Year 11 Chemistry **_SOLUTIONS_**

Chemical Calculations Assignment

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) $M_{Na_2CO_3} = 2\times 22.99$
$+12.01$
$+3\times 16.00$
$=105.99\text{ g mol}^{-1}$

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

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

3. H_2 $M = 2.016\text{ g mol}^{-1}$
O_2 $M = 32.00\text{ g mol}^{-1}$
H_2O $M = 18.016\text{ g mol}^{-1}$

4.

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

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

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

(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) $\dfrac{n\left(\text{MnO}_4^{\;-}\right)}{n\left(\text{Fe}^{2+}\right)}=\dfrac{1}{5}$

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

$\dfrac{n\left(\text{MnO}_4^{\;-}\right)}{n\left(\text{Mn}^{2+}\right)}=\dfrac{1}{1}$ $\dfrac{n\left(\text{H}^{+}\right)}{n\left(\text{Fe}^{2+}\right)}=\dfrac{8}{5}$ $\dfrac{n\left(\text{Fe}^{3+}\right)}{n\left(\text{H}_2\text{O}\right)}=\dfrac{5}{4}$

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) $\dfrac{n\left(\text{H}_2\text{O}\right)}{n\left(\text{CH}_4\right)}=\dfrac{2}{1}$

(f) $n\left(\text{H}_2\text{O}\right)=\dfrac{2}{1}\times n\left(\text{CH}_4\right)=\dfrac{2}{1}\times 3.00=6.00\text{ moles}$

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

8.

(a) $\dfrac{n\left(\text{H}_2\right)}{n\left(\text{O}_2\right)}=\dfrac{2}{1}$

$$\begin{aligned}\therefore n\left(\text{H}_2\right)\text{ required} &= \frac{2}{1}\times n\left(\text{O}_2\right)\text{ present}\\ &=\frac{2}{1}\times 3.6\\ &=7.2\text{ mol}\end{aligned}$$

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:

$\dfrac{n\left(\text{H}_2\text{O}\right)}{n\left(\text{O}_2\right)}=\dfrac{2}{1}$

$$\begin{aligned}\therefore n\left(\text{H}_2\text{O}\right) &=\frac{2}{1}\times n\left(\text{O}_2\right)\\ &=\frac{2}{1}\times 3.6\\ &=7.2\text{ mol}\end{aligned}$$