Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE PHYSICS

H

Higher Tier Paper 1H

Specimen 2018 (set 2) Time allowed: 1 hour 45 minutes

Materials

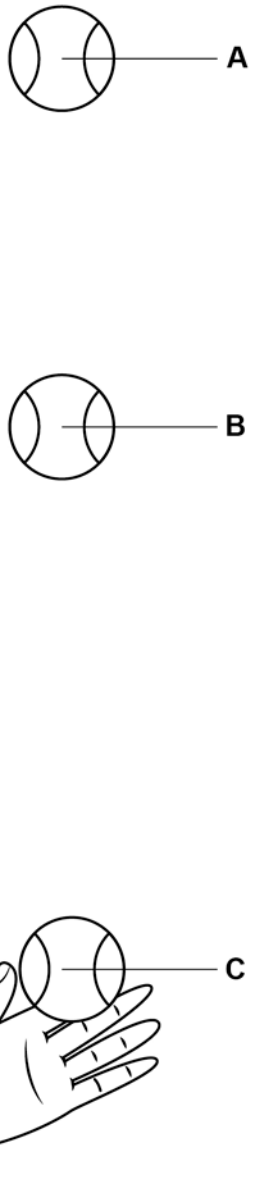
For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

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 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.

0 1 **Figure 1** shows a tennis ball thrown vertically into the air.

Figure 1



At position **C**, the ball has just left the tennis player's hand at a speed of 5.0 m/s

The tennis ball has a mass of 0.058 kg

0 1 . 1 Write down the equation that links kinetic energy, mass and speed.

[1 mark]

0 1 . 2 Calculate the kinetic energy of the tennis ball at position **C**.

[2 marks]

Kinetic energy = _____ J

0 1 . 3 At position **A** the tennis ball is at maximum height.

What is the gravitational potential energy of the tennis ball at position **A**?

Ignore the effect of air resistance.

[1 mark]

At position **B** the tennis ball has 0.38 J of gravitational potential energy.

0 1 . 4 Write down the equation that links gravitational field strength, gravitational potential energy, height and mass.

[1 mark]

0 1 . 5 Calculate the height of the tennis ball above the tennis player's hand when at position **B**.

gravitational field strength = 9.8 N/kg

[3 marks]

Height = _____ m

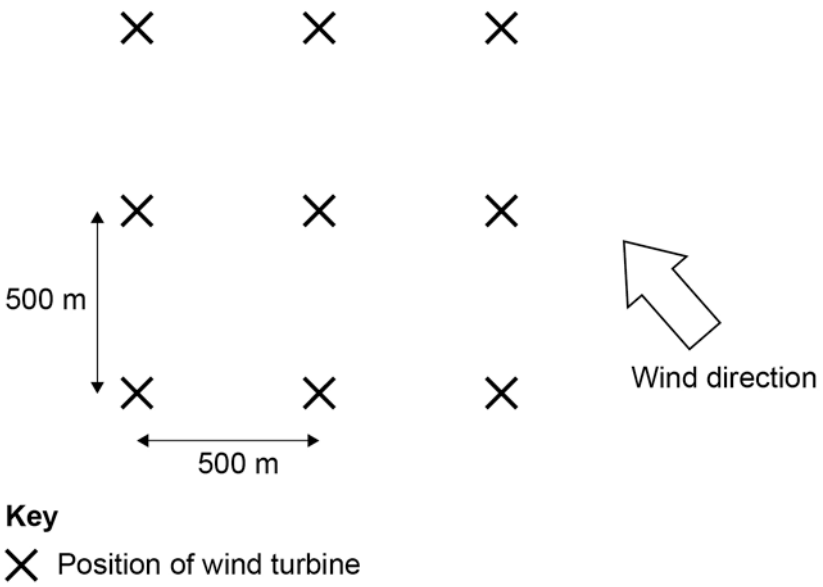
8

Turn over ►

0 2 The wind turbines in a wind farm must have a minimum distance of 500 m between them for maximum efficiency.

Figure 2 shows the position of nine wind turbines in a wind farm.

Figure 2



0 2 . 1 Suggest **one** way in which the layout of this wind farm ensures maximum efficiency when the wind direction changes.

