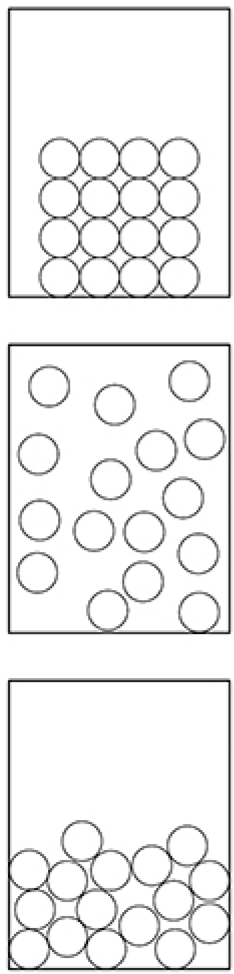
1. (a) A student investigated the three states of matter.

The arrangement of particles in the three states of matter are different.

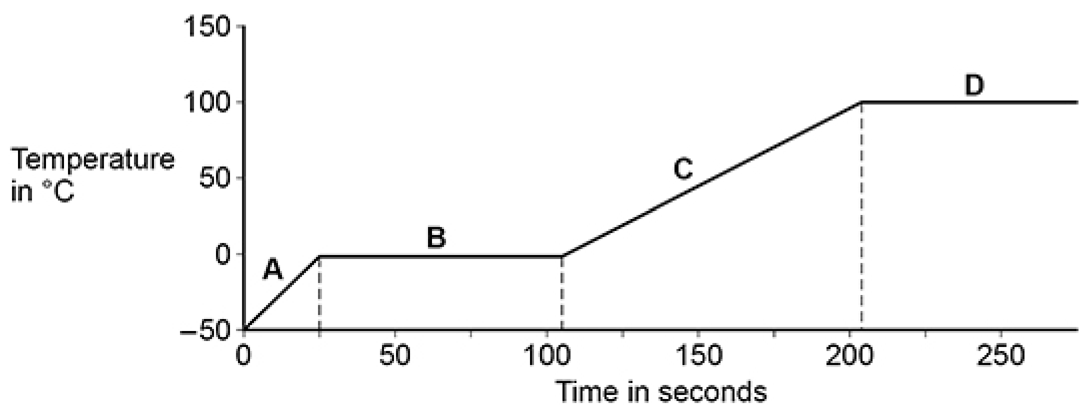
Draw **one** line from each particle arrangement to the state of matter.

Particle arrangement	**State of matter**
	Solid Liquid Gas

(2)

A large lump of ice was heated and changed state.

The figure below shows how the temperature varied with time.



(b) Which part of the figure above shows when the ice was melting?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) Which part of above the figure above shows when the water was boiling?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(d) Which property of the water particles changes as the temperature of the water increases?

Tick (✓) **one** box.

The kinetic energy of the particles	☐
The mass of each particle	☐
The number of particles	☐

(1)

(e) Calculate the thermal energy needed to melt 0.250 kg of ice at 0 °C.

specific latent heat of fusion of water = 334 000 J/kg

Use the equation:

thermal energy = mass × specific latent heat

____

____

____

Thermal energy = _______________ J

(2)

(f) Complete the sentence.

Choose the answer from the box.

condenses	**evaporates**	**ionises**	**sublimates**

A substance is heated and changes directly from a solid to a gas.

The substance ________________.

(1)

(Total 8 marks)

2. A student wanted to determine the density of a small piece of rock.

(a) Describe how the student could measure the volume of the piece of rock.

____

____

____

____

____

____

____

____

____

____

(4)

(b) The volume of the piece of rock was 18.0 cm^3.

The student measured the mass of the piece of rock as 48.6 g.

Calculate the density of the rock in g/cm^3.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

