Year 11 Chemistry **_SOLUTIONS_**

Chemical Calculations Assignment 1

Moles and Mass

1.

(a) *There is no single right answer for this, but the analogy should clearly relate that a mole is a specific number of objects.*

(b) Chemicals always react particle-to-particle, whereas the mass of particles is different for each chemical.

2.

(a) $$M_{Na_2CO_3} = \begin{aligned} & 2\times 22.99 \\ & +12.01 \\ & +3\times 16.00 \\ & =105.99 \text{ g mol}^{-1} \end{aligned}$$

(b) $$M_{Mg(NO_3)_2} = \begin{aligned} & 24.31 \\ & +2\times 14.01 \\ & +6\times 16.00 \\ & =148.33 \text{ g mol}^{-1} \end{aligned}$$

(c) $$M_{FeSi_2O_3.3H_2O} = \begin{aligned} & 55.85 \\ & +2\times 28.09 \\ & +3\times 16.00 \\ & +3\times\left(2\times 1.008+16.00\right) \\ & =214.078 \text{ g mol}^{-1} \end{aligned}$$

3. H_2 $\quad M = 2.016 \text{ g mol}^{-1}$

O_2 $\quad M = 32.00 \text{ g mol}^{-1}$

H_2O $\quad M = 18.016 \text{ g mol}^{-1}$

4.

(a) $$n=\frac{m}{M}=\frac{2.50}{105.99}=0.0236 \text{ mol}$$

(b) $$M = 14.01+\left(4\times 1.008\right)+35.45 = 53.49 \text{ g mol}^{-1}$$

$$n=\frac{m}{M}=\frac{0.62}{53.49}=0.012 \text{ mol}$$

(c) $$1 \text{ kg} = 1000 \text{ g}$$

$$n=\frac{m}{M}=\frac{1000}{249.66}=4.0 \text{ mol}$$

5.

(a) $$m = nM = 1.0\times 63.01 = 63 \text{ g}$$

(b) $$M_{Hg} = 200.6 \text{ g mol}^{-1}$$

$$m = nM = 0.0200\times 200.6 = 4.01 \text{ g}$$

6.

(a) $\frac{n(MnO_4^-)}{n(Fe^{2+})} = \frac{1}{5}$

(b) *There are many possible answers to this question, some examples are:*

$\frac{n(MnO_4^-)}{n(Mn^{2+})} = \frac{1}{1}$ $\frac{n(H^+)}{n(Fe^{2+})} = \frac{8}{5}$ $\frac{n(Fe^{3+})}{n(H_2O)} = \frac{5}{4}$

7.

(a) There is more oxygen than needed to exactly react with the CH_4 present.

(b) CH_4

(c) The reaction might be happening in air, which contains a lot of oxygen.

(d) According to the chemical equation, each mole of CH_4 used up produces one mole of CO_2. Since 3.00 moles of CH_4 are used up, 3.00 moles of CO_2 must be produced.

(e) $\frac{n(H_2O)}{n(CH_4)} = \frac{2}{1}$

(f) $n(H_2O) = \frac{2}{1} \times n(CH_4) = \frac{2}{1} \times 3.00 = 6.00 \text{ moles}$

(g) $m = nM = 6.00 \times 18.016 = 108 \text{ g}$

8.

(a) $\frac{n(H_2)}{n(O_2)} = \frac{2}{1}$

$$\begin{aligned} \therefore n(H_2) \text{ required} &= \frac{2}{1} \times n(O_2) \text{ present} \\ &= \frac{2}{1} \times 3.6 \\ &= 7.2 \text{ mol} \end{aligned}$$

There is more H_2 present (7.4) than required (7.2) so H_2 is in excess.

(b) Limiting reactant (O_2) determines quantity produced:

$\frac{n(H_2O)}{n(O_2)} = \frac{2}{1}$

$$\begin{aligned} \therefore n(H_2O) &= \frac{2}{1} \times n(O_2) \\ &= \frac{2}{1} \times 3.6 \\ &= 7.2 \text{ mol} \end{aligned}$$