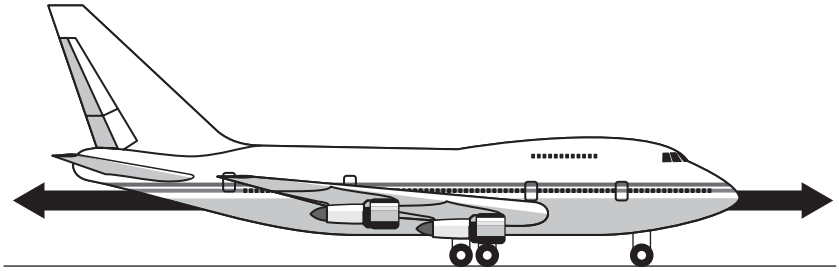
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.1.4 Resultant forces

Question 01

January 2008 | PHY2H | Original Q5 | Legacy

5 (a) The diagram shows an aircraft and the horizontal forces acting on it as it moves along a runway. The *resultant force* on the aircraft is zero.



(i) What is meant by the term *resultant force*?

.....

.....

(1 mark)

(ii) Describe the movement of the aircraft when the resultant force is zero.

.....

.....

(1 mark)

(b) The aircraft has a take-off mass of 320 000 kg. Each of the 4 engines can produce a maximum force of 240 kN.

Use the equation in the box to calculate the maximum acceleration of the aircraft.

resultant force = mass × acceleration

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

.....

.....

.....

Acceleration = ...

(3 marks)

4.5.1.4 Resultant forces

Question 01 · continued

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(c) As the aircraft moves along the runway to take off, its acceleration decreases even though the force from the engines is constant.

Explain why.

.....

.....

.....

.....

(2 marks)

7

Turn over for the next question

4.5.1.4 Resultant forces

Question 02

June 2008 | PHY3H | Original Q8 | Legacy

8 The London Eye is the largest observation wheel in the world.



The passengers ride in capsules. Each capsule moves in a circular path and accelerates.

8 (a) Explain how the wheel can move at a steady speed and the capsules accelerate at the same time.

.....

.....

.....

(2 marks)

8 (b) In which direction does each capsule accelerate?

.....

(1 mark)

8 (c) What is the name of the resultant force that causes the capsules to accelerate?

.....

(1mark)

4.5.1.4 Resultant forces

Question 02 · continued

for mark

8 (d) The designers of the London Eye had to consider **three** factors which affect the resultant force described in part (c).

Two factors that increase the resultant force are

- an increase in the speed of rotation
- an increase in the total mass of the wheel, the capsules and the passengers.

Name the other factor that affects the resultant force and state what effect it has on the resultant force.

.....

.....

(1 mark)

5

4.5.1.4 Resultant forces

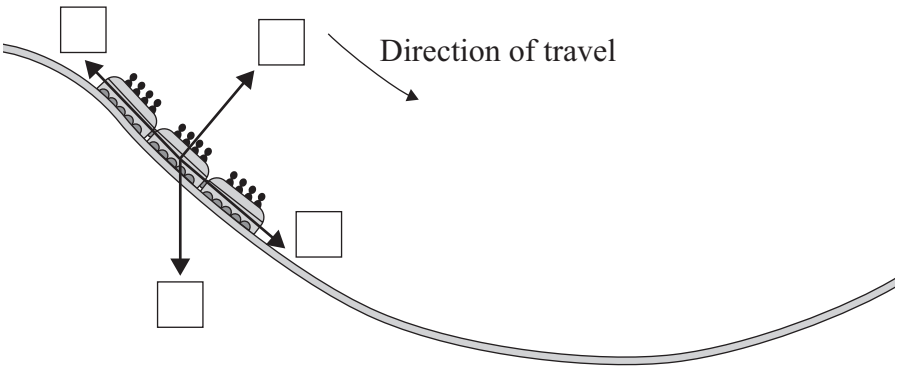
Question 03

January 2009 | PHY2H | Original Q1 | Legacy

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

1 (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)

1 (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)

1 (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

1 (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 03 · continued

for mark

1 (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 04

January 2010 | PHY2H | Original Q1 | Legacy

1 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.

1 (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.

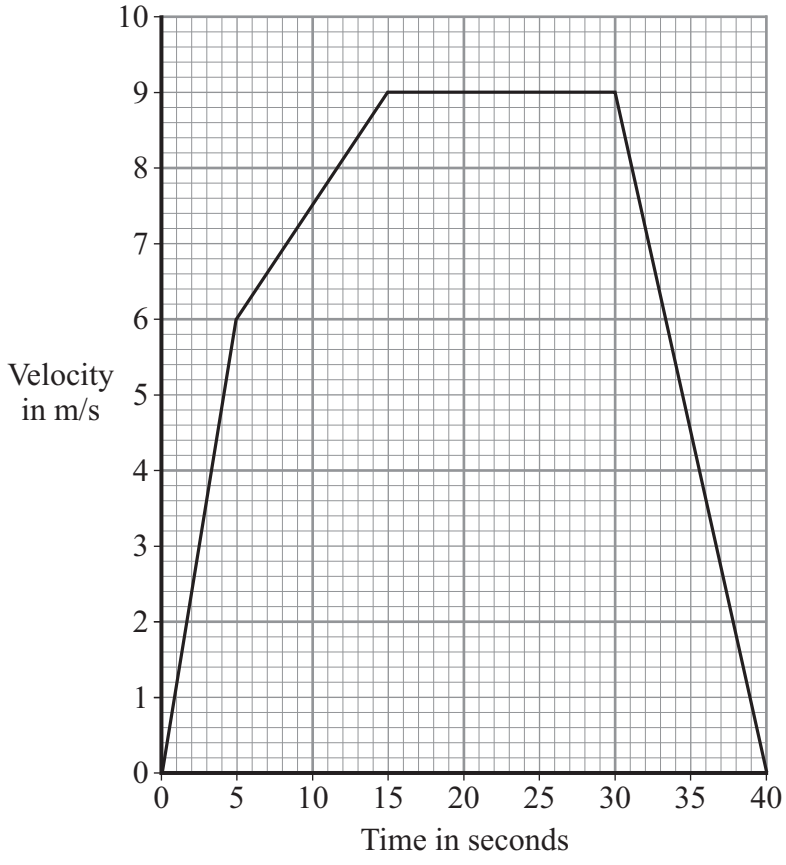
.....

.....

Resultant force = ...

(3 marks)

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



4.5.1.4 Resultant forces

Question 04 · continued

for mark

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

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

(1 mark)

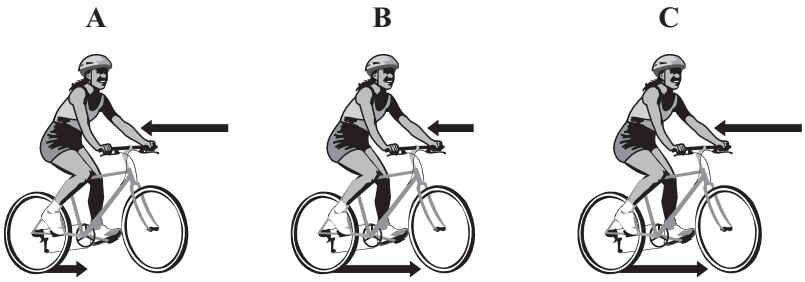
1 (b) (ii) Why has the data for the cyclist been shown as a line graph instead of a bar chart?

.....

.....

(1 mark)

1 (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.



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.

.....

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.....

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(3 marks)

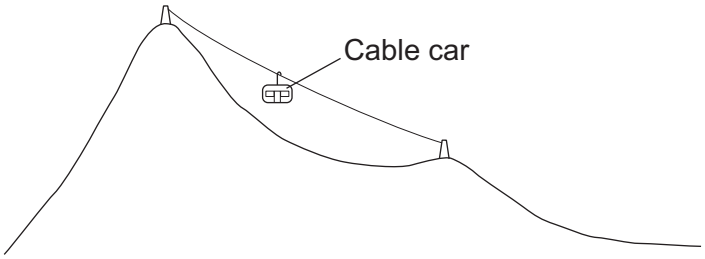
8

4.5.1.4 Resultant forces

Question 05

June 2010 | PHY2H | Original Q1 | Legacy

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



1 (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

1 (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)

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



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

(1 mark)

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

.....

.....

.....

.....

(2 marks)

Question 1 continues on the next page

4.5.1.4 Resultant forces

Question 05 · continued

1 (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)

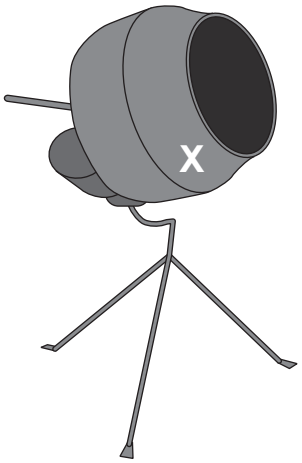
9

4.5.1.4 Resultant forces

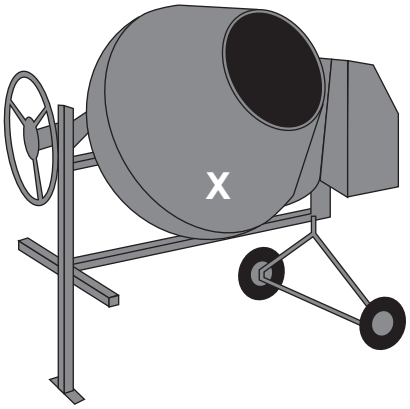
Question 06

June 2010 | PHY3H | Original Q4 | Legacy

4 The diagrams show two concrete mixers.



Concrete mixer **A**



Concrete mixer **B**

On each diagram, the centre of the white **X** marks the centre of mass of the concrete mixer and its contents.

4 (a) Complete the sentence to explain what the term *centre of mass* means.

The centre of mass of a concrete mixer and its contents is .....

.....

..... .

(1 mark)

4 (b) Both diagrams are drawn to the same scale.

Concrete mixer **B** is more stable than concrete mixer **A**.

