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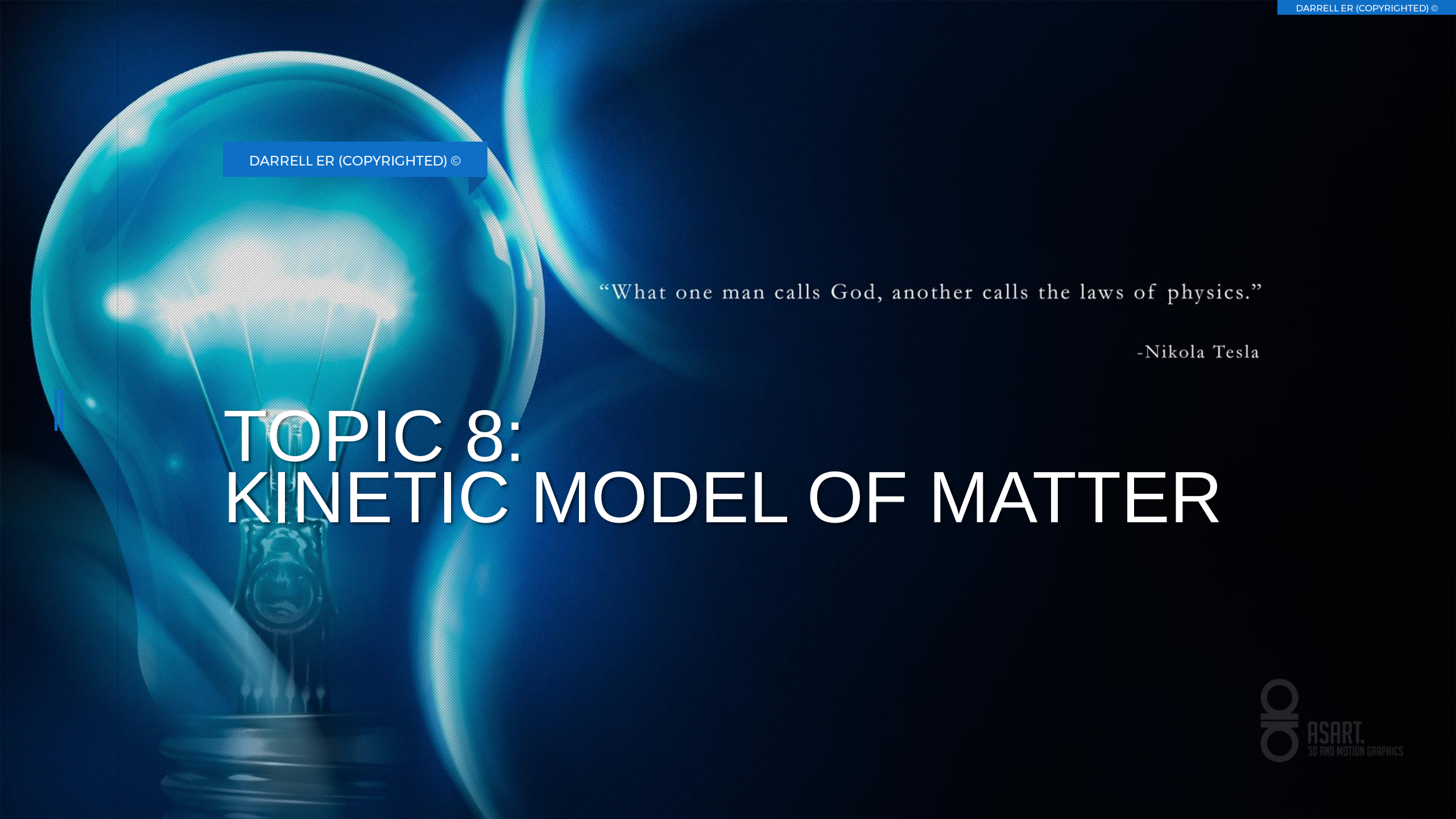

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"What one man calls God, another calls the laws of physics."

