AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.6.2.2

Newton's Second Law

Past-paper questions

Tier	**Higher**
Question groups	**18**
Available paper years	**2003–2024**

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:** _____

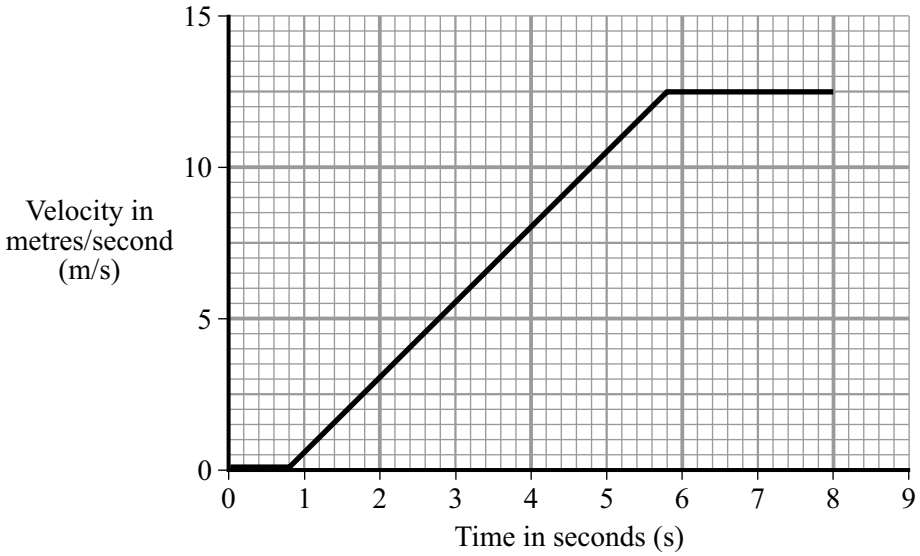
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.6.2.2 Newton's Second Law

Question 01

June 2003 | 3451H | Original Q10 | Legacy

10 A car travelling along a straight road has to stop and wait at red traffic lights. The graph shows how the velocity of the car changes after the traffic lights turn green.



(a) Between the traffic lights changing to green and the car starting to move there is a time delay. This is called the reaction time. Write down **one** factor that could affect the driver's reaction time.

.....

(1 mark)

(b) Calculate the distance the car travels while accelerating. Show clearly how you work out your answer.

.....

.....

Distance = ...metres

(3 marks)

(c) Calculate the acceleration of the car. Show clearly how you work out your final answer and give the units.

.....

.....

.....

Acceleration = ...

(4 marks)

4.5.6.2.2 Newton's Second Law

Question 01 · continued

MARGIN BLANK

(d) The mass of the car is 900 kg.

(i) Write down the equation that links acceleration, force and mass.

.....

(1 mark)

(ii) Calculate the force used to accelerate the car. Show clearly how you work out your final answer.

.....

.....

Force = ...newtons

(2 marks)

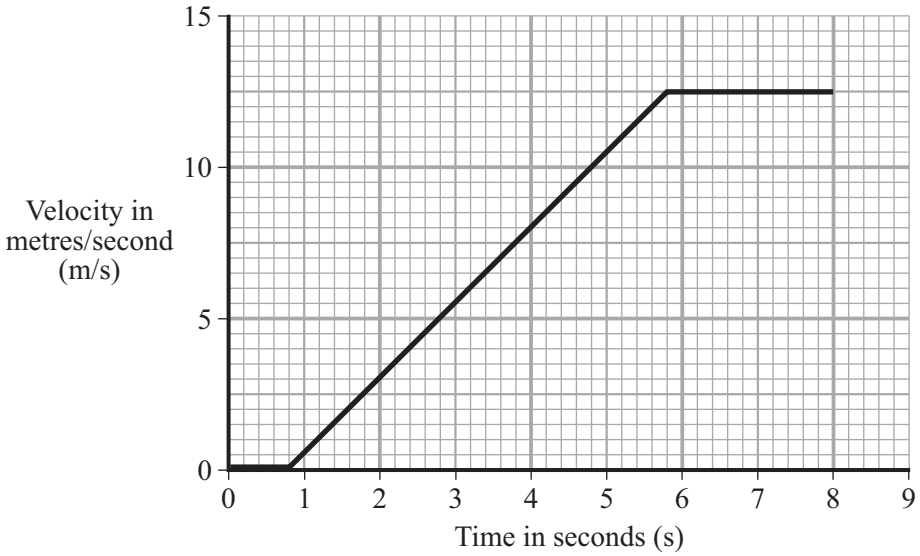
11

4.5.6.2.2 Newton's Second Law

Question 02

June 2003 | 3462H3 | Original Q8 | Legacy

8 A car travelling along a straight road has to stop and wait at red traffic lights. The graph shows how the velocity of the car changes after the traffic lights turn green.



(a) Between the traffic lights changing to green and the car starting to move there is a time delay. This is called the reaction time. Write down **one** factor that could affect the driver's reaction time.

.....

(1 mark)

(b) Calculate the distance the car travels while accelerating. Show clearly how you work out your answer.

.....

.....

Distance = ...metres

(3 marks)

(c) Calculate the acceleration of the car. Show clearly how you work out your final answer and give the units.

.....

.....

.....

Acceleration = ...

(4 marks)

4.5.6.2.2 Newton's Second Law

Question 02 · continued

1 /

MARGIN BLANK

(d) The mass of the car is 900 kg.

(i) Write down the equation that links acceleration, force and mass.

.....

(1 mark)

(ii) Calculate the force used to accelerate the car. Show clearly how you work out your final answer.

.....

.....

Force = ...newtons

(2 marks)

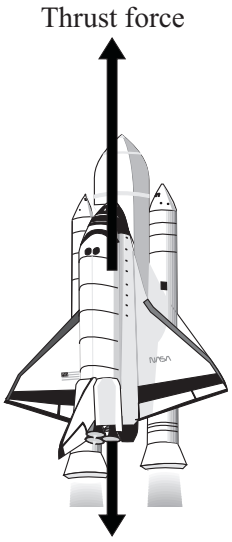
11

4.5.6.2.2 Newton's Second Law

Question 03

June 2004 | 3451H | Original Q5 | Legacy

5 (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)

4.5.6.2.2 Newton's Second Law

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 1200ºC.

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

.....

.....

