AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE PHYSICS

H

Higher Tier Paper 2

Time allowed: 1 hour 45 minutes

Materials

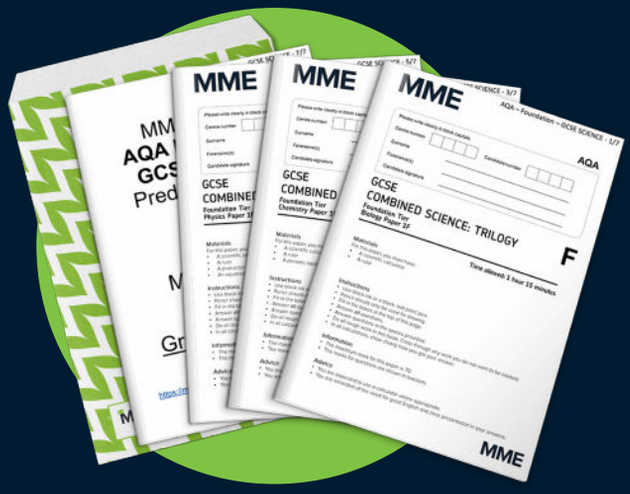
For this paper you must have:
- a ruler
- a scientific calculator
- a protractor
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

MME. Revision Products - GCSE Science



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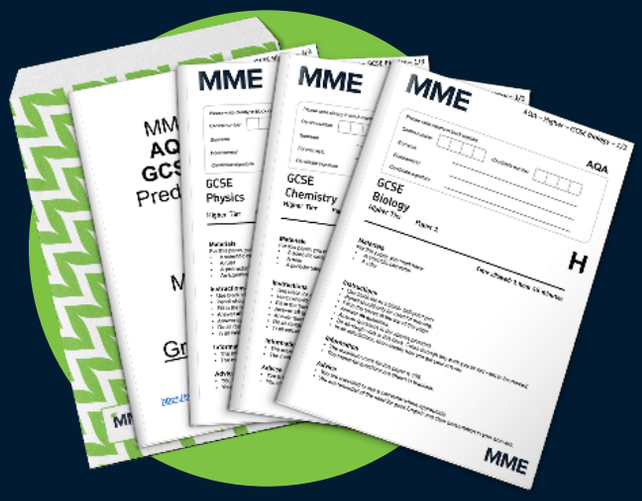

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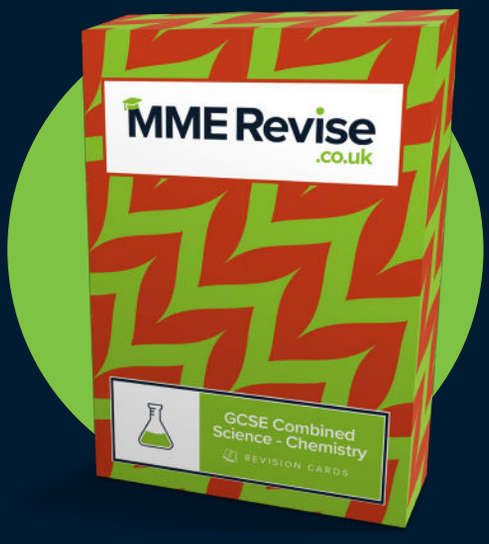

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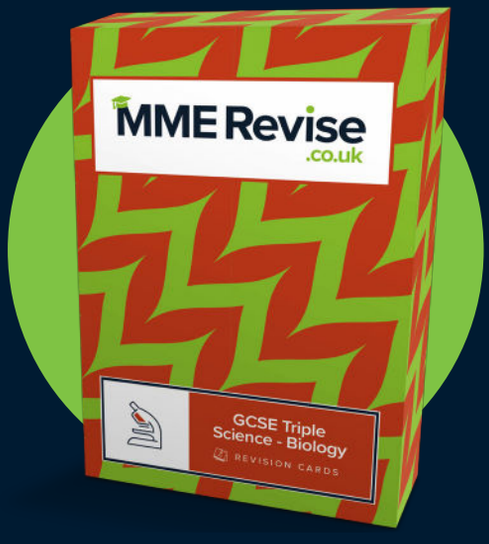

GCSE Triple Science
Revision Cards

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mmerevise.co.uk

Answer **all** questions in the spaces provided.

Do not write outside the box

0 1 **Figure 1** shows an electric super-car.

Figure 1

0 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 Capacity of the battery

2 The mass of the car

Do not write outside the box

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

0 1 . 2 Write down the equation which links acceleration (a), change in velocity (Δv) and time taken (t).

