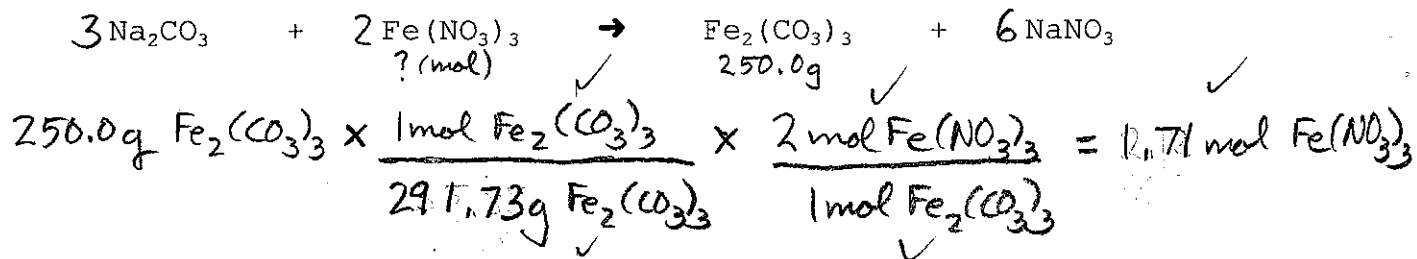


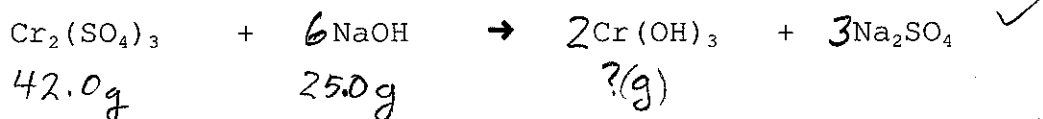


4. What amount of iron (III) nitrate is required to form 250.0 g of iron(III) carbonate



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5. What is the maximum possible mass of chromium(III) hydroxide that can form from 42.0 g of chromium(VI) sulphate and 25.0 g of sodium hydroxide



Consider  $\text{Cr}_2(\text{SO}_4)_3$

$$42.0\text{g Cr}_2(\text{SO}_4)_3 \times \frac{1\text{mol Cr}_2(\text{SO}_4)_3}{392.21\text{g Cr}_2(\text{SO}_4)_3} \times \frac{2\text{mol Cr}(\text{OH})_3}{1\text{mol Cr}_2(\text{SO}_4)_3} \times \frac{103.03\text{g Cr}(\text{OH})_3}{1\text{mol Cr}(\text{OH})_3} = 22.1\text{g Cr}(\text{OH})_3$$

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Consider  $\text{NaOH}$

$$25.0\text{g NaOH} \times \frac{1\text{mol NaOH}}{40.00\text{g NaOH}} \times \frac{2\text{mol Cr}(\text{OH})_3}{6\text{mol NaOH}} \times \frac{103.03\text{g Cr}(\text{OH})_3}{1\text{mol Cr}(\text{OH})_3} = 21.5\text{g Cr}(\text{OH})_3$$

$\therefore 21.5\text{g Cr}(\text{OH})_3$  is the maximum possible mass of  $\text{Cr}(\text{OH})_3$  /  $\text{NaOH}$  is the limiting reagent

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6. Determine the concentration of each of the following solutions:

a) 750 mL of a solution that contains 0.015 mol of HCl

$$n = 0.015 \text{ mol HCl}$$

$$C = \frac{n}{V} \quad \checkmark$$

$$\checkmark C = ? \text{ (M)}$$

$$C = \frac{0.015 \text{ mol HCl}}{0.750 \text{ L}} \quad \checkmark$$

$$V = 750 \text{ mL} \rightarrow 0.750 \text{ L} \quad \checkmark$$

$$C = 0.02 \text{ M HCl} \quad \checkmark$$

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b) 650 mL of a solution that contains 0.045 g of HCl

$$n = 0.045 \text{ g HCl} \times \frac{1 \text{ mol HCl}}{36.46 \text{ g HCl}} = 0.00123 \text{ mol HCl}$$

$$C = ? \text{ (M)}$$

$$V = 650 \text{ mL} \rightarrow 0.650 \text{ L} \quad \checkmark$$

$$C = \frac{n}{V} \quad \checkmark$$

$$C = 0.00190 \text{ M HCl} \quad \checkmark$$

$$C = \frac{0.00123 \text{ mol HCl}}{0.650 \text{ L}} \quad \checkmark$$

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c) 5.0 L of a solution of sulphuric acid made through the dilution of 55 mL of 12.0 M  $\text{H}_2\text{SO}_4$

$$C_s = 12.0 \text{ M}$$

$$C_D = \frac{C_s V_s}{V_D} \quad \checkmark$$

$$\checkmark V_s = 55 \text{ mL} \rightarrow 0.055 \text{ L} \quad \checkmark$$

$$\checkmark C_D = ?$$

$$C_D = \frac{12.0 \text{ M} \times 0.055 \text{ L}}{5.0 \text{ L}}$$

$$V_D = 5.0 \text{ L}$$

$$C_D = 0.132 \text{ M} \quad \checkmark$$

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7. Determine the mass of  $\text{Na}_2\text{CO}_3$  required to make 2.0 L of 0.25 M sodium carbonate solution.