(1 mark)

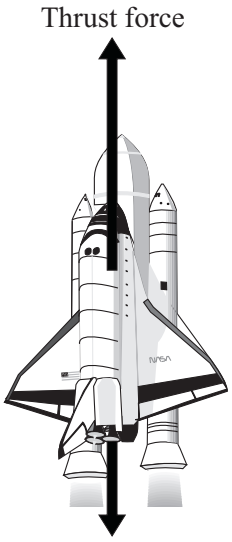
9

4.5.6.2.2 Newton's Second Law

Question 04

June 2004 | 3462H3 | Original Q5 | Legacy

5 (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)

4.5.6.2.2 Newton's Second Law

Question 04 · 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

4.5.6.2.2 Newton's Second Law

Question 05

June 2006 | 3451 | Original Q12 | Legacy

12 (a) The diagram shows an athlete accelerating.



The athlete has a mass of 65 kg and produces a constant forward force of 364 N.

(i) Write down the equation that links acceleration, force and mass.

.....

(1 mark)

(ii) Calculate the maximum acceleration of the athlete.

Show clearly how you work out your answer.

.....

.....

Acceleration = ... m/s^2

(2 marks)

(b) The athlete's forward force is the same throughout the race.

Explain why the acceleration of the athlete decreases to zero during the race.

.....

.....

.....

.....

(2 marks)

5

4.5.6.2.2 Newton's Second Law

Question 06

June 2006 | 3462 | Original Q10 | Legacy

10 (a) The diagram shows an athlete accelerating.



The athlete has a mass of 65 kg and produces a constant forward force of 364 N.

(i) Write down the equation that links acceleration, force and mass.

.....

(1 mark)

(ii) Calculate the maximum acceleration of the athlete.

Show clearly how you work out your answer.

.....

.....

Acceleration = ... m/s^2

(2 marks)

(b) The athlete's forward force is the same throughout the race.

Explain why the acceleration of the athlete decreases to zero during the race.

.....

.....

.....

.....

(2 marks)

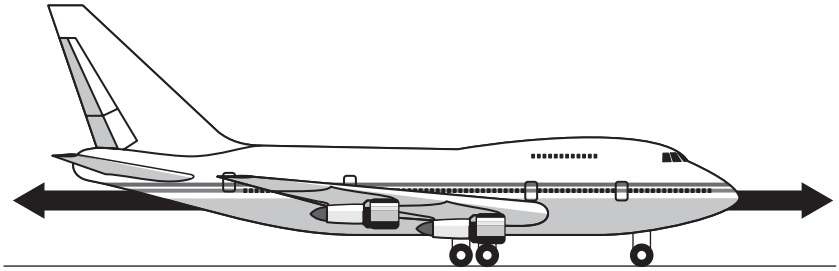
5

4.5.6.2.2 Newton's Second Law

Question 07

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)

4.5.6.2.2 Newton's Second Law

Question 07 · continued

BLANK

(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

4.5.6.2.2 Newton's Second Law

Question 08

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.

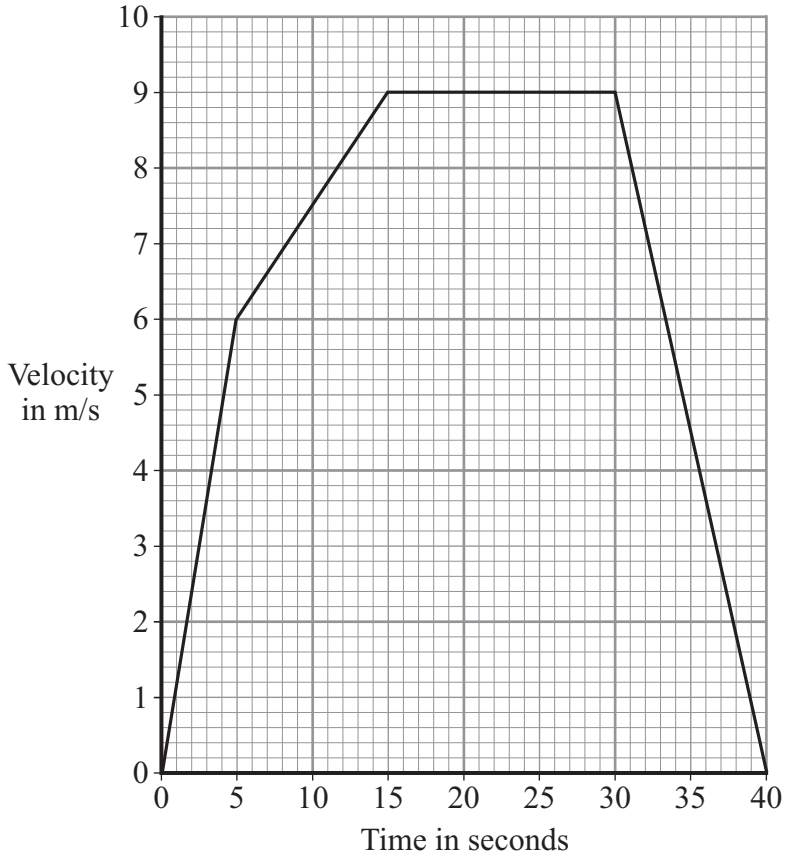
.....

.....

Resultant force = ...

(3 marks)

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



4.5.6.2.2 Newton's Second Law

Question 08 · continued

for mark

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

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

(1 mark)

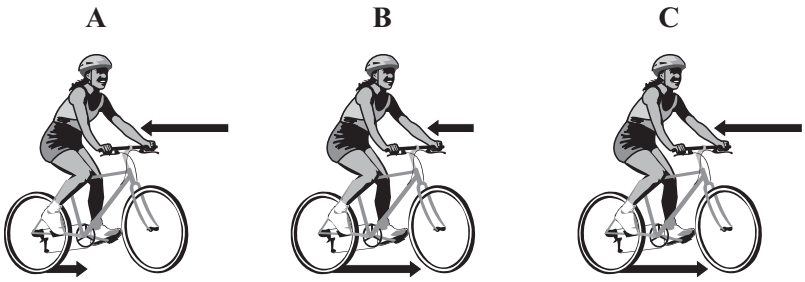
1 (b) (ii) Why has the data for the cyclist been shown as a line graph instead of a bar chart?

.....

.....

(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.

.....

.....