____

____

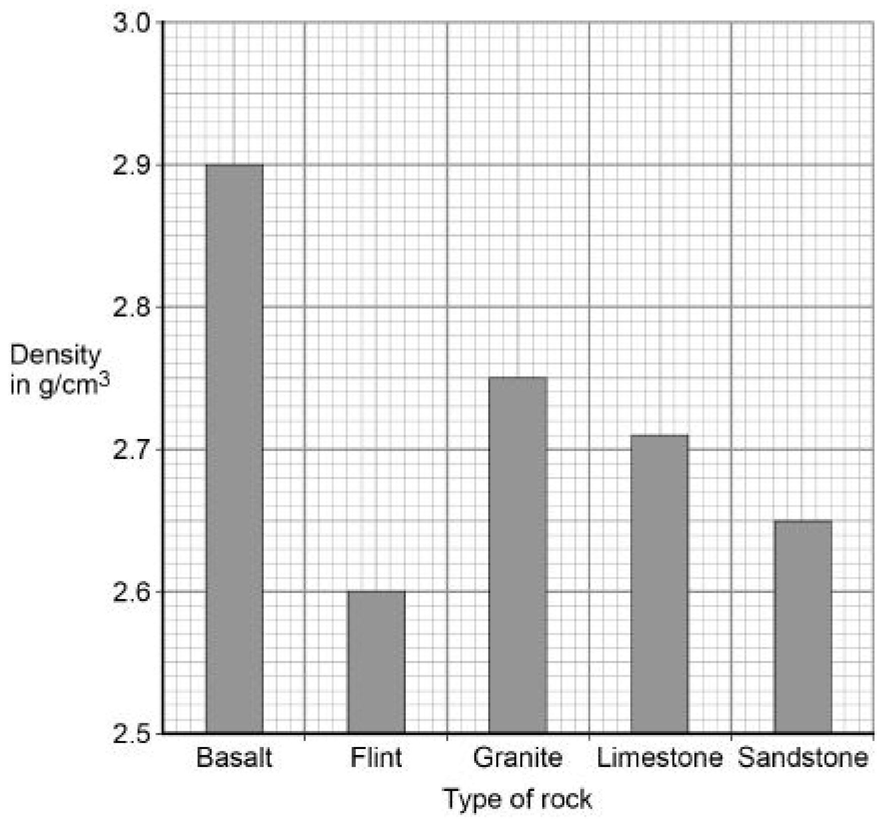
____

____

Density = ______________________ g/cm^3

(2)

The graph below shows the densities of different types of rock.



(c) What is the most likely type of rock that the student had?

Tick **one** box.

Basalt ☐

Flint ☐

Granite ☐

Limestone ☐

Sandstone ☐

(1)

(d) Give **one** source of error that may have occurred when the student measured the volume of the rock.

___

___

(1)

(e) How would the error you described in part **(d)** affect the measured volume of the rock?

___

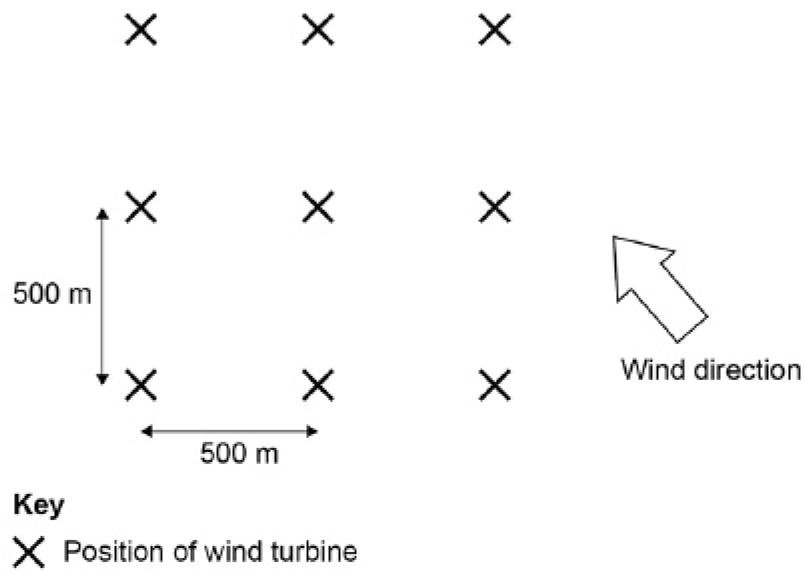
___

(1)

(Total 9 marks)

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

The diagram shows the position of nine wind turbines in a wind farm.



(a) Suggest **one** way in which the layout of this wind farm ensures maximum efficiency when the wind direction changes.

___

___

___

(1)

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

(b) Write down the equation that links density, mass and volume.

___

(1)

(c) Calculate the volume of air passing through the blades of one wind turbine in one second.

Give the unit.

Give your answer to 2 significant figures.

____

____

____

____

____

____

Volume in one second = ____________ Unit ____________

(5)

(d) The average power output from one of the wind turbines in the diagram 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.

____

____

____

Number of wind turbines = ______________________

(2)

(e) 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.