[1 mark]

$a = \Delta v / t$

0 1 . 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]

$a = \Delta v / t$

$20 = 28 - 0 / t$

$20 = 28 / t$ $\quad t = 28/20$

$t = 1.4$ s

Time taken = 1.4 s

Question 1 continues on the next page

Do not write outside the box

0 1 . 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)^2 − (initial velocity)^2 = 2 × a × s

$v^2 - u^2 = 2 \times a \times s$

$v^2 - 0^2 = 2 \times 10 \times 605$

$v^2 = 12100$

$v = \sqrt{12100} = 110$ m/s

Final velocity = 110 m/s

Do not write outside the box

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

0 1 . 5 Write down the equation which links distance (s), force (F) and work done (W).

[1 mark]

$W = Fs$

0 1 . 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]

$s = 7.5 \text{ km} = 7500$

$W = Fs = 4000 \times 7500$

$= 30\,000\,000$

Work done = 30 000 000 J

13

Turn over for the next question

0 2 A student used a ray box to shine a ray of light through air into a glass block.

The student investigated how the angle of refraction varied with the angle of incidence.

Table 1 shows the results.

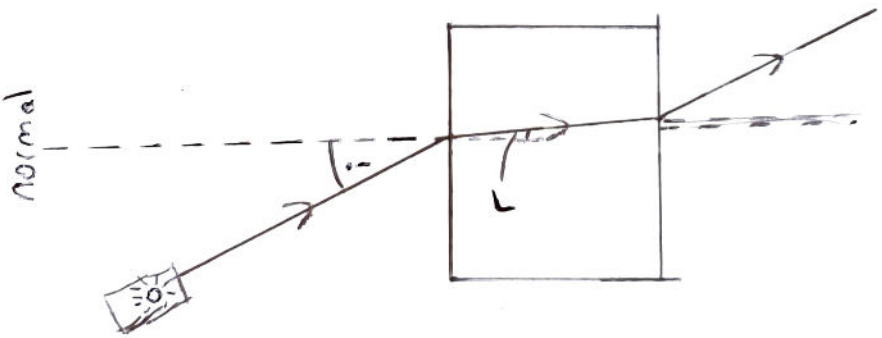
Table 1

Angle of incidence in degrees	Angle of refraction in degrees
10	5
20	10
30	14
40	19
50	23
60	26
70	28
80	29

0 2 . 1 Describe a method the student could have used to obtain the results in **Table 1**.

Your answer may include a labelled diagram.

[6 marks]



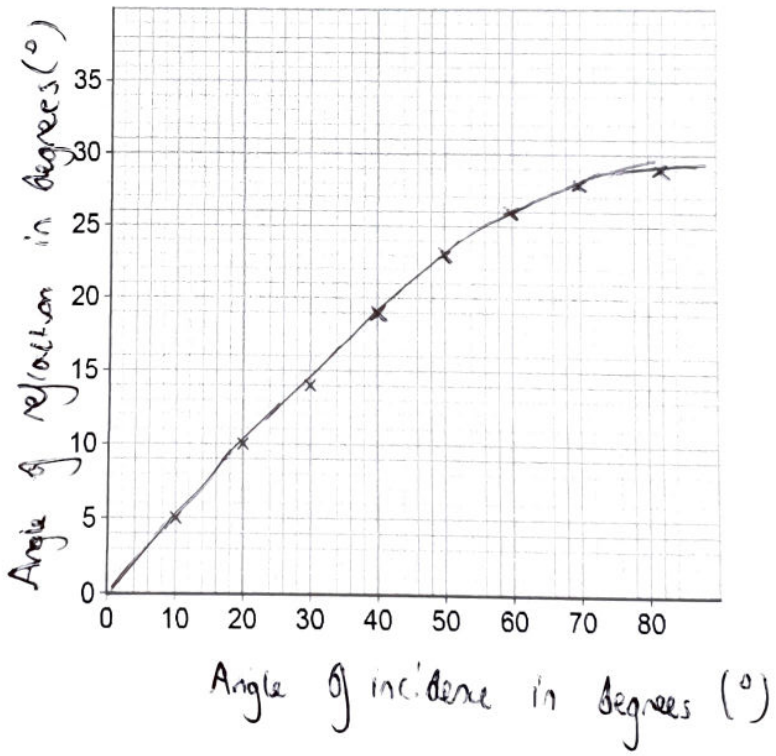
Firstly, place a glass block on a piece of paper, and draw around this glass block. Use a ray box to shine a ray of light through the glass box. Mark where the ray of light enters

Do not write outside the box

and emerges from the glass box. Remove the glass box and join the points to show the path of the complete ray through the block. Draw a normal line at 90 degrees to the surface. Use a protractor to measure the angle of incidence and refraction. Repeat the method by shining the ray box at different angles of incidence. Increase the angle of incidence by 10 degrees each time, up until 70°.

