AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Physics Paper 1F

Wednesday 23 May 2018 Afternoon Time allowed: 1 hour 15 minutes

Materials

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

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 70.
- 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	
TOTAL	

Do not write outside the box

0 1 There are many different energy resources.

0 1 . 1 Which **two** energy resources are renewable? → will not run out

[2 marks]

Tick **two** boxes.

plants – can grow more

- Biofuel ☑ ✓

fossil fuels

- Coal ☐ ×
- Gas ☐ ×

natural process

- Geothermal ☑ ✓

the elements used as the fuel will run out

- Nuclear fuel ☐ ×

0 1 . 2 Some non-renewable energy resources are more reliable than others.

Which statement correctly describes a reliable resource? → behaves in the way you expect

[1 mark]

Tick **one** box.

× It does not burn fuel. ☐

✓ It is predictable. ☑

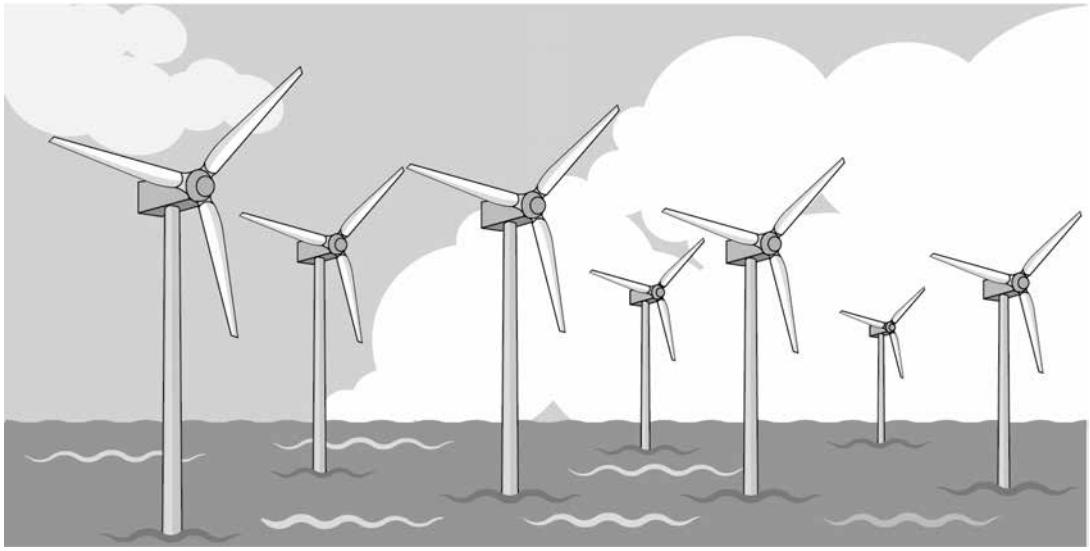
renewable × It will never run out. ☐

× It is cheap to use. ☐

Do not write outside the box

0 1 . 3 **Figure 1** shows a wind farm.

Figure 1



The total power output of the wind farm is 19.6 MW

All of the wind turbines have the same power output.

What is the power output of **one** wind turbine?

[1 mark]

Tick **one** box.

2.7 MW	☐
2.8 MW	✓
2.9 MW	☐
3.2 MW	☐
3.3 MW	☐

7 turbines in pictures

$\frac{19.6\ MW}{7} = 2.8\ MW$

0 1 . 4 Give **two** reasons why people might **not** like having wind turbines near their homes.

