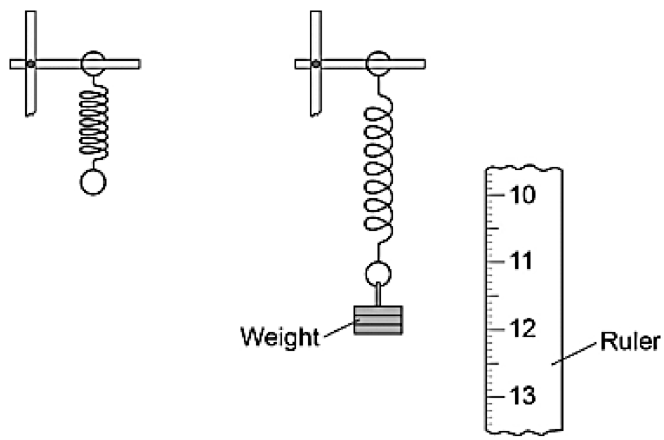
Motion GCSE AQA Higher Physics Past Papers Questions

01.

A student suspended a spring from a laboratory stand and then hung a weight from the spring.

Figure 1 shows the spring before and after the weight is added.

Figure 1



1 Measure the extension of the spring shown in **Figure 1**.

[1 mark]

Extension = ______________ mm

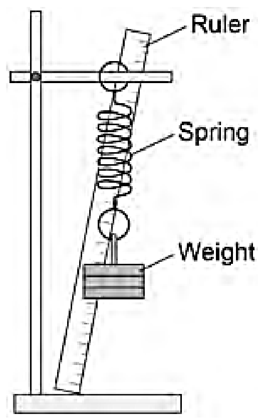
The student used the spring, a set of weights and a ruler to investigate how the extension of the spring depended on the weight hanging from the spring.

Before starting the investigation the student wrote the following prediction:

The extension of the spring will be directly proportional to the weight hanging from the spring.

Figure 2 shows how the student arranged the apparatus.

Figure 2



2 Before taking any measurements, the student adjusted the ruler to make it vertical.

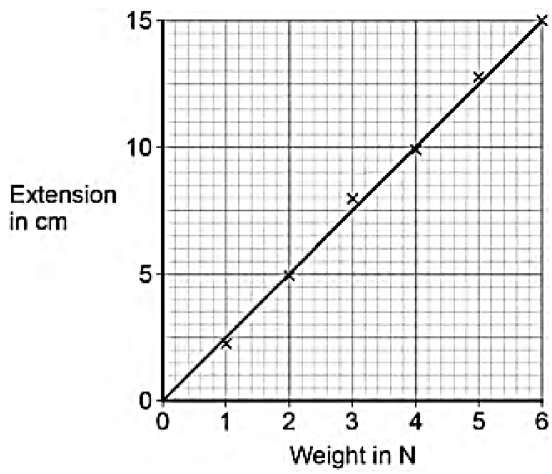
Explain why adjusting the ruler was important.

[2 marks]

The student measured the extension of the spring using a range of weights.

The student's data is shown plotted as a graph in **Figure 3**.

Figure 3



3 What range of weight did the student use?

[1 mark]

4 Why does the data plotted in **Figure 3** support the student's prediction?

[1 mark]

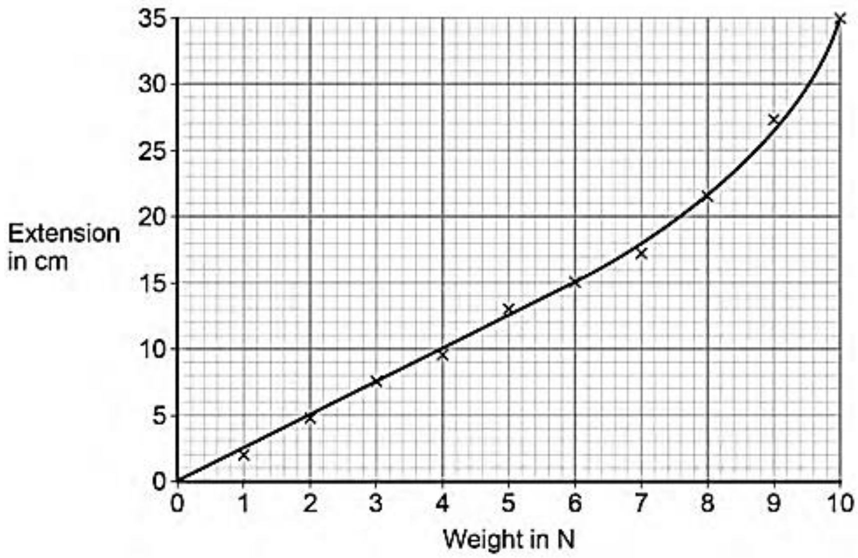
5 Describe **one** technique that you could have used to improve the accuracy of the measurements taken by the student.

[2 marks]

6 The student continued the investigation by increasing the range of weights added to the spring.

All of the data is shown plotted as a graph in **Figure 4**.

Figure 4



At the end of the investigation, all of the weights were removed from the spring.

What can you conclude from **Figure 4** about the deformation of the spring?

[2 marks]

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Give the reason for your conclusion.