0 2 . 2 **Figure 2** is an incomplete graph of the results.

Figure 2



Complete **Figure 2** using data from **Table 1**.

- Label the axes.
- Plot the remaining data.
- Draw a line of best fit.

[4 marks]

Question 2 continues on the next page

Do not write outside the box

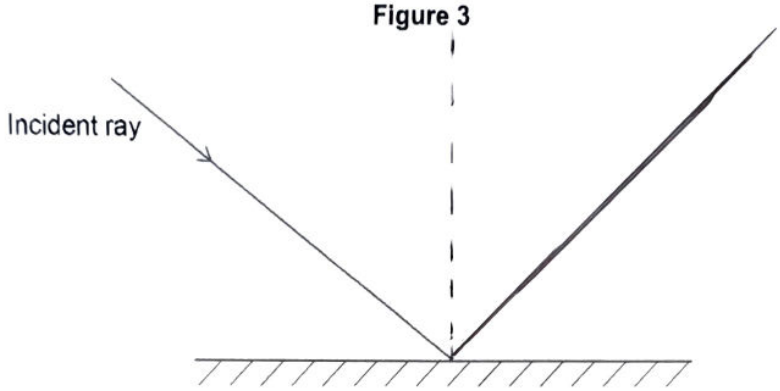
0 2 . 3 Complete the ray diagram in **Figure 3** to show the reflection of light from the surface of a plane mirror.

You should:

- draw the normal line
- draw the reflected ray.

[2 marks]

Figure 3



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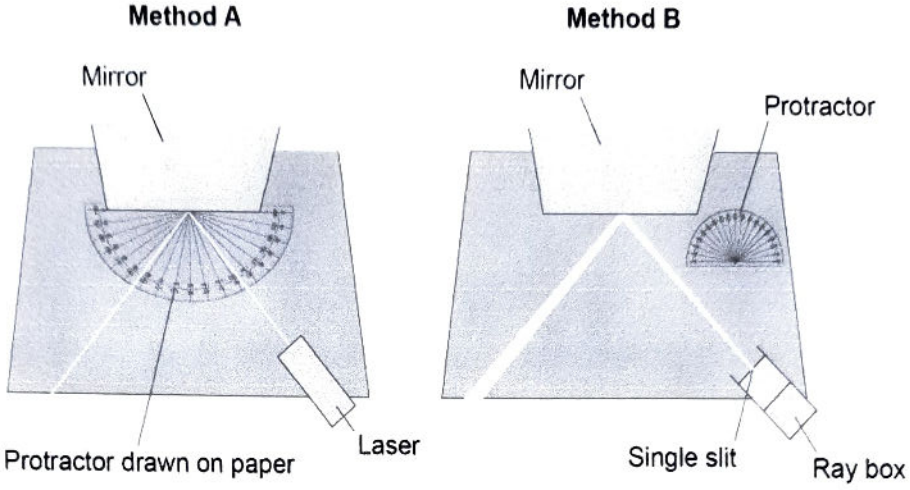
0 2 . 4 Two students investigated the reflection of light by a plane mirror.

Figure 4 shows the different equipment the students used.

Figure 4



Explain **two** ways that **Method A** is better than **Method B**.

[4 marks]

1 Method A is better because you don't have to move the mirror, which means it is more accurate and reduces random error.

2 Method A is also better because the ray doesn't diverge, meaning that it's easier to judge position of the ray.

16

Turn over for the next question

0 3 Speed limits on roads increase safety.

0 3 . 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 Icy road conditions

2 poor condition of breaks

0 3 . 2 Explain why the driver's reaction time affects the thinking distance of a car.

[2 marks]

This is because distance = speed x time. This means the longer the reaction time, the longer the distance.

