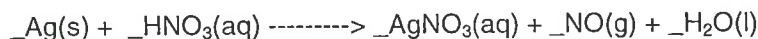
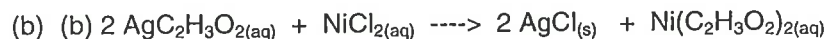
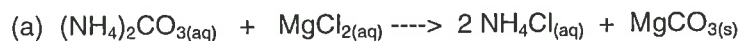


### SCH3U Solution Review Questions

1. Calculate the number of mL of 2.00 M HNO<sub>3</sub> solution required to react with 216 grams of Ag according to the equation.



2. Barium nitrate and potassium sulphate solutions react and form a precipitate. What is the precipitate? How many mL of 0.40 M Ba(NO<sub>3</sub>)<sub>2</sub> solution are required to precipitate completely the sulphate ions in 25 mL of 0.80 M K<sub>2</sub>SO<sub>4</sub> solution?
3. By the additions of water, 75.0 mL of 6.0 M H<sub>2</sub>SO<sub>4</sub> is diluted to 150.0 mL. What is the concentration of H<sub>2</sub>SO<sub>4</sub> after dilution?
4. What volume of 6.00 mol/L nitric acid, HNO<sub>3</sub>(aq), solution is needed to make 4.2 L of 0.15 mol/L HNO<sub>3</sub> solution?
5. Write ionic and net ionic equations for these reactions.



6. Trisodium phosphate (TSP), Na<sub>3</sub>PO<sub>4</sub>, is a useful cleaning agent, but it must be handled with care because its solutions are quite caustic. If a solution of Na<sub>3</sub>PO<sub>4</sub> is added to one containing a calcium salt such as CaCl<sub>2</sub>, a precipitate of calcium phosphate is formed. Write the balanced equation, then the total ionic and net ionic equations for this reaction.
7. How can we prepare 250 mL of 0.200 M NaHCO<sub>3</sub>?
8. How can 500 mL of 0.150 M Na<sub>2</sub>CO<sub>3</sub> solution be prepared?
9. What volume of 0.556 M HCl has enough hydrochloric acid to combine exactly with 24.5 mL of aqueous sodium hydroxide with a concentration of 0.458 M?

10. How many millilitres of 0.114 M H<sub>2</sub>SO<sub>4</sub> solution provide the sulphuric acid required to react with the sodium hydroxide. 32.2 mL of 0.122 M NaOH?

11. What volume of 0.337 M KOH provides enough solute to combine with the sulphuric acid in 18.6 mL of 0.156 M H<sub>2</sub>SO<sub>4</sub>?

12. How can we prepare 10.0 L of 0.040 M K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> from 0.200 M K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>?  $C_1V_1 = C_2V_2$

13. How many millilitres of water would have to be added to 100 mL of 0.40 M HCl to give a solution with a concentration of 0.10 M?  $C_1V_1 = C_2V_2$

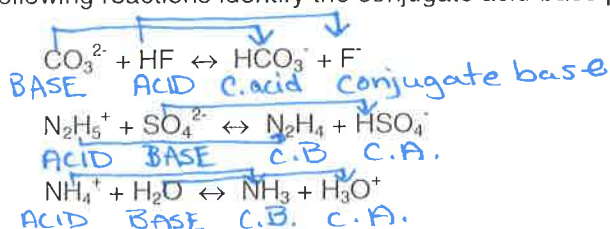
14. In a titration involving phosphoric acid, H<sub>3</sub>PO<sub>4</sub>, solution having a molarity of 0.345 M and a volume of 20.00 mL is titrated against a sample of Ca(OH)<sub>2</sub>. If the reaction requires 22.25 mL of base to reach the final endpoint, what is the molarity of the calcium hydroxide?

15. What is the pH of a 0.0010 M HCl solution?  $pH = -\log(0.001) = 3$

16. What hydrogen ion concentration corresponds to a pH of 8.64?  $10^{-pH} = 10^{-8.64} = 2.29 \times 10^{-9}$

17. Explain the meaning of the terms "strong" and "weak" when applied to acids and bases.   
 → ionizes a little (< 50%)

18. For the following reactions identify the conjugate acid-base pairs.   
 → ionizes a lot (> 99%)



c.A = conjugate acid  
 c.B = conjugate base

19. Give directions for preparing 2.0 L of 0.250 mol/L HCl using 11.7 M HCl.

$$C_1V_1 = C_2V_2$$

$$11.7(V_1) = 0.25(2)$$

$$V_1 = 0.0427 \text{ L} = 42.7 \text{ mL}$$

Measure 42.7 mL of 11.7 mol/L HCl and add water to make 2 L.

