Stoichiometry Practice

Indicate the state: gas, liquid, solid, aqueous of each substance.
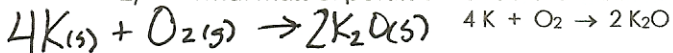
$$2SO_{2(g)} + O_{2(g)} \rightarrow SO_{3(g)}$$

1) What mass of sulphur trioxide is formed from 96 g of sulphur dioxide?

$$2\,SO_2 + O_2 \rightarrow 2\,SO_3$$
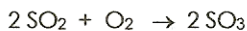
$$96g\ SO_2 \times \frac{1\,mol}{64.06g} \times \frac{2\,SO_3}{2\,SO_2} \times \frac{80.06g}{mol} = 119.97751g\ SO_3$$
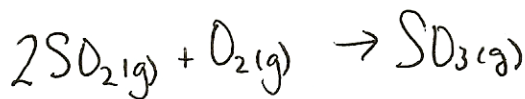
$$\boxed{120g\ SO_3}$$
(2 sig. figs.)

2) What mass of potassium oxide is formed when 9.75 g of potassium is burned in oxygen?

$$4K_{(s)} + O_{2(g)} \rightarrow 2K_2O_{(s)}$$

$$4\,K + O_2 \rightarrow 2\,K_2O$$

$$9.75g\ K \times \frac{1\,mol}{39.10g} \times \frac{2\,K_2O}{4K} \times \frac{94.2g}{mol} = 11.744g$$

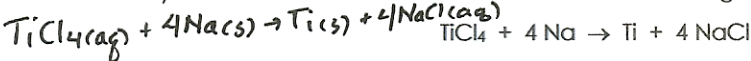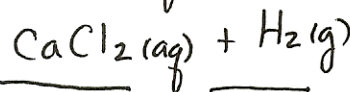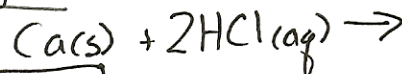$$\boxed{11.7g\ K_2O}\ (3\ sig.figs)$$

3) What mass of hydrogen is formed when 0.2 g of calcium reacts with hydrochloric acid?

$$Ca + 2\,HCl \rightarrow CaCl_2 + H_2$$
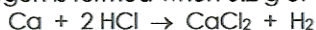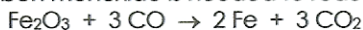
$$0.2g \times \frac{1\,mol}{40.08g} \times \frac{1\,H_2}{1\,Ca} \times 2.02g = \boxed{0.01g\ H_2}$$

$$Ca_{(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2\,(aq)} + H_{2(g)}$$

4) What mass of sodium is needed to reduce 1 kg of titanium chloride?

$$TiCl_{4(aq)} + 4Na_{(s)} \rightarrow Ti_{(s)} + 4NaCl_{(aq)}$$

$$TiCl_4 + 4\,Na \rightarrow Ti + 4\,NaCl$$

$$1\,Kg\ TiCl_4 = 1000g\ TiCl_4 \times \frac{1\,mol}{189.66g} \times \frac{4\,Na}{1\,TiCl_4} \times \frac{22.99g}{mol} = 485g \Rightarrow$$

$$\boxed{0.5\,Kg\ Na}$$

5) What mass of carbon monoxide is needed to reduce 1 kg of iron oxide to iron?

$$Fe_2O_3 + 3\,CO \rightarrow 2\,Fe + 3\,CO_2$$

$$1000g\ Fe_2O_3 \times \frac{1\,mol}{159.69g} \times \frac{3\,CO}{1\,Fe_2O_3} \times \frac{28.01g\ CO}{mol} = 526.2g\ CO$$

$$\boxed{0.5\,Kg\ CO}$$

6) What mass of oxygen is needed to burn 110 g of propane (C₃H₈)?

$$C_3H_8 + 5\,O_2 \rightarrow 3\,CO_2 + 4\,H_2O$$
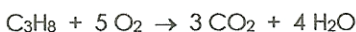
$$110g\ C_3H_8 \times \frac{1\,mol}{44.11g} \times \frac{5\,O_2}{1\,C_3H_8} \times \frac{32.0g}{mol} = 399g\ O_2$$

$$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$$
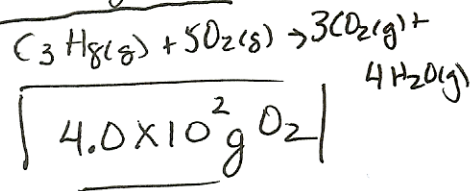
$$\boxed{4.0 \times 10^2 g\ O_2}$$
2 s.f.

7) What mass of iron reacts with 14.2 g of chlorine?

$$2\,Fe + 3\,Cl_2 \rightarrow 2\,FeCl_3$$
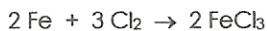
$$14.2g\ Cl_2 \times \frac{1\,mol}{70.91g} \times \frac{2\,Fe}{3\,Cl_2} \times \frac{55.85g}{mol} = \boxed{7.46g\ Fe}$$

8) 4.17 g of hydrated barium bromide crystals (BaBr₂.nH₂O) gave 3.72 g of anhydrous barium bromide on heating to constant mass. Work out the relative molecular mass (Mᵣ) of the hydrated barium bromide and the value of n.

$$BaBr_2.nH_2O \rightarrow BaBr_2 + n\,H_2O \quad \underline{\underline{n=2}}$$

$$Ba = 137.327$$
$$Br = 79.904$$

$$BaBr_2 = 297.14\,g/mol$$

$$3.72g\ BaBr_2 \times \frac{1\,mol}{297.14g} = 0.012519\,mol\ BaBr_2$$

$$② = \frac{0.02497\ H_2O}{0.012519\ BaBr_2}$$

$$\begin{array}{r} 4.17g \\ - 3.72g \\ \hline 0.45g \end{array}$$

$$BaBr_2.nH_2O$$
$$BaBr_2$$

$$n\,H_2O \div 18.02g/mol$$
$$= 0.02497\,mol\ H_2O$$