[2 marks]

1 noisy

2 ugly

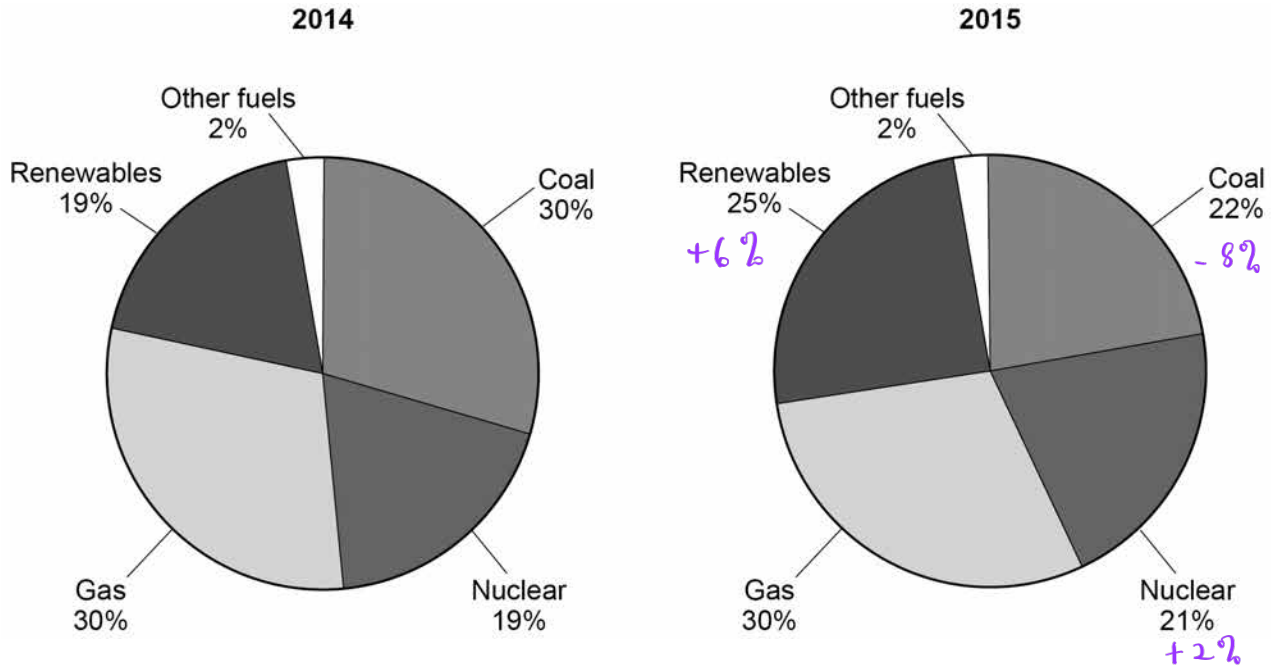
+ harm birds
+ lower house prices

Do not write outside the box

0 1 . 5 **Figure 2** shows the electricity generated by different energy resources in the UK.

The total amount of electricity generated was the same in 2014 and in 2015

Figure 2



There are changes in the amounts of different energy resources used between 2014 and 2015

Explain the environmental impacts of the changes.

[4 marks]

- detailed points
- logically linked

Percentage generated by coal decreased by 8%, so less fossil fuels were burnt. Less CO_2 released, less greenhouse gases emitted which means less global warming.

Percentage generated by nuclear increased by 2% so more nuclear fuel used. So more nuclear fuel used. So more hazardous waste produced.

+ less environment pollution
+ less acid rain
+ % gas remained the same

10

Do not write outside the box

0 2 **Figure 3** shows a mobile phone being recharged by a portable power source.

Figure 3

(What type of energy store is in a phone?

0 2 . 1 Why does the battery in the phone need recharging?

[1 mark]

Tick **one** box.

fuels, food, chemicals in batteries

✓ The store of chemical energy in the battery has reduced. ✓

temperature

✗ The store of thermal energy in the battery has reduced.

moving

✗ The store of kinetic energy in the battery has reduced.

✗ The store of gravitational energy in the battery has reduced.

position

Question 2 continues on the next page

Do not write outside the box

0 2 . 2 The power source provides a current of 1.86 A at a potential difference of 3.90 V

Calculate the power of the power source.