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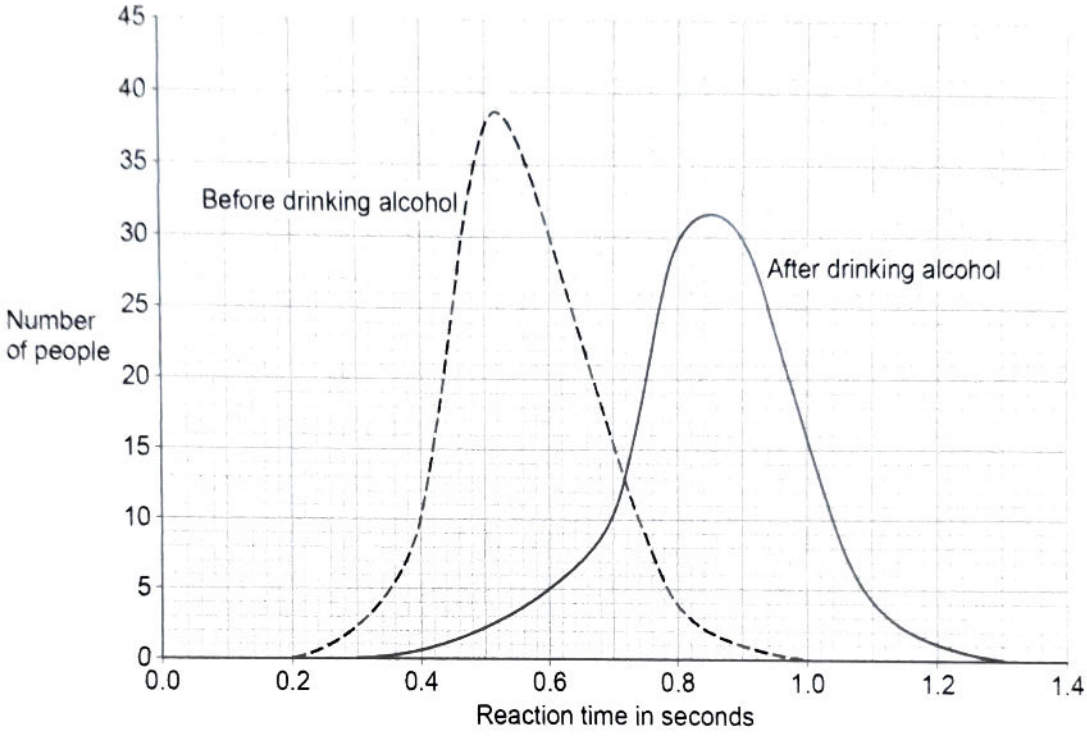
0 3 . 3 Scientists have investigated how drinking alcohol affects a person's reaction time.

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. ☐

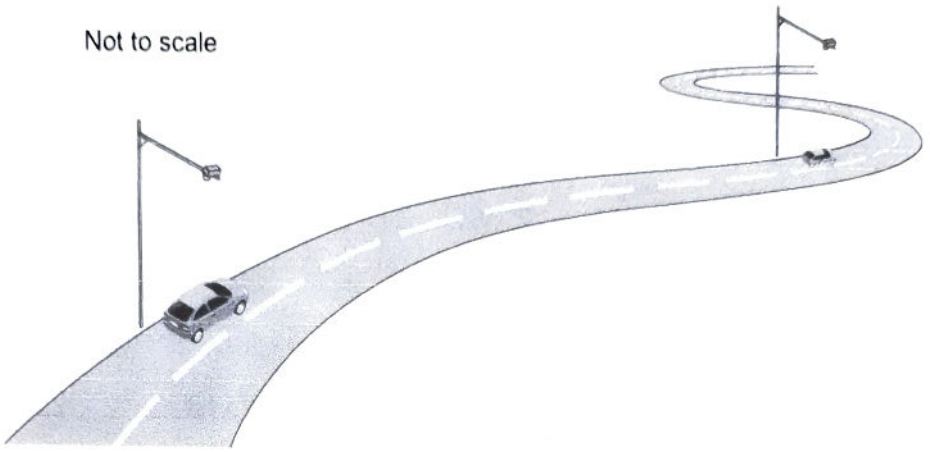
Question 3 continues on the next page

Figure 6 shows some speed cameras on a road.

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

Figure 6

Not to scale



0 3 . 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]

distance = 1.5 km = 1500 m

distance = speed x time

1500 = 20 x t

t = 1500 / 20 = 75 s

Minimum time = 75 s

Do not write outside the box

0 3 . 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]

Velocity is a vector, and speed is a scalar. Because the road is not straight, the car will change direction. This means the velocity changes because velocity has both magnitude and direction, whereas speed only has magnitude.

