What is the Kinetic Theory of Gases?

Worksheet

Gas molecules move randomly at high speed, colliding elastically with walls and each other. Pressure = force from wall collisions; temperature average kinetic energy (KE_avg = 3/2 kT per molecule).

Questions

1. In kinetic theory, gas molecules have:

A) zero volume
B) negligible volume
C) large volume
D) unknown volume

2. At constant volume and amount, doubling T does what to P?

A) halves it
B) doubles it
C) triples it
D) no change

3. Do all gases have the same average kinetic energy at 25C?

A) no, depends on mass
B) yes, KE T only
C) no, depends on P
D) yes, if ideal

4. Why do faster molecules at higher T exert more pressure?

A) more volume
B) more frequent, harder collisions
C) lower density
D) fewer collisions

5. At 300 K, find the root-mean-square (rms) speed of N molecules.

6. A gas at 300 K is heated to 600 K at constant volume. How does pressure change?

7. Compare average kinetic energies of He and O at the same temperature.

8. Define: What does kinetic theory assume about gas molecules?

9. Define: How is temperature related to kinetic energy?

10. Define: What causes gas pressure in kinetic theory?

Answer Key

1. B) negligible volume - Assumption 1: molecules are point-like, negligible volume vs. container.

2. B) doubles it - Gay-Lussac: P/T = const P = P(T/T) = P(2).

3. B) yes, KE T only - KE_avg = 3/2 kT - same T same KE, regardless of mass or type.

4. B) more frequent, harder collisions - Faster molecules hit walls more often and harder.

5. v_rms = (3RT/M) M(N) = 0.028 kg/mol, R = 8.314 J/(molK) v_rms = (38.314300/0.028) v_rms = (2,678,500) 517 m/s

6. At constant V and n: P/T = constant (Gay-Lussac's law) P/P = T/T = 600/300 = 2 Pressure doubles.

7. KE_avg = 3/2 kT (depends only on T, NOT on mass) At same T: both have identical average KE. (But v_rms of He is higher due to lower mass.)

8. They are tiny points in random motion, colliding elastically, with no forces between collisions.

9. Temperature is proportional to average kinetic energy: KE_avg = 3/2 kT per molecule.

10. Collisions of gas molecules with container walls.