

Name: _____

SCH 4C
Stoichiometry Unit Test

1. Balance the following equations



2. Perform each unit conversion. Be sure to use complete and extended units:

a) convert 72.9 g of NH_3 to number of molecules of NH_3

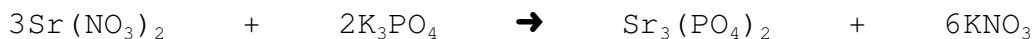
$$72.9 \text{ g NH}_3 \times \frac{1 \text{ mol NH}_3}{17.04 \text{ g NH}_3} \times \frac{6.022 \times 10^{23} \text{ molec NH}_3}{1 \text{ mol NH}_3} = 2.57 \times 10^{24} \text{ molec NH}_3$$

b) convert 8.79×10^{24} H atoms to the equivalent mass of CH_4

$$8.79 \times 10^{24} \text{ atoms H} \times \frac{1 \text{ molec CH}_4}{4 \text{ atoms H}} \times \frac{1 \text{ mol CH}_4}{6.022 \times 10^{23} \text{ molec CH}_4}$$

$$\times \frac{16.04 \text{ g CH}_4}{1 \text{ mol CH}_4} = 58.5 \text{ g CH}_4$$

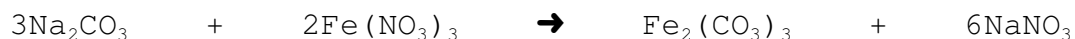
3. What mass of strontium nitrate is required to form 890.0 g of strontium phosphate?



$$890.0 \text{ g Sr}_3(\text{PO}_4)_2 \times \frac{1 \text{ mol Sr}_3(\text{PO}_4)_2}{452.80 \text{ g Sr}_3(\text{PO}_4)_2} \times \frac{3 \text{ mol Sr}(\text{NO}_3)_2}{1 \text{ mol Sr}_3(\text{PO}_4)_2}$$

$$\times \frac{211.64 \text{ g Sr}(\text{NO}_3)_2}{1 \text{ mol Sr}(\text{NO}_3)_2} = 1248 \text{ g Sr}(\text{NO}_3)_2$$

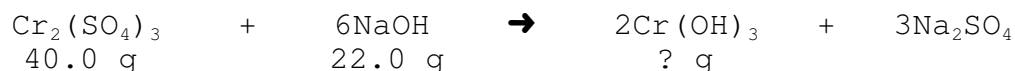
4. What amount of sodium carbonate is required to form 450.0 g of iron(III) carbonate



$$450.0 \text{ g Fe}_2(\text{CO}_3)_3 \times \frac{1 \text{ mol Fe}_2(\text{CO}_3)_3}{291.73 \text{ g Fe}_2(\text{CO}_3)_3} \times \frac{3 \text{ mol Na}_2\text{CO}_3}{1 \text{ mol Fe}_2(\text{CO}_3)_3}$$

$$= 4.63 \text{ mol Na}_2\text{CO}_3$$

5. What is the maximum possible mass of chromium(III) hydroxide that can form from 40.0 g of chromium(III) sulphate and 22.0 g of sodium hydroxide



$$40.0 \text{ g Cr}_2(\text{SO}_4)_3 \times \frac{1 \text{ mol Cr}_2(\text{SO}_4)_3}{392.21 \text{ g Cr}_2(\text{SO}_4)_3} \times \frac{2 \text{ mol Cr}(\text{OH})_3}{1 \text{ mol Cr}_2(\text{SO}_4)_3}$$

$$\times \frac{103.03 \text{ g Cr}(\text{OH})_3}{1 \text{ mol Cr}(\text{OH})_3} = 21.0 \text{ g Cr}(\text{OH})_3$$

$$22.0 \text{ g NaOH} \times \frac{1 \text{ mol NaOH}}{40.00 \text{ g NaOH}} \times \frac{2 \text{ mol Cr}(\text{OH})_3}{6 \text{ mol NaOH}}$$

$$\times \frac{103.03 \text{ g Cr}(\text{OH})_3}{1 \text{ mol Cr}(\text{OH})_3} = 18.9 \text{ g Cr}(\text{OH})_3$$

therefore the maximum possible mass of chromium(III) hydroxide that can form is 18.9 g Cr(OH)₃

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

a) 550 mL of a solution that contains 0.025 mol of HCl

$n = 0.025 \text{ mol HCl}$ $C = ?$ $V = 550 \text{ mL} \rightarrow 0.550 \text{ L}$	$C = \frac{n}{V}$ $C = \frac{0.025 \text{ mol}}{0.550 \text{ L}}$ $C = 0.0455 \text{ mol/L}$ $C = 0.0455 \text{ M}$
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b) 750 mL of a solution that contains 0.025 g of HCl

