Required Given

1. $N = n \times N_A \rightarrow N = ?$, $n = 0.03$ mol, $N_A = 6.022 \times 10^{23}$

Solution

$N = n \times N_A$

$= 0.03(6.022 \times 10^{23})$

$= 1.8066 \times 10^{22}$

$\because$ sigfigs

$\therefore N = 2 \times 10^{23}$ grains of sand

$\therefore$ The number of grains of sand is 2×10^{23}

2. a)

Given

$n = 3.5$ mol Na

$N_A = \frac{6.022 \times 10^{23} \text{ atoms Na}}{\text{mol Na}}$

Required

$N_{Na} = ?$

Solution

$N = n \times N_A$

$N_{Na} = n \times N_A$

$= 3.5 \text{ mol Na} \times \frac{6.022 \times 10^{23} \text{ atoms Na}}{\text{mol Na}}$

$= 2.1077 \times 10^{24}$

$N_{Na} = 2.1 \times 10^{24}$ atoms Na

$\therefore$ The number of atoms in 3.5 moles sodium is 2.1×10^{24} atoms Na

3. a)

Given

$N = 2.7 \times 10^{24}$ atoms Ne

$N_A = \dfrac{6.022 \times 10^{23} \text{ atoms Ne}}{\text{mol Ne}}$

Required

$n = ?$

Solution

$N = n \times N_A$

$n = \dfrac{N}{N_A}$

$n = \dfrac{2.7 \times 10^{24} \text{ atoms Ne}}{6.022 \times 10^{23} \text{ atom Ne/mol Ne}}$

$= 4.4835603$

$n = 4.5$ mol Ne

∴ there are 4.5 moles of Ne atoms

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4. a)

Given

Atomic mass of C = 12.011 u

Atomic mass of O = 15.999

molar mass = molecular mass

Required

molar mass of CO_2 = ?

~~molar~~

Solution

~~molar mass = 12.0~~

$$\text{molar mass} = \text{atomic mass of } C + 2(\text{atomic mas of } O)$$

$$= 12.011u + 2(15.999u)$$

$$\text{molar mass} = 44.009 \text{ g/mol} \doteq 44.0 \text{ g/mol}$$

∴ the molar mass of CO_2 is 44.0 g/mol

b) **Given**

Atomic mass of H = 1.008 u

Atomic mass of N = 14.007 u

Atomic mass of O = 15.999 u

molar mass = molecular mass

Required

molar mass of HNO_3 = ?

Solution

$$\text{molar mass} = \text{atomic mass of } H + \text{atomic mass of } N + 3(\text{atomic mass of } O)$$

$$= 1.008u + 14.007u + 3(15.999)u$$

$$\text{molar mass} = 63.012 \text{ g/mol}$$

$$\doteq 63.0 \text{ g/mol}$$

∴ the molar mass of HNO_3 is 63.0 g/mol

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5. a)

Given

$n = 3.5\ mol\ H_2O$

$N_A = \dfrac{6.022 \times 10^{23}\ molecules\ H_2O}{mol\ H_2O}$

Required

$N_{water} = ?$

Solution

$N = n \times N_A$

$N_{water} = 3.5\ mol\ H_2O \times \dfrac{6.022 \times 10^{23}\ molecules\ H_2O}{mol\ H_2O}$

$= 2.1077 \times 10^{24}$

$N_{water} = 2.1 \times 10^{24}$ molecules of water

∴ there are 2.1×10^{24} molecules of water

b) Given

$m_{O_3} = 100\ g$

$M_{O_3} = 15.999(3) = 47.997\ g/mol$

$N_A = \dfrac{6.022 \times 10^{23}\ molecules\ O_3}{mol\ O_3}$

Required

$N_{O_3} = ?$

Solution

$N_{O_3} = \dfrac{m_{O_3}}{M_{O_3}} \times N_A$

$= \dfrac{100\ g}{47.997\ g/mol} \times \dfrac{6.022 \times 10^{23}\ molecules\ O_3}{mol\ O_3}$

