

O Level Physics

Unit 9: Kinetic Model of Matter

1) Kinetic Model of Matter

	Solid	Liquid	Gas
Arrangement	<ul style="list-style-type: none">• Very closely packed• Orderly packed in regular pattern	<ul style="list-style-type: none">• Molecules slightly further apart than solids• Randomly arranged	<ul style="list-style-type: none">• Molecules far apart from each other• Randomly arranged
Movement	Vibrate about fixed positions	Free to move about but confined within vessel containing it, due to intermolecular attraction forces	Move about randomly at high speeds in all directions
Attractive forces between particles	Very strong attractive forces	Strong attractive forces but weaker than solids	Negligible forces of attraction

Brownian motion

- 2) Brownian motion is the random motion of tiny particles suspended in a fluid.
- 3) Brownian motion is caused by the continual uneven bombardment of fast-moving gas or liquid molecules on tiny particles on different sides. This results in the tiny particles moving in an erratic and random motion in all directions.

Effect of temperature on molecular motion

- 4) When the temp is raised, thermal energy is converted into kinetic energy of air molecules. Air molecules gain kinetic energy and bombard the smoke particles more frequently and violently. This causes the smoke particles to become more agitated and move faster.

Pressure in gases

- 5) Gas pressure is due to the bombardment of molecules on the wall of a container.
- 6) **Explain how air molecules exert a pressure on the walls of the container.**
Air molecules are always in continuous motion. At any one time, there are numerous collisions taking place between the air molecules and the wall of the container. This exerts a force and hence pressure on the wall of the container
- 7) **Why is the pressure exerted by air molecules equivalent at all points of the inner wall of the container?**
At any one time, numerous collisions take place between the walls of the container. Since air molecules move randomly in all directions, the average number of collisions hence the force exerted on any part of the wall per unit area is the same. Thus the pressure is the same at all points of the wall.

Pressure-temperature relationship

- 8) The pressure of a fixed mass of gas is linearly related to its temperature provided the volume is constant.
- 9) **Explain how the movement of a car at high speeds can result in an increase in the pressure exerted on the tyre.**
- The friction between the tyre and the ground causes the temperature of the air in the tyre to increase.
 - When the temp is raised, thermal energy is converted to kinetic energy of the air molecules.
 - This increase in kinetic energy causes the air molecules to collide with the wall of the tyre more frequently and violently.
 - This results in an increase in pressure exerted provided volume is constant.

Volume-temperature relationship

- 10) The volume of a fixed mass of gas is linearly related to its temp provided pressure is constant.
- 11) When a gas is heated, it will expand to increase its volume in order for the pressure to remain constant.
- 12) **Explain how a rise in temp will increase the volume of a gas.**
- When gas is heated, thermal energy is converted into kinetic energy of air molecules.
 - This kinetic energy increase causes air molecules to collide with the wall of the container more frequently and violently, causing the pressure to increase.
 - The gas will thus expand to allow pressure to remain constant.

Pressure-volume relationship

- 13) The volume of a fixed mass of gas is inversely proportional to its pressure provided temp and the mass of the gas is kept constant.
- 14) The pressure will halve when the same volume of gas is doubled; the pressure will double when the same volume of gas is halved, provided temp is kept constant.
- 15) **A volume of gas is compressed such that the new volume is halved. The temperature is constant. What would the new pressure become? Explain why.**
- The pressure will double. When the volume of the container is halved, the number of air molecules per unit volume will be doubled due to lesser space available. Consequently, the frequency of collisions of air molecules on the wall per unit area is also doubled, causing the force exerted and hence pressure to double.

Notes: