AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.6.1.5

Acceleration

Past-paper questions

Tier	**Foundation**
Question groups	**43**
Available paper years	**2003–2025**

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:** _____

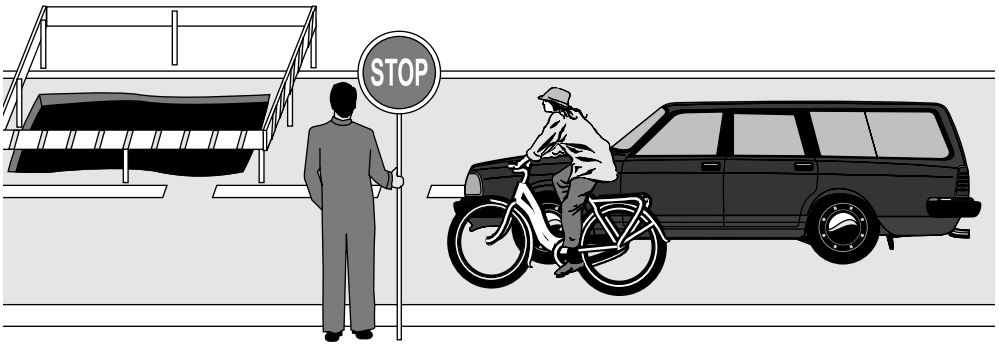
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.6.1.5 Acceleration

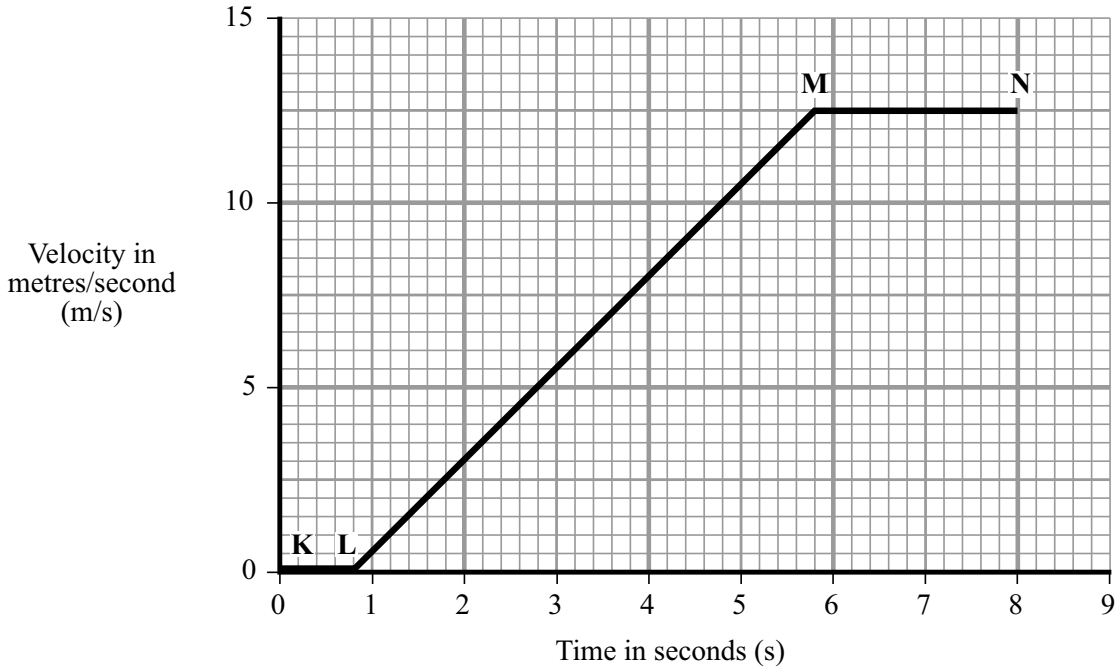
Question 01

June 2003 | 3451F | Original Q5 | Legacy

5 A car and a bicycle are travelling along a straight road. They have stopped at road works.



The graph shows how the velocity of the car changes after the sign is changed to GO.



(a) Between which two points on the graph is the car moving at constant velocity?

.....

(1 mark)

(b) Between which two points on the graph is the car accelerating?

.....

(1 mark)

4.5.6.1.5 Acceleration

Question 01 · continued

MARGIN BLANK

(c) Between the sign changing to GO and the car starting to move, there is a time delay. This is called the reaction time.

(i) What is the reaction time of the car driver?

Reaction time = ...seconds
(1 mark)

(ii) Which **one** of the following could increase the reaction time of a car driver? Tick the box next to your choice.

Drinking alcohol ☐

Wet roads ☐

Worn car brakes ☐

(1 mark)

(d) The cyclist starts to move at the same time as the car. For the first 2 seconds the cyclist's acceleration is constant and is greater than that of the car.

Draw a line on the graph to show how the velocity of the cyclist might change during the first 2 seconds of its motion.

(2 marks)

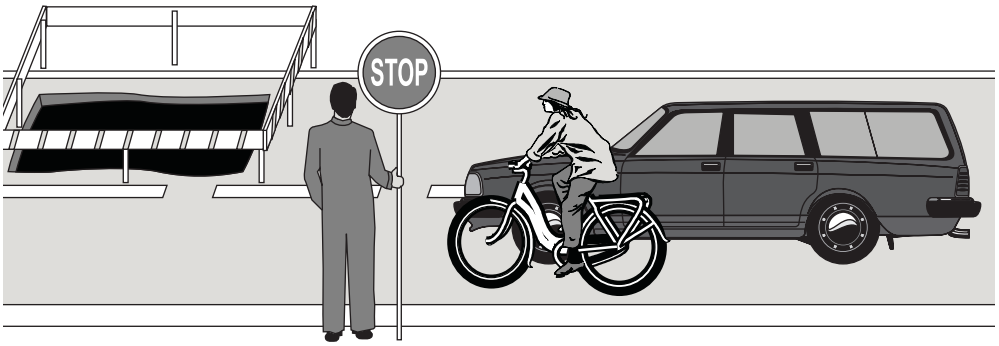
6

4.5.6.1.5 Acceleration

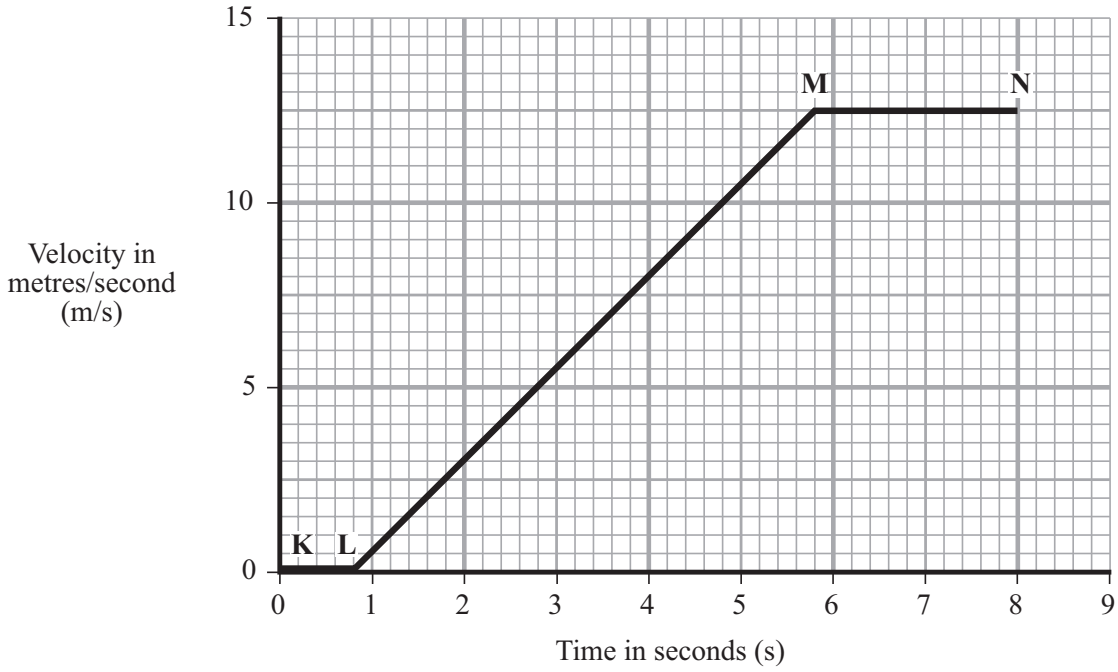
Question 02

June 2003 | 3462F3 | Original Q5 | Legacy

5 A car and a bicycle are travelling along a straight road. They have stopped at road works.



The graph shows how the velocity of the car changes after the sign is changed to GO.



(a) Between which two points on the graph is the car moving at constant velocity?

.....

(1 mark)

(b) Between which two points on the graph is the car accelerating?

.....

(1 mark)

4.5.6.1.5 Acceleration

Question 02 · continued

MARGIN BLANK

(c) Between the sign changing to GO and the car starting to move, there is a time delay. This is called the reaction time.

(i) What is the reaction time of the car driver?

Reaction time = ...seconds
(1 mark)

(ii) Which **one** of the following could increase the reaction time of a car driver? Tick the box next to your choice.

Drinking alcohol ☐

Wet roads ☐

Worn car brakes ☐

(1 mark)

(d) The cyclist starts to move at the same time as the car. For the first 2 seconds the cyclist's acceleration is constant and is greater than that of the car.

Draw a line on the graph to show how the velocity of the cyclist might change during the first 2 seconds of its motion.

(2 marks)

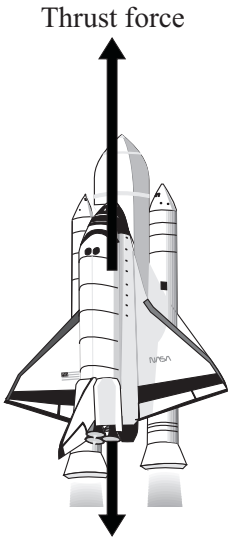
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4.5.6.1.5 Acceleration

Question 03

June 2004 | 3451F | Original Q12 | Legacy

12 (a) The arrows in the diagram represent the size and direction of the forces on a space shuttle, fuel tank and booster rockets one second after launch. The longer the arrow the bigger the force.



(i) Describe the upward motion of the space shuttle one second after launch.

.....

(1 mark)

(ii) By the time it moves out of the Earth's atmosphere, the total weight of the space shuttle, fuel tank and booster rockets has decreased and so has the air resistance.

How does this change the motion of the space shuttle? (Assume the thrust force does not change).

.....

(1 mark)

(b) The space shuttle takes 9 minutes to reach its orbital velocity of 8100 m/s.

(i) Write down the equation that links acceleration, change in velocity and time taken.

.....

(1 mark)

(ii) Calculate, in m/s^2, the average acceleration of the space shuttle during the first 9 minutes of its flight. Show clearly how you work out your answer.

.....

.....

average acceleration =.....m/s^2

(2 marks)

4.5.6.1.5 Acceleration

Question 03 · continued

MARGIN
BLANK

(iii) How is the velocity of an object different from the speed of an object?

.....

.....

(1 mark)

(c) The space shuttle can stay in orbit around the Earth for several weeks.



Not to scale

Explain why the space shuttle stays in orbit and does not fall to the Earth.

.....

.....

.....

.....

(2 marks)

(d) As the shuttle returns to Earth, friction causes its outside temperature to go as high as 1200°C.

Why is the underneath of the shuttle covered with black tiles?

.....

.....

(1 mark)

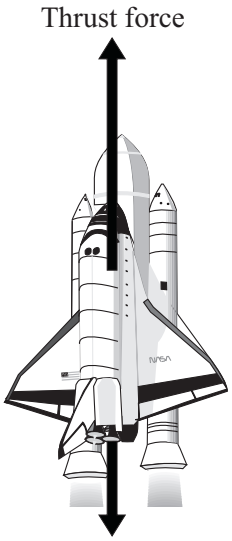
9

4.5.6.1.5 Acceleration

Question 04

June 2004 | 3462F3 | Original Q10 | Legacy

10 (a) The arrows in the diagram represent the size and direction of the forces on a space shuttle, fuel tank and booster rockets one second after launch. The longer the arrow the bigger the force.



(i) Describe the upward motion of the space shuttle one second after launch.

.....

(1 mark)

(ii) By the time it moves out of the Earth's atmosphere, the total weight of the space shuttle, fuel tank and booster rockets has decreased and so has the air resistance.

How does this change the motion of the space shuttle? (Assume the thrust force does not change).

.....

(1 mark)

(b) The space shuttle takes 9 minutes to reach its orbital velocity of 8100 m/s.

(i) Write down the equation that links acceleration, change in velocity and time taken.

.....

(1 mark)

(ii) Calculate, in m/s^2, the average acceleration of the space shuttle during the first 9 minutes of its flight. Show clearly how you work out your answer.

.....

.....

average acceleration =.....m/s^2

(2 marks)

4.5.6.1.5 Acceleration

Question 04 · continued

1 /

MARGIN BLANK

(iii) How is the velocity of an object different from the speed of an object?

.....

.....

(1 mark)

(c) The space shuttle can stay in orbit around the Earth for several weeks.



Not to scale

Explain why the space shuttle stays in orbit and does not fall to the Earth.

.....

.....

.....

.....

(2 marks)

(d) As the shuttle returns to Earth, friction causes its outside temperature to go as high as 1200°C.

Why is the underneath of the shuttle covered with black tiles?

.....

.....

(1 mark)

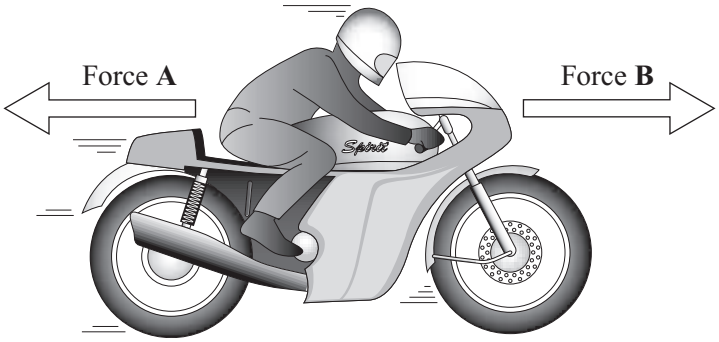
9

4.5.6.1.5 Acceleration

Question 05

June 2005 | 3451 | Original Q14 | Legacy

14 (a) The diagram shows the horizontal forces that act on a **moving** motorbike.



(i) Describe the movement of the motorbike when force **A** equals force **B**.

.....

.....

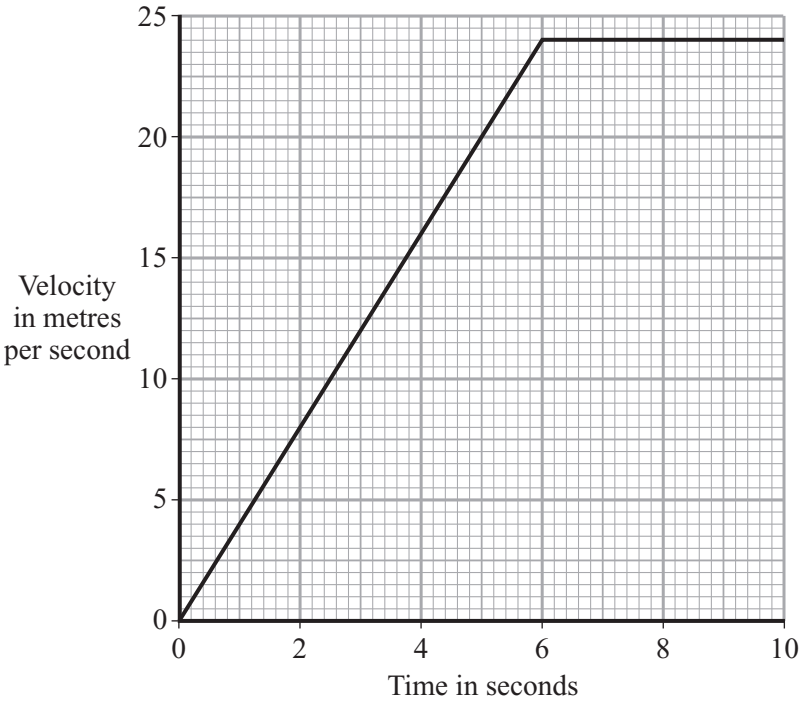
(2 marks)

(ii) What happens to the speed of the motorbike if force **B** becomes smaller than force **A**?

.....

(1 mark)

(b) The graph shows how the velocity of a motorbike changes when it is travelling along a straight road.



4.5.6.1.5 Acceleration

Question 05 · continued

MARGIN BLANK

(i) What was the change in velocity of the motorbike in the first 5 seconds?

.....

(1 mark)

(ii) Write down the equation which links acceleration, change in velocity and time taken.

.....

(1 mark)

(iii) Calculate the acceleration of the motorbike during the first 5 seconds. Show clearly how you work out your answer and give the unit.

.....

.....

Acceleration = ...

(3 marks)

(c) A car is travelling on an icy road.

Describe and explain what might happen to the car when the brakes are applied.

.....

.....

.....

.....

