Assignment

Generic Elective

Physical Chemistry, Ist year

Semester II (2020)

Gases

1. A bulb of capacity 1 dm^3 contains 1.03×10^{23} gaseous hydrogen molecules and the pressure exerted by these molecules is 101325 kPa. Calculate the average square molecular speed and the temperature.

2. The molar volume of helium at 10.1325 MPa and 273 K is 0.011075 of its molar volume at 101.325 kPa at 273 K. Calculate the radius of helium atom. The value of 'a' may be neglected.

3. Arrange root mean square, most probable and average speeds in the order of increasing value. Discuss the effects of temperature and pressure on these speeds.

4. A flask of 2 dm^3 capacity contains O_2 at 101325 kPa and 300 K. The gas pressure is reduced to 0.10 Pa by attaching a flask to a pump. Assuming ideal behaviour answer the following
   (a) What will be the volume of the gas which is left behind?
   (b) What amount of O_2 and the corresponding number of molecules are left behind in the flask?
   (c) If now 2 g of N_2 is introduced, what will be the pressure of the flask?

5. For O_2 gas molecules, the root mean square speeds at T1, the average speed at T2 and most probable speed at T3 are equal to 1.5×10^3 m/s. Calculate T1, T2 and T3.

6. Calculate the values of σ, λ, Z_1, and Z_{11} for oxygen at 298 K at the pressure of 101.325 kPa, given van der Waals constant $b = 3.183 \times 10^3$ dm^3mol^{-1} .

7. Calculate the number of collisions per square metre per second O2 molecules with a wall at a pressure of 101.325 kPa and temperature at 298 K.

8. The mean free path of the molecule of a certain gas at 300 K is 2.6×10^{-5} m. The collision diameter of the molecule is 0.26 nm. Calculate (a) pressure of the gas and (b) number of the molecules per unit volume of the gas.
9. At 273 K, and under a pressure of 10.1325 MPa, the compressibility factor of O_2 is 0.927. Calculate the mass of O_2 necessary to fill a gas cylinder of 100 dm^3 capacity under the given conditions.