.....

.....

.....

.....

(3 marks)

8

4.5.6.2.2 Newton's Second Law

Question 09

January 2010 | PHY3H | Original Q1 | Legacy

1 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 ^{o}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

1 (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)

1 (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)

4.5.6.2.2 Newton's Second Law

Question 09 · continued

for mark

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

.....

(1 mark)

1 (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)

1 (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)

1 (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)

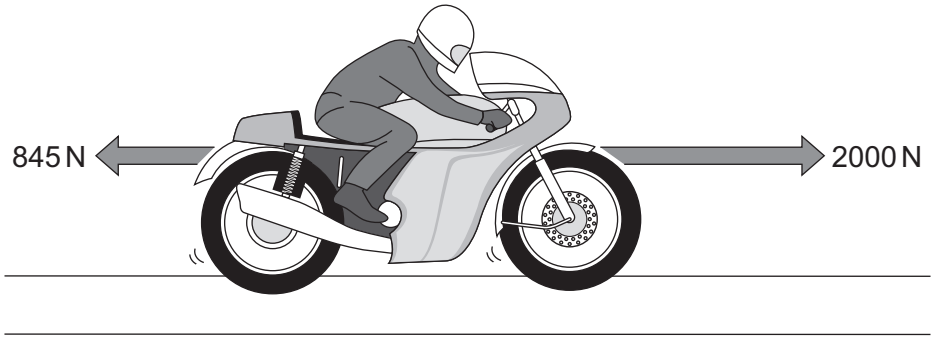
7

4.5.6.2.2 Newton's Second Law

Question 10

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)

4.5.6.2.2 Newton's Second Law

Question 10 · 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

4.5.6.2.2 Newton's Second Law

Question 10 · 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.

.....

.....

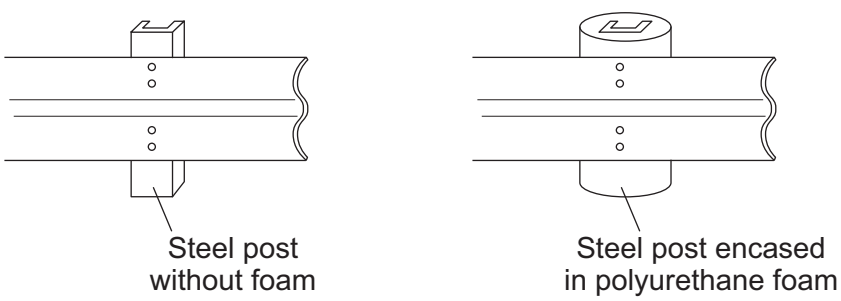
.....

.....

(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.

.....

.....

.....

.....

.....

(3 marks)

4.5.6.2.2 Newton's Second Law

Question 10 · continued

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.

.....

.....

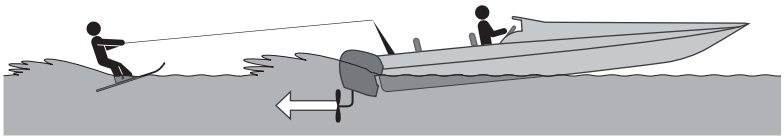
(1 mark)

11

4.5.6.2.2 Newton's Second Law

Question 11

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)

4.5.6.2.2 Newton's Second Law

Question 11 · 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)

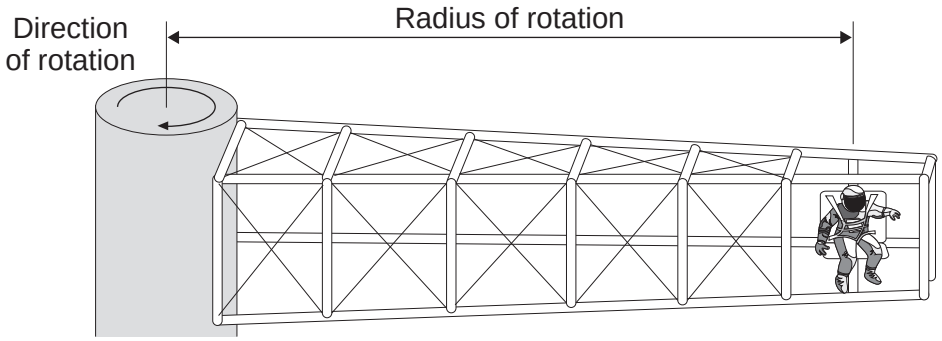
9

4.5.6.2.2 Newton's Second Law

Question 12

June 2013 | PH3HP | Original Q5 | Legacy

5 The diagram shows a 'G-machine'. The G-machine is used in astronaut training.



The G-machine moves the astronaut in a horizontal circle.

5 (a) When the G-machine is rotating at constant speed, the astronaut is accelerating.

State the name and direction of the force causing the astronaut to accelerate.

Name of force .....

Direction of force .....

.....

(2 marks)

