1 A diver works in the sea on a day when the atmospheric pressure is 101 kPa and the density of the seawater is 1028 kg/m^3.



(a) The diver uses compressed air to breathe under water.

1700 litres of air from the atmosphere is compressed into a 12-litre gas cylinder.

The compressed air quickly cools to its original temperature.

Calculate the pressure of the air in the cylinder.

(3)

pressure = ... kPa

(b) (i) State the equation linking pressure difference, depth, density and g.

(1)

(ii) Calculate the increase in pressure when the diver descends from the surface to a depth of 11 m.

(2)

increase in pressure = ... kPa

(iii) Calculate the total pressure on the diver at a depth of 11 m.

Assume that the atmospheric pressure remains at 101 kPa.

(1)

total pressure = ... kPa

(c) As the diver breathes out, bubbles of gas are released and rise to the surface.

The bubbles increase in volume as they rise.

Explain this increase in volume.

(2)

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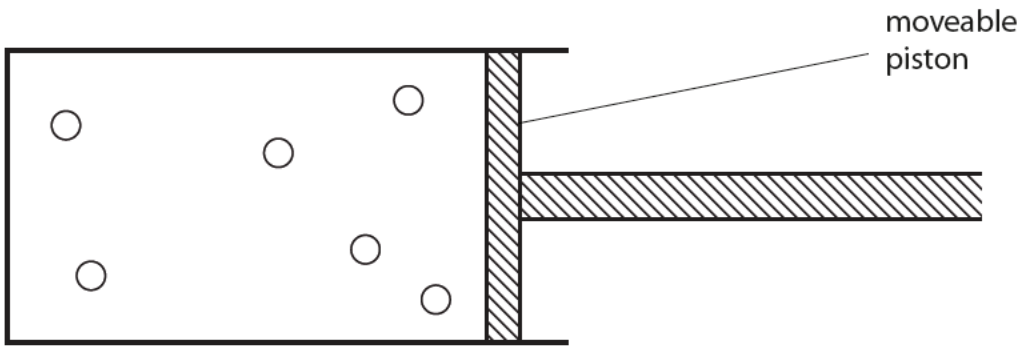
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(Total for Question 1 = 9 marks)

2 The diagram shows some gas particles in a container.

The piston can be moved in or out to change the volume of the gas.



(a) Add arrows to the diagram to show the random motion of the gas particles.

(2)

(b) Explain how the motion of the gas particles produces a pressure inside the container.

(3)

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(c) State what would happen to the pressure if you pushed the piston into the container without changing the temperature.

(1)

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(d) When the gas in the container is heated, the piston moves outwards.

Place ticks (✓) against the **three** correct statements.

(3)

Statement	Tick (✓)
the gas particles get bigger	
the mass of the gas particles stays the same	
the gas particles move faster	
the average distance between the gas particles increases	
the temperature of the gas decreases	

(Total for Question 2 = 9 marks)

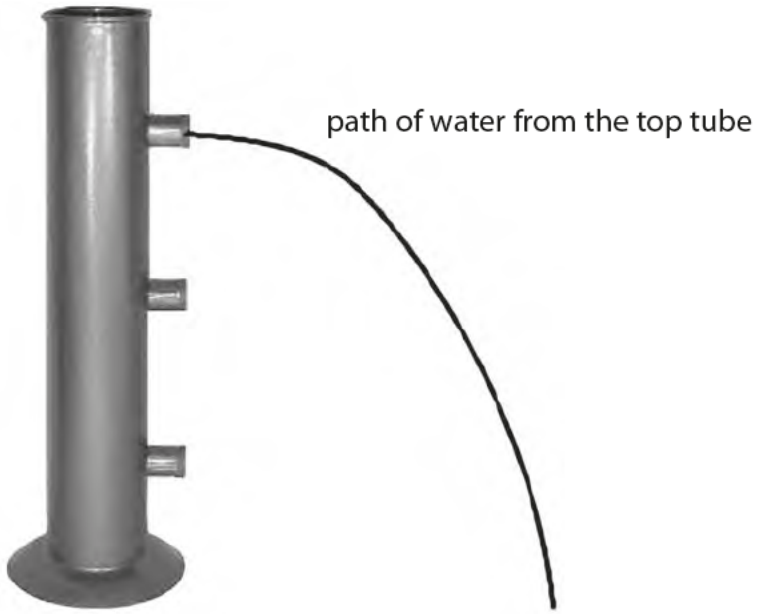
3 This question is about pressure in a liquid.

(a) A teacher uses this apparatus to demonstrate pressure difference in water.

The apparatus is hollow and has three short tubes at different depths.

The teacher completely fills the apparatus with water.

Water comes out of all the tubes.



(i) State the relationship between pressure difference, height, density and *g*.

(1)

(ii) The diagram shows the path of water coming from the top tube.

Complete the diagram by drawing the paths of water you would expect to see from the other two tubes.