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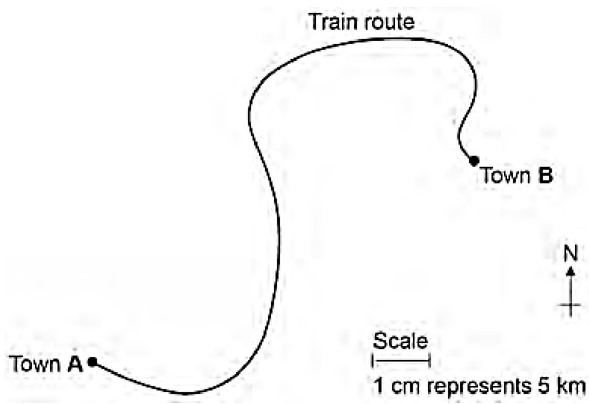
02.

A train travels from town **A** to town **B**.

Figure 14 shows the route taken by the train.
Figure 14 has been drawn to scale.

Figure 14



. 1 The distance the train travels between **A** and **B** is not the same as the displacement of the train.

What is the difference between distance and displacement?

[1 mark]

. 2 Use **Figure 14** to determine the displacement of the train in travelling from **A** to **B**.

Show how you obtain your answer.

[2 marks]

Displacement = ______________ km

Direction = ______________

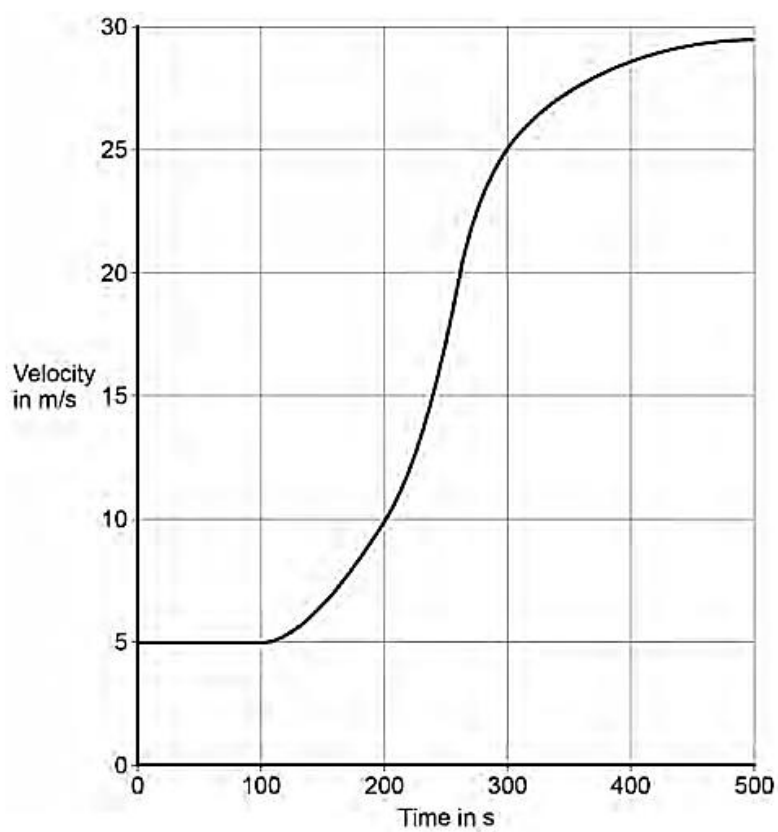
3 There are places on the journey where the train accelerates without changing speed.

Explain how this can happen.

[2 marks]

4 **Figure 15** shows how the velocity of the train changes with time as the train travels along a straight section of the journey.

Figure 15



Estimate the distance travelled by the train along the section of the journey shown in **Figure 15**.

To gain full marks you must show how you worked out your answer.

[3 marks]

Distance = ________________ m

03.

The stopping distance of a car is the sum of the thinking distance and the braking distance.

Table 4 shows how the thinking distance and braking distance vary with speed.

Table 4

Speed in m/s	Thinking distance in m	Braking distance in m
10	6	6.0
15	9	13.5
20	12	24.0
25	15	37.5
30	18	54.0

. 1 What is meant by the braking distance of a vehicle?

[1 mark]

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____

. 2 The data in **Table 4** refers to a car in good mechanical condition driven by an alert driver.

Explain why the stopping distance of the car increases if the driver is very tired.

[2 marks]

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3 A student looks at the data in **Table 4** and writes the following:

thinking distance ∝ speed

braking distance ∝ speed

Explain whether the student is correct.

[2 marks]

Applying the brakes with too much force can cause a car to skid.

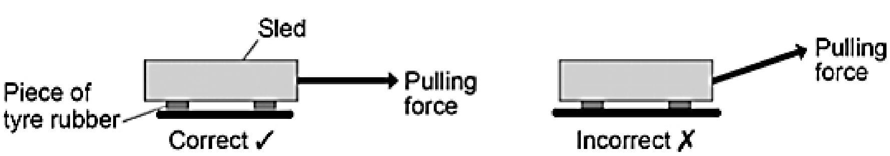
The distance a car skids before stopping depends on the friction between the road surface and the car tyres and also the speed of the car.