The two features which make concrete mixer **B** more stable are:

1 .....

.....

2 .....

.....

(2 marks)

4.5.1.4 Resultant forces

Question 06 · continued

4 (c) Use the terms ‘line of action of the weight’ and ‘resultant moment’ to explain why a stable concrete mixer does not fall over when it is given a small push.

.....

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.....

.....

.....

(2 marks)

5

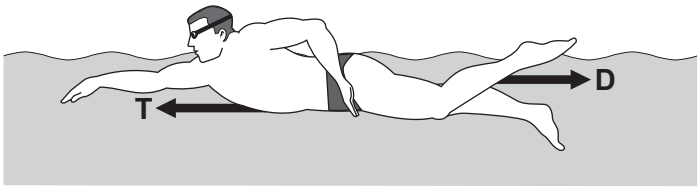
Turn over for the next question

4.5.1.4 Resultant forces

Question 07

January 2011 | PHY2H | Original Q1 | Legacy

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



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

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

..... N
(1 mark)

1 (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)

1 (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.

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.....
(3 marks)

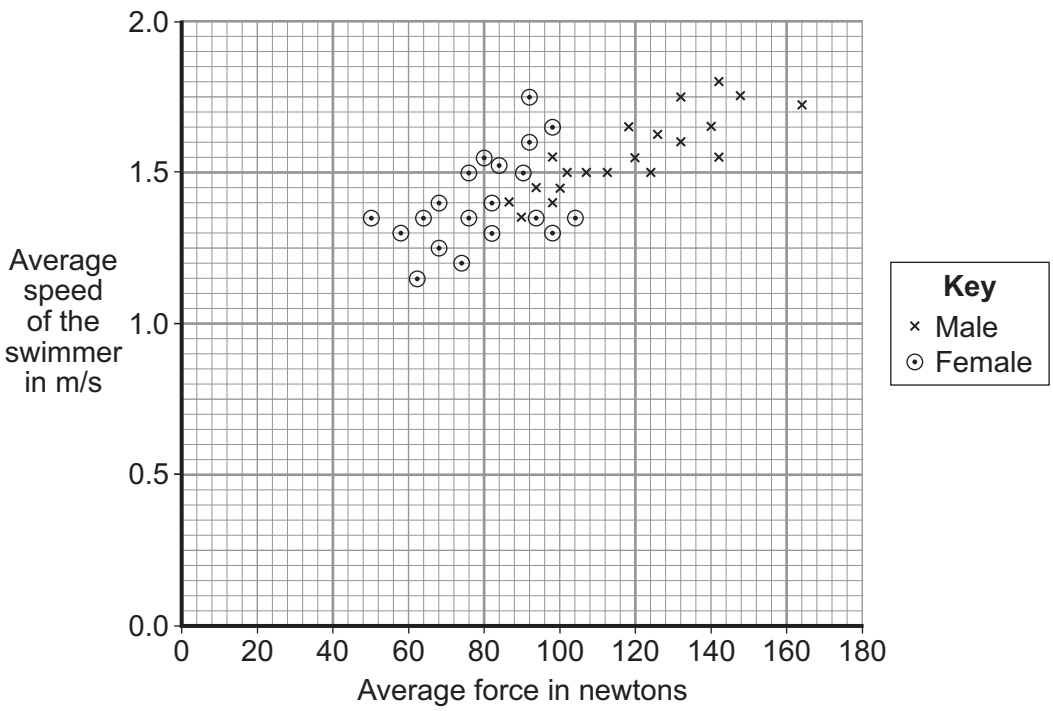
Question 1 continues on the next page

4.5.1.4 Resultant forces

Question 07 · continued

1 (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.



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

.....

(1 mark)

1 (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 07 · continued

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

.....

.....

(1 mark)

1 (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

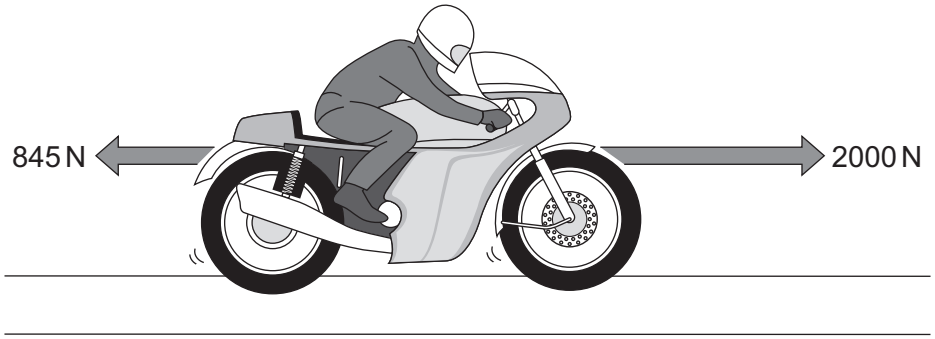
Turn over for the next question

4.5.1.4 Resultant forces

Question 08

June 2011 | PHY2H | Original Q7 | Legacy

7 The arrows in the diagram represent the horizontal forces acting on a motorbike at one moment in time.



7 (a) The mass of the motorbike and rider is 275 kg.

Use the equation in the box to calculate the acceleration of the motorbike at this moment in time.

resultant force = mass × acceleration

Show clearly how you work out your answer.

.....

.....

.....

.....

.....

Acceleration = ... m/s ^{2}

(3 marks)

4.5.1.4 Resultant forces

Question 08 · continued

7 (b) A road safety organisation has investigated the causes of motorbike accidents.

The main aim of the investigation was to find out whether there was any evidence that young, inexperienced riders were more likely to be involved in an accident than older, experienced riders.

Data obtained by the organisation from a sample of 1800 police files involving motorbike accidents, is summarised in the table.

Size of motorbike engine	Percentage of all motorbikes sold	Total number in the sample of 1800 accident files
up to 125 cc	36	774
126 to 350 cc	7	126
351 to 500 cc	7	162
over 500 cc	50	738

Most of the motorbikes with engines up to 125 cc were ridden by young people. The motorbikes with engines over 500 cc were ridden by older, more experienced riders.

7 (b) (i) In terms of the main aim of the investigation, is this data valid?

Draw a ring around your answer. **NO** **YES**

Explain the reason for your answer.

.....

.....

.....

.....

(2 marks)

Question 7 continues on the next page

4.5.1.4 Resultant forces

Question 08 · continued

7 (b) (ii) The organisation concluded that:

"Young, inexperienced riders are more likely to be involved in a motorbike accident than older, experienced riders".

Explain how the data supports this conclusion.

.....

.....

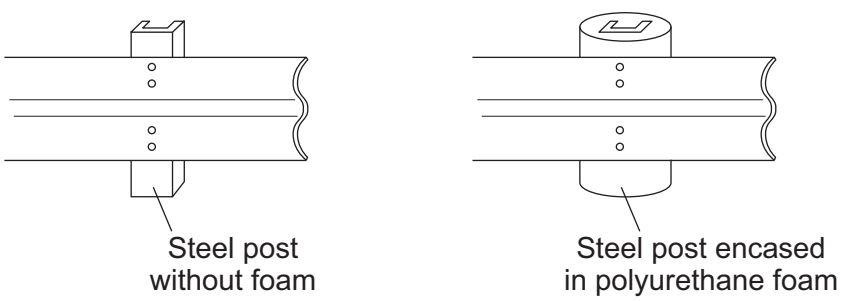
.....

.....

(2 marks)

7 (c) Of particular concern to motorbike riders is the design of steel crash barriers. Riders falling off and sliding at high speed into a steel support post are often seriously injured.

One way to reduce the risk of serious injury is to cover the post in a thick layer of high impact polyurethane foam.



7 (c) (i) Use the ideas of momentum to explain how the layer of foam reduces the risk of serious injury to a motorbike rider sliding at high speed into the support post.

.....

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.....

.....

(3 marks)

4.5.1.4 Resultant forces

Question 08 · continued June 2011 | PHY2H | Original Q7 | Legacy

7 (c) (ii) Crash barrier tests use dummies that collide at 17 m/s with the barrier. Each test costs about £12 000. New safety devices for crash barriers are tested many times to make sure that they will improve safety.

Do you think that the cost of developing the new safety devices is justified?

Draw a ring around your answer. **NO** **YES**

Give a reason for your answer.

.....

.....

(1 mark)

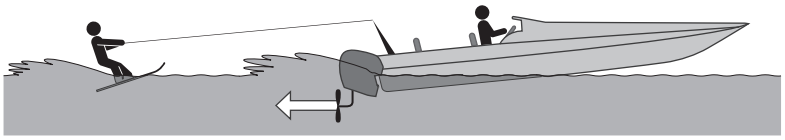
11

4.5.1.4 Resultant forces

Question 09

June 2013 | PH2HP | Original Q1 | Legacy

1 The diagram shows a boat pulling a water skier.



1 (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)

1 (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.

1 (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

1 (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)

1 (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

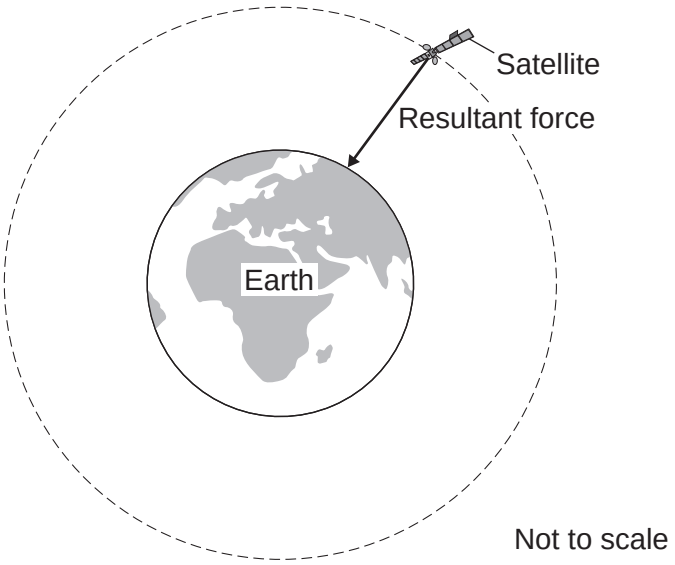
4.5.1.4 Resultant forces

Question 10

June 2014 | PH3HP | Original Q2 | Legacy

2 Man-made satellites can orbit the Earth, as shown in **Figure 3**.

Figure 3



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

The resultant force is called the centripetal force.