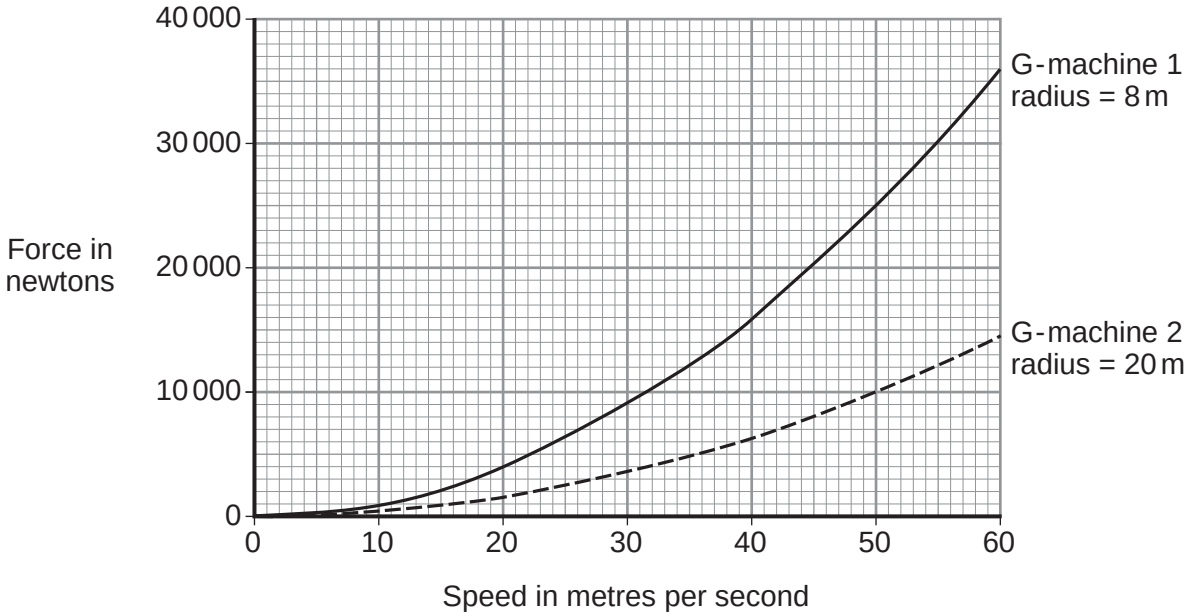
4.5.6.2.2 Newton's Second Law

Question 12 · continued

5 (b) The force causing the astronaut to move in a circle is measured.

The graph shows how the speed of the astronaut affects the force causing the astronaut to move in a circle for two different G-machines.

The radius of rotation of the astronaut is different for each G-machine.



5 (b) (i) State **three** conclusions that can be made from the graph.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

5 (b) (ii) The speed of rotation of G-machine 1 is increased from 20 m/s to 40 m/s.

Determine the change in force on the astronaut.

.....

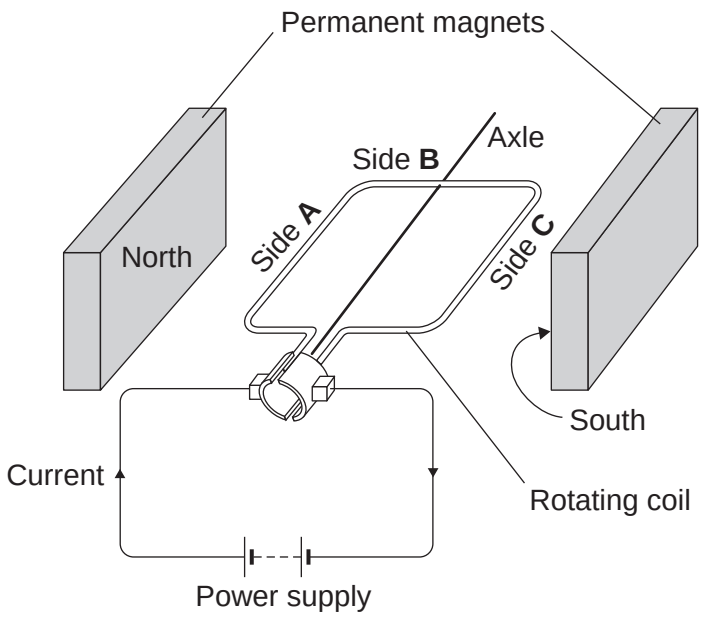
Change in force = ... N

(1 mark)

4.5.6.2.2 Newton's Second Law

Question 12 · continued

5 (c) Each G-machine is rotated by an electric motor. The diagram shows a simple electric motor.



5 (c) (i) A current flows through the coil of the motor.

Explain why side **A** of the coil experiences a force.

.....

.....

.....

.....

(2 marks)

5 (c) (ii) Draw arrows on the diagram to show the direction of the forces acting on side **A** of the coil and side **C** of the coil.

(1 mark)

5 (c) (iii) When horizontal, side **B** experiences no force.

Give the reason why.

.....

.....

(1 mark)

4.5.6.2.2 Newton's Second Law

Question 12 · continued

5 (d) While a G-machine is rotating, the operators want to increase its speed.

What can the operators do to make the G-machine rotate faster?

.....

.....

(1 mark)

5 (e) The exploration of space has cost a lot of money.

Do you think spending lots of money on space exploration has been a good thing?

Draw a ring around your answer.

Yes **No**

Give a reason for your answer.

.....

.....

(1 mark)

12

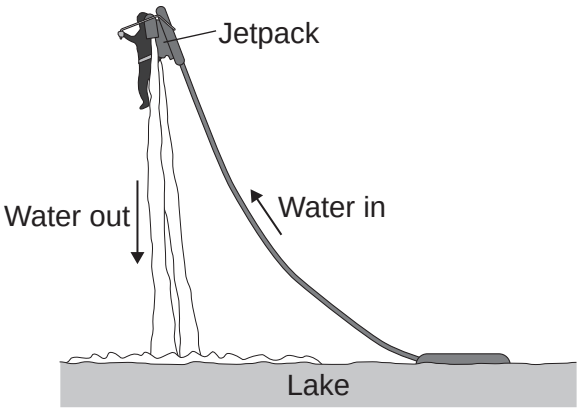
4.5.6.2.2 Newton's Second Law

Question 13

June 2016 | PH2HP | Original Q7 | Legacy

7 **Figure 14** shows a person using a device called a jetpack. Water is forced downwards from the jetpack and produces an upward force on the person.

Figure 14



7 (a) State the condition necessary for the person to be able to remain stationary in mid-air.

[1 mark]

_____

_____

7 (b) The person weighs 700 N and the jetpack weighs 140 N.

7 (b) (i) Calculate the combined mass of the person and the jetpack.

Gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

Combined mass = _____ kg

4.5.6.2.2 Newton's Second Law

Question 13 · continued

7 (b) (ii) Increasing the upward force to 1850 N causes the person to accelerate upwards.