[1 mark]

The average mass of air passing through the blades of one wind turbine is 51 000 kg per second.

The density of air is 1.2 kg / m^3

0 2 . 2 Write down the equation that links density, mass and volume.

[1 mark]

0 2 . 3 Calculate the volume of air passing through the blades of one wind turbine per second.

Give the unit.

Give your answer to 2 significant figures.

[5 marks]

Volume per second = _____ Unit _____

Question 2 continues on the next page

0 2 . 4 The average power output from one of the wind turbines in **Figure 2** is 1.6×10^6 W

The average power output of a nuclear power station is 2.4×10^9 W

Calculate the number of wind turbines needed to generate power equal to one nuclear power station.

[2 marks]

Number of wind turbines = _____

0 2 . 5 The UK requires a minimum electrical power of 2.5×10^{10} W at any time.

Give **two** reasons why wind turbines alone are unlikely to be used to meet this requirement.

[2 marks]

1 _____

2 _____

11

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 3 The specific heat capacity of aluminium can be determined by experiment.

0 3 . 1 Draw a labelled diagram showing how the apparatus used to determine the specific heat capacity of aluminium should be arranged.

[3 marks]

0 3 . 2 Describe how you could use the apparatus you drew in Question **03.1** to determine the specific heat capacity of aluminium.

[6 marks]

Question 3 continue on the next page

0 3 . 3 Methods used to determine the specific heat capacity of aluminium may give a value greater than the actual value.

Explain why.

[2 marks]

11

0 4 Nuclear fission and nuclear fusion are two processes that release energy.

0 4 . 1 The following nuclear equation represents the fission of uranium-235 (U-235).

$$^{1}_{0}n + {}^{235}_{92}U \longrightarrow {}^{236}_{92}U \longrightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\,{}^{1}_{0}n + \text{energy}$$

Chemical symbols:

- Ba = barium
- Kr = krypton
- $^{1}_{0}n$ = neutron

Describe the process of nuclear fission.

Use the information in the equation.

[4 marks]

Question 4 continues on the next page

0 4 . 2 Explain what happens in the process of nuclear fusion.

[3 marks]

0 4 . 3 Fission reactors are used in nuclear power stations.

Engineers are developing fusion reactors for use in power stations.

Fusion uses isotopes of hydrogen called deuterium and tritium.

- Deuterium is naturally occurring and can be easily extracted from seawater.
- Tritium can be produced from lithium. Lithium is also found in seawater.

Table 1 shows the energy released from 1 kg of fusion fuel and from 1 kg of fission fuel.

Table 1

Type of fuel	**Energy released from 1 kg of fuel in joules**
Fusion	3.4×10^{14}
Fission	8.8×10^{13}

Suggest **two** advantages of the fuel used in a fusion reactor compared with the fuel used in a fission reactor.

[2 marks]

1 _____

_____

_____

2 _____

_____

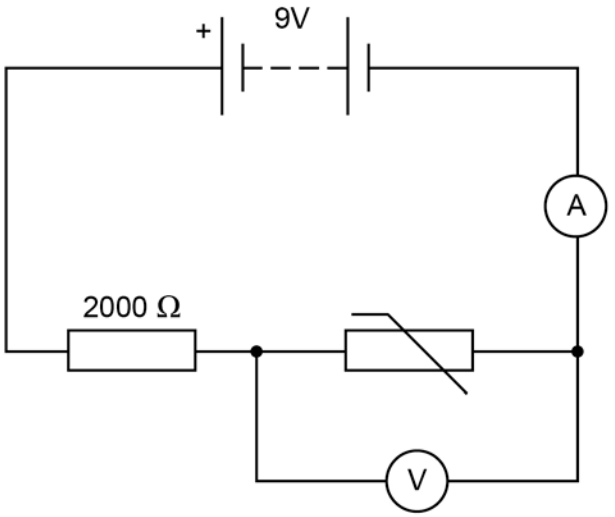
_____

9

Turn over for the next question

0 5 **Figure 3** shows a temperature sensing circuit used to control a heating system in a house.

Figure 3



0 5 . 1 What quantity does the ammeter measure?

