Kinetic theory and gases

1 (a) Kinetic theory describes the movement of particles in the three states of matter.

Gas is one of the states of matter.

(i) Name the other two states of matter.

(2)

1 .....

2 .....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The average kinetic energy of the particles in a gas is directly proportional to

(1)

☐ **A** the pressure of the gas

☐ **B** the temperature of the gas measured in degrees Celsius

☐ **C** the temperature of the gas measured in Kelvin

☐ **D** the volume of the gas

(b) The photograph shows an oxygen cylinder that can be used in an ambulance.



(i) Explain how particles of oxygen gas exert a pressure on the inside of the cylinder.

(2)

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.....

.....

(ii) This cylinder can release 340 litres of oxygen at a pressure of 101 000 Pa.

The inside volume of the cylinder is 2.5 litres.

Use the equation

$$P_2 = \frac{P_1 V_1}{V_2}$$

to calculate the pressure of the oxygen in the cylinder before the gas is released.

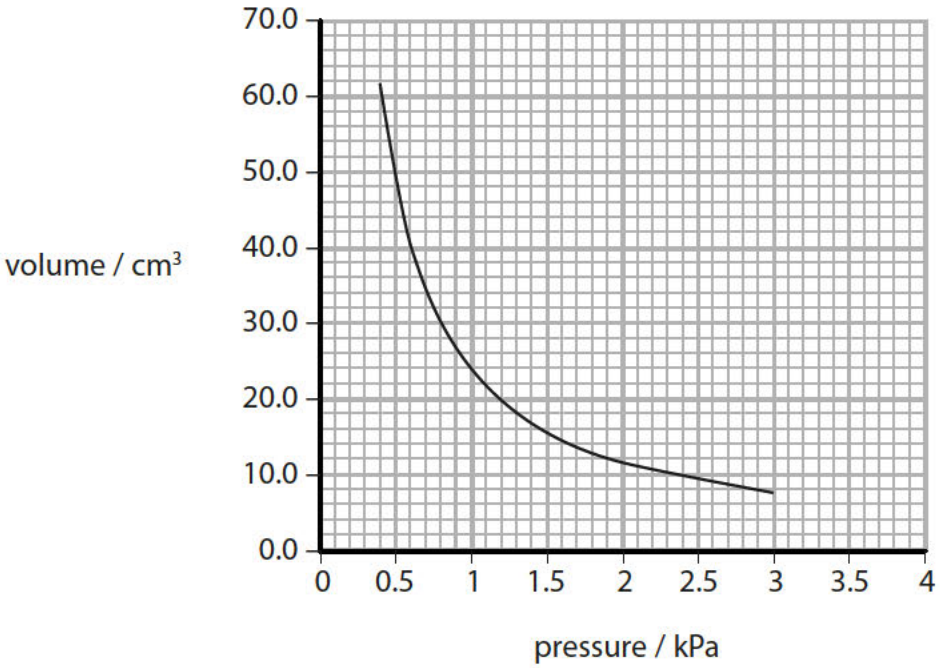
(3)

pressure of oxygen = ... Pa

(Total for Question 2 = 8 marks)

2 (a) A student investigated how the volume and pressure of a gas were related.

The graph shows how the volume of a gas changes with pressure.



The table shows the results used to plot the graph.

pressure / kPa	volume / cm³
2.5	.....
2.0	11.9
.....	14.0
1.4	17.0
1.0	24.0
0.4	61.5

(i) Use the graph to complete the table.

(2)

(ii) The results were taken at a constant temperature of 23 °C.

Complete the sentence by putting a cross (☒) in the box next to your answer.

A temperature of 23 °C can be written in kelvin as

(1)

☒ **A** −273 K

☒ **B** 250 K

☒ **C** 273 K

☒ **D** 296 K

(iii) Estimate a value for the volume when the pressure becomes 4 kPa.

(1)

volume = ... cm^3

(iv) When the pressure of the gas is 2.2 kPa, the volume of the gas is 10.8 cm^3.

