Particle Model of Gases (Kinetic Theory of Gases)

1.

(a) In the 17th century a scientist called Robert Boyle carried out experiments on gases. He found that the relationship

$$p_1V_1 = p_2V_2$$

is true when p_1 and V_1 are the initial pressure and volume of the gas and p_2 and V_2 are the final pressure and volume of the gas.

(i) What two things must remain constant for this relationship to be true?

1 .....

2 .....

(2)

(ii) Some gas has a volume of 1.2 m^3 at a pressure of 120 kPa.
Calculate its volume, in m^3, when the pressure is increased to 250 kPa.

.....

.....

Volume = ... m^3

(2)

Only Edexcel GCSE and Edexcel IGCSE students need to do part (b). All exam board students should do part (c).

(b) (i) Convert a temperature of –273 °C into kelvin.

.....

Temperature = ... K

(1)

(ii) What is special about this temperature?

.....

.....

(1)

(c) Some gas is trapped in a metal cylinder. The temperature outside the metal cylinder increases.
Explain how this affects the particles in the gas and what effect this has.

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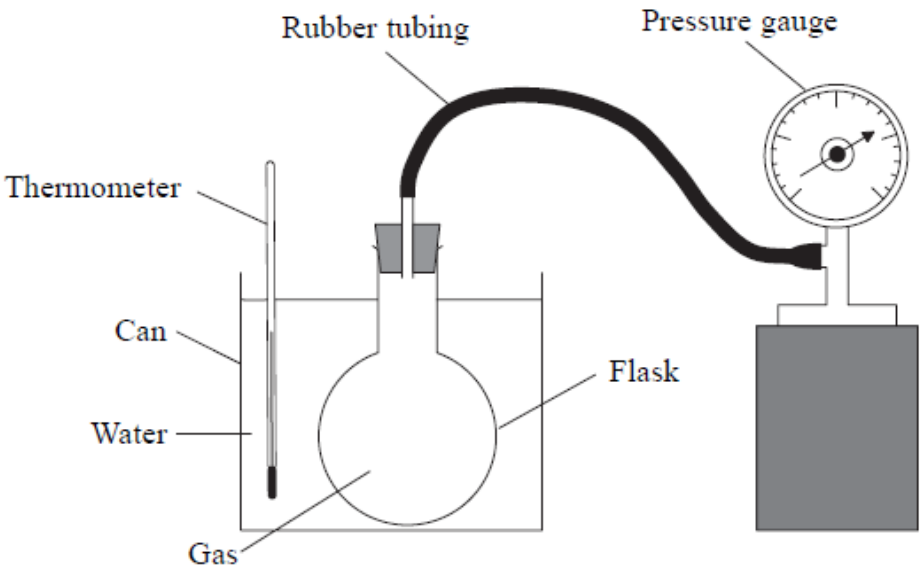
.....

.....

(3)

2.

The diagram shows the apparatus used to investigate how the pressure of a gas changes with temperature. As the water surrounding the gas is heated the pressure of the gas is measured using the pressure gauge.



(a) Explain how the gas exerts pressure.

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(2)

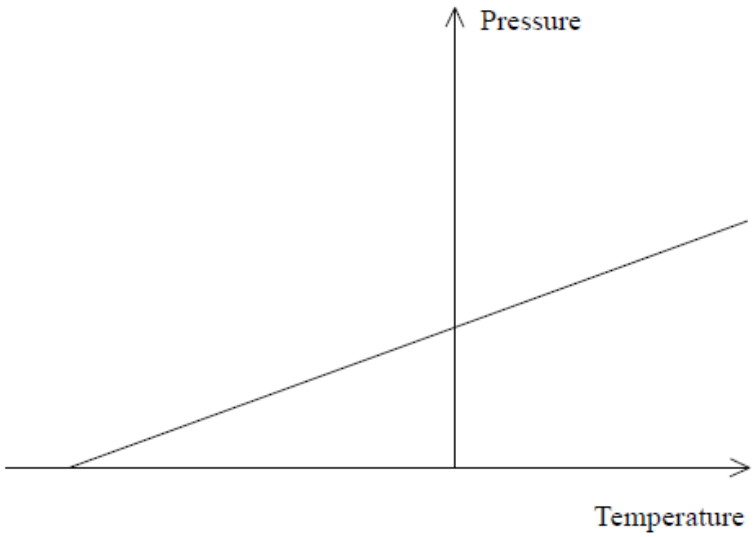
(b) Complete the table to show what happens to the gas in the flask as the temperature is increased. Use the words **increases**, **decreases**, or **stays the same**.