1. ____

____

2. ____

____

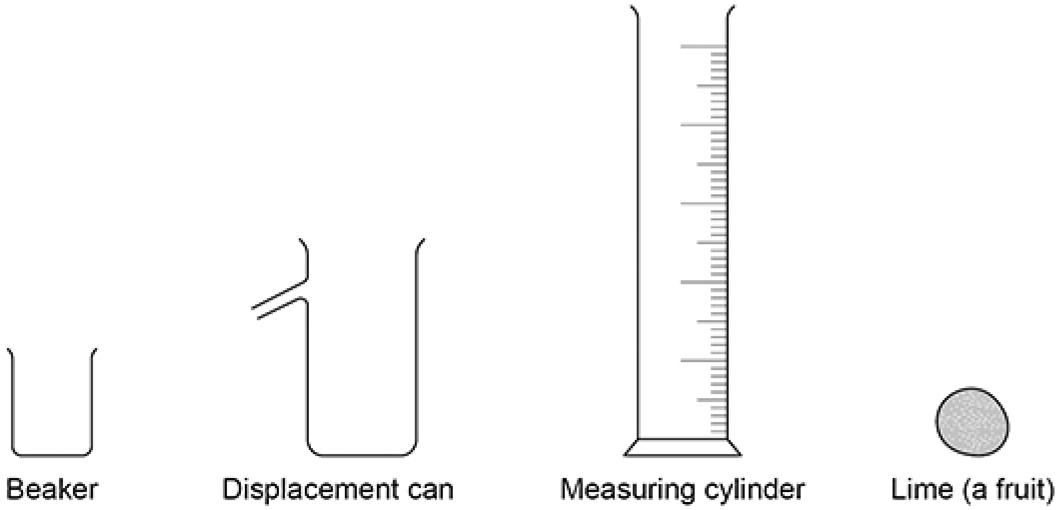
(2)

(Total 11 marks)

4. A student investigated the density of different fruits.

To determine the density of each fruit, the student measured the volume of each fruit.

The figure below shows the equipment the student could have used.



(a) Describe a method the student could have used to measure the volume of the lime.

____

____

____

____

____

____

____

____

____

____

____

____

(4)

(b) The student measured the volume of each fruit three times and then calculated a mean value.

The three measurements for a grape were

$2.1\ cm^3$ $2.1\ cm^3$ $2.4\ cm^3$

Calculate the mean value.

___

___

___

Mean value = ______________ cm^3

(2)

(c) What are the advantages of taking three measurements and calculating a mean value?

Tick (✓) **two** boxes.

Allows anomalous results to be identified and ignored.	☐
Improves the resolution of the volume measurement.	☐
Increases the precision of the measured volumes.	☐
Reduces the effect of random errors when using the equipment.	☐
Stops all types of error when using the equipment.	☐

(2)

(d) The mass of an apple was 84.0 g.

The volume of the apple was 120 cm^3.

Calculate the density of the apple.

Give your answer in g/cm^3.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

____

____

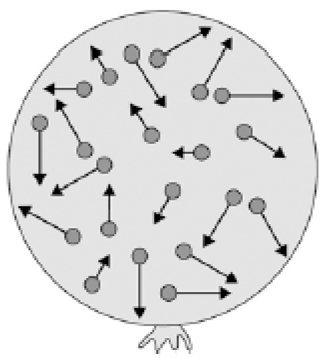
____

Density = ________________ g/cm^3

(2)

(Total 10 marks)

5. The figure below shows a balloon filled with helium gas.



(a) Describe the movement of the particles of helium gas inside the balloon.

____

____

____

____

(2)

(b) What name is given to the total kinetic energy and potential energy of all the particles of helium gas in the balloon?

Tick **one** box.

External energy ☐

Internal energy ☐

Movement energy ☐

(1)

(c) Write down the equation which links density, mass and volume.

____

(1)

(d) The helium in the balloon has a mass of 0.00254 kg.

The balloon has a volume of 0.0141 m^3.

Calculate the density of helium. Choose the correct unit from the box.

m^3 / kg	**kg / m^3**	**kg m^3**

____

____

____

____

Density = ____________________ Unit __________

(3)

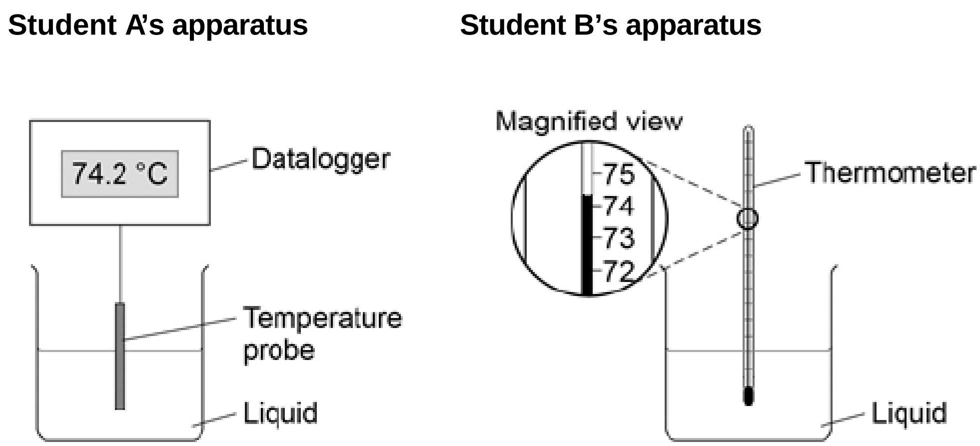
(Total 7 marks)

