Answer on Question #65158 - Chemistry – Organic Chemistry

Task:

In a volume of 0.400 dm^3 of CH_2CL_2 there are $3.73*10^{24}$ molecules at 25 degree celsius.
Calculate:
(A) The density of the substance at 25 degree celsius, expressed in g.cm^3.
(B) The number of atoms present in 425g of CH_2CL_2. (Solve by means of complete numerical development without omitting the statements or the units)

Solution:

Part (A):

We find the amount of CH_2Cl_2, using the following formula:

$$n = \frac{N}{N_a};$$

$$n(CH_2Cl_2) = \frac{N(CH_2Cl_2)}{N_a} = \frac{3.73\times10^{24}}{6.022\times10^{23}} = 6.194\,(moles\ of\ CH_2Cl_2)$$

We find the mass of CH_2Cl_2, using the following formula:

$$n = \frac{m}{M}; \quad \Rightarrow \quad m = n\times M$$

$$M(CH_2Cl_2) = 84.93\,{}^{g}\!/_{mol}$$

$$m(CH_2Cl_2) = n(CH_2Cl_2)\times M(CH_2Cl_2);$$

$$m(CH_2Cl_2) = 6.194\,mol\times 84.93\,{}^{g}\!/_{mol} = 526.056\,g$$

Convert dm^3 in L:

$$1\,dm^3 = 1\,L = 1000\,mL = 1000\,cm^3;$$

$$0.400\,dm^3 = X\,mL;$$

$$X = V(CH_2Cl_2) = \frac{1000\,cm^3\times 0.400\,dm^3}{1\,dm^3} = 400\,cm^3$$

We find the density of the substance, using the following formula:

$$\rho = \frac{m}{V};$$

$$\rho(CH_2Cl_2) = \frac{m(CH_2Cl_2)}{V(CH_2Cl_2)} = \frac{526.056\,g}{400\,cm^3} = 1.31514\,{}^{g}\!/_{cm^3}$$

Answer (A): The density of the substance is 1.31514 g*cm^{-3}

Part (B):

We find the amount of CH_2Cl_2, using the following formula:

$$n = \frac{m}{M};$$

$$n(CH_2Cl_2) = \frac{m(CH_2Cl_2)}{M(CH_2Cl_2)} = \frac{425g}{84.93\,g/mol} = 5.004(moles\ of\ CH_2Cl_2)$$

We find the number molecules of CH_2Cl_2, using the following formula:

$$n = \frac{N}{N_a}; \quad \Rightarrow \quad N = n \times N_a;$$

$$N(molecules) = n(CH_2Cl_2) \times N_a;$$

$$N(molecules\ of\ CH_2Cl_2) = 5.004 \times 6.022 \times 10^{23} = 30.134 \times 10^{23}$$

In molecule CH_2Cl_2 contains 5 atoms. Then,

$$N(atoms) = 5 \times N;$$

$$N(atoms\ of\ CH_2Cl_2) = 5 \times 30.134 \times 10^{23} = 1.5067 \times 10^{25}$$

Answer (B): The number of atoms = 1.5067*10^{25}.