	Increases, decreases, or stays the same
Speed of gas particles	
Pressure in the flask	
Mass of particles	
Volume of gas	

(4)

Only Edexcel GCSE and Edexcel IGCSE students need to do part (c).

(c) A sketch graph of the results of the experiment is shown.



(i) What does the graph show about the way in which the pressure of the gas changes with increasing temperature?

.....

(1)

(ii) Write an **X** on the horizontal axis to show where the temperature is absolute zero.

(1)

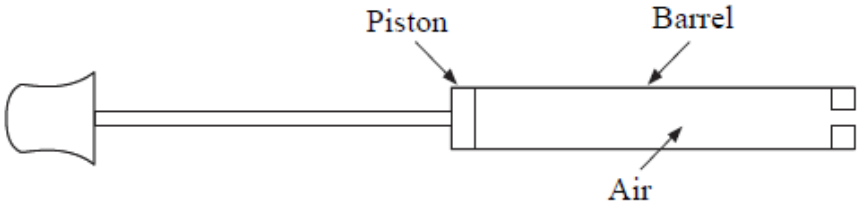
(iii) What is the speed of the gas particles at this temperature?

.....

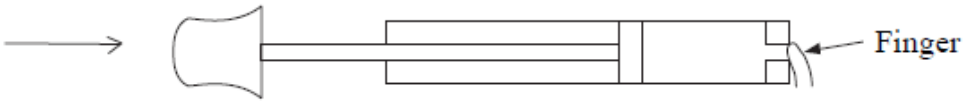
(1)

3.

The diagram shows a bicycle pump which can be used for pumping air into a bicycle tyre. The volume of the air in the barrel is 18 cm^3 and the air pressure is 100 000 Pa.



A finger is placed over the end of the pump. The piston is moved very slowly to the position shown below so that the volume of the air trapped in the barrel is 6 cm^3.



(a) (i) Calculate the new air pressure in the pump.

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.....

(3)

(ii) State **two** assumptions that you have made in your calculation.

1 .....

2 .....

(2)

(b) What, if anything, has happened to the size of the diameter of the air molecules in the trapped air as a result of changing the volume of the air in the pump?

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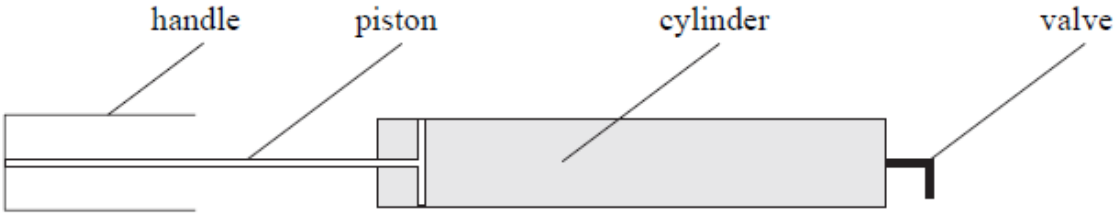
(1)

4.

The diagram shows the structure of one type of bicycle pump.



(a) Circle **two** words in the box which best describe the motion of the molecules in the air in the cylinder.

backwards	**constant**	**fast**	**forwards**
random	**regular**	**slow**	**steady**

(1)

(b) Explain how the molecules exert a pressure on the inside of the cylinder.

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.....

.....

(3)

(c) (i) The pressure inside the pump is 150 kPa when the volume of air in the cylinder is 90 cm^3. Use the equation

$$p_1V_1 = p_2V_2$$

to calculate the pressure in kPa when the air is compressed to a volume of 50 cm^3.

.....

.....

Pressure = ... kPa

(2)

(ii) What assumptions did you make in order to answer (c)(i)?

1 .....

.....

2 .....

.....

(2)

(iii) Name the unit which is represented by the symbol kPa.

.....

(1)