3.2 Modelling a Gas

Question Paper

Course	DP IB Physics
Section	3. Thermal Physics
Topic	3.2 Modelling a Gas
Difficulty	Easy

Time allowed: 60

Score: /46

Percentage: /100

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Question 1a

(a) Define the mole.

[1]

[1 mark]

Question 1b

4.7×10^{23} molecules of neon gas is trapped in a cylinder.

(b)
Calculate the number of moles of neon gas in the cylinder.

[2]

[2 marks]

Question 1c

The molar mass of neon gas is 20 g mol^{-1}.

(c)
Calculate the mass of the neon gas in the cylinder.

[4]

[4 marks]

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Question 1d

The cylinder containing the neon gas has a volume 5.2 m^3 and pressure of 600 Pa.

(d)
Calculate the temperature of the gas.

[3]

[3 marks]

Question 2a

(a)
State what is meant by an ideal gas.

[1]

[1 mark]

Question 2b

(b)
State the conditions for a real gas to approximate to an ideal gas.

[3]

[3 marks]

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Question 2c

(c)

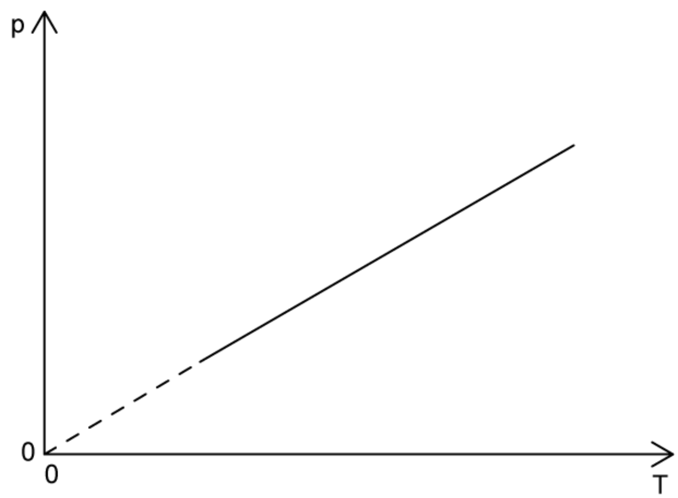
Describe how the ideal gas constant, *R*, is defined.

[2]

[2 marks]

Question 2d

The graphs shows how pressure, *p*, varies with absolute temperature, *T*, for a fixed mass of an ideal gas.



(d)

Outline the changes, or otherwise, to the volume and density of the ideal gas as the absolute temperature increases.

[2]

[2 marks]

Question 3a

(a)

State three assumptions of the kinetic model of an ideal gas.

[3]

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[3 marks]

Question 3b

A tank of volume 21 m^3 contains 7.0 moles of an ideal monatomic gas. The temperature of the gas is 28 °C.

(b)
Calculate the average kinetic energy of the particles in the gas.

[3]

[3 marks]

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Question 3c

The following paragraph explains, with reference to the kinetic model of an ideal gas, how an increase in temperature of the gas leads to an increase in pressure.

A ________ temperature implies ________ average speed and therefore higher ________. This increases the ________ transferred to the walls from ________ frequent collisions. This increased ________ per collision leads to an increased ________.

(c)
Complete the sentences using keywords from the box below.

These words can be used once, more than once, or not at all

pressure   force   momentum

higher   lower   less   more   kinetic energy

[3]

[3 marks]

Question 3d

(d)
Calculate the pressure of the gas described in part (b).

[3]

[3 marks]

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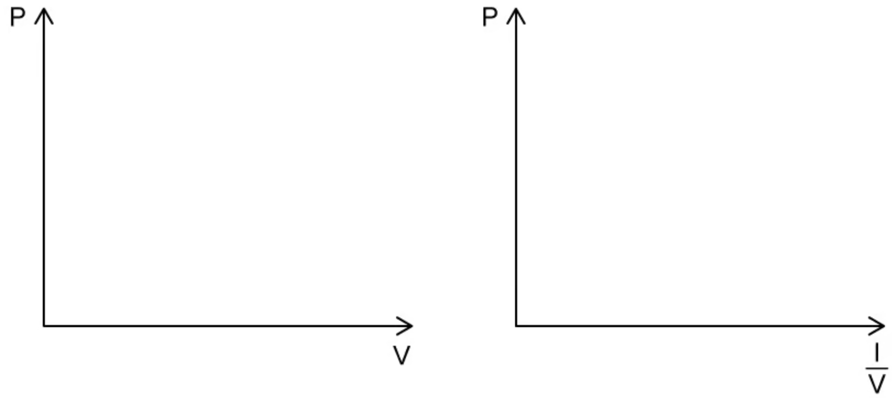
Question 4a

(a)
Sketch on both axes the change in pressure and volume for an ideal gas at constant temperature.



[2]

[2 marks]

Question 4b

(b)
Sketch the graphs in part (a) at a higher temperature.

[2]

[2 marks]

Question 4c

For an ideal gas at constant volume, the pressure, *p*, and temperature, *T*, are directly proportional:

$$p \propto T$$

(c)
State the equation for an initial pressure p_1 at temperature T_1 and final pressure p_2 and temperature T_2.

[1]

[1 mark]

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Question 4d

The final pressure of an ideal gas is 500 Pa and its temperature rises from 410 K to 495 K.

(d)
Calculate the initial pressure of the gas.

[3]

[3 marks]

Question 5a

(a)
Define pressure.

[1]

[1 mark]

Question 5b

When there are a large number of particles in a container, their collisions with the walls of the container give rise to gas pressure.

An ideal gas with a pressure of 166 kPa collides with the walls of its container with a force of 740 N.

(b)
Calculate the area that each particle collides on.

[4]

[4 marks]

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Question 5c

An ideal gas is one that obeys the relationship

$$pV \propto T$$

(c)
If the volume an ideal gas increases, explain how this affects the:

(i)
Pressure, if the temperature remains constant.

[1]

(ii) Temperature, if the pressure remains constant.

[1]

[2 marks]

Question 5d

The ideal gas equation can be rearranged to give

$$\frac{pV}{T} = \text{constant}$$

This relationship only holds true under a certain condition.

(d)
State the condition required for the equation to apply to an ideal gas.

[1]

[1 mark]

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