PRACTICE PROBLEMS – CH 5

[Please keep record of TIME]

Problem 1

Assume ideal gas behavior. Data - Molar masses (kg/kmol): H=1, C=12, O=16. Collision diameter for dioxide (CO_2) = 342 pm.

a) Calculate the rms speed of CO_2 molecules at 300°C and 2 atm.

b) Determine the average time between collisions for molecules of CO_2 at 300°C and 2 atm.

c) How many molecules of CO_2 at 300°C and 2 atm would occupy a volume of 1 mm^3?

d) Calculate the total kinetic energy of all of the CO_2 gas in a 1 mm^3 volume at 300°C and 2 atm.

Ans:

a) 570 m/s

b) 1.43×10^{-10} s

c) 2.561×10^{16} molecules

d) 3.039×10^{-4} J

Problem 2

At low pressures and high temperatures, nitrogen (Molar mass = 28 kg/kmol) can be assumed to behave like an ideal gas.

a) What is the velocity that the highest number of nitrogen molecules would be expected to be travelling at if the conditions are 250°C and 2 bar (1 bar = 100 kPa)?

b) What is the root mean square velocity of nitrogen molecules at 250°C and 2 bar ?

c) What is the mean separation distance between nitrogen molecules at 250°C and 2 bar ?

d) If the viscosity of nitrogen is 5×10^{-5} Pa.s at 250°C and 2 bar, what would the viscosity be at 500°C and 4 bar?

e) Using the information in (d), what is the collision diameter of a nitrogen molecule?

f) What would be the force pushing on the inside surface of a spherical 1 m diameter balloon filled with nitrogen at 500°C and 4 bar?

Ans:

a) 557.3 m/s

b) 682.6 m/s

c) 33 Å

d) 6.08×10^{-5} Pa.s

e) 2.565 Å

f) 400 kPa