(2 marks)

(d) Name **three** factors, other than weather conditions, which would increase the overall stopping distance of a vehicle.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

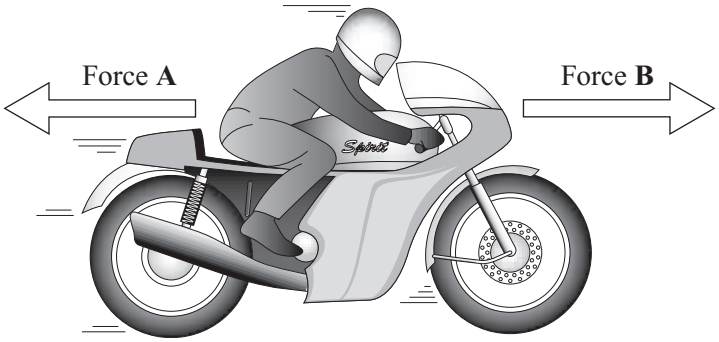
13

4.5.6.1.5 Acceleration

Question 06

June 2005 | 3462 | Original Q12 | Legacy

12 (a) The diagram shows the horizontal forces that act on a **moving** motorbike.



(i) Describe the movement of the motorbike when force **A** equals force **B**.

.....

.....

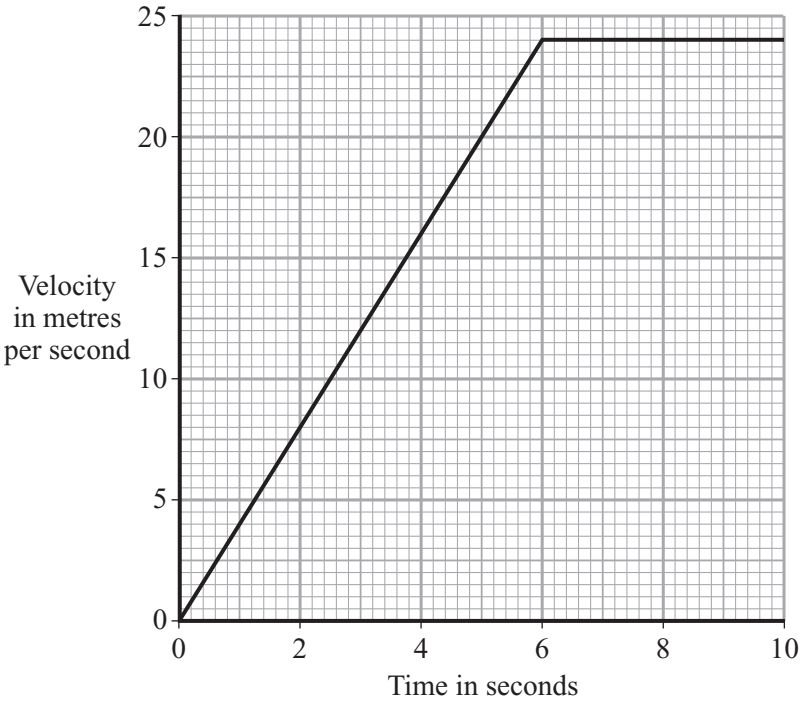
(2 marks)

(ii) What happens to the speed of the motorbike if force **B** becomes smaller than force **A**?

.....

(1 mark)

(b) The graph shows how the velocity of a motorbike changes when it is travelling along a straight road.



4.5.6.1.5 Acceleration

Question 06 · continued

MARGIN BLANK

(i) What was the change in velocity of the motorbike in the first 5 seconds?

.....

(1 mark)

(ii) Write down the equation which links acceleration, change in velocity and time taken.

.....

(1 mark)

(iii) Calculate the acceleration of the motorbike during the first 5 seconds. Show clearly how you work out your answer and give the unit.

.....

.....

Acceleration = ...

(3 marks)

(c) A car is travelling on an icy road.

Describe and explain what might happen to the car when the brakes are applied.

.....

.....

.....

.....

(2 marks)

(d) Name **three** factors, other than weather conditions, which would increase the overall stopping distance of a vehicle.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

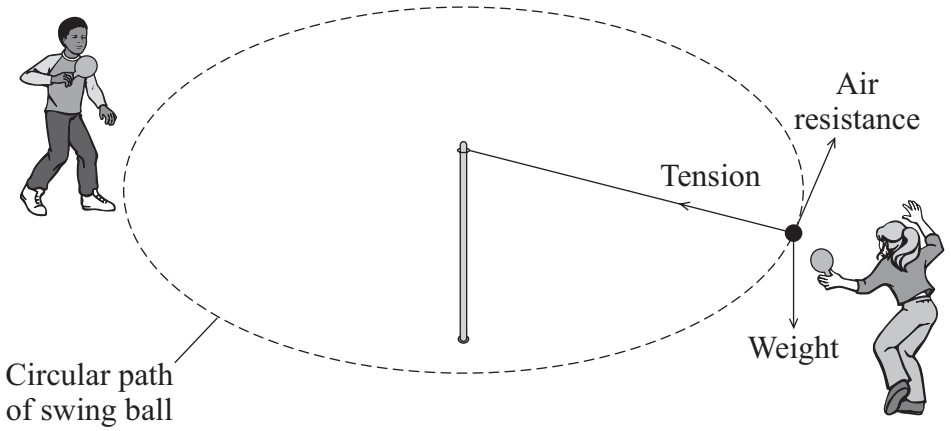
13

4.5.6.1.5 Acceleration

Question 07

January 2008 | PHY3F | Original Q3 | Legacy

3 The diagram shows two children playing with a toy called a swing ball. The ball is joined to a pole by a strong string. The children hit the ball so that it goes round in a circular path.



(a) Which force causes the ball to move in a circle?

Draw a ring around your answer.

air resistance **tension** **weight**

(1 mark)

(b) Complete the sentences by ticking (✓) the correct ending.

(i) The force needed to make the ball move in a circular path is larger if

the speed of the ball is increased. ☐

the speed of the ball is decreased. ☐

the string is made longer. ☐

(1 mark)

(ii) The continuous acceleration of a ball moving in a circular path changes

the speed of the ball. ☐

the direction of the ball. ☐

the weight of the ball. ☐

(1 mark)

4.5.6.1.5 Acceleration

Question 07 · continued

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(c) Which of the following words is used to describe any force that causes an object to move in a circular path?

Draw a ring around your answer.

centripetal **frictional** **gravitational** **universal**

(1 mark)

4

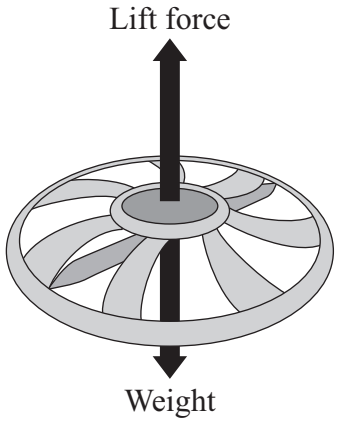
Turn over for the next question

4.5.6.1.5 Acceleration

Question 08

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)

4.5.6.1.5 Acceleration

Question 08 · 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)

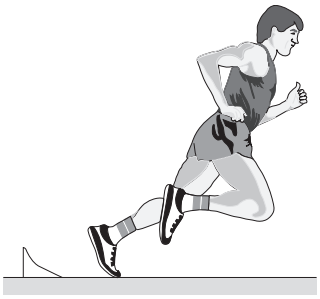
8

4.5.6.1.5 Acceleration

Question 09

January 2009 | PHY2F | Original Q8 | Legacy

8 (a) The diagram shows an athlete at the start of a race. The race is along a straight track.



In the first 2 seconds, the athlete accelerates constantly and reaches a speed of 9 m/s.

8 (a) (i) Use the equation in the box to calculate the acceleration of the athlete.

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

Show clearly how you work out your answer.

.....

.....

.....

Acceleration = ...

(2 marks)

8 (a) (ii) Which **one** of the following is the unit for acceleration?

Draw a ring around your answer.

J/s **m/s** **m/s^2** **Nm**

(1 mark)

4.5.6.1.5 Acceleration

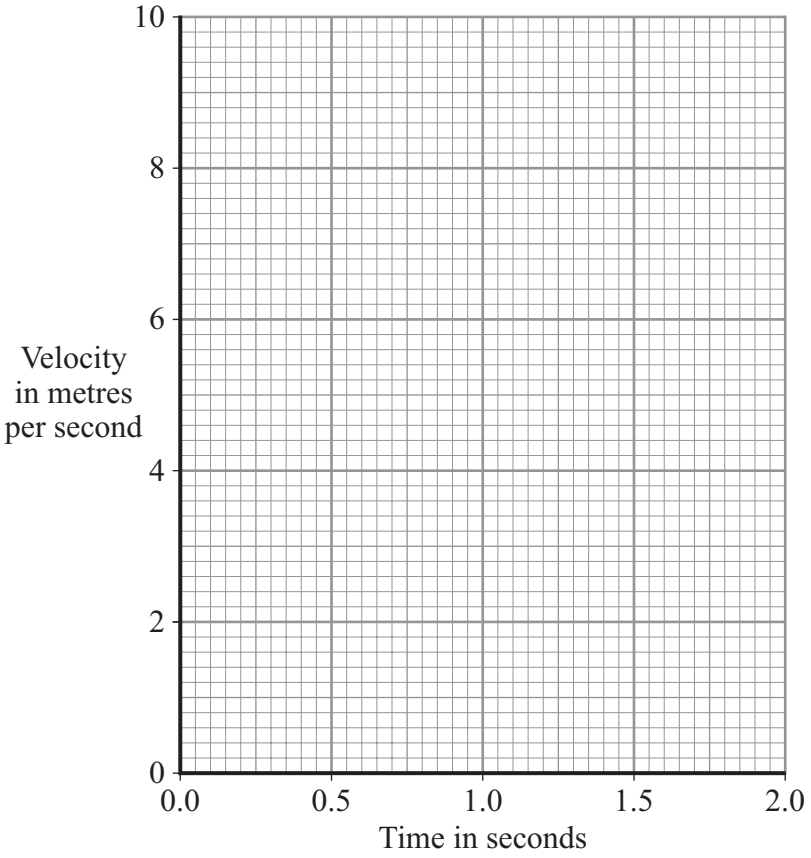
Question 09 · continued

for mark

8 (a) (iii) Complete the following sentence.

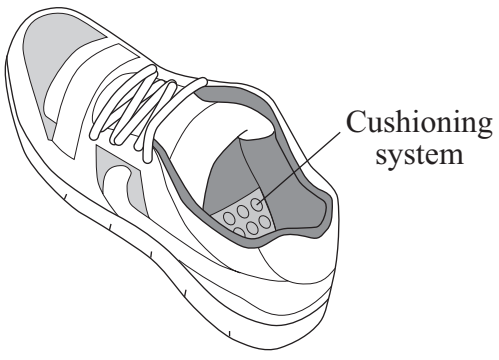
The velocity of the athlete is the ..... of the athlete in a given direction. *(1 mark)*

8 (a) (iv) Complete the graph to show how the velocity of the athlete changes during the first 2 seconds of the race.



(2 marks)

8 (b) Many running shoes have a cushioning system. This reduces the impact force on the athlete as the heel of the running shoe hits the ground.



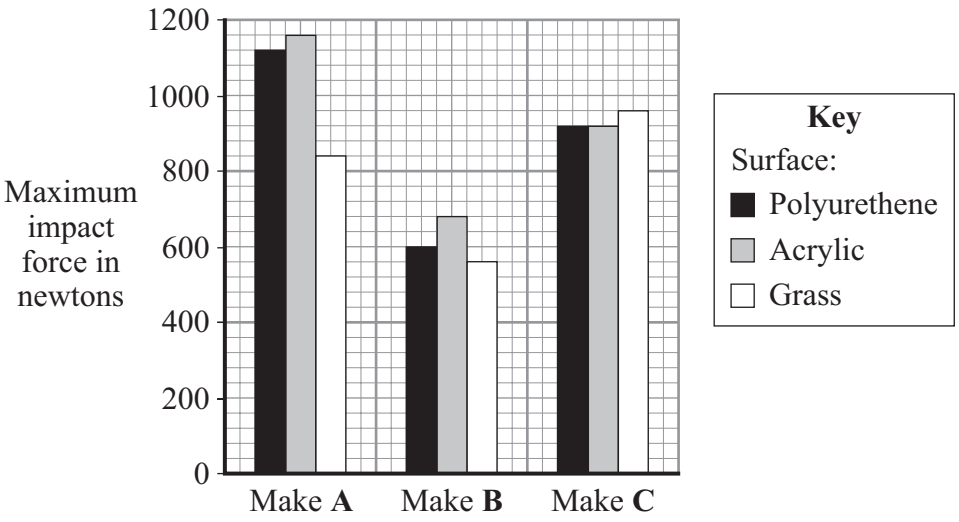
Question 8 continues on the next page

4.5.6.1.5 Acceleration

Question 09 · continued

for mark

The bar chart shows the maximum impact force for three different makes of running shoe used on three different types of surface.



8 (b) (i) Which **one** of the three makes of running shoe, **A**, **B** or **C**, has the best cushioning system?

.....

Explain the reason for your answer.

.....

.....

.....

.....

(3 marks)

8 (b) (ii) The data needed to draw the bar chart was obtained using a robotic athlete fitted with electronic sensors.

Why is this data likely to be more reliable than data obtained using human athletes?

.....

.....

(1 mark)

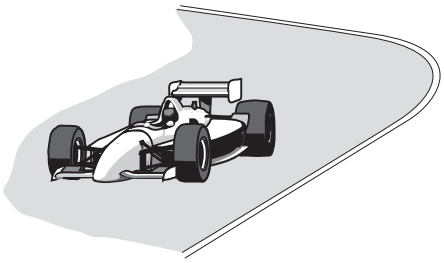
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4.5.6.1.5 Acceleration

Question 10

January 2009 | PHY3F | Original Q3 | Legacy

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



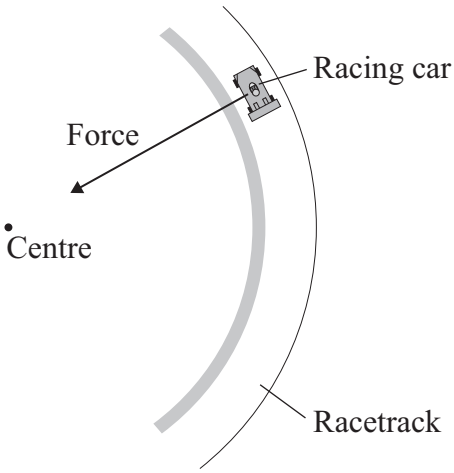
A racing car can accelerate by changing

its direction only
its speed only
either its direction or its speed

.

(1 mark)

3 (b) A racing car moves round a circular part of a racetrack.



A force acts on the racing car. The force is towards the centre of the circular part of the racetrack.

4.5.6.1.5 Acceleration

Question 10 · continued

for mark

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

3 (b) (i) The force is caused by

electrostatics
friction
gravity

.

(1 mark)

3 (b) (ii) The force is a

centripetal force
circular force
perpendicular force

.

(1 mark)

3 (b) (iii) If another racing car has a greater mass and travels at the same speed around the same racetrack, then the force will need to

decrease
stay the same
increase

.

(1 mark)

3 (b) (iv) When the racing car goes faster, the force will need to

decrease
stay the same
increase

.

(1 mark)

Question 3 continues on the next page

4.5.6.1.5 Acceleration

Question 10 · continued

for mark

3 (c) This is an item from a newspaper.

No to racetrack plan

At last night's meeting, one local resident said, "The racetrack will be noisy but motor racing leads to safety improvements in all our cars."

"We'll need better brakes. Motor racing encourages speeding and leads to more accidents", said another.

Most of the residents were against the plan to build a racetrack.

Do you agree with most of the residents?

Put a tick (✓) in the box next to your answer and explain.

Yes ☐ No ☐ Not sure ☐

.....

.....

.....

.....

(2 marks)

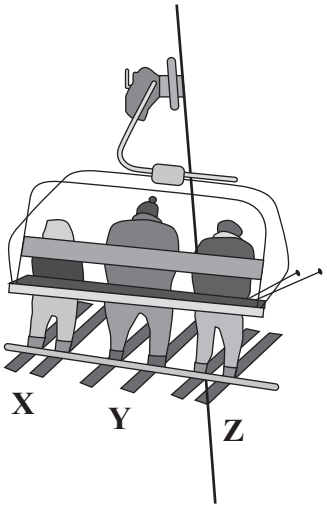
7

4.5.6.1.5 Acceleration

Question 11

June 2009 | PHY2F | Original Q2 | Legacy

2 (a) The diagram shows three skiers, **X**, **Y** and **Z**, on a moving chairlift.
The mass of each skier is given in the table.



Skier	Mass in kg
X	65
Y	90
Z	80

Which **one** of the skiers, **X**, **Y** or **Z**, has the most momentum?

.....

Give the reason for your answer.

.....

.....

(2 marks)

2 (b) At one point in the journey, the chairlift accelerates to a higher speed.

What happens to the momentum of the three skiers as the chairlift accelerates?

.....