Friction can be investigated by pulling a device called a 'sled' across a surface at constant speed.

Figure 16 shows a sled being pulled correctly and incorrectly across a surface.

The constant of friction for the surface is calculated from the value of the force pulling the sled and the weight of the sled.

Figure 16



4 Why is it important that the sled is pulled at a constant speed?

[1 mark]

Tick **one** box.

If the sled accelerates it will be difficult to control. ☐

If the sled accelerates the value for the constant of friction will be wrong. ☐

If the sled accelerates the normal contact force will change. ☐

5 If the sled is pulled at an angle to the surface the value calculated for the constant of friction would not be appropriate.

Explain why.

[2 marks]

6 By measuring the length of the skid marks, an accident investigator determines that the distance a car travelled between the brakes being applied and stopping was 22 m.

The investigator used a sled to determine the friction. The investigator then calculated that the car decelerated at 7.2 m/s^2.

Calculate the speed of the car just before the brakes were applied.

Give your answer to two significant figures.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

Speed = ______________________ m/s

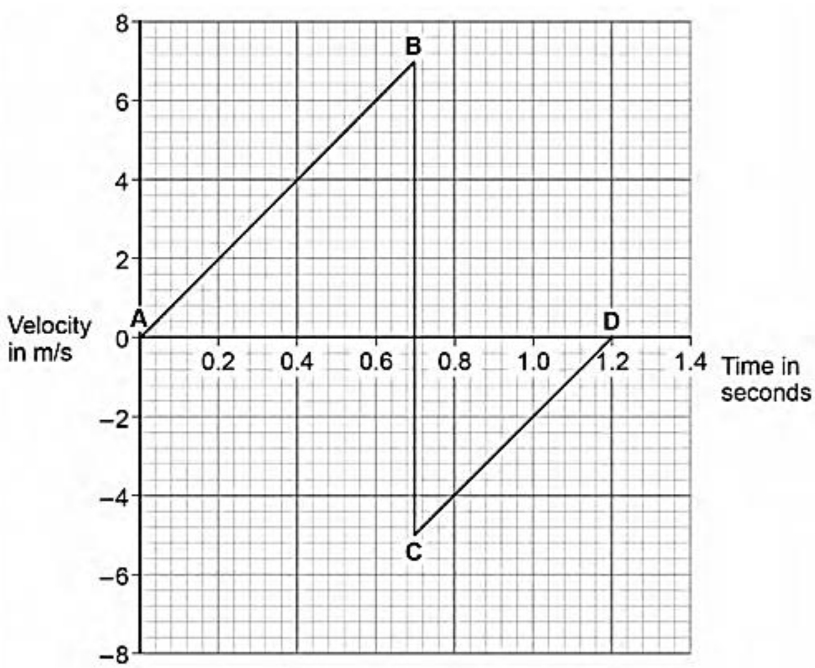
04. A child drops a ball.

The ball hits the ground and bounces.

Figure 1 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 1



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

[2 marks]

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

[1 mark]

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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. ☐

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

Explain how the data in **Figure 1** shows this energy transfer.

[4 marks]

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8

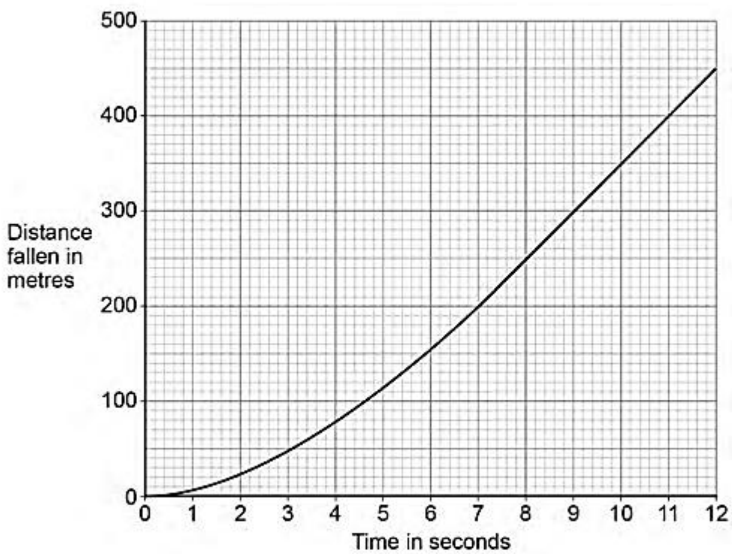
05.

An aeroplane is 4000 m above the Earth's surface.

A skydiver jumps from the aeroplane and falls vertically.

Figure 15 shows the distance the skydiver falls during the first 12 seconds after jumping.

Figure 15

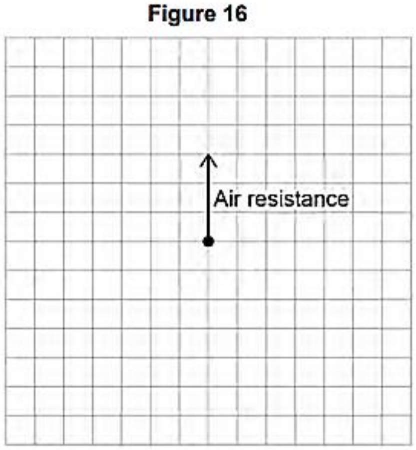


1 **Figure 16** shows part of the free body diagram for the skydiver three seconds after jumping.