Calculate the acceleration of the person and the jetpack. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Acceleration = _____ Unit _____

6

4.5.6.2.2 Newton's Second Law

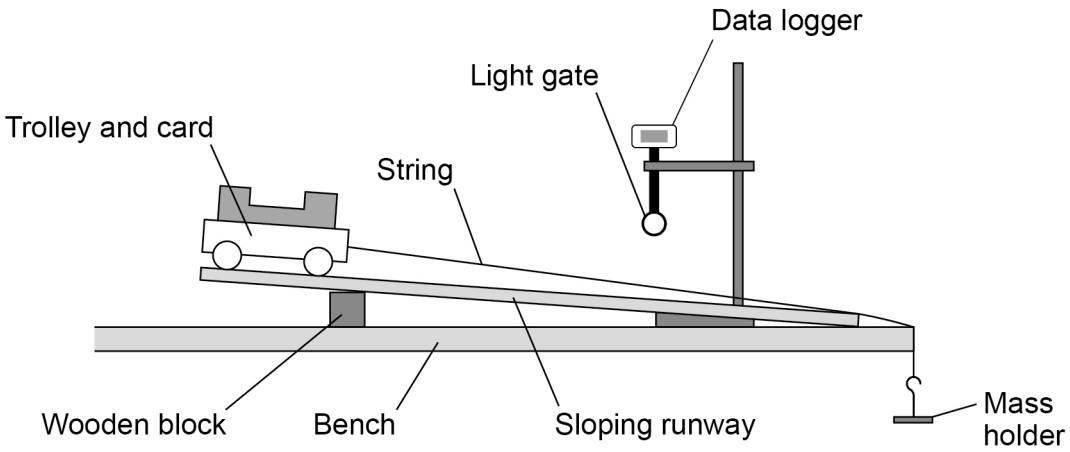
Question 14

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 14 · 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.

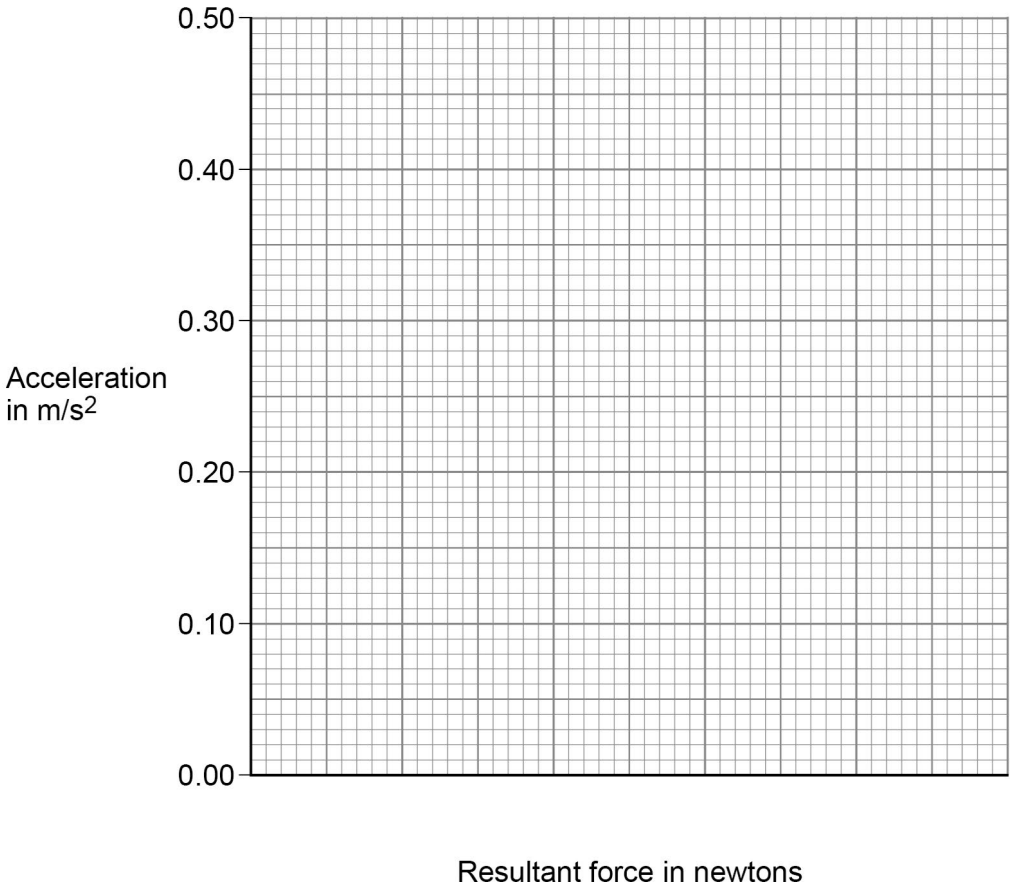
Table 1 shows the results.

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]