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

[1 mark]

.....

2 (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 10 · continued

2 (c) **Table 1** gives data for five different satellites orbiting the Earth.

Table 1

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

2 (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]

.....

.....

2 (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 2 continues on the next page

4.5.1.4 Resultant forces

Question 10 · continued

2 (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

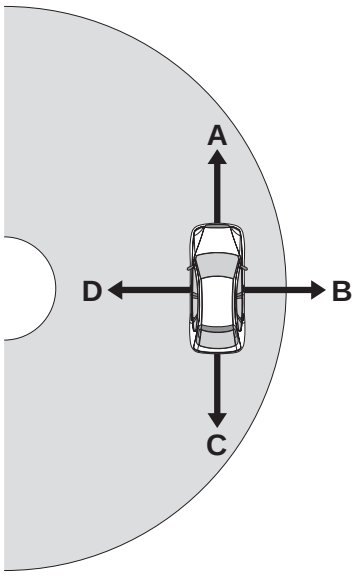
4.5.1.4 Resultant forces

Question 11

June 2015 | PH3HP | Original Q2 | Legacy

2 (a) **Figure 3** shows a car travelling around a bend in the road. The car is travelling at a constant speed.

Figure 3



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

2 (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** ☐

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

[1 mark]

.....

4.5.1.4 Resultant forces

Question 11 · continued

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

[2 marks]

1 .....

2 .....

2 (b) **Figure 4** shows a racing car.

Figure 4



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

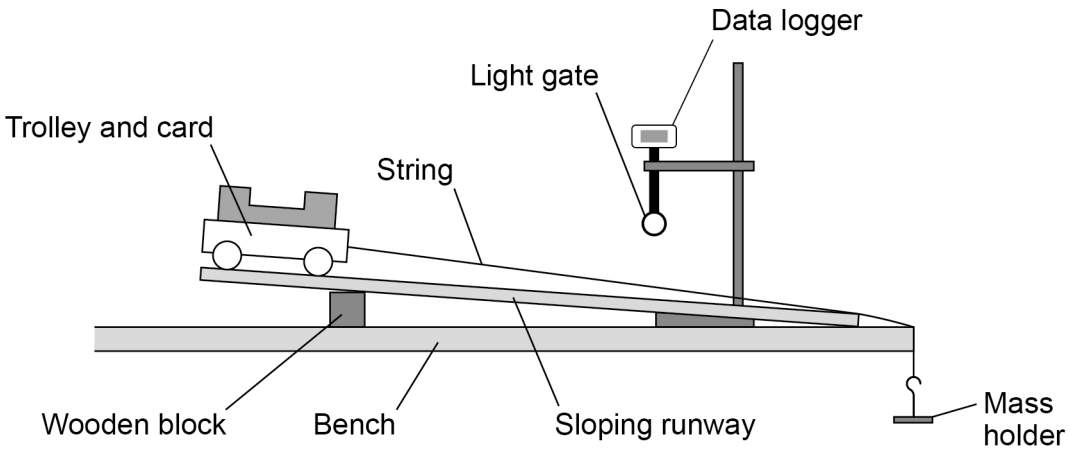
Question 12

November 2020 | 8463/2H | Original Q1

0 1 A student investigated the acceleration of a trolley.

Figure 1 shows how the student set up the apparatus.

Figure 1



0 1 . 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 1** 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 1 . 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]

Question 12 · 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.

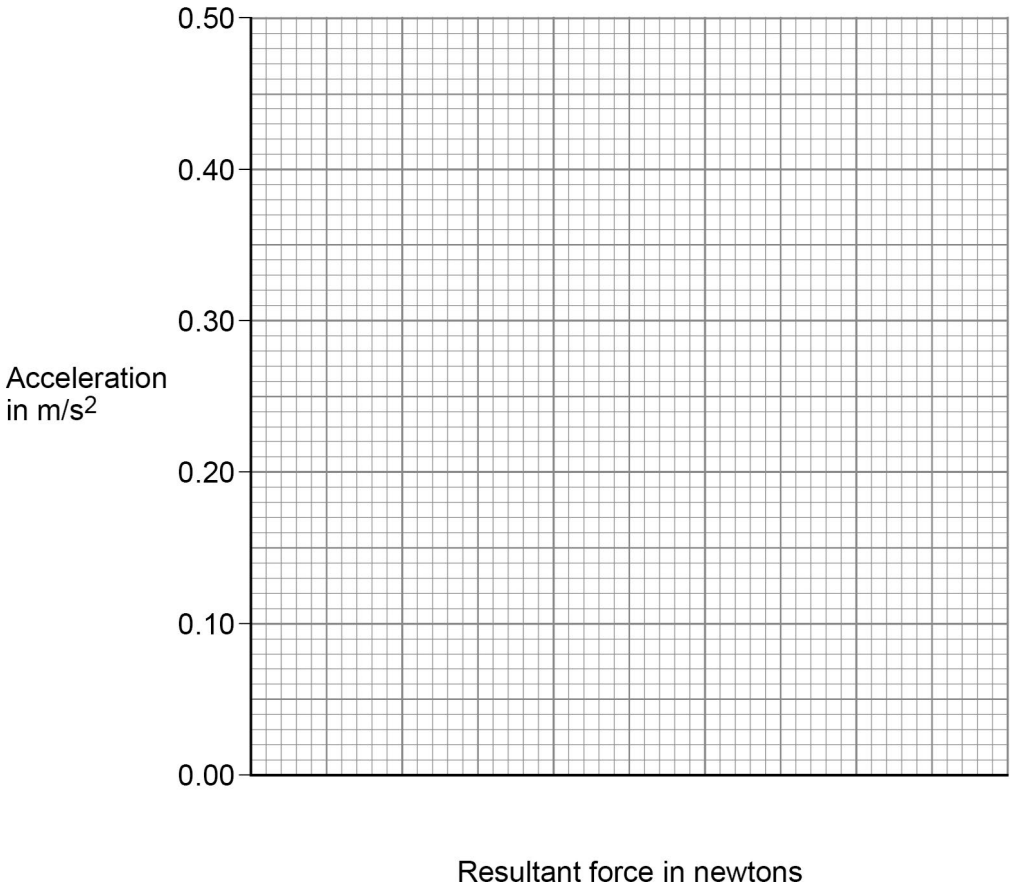
Table 1 shows the results.

Table 1

Resultant force in newtons	Acceleration in m/s^2
0.05	0.08
0.10	0.18
0.15	0.25
0.20	0.32
0.25	0.41

Figure 2 is an incomplete graph of the results.

Figure 2



0 1 . 3 Complete **Figure 2**.

- 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 12 · continued

0 1 . 4 Describe the relationship between the resultant force on the trolley and the acceleration of the trolley.

[1 mark]

0 1 . 5 Describe how the investigation could be improved to reduce the effect of random errors.

[2 marks]

0 1 . 6 Write down the equation that links acceleration (*a*), mass (*m*) and resultant force (*F*).

[1 mark]

0 1 . 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 13

November 2020 | 8463/2H | Original Q4

0 4 A door is fitted with a security lens and a lock.

The security lens allows a person to see a visitor before opening the door.

The security lens is concave.

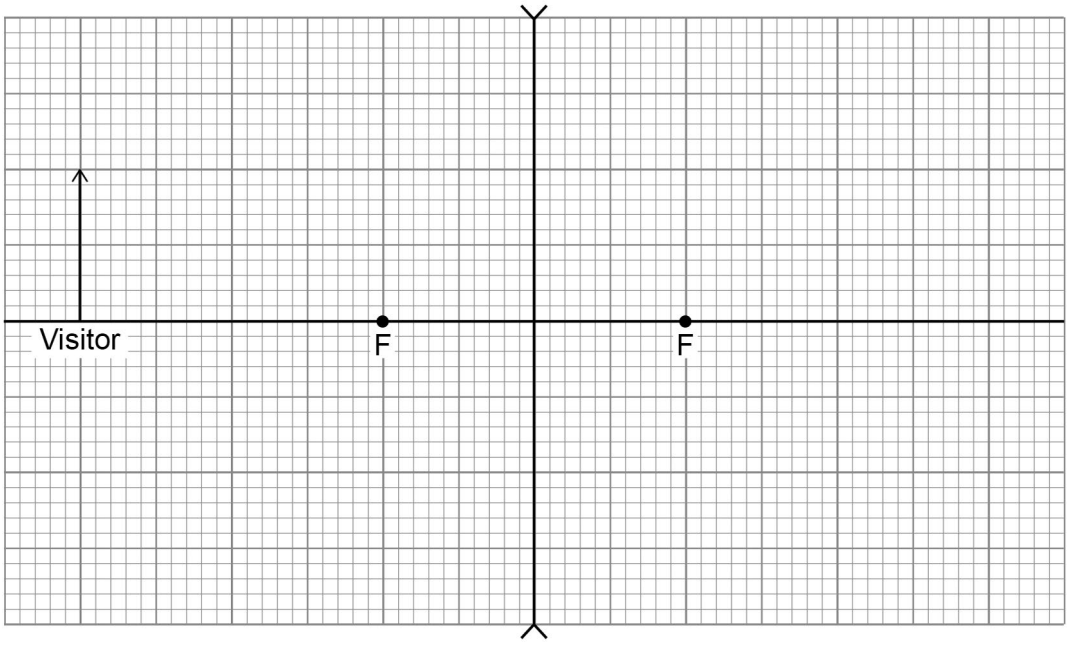
0 4 . 1 **Figure 5** is an incomplete ray diagram representing a visitor standing near the security lens.

Complete **Figure 5** to show how an image of the visitor is formed by the concave lens.

Draw an arrow to represent the image.

