

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

Solution

$$N = n \times N_A$$

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

$$= 1.8066 \times 10^{22}$$

$\therefore$  sigfigs

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

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

2. a)

Given

$$n = 3.5 \text{ mol Na}$$

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

Required

$$N_{\text{Na}} = ?$$

Solution

$$N = n \times N_A$$

~~$N_{\text{Na}} = n \times N_A$~~

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

$$= 2.1077 \times 10^{24}$$

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

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

2. b)

Given

$$n = 0.5 \text{ mol He}$$

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

Required

$$N_{\text{He}} = ?$$

Solution

$$N = n \times N_A$$

$$N_{\text{He}} = 0.5 \text{ mol He} \times \frac{6.022 \times 10^{23} \text{ atoms He}}{\text{mol He}}$$

$$= 3.011 \times 10^{23}$$

$$N_{\text{He}} = 3 \times 10^{23} \text{ atoms He}$$

∴ The number of helium atoms is  $3 \times 10^{23}$

3. a)

Given

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

Required

$$n = ?$$

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

mol Ne

Solution

$$N = n \times N_A$$

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

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

$$= 4.4835603$$

$$n = 4.5 \text{ mol Ne}$$

∴ There are 4.5 moles of Ne atoms

3.6)

Given

$$N = 3.2 \times 10^{12} \text{ atoms H}$$

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

Required

$$n = ? \text{ mol H}$$

$$\frac{3.2 \times 10^{12} \text{ atoms H}}{6.022 \times 10^{23} \text{ atoms H/mol H}} = n$$

cancel

Solution

$$N = n \times N_A$$

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

$$= \frac{3.2 \times 10^{12} \text{ atoms H}}{6.022 \times 10^{23} \text{ atoms H/mol H}}$$

$$= 5.3138492 \times 10^{-12}$$

$$n = 5.3 \times 10^{-12} \text{ mol H}$$

$\therefore$  There are  $5.3 \times 10^{-12}$  moles of H atoms

5  
a)

Given

Atomic mass of C = 12.011 u

Atomic mass of O = 15.999

molar mass = molecular mass

Solution

$$\text{molar mass} = 12.0$$

$$\begin{aligned}\text{molar mass} &= \text{atomic mass of C} + 2(\text{atomic mass of O}) \\ &= 12.011 \text{ u} + 2(15.999) \text{ u}\end{aligned}$$

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

∴ The molar mass of  $\text{CO}_2$  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

Solution

molar mass = atomic mass of H + atomic mass of N + 3(atOMIC mass of O)

$$= 1.008 \text{ u} + 14.007 \text{ u} + 3(15.999) \text{ u}$$

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

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

∴ The molar mass of  $\text{HNO}_3$  is 63.0 g/mol

Required

molar mass of  $\text{CO}_2$  = ?

~~molar~~

Q.C)

Given

Atomic mass of Al = 26.982 u

Atomic mass of O = 15.999 u

Atomic mass of H = 1.008 u

molecular mass = molar mass

Required:

molar mass of  $\text{Al}(\text{OH})_3$  = ?

Solution

$$\begin{aligned}\text{molar mass} &= \text{atomic mass of Al} + 3(\text{atomic mass of O}) + 3(\text{atomic mass H}) \\ &= 26.982 \text{ u} + 3(15.999) \text{ u} + 3(1.008) \text{ u}\end{aligned}$$

$$\text{molar mass} = 78.003 \text{ g/mol}$$

$$\doteq 78.0 \text{ g/mol}$$

$\therefore$  The molar mass of  $\text{Al}(\text{OH})_3$  is 78.0 g/mol

D)

Given

Atomic mass of Si = 28.086 u

Atomic mass of Cl = 35.453 u

molecular mass = molar mass

Required:

molar mass of  $\text{SiCl}_4$  = ?