Use the equation:

power = potential difference × current

Choose the correct unit from the box.

[3 marks]

coulomb charge — joule energy — watt power

C	J	W

= 3.9 V x 1.86 A ✓

= 7.254

Power = 7.254 ✓

Unit W ✓

Do not write outside the box

0 2 . 3 A student needs a new power source.

Figure 4 shows three different sized power sources.

Figure 4

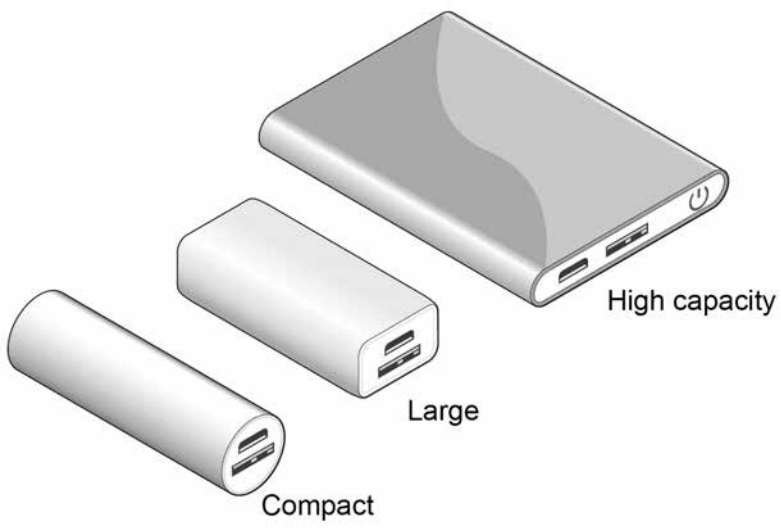


Table 1 gives data about the different power sources.

$\frac{1}{40} < \frac{1}{60} < \frac{1}{100}$

Table 1

Power source	Number of charges	Mass in grams
Compact	1	100
Large	5	200
High capacity	10	600

- $\frac{1}{100}$
- $\frac{5}{200} = \frac{1}{40}$
- $\frac{10}{600} = \frac{1}{60}$

×5, ×2, ×½, ×⅓

The student chose the large power source.

Suggest why the student chose the large power source.

[4 marks]

Large power source has 5x the number of charges as the compact power source, with only 2x the mass. Although large PS has half the number of charges as the high capacity PS, it is only ⅓ the mass.

- highest charge to mass ratio ✓
- large PS charge/mass ¹/₄₀ ✓
- large PS ↑ charge/mass ✓

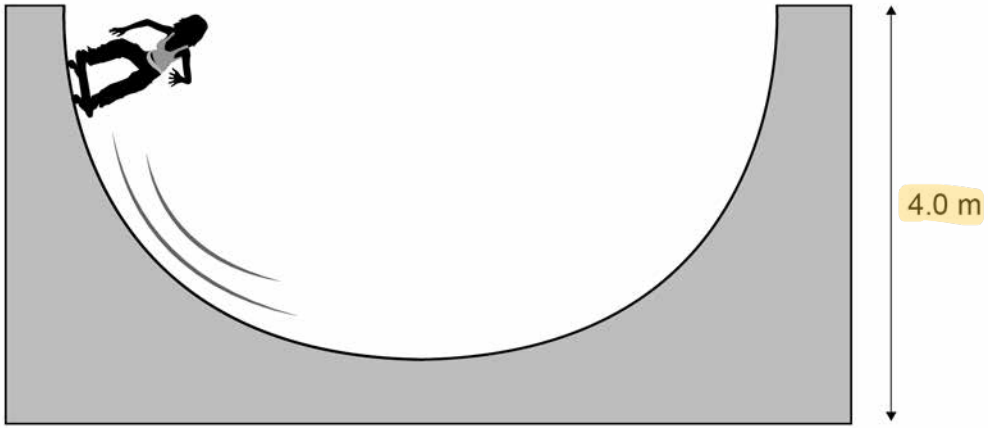
8

Turn over ►

Do not write outside the box

0 3 **Figure 5** shows a girl skateboarding on a semi-circular ramp.