6. Two students investigated the change of state of stearic acid from liquid to solid.

They measured how the temperature of stearic acid changed over 5 minutes as it changed from liquid to solid.

Figure 1 shows the different apparatus the two students used.

Figure 1



(a) Choose **two** advantages of using student **A**'s apparatus.

Tick **two** boxes.

Student **A**'s apparatus made sure the test was fair. ☐

Student **B**'s apparatus only measured categoric variables. ☐

Student **A**'s measurements had a higher resolution. ☐

Student **B** was more likely to misread the temperature. ☐

(2)

(b) Student **B** removed the thermometer from the liquid each time he took a temperature reading.

What type of error would this cause?

Tick **one** box.

A systematic error ☐

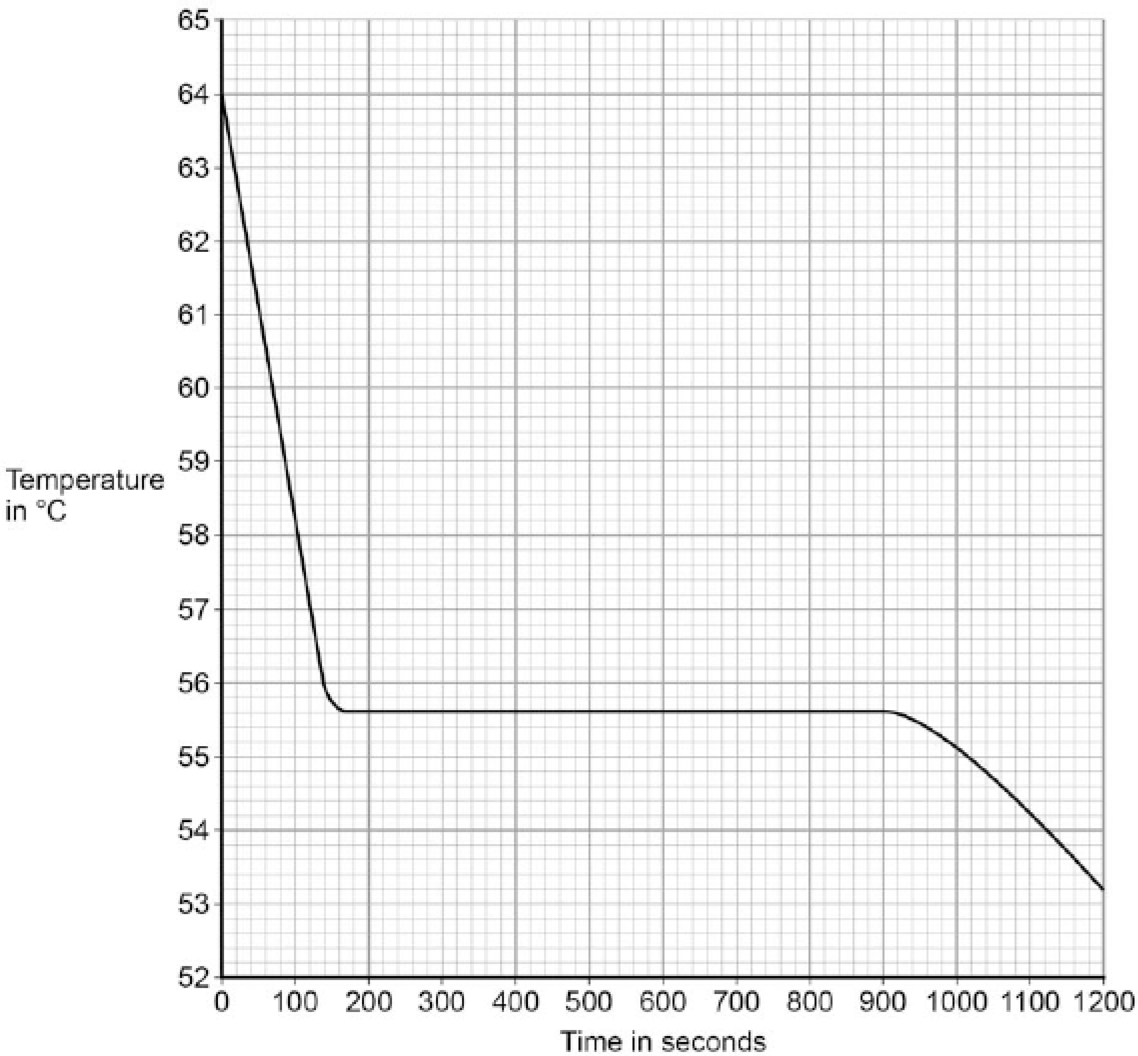
A random error ☐

A zero error ☐

(1)

(c) Student **A**'s results are shown in **Figure 2**.

Figure 2



What was the decrease in temperature between 0 and 160 seconds?

Tick **one** box.

8.2 °C ☐

8.4 °C ☐

53.2 °C ☐

55.6 °C ☐

(1)

(d) Use **Figure 2** to determine the time taken for the stearic acid to change from a liquid to a solid.

Time = ____________ seconds

(1)

(e) Calculate the energy transferred to the surroundings as 0.40 kg of stearic acid changed state from liquid to solid.

The specific latent heat of fusion of stearic acid is 199 000 J / kg.

