Easter HW 1 Combined science - Physics (Higher)

Physics Paper 1

Topic P3 Particle model

6.3.3 Particle model and pressure

You must complete this homework on Lined/ plain A4 paper and bring it in to school on 19/04/22

Q1.

The particle model can be used to explain the properties of gases.

(a) Describe the direction of motion of the particles in a gas.

(1)

(b) Explain why heating a gas increases the average speed of the gas particles.

(3)

(c) Water can exist as either a liquid or a gas at 100 °C.

Explain why a mass of gaseous water at 100 °C contains more energy than an equal mass of liquid water at 100 °C.

(2)

(d) Water vapour is a gas. Gases change state when they cool.

The figure below shows condensation on a cold bathroom mirror.

A volume of 2.5×10^{-5} m^3 of condensation forms on the mirror.

Density of water = 1000 kg / m^3

Specific latent heat of vaporisation of water = 2.26×10^6 J / kg.

Calculate the energy released when the condensation forms.

Energy released = _____ J

(5)

(e) Central heating boilers burn gas and use the energy released to heat water.

Modern condensing central heating boilers take advantage of the energy that is released when water condenses.

Waste water vapour produced when the water is heated in the boiler is used to preheat the cold water entering the boiler.

Give some of the arguments in favour of condensing boilers compared to older non-condensing boilers.

(4)

(Total 15 marks)

Q2.

A scientist cooled the air inside a container.

(a) The temperature of the air changed from 20 °C to 0 °C

The volume of the container of air stayed the same.

Explain how the motion of the air molecules caused the pressure in the container to change as the temperature decreased.

_____

_____

_____

_____

_____

_____

(3)

(b) The air contained water that froze at 0 °C

The change in internal energy of the water as it froze was 0.70 kJ

The specific latent heat of fusion of water is 330 kJ/kg

Calculate the mass of ice produced.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

_____

Mass of ice = _____ kg

(3)

(c) The air also contained oxygen, nitrogen and carbon dioxide.

Oxygen boils at −183 °C and freezes at −218 °C
Nitrogen boils at −195 °C and freezes at −210 °C
Carbon dioxide sublimates at −78 °C

The scientist continued to cool the air to a temperature of −190 °C

What is the state of each substance at −190 °C?

Tick (✓) **one** box for **each** row of the table.

Substance	Solid	Liquid	Gas
Oxygen			
Nitrogen			
Carbon dioxide			

(2)

(d) The air also contained a small amount of argon.

As the temperature of the air decreased from 20 °C to –190 °C the argon changed from a gas to a liquid to a solid.

Explain the changes in the arrangement and movement of the particles of the argon as the temperature of the air decreased.

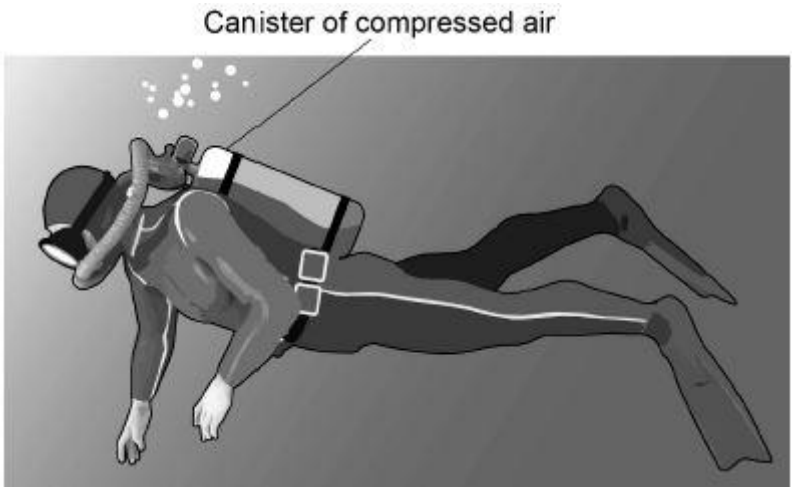
(6)

(Total 14 marks)

Q3.

Figure 1 shows a diver.

Figure 1



(a) Which two sentences describe the movement of the air particles in the canister?

Tick **two** boxes.

They vibrate about a fixed position. ☐

They move in random directions. ☐

The motion of all the particles is predictable. ☐

They move with a range of different speeds. ☐

They move in circular paths. ☐

(2)

(b) The temperature of the air inside the canister increases.

What happens to the movement of the air particles?

_____

(1)

(c) It could be dangerous if the temperature of the air inside the canister increased by a large amount.

Explain why.

_____

_____

_____

_____

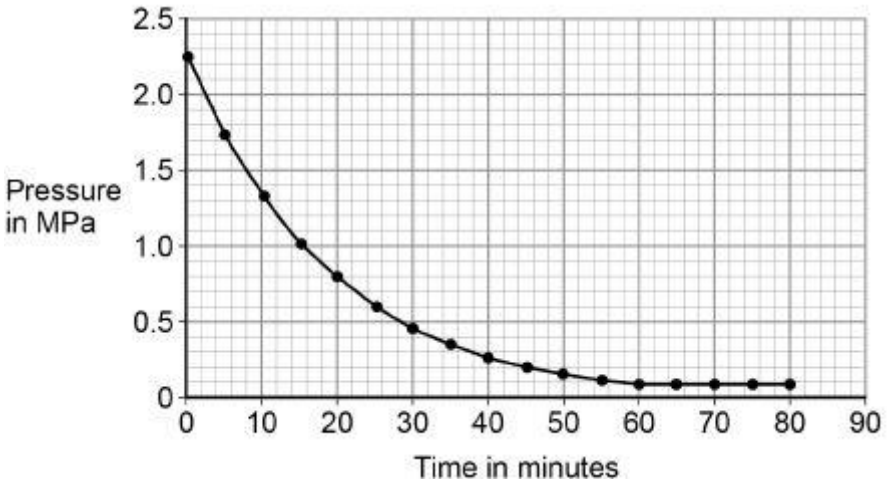
(2)

A canister of air was tested to find out how the pressure changed when it was used by a diver.

- Air was allowed to escape from the canister.
- The pressure of the air in the canister was recorded every 5 minutes for 80 minutes.

Figure 2 shows the results.

Figure 2



(d) Estimate the atmospheric pressure.

Use **Figure 2**

Atmospheric pressure = _____ MPa

(1)

(e) Divers can safely stay underwater until the pressure of the air in the canister has reduced to 25% of its original value.

Determine the maximum time the diver can safely stay underwater.

Use **Figure 2**

_____

_____

Time = _____ minutes

(3)

(f) What happens to the volume of the air when it is released from the canister?

_____

(1)

(Total 10 marks)