# Answer Key: Stoich Practice (Level 1)

1. $\frac{32.0\text{ g S}}{} \times \frac{1\text{ mol S}}{32.1\text{ g S}} \times \frac{1\text{ mol Fe}}{1\text{ mol S}} \times \frac{55.8\text{ g Fe}}{1\text{ mol Fe}} = \underline{55.6\text{ g Fe}}$

2. $\frac{31.8\text{ g Zn}}{} \times \frac{1\text{ mol Zn}}{65.4\text{ g Zn}} \times \frac{1\text{ mol } H_2}{1\text{ mol Zn}} \times \frac{2.0\text{ g } H_2}{1\text{ mol } H_2} = \underline{0.97\text{ g } H_2}$

3. $\frac{128\text{ g } SO_2}{} \times \frac{1\text{ mol } SO_2}{64.1\text{ g } SO_2} \times \frac{1\text{ mol } H_2SO_3}{1\text{ mol } SO_2} \times \frac{82.1\text{ g } H_2SO_3}{1\text{ mol } H_2SO_3} = \underline{164\text{ g } H_2SO_3}$

4. $\frac{34.3\text{ g NaBr}}{} \times \frac{1\text{ mol NaBr}}{102.9\text{ g}} \times \frac{1\text{ mol AgBr}}{1\text{ mol NaBr}} \times \frac{187.8\text{ g AgBr}}{1\text{ mol AgBr}} = \underline{62.6\text{ g AgBr}}$

5. $\frac{50.0\text{ g FeS}}{} \times \frac{1\text{ mol FeS}}{87.9\text{ g}} \times \frac{1\text{ mol } H_2S}{1\text{ mol FeS}} \times \frac{34.1\text{ g } H_2S}{1\text{ mol } H_2S} = \underline{19.4\text{ g } H_2S}$

6. $\frac{25.0\text{ g Mg}}{} \times \frac{1\text{ mol Mg}}{24.3\text{ g Mg}} \times \frac{2\text{ mol } HNO_3}{1\text{ mol Mg}} \times \frac{63\text{ g } HNO_3}{1\text{ mol } HNO_3} = \underline{130\text{ g } HNO_3}$

7. $\frac{75.0\text{ g } Cu_2O}{} \times \frac{1\text{ mol } Cu_2O}{143\text{ g } Cu_2O} \times \frac{2\text{ mol}}{1\text{ mol}} \times \frac{99.0\text{ g CuCl}}{1\text{ mol}} = \underline{\cancel{104}\ 105\text{ g CuCl}}$

8. $\frac{100.0\text{ g } NaNO_3}{} \times \frac{1\text{ mol}}{85.0\text{ g } NaNO_3} \times \frac{1\text{ mol } O_2}{2\text{ mol}} \times \frac{22.4\text{ L}}{1\text{ mol } O_2} = \underline{\cancel{13.18}\ 13.2\text{ L } O_2}$

9. $\frac{75.0\text{ g } H_2O}{} \times \frac{1\text{ mol } H_2O}{18.0\text{ g } H_2O} \times \frac{1\text{ mol } O_2}{2\text{ mol } H_2O} \times \frac{22.4\text{ L}}{1\text{ mol } O_2} = \underline{46.7\text{ L } O_2}$

10. $\frac{50.0\text{ L CO}}{} \times \frac{1\text{ mol CO}}{22.4\text{ L}} \times \frac{1\text{ mol } CO_2}{2\text{ mol CO}} \times \frac{22.4\text{ L } CO_2}{1\text{ mol } CO_2} = \underline{25.0\text{ L } CO_2}$

# Answer Key : Stoich Practice (Level 2)

1. $4Al + 3O_2 \rightarrow 2Al_2O_3$

$$25.0\text{ g Al} \left|\frac{1\text{ mol}}{27.0\text{ g}}\right.\left|\frac{2\text{ mol } Al_2O_3}{4\text{ mol Al}}\right.\left|\frac{102\text{ g } Al_2O_3}{1\text{ mol } Al_2O_3}\right. = 47.2\text{ g } Al_2O_3$$