[1 mark]

_____

0 5 . 2 The current in the circuit is 3.5 mA when the potential difference across the thermistor is 4.2 V

Calculate the resistance of the thermistor.

[3 marks]

_____

_____

_____

Resistance = _____ Ω

0 5 . 3 Calculate the charge that flows through the thermistor in 5 minutes when the current is 3.5 mA

[3 marks]

Charge = _____ C

0 5 . 4 Explain why the potential difference across the thermistor changes as the temperature in the house decreases.

[2 marks]

0 5 . 5 The circuit shown in **Figure 3** can be modified to turn lights on and off by replacing the thermistor with a Light Dependent Resistor (LDR).

Draw the circuit symbol for an LDR in the space below.

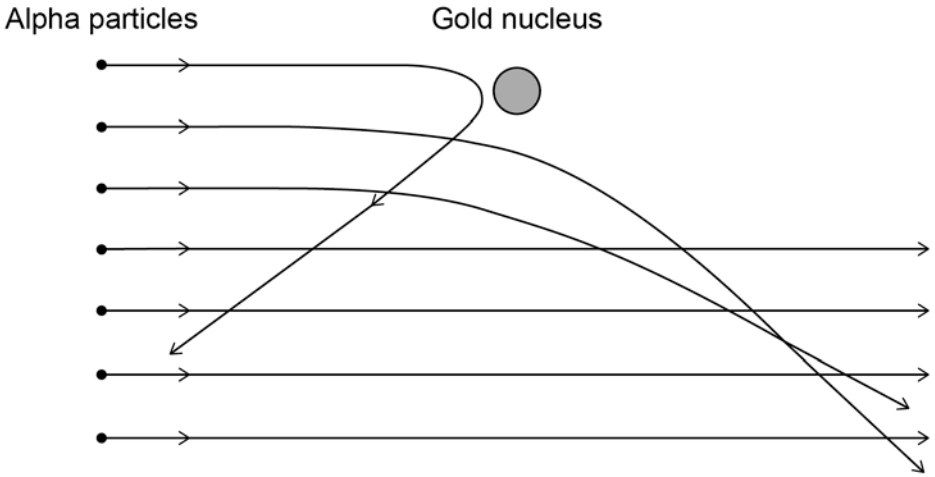
[1 mark]

10

0 6 . 1 In the early 20th century, scientists developed an alpha particle scattering experiment using gold foil.

Figure 4 shows the paths of some of the alpha particles in the alpha particle scattering experiment.

Figure 4



0 6 . 1 Explain how the paths of the alpha particles were used to develop the nuclear model of the atom.

[4 marks]

0 6 . 2 Niels Bohr adapted the nuclear model by suggesting electrons orbited the nucleus at specific distances.

Explain how the distance at which an electron orbits the nucleus may be changed.

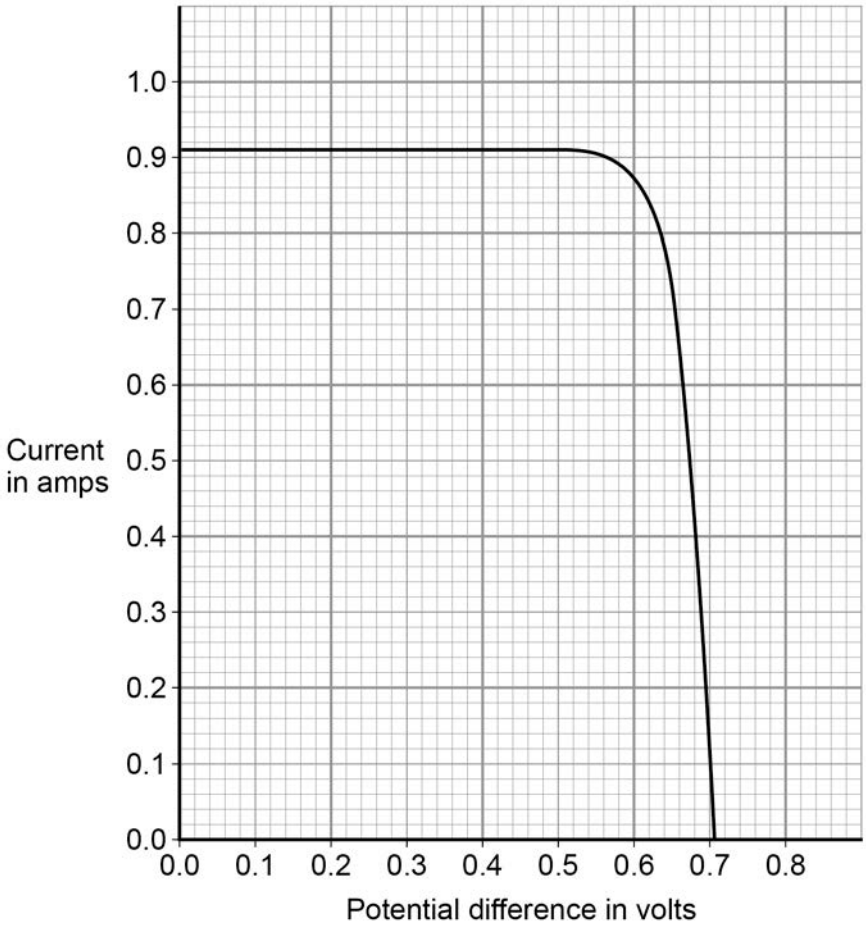
[3 marks]

