/95 = %

Name: _____

SCH 4C
Stoichiometry Unit Test

1. Balance the following equations

a) $MgSO_4 + 2HCl \rightarrow MgCl_2 + H_2SO_4$

b) $2C_{10}H_{22} + 31O_2 \rightarrow 20CO_2 + 22H_2O$

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

a) convert 80.4 g of CO_2 to number of molecules of CO_2

$$80.4\,g\,CO_2 \times \frac{1\,mol\,CO_2}{44.01\,g\,CO_2} \times \frac{6.022\times10^{23}\,molec\,CO_2}{1\,mol\,CO_2} = 1.10\times10^{24}\,molec\,CO_2$$

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b) convert 3.65×10^{23} Cl atoms to the equivalent mass of $HSiCl_3$

$$3.65\times10^{23}\,Cl\,atoms \times \frac{1\,molec\,HSiCl_3}{3\,atoms\,Cl} \times \frac{1\,mol\,HSiCl_3}{6.022\times10^{23}\,molec\,HSiCl_3} \times \frac{135.45\,g\,HSiCl_3}{1\,mol\,HSiCl_3}$$

$$= 27.4\,g\,HSiCl_3$$

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3. What mass of potassium phosphate is required to form 54.0 g of strontium phosphate?

$3Sr(NO_3)_2 + 2K_3PO_4 \rightarrow Sr_3(PO_4)_2 + 6KNO_3$

$?\,g \qquad 54.0\,g$

$$54.0\,g\,Sr_3(PO_4)_2 \times \frac{1\,mol\,Sr_3(PO_4)_2}{452.80\,g\,Sr_3(PO_4)_2} \times \frac{2\,mol\,K_3PO_4}{1\,mol\,Sr_3(PO_4)_2} \times \frac{212.27\,g\,K_3PO_4}{1\,mol\,K_3PO_4}$$

$$= 50.7\,g\,K_3PO_4$$

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/22

4. What (amount) of iron (III) nitrate is require to from 250.0 g of iron(III) carbonate ✓

$3\,Na_2CO_3 + 2\,Fe(NO_3)_3 \rightarrow Fe_2(CO_3)_3 + 6\,NaNO_3$

? (mol) ✓ 250.0 g ✓

$$250.0\,g\ Fe_2(CO_3)_3 \times \frac{1\,mol\ Fe_2(CO_3)_3}{291.73\,g\ Fe_2(CO_3)_3} \times \frac{2\,mol\ Fe(NO_3)_3}{1\,mol\ Fe_2(CO_3)_3} = 1.71\,mol\ Fe(NO_3)_3$$ ✓ ✓ ✓

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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

$Cr_2(SO_4)_3 + 6\,NaOH \rightarrow 2\,Cr(OH)_3 + 3\,Na_2SO_4$ ✓

42.0 g 25.0 g ?(g)

Consider $Cr_2(SO_4)_3$

$$42.0\,g\ Cr_2(SO_4)_3 \times \frac{1\,mol\ Cr_2(SO_4)_3}{392.21\,g\ Cr_2(SO_4)_3} \times \frac{2\,mol\ Cr(OH)_3}{1\,mol\ Cr_2(SO_4)_3} \times \frac{103.03\,g\ Cr(OH)_3}{1\,mol\ Cr(OH)_3}$$ ✓ ✓ ✓

$$= 22.1\,g\ Cr(OH)_3$$ ✓

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Consider NaOH

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

$$= 21.5\,g\ Cr(OH)_3$$ ✓

∴ $21.5\,g\ Cr(OH)_3$ is the maximum possible mass of $Cr(OH)_3$ / 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

$n = 0.015 \text{ mol HCl}$ ✓

$C = ?\ (M)$ ✓

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

$C = \frac{n}{V}$ ✓

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

$C = 0.02 \text{ M HCl}$ ✓

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

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

$C = ?\ (M)$

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

$C = \frac{n}{V}$ ✓

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

$C = 0.00190 \text{ M HCl}$ ✓

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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 H_2SO_4

$C_S = 12.0 \text{ M}$

$V_S = 55 \text{ mL} \rightarrow 0.055 \text{ L}$ ✓

$C_D = ?$ ✓

$V_D = 5.0 \text{ L}$

$C_D = \frac{C_S V_S}{V_D}$ ✓

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

$C_D = 0.132 \text{ M}$ ✓

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/16

7. Determine the mass of Na_2CO_3 required to make 2.0 L of 0.25 M sodium ~~hydr~~carbonate solution.

$n = ?$

$C = 0.25\,M\ Na_2CO_3$

$V = 2.0\,L$ ✓

$n = CV$ ✓

$n = \frac{0.25\ mol\ Na_2CO_3}{1\,L} \times 2.0\,L$

$n = 0.50\ mol\ Na_2CO_3$ ✓

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$0.50\ mol\ Na_2CO_3 \times \frac{105.99\ g\ Na_2CO_3}{1\ mol\ Na_2CO_3} = 53.0\ g\ Na_2CO_3$ ✓ ✓

8. Determine the concentration of solution that would result if 85.0 g of $NaHCO_3$ is dissolved in 1.5 L of water. What will this concentration become if 8.0 L of water is added?

$n = 85.0\ g\ NaHCO_3 \times \frac{1\ mol\ NaHCO_3}{84.01\ g\ NaHCO_3} = 1.01\ mol\ NaHCO_3$

$C = ?$

$V = 1.5\,L$ ✓

$C = \frac{n}{V} \rightarrow C = \frac{1.01\ mol\ NaHCO_3}{1.5\,L} \rightarrow C = 0.675\,M\ NaHCO_3$ ✓

$C_S = 0.675\,M$ ✓

$V_S = 1.5\,L$ ✓

$C_D = ?$

$V_D = 1.5\,L + 8.0\,L = 9.5\,L$

$C_D = \frac{C_S V_S}{V_D}$ ✓

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

$C_D = 0.107\,M\ NaHCO_3$ ✓

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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?

$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$ ✓

250 mL, 0.25M | 300mL, 0.35M | ? g

Consider $Pb(NO_3)_2$

$n = ?$ $\quad c = 0.25M$ ✓ $\quad V = 250mL \rightarrow 0.250L$

$n = CV$ ✓

$n = 0.25 mol/L \times 0.250L$

$n = 0.0625 mol\ Pb(NO_3)_3$ ✓

$$0.0625 mol\ Pb(NO_3)_3 \times \frac{1 mol\ PbI_2}{1 mol\ Pb(NO_3)_2} \times \frac{461.01 g\ PbI_2}{1 mol\ PbI_2} = 28.8 g\ PbI_2$$ ✓

Consider KI

$n = ?$ $\quad c = 0.35M$ ✓ $\quad V = 300mL \rightarrow 0.300L$

$n = CV$

$n = 0.35 mol/L \times 0.300L$

$n = 0.105 mol\ KI$ ✓

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$$0.105 mol\ KI \times \frac{1 mol\ PbI_2}{2 mol\ KI} \times \frac{461.01 g\ PbI_2}{1 mol\ PbI_2} = 24.2 g\ PbI_2$$ ✓

↑ 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 K_2CO_3

$K_2CO_3 \rightarrow 2K^{1+} + CO_3^{2-}$

$$\frac{0.0015 g\ K_2CO_3}{250 mL} \times \frac{1 mol\ K_2CO_3}{138.21 g\ K_2CO_3} \times \frac{2 mol\ K^{1+}}{1 mol\ K_2CO_3} \times \frac{39.10 g\ K^{1+}}{1 mol\ K^{1+}}$$

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

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