Use the equation

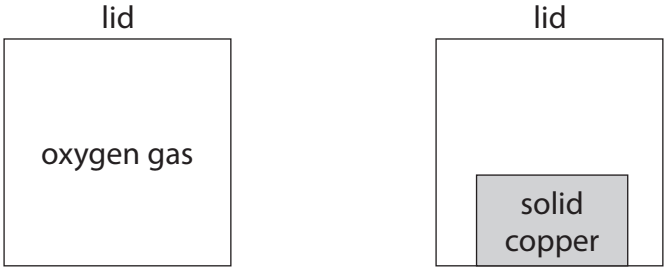
$$V_2 = \frac{P_1 V_1}{P_2}$$

to calculate the volume of the gas when the pressure of the gas is 0.2 kPa.

(2)

volume = ... cm^3

*(b) The diagrams show a block of solid copper and some oxygen gas in two closed containers.



The oxygen exerts a pressure on the lid of its container.

The copper does not exert a pressure on the lid of its container.

Explain, using kinetic theory, why the oxygen exerts a pressure on the lid but the copper does not.

(6)

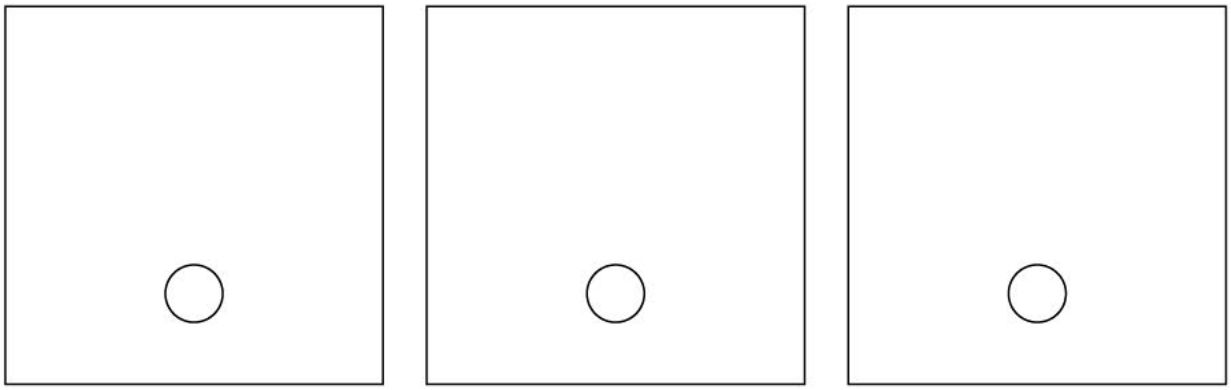
(Total for Question 6 = 12 marks)

3 (a) (i) Complete n a solid,

liquid and gas.

One particle in each box has been drawn for you.

(3)



solid liquid gas

Figure 1

(ii) Which row of the table is correct for water compared to steam?

(1)

		the density of water is	the water molecules are
☐	**A**	bigger	smaller
☐	**B**	smaller	bigger
☐	**C**	bigger	closer together
☐	**D**	smaller	further apart

(b) A student investigates the density of a copper block and the density of a small stone, as shown in Figure 2.

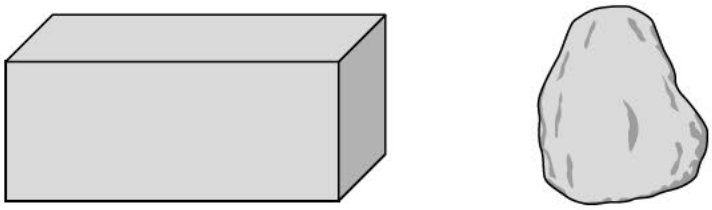


Figure 2

(i) The student calculates the volume of the block as 13 cm^3.

She finds that the mass of the block is 100 g.

Calculate the density of the block.

Use the equation

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

(2)

density = ... g/cm^3

(ii) The student found the volume of the copper block by multiplying the area of its base by its height.

The small stone does not have straight sides.

Describe how the student could measure the volume of the small stone.
You may use a diagram if it helps your answer.

(3)

(Total for Question 1 = 9 marks)

4 (a) Figure 13 shows a tank for holding water.

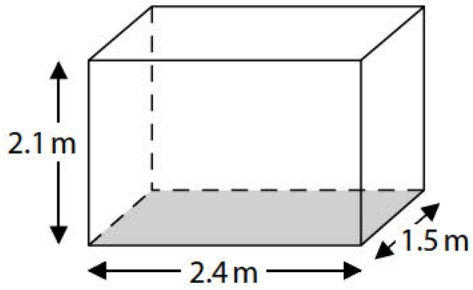


Figure 13

The tank has sides of 2.4 m, 2.1 m and 1.5 m.