-Nikola Tesla

TOPIC 8: KINETIC MODEL OF MATTER

ASART. 3D AND MOTION GRAPHICS

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THE ABOUT

CHAPTER ANALYSIS

MASTERY

- Straight forward chapter
- Understand relationship of gas

EXAM

- Commonly tested in MCQ
- Tested together with other Thermal Physics chapters

WEIGHTAGE

- Light-medium overall weightage
- Constitute to around **3%** of marks for past 5 year papers

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KEY CONCEPT

KINETIC MODEL OF MATTER
SOLID, LIQUID, GAS
TEMPERATURE & MOTION OF MOLECULES

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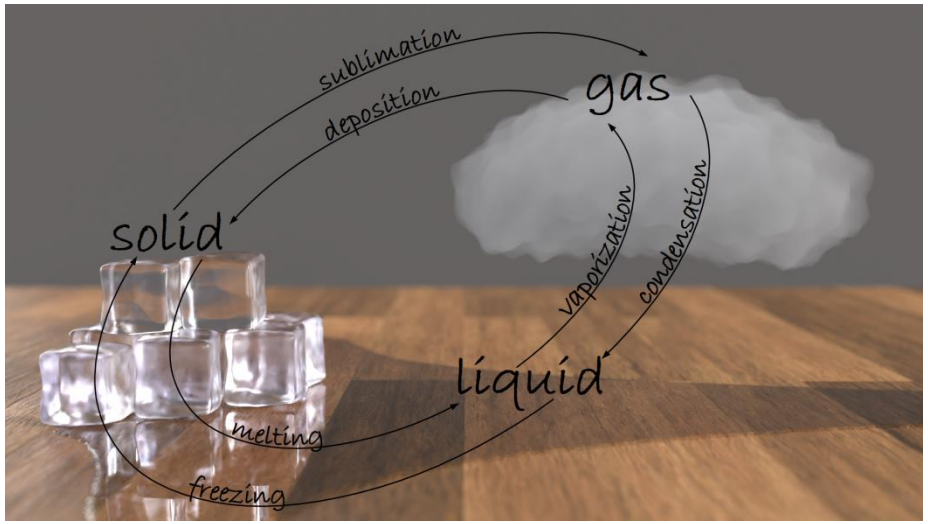
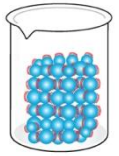
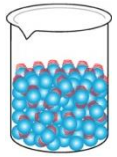
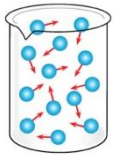
KINETIC MODEL OF MATTER



KINETIC MODEL OF MATTER

Physical properties	Solid	Liquid	Gas
Diagram			
Arrangement of particles	**Packed close together; orderly arrangement**	**Packed loosely together; disorderly arrangement**	**Far apart; random arrangement**
Movement of particles	**Vibrate about fixed position**	**Slide over one another**	**Moves randomly at high speed**
Shape & Volume	Fixed shape & fixed Volume	No fixed shape but has fixed volume	No fixed shape & no fixed volume (can be compressed)
Space between molecules	Very little	Little space (more than solid)	Large space
Forces between particles	Very strong attraction	Strong attraction (weaker than solid)	Weak attraction
Density	Very high – particles are close together	High – particles are close together	Very low – particles are far apart