4.5.6.2.2 Newton's Second Law

Question 14 · 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

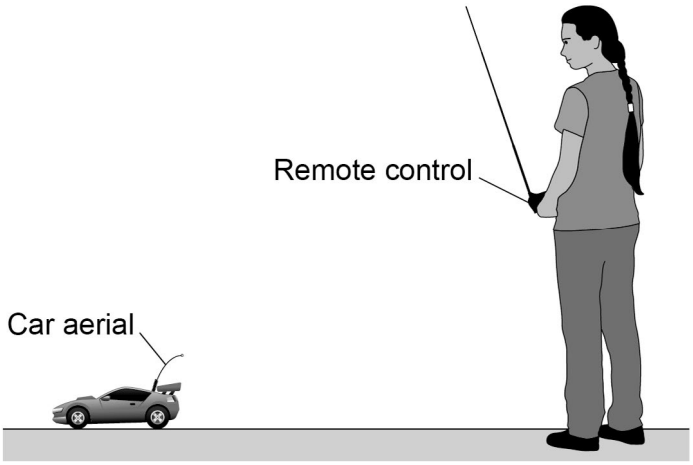
4.5.6.2.2 Newton's Second Law

Question 15

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 _____

4.5.6.2.2 Newton's Second Law

Question 15 · 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

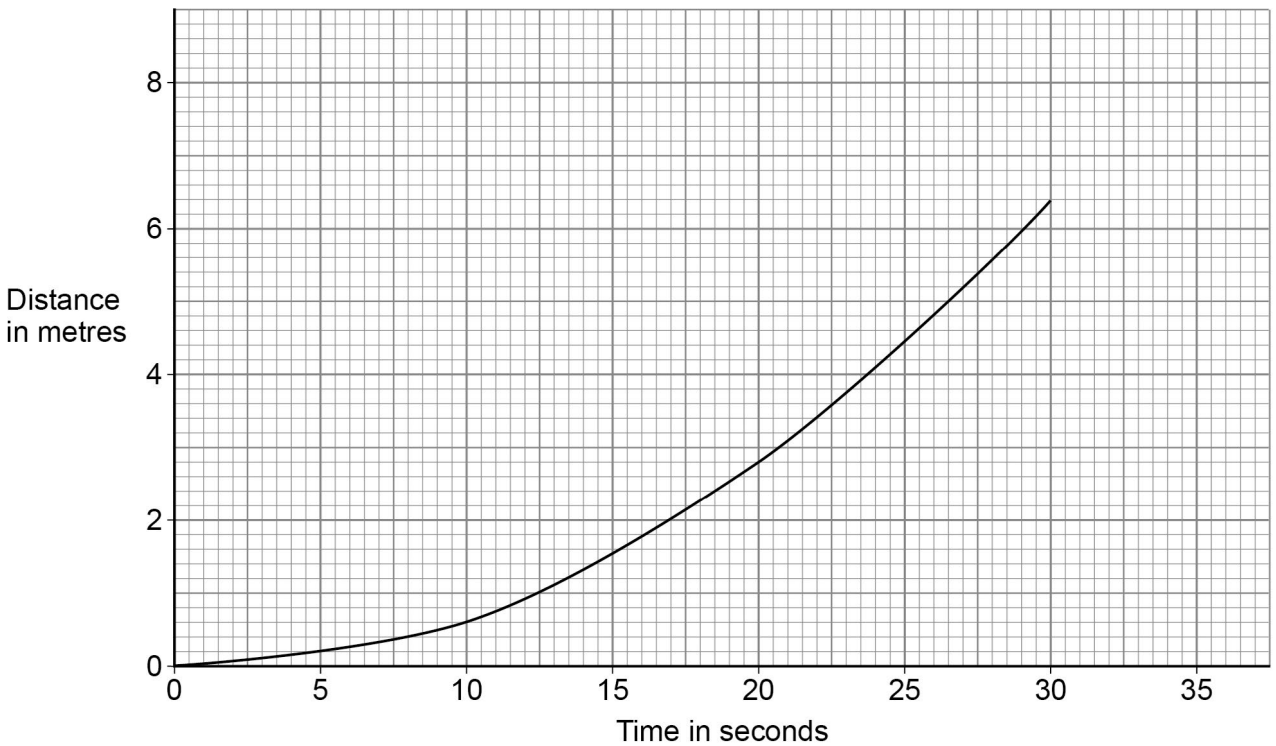
Question 6 continues on the next page

4.5.6.2.2 Newton's Second Law

Question 15 · 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

4.5.6.2.2 Newton's Second Law

Question 15 · 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

4.5.6.2.2 Newton's Second Law

Question 16

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

4.5.6.2.2 Newton's Second Law

Question 16 · 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]

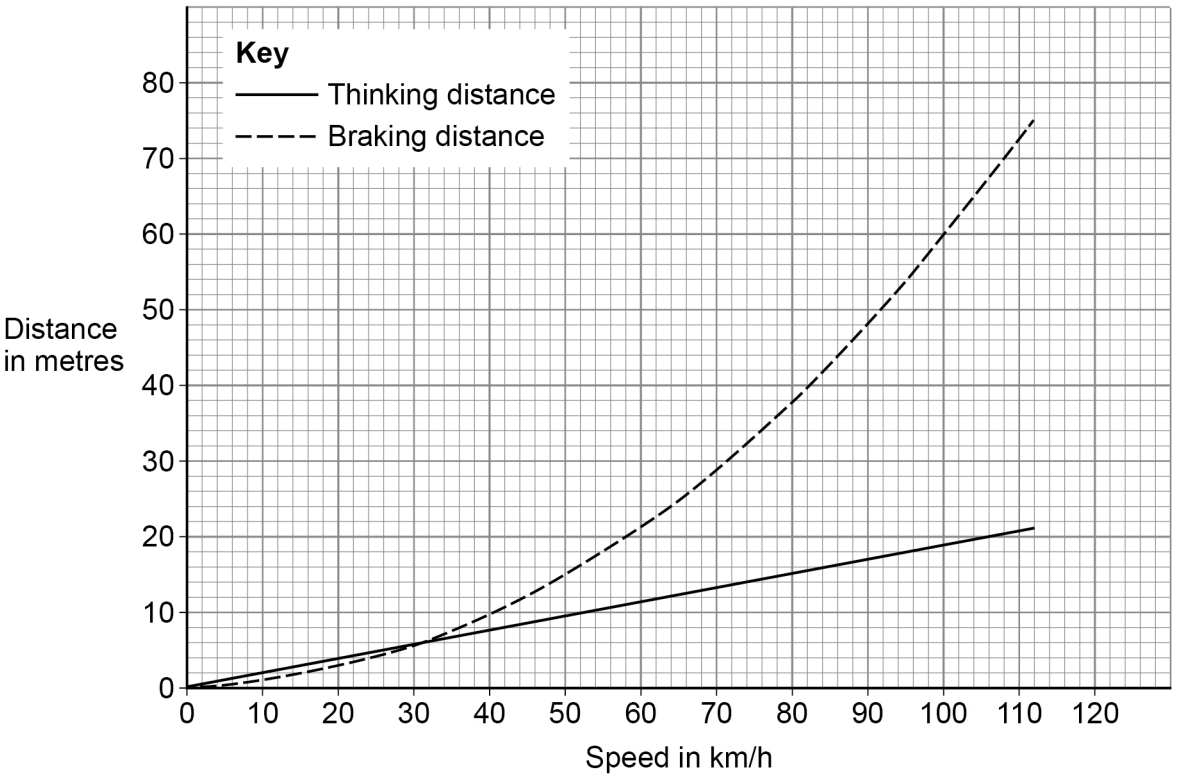
Deceleration = _____ m/s^2

4.5.6.2.2 Newton's Second Law

Question 16 · 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

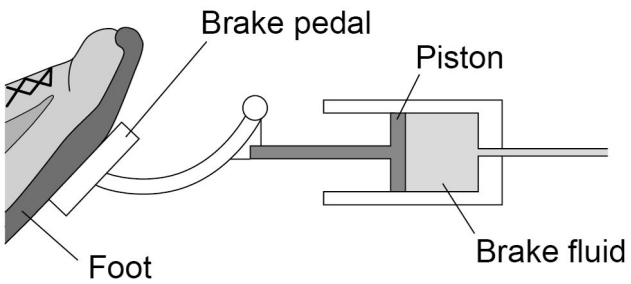
Question 1 continues on the next page

4.5.6.2.2 Newton's Second Law

Question 16 · 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.