Complete the free body diagram for the skydiver.

[2 marks]

Figure 16



. 2 Explain the changing motion of the skydiver in terms of the forces acting on the skydiver.

[4 marks]

. 3 Use **Figure 15** to determine the speed of the skydiver between 7 seconds and 12 seconds.

[3 marks]

Speed = ____________________ m/s

. 4 In 2012 a skydiver jumped from a helium balloon 39 000 metres above the Earth's surface. The skydiver reached a maximum speed of 377 m/s

Jumping from 39 000 metres allowed the skydiver to reach a much higher speed than a skydiver jumping from 4000 metres.

Explain why.

[3 marks]

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12

06.

. 1 **Table 3** gives the frequencies in the hearing ranges of five different animals.

Table 3

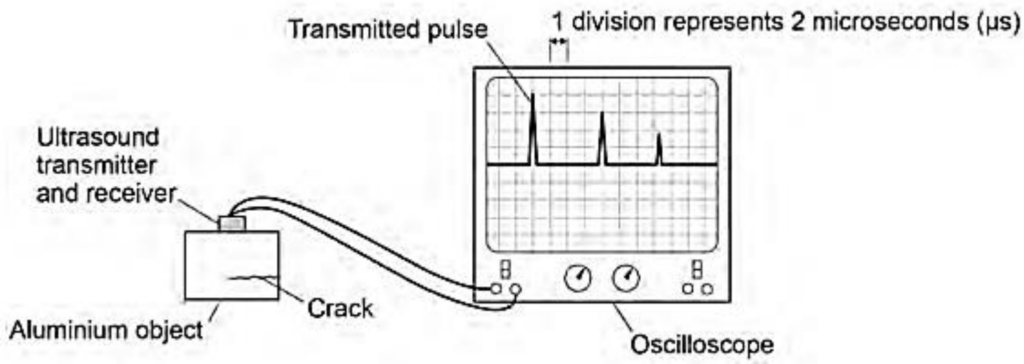
Animal	Frequencies of hearing range
Cat	55 Hz to 77 kHz
Chicken	125 Hz to 2 kHz
Dog	20 Hz to 30 kHz
Gerbil	56 Hz to 60 kHz
Horse	55 Hz to 33 kHz

Which **one** of the animals from **Table 3** would not be able to hear ultrasound?

[1 mark]

Figure 17 shows ultrasound being used to detect a hidden crack in a solid aluminium object. The transmitted and reflected pulses of ultrasound are shown on the screen.

Figure 17



07.

Which of the following is the same as 2 microseconds?

[1 mark]

Tick (✓) **one** box.

2×10^{3} s ☐

2×10^{-3} s ☐

2×10^{-6} s ☐

2×10^{-9} s ☐

08.

Ultrasound travels at 6300 m/s in aluminium.

Determine the depth of the crack below the top surface of the aluminium.

Use information from **Figure 17**.

Give your answer to **two** significant figures.

[4 marks]

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Depth = ____________________ m

Figure 18 shows the parts of a moving-coil microphone.

Figure 18

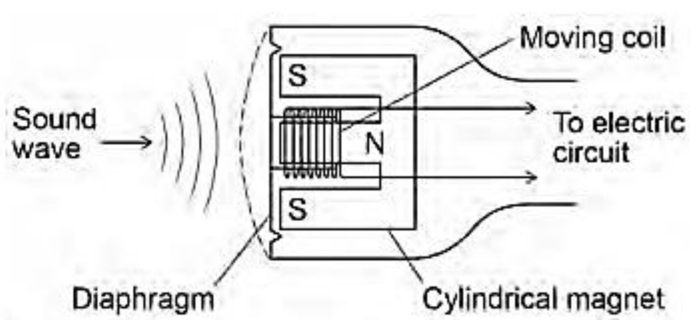
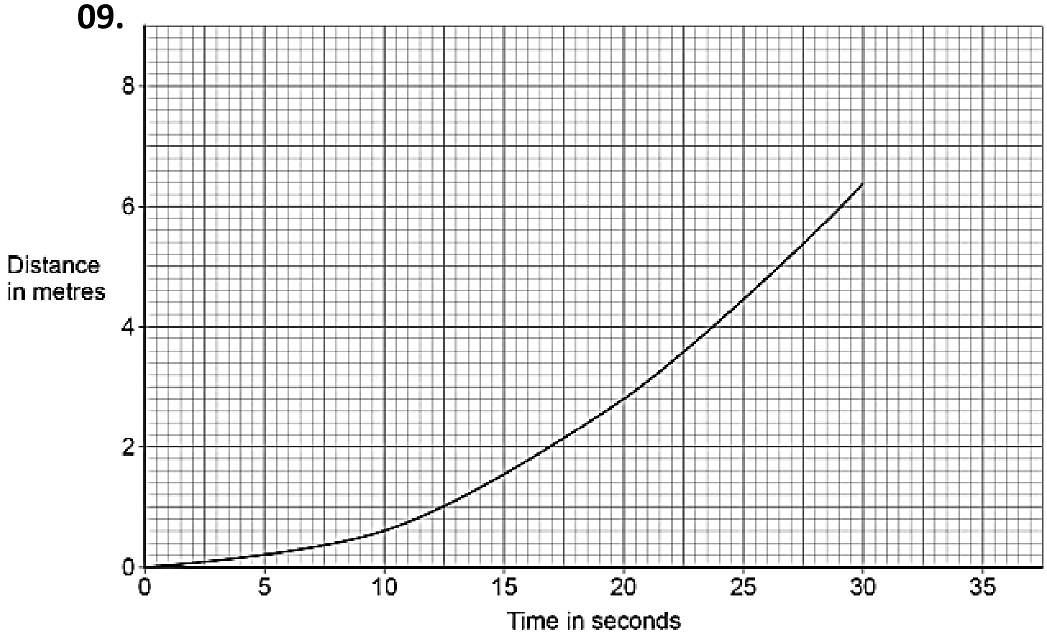


