Kinetic Particle Model of Matter

Question Paper

Course	CIE IGCSE Physics
Section	2. Thermal Physics
Topic	Kinetic Particle Model of Matter
Difficulty	Hard

Time Allowed 60

Score /48

Percentage /100

Question 1a

Extended Tier Only

A cube of side 0.040 m is floating in a container of liquid. Fig. 3.1 shows that the surface of the liquid is 0.028 m above the level of the bottom face of the cube.

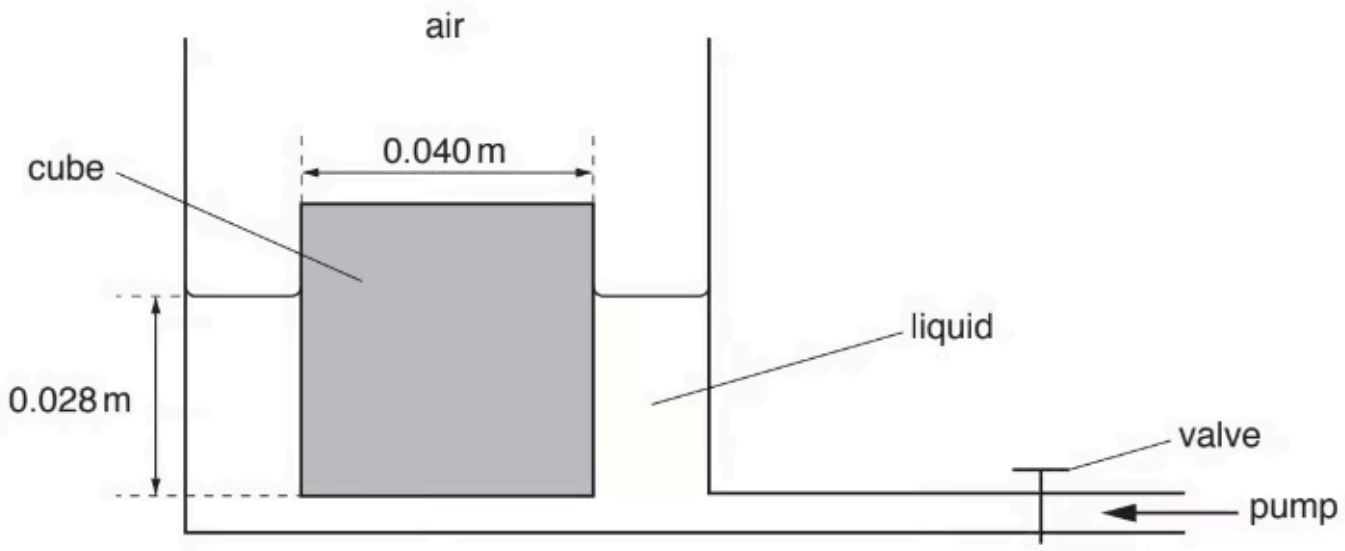

Fig. 3.1

The pressure of the air above the cube exerts a force on the top face of the cube. The valve is closed.

Explain, in terms of air molecules, how the force due to the pressure of the air is produced.

[3 marks]

Question 1b

Extended

The density of the liquid in the container is 1500 kg / m^3.

Calculate:

(i) the pressure due to the liquid at a depth of 0.028 m

pressure = ... [2]

(ii) the force on the bottom face of the cube caused by the pressure due to the liquid.

force = ... [2]

[4 marks]

Question 1c

Extended

The valve is opened and liquid is pumped into the container. The surface of the liquid rises a distance of 0.034 m.

The cube remains floating in the liquid with its bottom face 0.028 m below the surface of the liquid.

(i) Calculate the work done on the cube by the force in (b)(ii).

work done = ... [2]

(ii) Suggest one reason why this is not an efficient method of lifting up the cube.

[1]

[3 marks]

Question 2a

Extended

A microscope that produces a very high magnification is used to observe the Brownian motion of smoke particles in air.

Fig. 5.1(a) shows the apparatus used with the microscope. Fig. 5.1(b) represents the view through the microscope and shows one of the smoke particles being observed.

