Ideal Gases

Question paper 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Ideal Gases
Sub Topic	
Paper Type	Theory
Booklet	Question paper 1

Time Allowed: **57 minutes**

Score: **/47**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** Define *pressure*.

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.... [1]

(b) Use the kinetic model to explain the pressure exerted by a gas.

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.... [4]

(c) Explain whether the collisions between the molecules of an ideal gas are elastic or inelastic.

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.... [2]

2 **(a)** Describe apparatus that demonstrates Brownian motion. Include a diagram.

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.... [2]

(b) Describe the observations made using the apparatus in **(a)**.

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.... [2]

(c) State and explain two conclusions about the properties of molecules of a gas that follow from the observations in **(b)**.

1. ....

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2. ....

....

[2]

3 **(a)** State two assumptions of the simple kinetic model of a gas.

1. ....

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2. ....

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[2]

(b) Use the kinetic model of gases and Newton's laws of motion to explain how a gas exerts a pressure on the sides of its container.

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.... [3]

4 **(a)** Explain the difference in densities in solids, liquids and gases using ideas of the spacing between molecules.

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.... [3]

(b) A hydrogen nucleus (proton) may be assumed to be a sphere of radius 1×10^{-15} m. Calculate the density of a hydrogen nucleus.

density = ... kg m^{-3} [3]

(c) The density of hydrogen gas in a pressurised cylinder is $4\,\text{kg m}^{-3}$. Suggest a reason why this density is much less than your answer in **(b)**.

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.... [1]

5 **(a)** State the evidence for the assumption that

(i) there are significant forces of attraction between molecules in the solid state,

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....[1]

(ii) the forces of attraction between molecules in a gas are negligible.

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....[1]

(b) Explain, on the basis of the kinetic model of gases, the pressure exerted by a gas.

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....[4]

(c) Liquid nitrogen has a density of 810 kg m^{-3}. The density of nitrogen gas at room temperature and pressure is approximately 1.2 kg m^{-3}.
Suggest how these densities relate to the spacing of nitrogen molecules in the liquid and in the gaseous states.

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....[2]

6 Some smoke particles are viewed through a microscope, as illustrated in Fig. 5.1.

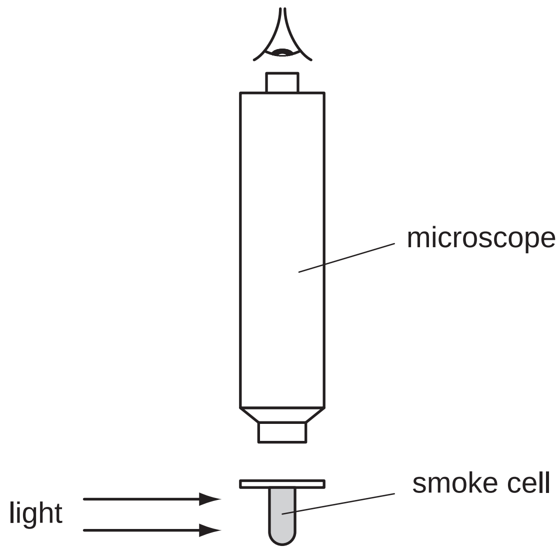

Fig. 5.1

Brownian motion is observed.

(a) Explain what is meant by *Brownian motion.*

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.... [2]

(b) Suggest and explain why Brownian motion provides evidence for the movement of molecules as assumed in the kinetic theory of gases.

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.... [2]

(c) Smoke from a poorly maintained engine contains large particles of soot.
Suggest why the Brownian motion of such large particles is undetectable.

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.... [2]

7 The Brownian motion of smoke particles in air may be observed using the apparatus shown in Fig. 2.1.

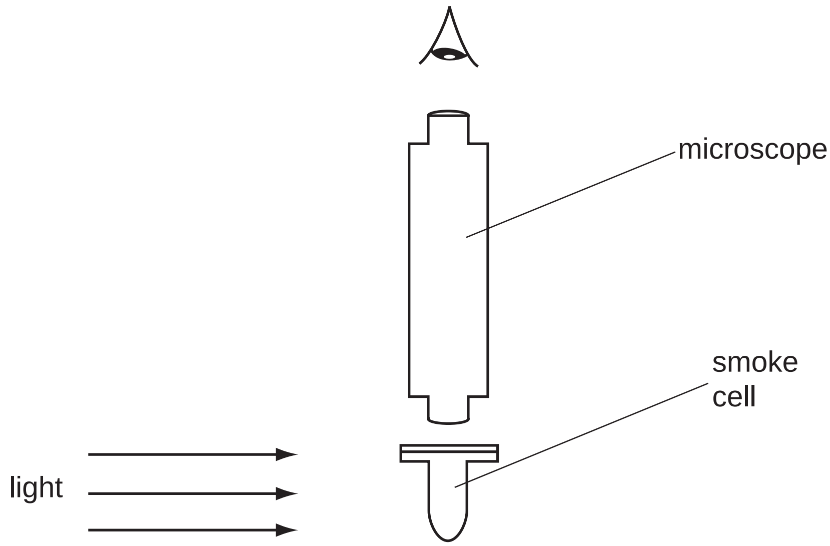

Fig. 2.1

(a) Describe what is seen when viewing a smoke particle through the microscope.

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....[2]

(b) Suggest and explain what difference, if any, would be observed in the movement of smoke particles when larger smoke particles than those observed in **(a)** are viewed through the microscope.

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....[2]

8 In a sample of gas at room temperature, five atoms have the following speeds:

$$1.32 \times 10^3\,\mathrm{m\,s^{-1}}$$
$$1.50 \times 10^3\,\mathrm{m\,s^{-1}}$$
$$1.46 \times 10^3\,\mathrm{m\,s^{-1}}$$
$$1.28 \times 10^3\,\mathrm{m\,s^{-1}}$$
$$1.64 \times 10^3\,\mathrm{m\,s^{-1}}.$$

For these five atoms, calculate, to three significant figures,

(a) the mean speed,

mean speed = ... $\mathrm{m\,s^{-1}}$ [1]

(b) the mean-square speed,

mean-square speed = ... $\mathrm{m^2\,s^{-2}}$ [2]

(c) the root-mean-square speed.

root-mean-square speed = ... $\mathrm{m\,s^{-1}}$ [1]