Figure 9

09.



Describe the motion of the car during the first 30 seconds.

[1 mark]

10.
Determine the speed of the car 20 seconds after it started to move.

[4 marks]

Speed = ____________ m/s

11.

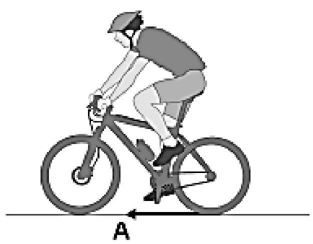
Explain why the car has a maximum speed.

[4 marks]

12. **Figure 11** shows a cyclist riding a bicycle.

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

Figure 11



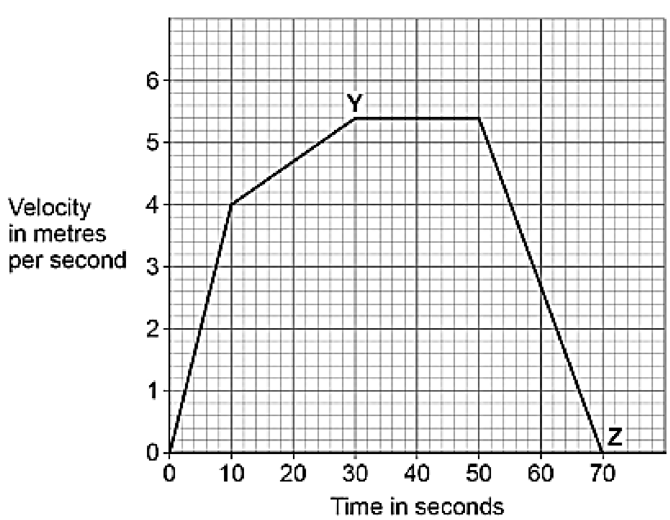
. 1 What name is given to force **A**?

[1 mark]

____

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

Figure 12



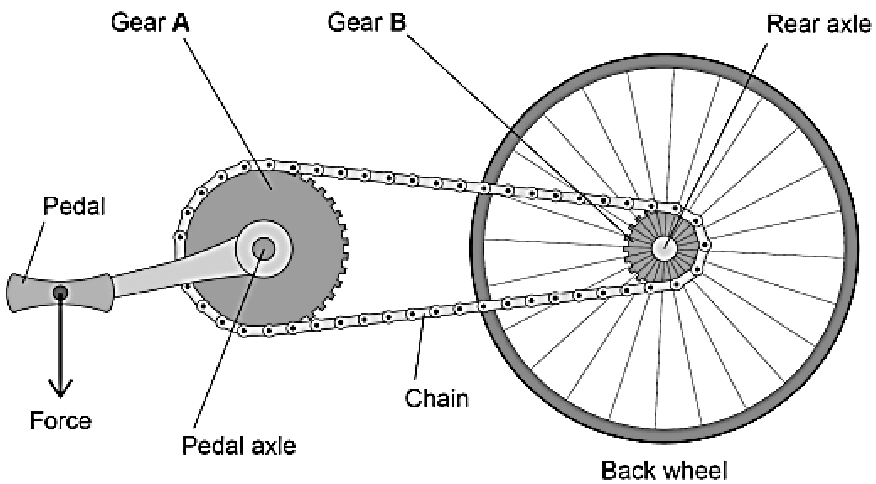
2 Determine the distance travelled by the cyclist between **Y** and **Z**.

[3 marks]

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

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

Figure 13

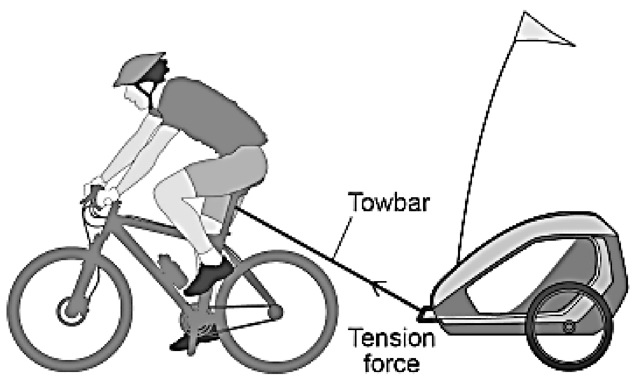


Describe how the force on the pedal causes a moment about the rear axle.