13

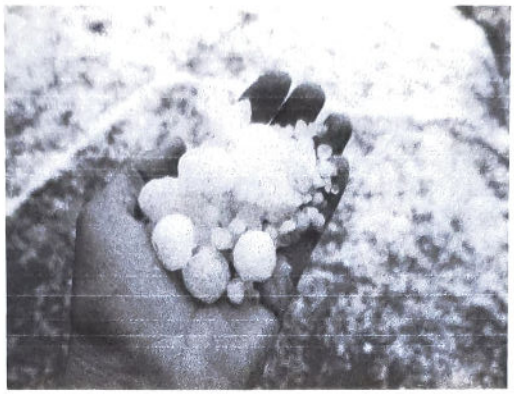
Turn over for the next question

Do not write outside the box

0 4 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.

0 4 . 1 Why does the hailstone accelerate?

[1 mark]

The hailstone accelerates because there is a resultant force acting.

0 4 . 2 The hailstone stops accelerating and reaches terminal velocity.

Explain why the hailstone reaches terminal velocity.

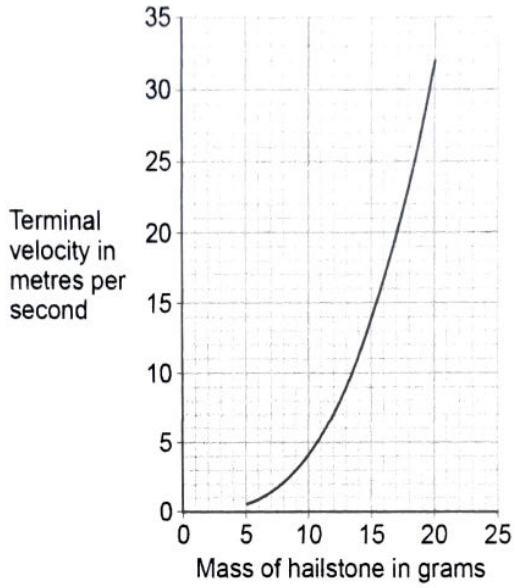
[3 marks]

As the velocity of the hail stone increases, so does the air resistance. This continues until the air resistance becomes equal the weight of the hailstone. At this point, the resultant force is equal to zero.

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

Figure 8 shows the results.

Figure 8



0 4 . 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. ☑

Do not write outside the box

0 4 . 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]

Kinetic energy depends on both mass and velocity, this can be seen in $E_k = \frac{1}{2}mv^2$. As mass increases, so does the terminal velocity. Kinetic energy is proportional to mass, and is proportional to velocity^2. So as mass doubles, kinetic energy more than doubles.

0 4 . 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 Nm ☑

1 N/m ☐

1 N/m^2 ☐

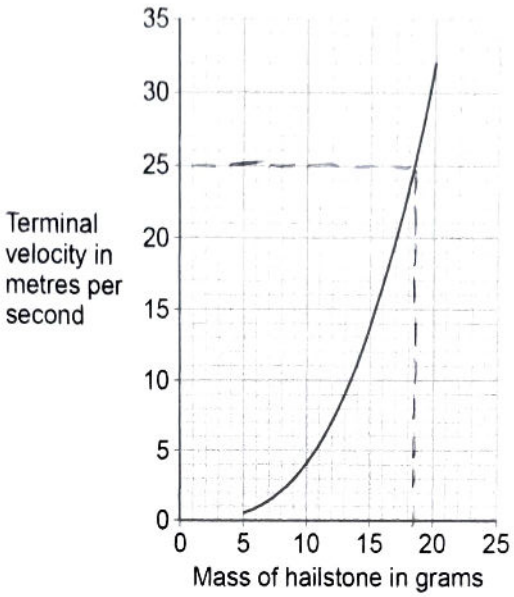
1 Nm^2 ☐

Question 4 continues on the next page

Do not write outside the box

Figure 8 is repeated below.

Figure 8



0 4 . 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]

m = 0.0185 kg from graph.

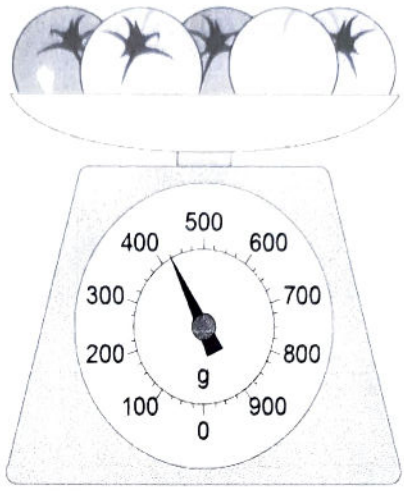
$F = \frac{mv}{t} = \frac{0.0185 \times 25}{0.060} = 7.708$ N

Average force = 7.708 N

12

0 5 **Figure 9** shows a balance used to measure the mass of five tomatoes.

