O Level Pure Physics Structured

Kinetic Model of Matter Test 1.0

Q1

A student used the set-up as shown in Fig. 5.1 to study the pressure ***P*** and volume **V** of a fixed mass of gas inside an elastic flask **A** at various thermodynamic temperatures ***T***.

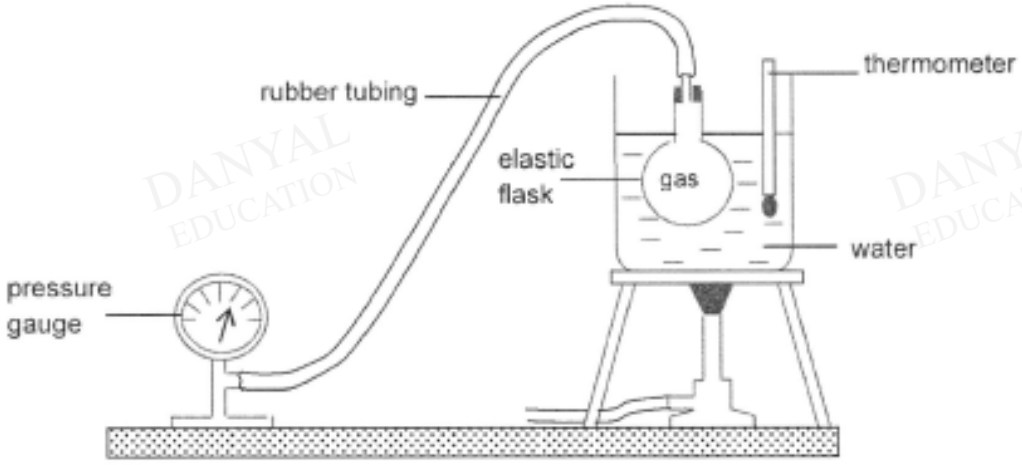

Fig. 5.1

The student's tabulated readings of ***P*** and ***T*** are shown in Fig. 5.2 below.

T / **K**	293	323	337	371
P / **kPa**	90	85	80	78
V / cm^3	40	42	45	47

Fig. 5.2

(a) Explain why the relationship between the pressure and volume of the gas is inverse when the temperature of the gas increases. **[2]**

(b) If the elastic flask is changed into a glass flask, state and explain, in terms of the kinetic theory of particles, what happens to the pressure of gas when the temperature of the gas increases. **[3]**

Q2

Fig. 3.1 shows a freezer for keeping food frozen.

Fig. 3.1

(b) **(i)** The lid of the freezer is closed and air at room temperature is trapped inside the freezer. The freezer is switched on.

State and explain, using ideas about molecules, what happens to the pressure of the air in the freezer, as it cools.

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.....[3]

(ii) When the freezer reaches its operating temperature, it is more difficult to open the lid. Explain why.

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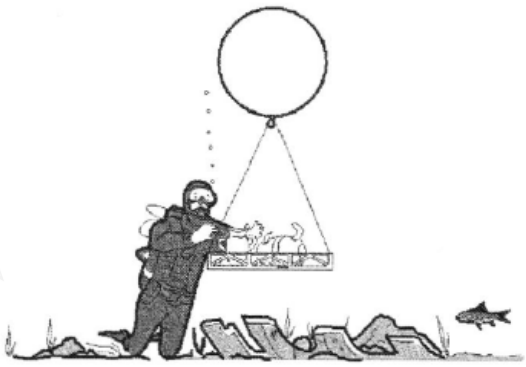
.....[1]

Q3

The figure below shows a diver working below the surface of a lake. The density of the water in the lake is 1000 kg/m^3, the atmospheric pressure at the surface is 1.0×10^5 Pa and the gravitational field strength is 10N/kg.



The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

(a) Calculate the total pressure at 15 m below the surface of the lake.

total pressure = _____ [2]

(b) The air in the balloon occupies a volume of 0.048 m^3 at the pressure calculated in **(a)**. When the diver releases the tray, the balloon, started to ascend with the tray. The temperature of the air in the balloon does not change.

Calculate the volume occupied by the air in the balloon when it reaches the surface of the lake.

volume = _____ [2]

(c) State one difference between the motion of the molecules of water in the lake and the molecules of air in the balloon.

_____

_____ [1]

(d) In ascending to the surface of the lake, the balloon first accelerates and before reaching a constant speed before it arrives at the surface.

(i) Explain how the forces acting on the balloon cause it to behave in this way.