(1 mark)

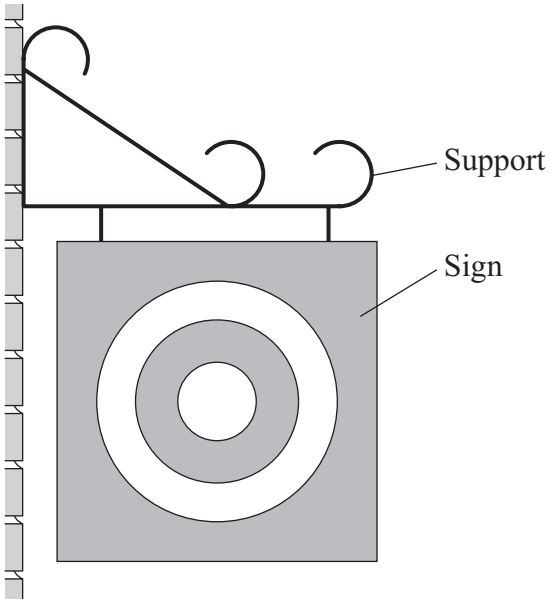
3

4.5.6.1.5 Acceleration

Question 12

June 2009 | PHY3F | Original Q1 | Legacy

1 The drawing shows a sign which hangs outside a shop.



1 (a) Draw an **X** on the sign so that the centre of your **X** is at the centre of mass of the sign.

(1 mark)

1 (b) Use a ruler to draw **one** axis of symmetry on the sign.

(1 mark)

1 (c) One force which acts on the sign is its weight.

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

The moment of the weight produces

an accelerating
a balancing
a turning

effect.

(1 mark)

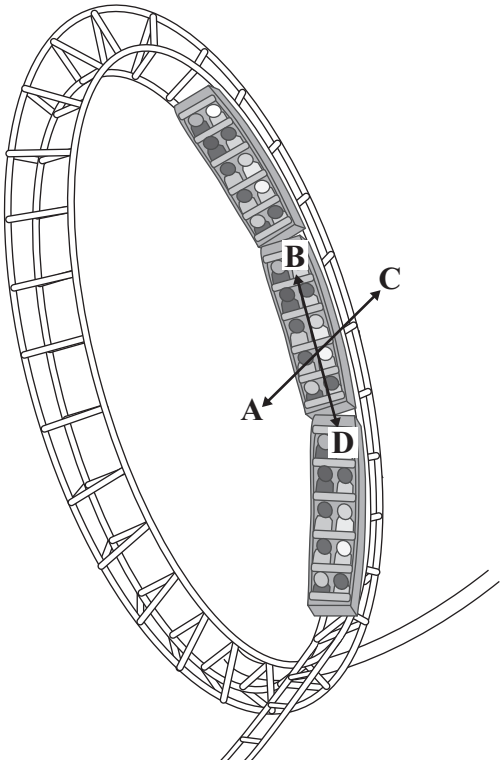
3

4.5.6.1.5 Acceleration

Question 13

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)

4.5.6.1.5 Acceleration

Question 13 · 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

4.5.6.1.5 Acceleration

Question 14

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.

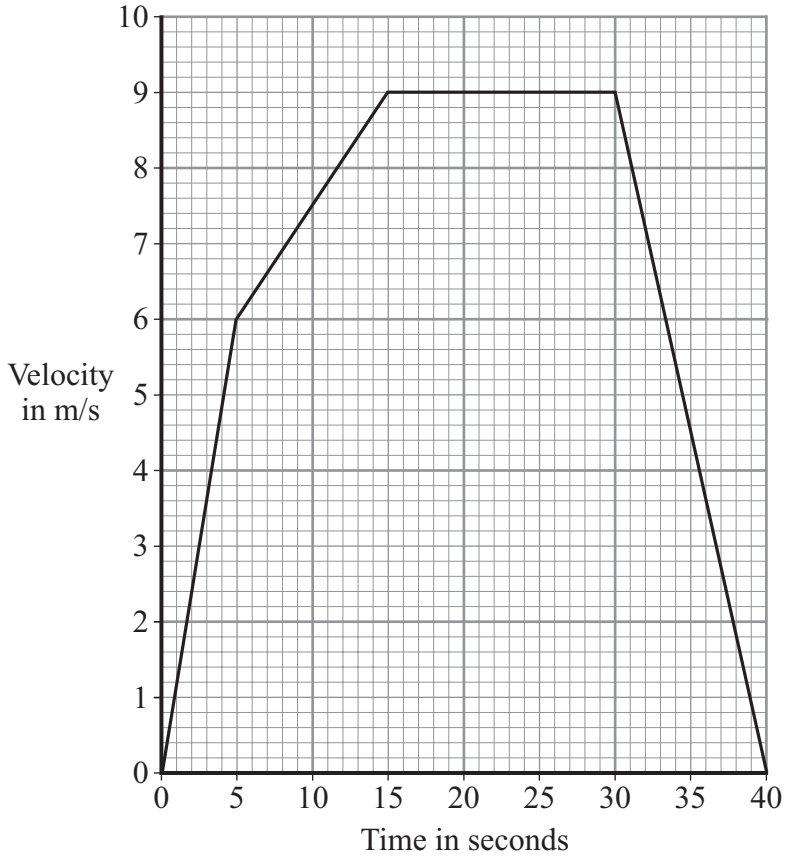
.....

.....

Resultant force = ...

(3 marks)

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



4.5.6.1.5 Acceleration

Question 14 · 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?

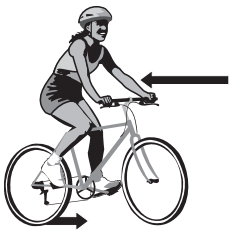
.....

.....

(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

4.5.6.1.5 Acceleration

Question 15

7 A student collects data from the Internet about planets in the solar system.
She arranges the data into a table.

Name of the planet	Distance from the Sun in millions of kilometres	Time taken for one orbit of the Sun in years	Time taken to spin on its axis in hours	Average temperature on the side facing the Sun in °C
Mercury	60	0.24	1400	+430
Venus	110	0.60	5800	+470
Earth	150	1	24	+20
Mars	230	2	25	–20
Jupiter	780	12	10	–150
Saturn	1400	30	10	–180
Uranus	2900	84	17	–220
Neptune	4500	160	16	–230

7 (a) Name the **two** variables in the student's table which **always** have the relationship:

As one increases, so does the other.

..... and .....

(1 mark)

7 (b) (i) Give an example of **two** variables in the student's table which **generally** have the relationship:

As one increases, the other decreases.

..... and .....

(1 mark)

7 (b) (ii) Which piece of data does not seem to fit the relationship in (b)(i)?

.....

(1 mark)

4.5.6.1.5 Acceleration

Question 15 · continued

for mark

7 (c) Scientists plan to launch a satellite which will orbit Mars above its equator.
It will be a geostationary satellite.

How many hours will it take to orbit Mars?

..... hours
(1 mark)

7 (d) Mars has two moons.

Neither of them is in a geostationary orbit and they both take different times to orbit the planet.

Which **one** of these statements is correct.
Put a tick (✓) in the box next to your answer.

The two moons will always be above the same point on the surface of Mars. ☐

The two moons will be in different positions at different times. ☐

You can never see both moons at the same time. ☐

(1 mark)

7 (e) Use words from the box to complete the **three** spaces in the passage.

circular	**direction**	**friction**	**gravitational**	**speed**	**universal**

The moons of the planet Neptune move in circular paths around the planet.

They continuously accelerate towards the centre of Neptune.

The acceleration changes the ..... of each moon but does not change its ..... . The force causing the acceleration is a ..... force.

(2 marks)

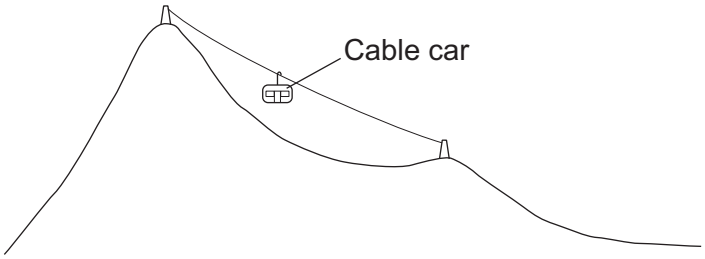
7

4.5.6.1.5 Acceleration

Question 16

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)

4.5.6.1.5 Acceleration

Question 16 · 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

4.5.6.1.5 Acceleration

Question 16 · 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

4.5.6.1.5 Acceleration

Question 17

3 A high-speed train accelerates at a constant rate in a straight line.
The velocity of the train increases from 30 m/s to 42 m/s in 60 seconds.

3 (a) (i) Calculate the change in the velocity of the train.

.....

Change in velocity = ... m/s
(1 mark)

3 (a) (ii) Use the equation in the box to calculate the acceleration of the train.

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

Show clearly how you work out your answer and give the unit.
Choose the unit from the list below.

m/s **m/s^2** **N/kg** **Nm**

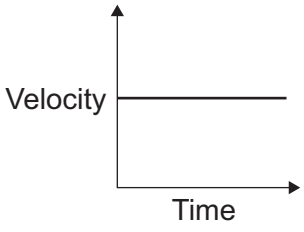
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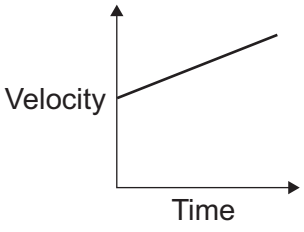
Acceleration = ...
(2 marks)

3 (b) Which **one** of the graphs, **A**, **B** or **C**, shows how the velocity of the train changes as it accelerates?

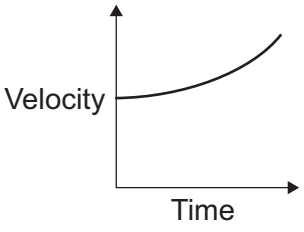
Write your answer, **A**, **B** or **C**, in the box.



A



B



C

Graph ☐

(1 mark)

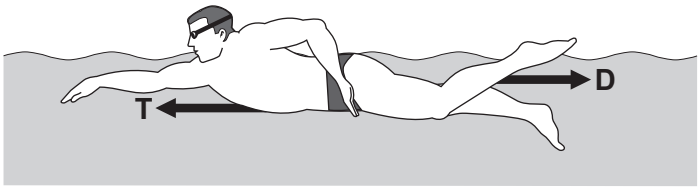
4

4.5.6.1.5 Acceleration

Question 18

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.

.....

.....

.....

.....

.....

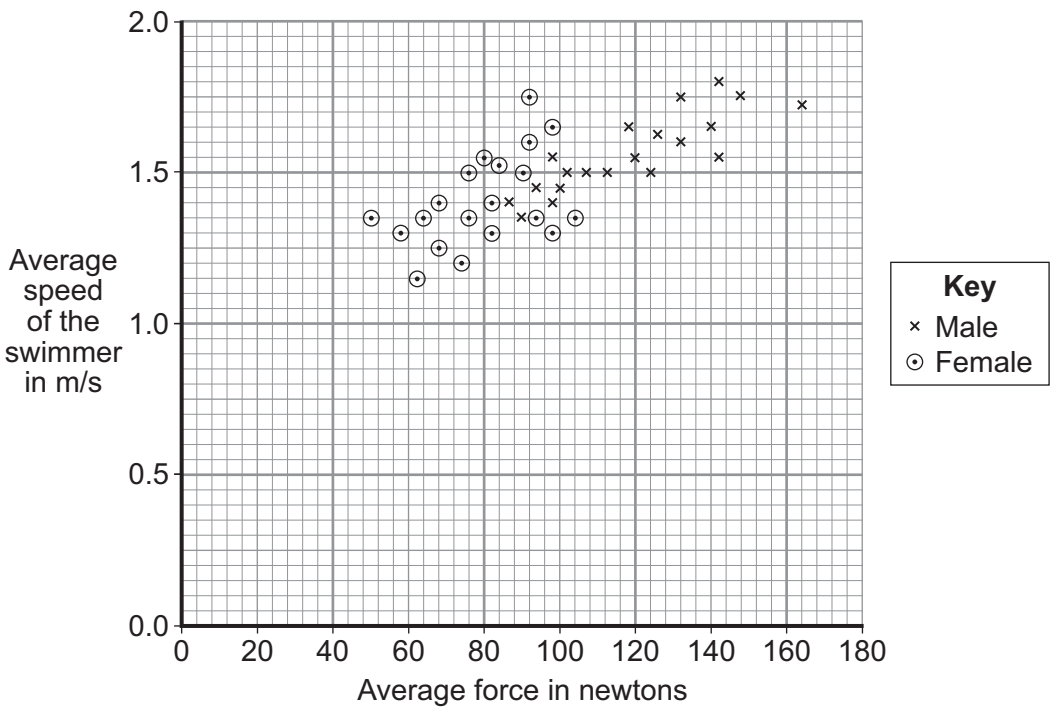
.....
(3 marks)

Question 7 continues on the next page

Question 18 · 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)

4.5.6.1.5 Acceleration

Question 18 · 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

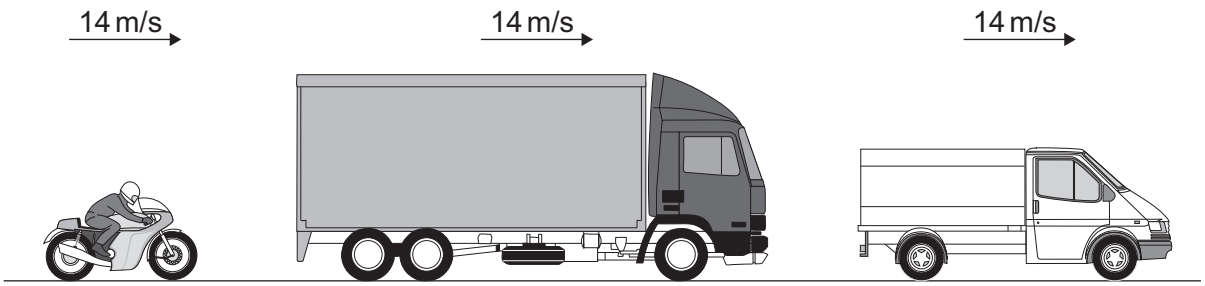
Turn over for the next question

4.5.6.1.5 Acceleration

Question 19

June 2011 | PHY2F | Original Q3 | Legacy

3 (a) (i) The diagram shows three vehicles travelling along a straight road at 14 m/s.



Motorbike
Mass = 175 kg

Lorry
Mass = 10 000 kg

Van
Mass = 3000 kg

Which vehicle has the greatest momentum?

.....

Give the reason for your answer.

.....

.....

.....

(2 marks)

3 (a) (ii) Use the equation in the box to calculate the momentum of the motorbike when it travels at 14 m/s.

momentum = mass × velocity

Show clearly how you work out your answer.

.....

.....

Momentum = ...kg m/s

(2 marks)

4.5.6.1.5 Acceleration

Question 19 · continued June 2011 | PHY2F | Original Q3 | Legacy

3 (b) The motorbike follows the lorry for a short time, and then accelerates to overtake both the lorry and van.

3 (b) (i) Complete the following sentence by drawing a ring around the correct line in the box.

When the motorbike starts to overtake, the kinetic energy

of the motorbike

decreases.
stays the same.
increases.

(1 mark)

3 (b) (ii) Give a reason for your answer to part (b)(i).

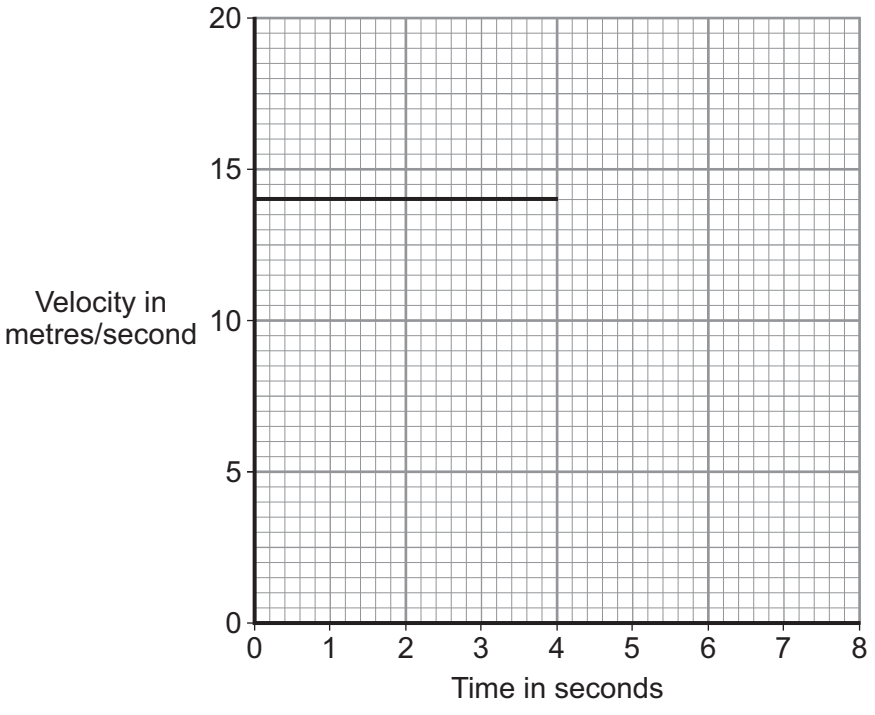
.....