7

Turn over for the next question

0 7 **Figure 5** shows a graph of current against potential difference for a solar cell when light of intensity 450 W/m^2 is incident on it.

Figure 5



0 7 . 1 Determine the power output of the solar cell when the potential difference is 0.5 V

Use data from **Figure 5**.

[3 marks]

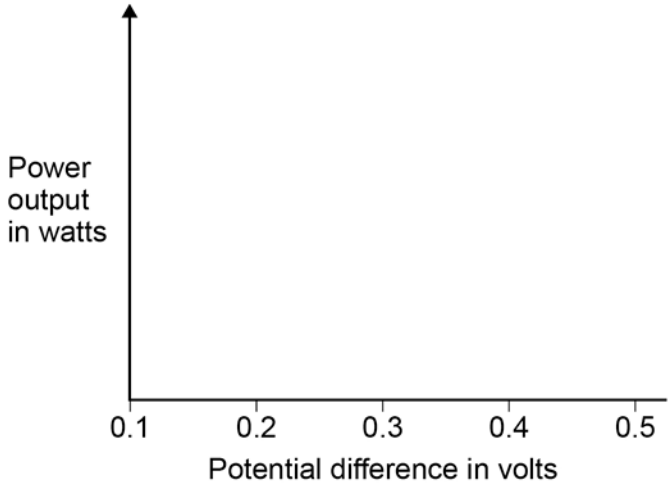
Power = _____ W

0 7 . 2 Draw a sketch graph on **Figure 6** to show how the power output of the solar cell varies with potential difference between 0.1 V and 0.5 V

No values need to be included on the vertical axis.

[2 marks]

Figure 6



0 7 . 3 The maximum power output of this solar cell is 0.52 W

When the light intensity is 450 W/m^2 the cell has an efficiency of 0.15 at the maximum power output.

Calculate the area of the solar cell.

[4 marks]

Area = _____ m^2

Question 7 continues on the next page

Turn over ►

0 7 . 4 A householder has four solar cells.

Each of the solar cells has a resistance of 0.78 Ω

Explain how the solar cells should be connected so that the total resistance is as low as possible.

[2 marks]

11

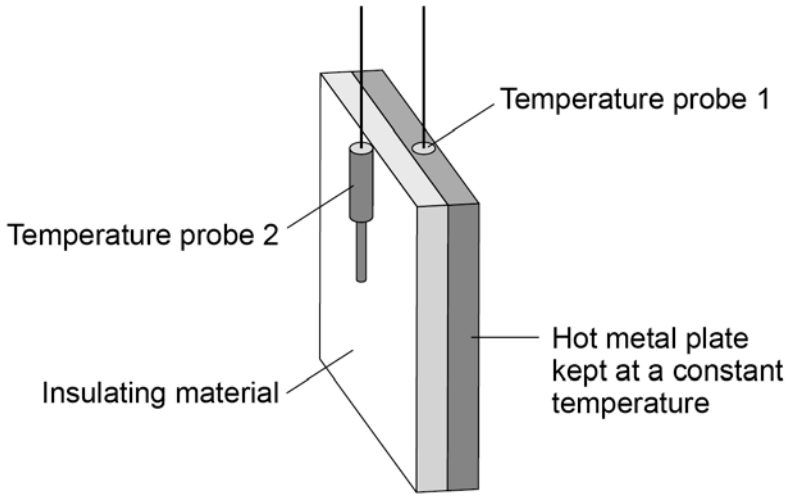
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 8 A student investigated the properties of three types of insulation.