$p = F \times A$ ☐

$p = F \times A^2$ ☐

$p = \frac{F}{A}$ ☐

$p = \frac{A}{F}$ ☐

4.5.6.2.2 Newton's Second Law

Question 16 · 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

4.5.6.2.2 Newton's Second Law

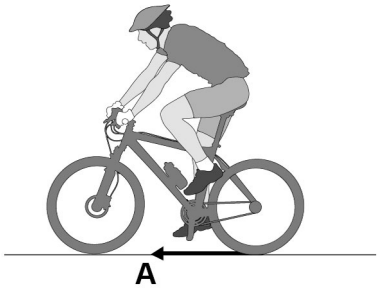
Question 17

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

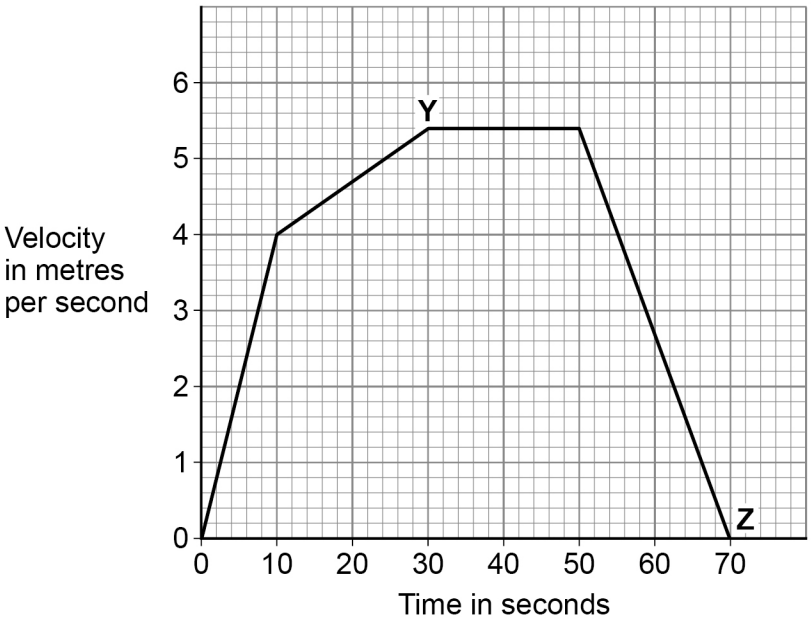


0 7 . 1 What name is given to force **A**?

[1 mark]

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

Figure 12



Question 17 · continued

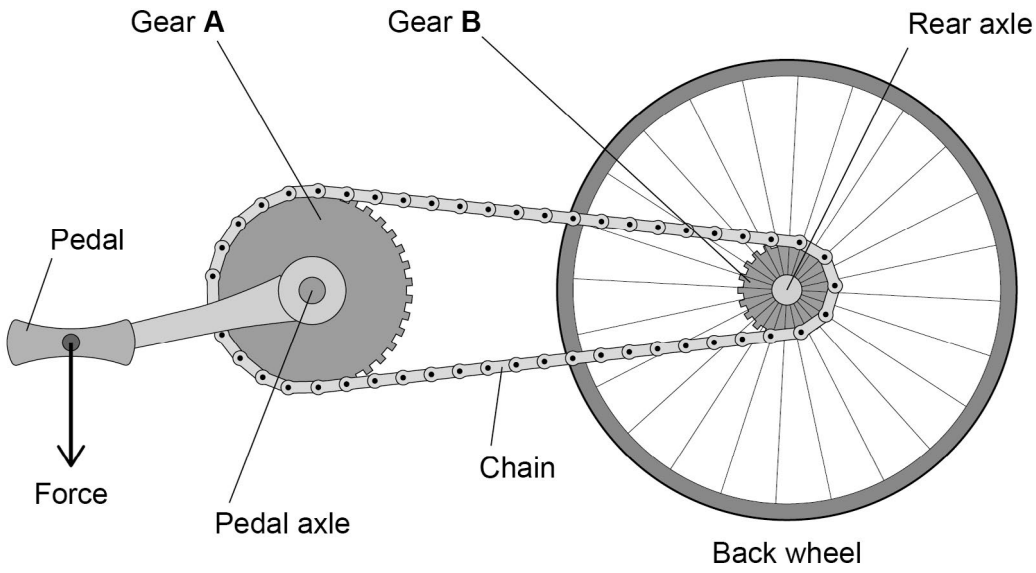
0 7 . 2 Determine the distance travelled by the cyclist between **Y** and **Z**.

[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]