Use the correct equation from the Physics Equations Sheet.

____

____

____

Energy = ______________________ J

(2)

(f) After 1200 seconds the temperature of the stearic acid continued to decrease.

Explain why.

____

____

____

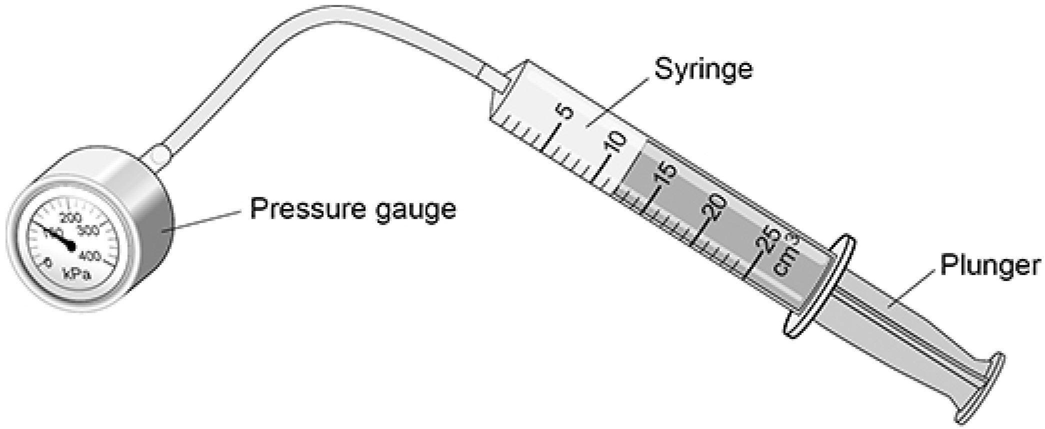
____

(2)

(Total 9

7. A teacher demonstrated the relationship between the pressure in a gas and the volume of the gas.

The figure below shows the equipment used.



(a) What is the range of the syringe?

Tick (✓) **one** box.

From 0 to 1 cm^3	☐
From 0 to 5 cm^3	☐
From 0 to 25 cm^3	☐

(1)

(b) The relationship between the pressure and volume of a gas is given by the equation:

pressure × volume = constant

Complete the sentence.

For this equation to apply, both the mass of gas and the ________________ of the gas must stay the same.

(1)

(c) The initial volume of the gas in the syringe was 12 cm^3.

The initial pressure of the gas in the syringe was 101 000 Pa.

Calculate the constant in the equation below.

pressure × volume = constant

____

____

____

Constant = ________________ Pa cm^3

(2)

(d) The teacher pulled the plunger slowly outwards and the gas expanded.

The new volume of the gas was 24 cm^3.

Calculate the new pressure in the gas.

The constant has the same value as in part (c)

____

____

____

____

____

New pressure = ________________ Pa

(3)

(e) Which change occurs when the plunger is pulled slowly outwards?

