Limiting Reagents - Answers

1a) $2NH_3 + 2\frac{1}{2}O_2 \rightarrow 2NO + 3H_2O$

$\frac{3.25}{17} = 0.19$ moles of NH_3

$\frac{3.50}{32} = 0.11$ moles of O_2

So 0.19 moles of NH_3 = 0.19 moles of NO.

0.11 moles of O_2 = $\frac{0.11}{2.5} \times 2 = 0.088$ moles of NO

⇓

limiting Reagent.

b) $0.088 \times 30 = \underline{\underline{2.64g}}$ of NO.

c) $0.19 - 0.088 = 0.102$ moles of NH_3 unused

$0.102 \times 17 = \underline{\underline{1.734g}}$

2a) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

$\frac{4.95g}{32} = 0.155$ moles of C_2H_4

$\frac{3.25}{32} = 0.102$ moles of O_2

So 0.155 moles of C_2H_4 $\times 2$ = 0.31 moles of CO_2

0.102 moles of O_2 = $\frac{0.102}{3} \times 2$ = 0.068 moles of CO_2

∴ O_2 is limiting reagent.

b) $0.068 \times 44 = \underline{2.992g \text{ of } CO_2 \text{ formed}}$

3. a) $C_6H_6 + Br_2 \longrightarrow C_6H_5Br + HBr$

$\frac{42.1g}{78} = 0.54$ moles of C_6H_6 $\frac{73.0g}{159.8} = 0.457$ moles of Br_2

0.46 moles of Br_2 is limiting reagent. $\therefore$ $0.46 \times 156.9 = 71.68g$ of C_6H_5Br

b) $\frac{63.6}{71.68} \times 100 = \underline{\underline{88.7\%}}$

4) $C_4H_9OH + NaBr + H_2SO_4 \longrightarrow C_4H_9Br + NaHSO_4 + H_2O$

$\frac{15.0g}{74} = 0.203$ moles of C_4H_9OH $\frac{22.4}{102.9} = 0.22$ moles of NaBr $\frac{32.7}{98.1} = 0.33$ moles of H_2SO_4

$\therefore$ 0.203 moles of C_4H_9OH is the limiting reagent. $0.203 \times 136.9 = 27.79g$ (theoretical yield)

$\frac{17.1g}{27.79g} \times 100 = \underline{\underline{61.5\%}}$

5) $3Si + 2N_2 \longrightarrow Si_3N_4$

$\frac{125}{95} \times 100 = 131.6g$ would be theoretical 100% yield. $\frac{131.6g}{140.3} = 0.94$ moles of Si_3N_4 $\times 3 = 2.82$ moles of Si.

$2.82 \times 28.1 = \underline{79.2g}$ of Si needed.

6a) $C_2H_5OH + O_2 \longrightarrow CH_3COOH + H_2O$

$\frac{0.0274g}{60} = 0.456 \times 10^{-3}$ moles of ethanoic acid   also = moles of O_2.

$0.456 \times 10^{-3} \times 32 = 0.0146g$ of O_2 in $1cm^3$ $\therefore \times 1000 = 14.6g$ in $1dm^3$.

b) $\frac{1000}{100} \times 8.5 = 85cm^3$ of ethanol   density × vol = mass

$0.816 \times 85 = 69.36g$ of ethanol in $1000cm^3$ $\frac{69.36}{46} = 1.51$ moles of ethanol

$\therefore$ 1.51 moles of ethanoic acid $\times 60 = 90.5g$ of ethanoic acid (theoretical)

$0.0274 \times 1000 = 27.4g$ in $1000cm^3$

$\therefore \frac{27.4g}{90.5g} \times 100 = 30.3\%$

7a) $P_4 + 3O_2 \longrightarrow P_4O_6$

$P_4O_6 + 2O_2 \longrightarrow P_4O_{10}$

$\frac{5.77g}{124} = 0.0465$ moles of P_4

$\frac{5.77g}{32} = 0.18$ moles of O_2.

if limiting:

0.0465 moles of P_4 = 0.0465 moles of P_4O_6 ← first limiting

∴ $0.0465 \times 3 = 0.1395$ moles of O_2 needed

so: $0.18 - 0.1395 = 0.0405$ moles left over

0.18 moles of O_2 = $\frac{0.18}{3} = 0.0601$ moles of P_4O_6

if limiting

0.0465 moles of P_4O_6 = 0.0465 of P_4O_{10}

0.0405 moles of O_2 = $\frac{0.0405}{2} = 0.02025$ moles of O_2 ← limiting factor is O_2

b) $0.02025 \times 284 = 5.75g$

c) $0.0465 - 0.02025 = 0.02625$ moles of P_4O_6 left over $\times 220 = 5.775g$