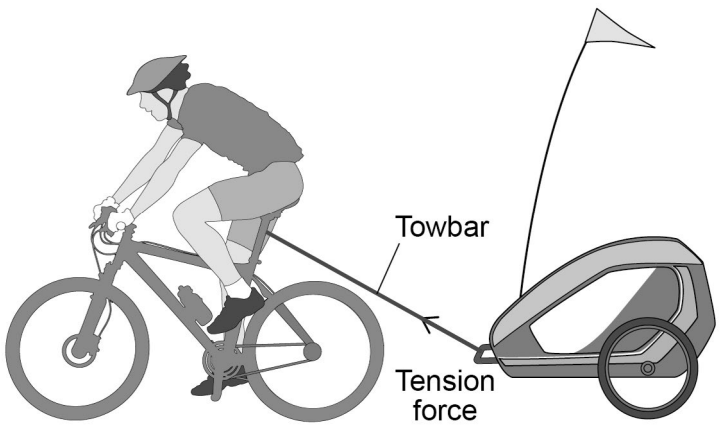
Question 7 continues on the next page

4.5.6.2.2 Newton's Second Law

Question 17 · 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

4.5.6.2.2 Newton's Second Law

Question 17 · continued

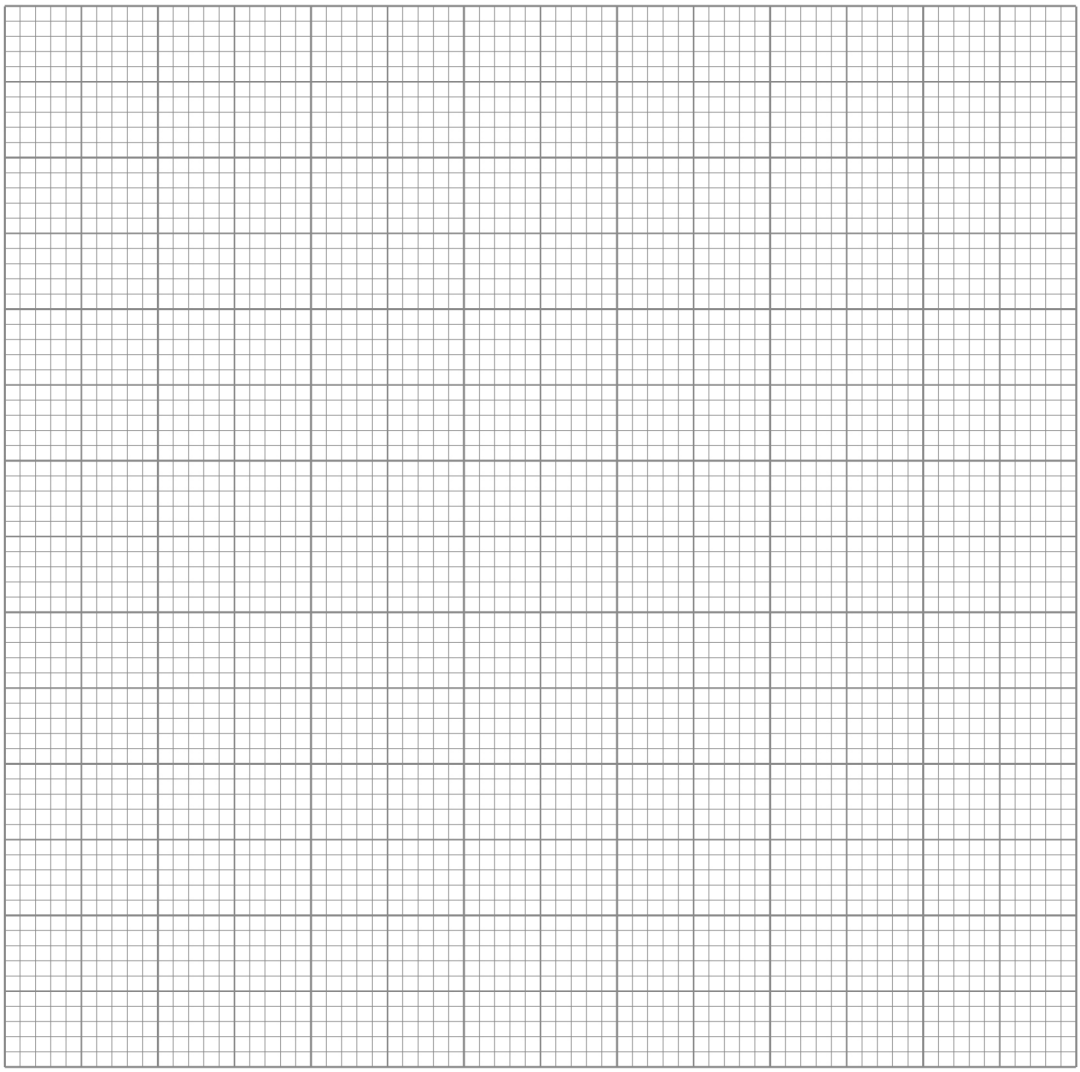
0 7 . 5 The resultant force of the towbar on the trailer has a horizontal component and a vertical component.

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

4.5.6.2.2 Newton's Second Law

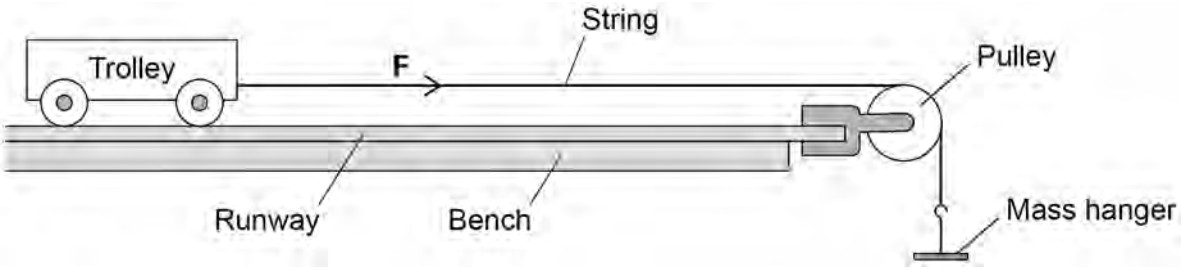
Question 18

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

4.5.6.2.2 Newton's Second Law

Question 18 · 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

4.5.6.2.2 Newton's Second Law

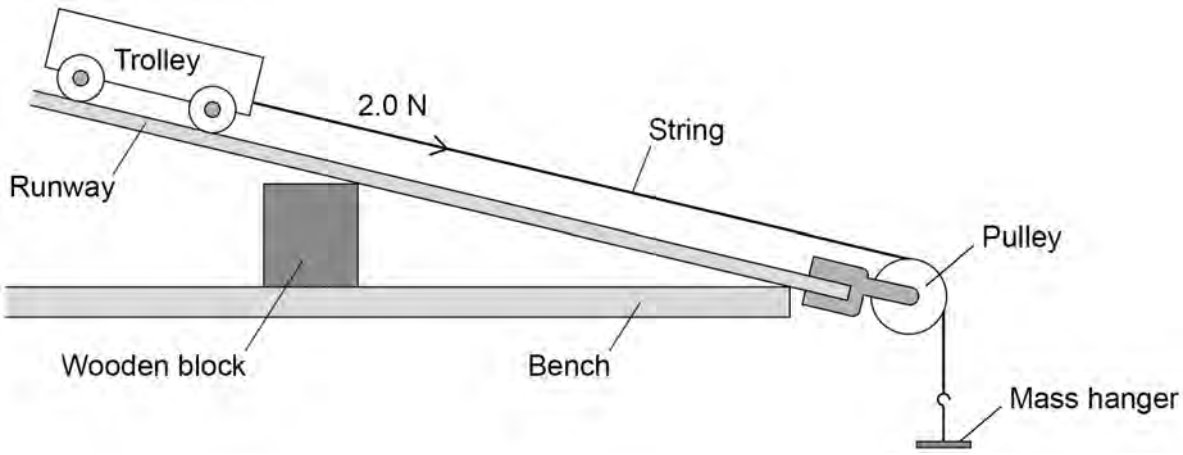
Question 18 · continued

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