Solution

$$\begin{aligned}\text{molar mass} &= \text{atomic mass of Si} + 4(\text{atomic mass of Cl}) \\ &= 28.086 \text{ u} + 4(35.453) \text{ u}\end{aligned}$$

$$\text{molar mass} = 169.898 \text{ g/mol}$$

$$\doteq 169.9 \text{ g/mol}$$

$\therefore$  The molar mass of  $\text{SiCl}_4$  is 169.9 g/mol

5. a)

Given

$$n = 3.5 \text{ mol H}_2\text{O}$$

$$N_A = \frac{6.022 \times 10^{23} \text{ molecules H}_2\text{O}}{\text{mol H}_2\text{O}}$$

Required

$$N_{\text{water}} = ?$$

Solution

$$N = n \times N_A$$

$$N_{\text{water}} = 3.5 \text{ mol H}_2\text{O} \times \frac{6.022 \times 10^{23} \text{ molecules H}_2\text{O}}{\text{mol H}_2\text{O}}$$
$$= 2.1077 \times 10^{24}$$

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

∴ there are  $2.1 \times 10^{24}$  molecules of water

b) Given

$$m_3 = 100 \text{ g}$$

$$M_{\text{O}_3} = 15.999(3) = 47.997 \text{ g/mol}$$

$$N_A = \frac{6.022 \times 10^{23} \text{ molecules O}_3}{\text{mol O}_3}$$

Required

$$N_{\text{O}_3} = ?$$

Solution

$$N_{\text{O}_3} = \frac{m_{\text{O}_3}}{M_{\text{O}_3}} \times N_A$$

$$= \frac{100 \text{ g}}{47.997 \text{ g/mol}} \times \frac{6.022 \times 10^{23} \text{ molecules O}_3}{\text{mol O}_3}$$

$$= 1.25466 \times 10^{24}$$

$$N_{\text{Ozone}} = 1.3 \times 10^{24} \text{ molecules of O}_3 \rightarrow \therefore \text{There are } 1.3 \times 10^{24} \text{ molecules of ozone}$$

6. a)

Given

$$M_N = 14.007 \text{ g/mol}$$

$$M_{O_2} = 2(15.999) = 31.998 \text{ g/mol}$$

$$M_{NO_2} = M_N + M_{O_2} = 14.007 + 31.998 = 46.005 \text{ g/mol}$$

~~$$n = 5 \text{ mol } NO_2$$~~

Required

$$m_{NO_2} = ?$$

Solution

$$m = n \times M$$

$$m_{NO_2} = 5 \text{ mol } NO_2 \times 46.005 \text{ g/mol}$$

$$= 230.025 \text{ g}$$

$$\approx 230 \text{ g}$$

∴ The mass of  $NO_2$  is 230 grams

6.b)

Given

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

$$M_{Fe} = 55.845 \text{ g/mol}$$

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

Required

$$m_{Fe} = ?$$

Solution

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

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

$$= 0.016642295 \text{ g}$$

$$= 0.017 \text{ g}$$

∴ The mass is 0.017 grams of Fe

<sup>10</sup>  
6°C)

### Given

$$N_{CO} = 7.5 \times 10^{25} \text{ molecules CO}$$

$$M_{CO} = M_C + M_O = 12.011 + 15.999 = 28.01 \text{ g/mol}$$

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

### Required

$$m_{CO} = ?$$

### Solution

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

$$m_{CO} = \frac{N_{CO} \times M_{CO}}{N_A}$$

$$= \frac{7.5 \times 10^{25} \text{ molecules CO} \times 28.01 \text{ g/mol}}{6.022 \times 10^{23} \text{ molecule CO / mol CO}}$$

$$= 3488.458984$$

$$= 3500 \text{ grams}$$

∴ The mass of CO is 3500g

7. a)

Given

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

$$m_{H_2O} = 250 \text{ g}$$

Required

$$n = ?$$

Solution

$$m = n \times M$$

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

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

$$= 13.877324 \text{ mol}$$

$$n = 14 \text{ mol } H_2O$$

∴ There are 14 moles of water molecules

b) n

Given

$$M_{\text{NaOH}} = M_{\text{Na}} + M_{\text{O}} + M_{\text{H}} = 22.990 + 15.999 + 1.008 = 39.997 \text{ g/mol}$$

