06/07/23

Balance the following chemical reaction: C_8H_{18} (l) + O_2(g) → CO_2(g) + H_2O (l)

$C_8H_{18(l)} + \frac{25}{2}O_{2(g)} \rightarrow 8CO_{2(g)} + 9H_2O_{(l)}$

If you have 1.75 kg of C_8H_{18}, how many kg of oxygen gas do you need to react with all of the C_8H_{18}? And how much CO_2 will form if that reaction occurs?

$1.75\ kg\ C_8H_{18} \times \frac{1000\ g}{1\ kg} \times \frac{1\ mole\ C_8H_{18}}{114.2\ g} \times \frac{12.5\ mol\ O_2}{1\ mol\ C_8H_{18}} \times \frac{32\ g\ O_2}{1\ mol\ O_2} \times \frac{1\ kg}{1000\ g}$

$15.3\ mol\ C_8H_{18}$

$= 6.13\ kg\ O_2$

$15.3\ mol\ C_8H_{18} \times \frac{8\ mol\ CO_2}{1\ mol\ C_8H_{18}} \times \frac{44\ g\ CO_2}{mol} = 5394\ g$ or $5.39\ kg\ CO_2$

If you react 1.25 kg of C_8H_{18} with 575 grams of O_2, how much water will be formed?

$1750\ g\ C_8H_{18} \times \frac{1\ mol}{114\ g} = 10.96\ mol$

$575\ g\ O_2 \times \frac{1\ mol}{32\ g} = 17.97\ mol$ ← limiting reactant

$17.97\ mol\ O_2 \times \frac{9\ mol\ H_2O}{12.5\ mol\ O_2} = 12.94\ mol\ H_2O \times \frac{18.02\ g}{mol} = 233\ g\ H_2O$

How much sodium nitrate do you need to make 750 mL of a 0.28 M sodium nitrate solution?

$0.75\,L \times \frac{0.28\,mol}{L} = 0.21\,mol\ NaNO_3$ needed

$0.21\,mol\ NaNO_3 \times \frac{85\,g}{1\,mol} = 17.9\,g\ NaNO_3$

If you combine 352 grams of $C_6H_{12}O_6$ with enough water to make 1.50 L of solution, what is the molarity of this solution?

$352\,g\ sugar \times \frac{1\,mol}{180.16\,g} = 1.95\,mol$

$\frac{1.95\,mol}{1.5\,L} \rightarrow 1.3\,M$ sugar

If you combine 79.5 grams of sodium oxalate with enough water to make 2.5 L of solution, what will be the concentration of the **sodium ion** in this solution?

$79.5\,g\ Na_2C_2O_4 \times \frac{1\,mol\ Na_2C_2O_4}{134\,g} \times \frac{2\,mol\ Na^+}{1\,mol\ Na_2C_2O_4} = 1.19\,mol\ Na^+$

$\frac{1.19\,mol}{2.5\,L} \rightarrow [Na^+] = 0.475\,M$

If you have 500 mL of a 0.45 M solution of magnesium nitrate, how do you make 250 mL of a 0.18 M magnesium nitrate solution?

$0.25\,L \times \frac{0.18\,mol}{L} = 0.045\,mol\ Mg(NO_3)_2$ needed

Take 100 mL 0.45 M solution and add water to get total volume → 250 mL

You combine 350 mL of 0.25 M aluminum nitrate with 425 mL of 0.15 M ammonium carbonate.

a) Write the balanced total and net ionic equations for what happens

$2Al^{3+}_{(aq)} + 6NO_3^-{}_{(aq)} + 6NH_4^+{}_{(aq)} + 3CO_3^{-2}{}_{(aq)} \rightarrow Al_2(CO_3)_3{}_{(s)} + 6NH_4^+{}_{(aq)} + 6NO_3^-{}_{(aq)}$

Net: $2Al^{3+}_{(aq)} + 3CO_3^{-2}{}_{(aq)} \rightarrow Al_2(CO_3)_3{}_{(s)}$

b) How many grams of precipitate form?

$0.35L \times \frac{0.25\ mol\ Al^{3+}}{L} = 0.0875\ mol\ Al^{3+}$

$0.425L \times \frac{0.15\ mol\ CO_3^{2-}}{L} = 0.06375\ mol\ CO_3^{2-}$

To react w/all Al^{3+} requires $0.0875\ mol\ Al^{3+} \times \frac{3\ mol\ CO_3^{2-}}{2\ mol\ Al^{3+}} = 0.13\ mol\ CO_3^{2-}$

Not enough CO_3^{2-} so CO_3^{2-} is limiting

$0.06375\ mol\ CO_3^{2-} \times \frac{1\ mol\ Al_2(CO_3)_3}{3\ mol\ CO_3^{2-}} \times \frac{234\ g\ Al_2(CO_3)_3}{1\ mole} = 4.97\ g\ Al_2(CO_3)_3$

c) What is the concentration of each ionic species in solution after the mixing occurs?

$[CO_3^{2-}] = 0 \qquad V_{total} = 0.775\ L$

$\text{moles } NO_3^- = 0.35L \times \frac{0.25\ mol\ Al(NO_3)_3}{L} \times \frac{3\ mol\ NO_3^-}{1\ mol\ Al(NO_3)_3} = 0.2625\ mol\ NO_3^-$

$[NO_3^-] = \frac{0.2625\ mol}{0.775L} = 0.339\ M$

$0.425\ L\ (NH_4)_2CO_3 \times \frac{0.15\ mol}{L} \times \frac{2\ mol\ NH_4^+}{1\ mol\ (NH_4)_2CO_3} = 0.1275\ mol\ NH_4^+$

$[NH_4^+] = \frac{0.1275\ mol}{0.775L} = 0.165\ M$

$0.06375\ mol\ CO_3^{2-} \times \frac{2\ mol\ Al^{3+}}{3\ mol\ CO_3^{2-}} = 0.0425\ mol\ Al^{3+}\ \text{in ppt}$

$0.0875\ mol\ Al^{3+} - 0.0425\ mol\ Al^{3+} = 0.045\ mol\ Al^{3+}\ \text{in soln}$

$[Al^{3+}] = \frac{0.045\ mol}{0.775L} = 0.058M$