Figure 7 shows the apparatus the student used.

Figure 7



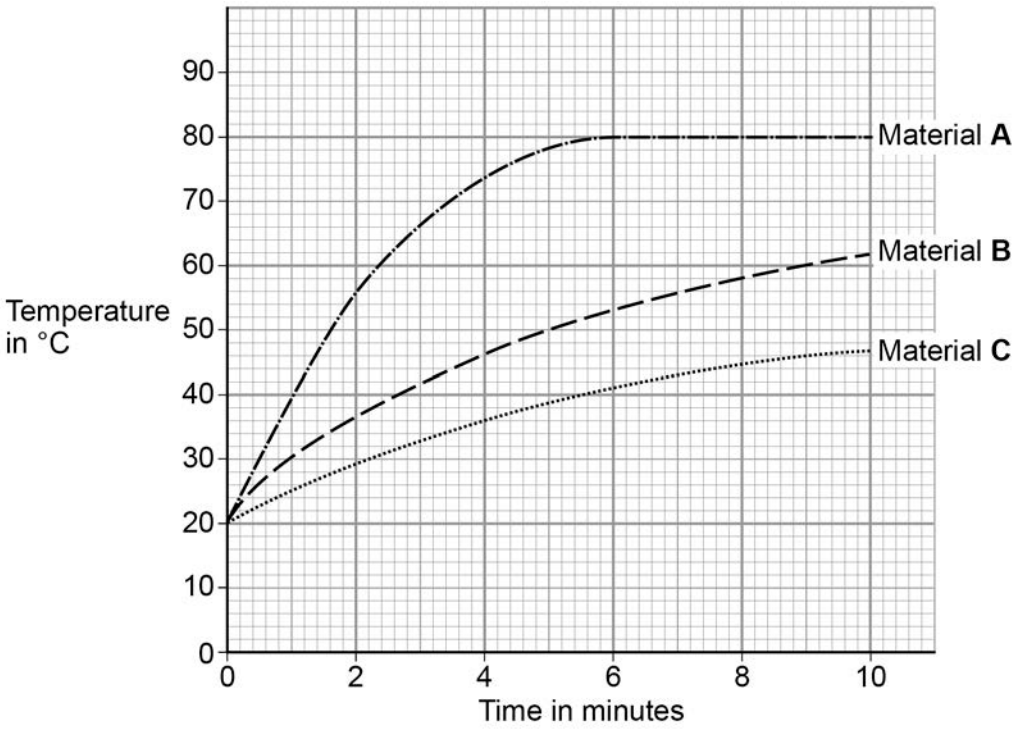
In the investigation different insulating materials were placed in contact with the hot metal plate.

Temperature probes measured the temperature on each side of the material.

The temperature probes were connected to a data logger.

Figure 8 shows how the temperature measured by temperature probe 2 changed over 10 minutes for each of the materials.

Figure 8



0 8 . 1 What was the temperature of the hot metal plate? _____ °C

[1 mark]

0 8 . 2 Which material is the best insulator?

[2 marks]

Tick **one** box.

A ☐ **B** ☐ **C** ☐

Give the reason for your answer.

_____

_____

Question 8 continues on the next page

0 8 . 3 Another student repeated the investigation but doubled the thickness for all three insulating materials.