(2)

(iii) Explain the pattern of the paths of water from the tubes.

(2)

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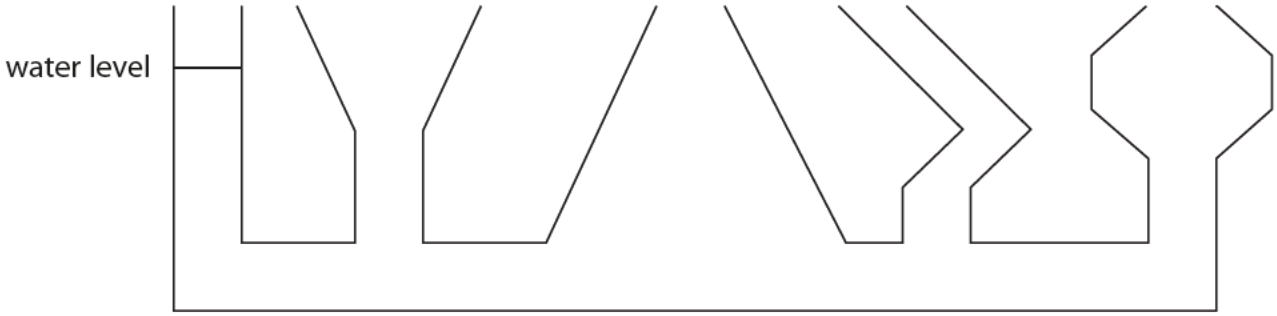
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(b) In another demonstration, the teacher uses this container.

The container is made of glass and each section has a different shape.

The teacher pours water into the container until it reaches the level shown in the left-hand section.



(i) Complete the diagram by drawing the water levels in the other four sections.

(1)

(ii) Explain why the water fills the container in the way you have shown.

(2)

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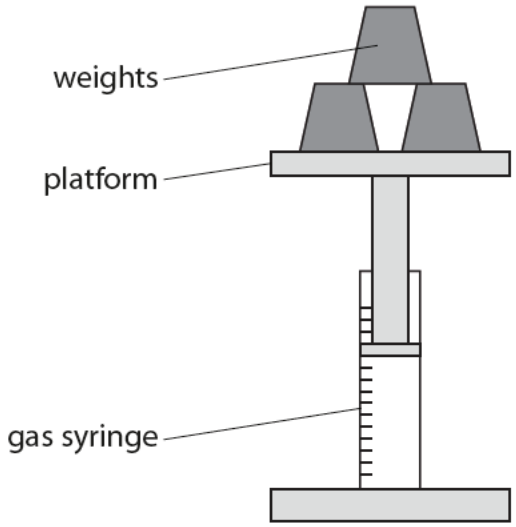
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(Total for Question 3 = 8 marks)

4 A student uses this apparatus to investigate the pressure and volume inside a sealed gas syringe.



She takes readings of the volume as she increases the pressure (loading) and as she decreases the pressure (unloading).

These are her results.

Pressure in kPa	Volume of gas in cm^3		
	loading	unloading	average (mean)
100	50	50	50
90	56	55	55.5
84	60	60	60
55	90		92
60	85	83	84
50	101	101	101

(a) (i) Complete the table by filling in the missing value.

(1)

(ii) Suggest why the student takes readings for increasing the pressure and for decreasing the pressure.

(2)

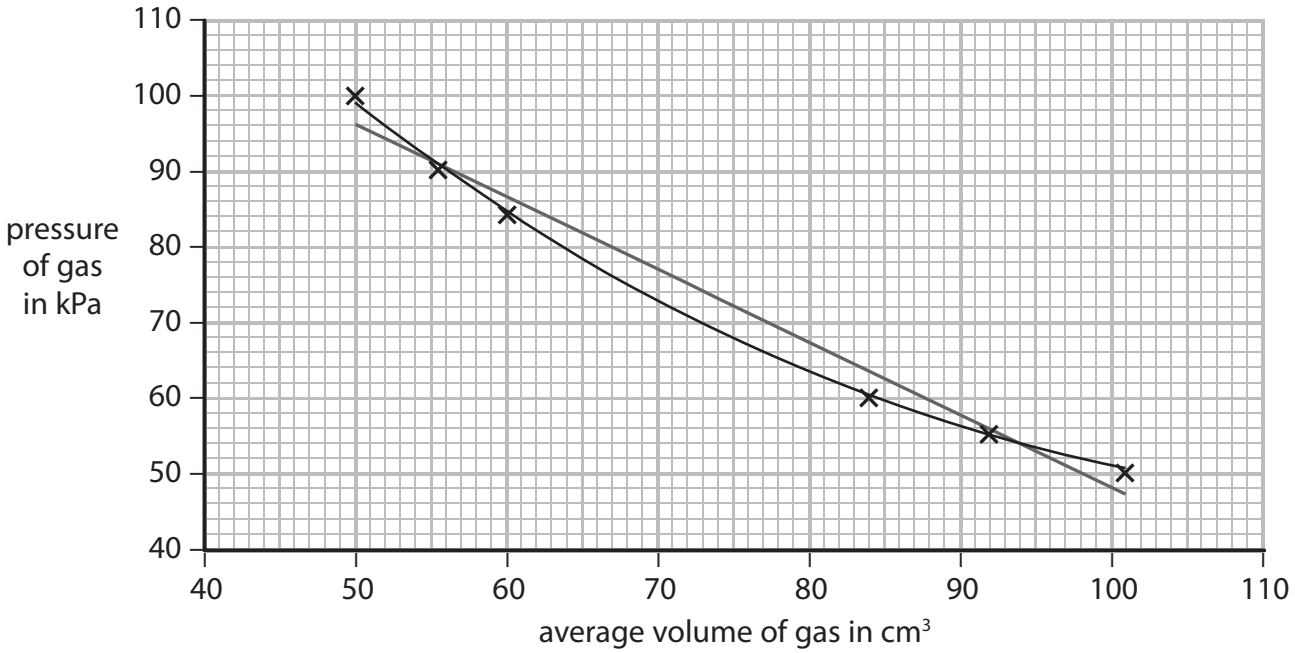
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(b) The student plots this graph.