# Solution Review Questions Answers

3.

$$C_1 V_1 = C_2 V_2$$

$$6(75) = C_2(150)$$

$$C_2 = 3 \text{ mol/L}$$

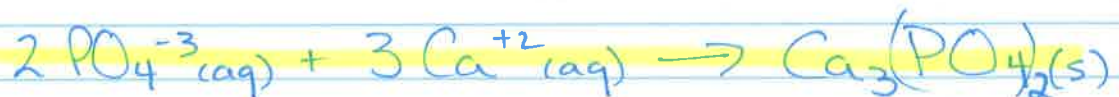
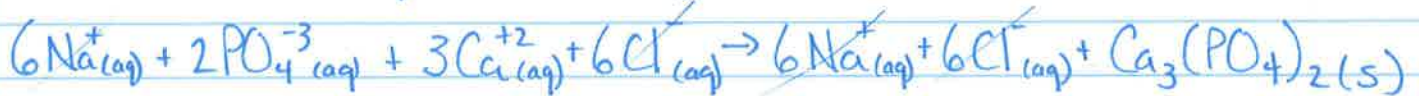
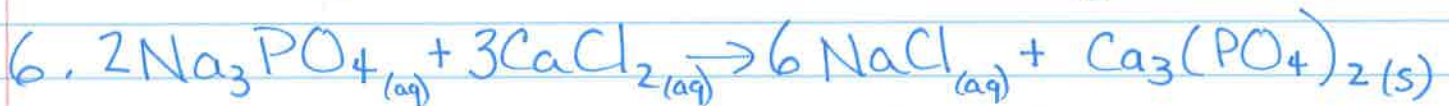
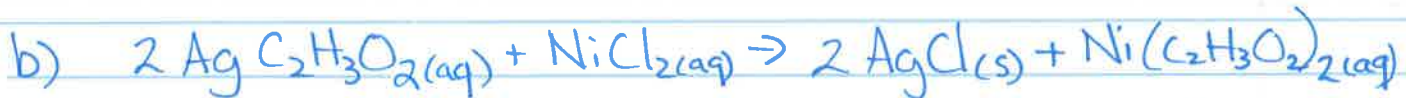
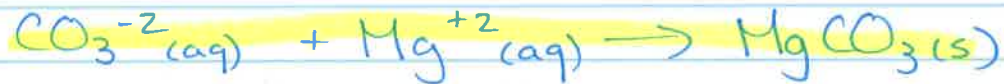
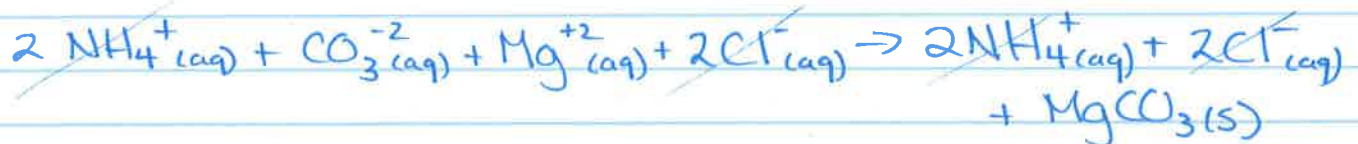
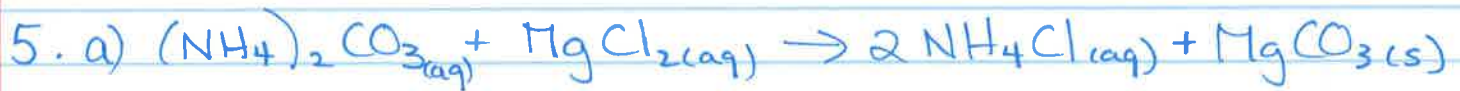
4.

$$C_1 V_1 = C_2 V_2$$

$$6(V_1) = 0.15(4.2)$$

$$V_1 = 0.105 \text{ L}$$

$$= 105 \text{ mL}$$



7.

