

TOPICS COVERED

1. Kinetic Molecular Theory
2. Graham's Law of effusion

Conclusion from Clicker question

1. The higher the temperature, the faster the particles of a gas move
2. Increase in temperature leads to increase in the speed of the particles.
3. Particles of a particular gas at certain temperature and pressure do have a wide distribution of the speeds of the particles. This is because some particles are fast and others are slow and their speeds change all the time.
4. Particles in different gases at the same temperature have different speeds, the heavier the particle the slower it is and the lighter the particle, the faster it is.
5. Average velocity cannot be used to solve for speed, instead Root-mean square (r.m.s) speed should be used.

Average Mean Velocity vs. Root Mean Square Velocity (r.m.s)

Kinetic Molecular Theory

Can use this theory to predict the r.m.s speed of a gas.

Kinetic energy only depends on temperature. Measure of the kinetic energy is

$$KE = \frac{1}{2} mv^2$$

Temperature is directly proportional to Kinetic Energy. It is important to notice that there is mass in Kinetic energy. Kinetic energy is dependent on mass. This is clear in the following formula;

$$KE = \frac{1}{2} mv^2 =$$

$$\frac{1}{2} m (3RT/m) = (3/2) RT$$

Uses of the kinetic molecular theory

1. Used to identify molecules. This is possible since the speed of a certain particle of a gas can be used to determine its molecular weight. The heavier the molecule, the slower it is and vice versa
2. It can be used to determine the amount of gas that can or has been produced in a reaction.

How do we explain this at the particle and mathematical level?

Graham's Law of Effusion

Effusion is the escape of a gas through pores or a porous surface.

The rate of effusion is directly affected by the size of the gas particle. Larger particles effuse slower than smaller particles. The behavior of a gas can be predicted by the kinetic molecular theory.

Graham's law formula is

$$T_A = T_B \text{ so } KE_A = KE_B$$

$$\text{Therefore, } \frac{1}{2} M_A V_A^2 = \frac{1}{2} M_B V_B^2$$

$$V_A^2 / V_B^2 = M_B / M_A$$

OR

$$V_A / V_B = \sqrt{M_B / M_A}$$

Ways to interpret or read Graham's Law.

1. According to Graham's Law, the speed of particles is inversely proportional to the r.m.s
 2. Rates of effusion: the rate of leakage of a gas is directly proportional to its r.m.s speed of particles.
 3. Time taken for effusion: the faster the speed of the particle, the less time it takes to effuse.
- Therefore the time taken to effuse is inversely proportional to the rate of speed.