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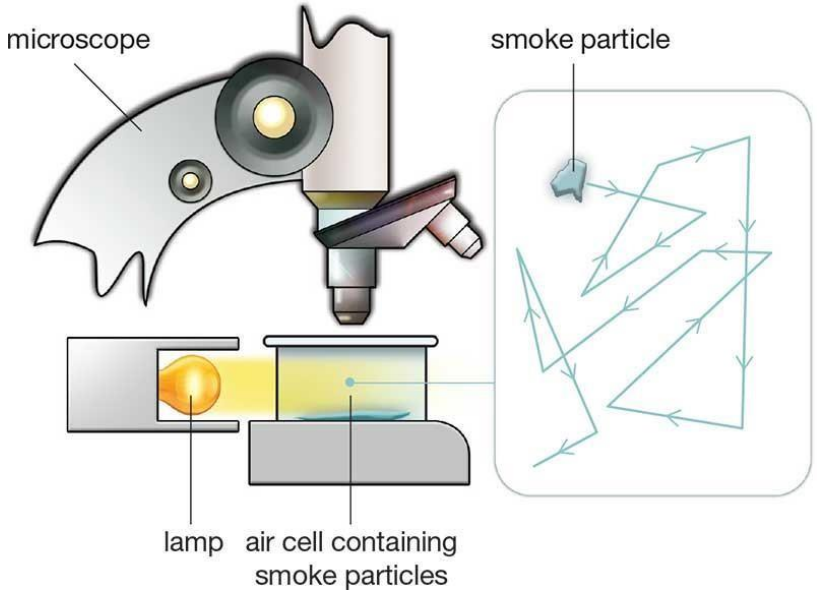
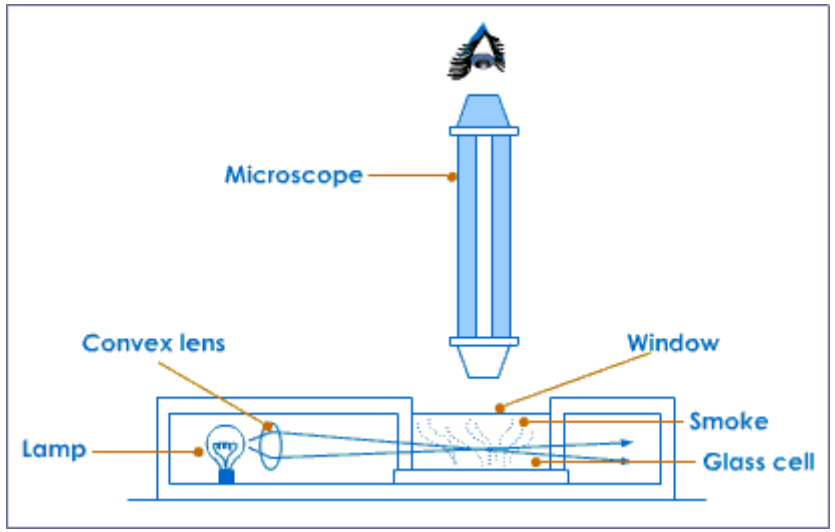
BROWNIAN MOTION



BROWNIAN MOTION

Brownian motion is defined as the **constant random movement** of smoke particles suspended in a fluid (liquid or gas) due to the **uneven bombardment of the suspended particles by the air molecules.**

Smoke particles movement



Smoke particles are observed to move continuously and randomly as they are **being hit** by unseen, fast-moving **air molecules**.

The reflection of light off the surfaces of the smoke particles appears as **bright specks** of lights to observers.

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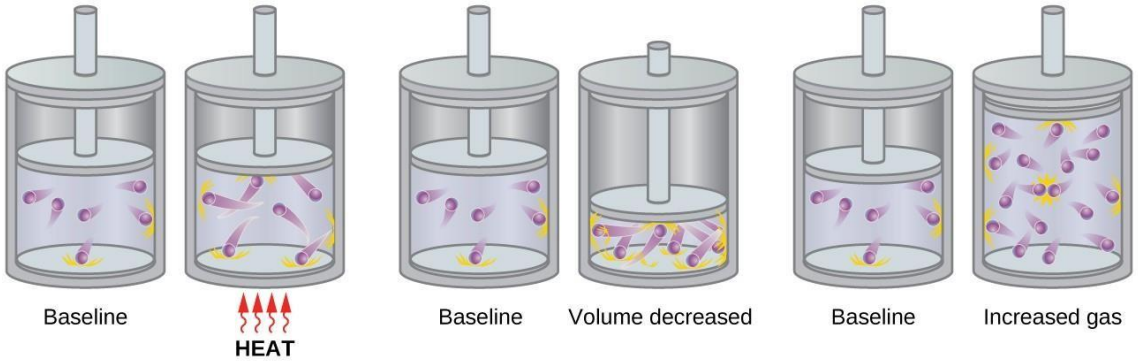
RELATIONSHIP OF GAS



PRESSURE, VOLUME & TEMPERATURE OF GAS

For a gas inside a container, the gaseous molecules will collide against the container wall and exert a force per unit area, giving rise to gaseous pressure.

A higher frequency of collision will also result in greater force exerted and hence increasing the pressure as well.

Formula:

$$PV = nRT$$

Can be simplified to,

$$PV \propto T$$

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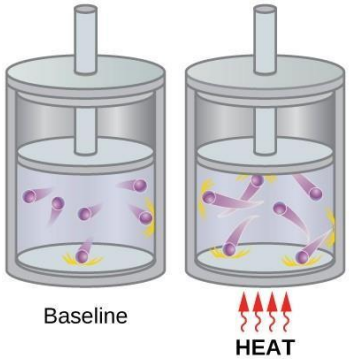
RELATIONSHIP OF GAS



<u>Pressure ∝ Temperature</u>

For a fixed mass of gas at constant volume, when temperature is higher, thermal energy is transferred to the molecules and gaseous particles move faster.

