

## 4.3 - Kinetic Theory of Gases

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- (1999) Write down the equation of state of an ideal gas defining all the symbols used.
- (1999) If the root-mean-square velocity of a hydrogen molecule at  $0^{\circ}\text{C}$  is  $1840\text{ m/s}$ , find the root-mean-square velocity of the molecule at  $100^{\circ}\text{C}$ .
- (1999) State the main assumptions of the kinetic theory of gases.
- (1999) Derive an expression for the pressure exerted by an ideal gas on the walls of its container.
- (1999) How does the average translational kinetic energy of a molecule of an ideal gas change if
  - the pressure is doubled while the volume is kept constant?
  - the volume is doubled while the pressure is kept constant?
- (1999) Calculate the value of the root mean-square speed of molecules of helium at  $0^{\circ}\text{C}$ .
- (2000) What factors lead the real gas to obey the ideal gas equation  $PV = RT$ ?
- (2000) Define the root-mean-square (r.m.s.) speed of the gas molecules. Hence find the r.m.s. speed of oxygen gas molecules at  $10^5\text{ Pa}$  pressure when the density is  $1.43\text{ kg/m}^3$ .
- (2000) Derive an expression for the work done per mole in an isothermal expansion of Vander Waals gas from volume  $V_1$  to volume  $V_2$ .
- (2007) Define an ideal gas.
- (2007) State the four (4) assumptions necessary for an ideal gas that are used to develop the expression  $p = \frac{1}{3}\rho C^2$ .
- (2007) How is pressure explained in terms of the kinetic theory?
- (2007) Without a detailed mathematical analysis argue the steps to follow in deriving the relation  $p = \frac{1}{3}\rho C^2$ .
- (2007) Define the temperature of an ideal gas as a consequence of the kinetic theory.
- (2007) A mole of an ideal gas at  $300\text{K}$  is subjected to a pressure of  $10^5\text{ N/m}^2$  and its volume is  $2.5 \times 10^{-2}\text{ m}^3$ . Calculate the:
  - molar gas constant  $R$
  - Boltzmann constant  $k$

- average translational kinetic energy of a molecule of the gas.
- (2013) Define compressibility of a gas in terms of the elasticity of gases.
- (2013) Helium gas occupies a volume of  $4 \times 10^{-2} \text{ m}^3$  at a pressure of  $2 \times 10^5 \text{ Pa}$  and temperature of  $300 \text{ K}$ . Calculate the mass of helium and the r.m.s speed of its molecules.
- (2014) One mole of a gas expands from volume,  $V_1$ , to a volume  $V_2$ . If the gas obeys the Van-der-Waals equation,  $(p + a/v^2)(vb) = RT$ , derive the formula for work done in this process.
- (2019) Based on the kinetic theory of gases determine:
  - The average translational kinetic energy of air at a temperature of  $290 \text{ K}$ .
  - The root mean square speed (r.m.s) of air at the same temperature (above).