.....

(1 mark)

3 (b) (iii) The graph shows the velocity of the motorbike up to the time when it starts to accelerate. The motorbike accelerates constantly, going from a speed of 14 m/s to a speed of 20 m/s in a time of 2 seconds. The motorbike then stays at 20 m/s.

Complete the graph to show the motion of the motorbike over the next 4 seconds.



(3 marks)

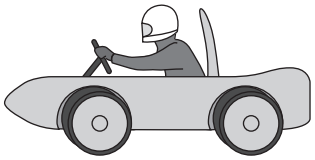
9

4.5.6.1.5 Acceleration

Question 20

January 2013 | PH2FP | Original Q6 | Legacy

6 Some students designed and built an electric-powered go-kart.
The go-kart is shown below.



6 (a) Suggest **two** changes that could be made to the design of the go-kart to increase its top speed.

1 .....

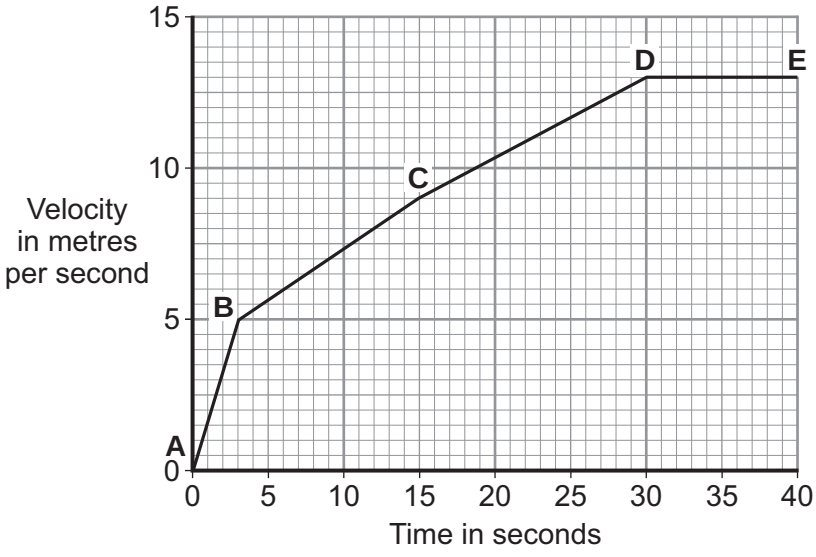
.....

2 .....

.....

(2 marks)

6 (b) A go-kart with a new design is entered into a race.
The velocity-time graph for the go-kart, during the first 40 seconds of the race, is shown below.



4.5.6.1.5 Acceleration

Question 20 · continued

6 (b) (i) Between which **two** points did the go-kart have the greatest acceleration?

Tick (✓) **one** box.

A–B ☐

B–C ☐

C–D ☐

Give a reason for your answer.

.....

.....

(2 marks)

6 (b) (ii) The go-kart travels at a speed of 13 m/s between points **D** and **E**.
The total mass of the go-kart and driver is 140 kg.

Calculate the momentum of the go-kart and driver between points **D** and **E**.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Momentum = ... kg m/s
(2 marks)

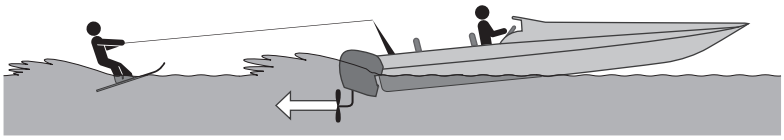
6

4.5.6.1.5 Acceleration

Question 21

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)

4.5.6.1.5 Acceleration

Question 21 · 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

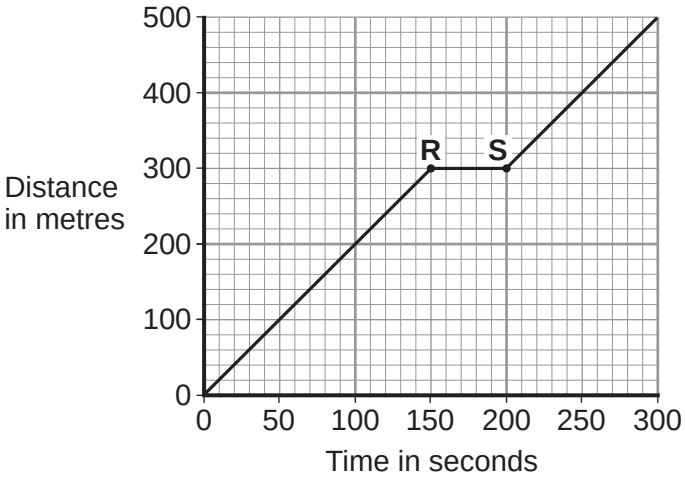
4.5.6.1.5 Acceleration

Question 22

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 ☐

4.5.6.1.5 Acceleration

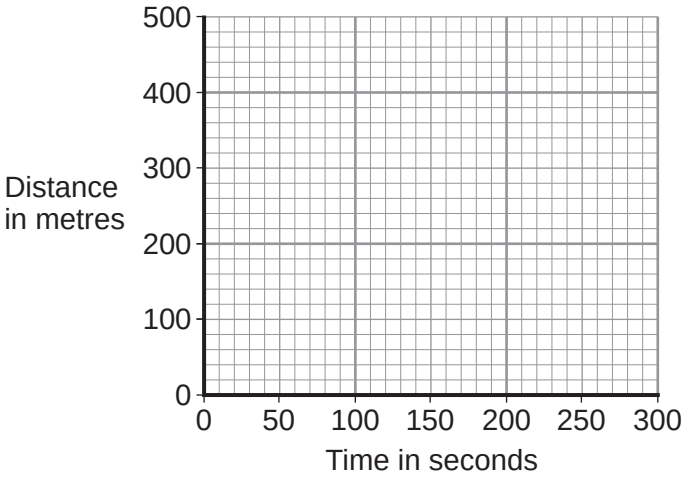
Question 22 · continued

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

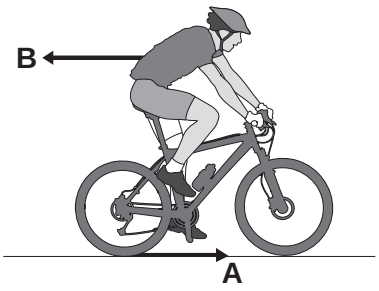
4.5.6.1.5 Acceleration

Question 23

June 2014 | PH2FP | Original Q8 | Legacy

8 (a) **Figure 13** shows the horizontal forces acting on a moving bicycle and cyclist.

Figure 13



8 (a) (i) What causes force **A**?

Draw a ring around the correct answer.

[1 mark]

friction **gravity** **weight**

8 (a) (ii) What causes force **B**?

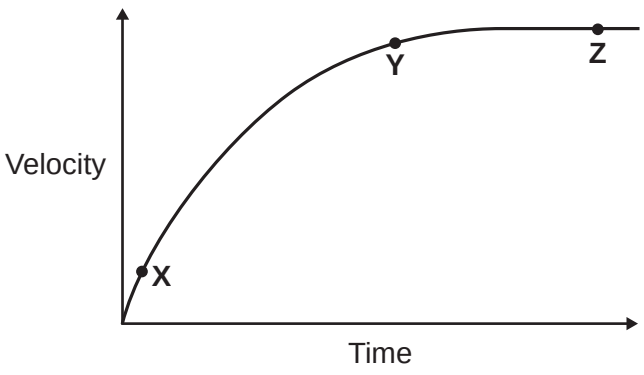
[1 mark]

.....

8 (a) (iii) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Figure 14 shows how the velocity of the cyclist changes during the first part of a journey along a straight and level road. During this part of the journey the force applied by the cyclist to the bicycle pedals is constant.

Figure 14



4.5.6.1.5 Acceleration

Question 23 · continued

Describe how **and** explain, in terms of the forces **A** and **B**, why the velocity of the cyclist changes:

- between the points **X** and **Y**
- and between the points **Y** and **Z**, marked on the graph in **Figure 14**.

[6 marks]

Extra space .....

Question 8 continues on the next page

4.5.6.1.5 Acceleration

Question 23 · continued

8 (b) (i) The cyclist used the brakes to slow down and stop the bicycle.

A constant braking force of 140 N stopped the bicycle in a distance of 24 m.

Calculate the work done by the braking force to stop the bicycle. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

Work done = ...

8 (b) (ii) Complete the following sentences.

[2 marks]

When the brakes are used, the bicycle slows down. The kinetic energy of the bicycle ..... .

At the same time, the ..... of the brakes increases.

13

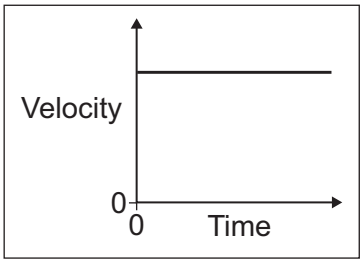
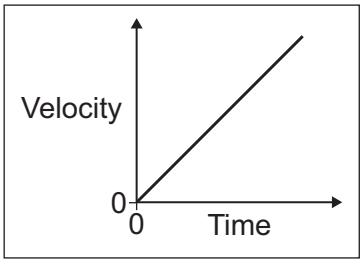
4.5.6.1.5 Acceleration

Question 24

June 2015 | PH2FP | Original Q5 | Legacy

5 (a) Draw **one** line from each velocity–time graph to the statement describing the motion shown by the graph.

[2 marks]

Velocity–time graph	Motion shown by graph
	Constant acceleration
	Not moving
	Constant deceleration
	Constant velocity

5 (b) Use the correct answer from the box to complete the sentence.

[1 mark]

energy	**momentum**	**speed**

The velocity of an object includes both the ..... of the object and the direction the object is moving.

Question 5 continues on the next page

4.5.6.1.5 Acceleration

Question 24 · continued

5 (c) At the start of a race, a horse accelerates from a velocity of 0 m/s to a velocity of 9 m/s in 4 seconds.

5 (c) (i) Calculate the acceleration of the horse.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

Acceleration = ... m/s^2

5 (c) (ii) When the horse accelerates, what, if anything, happens to the air resistance acting against the horse?

[1 mark]

Tick (✓) **one** box.

The air resistance decreases. ☐

The air resistance is constant. ☐

The air resistance increases. ☐

5 (d) A horse and a pony walk across a field at the same constant speed.

The horse has 4000 joules of kinetic energy.

The pony is **half** the mass of the horse.

What is the kinetic energy of the pony?

[2 marks]

Draw a ring around the correct answer.

2000 J **4000 J** **8000 J**

Give a reason for your answer.

.....

.....

8

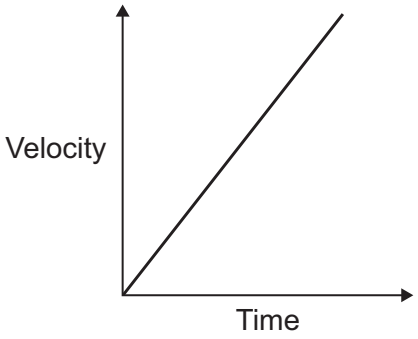
4.5.6.1.5 Acceleration

Question 25

June 2017 | PH2FP | Original Q6 | Legacy

6 (a) **Figure 11** shows the velocity-time graph for an object that is accelerating.

Figure 11



How do you know from the velocity-time graph that the object is accelerating?

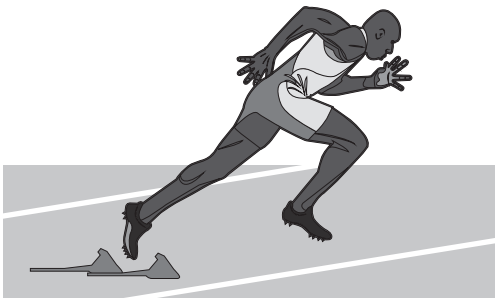
[1 mark]

_____

_____

6 (b) **Figure 12** shows an athlete sprinting away from the starting blocks.

Figure 12



The athlete has a mass of 85 kg
The force causing the athlete to accelerate is 425 N

Calculate the acceleration of the athlete.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

Acceleration = _____ m/s^2

3

4.5.6.1.5 Acceleration

Question 26

June 2018 | 8463/1F | Original Q1

0 1 **Figure 1** shows a cyclist riding along a flat road.

Figure 1



0 1 . 1 Complete the sentence.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**gravitational potential**	**kinetic**

As the cyclist accelerates, the _____ energy store in the cyclist's body decreases and the _____ energy of the cyclist increases.

0 1 . 2 The mass of the cyclist is 80 kg. The speed of the cyclist is 12 m/s.

Calculate the kinetic energy of the cyclist.

Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$$

[2 marks]

_____

_____

_____

_____

Kinetic energy = _____ J

4.5.6.1.5 Acceleration

Question 26 · continued

0 1 . 3 When the cyclist uses the brakes, the bicycle slows down.

This causes the temperature of the brake pads to increase by 50 °C.
The mass of the brake pads is 0.040 kg.
The specific heat capacity of the material of the brake pads is 480 J/kg °C.

Calculate the change in thermal energy of the brake pads.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

Change in thermal energy = _____ J

0 1 . 4 How is the internal energy of the particles in the brake pads affected by the increase in temperature?

Tick **one** box.

[1 mark]

- Decreased ☐
- Increased ☐
- Not affected ☐

7

4.5.6.1.5 Acceleration

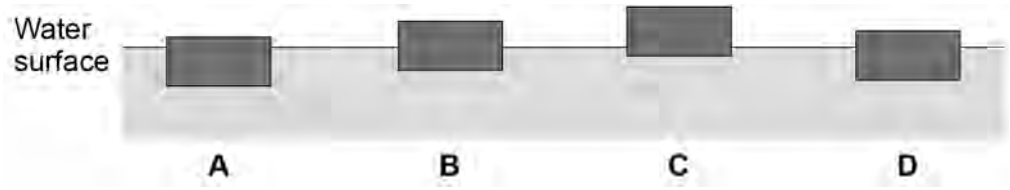
Question 27

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

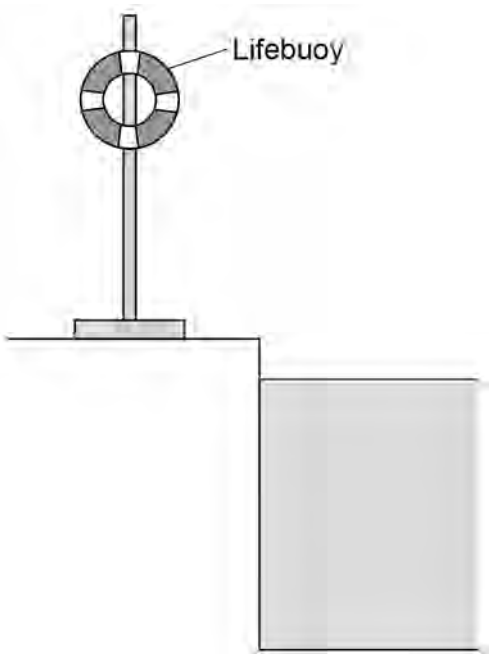
4.5.6.1.5 Acceleration

Question 27 · continued

June 2018 | 8463/2F | Original Q6

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

4.5.6.1.5 Acceleration

Question 27 · 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

4.5.6.1.5 Acceleration

Question 28

June 2018 | 8463/2F | Original Q10

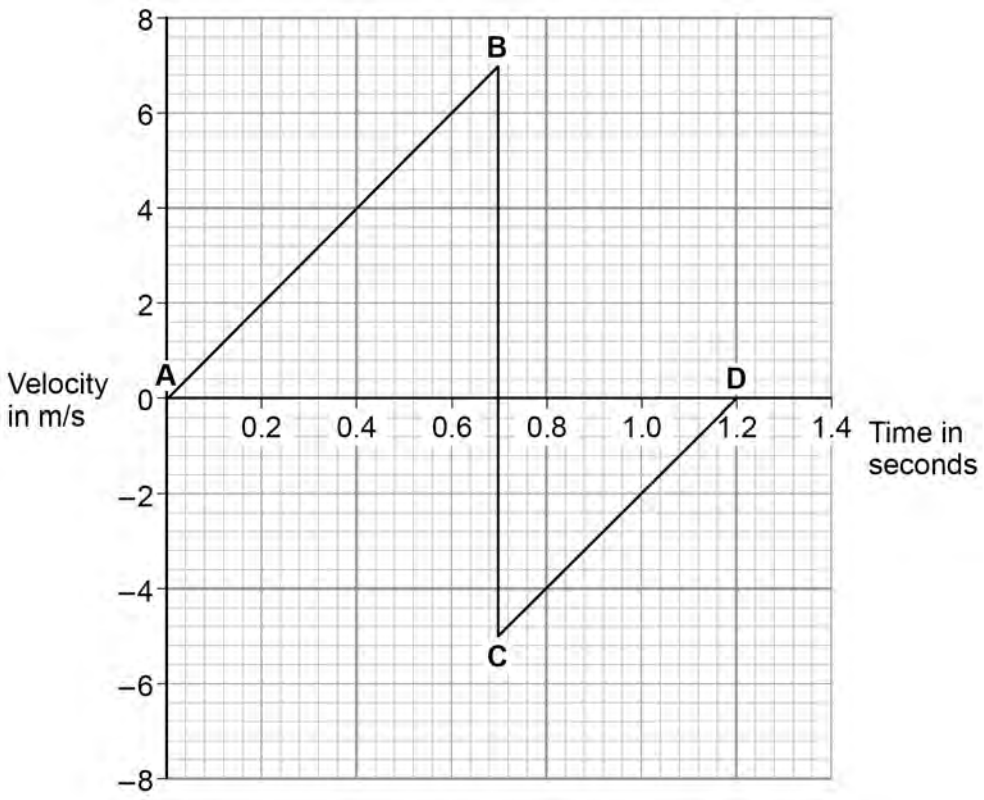
1 0 A child drops a ball.