Figure 5



The girl has a mass of 50 kg

0 3 . 1 Calculate the gravitational potential energy (g.p.e.) of the girl at the top of the ramp.

Use the equation:

g.p.e. = mass × gravitational field strength × height

gravitational field strength = 9.8 N/kg

[2 marks]

= 50 kg × 9.8 N/kg × 4 m

= 1960 J

g.p.e. = 1960 J

0 3 . 2 The girl has a speed of 7 m/s at the bottom of the ramp.

Calculate the kinetic energy of the girl at the bottom of the ramp.

Use the equation:

kinetic energy = 0.5 × mass × (speed)^2

[2 marks]

= 0.5 × 50 kg × (7 m/s)^2

= 1225 J

Kinetic energy = 1225 J

Do not write outside the box

0 3 . 3 Not all of the g.p.e. has been transferred to kinetic energy.

Which **two** statements explain why?

[2 marks]

Tick **two** boxes.

All GPE transferred to KE

GPE = 100 J

KE = 100 J

---- GPE = 0

- ✓ Some energy is wasted. ☑
- ✗ The mass of the girl is too low. ☐
- ✗ The ramp is not high enough. ☐
- ✓ The g.p.e. of the girl is not zero. ☑
- ✗ The speed of the girl is too great. ☐

GPE = 100 J

KE = 50 J

---- GPE = 50 J

not all GPE transferred to KE

0 3 . 4 Explain how lubricating the wheels of the skateboard can increase the speed of the girl.

↳ more slippery reduce friction

friction = force opposing when two objects rub

Use ideas about energy in your explanation.

[3 marks]

Reduces the amount of friction. More energy is usefully transferred. Greater kinetic energy.

GPE → KE

When there is no friction

- All GPE is transferred to KE

GPE → KE + WD to oppose friction

When there is friction

- Some GPE is transferred to energy to overcome the friction
- less GPE is transferred to KE

9

Turn over for the next question

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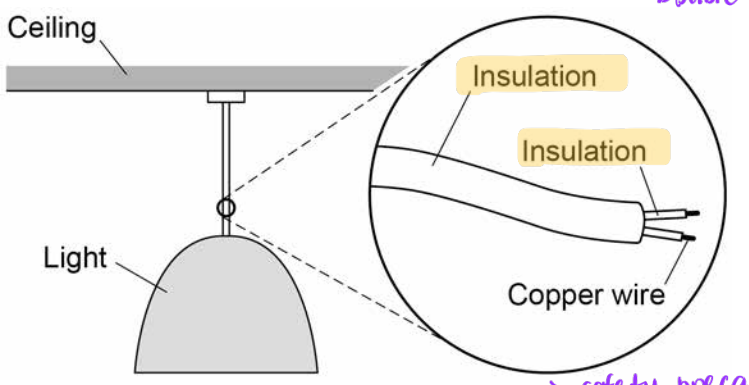
0 4 Some ceiling lights in the home are connected to the mains by a two-core cable.

Figure 6 shows a ceiling light.

Insulator = does not conduct electricity
• Double insulation

Figure 6



0 4 . 1 Suggest why some ceiling lights do **not** have an earth wire.

safety precaution
stop appliance becoming live

[2 marks]

Since the casing is not made of metal, there is very little danger of an electric shock.

0 4 . 2 Write down the equation that links charge flow, current and time.

Q I t Q = It

[1 mark]

charge flow = current x time

0 4 . 3 There is a current of 2.95 A in one of the copper wires for 60 seconds.

Calculate the charge flow through the wire.