[3 marks]

Figure 5



0 4 . 2 The visitor moves further away from the security lens in the door.

How does the size of the image change?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Increases ☐

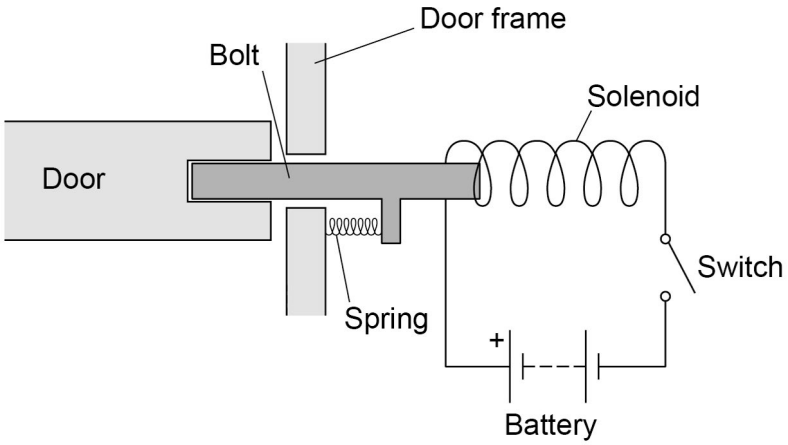
Stays the same ☐

4.5.1.4 Resultant forces

Question 13 · continued

Figure 6 shows a diagram of the lock. The door unlocks when the switch is closed.

Figure 6



0 4 . 3 Which material should the bolt be made from?

[1 mark]

Tick (✓) **one** box.

Aluminium ☐

Brass ☐

Copper ☐

Iron ☐

0 4 . 4 Explain why the door unlocks when the switch is closed.

[3 marks]

4.5.1.4 Resultant forces

Question 13 · continued

0 4 . 5 When the door unlocks, a force of 2.88 N is applied to the spring.

The spring extends by 1.50 cm.

Calculate the spring constant of the spring.

[4 marks]

Spring constant = _____ N/m

0 4 . 6 Give **two** ways the resultant force on the bolt could be increased.

[2 marks]

1 _____

2 _____

14

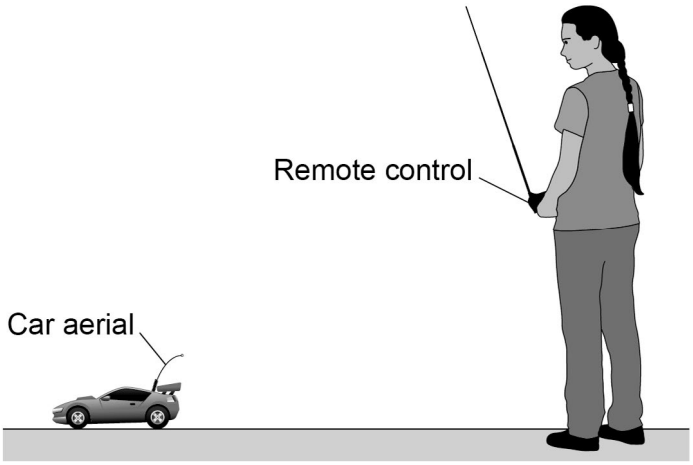
4.5.1.4 Resultant forces

Question 14

November 2020 | 8463/2H | Original Q6

0 6 **Figure 8** shows a student playing with a remote-controlled car.

Figure 8



0 6 . 1 The remote control transmits radio waves to the car aerial.

The transmitted radio waves have a frequency of 320 MHz.

speed of radio waves = 3.0×10^8 m/s

Calculate the wavelength of the radio waves.

Give the unit.

[5 marks]

Wavelength = _____ Unit _____

4.5.1.4 Resultant forces

Question 14 · continued

0 6 . 2 The car aerial is connected to an electrical circuit in the car.

Describe what happens in the electrical circuit when the car aerial absorbs radio waves.

[2 marks]

0 6 . 3 The car produces sound waves.

Give **two** ways in which radio waves are different to sound waves.

[2 marks]

1

2

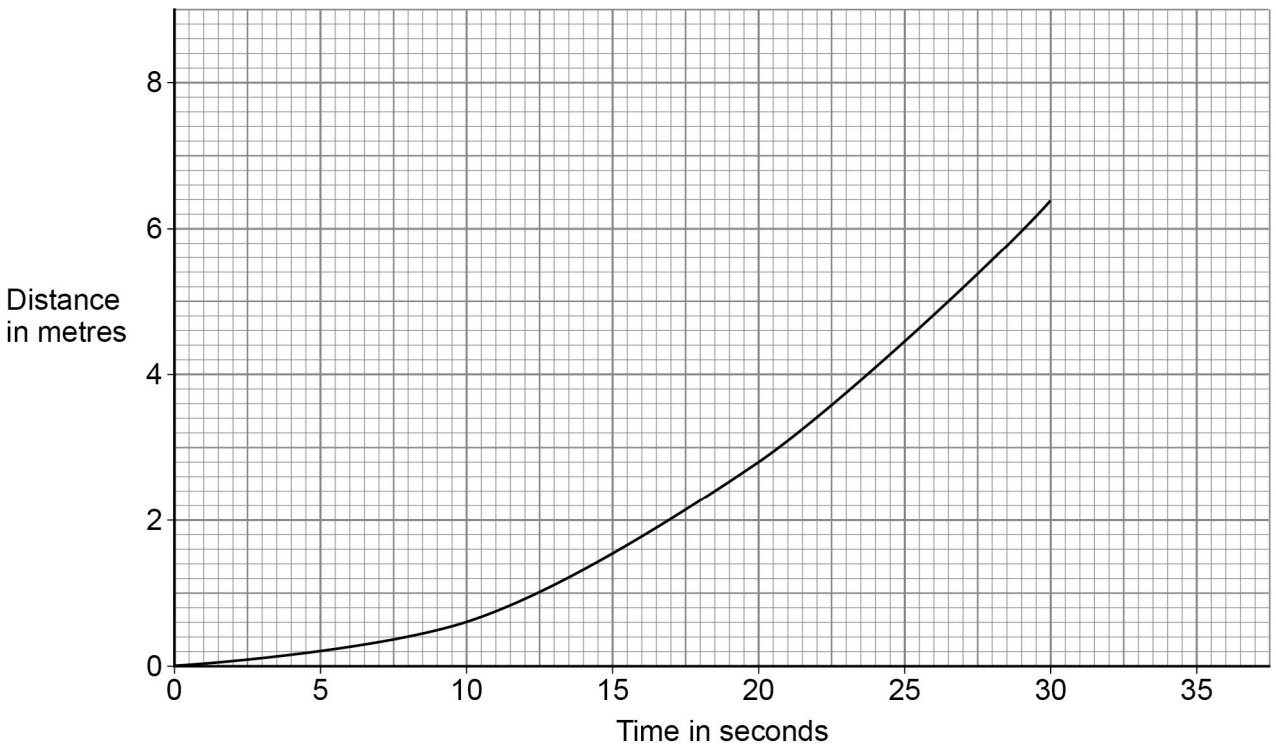
Question 6 continues on the next page

4.5.1.4 Resultant forces

Question 14 · continued

Figure 9 shows the distance-time graph for the first 30 seconds of the car's motion.

Figure 9



0 6 . 4 Describe the motion of the car during the first 30 seconds.

[1 mark]

0 6 . 5 Determine the speed of the car 20 seconds after it started to move.

[4 marks]

Speed = _____ m/s

4.5.1.4 Resultant forces

Question 14 · continued

0 6 . 6 A different car accelerated from 0.12 m/s to 0.52 m/s.

The acceleration of the car was 0.040 m/s^2.

The work done to accelerate the car was 0.48 J.

Calculate the resultant force needed to accelerate the car.

[6 marks]

Resultant force = _____ N

0 6 . 7 Explain why the car has a maximum speed.

[4 marks]

24

4.5.1.4 Resultant forces

Question 15

November 2021 | 8463/2H | Original Q1

0 1 The thinking distance and braking distance for a car vary with the speed of the car.

0 1 . 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 1 continues on the next page

4.5.1.4 Resultant forces

Question 15 · continued

0 1 . 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 1 . 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]

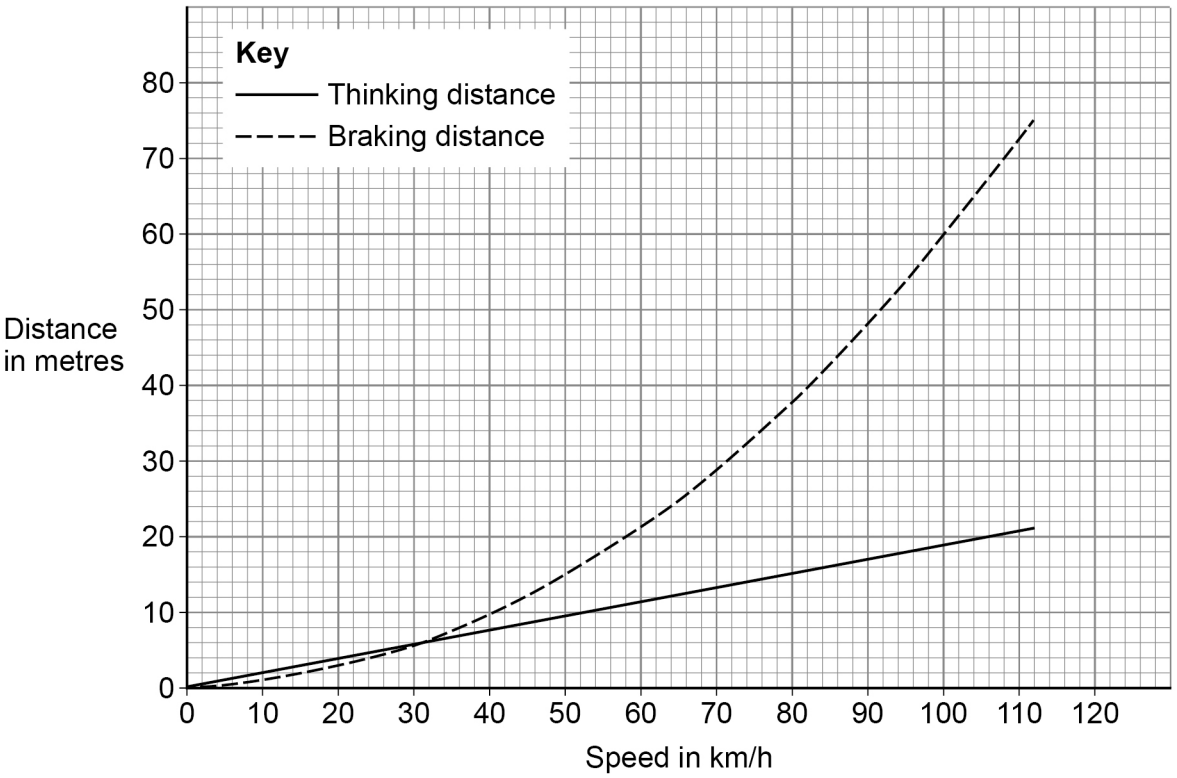
Deceleration = _____ m/s^2

4.5.1.4 Resultant forces

Question 15 · continued

0 1 . 4 **Figure 1** shows how the thinking distance and braking distance for a car vary with the speed of the car.

