Section 2 Review Chapter 9

6) $Fe + 2HCl \longrightarrow FeCl_2 + H_2$

$$8.85\,g\,Fe \times \frac{1\,mol\,Fe}{55.8\,g\,Fe} \times \frac{1\,mol\,H_2}{1\,mol\,Fe} \times \frac{2.0\,g\,H_2}{1\,mol\,H_2} = \boxed{0.317\,g\,H_2} \leftarrow \text{theoretical}$$

$$\%\ Yield = \frac{actual}{theoretical} \times 100 = \frac{0.27\,g\,H_2}{0.317\,g\,H_2} \times 100 = \boxed{85.12\%}$$

7) a) $P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$

b) $$100.0\,g\,P_4O_{10} \times \frac{1\,mol\,P_4O_{10}}{284\,g\,P_4O_{10}} \times \frac{4\,mol\,H_3PO_4}{1\,mol\,P_4O_{10}} \times \frac{98.0\,g\,H_3PO_4}{1\,mol\,H_3PO_4} = \boxed{138.0\,g\,H_3PO_4}$$

Limiting: P_4O_{10}

$$200.0\,g\,H_2O \times \frac{1\,mol\,H_2O}{18.0\,g\,H_2O} \times \frac{4\,mol\,H_3PO_4}{6\,mol\,H_2O} \times \frac{98.0\,g\,H_3PO_4}{1\,mol\,H_3PO_4} = \boxed{725.9\,g\,H_3PO_4}$$

excess: H_2O

c) $$\%\ Yield = \frac{126.2\,g\,H_3PO_4}{138.0\,g\,H_3PO_4} \times 100 = \boxed{91.45\%}$$

8) $TiCl_4 + O_2 \longrightarrow TiO_2 + 2Cl_2$

$$3.5\,mol\,TiCl_4 \times \frac{1\,mol\,TiO_2}{1\,mol\,TiCl_4} = \boxed{3.5\,mol\,TiO_2}$$ Limiting: $TiCl_4$

$$4.5\,mol\,O_2 \times \frac{1\,mol\,TiO_2}{1\,mol\,O_2} = \boxed{4.5\,mol\,TiO_2}$$ excess: O_2

⑧ cont.

$$3.5\ mol\ TiCl_4 \times \frac{1\ mol\ TiO_2}{1\ mol\ TiCl_4} = \boxed{3.5\ mol\ TiO_2}\ \text{product 1}$$

$$3.5\ mol\ TiCl_4 \times \frac{2\ mol\ Cl_2}{1\ mol\ TiCl_4} = \boxed{7.0\ mol\ Cl_2}\ \text{product 2}$$

~~4.5 mol~~

$$3.5\ mol\ TiCl_4 \times \frac{1\ mol\ O_2}{1\ mol\ TiCl_4} = \boxed{3.5\ mol\ O_2}\ \text{used}$$

Left over = $4.5\ mol\ O_2 - 3.5\ mol\ O_2 = \boxed{1.0\ mol\ O_2}$

started w/ — used up — left over

⑨ $2Al + 3CuSO_4 \longrightarrow Al_2(SO_4)_3 + 3Cu$

$$1.85\ g\ Al \times \frac{1\ mol\ Al}{27.0\ g\ Al} \times \frac{3\ mol\ Cu}{2\ mol\ Al} \times \frac{63.5\ g\ Cu}{1\ mol\ Cu} = \boxed{6.53\ g\ Cu}$$

theoretical

$$\%\ Yield = \frac{actual}{theoretical}$$

$$0.566 = \frac{actual}{6.53\ g\ Cu}$$

$$\boxed{actual = 3.69\ g\ Cu}$$

(10) $CaCO_3 \longrightarrow CaO + CO_2$

$$2.00\times10^3\,g\,CaCO_3 \times \frac{1\,mol\,CaCO_3}{100.1\,g\,CaCO_3} \times \frac{1\,mol\,CaO}{1\,mol\,CaCO_3} \times \frac{56.1\,g\,CaO}{1\,mol\,CaO} = \boxed{1120.9\,g\,CaO}$$

theoretical

$1120.9 = 1.1209\times10^3$

$$\%\ Yield = \frac{1.05\times10^3\,g\,CaO}{1.1209\times10^3\,g\,CaO} \times 100 = \boxed{93.67\%}$$

(11) a) $Mg + 2H_2O \longrightarrow Mg(OH)_2 + H_2$

b) $$10.1\,g\,Mg \times \frac{1\,mol\,Mg}{24.3\,g\,Mg} \times \frac{1\,mol\,Mg(OH)_2}{1\,mol\,Mg} \times \frac{58.3\,g\,Mg(OH)_2}{1\,mol\,Mg(OH)_2} = \boxed{24.2\,g\,Mg(OH)_2}$$

theoretical

$$\%\ Yield = \frac{21.0\,g\,Mg(OH)_2}{24.2\,g\,Mg(OH)_2} \times 100 = \boxed{86.66\%}$$

c) $$24\,g\,Mg \times \frac{1\,mol\,Mg}{24.3\,g\,Mg} \times \frac{1\,mol\,Mg(OH)_2}{1\,mol\,Mg} \times \frac{58.3\,g\,Mg(OH)_2}{1\,mol\,Mg(OH)_2} = \boxed{57.6\,g\,Mg(OH)_2}$$

theoretical

$$0.95 = \frac{actual}{57.6\,g\,Mg(OH)_2} = \boxed{54.72\,g\,Mg(OH)_2}$$

(12)

$$CuO + H_2 \rightarrow Cu + H_2O$$

a) $19.9\,g\,CuO \times \frac{1\,mol\,CuO}{79.5\,g\,CuO} \times \frac{1\,mol\,Cu}{1\,mol\,CuO} \times \frac{63.5\,g\,Cu}{1\,mol\,Cu} = \boxed{15.9\,g\,Cu}$

Limiting: CuO

b) $2.02\,g\,H_2 \times \frac{1\,mol\,H_2}{2.0\,g\,H_2} \times \frac{1\,mol\,Cu}{1\,mol\,H_2} \times \frac{63.5\,g\,Cu}{1\,mol\,Cu} = \boxed{64.1\,g\,Cu}$

Excess: H_2

$$\%\ Yield = \frac{15.0\,g\,Cu}{15.9\,g\,Cu} \times 100 = \boxed{94.33\%}$$

c) $20.6\,g\,CuO \times \frac{1\,mol\,CuO}{79.5\,g\,CuO} \times \frac{1\,mol\,Cu}{1\,mol\,CuO} \times \frac{63.5\,g\,Cu}{1\,mol\,Cu} = \boxed{16.5\,g\,Cu}$

theoretical

$$0.910 = \frac{actual}{16.5\,g\,Cu} \qquad actual = \boxed{15.02\,g\,Cu}$$