Use your equation from question **04.2**

[2 marks]

Q = It

correct units ✓ correct calculation ✓✓

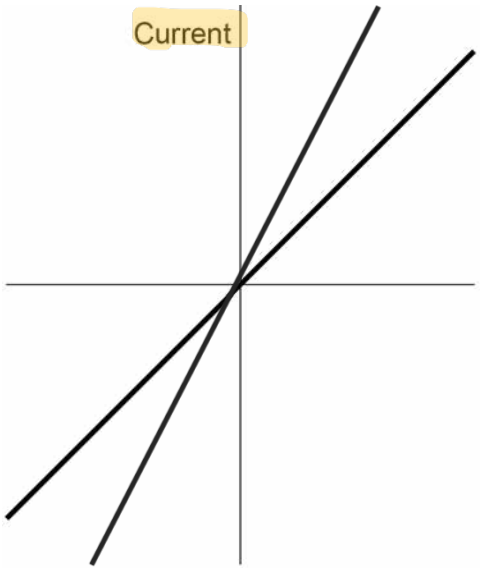
= 2.95 A x 60 seconds = 177 C

Charge flow = 177 ✓ C

Do not write outside the box

0 4 . 4 **Figure 7** shows a current potential difference graph for a piece of copper wire.

Figure 7



✓ straight line through the origin

✓ different the gradient

$V = IR$

$\frac{V}{I} = R$

gradient = $\frac{\text{diff } y}{\text{diff } x}$

grad = $\frac{I}{V} = \frac{1}{R}$

Draw another line on **Figure 7** for a wire with a different resistance.

different gradient

[2 marks]

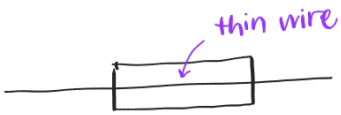
Question 4 continues on the next page

Do not write outside the box

Some fuses have a thin piece of copper that melts if the current is too large.

0 4 . 5 Draw the circuit symbol for a fuse.

[1 mark]



0 4 . 6 Describe how the movement of the copper particles in the wire changes when copper melts.

[2 marks]

solid → liquid

The particles vibrate about a fixed position regular arrangement. ✓

The particles change to being free to move around. ✓

0 4 . 7 Old copper wires are melted when they are recycled.

Calculate the energy needed to melt 500 kg of copper at its melting point.

Specific latent heat of fusion of copper = 200 kJ/kg

Use the Physics Equations Sheet.

[3 marks]

E = mL (kg) (J/kg)

thermal energy for change of state = mass × specific latent heat

mass = 500 kg ✓ unit

L = 200 kJ/kg

L = 200,000 J/kg ✓

= 500 kg × 200,000 J/kg ✓

= 100,000,000 J

Energy = 100,000,000 ✓ J

13

Do not write outside the box

0 5 Radioactive nuclei can emit alpha, beta or gamma radiation.

0 5 . 1 Which type of radiation is the most penetrating?

[1 mark]

Tick **one** box.

How easily something can pass through a material

Alpha (α)	☐	^4_2He paper
Beta (β)	☐	e^- mm aluminium
Gamma (γ)	☑	~~~ several cm lead

0 5 . 2 Which type of radiation is the most ionising?

[1 mark]

Tick **one** box.

Radiation can "ionise" atoms by removing their electrons

Alpha (α)	☑	^4_2He big + heavy
Beta (β)	☐	e^-
Gamma (γ)	☐	~~~

atoms → ions +

0 5 . 3 Which type of radiation has the longest range in air?

[1 mark]

Tick **one** box.

Alpha (α)	☐	^4_2He big + heavy
Beta (β)	☐	e^-
Gamma (γ)	☑	~~~

Question 5 continues on the next page

Do not write outside the box

When radioactive isotopes in the Earth's crust decay they release energy.

The decay causes the heating of rocks in the crust.

