06-07 Formulae, Equations and the Mole

Set A **Answer key**

A Multiple choice

9 MARKS

1 **D** 16 [1]

The formula has two units of CH_3CNOH: 4 carbon, 8 hydrogen, 2 nitrogen and 2 oxygen atoms, 16 atoms in total.

2 **D** $Ir(ClO)_3$ [1]

$Ir_2(SO_4)_3$ shows the ions are Ir^{3+} and SO_4^{2-}. $Zn(ClO)_2$ shows the ions are Zn^{2+} and ClO^-. So Ir^{3+} and ClO^- give $Ir(ClO)_3$.

3 **A** $2Zn + O_2 \rightarrow 2ZnO$ [1]

Oxygen is diatomic, O_2, and zinc oxide is ZnO (Zn^{2+} and O^{2-}).

4 **A** $C_6H_{12}O_6 + 3O_2 \rightarrow 6CO_2 + 6H_2O$ [1]

In A there are 12 oxygen atoms on the left (6 + 6) but 18 on the right (12 + 6). It needs $6O_2$.

5 **C** $w = 3, x = 2, y = 1, z = 6$ [1]

There are 3 Hg on the right, so $w = 3$ and $y = 1$. The values in D fit for Hg, P and y, but z is wrong, as H and O are not balanced.

6 **C** NO [1]

$Al(NO_3)_3$: 19.7%. Mg_3N_2: 28%. NO: $\frac{14}{30} \times 100 = 46.7\%$. NO_2: 30.4%.

7 **B** 63.67 [1]

$$A_r = \frac{68.54}{100} \times 63 + \frac{29.51}{100} \times 65 + \frac{1.95}{100} \times 67 = 63.67$$

8 **B** CH_2 [1]

Moles: C = $\frac{4.8}{12} = 0.4$, H = $\frac{0.8}{1} = 0.8$. The ratio is 1 : 2, so CH_2.

9 **D** N_2O_5 [1]

Mass of oxygen = 19.30 − 5.00 = 14.30 g. Moles: N = $\frac{5.00}{14}$ = 0.357, O = $\frac{14.30}{16}$ = 0.894. The ratio is 1 : 2.5 = 2 : 5.

B Structured questions

18 MARKS

10 **(a)** (1), 12, 8 [1]

(b) (1), 5, 3, 4 [1]

(c) 2, 3, 6, (1) [1]

11 **(a)** $2Na + 2H_2O \rightarrow H_2 + 2NaOH$ [1]

(b) $2HNO_3 + CaO \rightarrow Ca(NO_3)_2 + H_2O$ [1]

(c) $2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$ [1]

12 **(a)** $Ba(NO_3)_2 + K_2SO_4 \rightarrow BaSO_4 + 2KNO_3$ [1]

(b) $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ [1]

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Masses in 100 g: B = 78.6 g and C = 21.4 g. [1]

Moles: B = $\frac{78.6}{11}$ = 7.15 and C = $\frac{21.4}{12}$ = 1.78. [1]

Ratio 7.15 ÷ 1.78 = 4.01, about 4 : 1. The empirical formula is B_4C. [1]

14 **(a)**

Moles of sulfuric acid = 0.025 × 0.40 = 0.01 mol [1]

Moles of NaOH = 2 × 0.01 = 0.02 mol, so concentration = $\frac{0.02}{0.035}$ = 0.571 mol/dm^3 [1]

(b) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ [1]

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Moles of $Ca_3(PO_4)_2$ = $\frac{100}{310}$ = 0.32258 mol [1]

$Ca_3(PO_4)_2$: $CaSiO_3$ = 2 : 6 = 1 : 3, so moles of $CaSiO_3$ = 0.96774 mol [1]

Theoretical mass of $CaSiO_3$ = 0.96774 × 116 = 112.26 g [1]

Percentage yield = $\frac{87}{112.26}$ × 100% = 77.5% [1]

A common mistake is to include the number in front of a formula when working out its M_r.