$$n = ?$$

$$C = 0.25 \text{ M Na}_2\text{CO}_3$$

$$V = 2.0 \text{ L}$$

$$n = CV$$

$$n = \frac{0.25 \text{ mol Na}_2\text{CO}_3}{1 \text{ L}} \times 2.0 \text{ L}$$

$$n = 0.50 \text{ mol Na}_2\text{CO}_3$$

$$0.50 \text{ mol Na}_2\text{CO}_3 \times \frac{105.99 \text{ g Na}_2\text{CO}_3}{1 \text{ mol Na}_2\text{CO}_3} = 53.0 \text{ g Na}_2\text{CO}_3$$

8. Determine the concentration of solution that would result if 85.0 g of  $\text{NaHCO}_3$  is dissolved in 1.5 L of water. What will this concentration become if 8.0 L of water is added?

$$n = 85.0 \text{ g NaHCO}_3 \times \frac{1 \text{ mol NaHCO}_3}{84.01 \text{ g NaHCO}_3} = 1.01 \text{ mol NaHCO}_3$$

$$C = ?$$

$$V = 1.5 \text{ L}$$

$$C = \frac{n}{V} \rightarrow C = \frac{1.01 \text{ mol NaHCO}_3}{1.5 \text{ L}} \rightarrow C = 0.675 \text{ M NaHCO}_3$$

$$C_s = 0.675 \text{ M}$$

$$V_s = 1.5 \text{ L}$$

$$C_D = ?$$

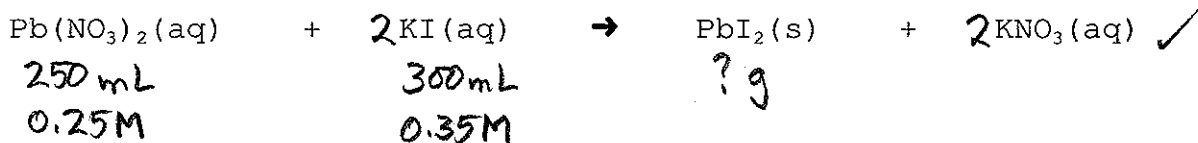
$$V_D = 1.5 \text{ L} + 8.0 \text{ L} = 9.5 \text{ L}$$

$$C_D = \frac{C_s V_s}{V_D}$$

$$C_D = \frac{0.675 \text{ M} \times 1.5 \text{ L}}{9.5 \text{ L}}$$

$$C_D = 0.107 \text{ M NaHCO}_3$$

9. What is the maximum possible mass of lead(II) iodide precipitate that could form from the reaction of 250 mL of 0.25 M lead(II) nitrate mixed with 300 mL of 0.35 M potassium iodide?



Consider  
 $\text{Pb(NO}_3)_2$

$$n = ?$$

$$n = CV \checkmark$$

$$C = 0.25 \text{ M} \checkmark$$

$$n = 0.25 \text{ mol/L} \times 0.250 \text{ L}$$

$$V = 250 \text{ mL} \rightarrow 0.250 \text{ L}$$

$$n = 0.0625 \text{ mol Pb(NO}_3)_2 \checkmark$$

$$0.0625 \text{ mol Pb(NO}_3)_2 \times \frac{1 \text{ mol PbI}_2}{1 \text{ mol Pb(NO}_3)_2} \times \frac{461.01 \text{ g PbI}_2}{1 \text{ mol PbI}_2} = 28.8 \text{ g PbI}_2 \checkmark$$

Consider  
KI

$$n = ?$$

$$n = CV$$

$$C = 0.35 \text{ M} \checkmark$$

$$n = 0.35 \text{ mol/L} \times 0.300 \text{ L}$$

$$V = 300 \text{ mL} \rightarrow 0.300 \text{ L}$$

$$n = 0.105 \text{ mol KI} \checkmark$$

$$0.105 \text{ mol KI} \times \frac{1 \text{ mol PbI}_2}{2 \text{ mol KI}} \times \frac{461.01 \text{ g PbI}_2}{1 \text{ mol PbI}_2} = 24.2 \text{ g PbI}_2$$

↑  
limiting reagent

↑  
maximum possible mass

BONUS: Determine the concentration of potassium ion in p.p.m. for 250 mL of solution that contains a mass of 0.0015 g of  $\text{K}_2\text{CO}_3$



$$\frac{0.0015 \text{ g K}_2\text{CO}_3}{250 \text{ mL}} \times \frac{1 \text{ mol K}_2\text{CO}_3}{138.21 \text{ g K}_2\text{CO}_3} \times \frac{2 \text{ mol K}^+}{1 \text{ mol K}_2\text{CO}_3} \times \frac{39.10 \text{ g K}^+}{1 \text{ mol K}^+}$$

$$\times \frac{1000 \text{ mg}}{1 \text{ g}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = \frac{3.395 \text{ mg}}{1 \text{ L}} \Rightarrow 3.395 \text{ p.p.m.}$$

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