Limiting Reactant Problem Set

1. $2Al(s) + 3CuCl_2(aq) \rightarrow 3Cu(s) + 2AlCl_3(aq)$

m: 0.25 g | 0.51 g

M: 26.982 g/mol | 134.452 g/mol

0.009265 mol | 0.003793 mol

÷ by coefficients: 2 | 3

0.00463 | 0.001264

↑ smaller # ∴ LR

∴ $CuCl_2$ is the limiting reactant.

2. $CaF_2(s) + H_2SO_4(aq) \rightarrow 2HF(g) + CaSO_4(s)$

m: 10.0 g | 15.5 g

M: 78.074 g/mol | 98.077 g/mol

0.12808 mol | 0.15804 mol

÷ by coefficients: 1 | 1

↑ smaller # ∴ LR

∴ CaF_2 is the limiting reactant.

3. $6ClO_2(g) + 3H_2O(l) \rightarrow 5HClO_3(aq) + HCl(aq)$

m: 71.00 g | 19.00 g | ?

M: 67.451 g/mol | 18.015 g/mol | 84.458 g/mol

1.0526 mol | 1.0547 mol

÷ by coefficients: 6 | 3

0.1754 | 0.3516

↑ smaller # ∴ LR.

$m_{HClO_3} = 1.0526\ mol\ ClO_2 \times \frac{5\ mol\ HClO_3}{6\ mol\ ClO_2} \times \frac{84.458\ g\ HClO_3}{mol\ HClO_3}$

$= 74.08\ g$

$\therefore$ the mass of $HClO_3$ produced is $74.08\ g$

OR

$m_{HClO_3} = 71.00\ g\ ClO_2 \times \frac{1\ mol\ ClO_2}{67.451\ g\ ClO_2} \times \frac{5\ mol\ HClO_3}{6\ mol\ ClO_2} \times \frac{84.458\ g\ HClO_3}{mol\ HClO_3}$

$= 74.08\ g \longrightarrow$ smaller amount $\therefore$ LR

$m_{HClO_3} = 19.00\ g\ H_2O \times \frac{1\ mol\ H_2O}{18.015\ g\ H_2O} \times \frac{5\ mol\ HClO_3}{3\ mol\ H_2O} \times \frac{84.458\ g\ HClO_3}{mol\ HClO_3}$

$= 148.5\ g$

4 a) $2MnI_2(s) + 13F_2(g) \rightarrow 2MnF_3(s) + 4IF_5(\ell)$

m	61.8 g	41.8 g	?
M	308.746 g/mol	37.996 g/mol	111.932 g/mol
	0.20016 mol	1.1001 mol	
	÷ 2	÷ 13	
	0.10008	0.08462 ← smaller # $\therefore$ LR	

b) $m_{MnF_3} = 1.1001\ mol\ F_2 \times \frac{2\ mol\ MnF_3}{13\ mol\ F_2} \times \frac{111.932\ g\ MnF_3}{mol\ MnF_3}$

$= 18.9\ g$

OR

$$m_{MnF_3} = 61.8\,g\ MnI_2 \times \frac{1\,mol\ MnI_2}{308.746\,g\ MnI_2} \times \frac{2\,mol\ MnF_3}{2\,mol\ MnI_2} \times \frac{111.932\,g\ MnF_3}{mol\ MnF_3}$$

$$= 22.4\,g$$

$$m_{MnF_3} = 41.8\,g\ F_2 \times \frac{1\,mol\ F_2}{37.996\,g\ F_2} \times \frac{2\,mol\ MnF_3}{13\,mol\ F_2} \times \frac{111.932\,g\ MnF_3}{mol\ MnF_3}$$

$$= 18.9\,g$$

↑ smaller # ∴ F_2 is the LR and the mass of MnF_3 produced is 18.9 g.

c) $$N_{MnF_3} = 1.1001\,mol\ F_2 \times \frac{2\,mol\ MnF_3}{13\,mol\ F_2} \times \frac{6.022\times10^{23}\ formula\ units}{mol}$$

$$= 1.02\times10^{23}\ formula\ units$$

∴ 1.02×10^{23} formula units are produced of MnF_3.

5.

	$BaCl_2(aq)$	+ $Na_2SO_4(aq)$	→ $BaSO_4(s)$	+ $2NaCl(aq)$
m	5.3 g	6.9 g	?	
M	208.233 g/mol	142.041 g/mol	233.388 g/mol	
	0.02545 mol / 1	0.04858 mol / 1		
	0.02545	0.04858		

↑ smaller # ∴ LR

$$m_{BaSO_4} = 0.02545\ mol\ BaCl_2 \times \frac{1\,mol\ BaSO_4}{1\,mol\ BaCl_2} \times \frac{233.388\,g\ BaSO_4}{1\,mol\ BaSO_4}$$

$$= 5.9\,g$$

∴ the mass of $BaSO_4$ produced is 5.9 g.