Figure 9



0 5 . 1 What is meant by 'centre of mass'?

[1 mark]

The point where the mass appears to be concentrated.

0 5 . 2 Calculate the mean weight of a tomato in **Figure 9**.

Use the Physics Equations Sheet.

gravitational field strength = 9.8 N/kg

[3 marks]

mass of 5 tomatoes = 0.425 kg from figure 9.

mass of 1 tomatoes = 0.425 / 5 = 0.085 kg

W = mg = 0.085 x 9.8 = 0.833

Weight = 0.833 N

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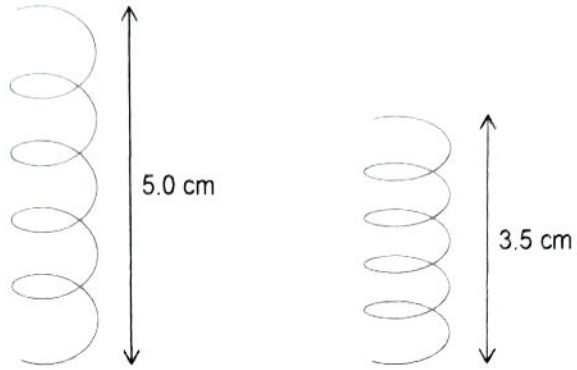
0 5 . 3 The balance in **Figure 9** contains a spring that compresses when the tomatoes are placed on the balance.

Figure 10 shows the spring with no force acting and with a 6.0 N force acting.

Figure 10



Determine the spring constant of the spring.

Use the Physics Equations Sheet.

[3 marks]

$F = kx$ $6.0 = k \times x$

$x = 5.0 - 3.5 = 1.5\text{cm} = 0.015\ m$

$6.0 = k \times 0.015$

$k = 6.0 / 0.015 = 400\ N/m$

Spring constant = 400 N/m

0 5 . 4 Explain **one** property of the spring that makes it suitable for use in the balance.

[2 marks]

The spring deforms elastically, so it will return to it's original length when the force is removed.

9

Do not write outside the box

0 6 Galaxies contain billions of stars.

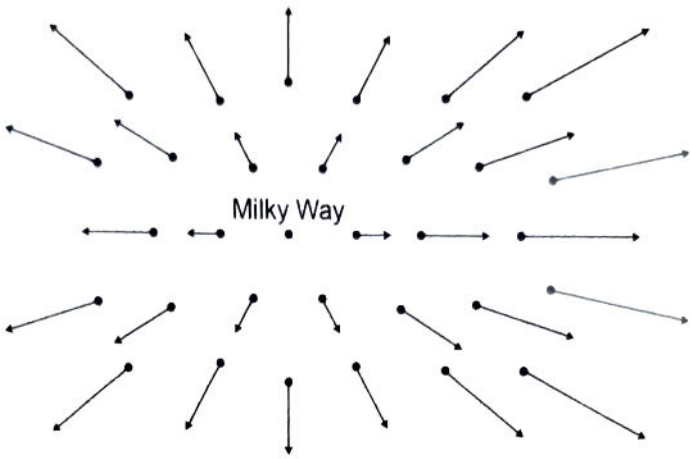
0 6 . 1 Compare the formation and life cycles of stars with a similar mass to the Sun to stars with a much greater mass than the Sun.

[6 marks]

All stars form in a cloud of gas and dust by gravity. This forms a protostar, where fusion begins. There is fusion of small nuclei into larger nuclei, such as hydrogen into helium. The next stage is the main sequence. This is a stable period where gravitational forces balance the outward forces due to fusion. After this stage is where the size of the star affects the path it takes. Stars around the same size as the sun expand to become a red giant, where as larger stars become a red super giant. Red giants then become white dwarfs as they contract. Stars much bigger than the sun become super novas instead of ~~red~~ white dwarves. White dwarfs then cool to black dwarfs, but supernovae either become a neutron star or a blackhole.

The points on **Figure 11** represent galaxies that are moving away from the Milky Way.

Figure 11



Each arrow represents the velocity of the galaxy relative to the Milky Way.