$$m_{\text{NaOH}} = 50 \text{ g}$$

Required

$$n = ?$$

Solution

$$m = n \times M$$

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

$$n = \frac{50 \text{ g}}{39.997 \text{ g/mol}}$$

$$= 1.250094 \text{ mol}$$

$$= 1 \text{ mol NaOH}$$

∴ There is 1 mole of NaOH

<sup>13</sup>  
7. C

Given

~~Given~~

$$N_{\text{CH}_4} = 3.5 \times 10^{24} \text{ molecules CH}_4$$

$$N_A = 6.022 \times 10^{23} \text{ molecules CH}_4$$

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$$\text{mol CH}_4$$

Required

$$n = ?$$

Solution

$$m = n \times M$$

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

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

---

$$\frac{1}{M}$$

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

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

$$= \frac{3.5 \times 10^{24} \text{ molecules CH}_4}{6.022 \times 10^{23} \text{ molecules CH}_4 / \text{mol CH}_4} = 5.81202 \approx 5.8 \text{ mol CH}_4$$

∴ There are 5.8 moles of CH<sub>4</sub>

<sup>m</sup> 8.a)

Given

$$n = 3.8 \text{ mol CH}_4$$

$$N_A = \frac{6.022 \times 10^{23} \text{ CH}_4 \text{ fu}}{\text{mol CH}_4}$$

$$\# \text{ of C in CH}_4 = 1$$

Requireds

$$N_c = ?$$

Solution

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

$$= \frac{3.8 \text{ mol CH}_4}{\text{mol CH}_4} \times \frac{6.022 \times 10^{23} \text{ CH}_4 \text{ fu}}{\text{mol CH}_4} \times \frac{1 \text{ C atoms}}{\text{CH}_4 \text{ fu}}$$

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

$$= 2.28836 \times 10^{24}$$

$$= 2.3 \times 10^{24}$$

∴ There are  $2.3 \times 10^{24}$  carbon atoms  
in 3.8 moles of  $\text{CH}_4$

8. b)

Given

$$m = 100 \text{ g}$$

$$M_{\text{C}_2\text{H}_6} = M_{\text{C}_2} + M_{\text{H}_6} = 2(12.01) + 6(1.008) = 30.07 \text{ g/mol C}_2\text{H}_6$$

$$N_A = \frac{6.022 \times 10^{23} \text{ C}_2\text{H}_6 \text{ fu}}{\text{mol C}_2\text{H}_6}$$

$$\# \text{ of C in C}_2\text{H}_6 = 2$$

Required

$$N_c = ?$$

$$N_c = \frac{m}{M} \times N_A \times \# \text{ of C}$$

$$= \frac{100 \text{ g}}{30.07 \text{ g/mol C}_2\text{H}_6} \times \frac{6.022 \times 10^{23} \text{ C}_2\text{H}_6 \text{ fu}}{\text{mol C}_2\text{H}_6} \times \frac{2 \text{ C atoms}}{\text{C}_2\text{H}_6 \text{ fu}}$$

$$= \frac{100}{30.07} (6.022 \times 10^{23}) \times 2 \text{ C atoms}$$

$$= 4.0053 \times 10^{24} \text{ C atoms}$$

$$= 4 \times 10^{24} \text{ C atoms}$$

$\therefore$  There are  $4 \times 10^{24}$  carbon atoms in 100 g of ethane.

u  
q.

Given

$$n = 2 \text{ mol } \text{CCl}_4$$

Ratio of Cl to  $\text{CCl}_4 = 4:1$

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

Required

$$m_{\text{Cl}} = ?$$

Solution

$$\begin{aligned} m_{\text{Cl}} &= \cancel{n} \times M_{\text{Cl}} \times \frac{4 \text{ mol Cl}}{1 \text{ mol } \text{CCl}_4} \\ &= \frac{2 \cancel{\text{mol } \text{CCl}_4} \times 35.453 \cancel{\text{g Cl}}}{\cancel{\text{mol Cl}}} \times \frac{4 \cancel{\text{mol Cl}}}{1 \cancel{\text{mol } \text{CCl}_4}} \\ &= 2 \times 35.453 \times \frac{4}{1} \text{ g Cl} \\ &= 273.624 \text{ g Cl} \\ &\approx 300 \text{ g Cl} \end{aligned}$$

$\therefore$  The mass of chlorine in 2 mole  $\text{CCl}_4$  is 300 grams