_____

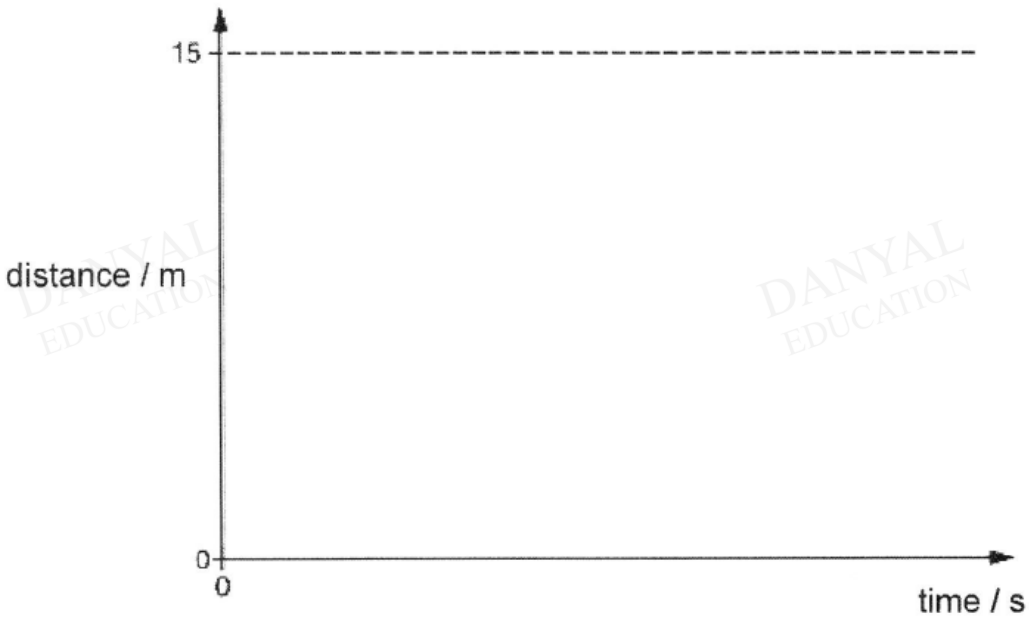
_____

_____

_____

_____ [3]

(ii) On the axes below, sketch the distance-time graph for the balloon as it travels 15 m to the surface. [2]



Q4

Fig. 5.1 shows the motion and arrangement of a liquid particles as drawn by a student.

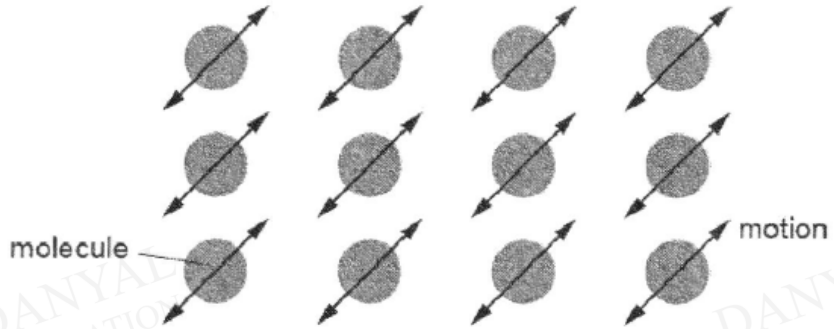


Fig. 5.1

(a) Describe how you would re-draw the diagram to make it more accurate.

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..... [2]

(b) Describe how the movement and arrangement of particle would change as it is slowly heated from liquid to gaseous state.

.....

..... [2]

Q5

a. On a hot day, a child drinks all the water in a plastic bottle. She then screws the cap back tightly on the bottle, so that the bottle contains only air.

She throws the bottle into a waste basket, where the sun shines on it. After a while in the sun's rays, the air in the bottle is much hotter than before.

i. State and explain what has happened to the pressure of the air in the bottle.

[1]

ii. In terms of the behaviour of the air molecules, explain your answer to (a)(i).

[1]

Answers

Kinetic Model of Matter Test 1.0

Q1

(a)	As the temperature increases, **the pressure will increase.** However, as the **flask is able to expand,** the **volume of the flask will increase**, thus allow the drop in the pressure,	B1 B1
(b)	As the temperature of the gas increases, **the average speed of the molecules will increase**, there **will be an increase in the force exerted per unit area** of the surface of the flask, as **P = F / A,** the pressure per unit area will increase.	B1 B1 B1

Q2

(b)(i)	pressure decreases. molecules slow down less frequent/less violent(molecular) collision **with wall**	[1] [1] [1]
MC	Majority of the students obtained full credit with only a few exceptions whose answers were not complete.	
(b)(ii)	**pressure difference** causes a downward **force** on lid or pressure outside is greater than pressure inside.	[1]
MC	Only **about** half the students were correct. If the students do not mentioned about **pressure difference** or **force** they are unlikely to get any credit.	

Q3

(a) pressure = $(1000 \times 15 \times 10) + 1.0 \times 10^5$ **[1]**
= 2.5×10^5 Pa **[1]**

(b) 250 000 (0.048) = 100 000 (V_2) **[1]**
V_2 = 0.12 m^3 **[1]**

(c) The particles in water slides past one another while the particles in air moves randomly at high speeds. **[1]**

(d) **(i)** The upward force is initially greater than the downward force, which results in an upward resultant force. **[1]**
As the speed increases, the resistance increases. **[1]**
Resultant force is zero when the resistance equals to the upward force. **[1]**

(ii) Increasing gradient **[1]**
Constant gradient **[1]**

Q4

ia	Molecules should not be in orderly manner and closer to each other	B1
	Motion should be random and not in the fixed direction	B1
ib	Move faster	B1
	More spaced apart, in random order	B1

Q5

i. State and explain what has happened to the pressure of the air in the bottle. [1]

The direct sun light will case the temperature of air to increase A1/2

When temperature increases, the pressure will increase A1/2

ii. In terms of the behaviour of the air molecules, explain your answer to (a)(i). [1]

When the temperature of the air is increased, it will case the air particles to move faster.
The particles will now hit against the side wall with a greater impact force. A1/2
The frequency of collision with the side wall will also be increased. A1/2
Since Pressure is the force acting per unit area, the pressure will increased as a result.