[2 marks]

Figure 14 shows a different cyclist towing a trailer.

Figure 14



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]

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Acceleration = ____________________ m/s^2

. 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

13.

Figure 1 shows an electric super-car.

Figure 1

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 ____

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

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

[1 mark]

____

. **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]

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____

Time taken = ______________________ s

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

Use the Physics Equations Sheet to answer questions **01.5** and **01.6**.

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

[1 mark]

.**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

14. Speed limits on roads increase safety.

1 The braking distance of a car increases as the speed of the car increases.

Give two **other** factors that **increase** the braking distance of a car.

[2 marks]

1 ____

2 ____

2 Explain why the driver's reaction time affects the thinking distance of a car.

[2 marks]

____

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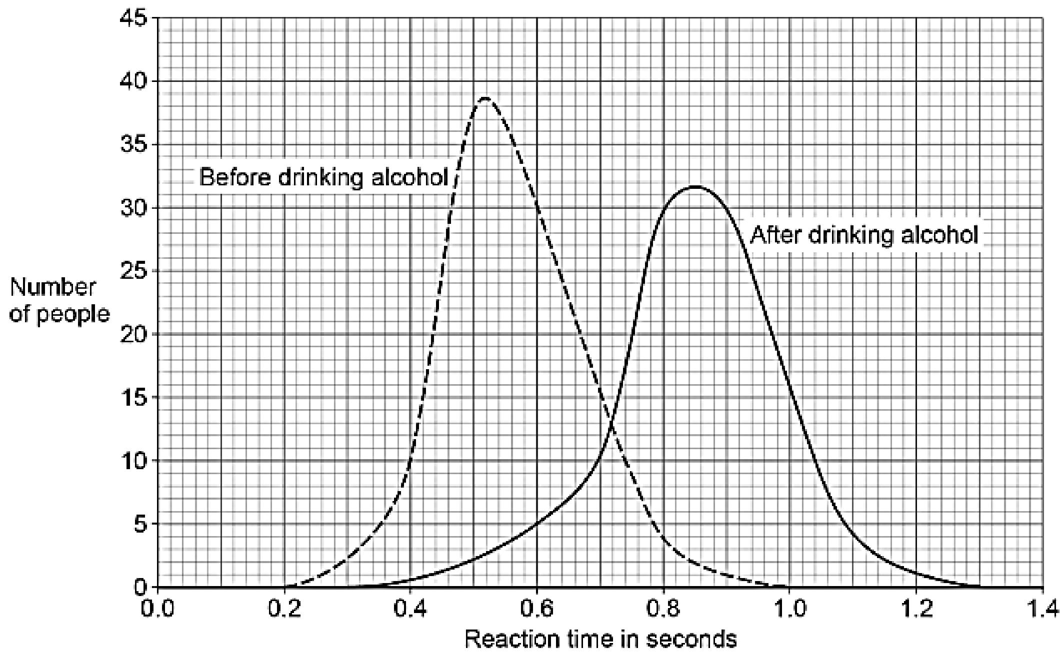
____

____

3 Scientists have investigated how drinking alcohol affects a person's reaction time.

Figure 5 shows the results of the investigation.

Figure 5



Which of the following conclusions can be made using **Figure 5**?

[2 marks]

Tick (✓) **two** boxes.

Every person's reaction time increases after drinking alcohol. ☐

Mean reaction time increases after drinking alcohol. ☐

Some people's reaction time is not affected by drinking alcohol. ☐

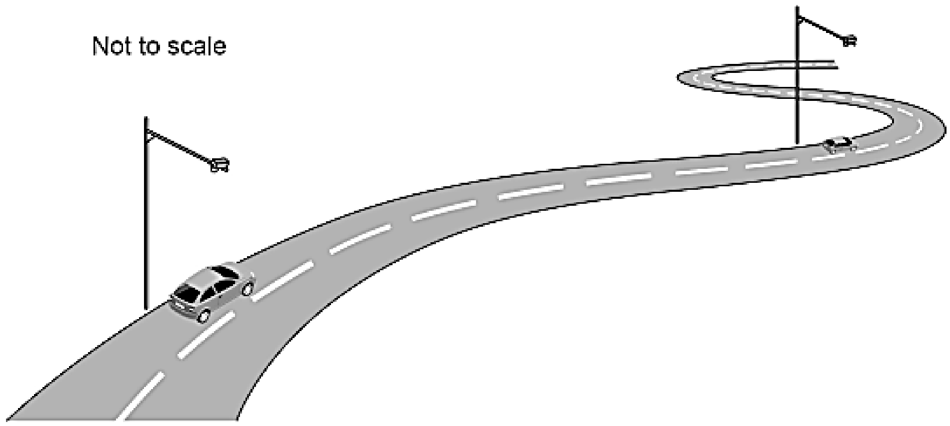
The change in reaction time is not the same for all people after drinking alcohol. ☐

There is a smaller range of reaction times after drinking alcohol. ☐

Figure 6 shows some speed cameras on a road.

The speed cameras determine the average speed of cars on the road.

Figure 6



]. 4 The speed limit on the road in **Figure 6** is 20 m/s.

The cameras in **Figure 6** are 1.5 km apart.