2. $3H_2O + 2Fe \rightarrow 3H_2 + Fe_2O_3$

$$100.0\text{ g Fe} \left|\frac{1\text{ mol}}{55.8\text{ g}}\right.\left|\frac{3\text{ mol}}{2\text{ mol}}\right.\left|\frac{18.0\text{ g } H_2O}{1\text{ mol}}\right. = 48.4\text{ g } H_2O$$

3. $2NH_4OH + Cu(NO_3)_2 \rightarrow 2NH_4NO_3 + Cu(OH)_2$

$$75.0\text{ g } Cu(NO_3)_2 \left|\frac{1\text{ mol}}{187.5\text{ g}}\right.\left|\frac{2\text{ mol}}{1\text{ mol}}\right.\left|\frac{35\text{ g } NH_4OH}{1\text{ mol } NH_4OH}\right. = 28.0\text{ g } NH_4OH$$

4. $4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$

$$25.0\text{ L } O_2 \left|\frac{1\text{ mol } O_2}{22.4\text{ L}}\right.\left|\frac{4\text{ mol } NH_3}{3\text{ mol } O_2}\right.\left|\frac{22.4\text{ L}}{1\text{ mol } NH_3}\right. = 33.3\text{ L } NH_3$$

$$16.7\text{ L } N_2$$

5. $Na_2CO_3 + 2HCl \rightarrow CO_2 + H_2O + 2NaCl$

$$5.0\text{ L } CO_2 \left|\frac{1\text{ mol } CO_2}{22.4\text{ L}}\right.\left|\frac{1\text{ mol } Na_2CO_3}{1\text{ mol } CO_2}\right.\left|\frac{106\text{ g } Na_2CO_3}{1\text{ mol } Na_2CO_3}\right. = 23.7 \approx 24\text{ g } Na_2CO_3$$

6. $Fe + 2CuNO_3 \rightarrow Fe(NO_3)_2 + 2Cu$

$$30.0\text{ g Fe} \left|\frac{1\text{ mol Fe}}{55.8\text{ g Fe}}\right.\left|\frac{2\text{ mol Cu}}{1\text{ mol Fe}}\right.\left|\frac{63.5\text{ g Cu}}{1\text{ mol Cu}}\right. = 68.3\text{ g Cu}$$

7. $H_2SO_4 + 2NH_4OH \rightarrow (NH_4)_2SO_4 + 2H_2O$

$$35.5\text{ g } NH_3 \left|\frac{1\text{ mol}}{35.0\text{ g}}\right.\left|\frac{1\text{ mol}}{2\text{ mol}}\right.\left|\frac{98.1\text{ g}}{1\text{ mol}}\right. = 49.8\text{ g } H_2SO_4$$

Level 2 Cont'd

8) $Cl_2 + 2KI \longrightarrow 2KCl + I_2$

$$85.8\text{ g KI} \left| \frac{1\text{ mol KI}}{166.0\text{ g KI}} \right| \frac{1\text{ mol } Cl_2}{2\text{ mol KI}} \left| \frac{71.0\text{ g } Cl_2}{1\text{ mol } Cl_2} \right| = \boxed{18.3\text{ g } Cl_2}$$

9) $H_2SO_4 + 2KOH \longrightarrow K_2SO_4 + 2H_2O$

$$150.0\text{ g } H_2SO_4 \left| \frac{1\text{ mol } H_2SO_4}{98.1\text{ g } H_2SO_4} \right| \frac{1\text{ mol } K_2SO_4}{1\text{ mol } H_2SO_4} \left| \frac{174.3\text{ g } K_2SO_4}{1\text{ mol } K_2SO_4} \right| = \boxed{2.67 \times 10^2\text{ g } K_2SO_4}$$

10) $N_2 + 3H_2 \longrightarrow 2NH_3$

$$150.0\text{ L } H_2 \left| \frac{1\text{ mol } H_2}{22.4\text{ L } H_2} \right| \frac{1\text{ mol } N_2}{3\text{ mol } H_2} \left| \frac{22.4\text{ L } N_2}{1\text{ mol } N_2} \right| = \boxed{50.0\text{ L } N_2}$$