Figure 1



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

[2 marks]

Stopping distance = _____ m

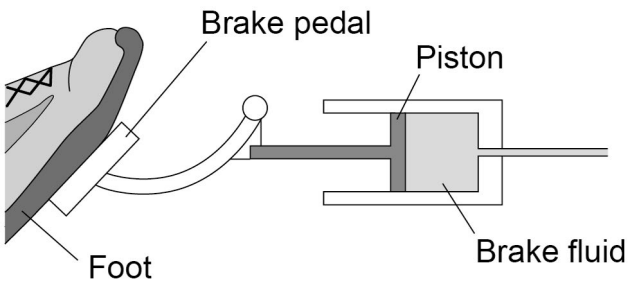
Question 1 continues on the next page

4.5.1.4 Resultant forces

Question 15 · continued

Figure 2 shows part of the braking system for a car.

Figure 2



0 1 . 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 15 · continued

0 1 . 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

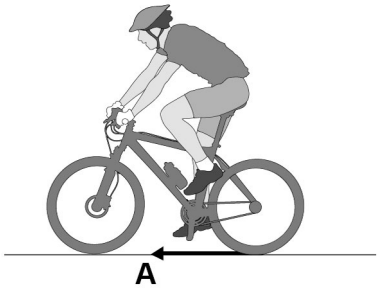
Question 16

November 2021 | 8463/2H | Original Q7

0 7 **Figure 11** shows a cyclist riding a bicycle.

Force **A** causes the bicycle to accelerate forwards.

Figure 11

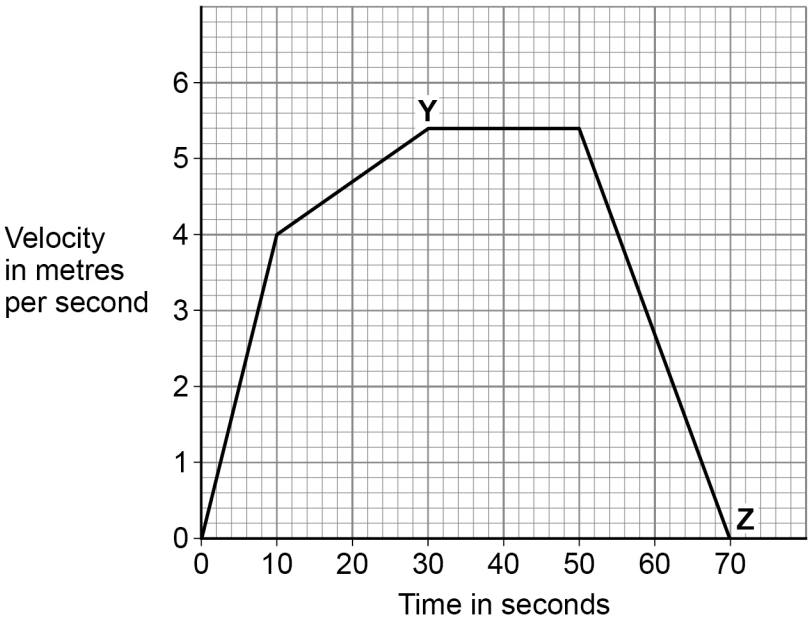


0 7 . 1 What name is given to force **A**?

[1 mark]

Figure 12 shows how the velocity of the cyclist changes during a short journey.

Figure 12



4.5.1.4 Resultant forces

Question 16 · continued

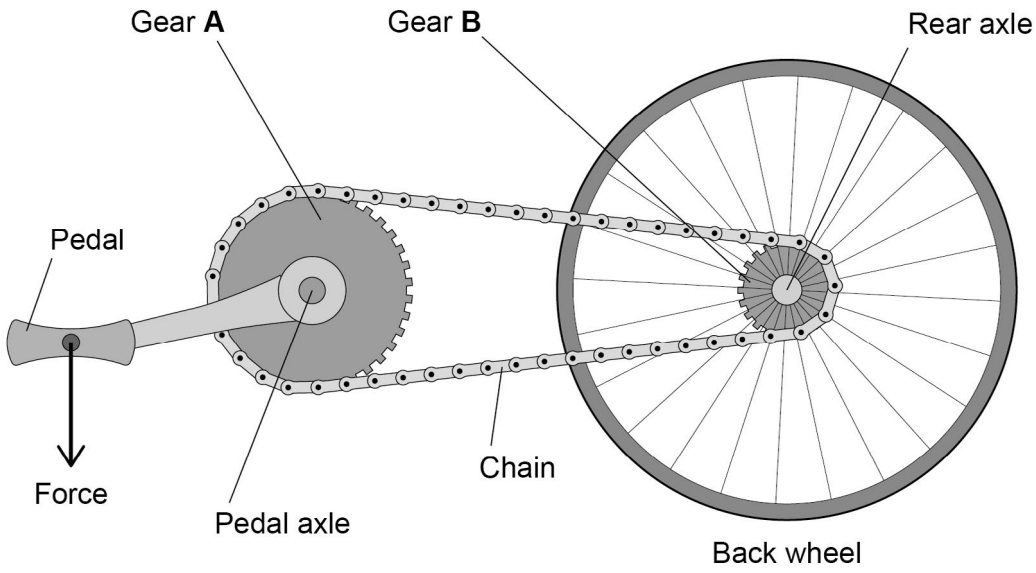
0 7 . 2 Determine the distance travelled by the cyclist between **Y** and **Z**.

[3 marks]

Distance travelled by the cyclist between **Y** and **Z** = _____ m

0 7 . 3 **Figure 13** shows the gears on the bicycle.

Figure 13



Describe how the force on the pedal causes a moment about the rear axle.

[2 marks]

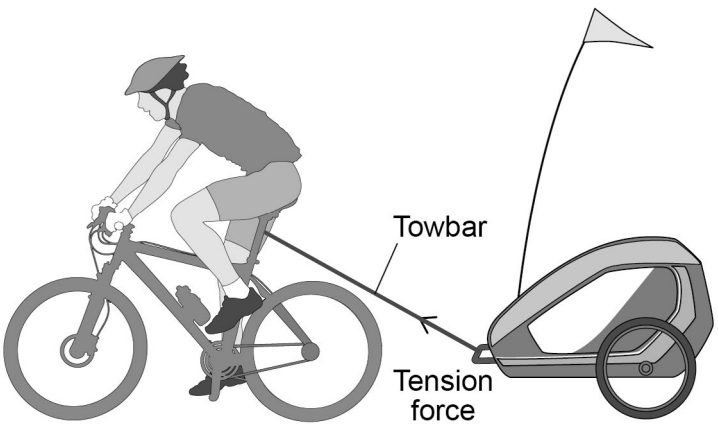
Question 7 continues on the next page

4.5.1.4 Resultant forces

Question 16 · continued

Figure 14 shows a different cyclist towing a trailer.

Figure 14



0 7 . 4 The speed of the cyclist and trailer increased uniformly from 0 m/s to 2.4 m/s.

The cyclist travelled 0.018 km while accelerating.

Calculate the initial acceleration of the cyclist.

[3 marks]