The ball hits the ground and bounces.

Figure 14 shows the velocity-time graph for the ball from when the ball is dropped until when the ball reaches the top of its first bounce.

Air resistance has been ignored.

Figure 14



1 0 . 1 Describe the motion of the ball between points **A** and **B** on **Figure 14**.

[2 marks]

1 0 . 2 What direction is the ball moving between points **C** and **D** on **Figure 14**?

[1 mark]

4.5.6.1.5 Acceleration

Question 28 · continued

June 2018 | 8463/2F | Original Q10

10.3 The ball and the Earth form a system.

What is meant by 'a system'?

Tick **one** box.

[1 mark]

A group of objects that interact. ☐

Objects with big differences in mass. ☐

Objects with gravitational potential energy. ☐

10.4 When the ball hits the ground, energy is transferred from the ball to the Earth.

Explain how the data in **Figure 14** shows this energy transfer.

[4 marks]

8

4.5.6.1.5 Acceleration

Question 29

June 2019 | 8463/1F | Original Q6

0 6 An electric car has a motor that is powered by a battery.

A diesel car has an engine that is powered by diesel fuel.

0 6 . 1 **Table 2** compares an electric car and a diesel car.

Table 2

Power source	Maximum acceleration in m/s^2	Mass of power source in kg	Range in km	Maximum power output in kW
Battery	4.8	420	220	200
Diesel fuel	3.2	51	1120	120

Give **two** advantages of the diesel car compared with the electric car in **Table 2**.

[2 marks]

1 _____

_____

2 _____

_____

0 6 . 2 The mass of the battery in the electric car is 420 kg

The total mass of the electric car is 1610 kg

Calculate the mass of the battery as a percentage of the total mass of the electric car.

[2 marks]

_____

_____

_____

_____

Percentage of total mass = _____ %

4.5.6.1.5 Acceleration

Question 29 · continued

0 6 . 3 Designers of electric car batteries want to increase the amount of energy that can be stored in a battery.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

Figure 8 shows an electric car being recharged.

Figure 8



0 6 . 4 Write down the equation which links energy transferred, power and time.

[1 mark]

_____

_____

0 6 . 5 The charger has a power output of 7000 W

Calculate the time taken to transfer 420 000 J of energy to the car battery.

[3 marks]

_____

_____

_____

_____

Time = _____ s

10

4.5.6.1.5 Acceleration

Question 30

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.

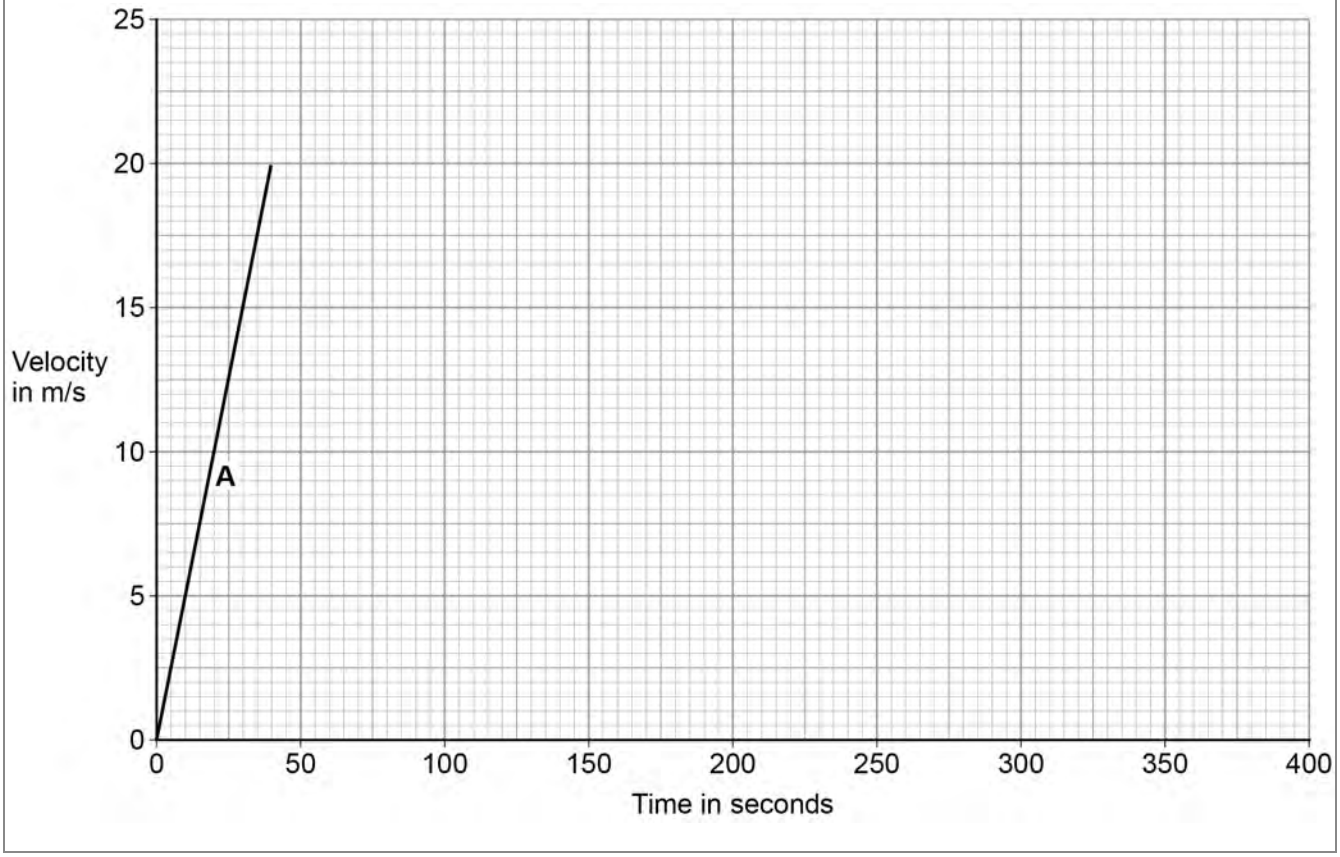
A ☐ **B** ☐ **C** ☐

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



4.5.6.1.5 Acceleration

Question 30 · 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

4.5.6.1.5 Acceleration

Question 31

November 2020 | 8463/2F | Original Q7

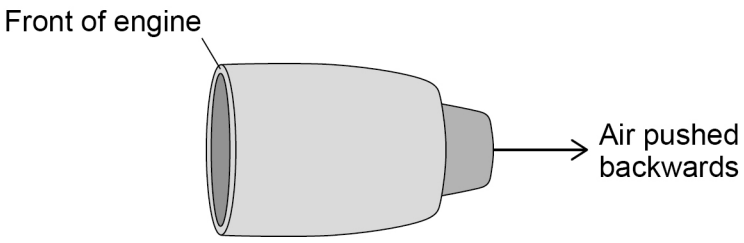
0 7 . 1 An aircraft travels at a constant velocity.

How is the velocity of the aircraft different to the speed of the aircraft?

[1 mark]

0 7 . 2 **Figure 11** shows one of the engines on the aircraft.

Figure 11



Air is taken into the front of the engine and pushed out of the back of the engine.

Explain the effect this has on the engine.

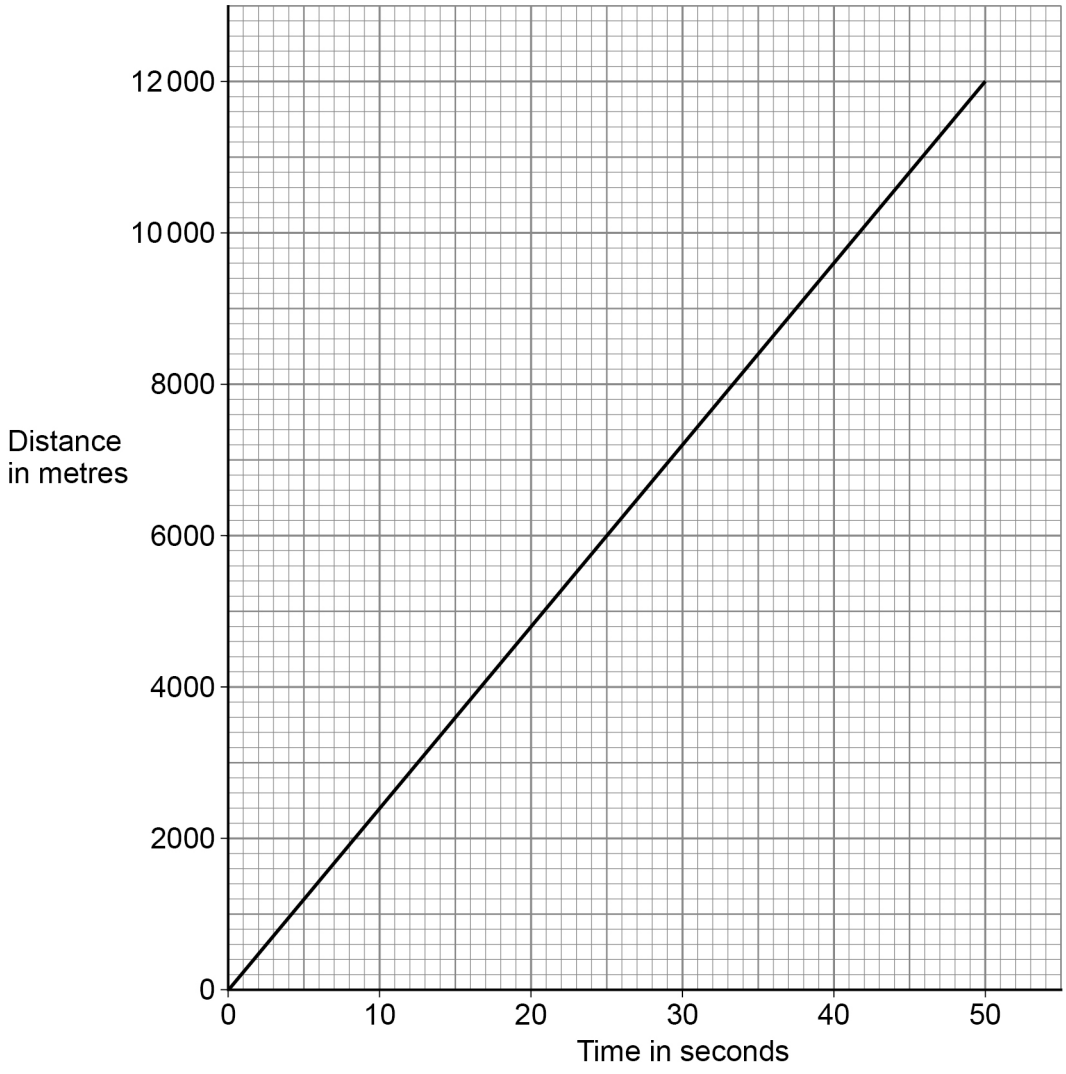
[2 marks]

4.5.6.1.5 Acceleration

Question 31 · continued

0 7 . 3 **Figure 12** shows a distance-time graph for the aircraft.

Figure 12



Determine the speed of the aircraft.

[3 marks]

Speed = _____ m/s

Question 7 continues on the next page

4.5.6.1.5 Acceleration

Question 31 · continued

0 7 . 4 Write down the equation that links acceleration (a), change in velocity (Δv) and time taken (t).

[1 mark]

0 7 . 5 At a different stage of the flight, the aircraft was travelling at a velocity of 250 m/s.

The aircraft then decelerated at 0.14 m/s^2.

Calculate the time taken for the aircraft to decelerate from 250 m/s to 68 m/s.

[4 marks]

Time = _____ s

4.5.6.1.5 Acceleration

Question 31 · continued

0 7 . 6 Write down the equation that links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 7 . 7 When the aircraft landed, it travelled 2000 m before stopping.

The work done to stop the aircraft was 140 000 000 J.

Calculate the mean force used to stop the aircraft.

[3 marks]

Mean force = _____ N

15

4.5.6.1.5 Acceleration

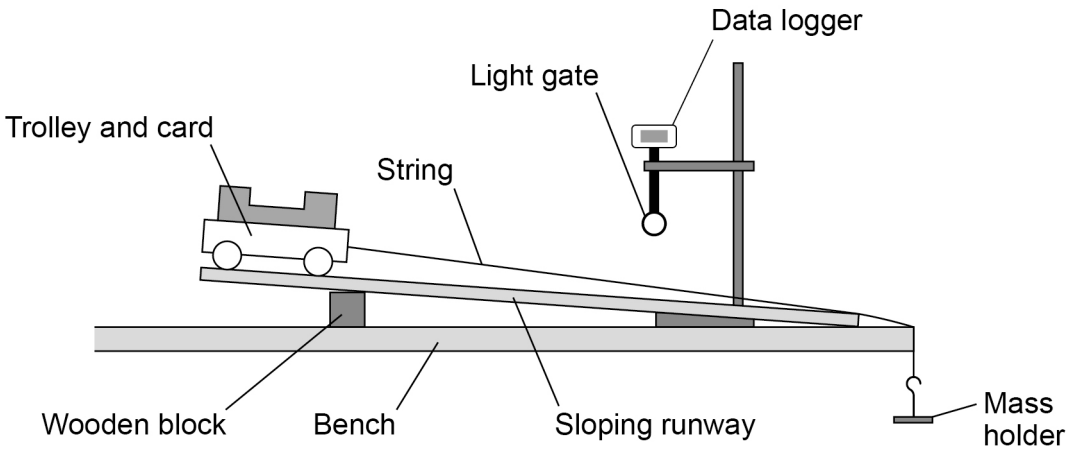
Question 32

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]

4.5.6.1.5 Acceleration

Question 32 · 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.

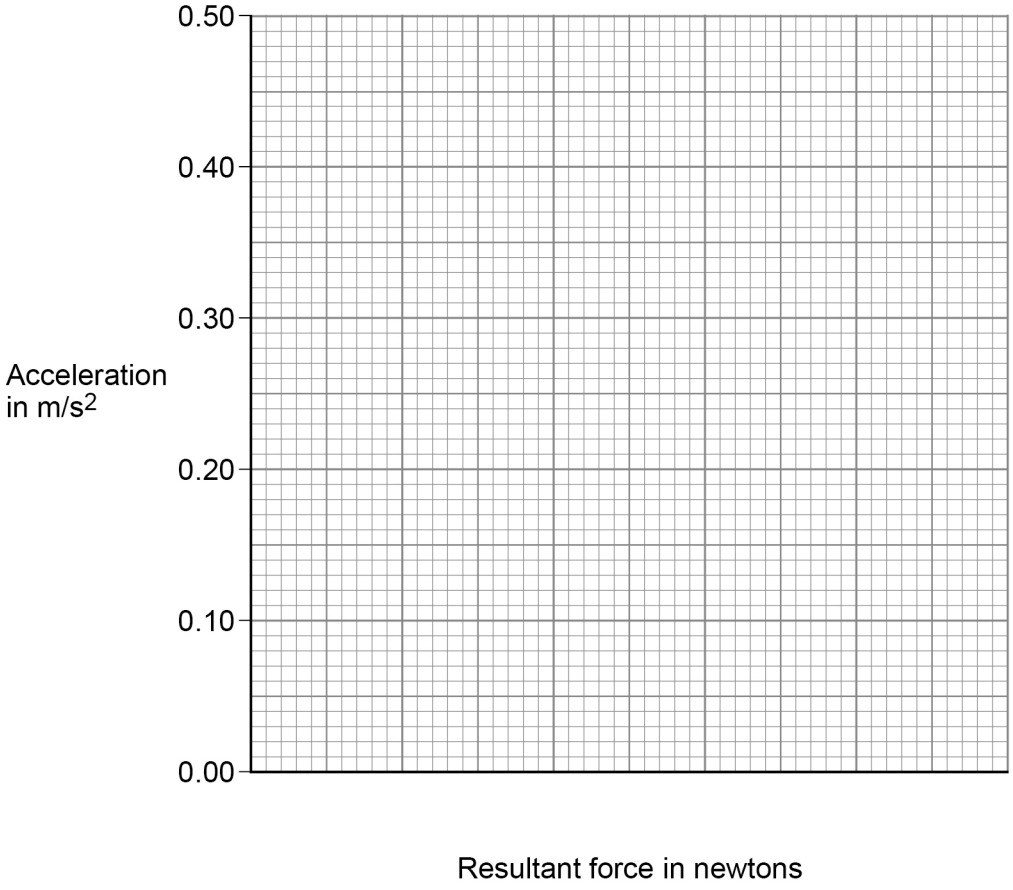
Table 4 shows the results.