# Stoichiometry (Level 3) Key

1. $2Al + Fe_2O_3 \longrightarrow Al_2O_3 + 2Fe$

$$\frac{27.8\text{ g } Fe_2O_3}{} \left| \frac{1\text{ mol } Fe_2O_3}{159.6\text{ g } Fe_2O_3} \right| \frac{2\text{ mol Al}}{1\text{ mol } Fe_2O_3} \left| \frac{27.0\text{ g Al}}{1\text{ mol Al}} \right. = \boxed{9.41\text{ g Al}}$$

2. $2Sb + 3Cl_2 \longrightarrow 2SbCl_3$

$$\frac{58.9\text{ g } SbCl_3}{} \left| \frac{1\text{ mol } SbCl_3}{228.3\text{ g } SbCl_3} \right| \frac{3\text{ mol } Cl_2}{2\text{ mol } SbCl_3} \left| \frac{22.4\text{ L } Cl_2}{1\text{ mol } Cl_2} \right. = \boxed{8.67\text{ L } Cl_2}$$

3. $4Fe + 3O_2 \longrightarrow 2Fe_2O_3$

$$\frac{20.8\text{g } Fe_2O_3}{} \left| \frac{1\text{ mol } Fe_2O_3}{159.6\text{ g } Fe_2O_3} \right| \frac{4\text{ mol Fe}}{2\text{ mol } Fe_2O_3} \left| \frac{55.9\text{ g Fe}}{1\text{ mol Fe}} \right. = \boxed{14.5\text{ g Fe}}$$

4. $Al_2(SO_4)_3 + 6NH_4Br \longrightarrow 3(NH_4)_2SO_4 + 2AlBr_3$

$$\frac{8.75\text{ g } NH_4Br}{} \left| \frac{1\text{ mol } NH_4Br}{97.9\text{ g } NH_4Br} \right| \frac{2\text{ mol } AlBr_3}{6\text{ mol } NH_4Br} \left| \frac{266.7\text{g } AlBr_3}{1\text{ mol } AlBr_3} \right. = \boxed{7.95\text{ g } AlBr_3}$$

5. $$\frac{95.5\text{ g } H_3PO_4}{} \left| \frac{1\text{ mol } H_3PO_4}{98.0\text{ g } H_3PO_4} \right| \frac{3\text{ mol } H_2O}{2\text{ mol } H_3PO_4} \left| \frac{18.0\text{ g } H_2O}{1\text{ mol } H_2O} \right. = \boxed{26.3\text{ g } H_2O}$$

$3H_2O + P_2O_5 \longrightarrow 2H_3PO_4$

$$\frac{95.5\text{g } H_3PO_4}{} \left| \frac{1\text{ mol } H_3PO_4}{98.0\text{ g } H_3PO_4} \right| \frac{1\text{ mol } P_2O_5}{2\text{ mol } H_3PO_4} \left| \frac{142.0\text{ g } P_2O_5}{1\text{ mol } P_2O_5} \right. = \boxed{69.2\text{ g } P_2O_5}$$

6. $C + O_2 \longrightarrow CO_2$

moles $CO_2$ formed:

$$\frac{50.0\text{ g } O_2}{} \left| \frac{1\text{ mol } O_2}{32.0\text{ g } O_2} \right| \frac{1\text{ mol } CO_2}{1\text{ mol } O_2} = 1.5625\text{ mol } CO_2$$

moles $CO_2$ formed:

$$\frac{25.0\text{ g C}}{} \left| \frac{1\text{ mol C}}{12.0\text{ g C}} \right| \frac{1\text{ mol } CO_2}{1\text{ mol C}} = 2.0833\text{ mol } CO_2$$

NOT ENOUGH $O_2$ ($O_2$ is LIMITING)

C in excess.

$$\frac{50.0\text{ g } O_2}{} \left| \frac{1\text{ mol } O_2}{32.0\text{ g } O_2} \right| \frac{1\text{ mol C}}{1\text{ mol } O_2} \left| \frac{12.0\text{ g C}}{1\text{ mol C}} \right. = 18.75\text{ g C used.}$$