Acceleration = _____ m/s^2

4.5.1.4 Resultant forces

Question 16 · continued

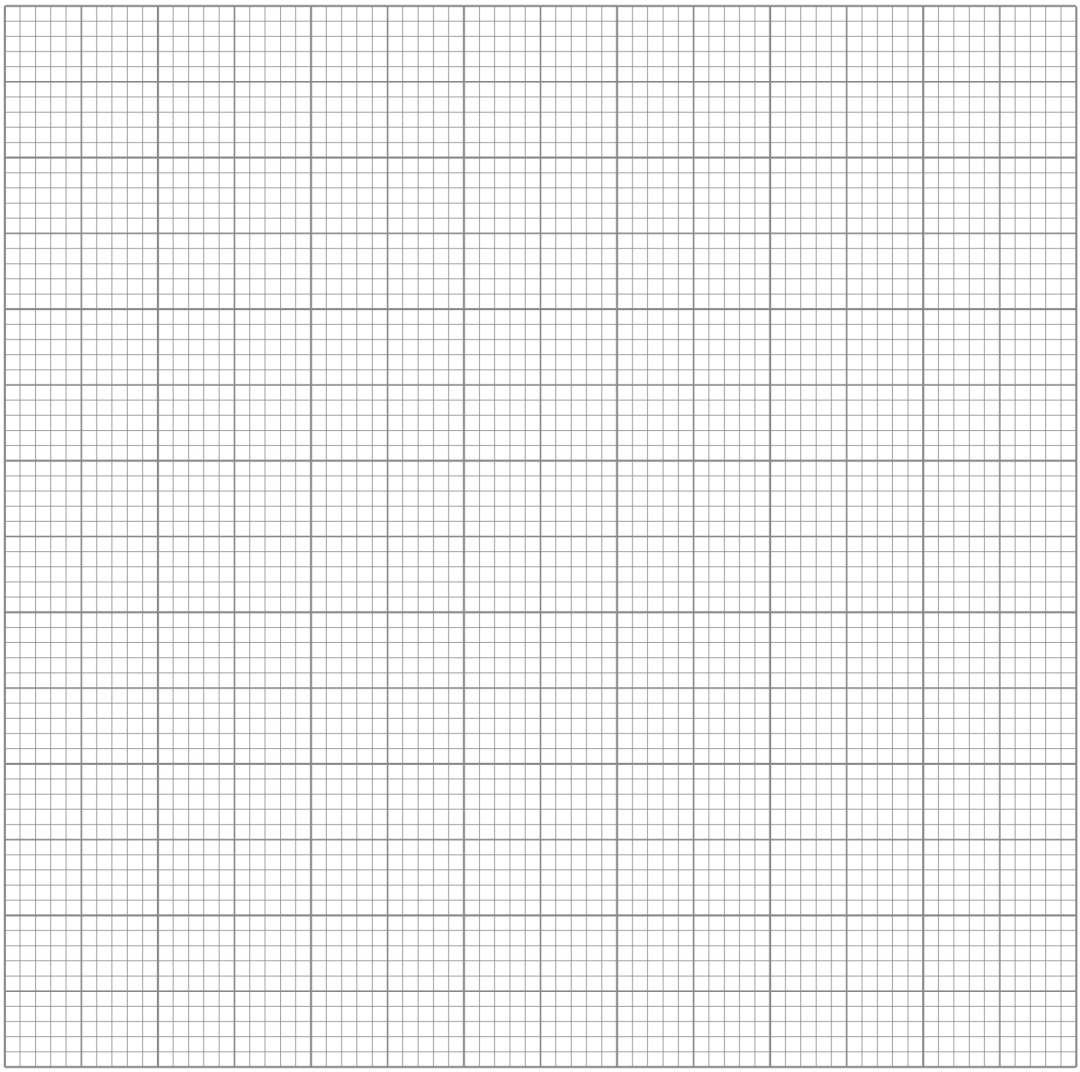
0 7 . 5 The resultant force of the towbar on the trailer has a horizontal component and a vertical component.

horizontal force = 200 N

vertical force = 75 N

Determine the magnitude and direction of the resultant force of the towbar on the trailer by drawing a vector diagram.

[4 marks]



Magnitude of force = _____ N

Direction of force = _____ degrees

13

4.5.1.4 Resultant forces

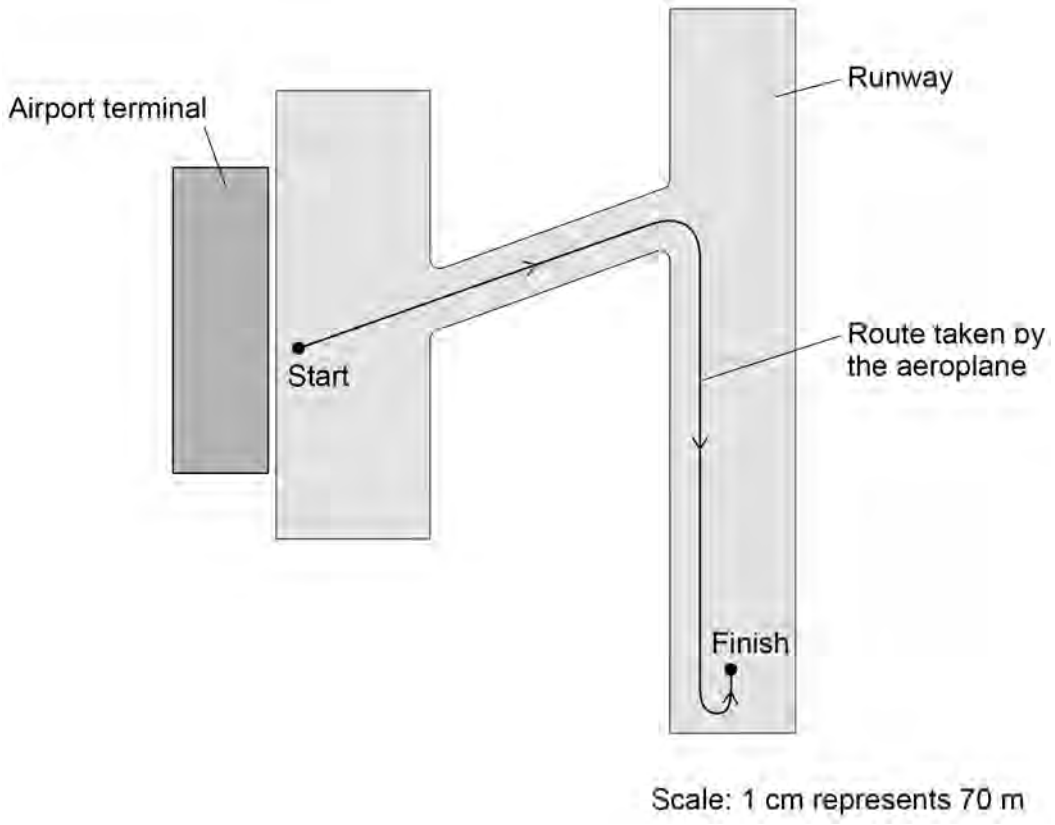
Question 17

June 2023 | 8463/2H | Original Q2

0 2 **Figure 3** shows the route an aeroplane takes as it travels from an airport terminal to the runway.

Figure 3 has been drawn to scale.

Figure 3



0 2 . 1 Determine the magnitude of the aeroplane's displacement from the start point to the finish point on **Figure 3**.

[2 marks]

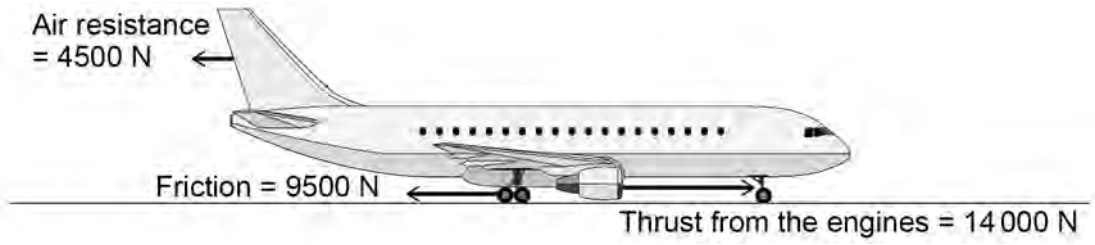
Displacement = _____ m

4.5.1.4 Resultant forces

Question 17 · continued

Figure 4 shows the direction of the horizontal forces acting on the aeroplane as it moves in a straight line towards the runway.

Figure 4



0 2 . 2 Determine the magnitude of the resultant horizontal force on the aeroplane.

[1 mark]

Resultant horizontal force = _____ N

0 2 . 3 Describe the motion of the aeroplane as it moves towards the runway.

[1 mark]

0 2 . 4 Air resistance and friction are contact forces.

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

[1 mark]

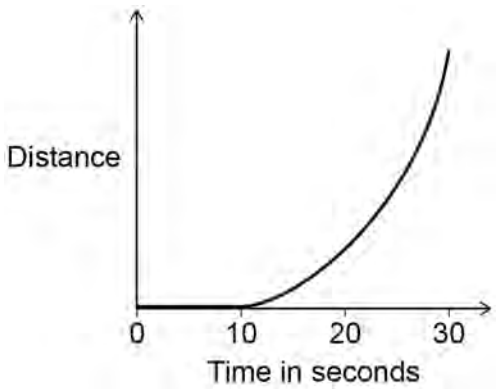
4.5.1.4 Resultant forces

Question 17 · continued

0 2 . 5 The aeroplane stops for a short time and then accelerates along the runway.

Figure 5 shows a distance–time sketch-graph for this stage of the journey.

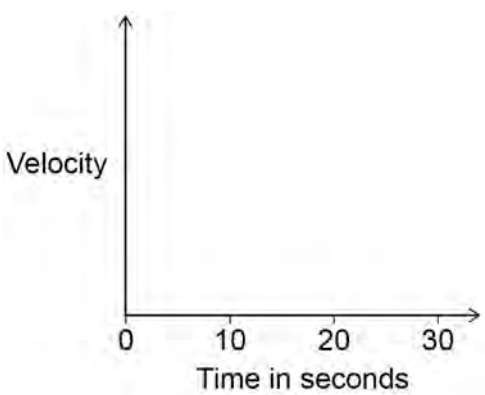
Figure 5



Draw the velocity–time sketch-graph for this stage of the journey on **Figure 6**.

