Stoichiometry Problems 3 Key

(1) $6Na + Fe_2O_3 \rightarrow 3Na_2O + 2Fe$ (100.0 g, 100.0 g, ___ g)

ER

$$\frac{100.0\text{ g Na}}{1}\left|\frac{1\text{ mol Na}}{22.99\text{ g Na}}\right|\frac{2\text{ mol Fe}}{6\text{ mol Na}}\left|\frac{55.85\text{ g Fe}}{1\text{ mol Fe}}\right| = 80.98\text{ g Fe}$$

LR

$$\frac{100.0\text{ g } Fe_2O_3}{1}\left|\frac{1\text{ mol } Fe_2O_3}{159.7\text{ g } Fe_2O_3}\right|\frac{2\text{ mol Fe}}{1\text{ mol } Fe_2O_3}\left|\frac{55.85\text{ g Fe}}{1\text{ mol Fe}}\right| = \boxed{69.94\text{ g Fe}}$$

theoretical yield

d) $$\frac{100.0\text{ g } Fe_2O_3}{1}\left|\frac{1\text{ mole } Fe_2O_3}{159.7\text{ g } Fe_2O_3}\right|\frac{6\text{ mol Na}}{1\text{ mol } Fe_2O_3}\left|\frac{22.99\text{ g Na}}{1\text{ mol Na}}\right| = 86.37\text{ g Na USED}$$

$$\frac{69.94\text{ g Fe}}{1}\left|\frac{1\text{ mol Fe}}{55.85\text{ g Fe}}\right|\frac{6\text{ mol Na}}{2\text{ mol Fe}}\left|\frac{22.99\text{ g Na}}{1\text{ mol Na}}\right| = 86.37\text{ g Na USED}$$

100.0 g − 86.37 g = 13.6 g Na EXCESS

available − used = left over

(2) $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ (LR option 1, ER option 2; 88.0 g, 64.0 g, ___ g)

LR

$$\frac{88.0\text{ g } CO_2}{1}\left|\frac{1\text{ mol } CO_2}{44.01\text{ g } CO_2}\right|\frac{1\text{ mol } C_6H_{12}O_6}{6\text{ mol } CO_2}\left|\frac{180.18\text{ g } C_6H_{12}O_6}{1\text{ mol } C_6H_{12}O_6}\right| = 60.0\text{ g } C_6H_{12}O_6$$

** Theoretical Yield

ER

$$\frac{64.0\text{ g } H_2O}{1}\left|\frac{1\text{ mol } H_2O}{18.02\text{ g } H_2O}\right|\frac{1\text{ mol } C_6H_{12}O_6}{6\text{ mol } H_2O}\left|\frac{180.18\text{ g } C_6H_{12}O_6}{1\text{ mol } C_6H_{12}O_6}\right| = 106.7\text{ g } C_6H_{12}O_6$$

107 g $C_6H_{12}O_6$

d) $$\frac{88.0\text{ g } CO_2}{1}\left|\frac{1\text{ mole } CO_2}{44.01\text{ g } CO_2}\right|\frac{6\text{ mol } H_2O}{6\text{ mol } CO_2}\left|\frac{18.02\text{ g } H_2O}{1\text{ mol } H_2O}\right| = 36.0\text{ g } H_2O \text{ USED}$$

64.0 g − 36.0 g = 28.0 g H_2O excess

available − used = excess

4) $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

60.0 g 80.0 g → ? g

LR → $\frac{60.0\text{ g } CaCO_3}{1} \left| \frac{1\text{ mol } CaCO_3}{100.09\text{ g } CaCO_3} \right| \frac{1\text{ mol } CaCl_2}{1\text{ mol } CaCO_3} \left| \frac{110.98\text{ g } CaCl_2}{1\text{ mol } CaCl_2} \right. = 66.5\text{ g } CaCl_2$ theoretical yield

ER → $\frac{80.0\text{ g HCl}}{1} \left| \frac{1\text{ mol HCl}}{36.46\text{ g HCl}} \right| \frac{1\text{ mol } CaCl_2}{2\text{ mol HCl}} \left| \frac{110.98\text{ g } CaCl_2}{1\text{ mol } CaCl_2} \right. = 121.8$

122 g $CaCl_2$

d) $\frac{60.0\text{ g } CaCO_3}{1} \left| \frac{1\text{ mol } CaCO_3}{100.09\text{ g } CaCO_3} \right| \frac{2\text{ mol HCl}}{1\text{ mol } CaCO_3} \left| \frac{36.46\text{ g HCl}}{1\text{ mol HCl}} \right. = 43.7\text{ g HCl USED}$

60.0 g − 43.7 g = 16.3 g EXCESS

available − used = excess

5) on last page

6) $N_2O_4 + 2N_2H_4 \rightarrow 3N_2 + 4H_2O$

8.00 g 4.00 g → ? g

ER → $\frac{8.00\text{ g } N_2O_4}{1} \left| \frac{1\text{ mol } N_2O_4}{92.02\text{ g } N_2O_4} \right| \frac{3\text{ mol } N_2}{1\text{ mol } N_2O_4} \left| \frac{28.02\text{ g } N_2}{1\text{ mol } N_2} \right. = 7.31\text{ g } N_2$

LR → $\frac{4.00\text{ g } N_2H_4}{1} \left| \frac{1\text{ mol } N_2H_4}{32.06\text{ g } N_2H_4} \right| \frac{3\text{ mol } N_2}{2\text{ mol } N_2H_4} \left| \frac{28.02\text{ g } N_2}{1\text{ mol } N_2} \right. = 5.24\text{ g } N_2$ theoretical yield

b iii) $\frac{4.00\text{ g } N_2H_4}{1} \left| \frac{1\text{ mol } N_2H_4}{32.06\text{ g } N_2H_4} \right| \frac{1\text{ mol } N_2O_4}{2\text{ mol } N_2H_4} \left| \frac{92.02\text{ g } N_2O_4}{1\text{ mol } N_2O_4} \right. = 5.74\text{ g } N_2O_4 \text{ used}$

8.00 g − 5.74 g = 2.26 g N_2O_4 EXCESS

5.) $K_2SO_3 + MgBr_2 \rightarrow 2\,KBr + MgSO_3$

275 g 500 g — g — g

LR

$$\frac{275\text{ g } K_2SO_3}{1} \left| \frac{1\text{ mol } K_2SO_3}{158.26\text{ g } K_2SO_3} \right| \frac{2\text{ mol KBr}}{1\text{ mol } K_2SO_3} \left| \frac{119.00\text{ g KBr}}{1\text{ mol KBr}} \right. = \boxed{414\text{ g KBr}}$$

theoretical yield

ER

$$\frac{500\text{ g } MgBr_2}{1} \left| \frac{1\text{ mol } MgBr_2}{184.10\text{ g } MgBr_2} \right| \frac{2\text{ mol KBr}}{1\text{ mol } MgBr_2} \left| \frac{119.00\text{ g KBr}}{1\text{ mol KBr}} \right. = 647\text{ g KBr}$$

d)

$$\frac{275\text{ g } K_2SO_3}{1} \left| \frac{1\text{ mol } K_2SO_3}{158.26\text{ g } K_2SO_3} \right| \frac{1\text{ mol } MgBr_2}{1\text{ mol } K_2SO_3} \left| \frac{184.10\text{ g } MgBr_2}{1\text{ mol } MgBr_2} \right. = 319.9$$

320 g $MgBr_2$ used

500 g − 320 g = $\boxed{180\text{ g } MgBr_2 \text{ excess}}$