Calculate the minimum time it takes to travel 1.5 km without breaking the speed limit.

Use the Physics Equations Sheet.

[4 marks]

Minimum time = ________________ s

5 The average speed of a car between the cameras and the average velocity of the car between the cameras are different.

Explain why.

[3 marks]

15.

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

Figure 7 shows different-sized hailstones.

Figure 7

A hailstone falls from a cloud and accelerates.

1 Why does the hailstone accelerate?

[1 mark]

____

____

2 The hailstone stops accelerating and reaches terminal velocity.

Explain why the hailstone reaches terminal velocity.

[3 marks]

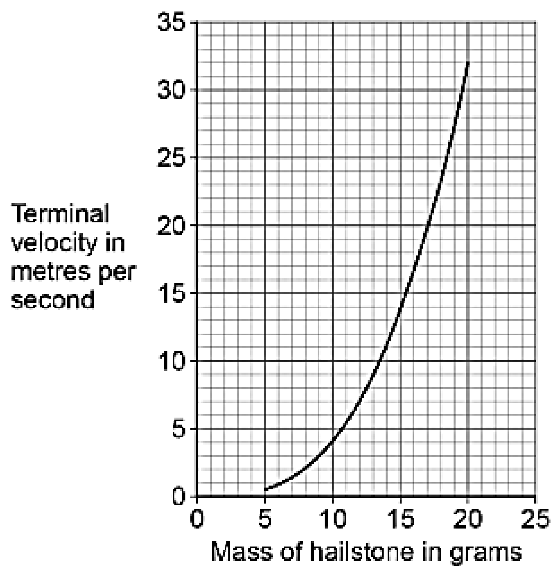
____

____

A scientist investigated how the mass of hailstones affects their terminal velocity.

Figure 8 shows the results.

Figure 8



3 Why does terminal velocity increase with mass?

[1 mark]

Tick (✓) **one** box.

As mass increases the cross-sectional surface area of a hailstone increases. ☐

As mass increases the volume of a hailstone increases. ☐

As mass increases the weight of a hailstone increases. ☐

4 Explain the difference in the maximum kinetic energy of a hailstone with a mass of 10 g and a hailstone with a mass of 20 g.

[3 marks]

5 The kinetic energy of a hailstone is measured in joules.

Which of the following is the same as 1 joule?

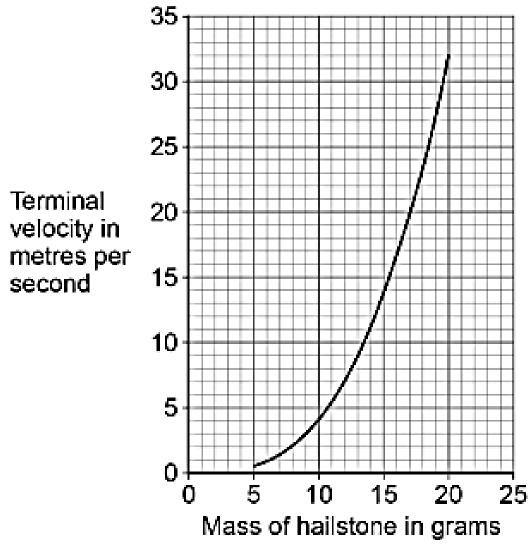
[1 mark]

Tick (✓) **one** box.

- 1 N m ☐
- 1 N/m ☐
- 1 N/m^2 ☐
- 1 N m^2 ☐

Figure 8 is repeated below.

Figure 8



6 A hailstone hit the ground at its terminal velocity of 25 m/s.

The hailstone took 0.060 s to stop moving.

Determine the average force on the hailstone as it hit the ground.

Use information from **Figure 8**.

Use the Physics Equations Sheet.

[3 marks]

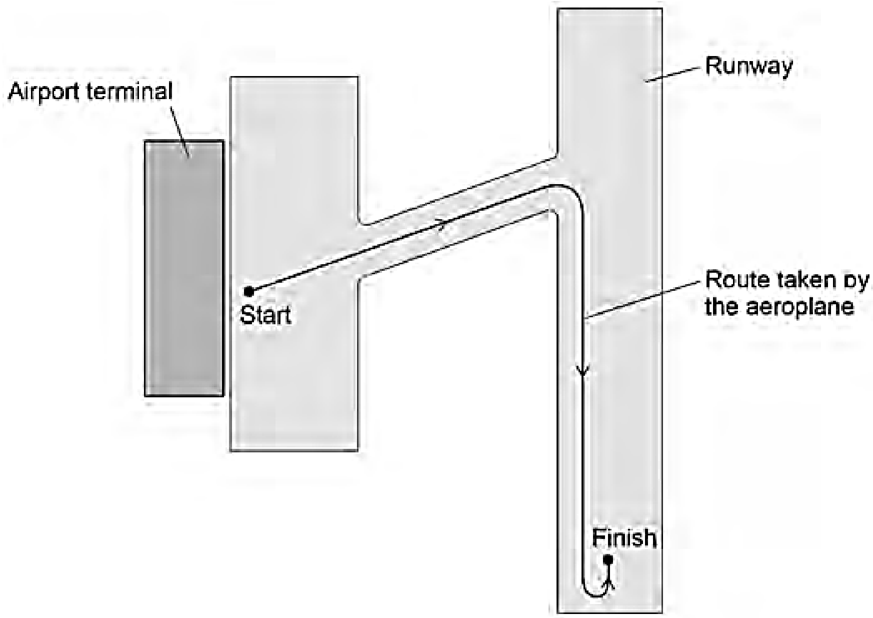
Average force = ____________ N

12

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

Figure 3 has been drawn to scale.