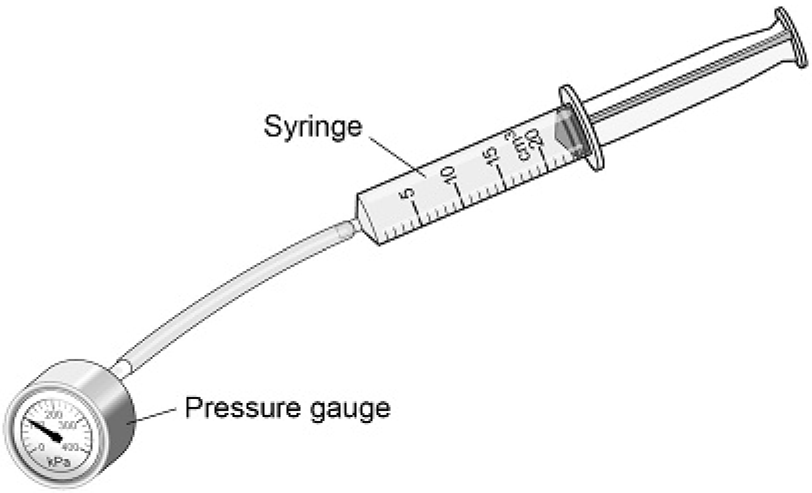
Tick (✓) **one** box.

The gas particles stop moving.	☐
There are more frequent collisions between the gas particles.	☐
There is more space between the gas particles.	☐

(1)

(Total 8 marks)

8. A student used the equipment in the image below to investigate how the pressure of a gas varies with the volume of the gas.



The syringe is filled with air.

The table below shows the results.

Volume in cm^3	**Pressure in kPa**
24	100
20	120
12	200
10	240

(a) Describe how the student could use the equipment in the image above to obtain the data shown in the table.

____

____

____

____

____

____

____

____

(4)

(b) Describe what happens to the pressure of the air when the volume of the air is halved.

____

____

____

____

(2)

(c) The temperature of the air in the syringe remained constant during the student's investigation.

Which **two** properties of the air particles would change if the temperature increased?

Tick (✓) **two** boxes.

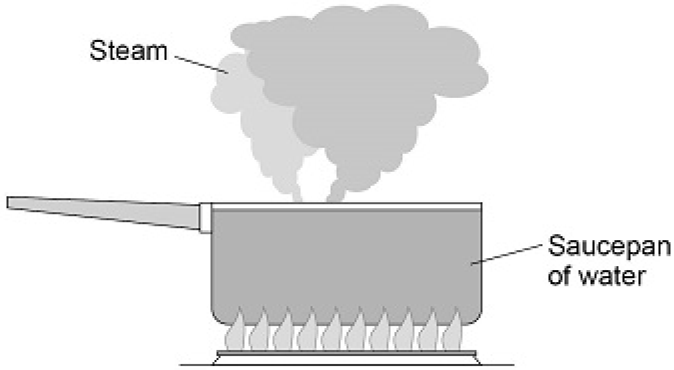
kinetic energy	☐
mass	☐
shape	☐
speed	☐
volume	☐

(2)

(Total 8 marks)

9. **Figure 1** shows water being heated. Eventually the water changed into steam.

Figure 1



(a) Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

greater than	**less than**	**the same as**

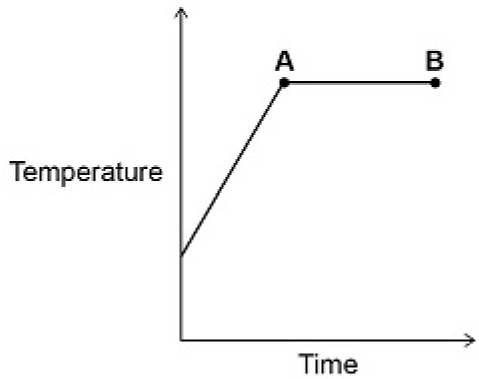
The distance between the particles in steam is ____________________________ the distance between the particles in liquid water.

The density of steam is ____________________________ the density of liquid water.

(2)

Figure 2 shows how the temperature of the water varied with time.

Figure 2



(b) What is the name of the process that is taking place between points **A** and **B**?

Give a reason for your answer.

Process ____

Reason ____

____

(2)

(c) A mass of 0.063 kg of water was turned into steam.

The specific latent heat of vaporisation of water is 2 260 000 J/kg

Calculate the thermal energy transferred to the water to turn it into steam.

Use the equation:

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

____

____

____

Energy = ______________________________ J

(2)

(d) The mass of the steam was 0.063 kg

The volume of the steam was 0.105 m^3

Calculate the density of steam.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Choose the unit from the box.

kg	**m^3 / kg**	**kg / m^3**

____

____

____

Density = ________________________ Unit __________________

(3)

(Total 9 marks)

10. The diagram below shows a cyclist riding along a flat road.

(a) Complete the sentence.