0 5 . 4 **Figure 8** shows the decay of uranium–238 (U–238) into thorium–234 (Th–234).

mass number = protons + neutrons

Figure 8

$$^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He$$

atomic / proton number

Complete **Table 2** to show the number of neutrons and protons in the nuclei.

[2 marks]

$^{234}_{90}Th$

234 = protons + neutrons

90 = protons

neutrons = 234 − 90 = 144

Table 2

Isotope	Number of neutrons	Number of protons
uranium–238	146	92
thorium–234	144	90

0 5 . 5 Geothermal power stations pump water through heated rocks.

The temperature of the water increases from 20 °C to its boiling point of 100 °C

Calculate the change in thermal energy when the mass of water heated is 150 kg

Specific heat capacity = 4 200 J/kg °C

Use the Physics Equations Sheet.

[3 marks]

$\Delta\theta = 100 - 20 = 80\,^{\circ}C$ ✓ mass = 150 kg $c = 4200$ J/kg °C

$E = mc\Delta\theta$

$= 150\text{ kg} \times 4200\text{ J/kg °C} \times 80\,^{\circ}C$ ✓ ✓ ✓

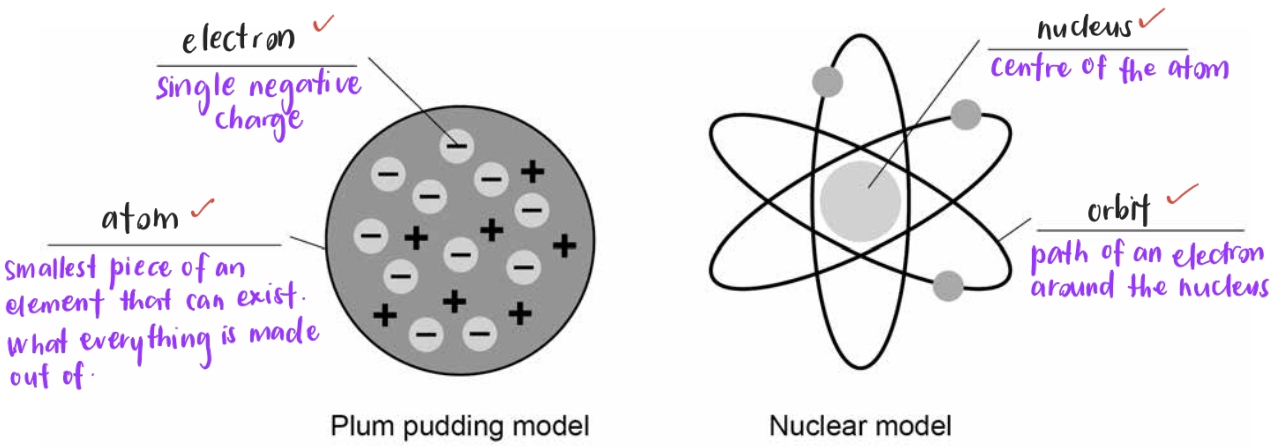
Change in thermal energy = 50 400 000 ✓ ✓ J

8

Do not write outside the box

0 6 **Figure 9** shows two models of the atom.

Figure 9



0 6 . 1 Write the labels on **Figure 9**

Choose the answers from the box.

[4 marks]

atom	**electron**	**nucleus**
neutron (neutrally charged sub-atomic particle)	**orbit**	**proton** (single +ve charge)

0 6 . 2 Explain why the total positive charge in every atom of an element is always the same.

[2 marks]

All elements have the same number of protons. And the number of protons is what determines the total positive charge.

(all protons have + charge)

All elements (of the same type) have the same proton/atomic number

(number of protons in the nucleus)

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 The results from the alpha particle scattering experiment led to the nuclear model.

Alpha particles were fired at a thin film of gold at a speed of 7% of the speed of light.

Determine the speed of the alpha particles.