$n = 0.025 \text{ g HCl} \times \frac{1 \text{ mol HCl}}{36.46 \text{ g HCl}} = 0.000686 \text{ mol HCl}$ $C = ?$ $V = 750 \text{ mL} \rightarrow 0.750 \text{ L}$	$C = \frac{n}{V}$ $C = \frac{0.000686 \text{ mol}}{0.750 \text{ L}}$ $C = 0.000914 \text{ mol/L}$ $C = 0.000914 \text{ M}$
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c) 4.0 L of a solution of sulphuric acid made through the dilution of 25 mL of 12.0 M H₂SO₄

$C_S = 12.0 \text{ M}$ $V_S = 25 \text{ mL} \rightarrow 0.025 \text{ L}$ $C_D = ?$ $V_D = 4.0 \text{ L}$	$C_D = \frac{C_S \times V_S}{V_D}$ $C_D = \frac{12.0 \text{ M} \times 0.025 \text{ L}}{4.0 \text{ L}}$ $C_D = 0.075 \text{ M}$
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7. Determine the mass of Na_2CO_3 required to make 4.0 L of 0.1 M sodium carbonate solution.

$n = ?$ $C = 0.1 \text{ M}$ $V = 4.0 \text{ L}$	$n = CV$ $n = 0.1 \frac{\text{mol}}{\text{L}} \times 4.0 \text{ L}$ $n = 0.4 \text{ mol Na}_2\text{CO}_3$ $0.4 \text{ mol Na}_2\text{CO}_3 \times \frac{105.99 \text{ g Na}_2\text{CO}_3}{1 \text{ mol Na}_2\text{CO}_3} = 42.4 \text{ g Na}_2\text{CO}_3$
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8. Determine the concentration of solution that would result if 45.0 g of NaHCO_3 is dissolved in 1.0 L of water. What will this concentration become if 4.0 L of water is added?

$n = 45.0 \text{ g NaHCO}_3 \times \frac{1 \text{ mol NaHCO}_3}{84.01 \text{ g NaHCO}_3} = 0.536 \text{ mol NaHCO}_3$ $C = ?$ $V = 1.0 \text{ L}$	$C = \frac{n}{V}$ $C = \frac{0.536 \text{ mol}}{1.0 \text{ L}}$ $C = 0.536 \text{ mol/L}$ $C = 0.536 \text{ M}$
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Adding 4.0 L of water to 1.0 L increases the total volume to 5.0 L. There is no change in amount. Therefore

$n = 0.536 \text{ mol NaHCO}_3$ (see above) $C = ?$ $V = 5.0 \text{ L}$	$C = \frac{n}{V}$ $C = \frac{0.536 \text{ mol}}{5.0 \text{ L}}$ $C = 0.107 \text{ mol/L}$ $C = 0.107 \text{ M}$
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9. What is the maximum possible amount of lead(II) iodide precipitate that could form from the reaction of 500 mL of 0.25 M lead(II) nitrate mixed with 400 mL of 0.30 M potassium iodide?



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

$n = ?$ $C = 0.25 \text{ M}$ $V = 500 \text{ mL} \rightarrow 0.500 \text{ L}$	$n = CV$ $n = 0.25 \frac{\text{mol}}{\text{L}} \times 0.500 \text{ L}$ $n = 0.125 \text{ mol}$
$0.125 \text{ mol Pb}(\text{NO}_3)_2 \times \frac{1 \text{ mol PbI}_2}{1 \text{ mol Pb}(\text{NO}_3)_2} = 0.125 \text{ mol PbI}_2$	

consider KI

$n = ?$ $C = 0.30 \text{ M}$ $V = 400 \text{ mL} \rightarrow 0.400 \text{ L}$	$n = CV$ $n = 0.30 \frac{\text{mol}}{\text{L}} \times 0.400 \text{ L}$ $n = 0.12 \text{ mol}$
$0.12 \text{ mol KI} \times \frac{1 \text{ mol PbI}_2}{2 \text{ mol KI}} = 0.06 \text{ mol PbI}_2$	

therefore the maximum possible amount of lead(II) iodide is 0.06 mol PbI_2

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 K_2CO_3

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

$$\times \frac{1000 \text{ mg}}{1 \text{ g}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = \frac{3.395 \text{ mg K}^{1+}}{1 \text{ L}} \rightarrow 3.395 \text{ p.p.m. K}^{1+} \text{ ion}$$