[2 marks]

Figure 6



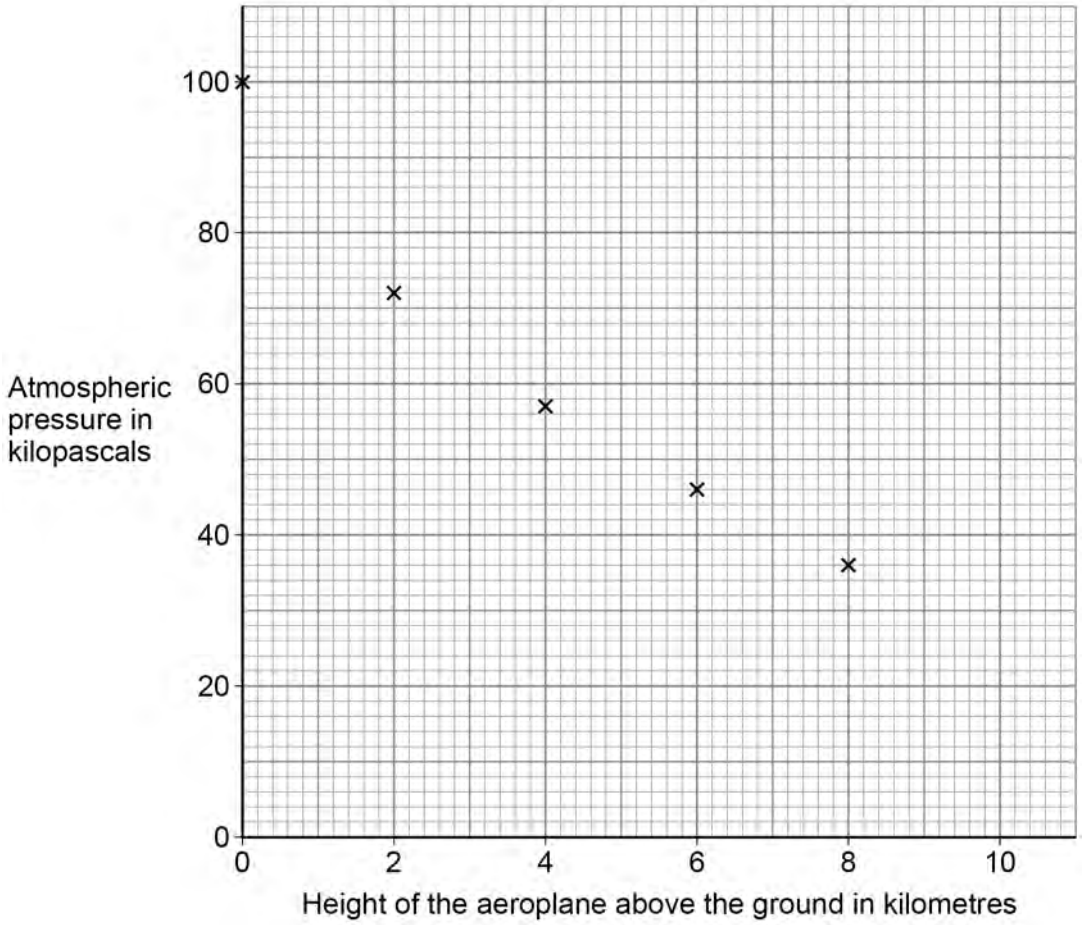
4.5.1.4 Resultant forces

Question 17 · continued

0 2 . 6 The aeroplane takes off from the runway, so its height above the ground increases.

Figure 7 shows how atmospheric pressure varies with the height of the aeroplane above the ground.

Figure 7



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

[2 marks]

Atmospheric pressure = _____ kPa

Question 2 continues on the next page

4.5.1.4 Resultant forces

Question 17 · continued

0 2 . 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 18

June 2024 | 8463/2H | Original Q2

0 2 **Figure 5** shows a young child using a baby walker.

Figure 5



0 2 . 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 18 · continued

Use the Physics Equations Sheet to answer questions **02.2** and **02.3**.

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

[1 mark]

0 2 . 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 2 . 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]

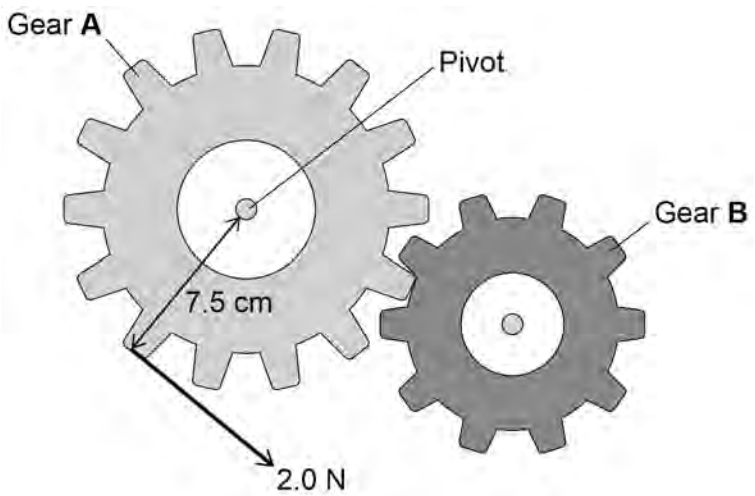
4.5.1.4 Resultant forces

Question 18 · continued

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

Figure 6 shows the gears.

Figure 6



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 18 · continued

Use the Physics Equations Sheet to answer questions **02.5** and **02.6**.

0 2 . 5 Write down the equation which links distance (*d*), force (*F*) and moment of a force (*M*).

[1 mark]

0 2 . 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 2 . 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

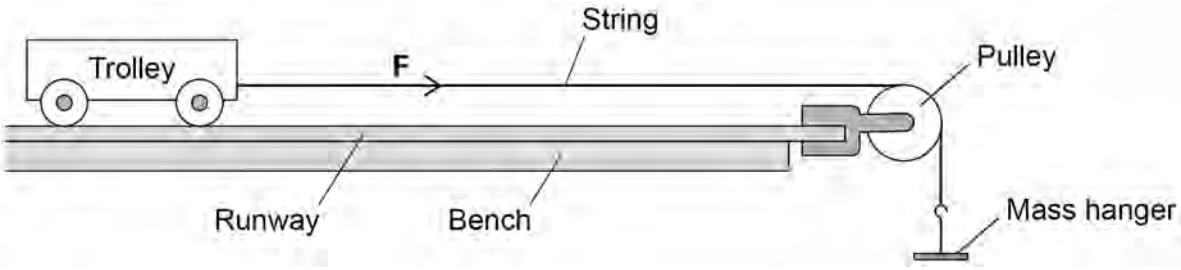
Question 19

June 2024 | 8463/2H | Original Q5

0 5 A student investigated how the acceleration of a trolley varies with the resultant force on the trolley.

Figure 10 shows some of the equipment used.

Figure 10



0 5 . 1 **Figure 10** shows the force **F** which acts through the string.

What name is given to force **F**?

[1 mark]

0 5 . 2 Give **one** variable that should have been a control variable in this investigation.

[1 mark]

Question 5 continues on the next page

Question 19 · continued

0 5 . 3 The student held the trolley stationary and then released it.

The trolley moved along the runway with a constant acceleration.

The student recorded the time taken for the trolley to travel a measured distance along the runway.

Describe how the acceleration of the trolley can be calculated using the time taken and distance travelled by the trolley.

[3 marks]

For one set of results, the force acting through the string was 2.0 N.

0 5 . 4 The student released the trolley three times and determined the following values for acceleration:

1.36 m/s^2 1.39 m/s^2 1.33 m/s^2

Calculate the uncertainty in the values of acceleration.

[2 marks]

Uncertainty = ± _____ m/s^2

4.5.1.4 Resultant forces

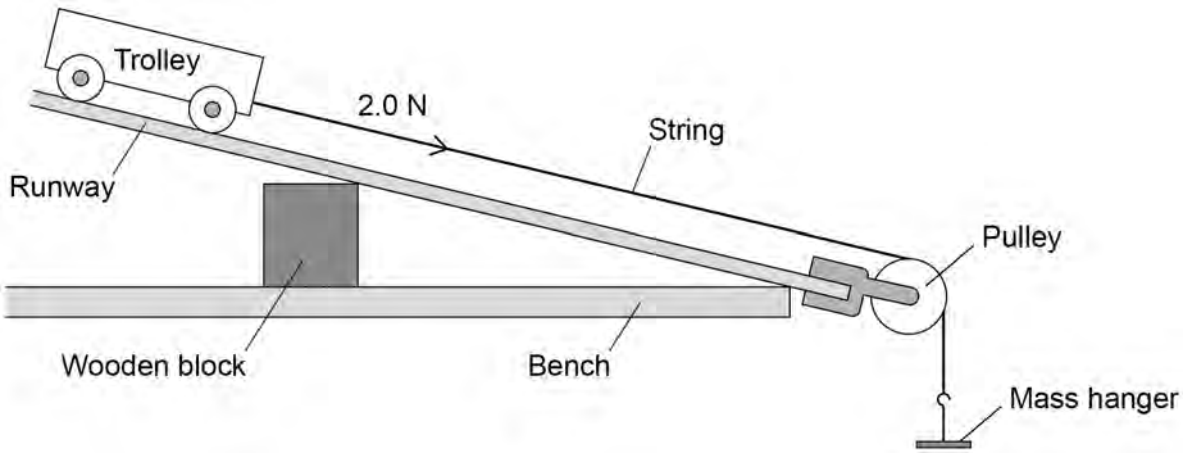
Question 19 · continued

0 5 . 5 The runway was then raised at one end.

The force acting through the string remained the same.

Figure 11 shows this.

Figure 11



Explain how the acceleration was affected by raising the end of the runway.

[2 marks]

9

4.5.1.4 Resultant forces

Question 20

June 2025 | 8463/2H | Original Q5

0 5 In a world record attempt, a skydiver jumped from a height of 40 km above the Earth.

0 5 . 1 **Figure 6** shows an incomplete free-body diagram for the skydiver a few seconds after the start of the jump.

Figure 6



The skydiver has not reached terminal velocity.

Complete the free-body diagram in **Figure 6**.

[2 marks]

4.5.1.4 Resultant forces

Question 20 · continued

0 5 . 2 During the first 2.5 minutes the mean acceleration of the skydiver was 0.64 m/s^2.

The initial velocity of the skydiver was 0 m/s.

Calculate the velocity of the skydiver 2.5 minutes after the start of the jump.

Use the Physics Equations Sheet.

[4 marks]

Velocity = _____ m/s

Question 5 continues on the next page

4.5.1.4 Resultant forces

Question 20 · continued

0 5 . 3 The skydiver accelerated until reaching terminal velocity.

Explain why the skydiver reached terminal velocity.

[4 marks]

0 5 . 4 Explain why the atmospheric pressure acting on the skydiver increased as the skydiver fell.