% → decimal ÷ 100

Speed of light = 300 000 000 m/s

[2 marks]

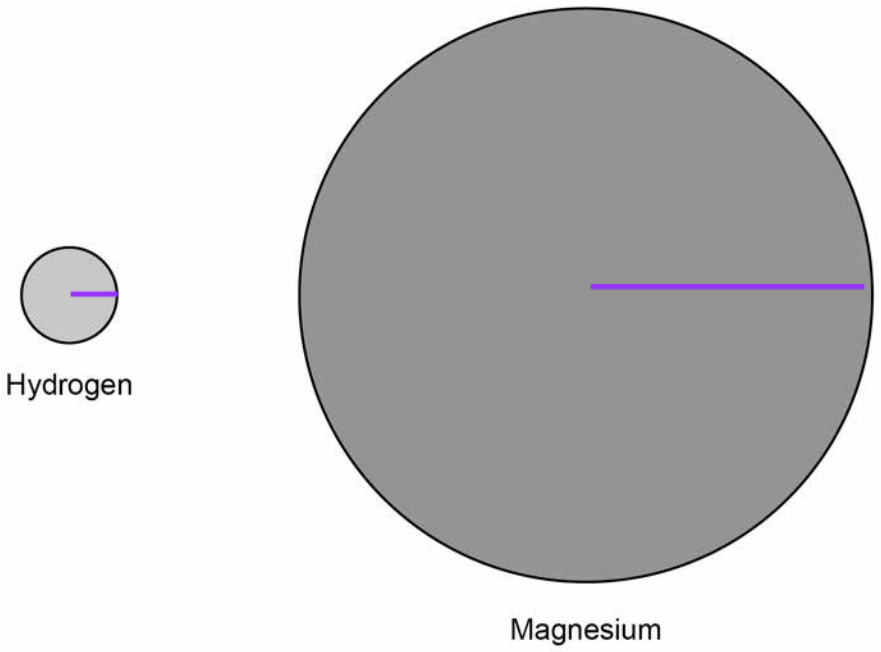
300,000,000 m/s x 7/100 ✓ → 0.07

= 21,000,000 m/s

Speed = 21,000,000 ✓ m/s

0 6 . 4 **Figure 10** shows two atoms represented as solid spheres.

Figure 10



A hydrogen atom has a radius of 2.5×10^{-11} m

Determine the radius of a magnesium atom.

Use measurements from **Figure 10**

[2 marks]

Mg rad / H rad = 6 Mg radius 6x size of H radius

$2.5 \times 10^{-11} \times 6 = 1.5 \times 10^{-10}$ m ✓

Radius = 1.5×10^{-10} ✓ m

10

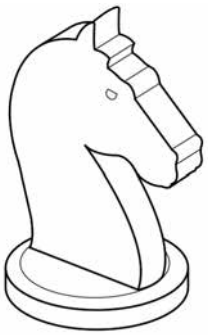
Do not write outside the box

0 7 A student wanted to determine the density of the irregular shaped object shown in **Figure 11**

Key point :
When you place an object in water, the volume of water displaced is equal to the volume of the water

density = mass / volume

Figure 11



0 7 . 1 Plan an experiment that would allow the student to determine the density of the object.

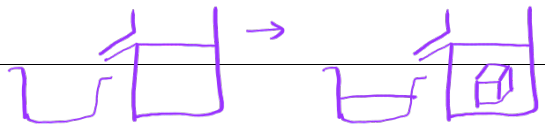
[6 marks]

First, measure mass using scales. Part fill a measuring cylinder with water. Measure the initial volume. Place object in water and measure the final volume. Final − initial volume = volume of object.

Density = mass / volume

6 marks :
- valid outcome
- all steps identified
- logically sequenced

- fill displacement can with water
- water level with spout
- place object in water
- collect displaced water
- measure volume of displaced water



displacement can & beaker

Question 7 continues on the next page

Do not write outside the box

0 7 . 2 Another student did a similar experiment.

He determined the density of five common plastic materials.