0 6 . 2 Light from all galaxies represented in **Figure 11** is red-shifted.

Describe what is meant by red-shift.

[2 marks]

Red shift is the observed increase in wavelength of light from galaxies that are moving away from us.

0 6 . 3 Explain how **Figure 11** provides evidence for the Big Bang theory.

[2 marks]

The galaxies furthest from the milky way have the largest arrows so are moving the fastest. This suggests that at some point, all galaxies started at the same point.

0 6 . 4 Sometimes scientists have to change theories about the universe.

Give the reason why.

[1 mark]

There might be new evidence which contradicts the current model.

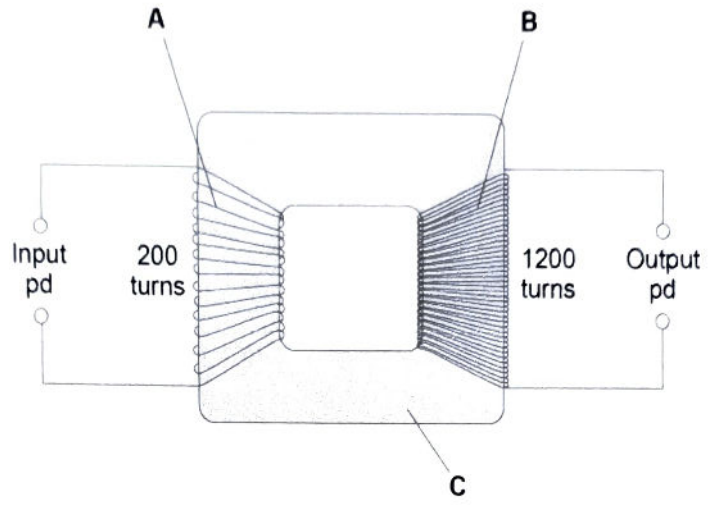
11

Do not write outside the box

0 7 The National Grid uses transformers to change potential difference (pd).

Figure 12 shows a transformer.

Figure 12



0 7 . 1 Identify the parts of the transformer labelled in **Figure 12**.

[2 marks]

A primary coil

B Secondary coil

C Iron core

0 7 . 2 There is an alternating input pd of 230 V.

Determine the output pd.

Use the Physics Equations Sheet.

[3 marks]

$\frac{V_p}{V_s} = \frac{n_p}{n_s}$ $\frac{230}{V_s} = \frac{200}{1200}$

$V_s = \frac{230 \times 1200}{200} = 1380$ V

Output pd = 1380 V

Do not write outside the box

0 7 . 3 The input pd causes an alternating current.

Explain why there is an alternating current in the output when the transformer is connected to a circuit.

[3 marks]

The alternating current causes a changing magnetic field around the primary coil. This creates a magnetic field that changes direction in the core. This induces an alternating potential difference across the secondary coil, causing an alternating current.

Question 7 continues on the next page

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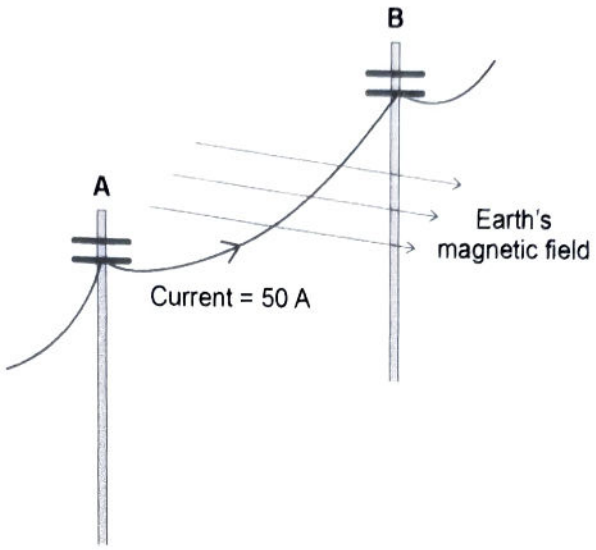
Figure 13 shows a large cable supported by two wooden poles. The cable is connected to an electricity supply.

Figure 13



0 7 . 4 There is a force on the cable due to the Earth's magnetic field when the current is in the direction **A** to **B**.

What is the direction of this force?

[1 mark]

Tick (✓) **one** box.

- Down ☑
- Left ☐
- Right ☐
- Up ☐

Do not write outside the box

0 7 . 5 The cable experiences a force of 0.045 N due to the Earth's magnetic field.

magnetic flux density = 60 μT

current = 50 A

Calculate the length of the cable between **A** and **B**.