25.0 g C (start) − 18.75 g C (used) = **6.3 g C left**

7. $CaCO_3 + H_2SO_4 \longrightarrow CO_2 + H_2O + CaSO_4$

moles $CO_2$ formed:

$$\frac{100.0\text{ g } H_2SO_4}{} \left| \frac{1\text{ mol } H_2SO_4}{98.1\text{ g } H_2SO_4} \right| \frac{1\text{ mol } CO_2}{1\text{ mol } H_2SO_4} = 1.0194\text{ mol } CO_2\text{ formed.}$$

moles $CO_2$ formed:

$$\frac{100.0\text{ g } CaCO_3}{} \left| \frac{1\text{ mol } CaCO_3}{100.1\text{ g } CaCO_3} \right| \frac{1\text{ mol } CO_2}{1\text{ mol } CaCO_3} = 0.9990\text{ mol } CO_2\text{ formed}$$

($CaCO_3$ is LIMITING)

$$\frac{0.9990\text{ mol } CO_2}{} \left| \frac{44.0\text{ g } CO_2}{1\text{ mol } CO_2} \right. = \textbf{44.0 g } CO_2\textbf{ formed}$$

8) $2HCl + Mg(OH)_2 \longrightarrow MgCl_2 + 2H_2O$

Question is asking: Is the base ($Mg(OH)_2$) limiting or not?

moles $MgCl_2$ formed:

$$\frac{5.0\text{ g HCl}}{36.5\text{ g HCl}} \left| \frac{1\text{ mol HCl}}{2\text{ mol HCl}} \right| \frac{1\text{ mol } MgCl_2}{} = 0.06849\text{ mol } MgCl_2$$

HCl is limiting

moles $MgCl_2$ formed:

$$\frac{24.0\text{ g } Mg(OH)_2}{58.3\text{ g } Mg(OH)_2} \left| \frac{1\text{ mol } Mg(OH)_2}{1\text{ mol } Mg(OH)_2} \right| \frac{1\text{ mol } MgCl_2}{} = 0.41166\text{ mol } MgCl_2$$

YES

9. $HCN + H_2S_2O_3 \longrightarrow HCNS + H_2SO_3$

moles HCNS formed:

$$\frac{1.000\text{ mg } H_2S_2O_3}{1000\text{ mg}} \left| \frac{1\text{ g}}{1\text{ mol } H_2S_2O_3} \right| \frac{1\text{ mol } H_2S_2O_3}{114.2\text{ g } H_2S_2O_3} \left| \frac{1\text{ mol HCNS}}{1\text{ mol } H_2S_2O_3} \right. = 8.757 \times 10^{-6}\text{ mol HCNS.}$$

$H_2S_2O_3$ is limiting

moles HCNS formed:

$$\frac{2.00\text{ mg HCN}}{1000\text{ mg}} \left| \frac{1\text{ g}}{27.0\text{ g HCN}} \right| \frac{1\text{ mol HCN}}{1\text{ mol HCN}} \left| \frac{1\text{ mol HCNS}}{} \right. = 7.4074 \times 10^{-5}\text{ mol HCNS}$$

NO, you're in trouble!

10. $2H_2S + 3O_2 \longrightarrow 2H_2O + 2SO_2$

moles $H_2O$ formed:

$$\frac{45.0\text{ L } O_2}{22.4\text{ L } O_2} \left| \frac{1\text{ mol } O_2}{3\text{ mol } O_2} \right| \frac{2\text{ mol } H_2O}{} = 1.3393\text{ mol } H_2O$$

moles $H_2O$ formed:

$$\frac{35.0\text{ g } H_2S}{34.1\text{ g } H_2S} \left| \frac{1\text{ mol } H_2S}{2\text{ mol } H_2S} \right| \frac{2\text{ mol } H_2O}{} = 1.02639\text{ mol } H_2O$$

$H_2S$ is limiting.

YES, 45.0 L of $O_2$ will be enough