[2 marks]

4.5.1.4 Resultant forces

Question 20 · continued

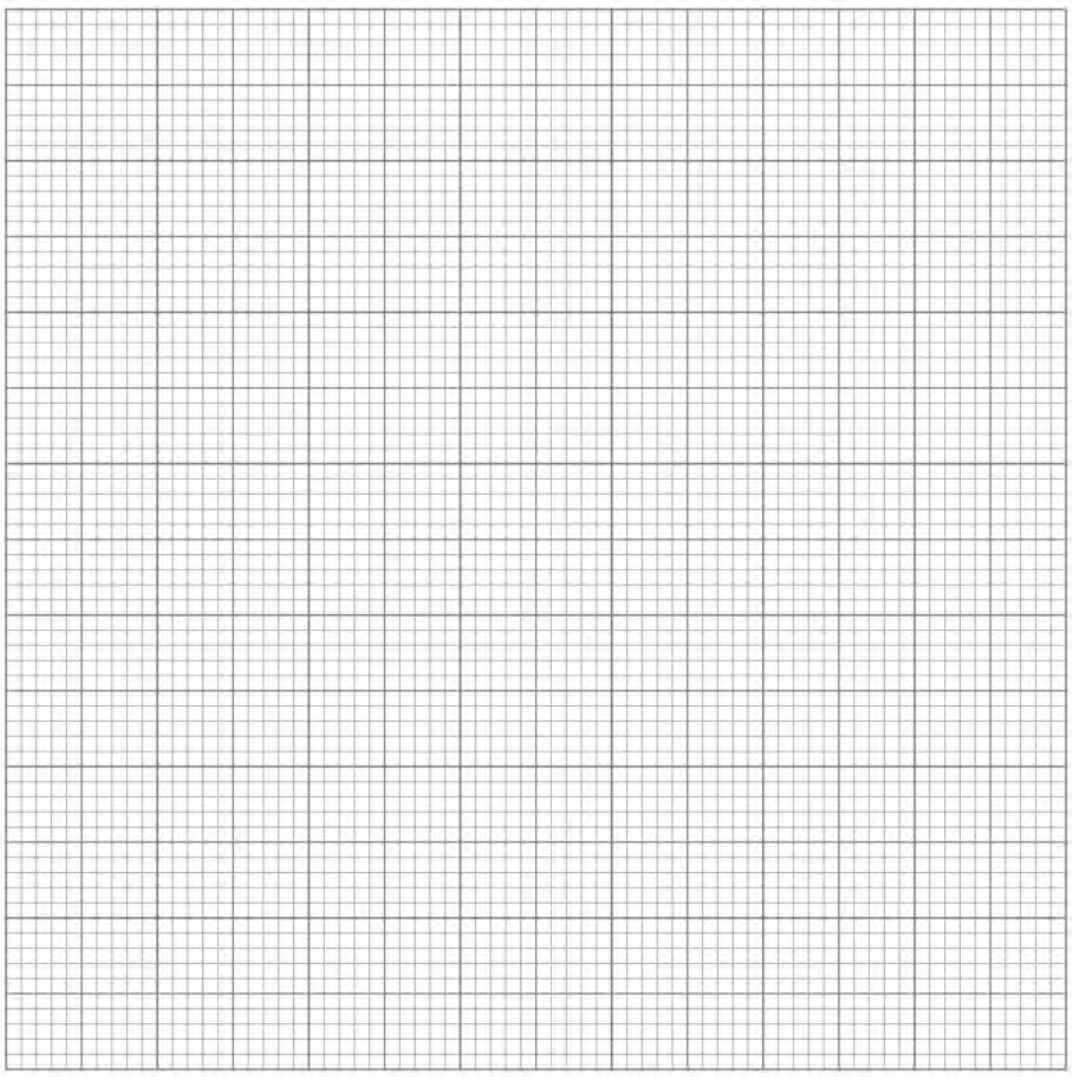
0 5 . 5 The skydiver opened his parachute.

A few seconds after opening the parachute, the resultant vertical force on the skydiver was 240 N upwards.

The wind caused a resultant horizontal force of 200 N to the left on the skydiver.

Draw a vector diagram to determine the resultant force on the skydiver.

[4 marks]



Magnitude of resultant force = _____ N

Angle to vertical of resultant force = _____ degrees

16

4.5.1.4 Resultant forces

Question 21

June 2025 | 8463/2H | Original Q6

0 6 A car manufacturer makes two cars, **X** and **Y**.

The cars are identical, apart from their mass.

Car **X** has a greater mass than car **Y**.

0 6 . 1 How does the maximum acceleration of car **X** compare with the maximum acceleration of car **Y**?

[1 mark]

0 6 . 2 Cars have air bags that inflate to protect the driver if the car stops very suddenly.

Explain how air bags reduce the chance of injury to the driver.

[3 marks]

Question 6 continues on the next page

4.5.1.4 Resultant forces

Question 21 · continued

0 6 . 3 Car **X** has a mass of 1400 kg and is travelling at 18 m/s.

The driver applies the brakes.

The car has a constant deceleration and comes to a stop in a distance of 24 m.

Calculate the resultant force on the car.

Use the Physics Equations Sheet.

[5 marks]

Resultant force = _____ N

0 6 . 4 Explain why braking causes an increase in the temperature of the brakes.

[2 marks]

4.5.1.4 Resultant forces

Question 21 · continued

0 6 . 5 The driver of a car applies the brakes so the car has a large deceleration.

Give **two** possible risks of a large deceleration.

[2 marks]

1 _____

_____

2 _____

_____

13

Turn over for the next question

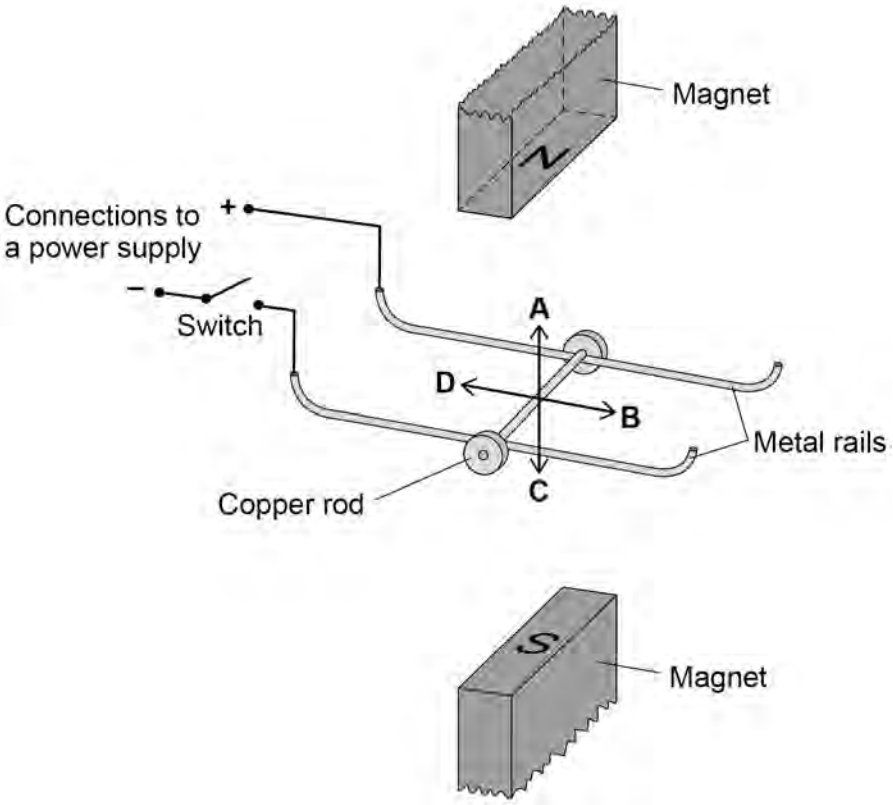
4.5.1.4 Resultant forces

Question 22

June 2025 | 8463/2H | Original Q7

0 7 **Figure 7** shows some apparatus used to demonstrate the motor effect.

Figure 7



When the switch is closed the copper rod accelerates.

0 7 . 1 What direction is the acceleration of the copper rod?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

4.5.1.4 Resultant forces

Question 22 · continued

0 7 . 2 The copper rod has a mass of 5.0 g.

The length of the copper rod in the magnetic field is 0.070 m.

The magnetic flux density is 0.30 T.

Calculate the initial acceleration of the rod when the current in the rod is 2.0 A.

Use the Physics Equations Sheet.

[5 marks]

Initial acceleration = _____ m/s^2

Question 7 continues on the next page

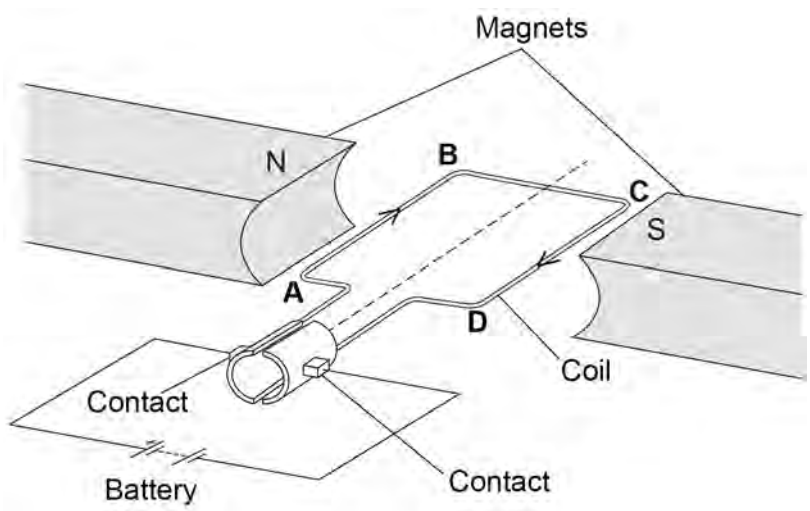
Question 22 · continued

Figure 8 shows a simple motor.

There is a magnetic field between the two permanent magnets.

When there is a current in the coil, a magnetic field is produced around the coil.

Figure 8



0 7 . 3 Explain how these magnetic fields cause the coil to continuously rotate.

[4 marks]

4.5.1.4 Resultant forces

Question 22 · continued

0 7 . 4 In **Figure 8** the coil of the motor is in a horizontal position.

Explain why the resultant moment on the coil is zero when the coil is in a vertical position.

[2 marks]

12

Turn over for the next question