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]

4.5.6.1.5 Acceleration

Question 32 · 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

4.5.6.1.5 Acceleration

Question 33

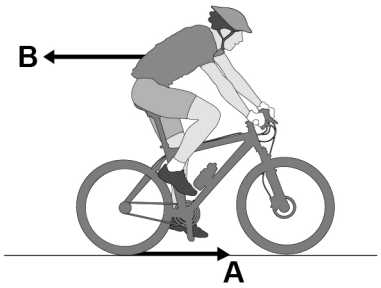
November 2021 | 8463/2F | Original Q2

0 2 **Figure 3** shows a cyclist on a bicycle.

The cyclist is moving at a constant velocity.

Arrows **A** and **B** represent the horizontal forces acting on the bicycle and cyclist.

Figure 3



0 2 . 1 What is force **A**?

[1 mark]

Tick (✓) **one** box.

- Air resistance ☐
- Friction ☐
- Tension ☐
- Upthrust ☐

4.5.6.1.5 Acceleration

Question 33 · continued

0 2 . 2 What is force **B**?

[1 mark]

Tick (✓) **one** box.

- Air resistance ☐
- Magnetic ☐
- Tension ☐
- Upthrust ☐

0 2 . 3 What is the relationship between force **A** and force **B** when the cyclist travels at a constant velocity?

[1 mark]

Tick (✓) **one** box.

- **A = B** ☐
- **A > B** ☐
- **A < B** ☐

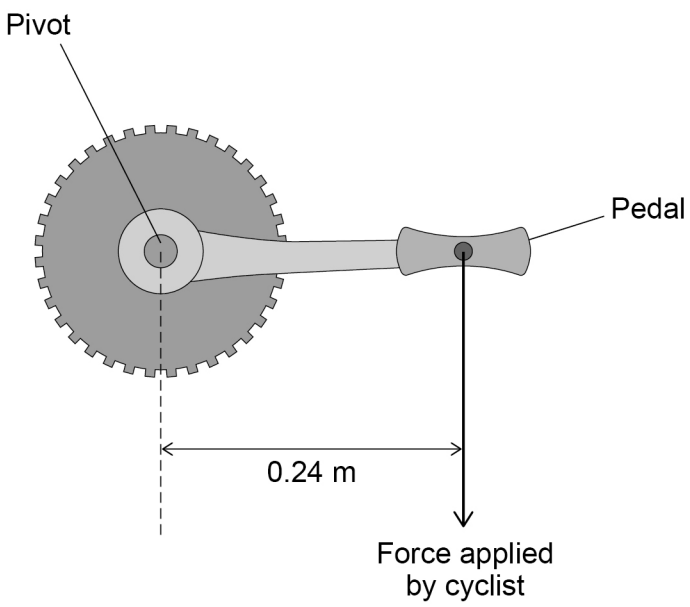
Question 2 continues on the next page

4.5.6.1.5 Acceleration

0 2 . 4 The cyclist applies a force of 150 N to one of the bicycle pedals.

Figure 4 shows the distance between the force applied and the pivot.

Figure 4



Calculate the moment about the pivot caused by the force applied to the pedal in **Figure 4**.

Use the equation:

moment of a force = force × distance

[2 marks]

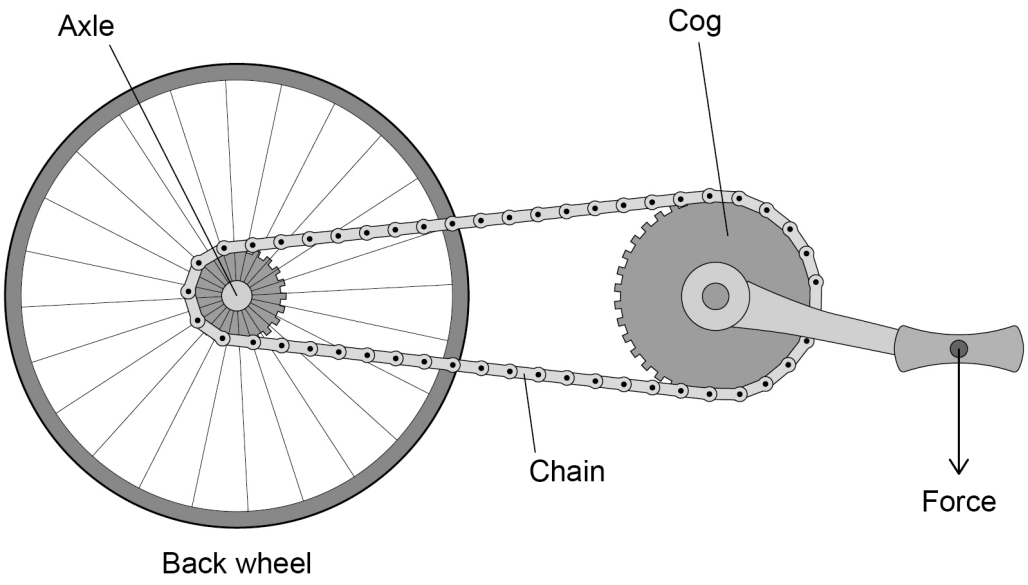
Moment = _____ N m

4.5.6.1.5 Acceleration

Question 33 · continued

0 2 . 5 **Figure 5** shows how the pedal is connected to the back wheel of the bicycle.

Figure 5



Complete the sentence.

Choose the answer from the box.

[1 mark]

axle	**chain**	**cog**

The force from the cyclist pushing down on the pedal is transmitted to the back wheel by the _____ .

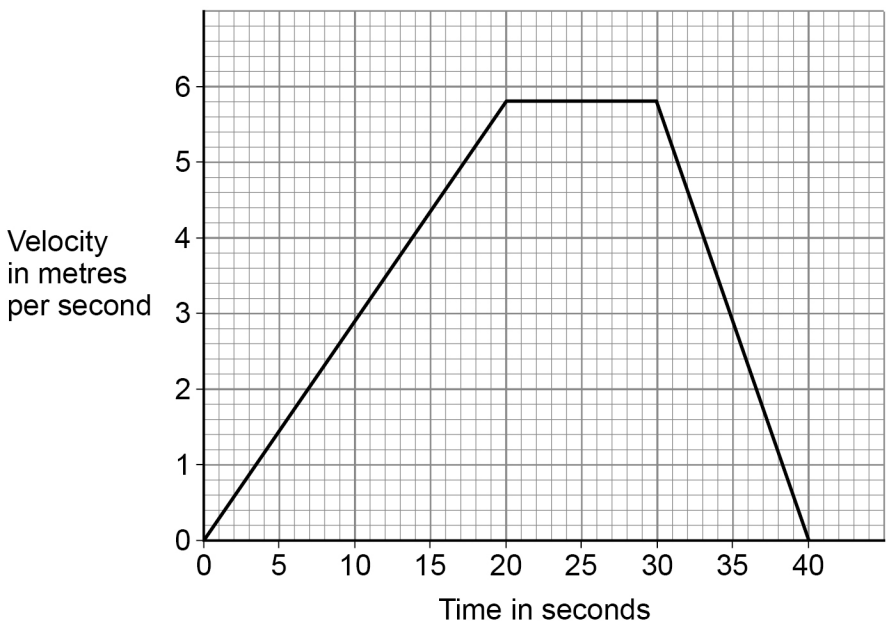
Question 2 continues on the next page

4.5.6.1.5 Acceleration

Question 33 · continued

Figure 6 shows how the velocity of the cyclist changes during a journey.

Figure 6



0 2 . 6 What is the change in velocity of the cyclist in the first 20 seconds of the journey?

[1 mark]

Tick (✓) **one** box.

5.2 m/s ☐

5.4 m/s ☐

5.6 m/s ☐

5.8 m/s ☐

4.5.6.1.5 Acceleration

Question 33 · continued

0 2 . 7 Determine the acceleration of the cyclist during the first 20 seconds of the journey.

Use your answer from Question **02.6**

Use the equation:

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

[2 marks]

Acceleration of the cyclist = _____ m/s^2

0 2 . 8 Complete the sentence.

Choose the answer from the box.

[1 mark]

deceleration	**speed**	**velocity**

Between 30 and 40 seconds the cyclist moves with

a constant _____ .

Question 2 continues on the next page

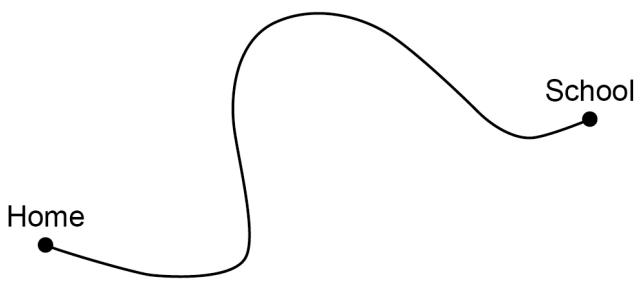
4.5.6.1.5 Acceleration

Question 33 · continued

0 2 . 9 The cyclist travels from home to school.

Figure 7 shows the route the cyclist followed.

Figure 7



Draw an arrow on **Figure 7** to show the displacement of the cyclist.

[1 mark]

11

4.5.6.1.5 Acceleration

Question 34

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

4.5.6.1.5 Acceleration

Question 34 · 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]

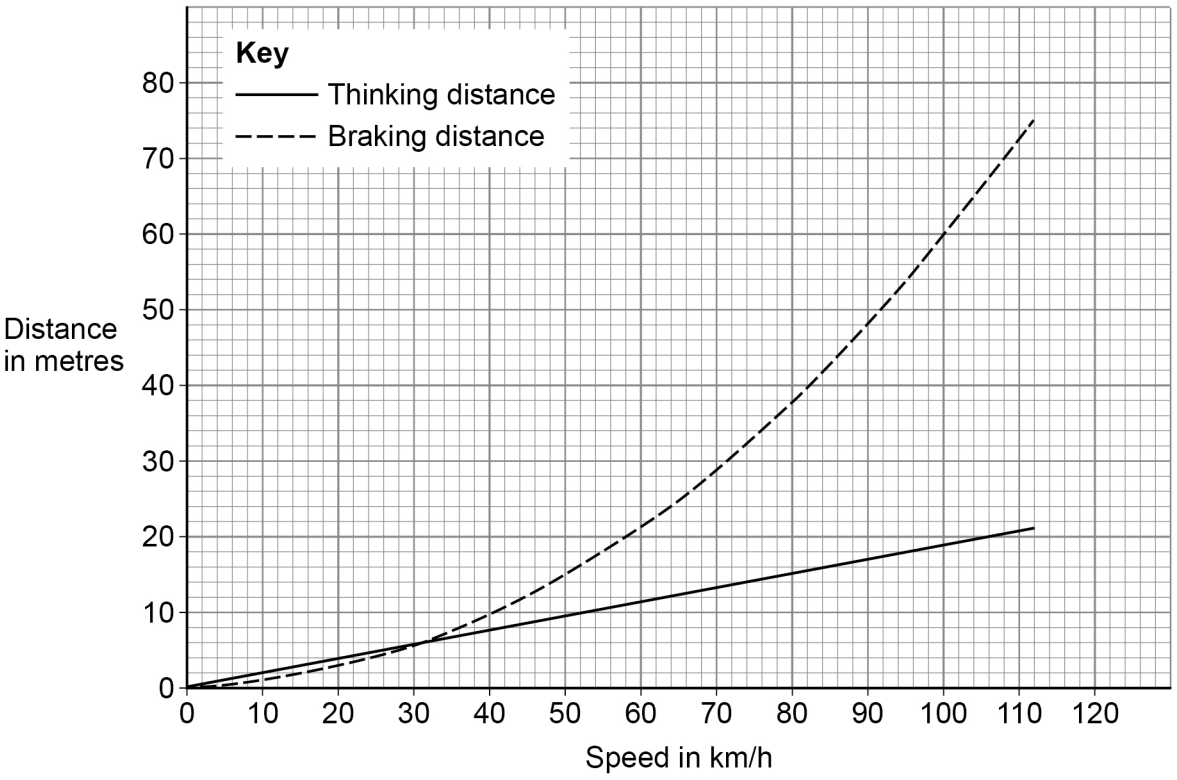
Deceleration = _____ m/s^2

4.5.6.1.5 Acceleration

Question 34 · 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

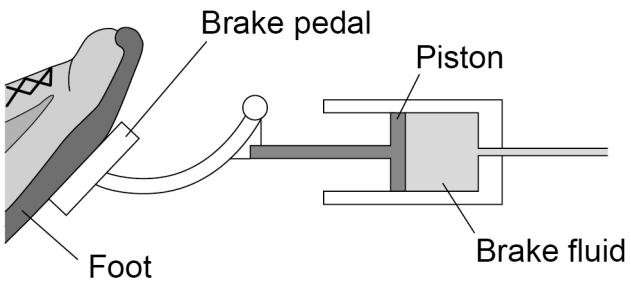
Question 8 continues on the next page

4.5.6.1.5 Acceleration

Question 34 · 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.

$p = F \times A$ ☐

$p = F \times A^2$ ☐

$p = \frac{F}{A}$ ☐

$p = \frac{A}{F}$ ☐

4.5.6.1.5 Acceleration

Question 34 · 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

4.5.6.1.5 Acceleration

Question 35

June 2022 | 8463/2F | Original Q2

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 ☐

4.5.6.1.5 Acceleration

Question 35 · 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. ☐

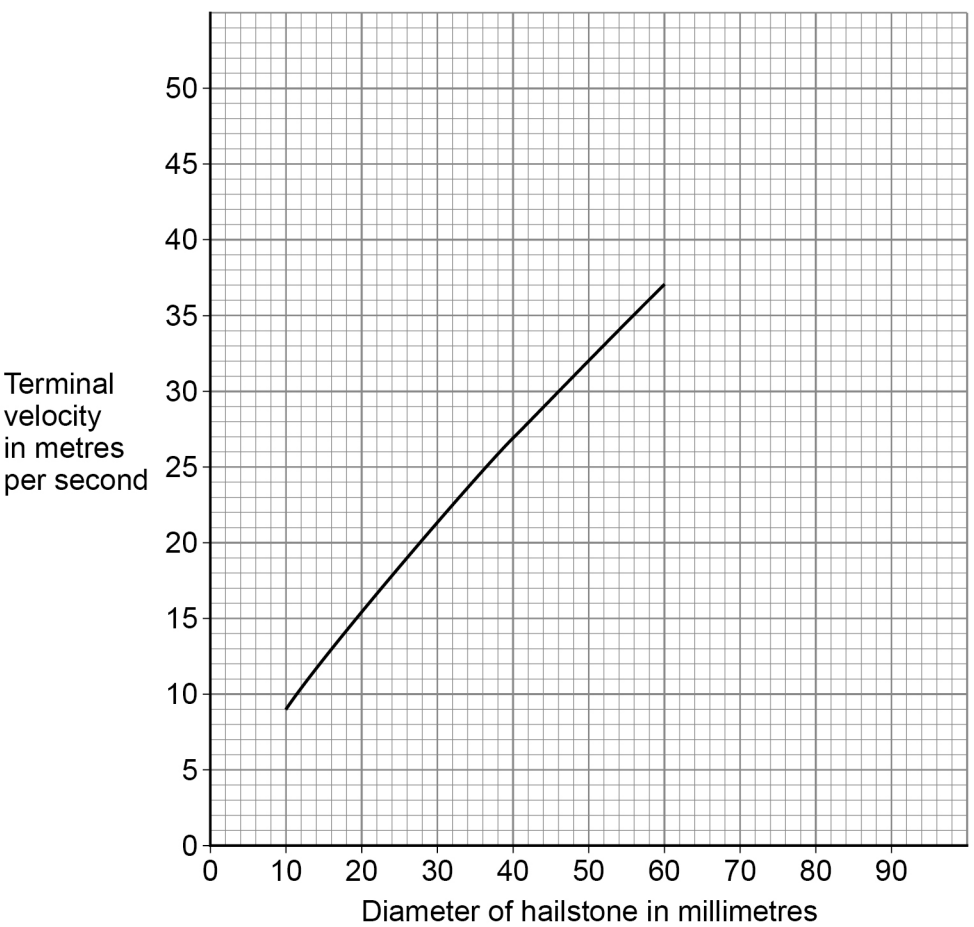
Question 2 continues on the next page

Question 35 · 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

4.5.6.1.5 Acceleration

Question 35 · 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

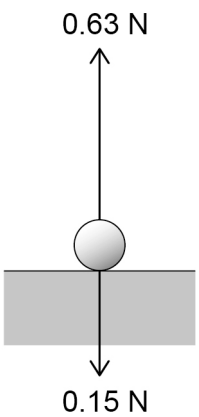
4.5.6.1.5 Acceleration

Question 35 · 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

4.5.6.1.5 Acceleration

Question 36

June 2022 | 8463/2F | Original Q8

0 8 **Figure 15** shows an electric super-car.

Figure 15



0 8 . 1 The battery in an electric car needs to be recharged.