$= 1.25466 \times 10^{24}$

$N_{ozone} = 1.3 \times 10^{24}$ molecules of O_3 → ∴ There are 1.3×10^{24} molecules of ozone

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6.10)

Given

$N_{Fe} = 1.8 \times 10^{20}$ atoms

$M_{Fe} = 55.845$ g/mol

$$N_A = \frac{6.022 \times 10^{23} \text{ atoms Fe}}{\text{mol Fe}}$$

Required

$m_{Fe} = ?$

Solution

$$m = \frac{N \times M}{N_A}$$

$$m_{Fe} = \frac{1.8 \times 10^{20} \text{ atom Fe} \times 55.845 \text{ g/mol}}{6.022 \times 10^{23} \text{ atoms Fe / mol Fe}}$$

$= 0.01669229 5$ g

$= 0.017$ g

∴ The mass is 0.017 grams of Fe

7. a)

Given

$M_{H_2O} = M_{H_2} + M_O = 2(1.008) + 15.999 = 18.015\ g/mol$

$m_{H_2O} = 250\ g$

Required

$n = ?$

Solution

$m = n \times M$

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

$$n = \frac{250g}{18.015\ g/mol}$$

$= 13.877324\ mol$

$n = 14\ mol\ H_2O$

$\therefore$ There are 14 moles of water molecules

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7. C

Given

$N_{CH_4} = 3.5 \times 10^{24}$ molecule CH_4

$$N_A = \frac{6.022 \times 10^{23} \text{ molecules } CH_4}{\text{mol } CH_4}$$

Required

$n = ?$

Solution

$m = n \times M$

$$n = \frac{m}{M} \longrightarrow \text{Sub in eqn for } m \Rightarrow m = \frac{N \times M}{N_A}$$

$$= \frac{\frac{N \times M}{N_A}}{M}$$

$$= \frac{N \times \cancel{M}}{N_A} \times \frac{1}{\cancel{M}}$$

$$= \frac{N}{N_A}$$

$$= \frac{3.5 \times 10^{24} \text{ molecules } CH_4}{6.022 \times 10^{23} \text{ molecules } CH_4 / \text{mol } CH_4} = 5.812022 = 5.8 \text{ mol } CH_4$$

$\therefore$ There are 5.8 moles of CH_4

8. a)

Given

$n = 3.8 \text{ mol } CH_4$

$N_A = \dfrac{6.022 \times 10^{23} \; CH_4 \; fu}{\text{mol } CH_4}$

# of C in CH_4 = 1

Requireds

$N_c = ?$

Solution

$N_c = n \times N_A \times \#\text{of C}$

$= \dfrac{3.8 \; \cancel{\text{mol } CH_4}}{} \times \dfrac{6.022 \times 10^{23} \; \cancel{CH_4 \; fu}}{\cancel{\text{mol } CH_4}} \times \dfrac{1 \text{ C atoms}}{\cancel{CH_4 \; fu}}$

$= 3.8 \times 6.022 \times 10^{23} \times 1 \text{ C atoms}$

$= 2.28836 \times 10^{24}$

$= 2.3 \times 10^{24}$

∴ There are 2.3×10^{24} Carbon atoms in 3.8 moles of CH_4

9.

Given

$n = 2 \text{ mol } CCl_4$

Ratio of Cl to CCl_4 = 4:1

$M_{Cl} = 35.453 \frac{g\ Cl}{mol\ Cl}$

Required

$m_{Cl} = ?$

Solution

$$m_{Cl} = n \times M_{Cl} \times \frac{4 \text{ mol Cl}}{1 \text{ mol } CCl_4}$$

$$= 2 \cancel{\text{mol } CCl_4} \times \frac{35.453 \text{ g Cl}}{\cancel{\text{mol Cl}}} \times \frac{4 \cancel{\text{mol Cl}}}{1 \cancel{\text{mol } CCl_4}}$$

$$= 2 \times 35.453 \times \frac{4}{1} \text{ g Cl}$$

$$= 283.624 \text{ g Cl}$$

$$\doteq 300 \text{ g Cl}$$

∴ The mass of chlorine in 2 mole CCl_4 is 300 grams