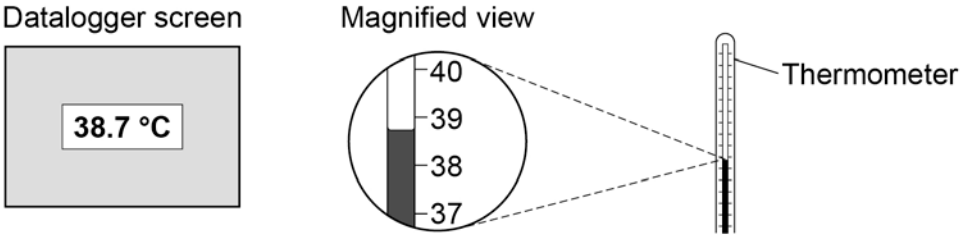
Suggest how using thicker insulation would affect the results of the second student's investigation compared with the first student's results.

[2 marks]

0 8 . 4 The students could have used a thermometer instead of temperature probes and a datalogger.

Figure 9 shows the datalogger screen and a thermometer.

Figure 9



Give **two** advantages of using the datalogger and temperature probes compared to a thermometer.

[2 marks]

1

2

0 8 . 5 **Table 2** gives information about four types of insulation that could be used for insulating the cavity walls of houses.

Table 2

Type of insulation	Thermal conductivity in W/m °C
Felt wool	0.070
Mineral wool	0.040
Polyurethane foam	0.030
Rock wool	0.045

Explain which **one** of the types of insulation in **Table 2** would be the best to use for cavity wall insulation.

[2 marks]

9

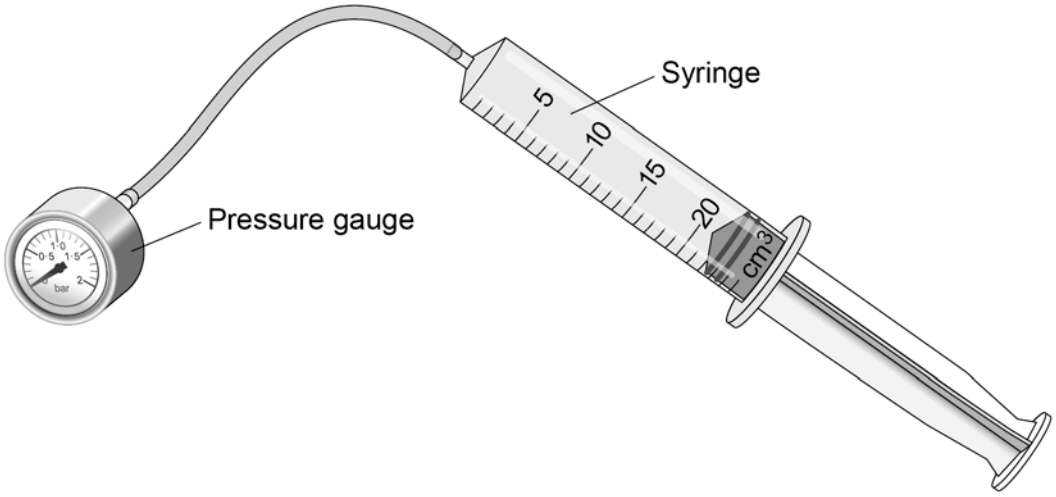
Turn over for the next question

0 9 A student investigated how the pressure of a gas varied with the volume of the gas.

The mass and temperature of the gas were constant.

Figure 10 shows the equipment the student used.

Figure 10



0 9 . 1 What is the resolution of the syringe?

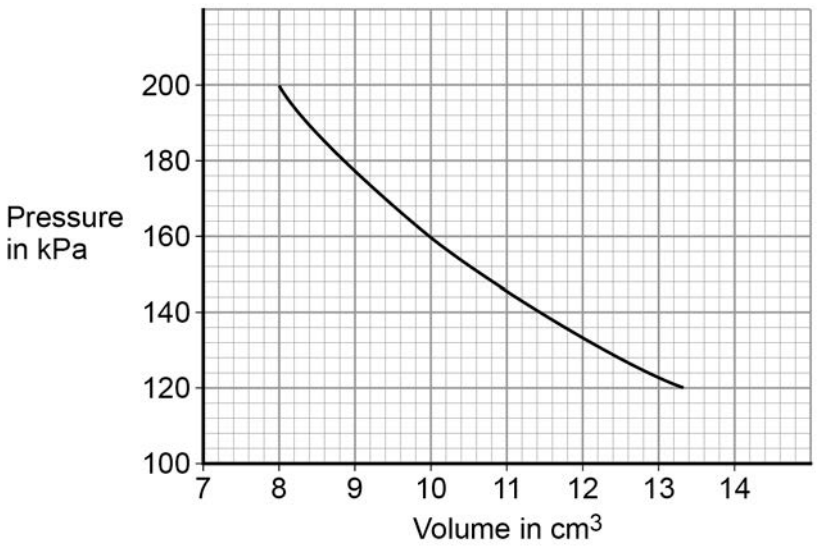
[1 mark]