Suggest **two** factors that affect the distance an electric car can travel before the battery needs to be recharged.

[2 marks]

1 _____

2 _____

4.5.6.1.5 Acceleration

Question 36 · continued

Use the Physics Equations Sheet to answer questions **08.2** and **08.3**.

0 8 . 2 Write down the equation which links acceleration (a), change in velocity (Δv) and time taken (t).

[1 mark]

0 8 . 3 The maximum acceleration of the car is 20 m/s^2.

Calculate the time taken for the speed of the car to change from 0 m/s to 28 m/s at its maximum acceleration.

[3 marks]

Time taken = _____ s

Question 8 continues on the next page

4.5.6.1.5 Acceleration

Question 36 · continued

0 8 . 4 In a trial run, the car accelerates at 10 m/s^2 until it reaches its final velocity.

distance travelled by the car = 605 m

initial velocity of the car = 0 m/s

Calculate the final velocity of the car.

Use the Physics Equations Sheet.

[3 marks]

Final velocity = _____ m/s

4.5.6.1.5 Acceleration

Question 36 · continued

Use the Physics Equations Sheet to answer questions **08.5** and **08.6**.

0 8 . 5 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 8 . 6 When travelling at its maximum speed the air resistance acting on the car is 4000 N.

Calculate the work done against air resistance when the car travels a distance of 7.5 km at its maximum speed.

[3 marks]

Work done = _____ J

13

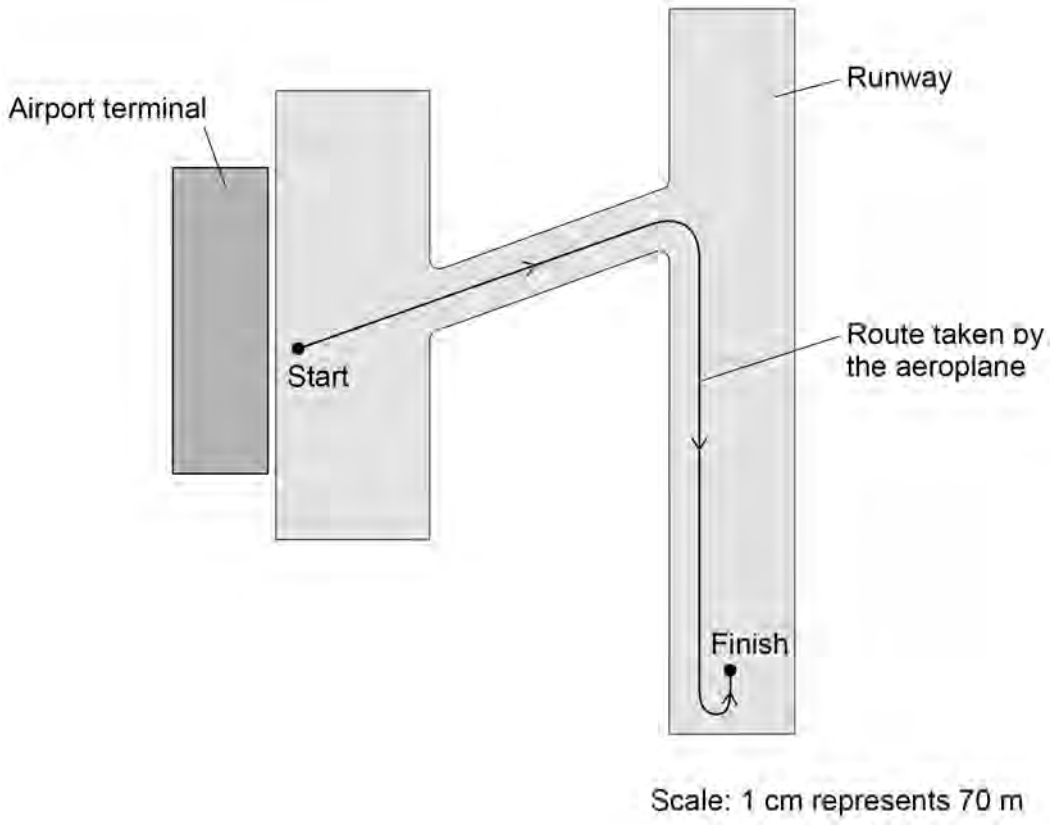
4.5.6.1.5 Acceleration

Question 37

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]

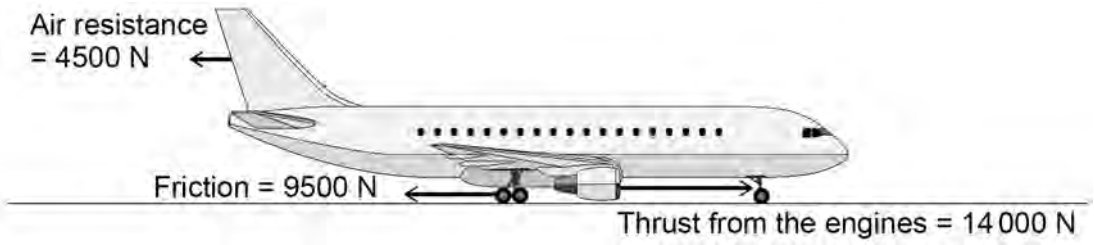
Displacement = _____ m

4.5.6.1.5 Acceleration

Question 37 · 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



1 0 . 2 Determine the magnitude of the resultant horizontal force on the aeroplane.

[1 mark]

Resultant horizontal force = _____ N

1 0 . 3 Describe the motion of the aeroplane as it moves towards the runway.

[1 mark]

1 0 . 4 Air resistance and friction are contact forces.

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

[1 mark]

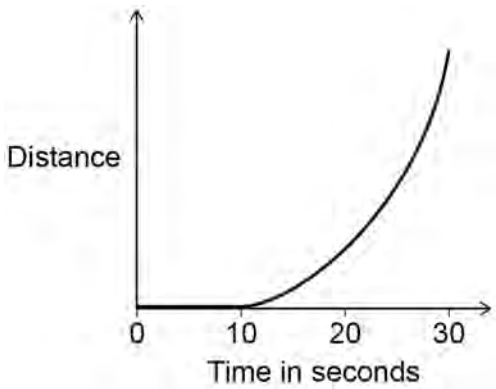
4.5.6.1.5 Acceleration

Question 37 · 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.

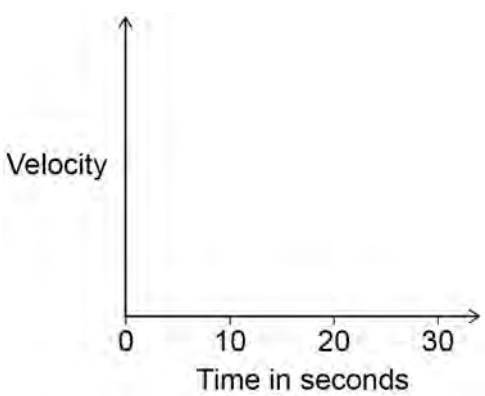
Figure 27



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

[2 marks]

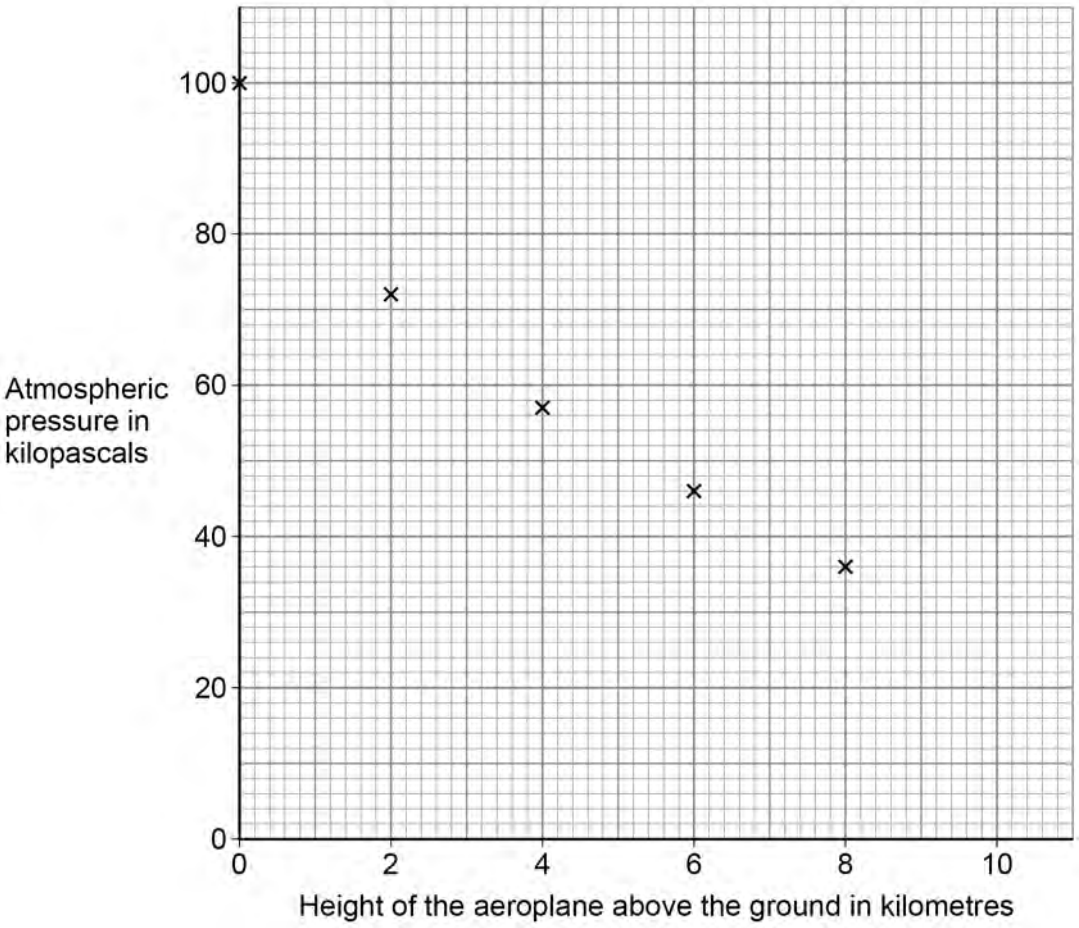
Figure 28



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

4.5.6.1.5 Acceleration

Question 37 · continued

1 0 . 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

4.5.6.1.5 Acceleration

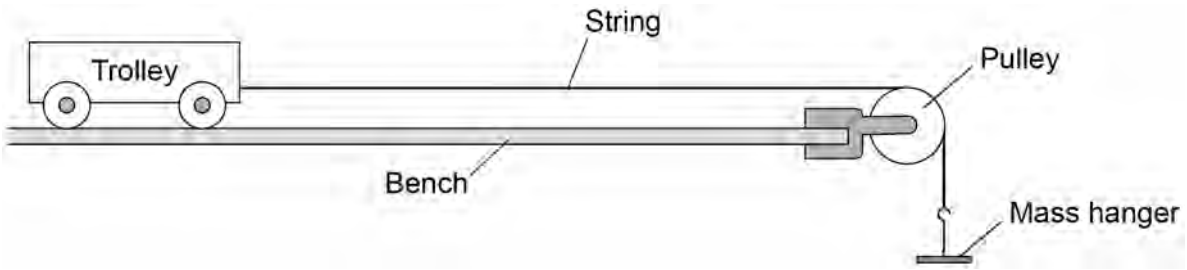
Question 38

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 ☐

4.5.6.1.5 Acceleration

Question 38 · 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]

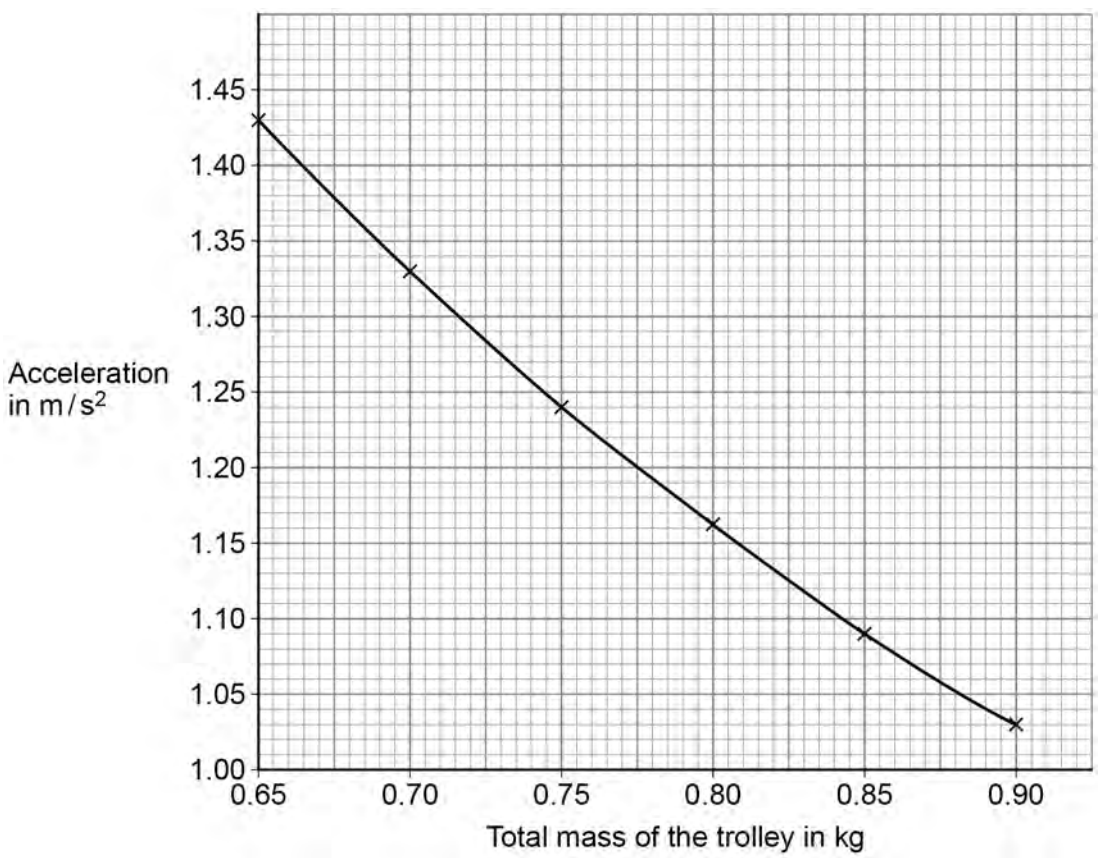
Mean acceleration = _____ m/s^2

4.5.6.1.5 Acceleration

Question 38 · continued

Figure 6 shows some of the results.

Figure 6



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

[1 mark]

4.5.6.1.5 Acceleration

Question 38 · 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

4.5.6.1.5 Acceleration

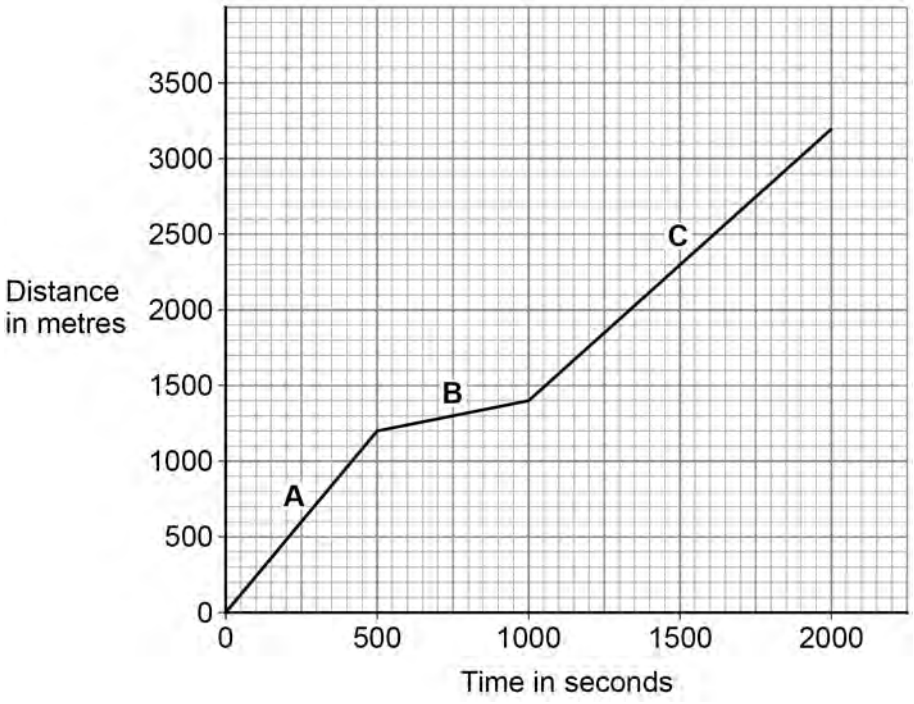
Question 39

June 2024 | 8463/2F | Original Q5

0 5 A person has been for a walk.

Figure 9 shows the distance–time graph for the walk.

Figure 9



0 5 . 1 Some quantities are scalar quantities and others are vector quantities.

Which of the following are scalar quantities?

[2 marks]

Tick (✓) **two** boxes.

