Set 19

1. a) $n(CO_2) = n(CaCO_3)$
$= 0.250$ mol
$V(CO_2) = 0.250 \times 22.4$
$= 5.60$ L

b) $n(O_2) = 5/2\ n(MnO_4^-)$
$= 2.5 \times 0.15$
$= 0.375$ mol
$V(O_2) = 0.375 \times 22.4$
$= 8.40$ L

c) $n(O_2) = ½\ n(H_2O_2)$
$= ½ \times 0.0300$
$= 0.0150$ mol
$V(O_2) = 0.0150 \times 22.4$
$= 0.336$ L

2. $n(Na) = \dfrac{4.60}{22.99}$
$= 0.200$ mol
$n(H_2) = ½\ n(Na)$
$= ½ \times 0.200$
$= 0.100$ mol
$V(H_2) = 0.100 \times 22.4$ L
$= 2.24$ L

3. $n((NH_4)_2SO_4) = \dfrac{22.82}{132.144}$
$= 0.173$ mol
$n(NH_3) = 2\ n((NH_4)_2SO_4)$
$= 2 \times 0.173$ mol
$= 0.345$ mol
$V(NH_3) = 0.345 \times 22.4$
$= 7.74$ L

4. $n(CO_2) = \dfrac{5.61}{22.4}$
$= 0.250$ mol
$n(CaCO_3) = n(CO_2)$
$= 0.250$ mol
$m(CaCO_3) = 0.250 \times 100.09$
$= 25.07$ g
$\%CaCO_3$: $\dfrac{25.07}{25.92} \times 100 = 96.7\%$

5. $n(H_2) = \frac{6.03}{22.4}$

$= 0.269$ mol

$n(Fe) = n(H_2)$

$= 0.269$ mol

$m(Fe) = 0.269 \times 55.85$

$= 15.03$ g

%Fe: $\frac{15.03}{15.30} \times 100 = 98.3\%$

6.

a) $n(HNO_3) = \frac{25x1000}{63.018}$

$= 3.97 \times 10^2$ mol

$n(N_2) = ½\ n(HNO_3)$

$= ½ \times (3.97 \times 10^2)$

$= 198.3$ mol

$m(N_2) = 198.3 \times 28.02$

$= 5.56 \times 10^3$ g

b) $V(N_2) = 1.98.3 \times 22.4$

$= 4.45 \times 10^3$ L

7. a) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Under identical conditions $n \propto v$

$n(CO_2) = ½\ n(H_2O$

$V(CO_2) = ½\ V(H_2O)$

$= ½ \times 2.50$

$= 1.25$ L

b) $n(CH_4) = ½\ n(H_2O)$

$V(CH_4) = ½\ V(H_2O)$

$= ½ \times 2.50$

$= 1.25$ L

(can also be calculated using number of moles)

8. $n(Na) = \frac{500x10^3}{22.99}$

$= 2.17 \times 10^4$ mol

$n(NH_3) = \frac{762x10^3}{22.4}$

$= 3.402x\ 10^4$ mol

1 mol of Na requires 1 mol of NH_3

2.17×10^4 mol of Na requires 2.17×10^4 mol NH_3

$N(NH_3\ req) < n(NH_3\ avail)$

$\therefore$ Na is LR

$N(NaCN) = n(Na)$

$= 2.17 \times 10^4$ mol

$M(NaCN) = (2.17 \times 10^4) \times 49.01$

$= 1.06 \times 10^6$ g (1.06 tonne)