This increases both the frequency of collision against the wall and the force exerted by each gaseous particle.

Pressure will hence increase.

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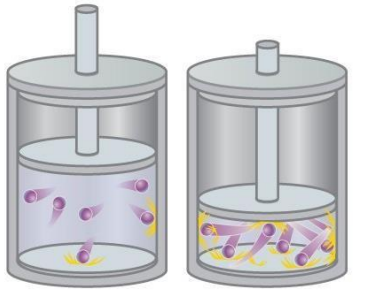
RELATIONSHIP OF GAS



Baseline Volume decreased

Volume decreased
Wall area decreased
= Increased pressure

Boyle's law

(b)

Pressure ∝ 1/ volume

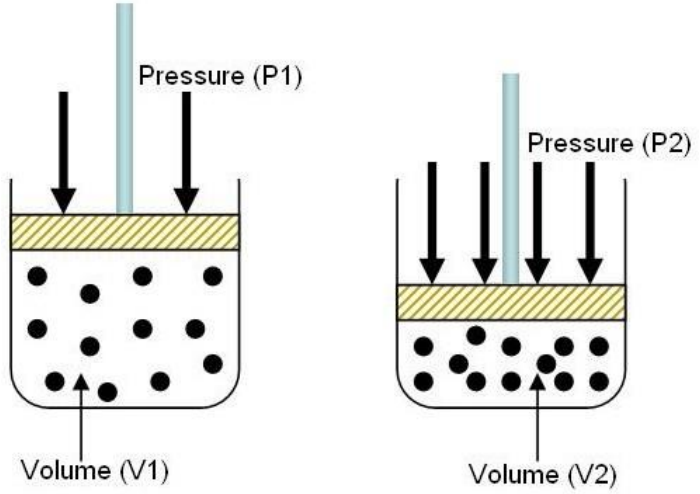
For a fixed mass of gas at constant temperature, average speed of the molecules remains the same.

Decreasing the volume of the container means that the number of gas molecules per unit volume in the container is increased.

As number of molecules hitting the wall per unit time also increases, pressure increases.

Boyle's Law

$$P_1 \times V_1 = P_2 \times V_2$$



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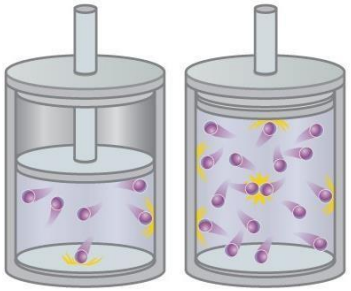
RELATIONSHIP OF GAS



Baseline Increased gas

Container pressure constant
More gas molecules added
= Increased volume

Avogadro's law

(c)

Volume ∝ Temperature

If pressure is constant, an increase in temperature would increase the volume of the container.

When temperature is higher, thermal energy is transferred to the molecules and gaseous particles move faster.

This increases both the frequency of collision against the wall and the force exerted by each gaseous particle.

Pressure will hence increase.

In order to reduce the frequency of collision in order to maintain a constant pressure, volume will increase to reduce the number of particles per unit volume and hence reducing the number of collisions, which helps to maintain pressure at constant value.

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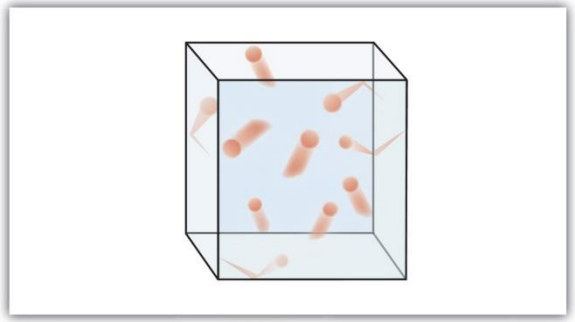
RELATIONSHIP OF TEMPERATURE & MOTION OF MOLECULES



TEMPERATURE ∝ MOTION OF MOLECULE

When **temperature is higher**, thermal energy is transferred to the molecules and **gaseous particles gain kinetic energy.**

This cause the molecules to move faster.

This increases both the frequency of collision against the wall and the force exerted by each gaseous particle.

Since pressure is force per unit area, pressure will hence increase.

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