- Displacement ☐
- Distance ☐
- Force ☐
- Speed ☐
- Velocity ☐

4.5.6.1.5 Acceleration

Question 39 · continued

0 5 . 2 What was the total distance walked by the person in 2000 seconds?

[1 mark]

Total distance = _____ m

0 5 . 3 Calculate the average speed of the person during the 2000 seconds.

Use your answer to Question **05.2**

Use the equation:

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

[2 marks]

_____

_____

_____

Average speed = _____ m/s

0 5 . 4 Which section of **Figure 9** shows the person walking the slowest?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

Reason _____

_____

4.5.6.1.5 Acceleration

Question 39 · continued

0 5 . 5 The person walked slowest when going up some steps.

Complete the sentence.

Choose the answer from the box.

[1 mark]

air resistance	**friction**	**gravity**

When walking up the steps, the person did more work against the force of _____.

0 5 . 6 On another day, the person ran the same route.

What is a typical speed for a person running?

[1 mark]

Tick (✓) **one** box.

0.3 m/s ☐

3.0 m/s ☐

30 m/s ☐

9

4.5.6.1.5 Acceleration

Question 40

June 2024 | 8463/2F | Original Q7

0 7 A swimming pool is being filled with water.

0 7 . 1 Calculate the weight of the water in the swimming pool when the mass of the water is 25 000 kg.

gravitational field strength = 9.8 N/kg

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

4.5.6.1.5 Acceleration

Question 40 · continued

0 7 . 2 When the swimming pool is full, the weight of the water is 1 960 000 N.

The bottom of the swimming pool has an area of 49 m^2.

Calculate the pressure at the bottom of the swimming pool when it is full.

Use the equation:

$$\text{pressure} = \frac{\text{weight}}{\text{area}}$$

Choose the unit from the box.

[3 marks]

m^2	**m^3**	**N**	**Pa**

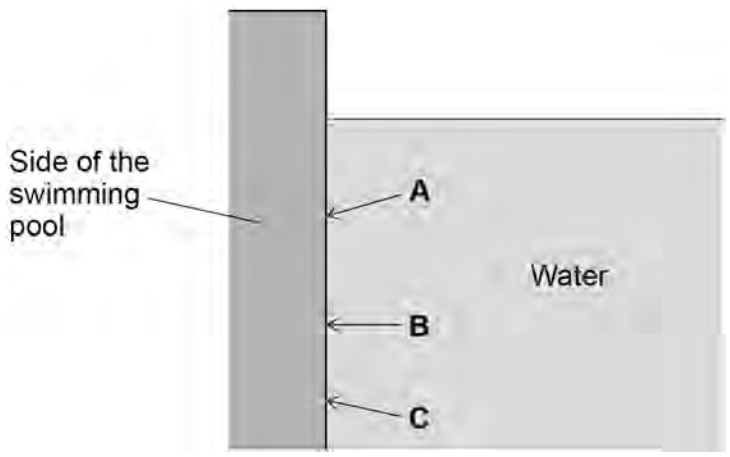
Pressure = _____ Unit _____

Question 7 continues on the next page

0 7 . 3 There is a force acting on the side of the swimming pool because of the water pressure.

Figure 11 shows the side of the swimming pool.

Figure 11



Which arrow shows the direction of the force acting on the side of the swimming pool?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

0 7 . 4 A child is swimming in the pool. The velocity of the child is 0.70 m/s.

The child then accelerates for 5.0 s, reaching a final velocity of 1.3 m/s.

Calculate the acceleration of the child.

Use the equation:

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

[2 marks]

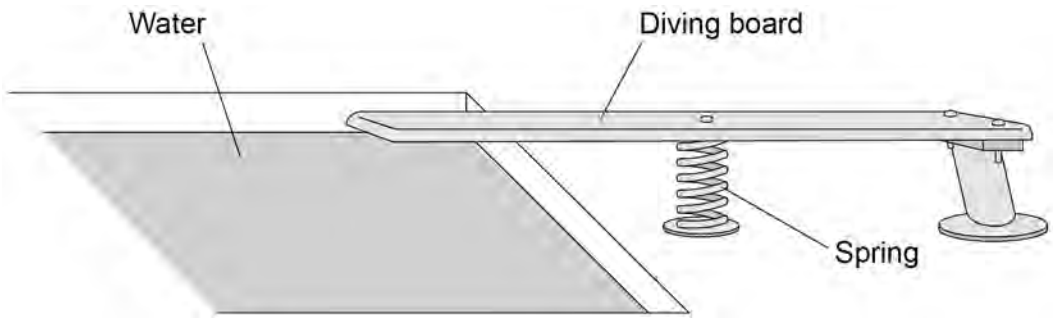
Acceleration = _____ m/s^2

4.5.6.1.5 Acceleration

Question 40 · continued

Figure 12 shows a diving board at the side of the swimming pool.

Figure 12



0 7 . 5 The original length of the spring is 0.84 m.

When the child stands on the diving board, the length of the spring decreases by 0.21 m.

Calculate the percentage change in the length of the spring.

[2 marks]

Percentage change in length = _____ %

Question 7 continues on the next page

4.5.6.1.5 Acceleration

Question 40 · continued

Use the Physics Equations Sheet to answer questions **07.6** and **07.7**.

0 7 . 6 Write down the equation which links extension (*e*), force applied to a spring (*F*) and spring constant (*k*).

[1 mark]

0 7 . 7 The force applied to the spring by the weight of the child is 336 N.

The change in length of the spring is 0.21 m.

Calculate the spring constant of the spring.

[3 marks]

Spring constant = _____ N/m

4.5.6.1.5 Acceleration

Question 40 · continued

0 7 . 8 The child steps off the diving board and falls into the swimming pool.

The initial velocity of the child is 0 m/s.

acceleration due to gravity = 9.8 m/s^2

Calculate the final velocity when the child has fallen a distance of 0.95 m through the air.

Give your answer to 2 significant figures.

Use the Physics Equations Sheet.

[4 marks]

Final velocity of child (2 significant figures) = _____ m/s

18

4.5.6.1.5 Acceleration

Question 41

June 2025 | 8463/2F | Original Q2

0 2 Very long trains can be pulled by more than one engine.

A train is made up of four engines pulling trucks filled with coal.

0 2 . 1 The coal in one truck has a mass of 75 000 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the coal in **one** truck.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

0 2 . 2 **One** engine exerts a forward force of 850 000 N.

Calculate the work done by **one** engine when the train moves a distance of 80 m.

Use the equation:

work done = force × distance moved

[2 marks]

Work done = _____ J

4.5.6.1.5 Acceleration

Question 41 · continued

0 2 . 3 Each of the four engines exerts a forward force of 850 000 N on the trucks.

Calculate the total forward force on the trucks.

[2 marks]

Total forward force = _____ N

0 2 . 4 The force exerted by the engines on the trucks is a contact force.

Which of the following is also a contact force?

[1 mark]

Tick (✓) **one** box.

- Electrostatic force ☐
- Frictional force ☐
- Gravitational force ☐

Question 2 continues on the next page

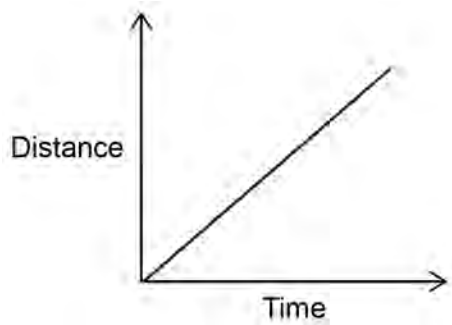
4.5.6.1.5 Acceleration

Question 41 · continued

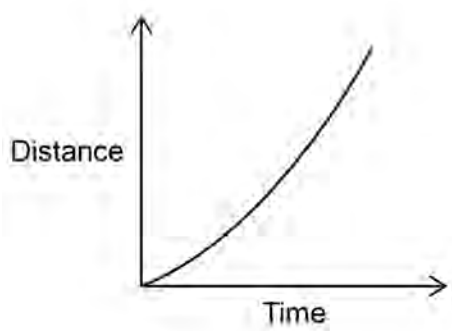
0 2 . 5 Which sketch graph represents the train moving at a constant speed?

[1 mark]

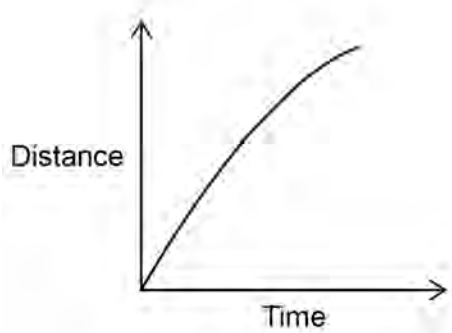
Tick (✓) **one** box.



☐



☐



☐

4.5.6.1.5 Acceleration

Question 41 · continued

0 2 . 6 The train accelerates for 150 s.

The velocity of the train changes from 16 m/s to 25 m/s.

Calculate the acceleration of the train.

Use the equation:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

[3 marks]

Acceleration = _____ m/s^2

11

Turn over for the next question

4.5.6.1.5 Acceleration

Question 42

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

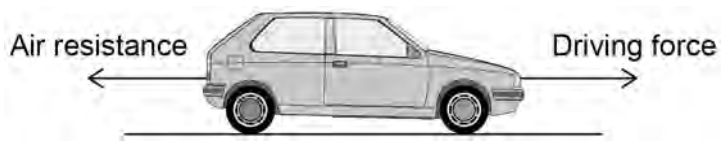
4.5.6.1.5 Acceleration

Question 42 · 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]

4.5.6.1.5 Acceleration

Question 42 · 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 _____.

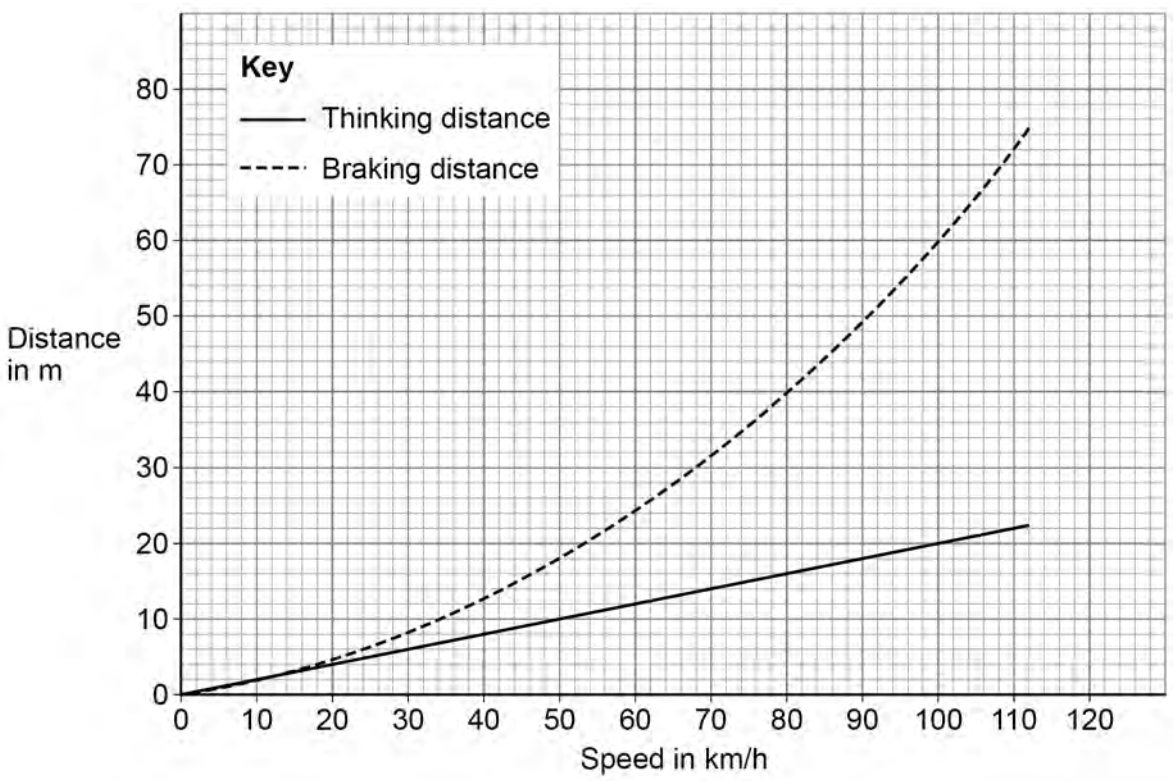
Question 4 continues on the next page

4.5.6.1.5 Acceleration

Question 42 · continued

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

4.5.6.1.5 Acceleration

Question 42 · 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

4.5.6.1.5 Acceleration

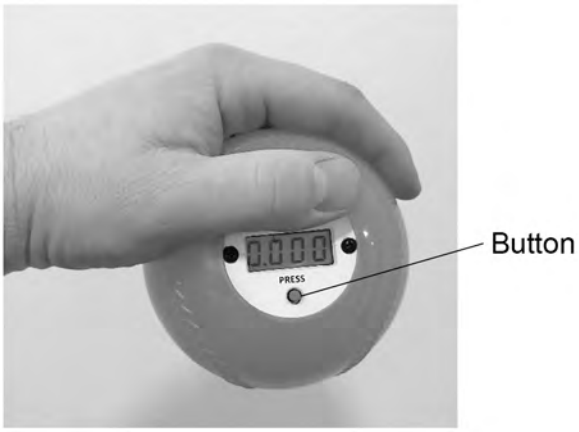
Question 43

June 2025 | 8463/2F | Original Q10

1 0 A student investigated the acceleration of a ball dropped from different heights.

Figure 15 shows a 'gravity ball' that the student used.

Figure 15



The button on the gravity ball starts the stopwatch.

When the gravity ball hits the floor, the stopwatch stops.

This is the method used.

1. Measure a vertical height above the floor.
2. Hold the gravity ball at the measured height.
3. Start the stopwatch on the gravity ball and drop the gravity ball.
4. Record the time shown on the stopwatch.
5. Repeat steps 1 to 4 using the same height.
6. Repeat steps 1 to 5 using different heights.

Question 43 · continued

1 0 . 1 The student dropped the ball from the same height five times and recorded the following results.

0.49 s 0.51 s 0.58 s 0.56 s 0.61 s

Calculate the uncertainty in these measurements of time.

[2 marks]

Uncertainty = ± _____ s

1 0 . 2 What type of error caused the variation in the measurements of time?

[1 mark]

Tick (✓) **one** box.

- Random error ☐
- Systematic error ☐
- Zero error ☐

1 0 . 3 Suggest **one** reason for the error that caused the variation in the measurements of time.

[1 mark]

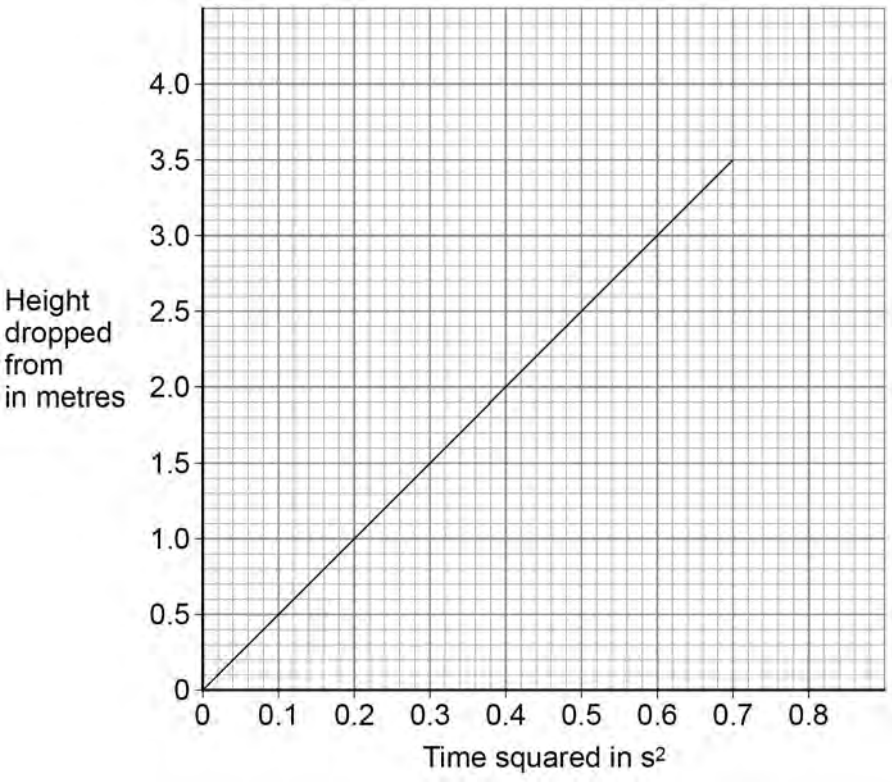
Question 10 continues on the next page

4.5.6.1.5 Acceleration

Question 43 · continued

1 0 . 4 **Figure 16** shows a graph of the height the ball was dropped from against the time squared.

Figure 16



The acceleration of the ball can be calculated using the equation:

acceleration = 2 × (gradient of the graph)

Determine the acceleration of the ball.

[3 marks]

Acceleration of ball = _____ m/s²

7