(i) Suggest a reason why the axes do not start from the origin (0,0).

(1)

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(ii) The student has drawn both a straight line of best fit and a curve of best fit.

Discuss which line is correct for this investigation.

(2)

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(iii) Suggest a way that the student could make this experiment valid (a fair test).

(1)

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(iv) Suggest two ways in which the student could improve the quality of her data.

(2)

1 .....

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2 .....

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(c) The student concludes that her data validates the relationship between pressure and volume of a fixed mass of gas.

Use data from this table to evaluate her conclusion.

(3)

Pressure in kPa	Average volume in cm^3	Space for calculations
100	50	
90	55.5	
84	60	
55	92	
60	84	
50	101	

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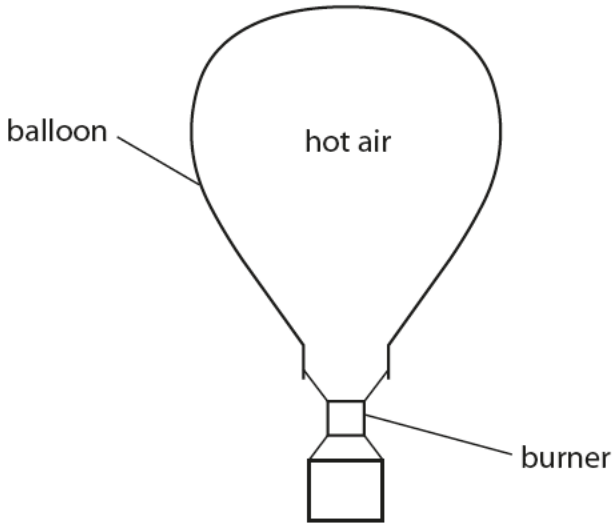
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(Total for Question 4 = 12 marks)

5 A hot air balloon is filled with air through an opening.

The air is heated using a burner.



(a) Describe the effect of an increase in temperature on the average speed of the air molecules.

(1)

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(b) The hot air causes a pressure on the inside of the balloon.

Use ideas about molecules to explain how the hot air causes this pressure.

(3)

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(c) Give a reason why the hottest air rises to the top of the balloon.

(1)

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(d) The average density of the hot air in the balloon is 0.95 kg/m^3.

The volume of this air is 2800 m^3.

(i) State the equation linking density, mass and volume.

(1)

(ii) Calculate the mass of hot air in the balloon.

(3)

mass of hot air = ... kg

(e) As the balloon climbs higher, the air pressure outside it decreases.

(i) Suggest a reason for this change in the outside air pressure.

(1)

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(ii) Suggest how the decrease in air pressure outside the balloon affects the hot air inside.

(1)

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(Total for Question 5 = 11 marks)

6 All gases above absolute zero exert a pressure on the walls of their container.

(a) (i) State the value of absolute zero in °C.

(1)

absolute zero = ... °C

(ii) Explain, in terms of its molecules, how a gas exerts a pressure on the walls of its container.

(3)

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(b) A pressure switch is used in a washing machine to control the flow of water. The water pushes on a flexible container and compresses some trapped air. When the pressure of this trapped air reaches 104 kPa, the pressure switch turns the water off.

The pressure of the trapped air is given by this relationship

$$\text{pressure of the trapped air} = \text{atmospheric pressure} + \text{pressure difference caused by water}$$

(i) State the equation linking pressure difference, height, density and g.

(1)

(ii) Calculate the height of water in the machine when the pressure of the trapped air reaches 104 kPa and the switch operates.

[atmospheric pressure = 100 kPa, density of water = 1000 kg/m^3]

(4)

height of water = ...m

(Total for Question 6 = 9 marks)