The pressure at the bottom of the tank is 12 kPa.

(i) State the equation relating pressure, force and area.

(1)

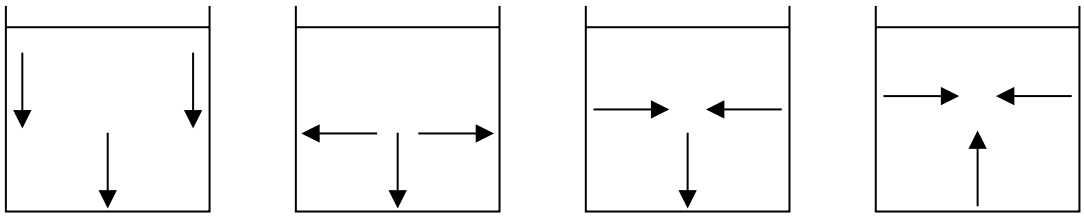
(ii) Calculate the weight of water in the tank.

(4)

weight = ... N

(iii) Which diagram shows the direction of the forces from the water on the inside of the tank?

(1)



☒ **A** ☒ **B** ☒ **C** ☒ **D**

(b) A student makes the following hypothesis:

'*When I increase the pressure on a fixed mass of gas, the volume of the gas decreases.*'

She has the equipment shown in Figure 14.

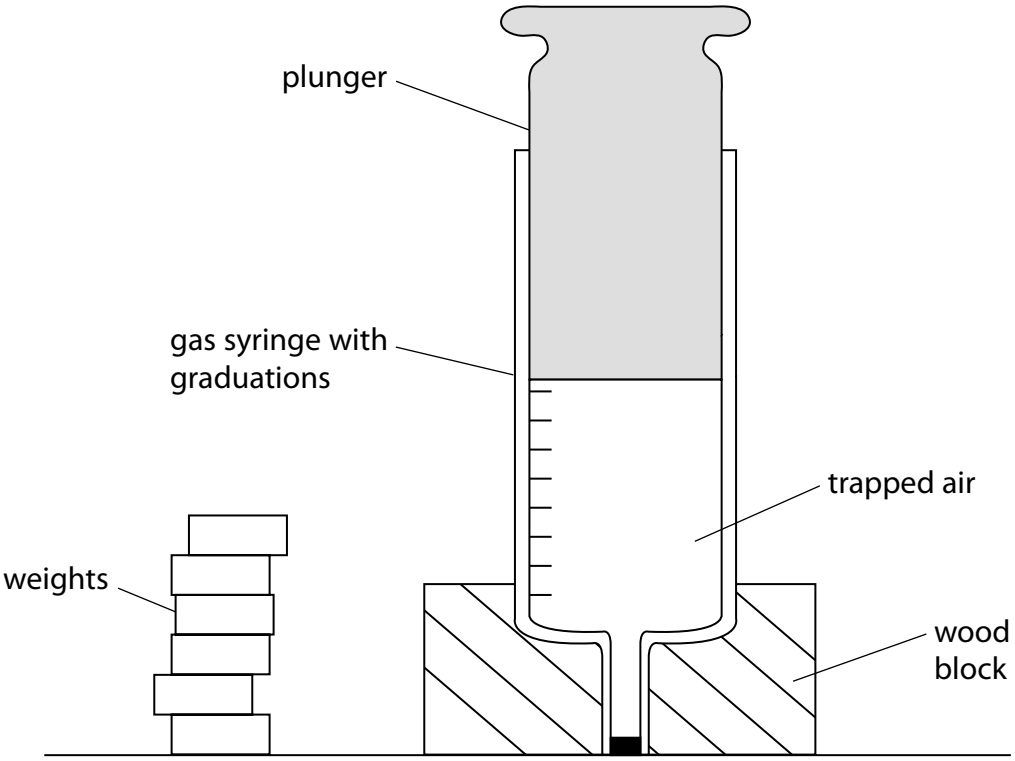


Figure 14

She measures the area of the plunger.

Devise a plan to test her hypothesis.

(4)

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(Total for Question 6 = 10 marks)