Choose answers from the box.

chemical	**elastic potential**	**gravitational potential**	**kinetic**

As the cyclist accelerates, the ______________________ energy store in the cyclist's body decreases and the ______________________ energy of the cyclist increases.

(2)

(b) The mass of the cyclist is 80 kg. The speed of the cyclist is 12 m/s.

Calculate the kinetic energy of the cyclist.

Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$$

____

____

____

____

Kinetic energy = ________________________ J

(2)

(c) When the cyclist uses the brakes, the bicycle slows down.

This causes the temperature of the brake pads to increase by 50 °C.
The mass of the brake pads is 0.040 kg.
The specific heat capacity of the material of the brake pads is 480 J/kg °C.

Calculate the change in thermal energy of the brake pads.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

____

____

____

Change in thermal energy = ________________________ J

(2)

(d) How is the internal energy of the particles in the brake pads affected by the increase in temperature?

Tick **one** box.

Decreased ☐

Increased ☐

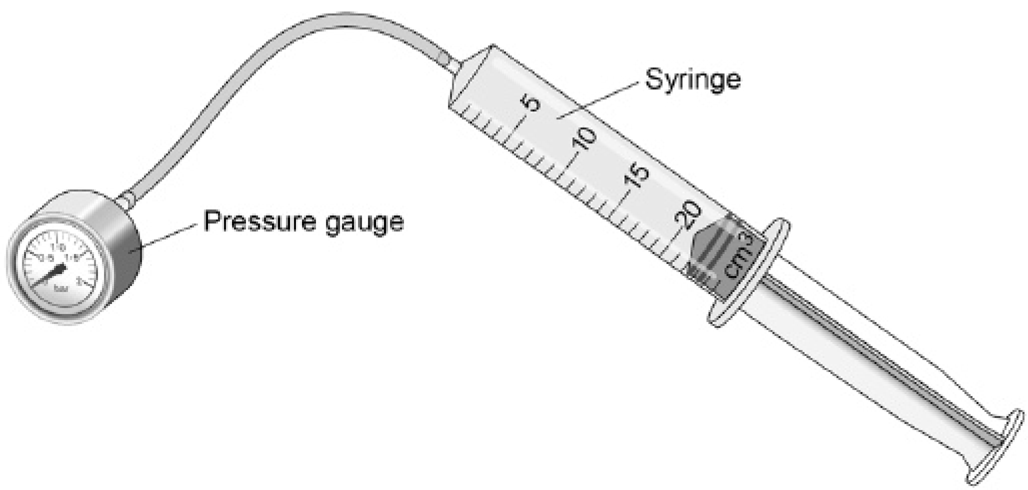
Not affected ☐

(1)
(Total 7 marks)

11. 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.

The diagram shows the equipment the student used.



(a) What is the range of the syringe?

Tick **one** box.

0 to 1 cm^3 ☐

0 to 5 cm^3 ☐

0 to 20 cm^3 ☐

0 to 25 cm^3 ☐

(1)

(b) What type of variable was the mass of gas?

Tick **one** box.

Control ☐

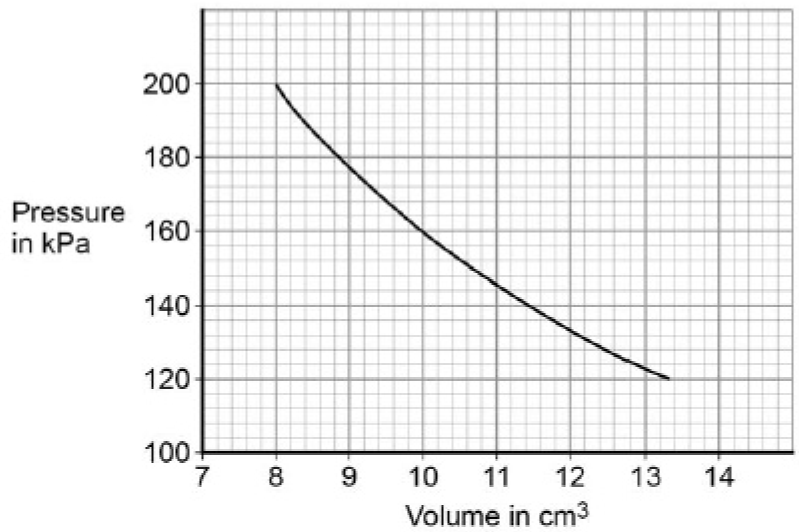
Dependent ☐

Independent ☐

(1)

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

The graph shows the student's results.