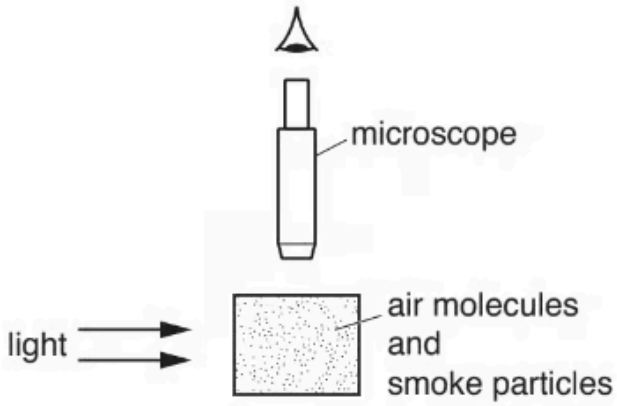

Fig. 5.1(a)

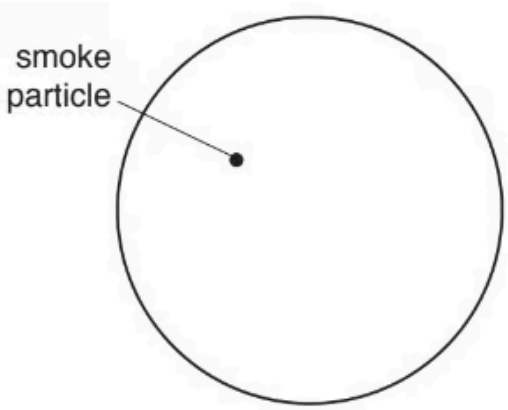

Fig. 5.1(b)

(i) On Fig. 5.1(b), draw a possible path for the smoke particle.

[2]

(ii) Describe how air molecules cause the smoke particle to follow the observed path.

[2]

[4 marks]

Question 2b

Fig. 5.2 shows a volume of gas in a cylinder.

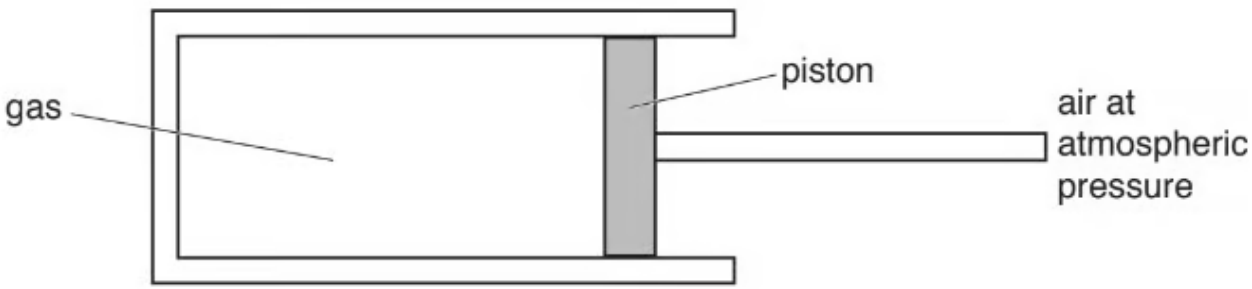

Fig. 5.2

The piston in the cylinder is free to move. The piston moves to the left when the temperature of the gas is decreased.

Explain, in terms of the molecules of the gas, why this happens.

[4 marks]

Question 3a

Describe qualitatively, in terms of particles, the effect on the pressure of a fixed mass of gas in a container when there is:

(i) an increase in temperature at a constant volume

[2]

(ii) an increase in volume at a constant temperature

[2]

[4 marks]

Question 3b

Extended

Table 1.1 gives a series of pressures and their corresponding volumes, obtained in an experiment with a fixed amount of gas. The gas obeys the law for a fixed amount of gas at a constant temperature.

pressure / kPa	120	240	480	580	1160
volume / cm^3	60	30	15	12.4	6.2

Table 1.1

(i) State the equation linking the pressure and volume at a constant temperature

[1]

(ii) Determine whether these figures indicate that the temperature was constant throughout the experiment.