_____ cm^3

The student compressed the gas in the syringe and read the pressure from the pressure gauge.

Figure 11 shows the student's results.

Figure 11



0 9 . 2 What conclusion can the student make from the data in **Figure 11**?

Use data from **Figure 11** in your answer.

[3 marks]

0 9 . 3 Explain why the pressure in the gas increases as the gas is compressed.

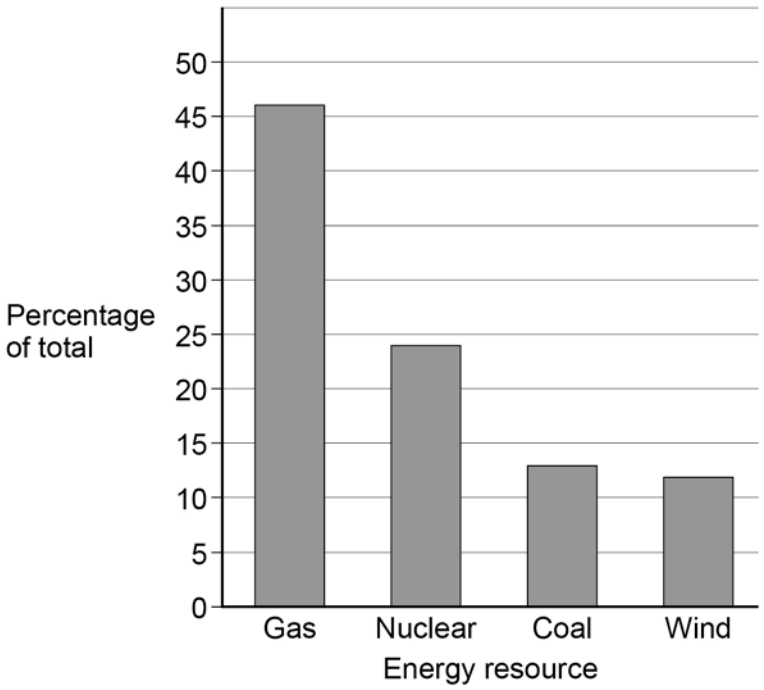
[4 marks]

8

Turn over for the next question

1 0 **Figure 12** gives information about the production of electricity in the UK in 2016.

Figure 12



1 0 . 1 The UK government signed the Paris Climate Agreement in April 2016.

The agreement commits the UK to reduce the amount of carbon dioxide released into the atmosphere.

Explain which energy resources in **Figure 12** should be used to meet the UK's commitment to the Paris Climate Agreement.

[4 marks]

1 0 . 2 On average, there is enough wind in the UK each year to supply all of the UK's electricity needs.

Explain why the UK may still need power stations that use fuel to generate electricity.

[2 marks]

Question 10 continues on the next page

1 0 . 3 All European countries signed the Paris Climate Agreement in 2016.

In the future, some European countries will only allow electric vehicles.

Suggest how this is likely to affect methods of electricity generation in these countries.
[3 marks]

9

1 1 **Figure 13** shows a battery-powered drone.

Figure 13

1 1 . 1 The battery in the drone can store 97.5 kJ of energy.

When the drone is hovering, the power output of the battery is 65.0 W

Calculate the time for which the drone can hover.

[3 marks]

Time = _____ seconds

Question 11 continues on the next page

1 1 . 2 The battery powers 4 motors in the drone.

Each motor has a resistance of 1.60 Ω when the power input is 19.6 W

The 4 motors are connected in parallel with the battery.

Calculate the current in the battery.

[4 marks]

Current = _____ A

7

END OF QUESTIONS