(c) The student concluded that when the pressure was multiplied by the corresponding volume the answer was the same.

Use data from the graph to show that the student's conclusion was correct.

___

___

___

___

___

___

(2)

(d) Complete the sentences.

Choose the answers from the box.

Each answer may be used once, more than once or not at all.

decreases	**increases**	**remains the same**

When the gas is compressed, the volume of gas in the syringe ________________ .

So the number of collisions each second between the gas particles inside the

syringe and the inside surface of the syringe ____________________ .

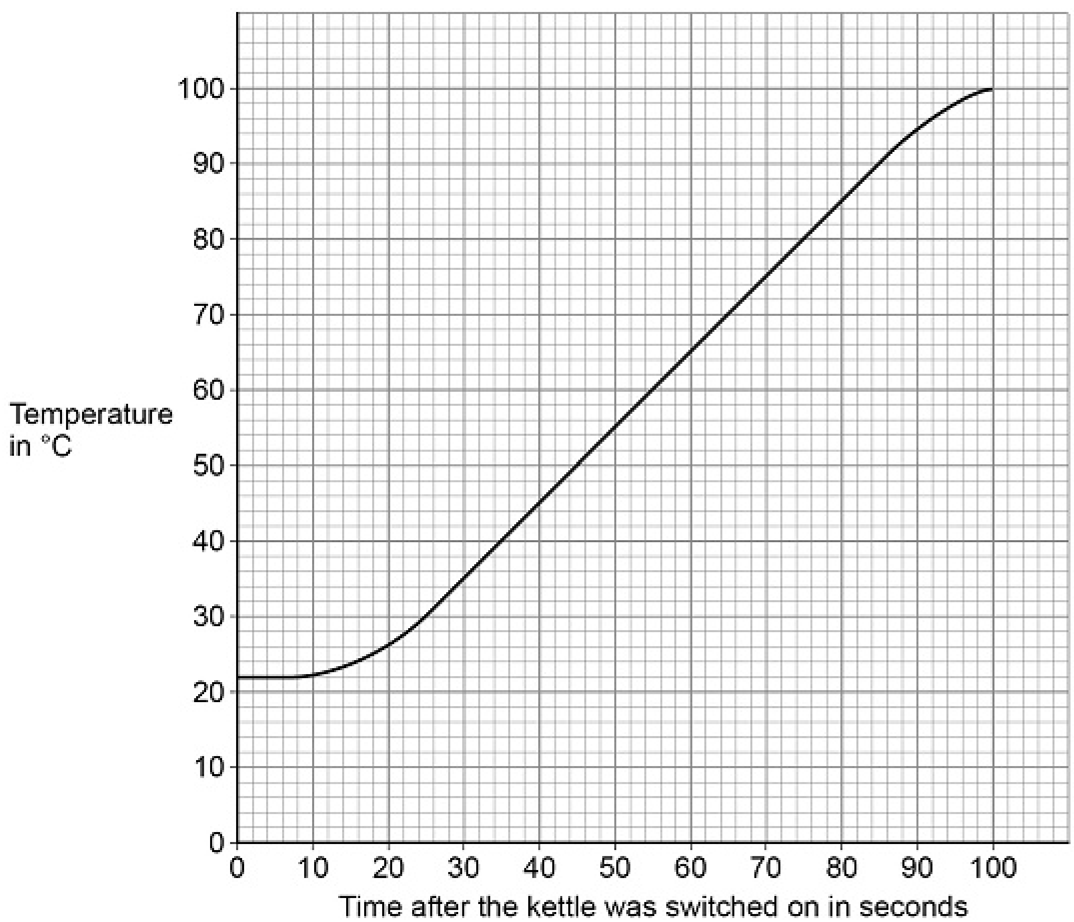
This means the force exerted on the inside surface of the container

walls ____________________ .

(3)
(Total 7 marks)

12. An electric kettle was switched on.

The graph below shows how the temperature of the water inside the kettle changed.



(a) When the kettle was switched on the temperature of the water did **not** immediately start to increase.

Suggest **one** reason why.

____

____

____

(1)

(b) The energy transferred to the water in 100 seconds was 155 000 J.

specific heat capacity of water = 4200 J/kg °C

Determine the mass of water in the kettle.

Use the graph above.

Give your answer to 2 significant figures.

____

____

____

____

____

____

____

Mass of water (2 significant figures) = _______________ kg

(5)

(c) The straight section of the line in above graph can be used to calculate the useful power output of the kettle.

Explain how.

____

____

____

____

____

____

____

(3)

(Total 9 marks)