[2]

[3 marks]

Question 3c

Extended

Air is trapped by a piston in a cylinder. The pressure of the air is 7.1×10^5 Pa. The distance from the closed end of the cylinder to the piston is 48 mm.

The piston is pushed in until the pressure of the air has risen to 9.0×10^5 Pa.

Calculate how far the piston has moved.

[4 marks]

Question 4a

Extended

Fig 1.1 shows the graph showing how the volume changes with pressure for a gas at a constant temperature

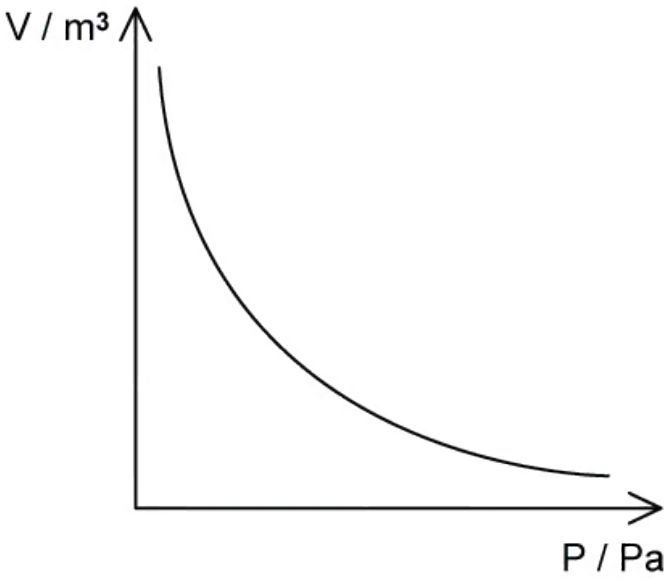

Fig 1.1

Sketch the graph for the same gas at a higher temperature.

[1 mark]

Question 4b

Extended

Sketch the graph of

(i) Pressure p against $\frac{1}{V}$ where V is the volume of a gas. Label this X.

[2]

(ii) The graph in part (i) but with the gas at a higher temperature. Label this Y.

[1]

[3 marks]

Question 4c

Extended

The piston in Fig 1.2 is pulled out of the cylinder from position A to position B, without changing the temperature of the air enclosed. Position B is double the length of the distance between position A and the end of the cylinder. The pressure when the piston is at position A is 2.5×10^5 Pa.

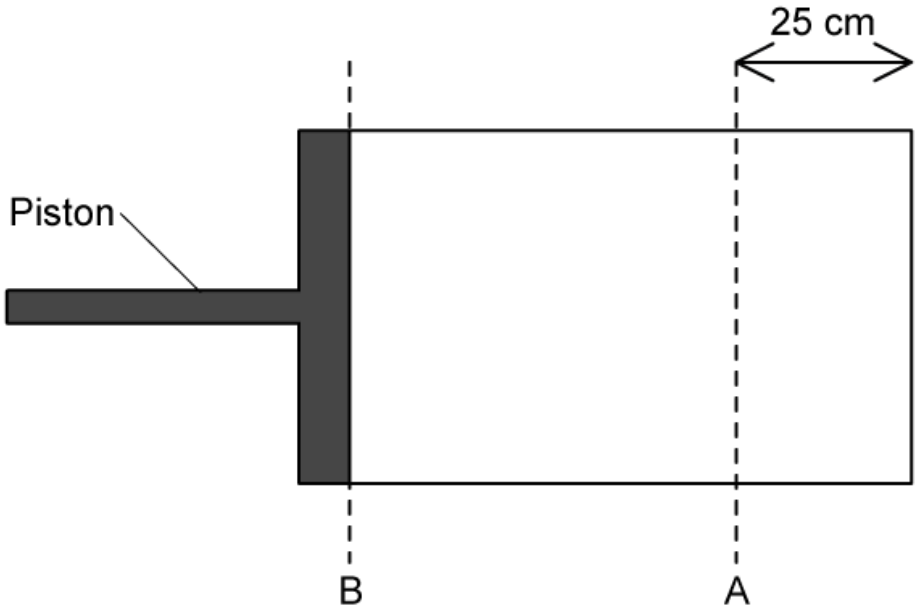

Fig. 1.2

Calculate the pressure when the piston is moved to position B.

