

1 (a) Explain, in terms of molecules, why it is possible to compress a gas, but not a liquid.

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.....  
.....

[2]

(b) Two containers made of insulating material contain the same volume of water at room temperature. The containers do not have lids. The volume of liquid in each container gradually decreases.

(i) After a certain time, the temperature of the water has decreased to below room temperature.

Explain, in terms of molecules, why the temperature has decreased.

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.....  
.....  
.....

[2]

(ii) One of the containers is wide and shallow. The other container is narrow and deep.

Predict which container has the greater rate of cooling. Explain your answer.

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.....  
.....

[2]

[Total: 6]

- 2 (a) State what happens to the molecules of a gas in a sealed container when the temperature of the gas is increased.

..... [1]

- (b) A quantity of gas is contained in a sealed container of fixed volume. The temperature of the gas is increased.

State, in terms of molecules, **two** reasons why the pressure of the gas increases.

1. ....

2. ....

[2]

- (c) A helium-filled weather balloon is held at ground level. The volume of the balloon is  $4800 \text{ m}^3$ . The pressure of the helium is 98 kPa.

The balloon is released and rises to a height where the volume of the balloon is  $7200 \text{ m}^3$ .

- (i) Calculate the new pressure of the helium. Assume that the temperature stays constant.

pressure = ..... [2]

- (ii) Suggest why it may be necessary to release helium from the balloon as it rises even higher.

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..... [1]

[Total: 6]

- 3 (a) A student carries out an experiment to find the relationship between the pressure  $p$  and the volume  $V$  of a fixed mass of gas. The table contains four of her sets of measurements.

$p/\text{kPa}$	250	500	750	1000
$V/\text{cm}^3$	30.0	15.2	9.8	7.6

- (i) Use the data in the table to suggest the relationship between the pressure and the volume in this experiment. Explain how you reach your conclusion.

.....  
 .....  
 .....  
 .....[2]

- (ii) State the property of the gas, apart from the mass, that remains constant during the experiment.

.....[1]

- (b) A lake is 5.0 m deep. The density of the water is  $1000 \text{ kg/m}^3$ .

- (i) Calculate the pressure at the bottom of the lake due to this depth of water.

pressure = .....[2]

- (ii) A bubble of gas escapes from the mud at the bottom of the lake and rises to the surface.

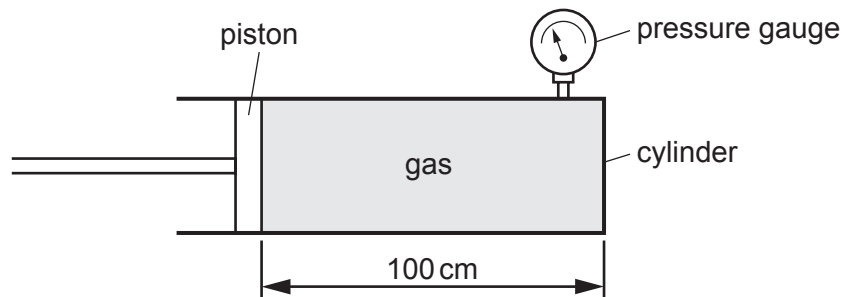
Place one tick in each row of the table to indicate what happens to the volume, the mass and the density of the gas in the bubble. Assume that no gas or water vapour enters or leaves the bubble.

	increases	stays the same	decreases
volume of bubble			
mass of gas in bubble			
density of gas in bubble			

[2]

[Total: 7]

4 Fig. 5.1 shows a gas contained in a cylinder enclosed by a piston.



**Fig. 5.1**

At first, the length of cylinder containing the gas is 100 cm. The pressure of the gas, shown by the pressure gauge, is 300 kPa. The area of cross-section of the cylinder is  $0.12 \text{ m}^2$ .

**(a)** Describe the motion of the molecules of the gas.

.....  
.....  
..... [1]

**(ii)** Use the idea of momentum to explain how the molecules exert a force on the walls of the cylinder.

.....  
.....  
..... [2]



(b) The piston is moved so that the new length of cylinder occupied by the gas is 40 cm. The temperature of the gas is unchanged.

(i) Calculate the new pressure of the gas.

pressure = ..... [2]

(ii) Explain, in terms of the behaviour of the molecules, why the pressure has changed.

.....  
.....  
..... [2]

[Total: 7]

5 (a) (i) State two ways in which the molecular structure of a liquid is different from the molecular structure of a solid.

1. ....

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2. ....

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[2]

(ii) Explain, in terms of energy, the process which takes place as a solid at its melting point changes into a liquid at the same temperature.

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..... [1]

(b) During a severe snowstorm, a layer of snow (ice crystals) forms on the body of an animal in a field. The snow and the surrounding air are at 0 °C. The snow begins to melt.

(i) The mass of snow that falls on the animal is 1.65 kg. The specific latent heat of fusion of snow is 330 000 J/kg.

Calculate the thermal energy needed to melt this snow.

thermal energy = ..... [2]

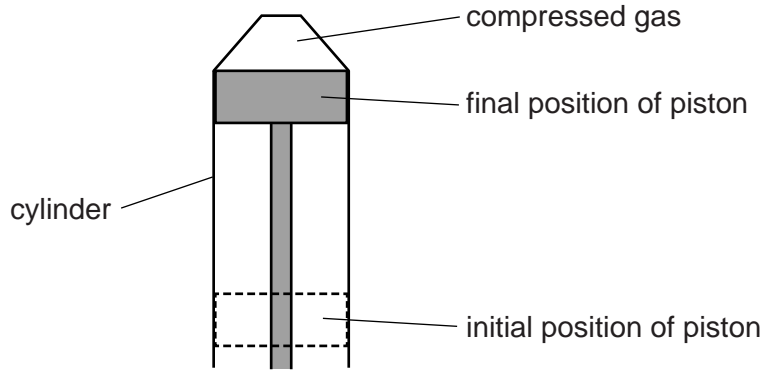
(ii) The animal derives energy from its food to maintain its body temperature.

State the energy change that takes place.

..... [1]

[Total: 6]

6 Fig. 2.1 shows a cylinder containing gas compressed by the movement of a piston.



**Fig. 2.1**

Initially the volume of the gas was  $470\text{ cm}^3$ . The piston moves up and compresses the gas to a volume of  $60\text{ cm}^3$ . The whole arrangement is left for some time until the gas cools to its original temperature. The pressure of the gas is now  $800\text{ kPa}$ .

(a) Calculate the initial pressure of the gas.

pressure = .....[3]

(b) Explain, in terms of molecules, the effect on the pressure of the gas if it was not given time to cool to its original temperature.

.....  
 .....  
 .....  
 .....[3]

(c) The area of the piston is  $5.5 \times 10^{-3}\text{ m}^2$  ( $0.0055\text{ m}^2$ ).

Calculate the force exerted by the gas on the piston when the pressure is  $800\text{ kPa}$ .

force = .....[2]

[Total: 8]





(ii) The piston is now fixed in place and the temperature of the gas is increased further.

Explain, in terms of the behaviour of molecules, what happens to the pressure of the gas.

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.....[2]

[Total: 8]