Use the Physics Equations Sheet.

[4 marks]

$B = 60\mu T = 60 \times 10^{-6}\ T$

~~0.04~~

$F = BIL$

$L = \frac{F}{BI}$ $\quad L = \frac{0.045}{60 \times 10^{-6} \times 50} = 15\ m$

$L = 15m$

Length = 15 m

0 7 . 6 State **one** assumption you made in your calculation.

[1 mark]

That the wire at a right angle to the magnetic field.

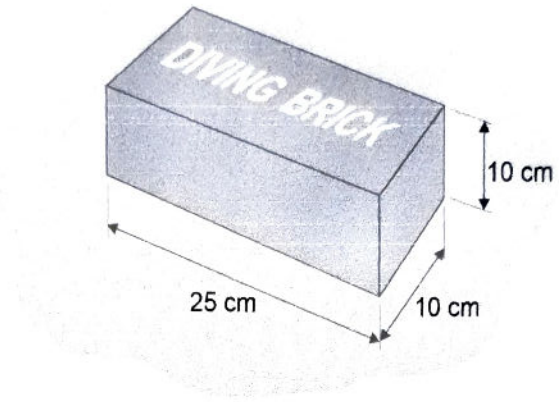
14

Turn over for the next question

0 8 Diving bricks sink to the bottom of a swimming pool.

Figure 14 shows a diving brick.

Figure 14



Swimmers practise diving to the bottom of the swimming pool to pick up the diving brick.

0 8 . 1 Explain why the forces on the brick at the bottom of the pool cause the brick to be stationary.

[3 marks]

The upthrust acts on the brick. The normal contact force also acts upwards on the brick. The force due to the weight is equal to the upthrust plus the normal contact force. Because the forces are balanced, this means the brick stays stationary.

Do not write outside the box

0 8 . 2 When the brick from **Figure 14** is at the bottom of the pool, the top surface of the brick is 2.50 m below the surface of the water.

The force acting on the top surface of the brick due to the weight of the water is 637 N.

gravitational field strength = 9.8 N/kg

Calculate the density of the water in the swimming pool.

Use the Physics Equations Sheet.

[6 marks]

We need the surface area of the top of brick 

Area = 25cm x 10cm = 0.25m x 0.10m = ~~0.025m²~~ 0.025m²

Pressure = Force / Area = 637N / 0.025m² = 25480 N/m²

Now we have the pressure on the brick, we can use $p = h \rho g$ (pressure = height x g x density)

$\rho = p/hg = 25480/2.5 \times 9.8 = 1040$ kg/m³

Density of water = 1040 kg/m³

Question 8 continues on the next page

0 8 . 3 Professional divers are trained in a very deep swimming pool.

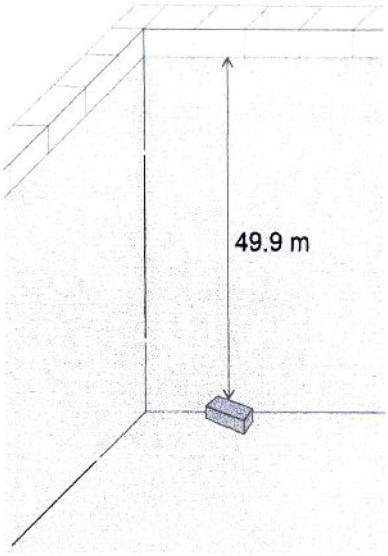
The density of the water in this pool is **not** the same as the density of the water in Question **08.2**

The diving brick was dropped into the very deep swimming pool.

When the brick was at a depth of 2.50 m, the force due to the weight of the water on the top surface of the brick was 618 N.

Figure 15 shows the diving brick at the bottom of the very deep swimming pool.

Figure 15



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Determine the force due to the weight of the water on the top surface of the brick in **Figure 15**.

Use the Physics Equations Sheet.

Give your answer to 3 significant figures.

[3 marks]

pressure = Force / Area $F = pA = h\rho gA$

For brick at 2.50 m: $F_a = h_a \rho_a g_a A_a$ $\frac{F_a}{F_b} = \frac{h_a}{h_b}$

For brick at 49.9: $F_b = h_b \rho_b g_b A_b$

$F_b = F_a \times \frac{h_b}{h_a} = 618 \times 49.9/2.5 = 12335.28$ N

Force (3 significant figures) = 12300 N

12

END OF QUESTIONS