[4 marks]

Question 5a

The fizz in a soda bottle is caused by carbonation. When the soda is bottled, carbon dioxide is added to the liquid to give it a fizzy taste. The carbon dioxide gas is kept in the liquid by the pressure inside the bottle.

When the bottle of soda is opened, state what happens to the pressure inside the bottle and why.

[2 marks]

Question 5b

A student is struggling with their revision and has sketched the following graph in Fig 1.1 to represent the change in temperature with volume for a gas at constant pressure.

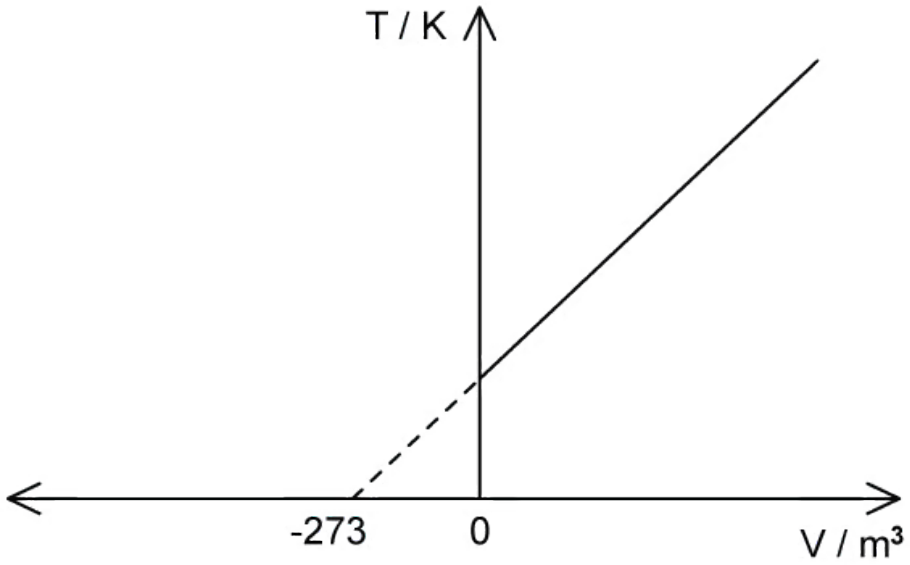

Fig 1.1

(i) State the mistake made in the student's graph.

[2]

(ii) Sketch a new graph to show the correct relationship between temperature and volume.

[2]

[4 marks]

Question 5c

Extended

Fig 1.2 shows two mugs of tea, A and B. They both hold the same volume of tea.

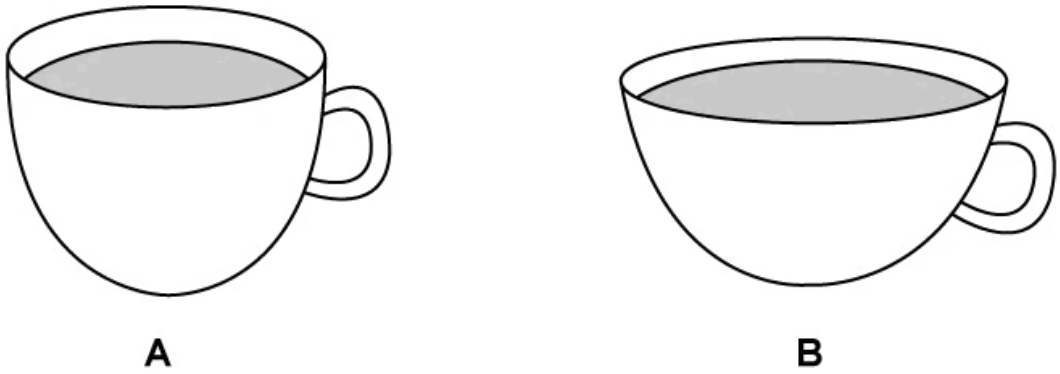

Fig 1.2

State from which mug the tea evaporates quicker. Explain why, in terms of the behaviour of molecules and the process of evaporation.

[5 marks]