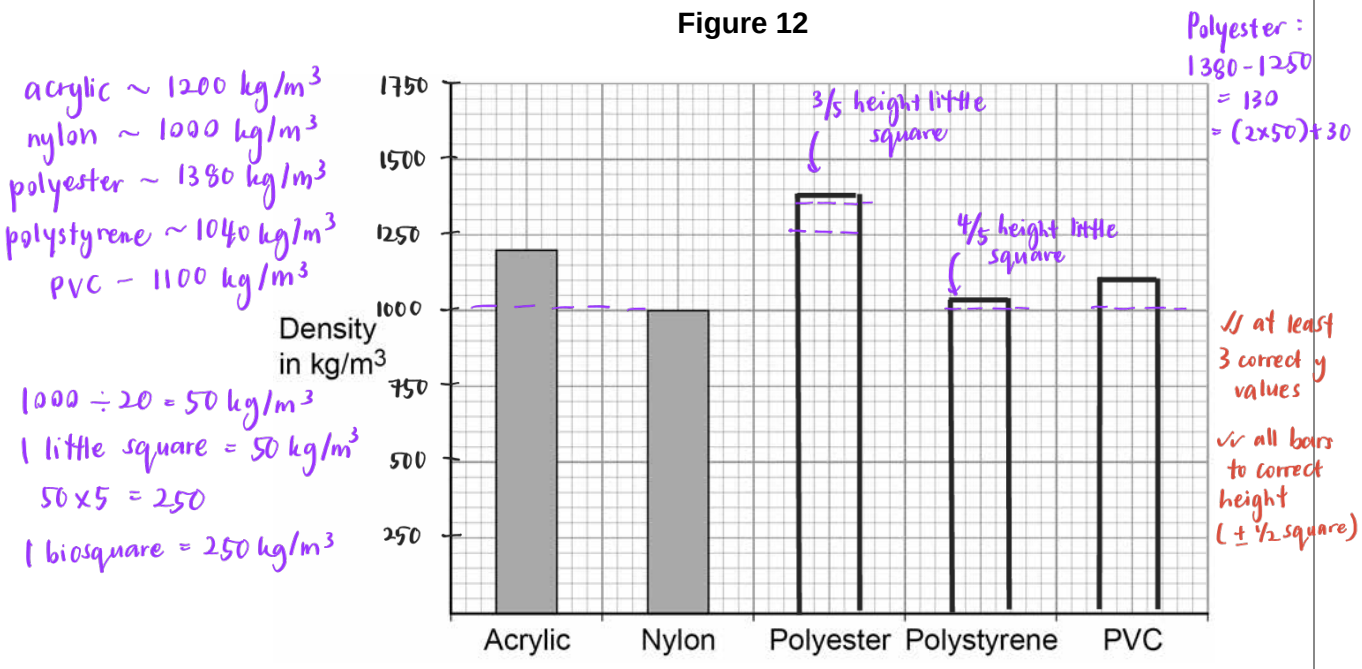
Table 3 shows the results.

Table 3

Plastic material	Density in kg/m^3
Acrylic	1200
Nylon	1000
Polyester	1380
Polystyrene	1040
PVC	1100

Figure 12 shows the results plotted in a bar chart.

Figure 12



Complete **Figure 12**

You should:

- Write the correct scale on the y-axis.
- Draw the bars for polyester, polystyrene and PVC.

[4 marks]

Do not write outside the box

0 7 . 3 The student is given a piece of a different plastic material.

The student determined the density of the material three times.

Table 4 shows the results.

Table 4

	Density in kg/m^3
1	960
2	1120
3	1040

uncertainty = range / 2

= (max value − min value) / 2

Determine the uncertainty in the student's results.

[2 marks]

(1120 − 960) / 2 = 80 kg/m^3 ✓

Uncertainty = 80 ✓ kg/m^3

12

END OF QUESTIONS

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