Figure 3



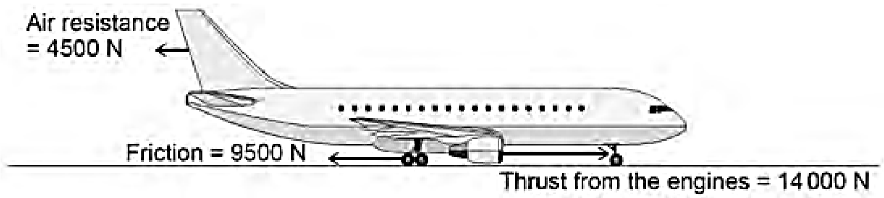
Scale: 1 cm represents 70 m

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

[2 marks]

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

Figure 4



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

[1 mark]

___

___

Resultant horizontal force = ______________ N

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

[1 mark]

___

___

. 4 Air resistance and friction are contact forces.

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

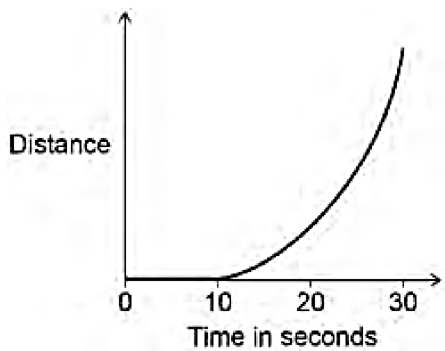
[1 mark]

___

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

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

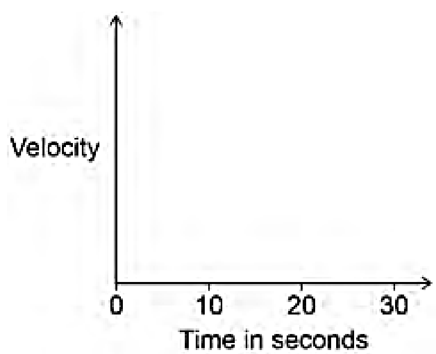
Figure 5



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

[2 marks]

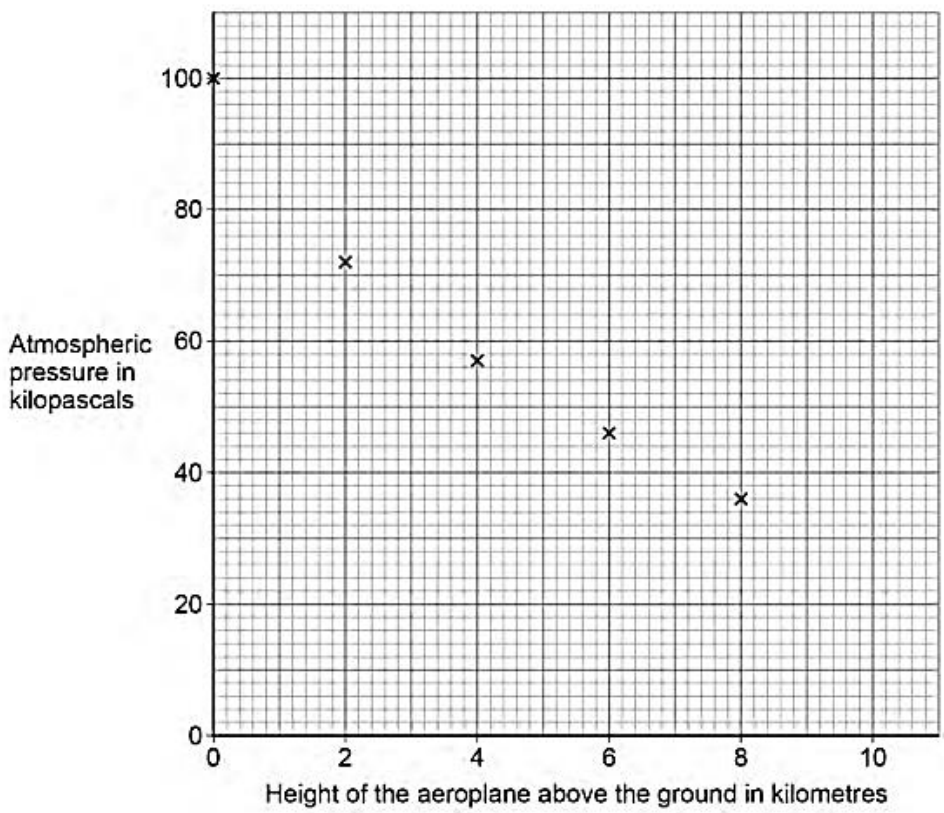
Figure 6



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

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

Figure 7



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

[2 marks]

Atmospheric pressure = ______________________ kPa

]. 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.