$$n = C \times V$$

$$= 0.2 \times 0.250$$

$$= 0.05 \text{ mol}$$

$$m = n \times M$$

$$= 0.05 \times 84.008$$

$$= 4.2 \text{ g}$$

Na	22.99
H	1.008
C	12.01
O <sub>3</sub>	48.00
	<hr/>
	84.008

$$8. \quad n = C \times V$$

$$= 0.15 \times 0.5$$

$$= 0.075 \text{ mol}$$

$$m = n \times M$$

$$= 0.075 \times 105.99$$

$$= 7.95 \text{ g}$$

$$\text{Na}_2 = 45.98$$

$$C = 12.01$$

$$\text{O}_3 = \frac{48.00}{105.99}$$



$$V = ? \quad V = 0.0245 \text{ L}$$

$$C = 0.556 \quad C = 0.458 \text{ mol/L}$$

$$n = 0.011221 \quad n = C \times V$$

$$V = \frac{n}{C} = \frac{0.011221}{0.458} = 0.0245 \text{ L}$$

$$\uparrow \div 1 \times 1$$



$$V = ? \quad V = 32.2 \text{ mL}$$

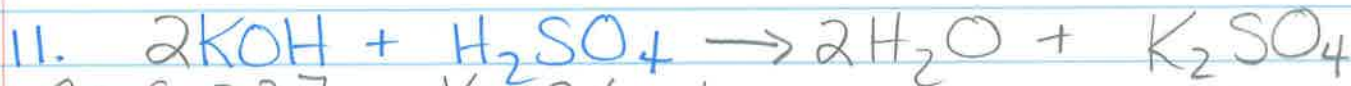
$$C = 0.114 \quad = 0.0322 \text{ L}$$

$$V = \frac{n}{C} = \frac{0.01723}{0.114} = 0.151 \text{ L}$$

$$n = 1.9642 \times 10^{-3} \quad n = C \times V$$

$$= 3.9284 \times 10^{-3}$$

$$\uparrow \div 2 \times 1$$



$$C = 0.337 \quad V = 18.6 \text{ mL}$$

$$V = ? \quad = 0.0186 \text{ L}$$

$$n = 5.8 \times 10^{-3} \quad C = 0.156$$

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

$$= \frac{5.8 \times 10^{-3}}{0.337}$$

$$= 0.0172 \text{ L}$$

$$n = C \times V$$

$$= 0.0186 \times 0.156$$

$$= 2.9 \times 10^{-3}$$

$$\uparrow \div 1 \times 2$$



$$12. \quad C_1 V_1 = C_2 V_2$$

$$(0.2)(V_1) = 0.04(10)$$

$$V_1 = 2 \text{ L}$$

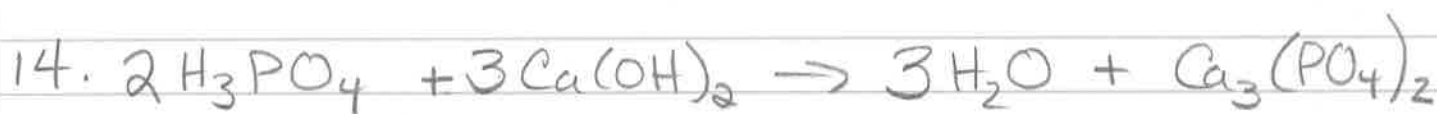
Take 2 L of 0.2  $K_2Cr_2O_7$  and add distilled  $H_2O$  until 10 L is attained.

$$13. \quad C_1 V_1 = C_2 V_2$$

$$0.4(100 \text{ mL}) = 0.1(V_2)$$

$$V_2 = 4000 \text{ mL}$$

4000 - 100 = 3900 mL to add



$$V = 20 \text{ mL}$$

$$= 0.02 \text{ L}$$

$$C = 0.345$$

$$n = C \times V$$

$$= 0.02 \times 0.345$$

$$= 6.9 \times 10^{-3} \text{ mol}$$

$$V = 22.25 \text{ mL}$$

$$= 0.02225 \text{ L}$$

$$C = \frac{n}{V} = \frac{0.01035}{0.02225}$$

$$= 0.465 \text{ mol/L}$$

$$n = 0.01035 \text{ mol}$$

$$\boxed{\div 2 \times 3}$$

15.

# also Solution Review Question Answers \*1 + 2.

## Molarity and Dilutions Worksheet - EXTRA PRACTICE

1. Calculate the final concentration of a solution that is made by dissolving 14.8 g of solid sodium hydroxide in 600.0 mL of solution.

$C = n/V$ , we need to find  $n$  to do this calculation.

$$n = m/MM \rightarrow n = 14.8 / 40.0 = 0.370 \text{ mol}$$

$$C = 0.370 \text{ mol} / 0.600 \text{ L} = 0.617 \text{ M}$$

2. If I add water to 100 mL of a 0.15 M NaOH solution until the final volume is 150 mL, what will the molarity of the diluted solution be?

$$C_1 V_1 = C_2 V_2$$

$$M_1 V_1 = M_2 V_2$$

$$(0.15 \text{ M})(100 \text{ mL}) = x (150 \text{ mL})$$

$$x = 0.100 \text{ M}$$

3. If I add 25 mL of water to 125 mL of a 0.15 M NaOH solution, what will the molarity of the diluted solution be?

$$C_1 V_1 = C_2 V_2$$

$$M_1 V_1 = M_2 V_2$$

$$(0.15 \text{ M})(125 \text{ mL}) = x (150 \text{ mL})$$

$$x = 0.125 \text{ M}$$

4. I have 345 mL of a 1.5 M NaCl solution. If I boil the water until the volume of the solution is 250 mL, what will the molarity of the solution be?

$$C_1 V_1 = C_2 V_2$$

$$M_1 V_1 = M_2 V_2$$

$$(1.5 \text{ M})(345 \text{ mL}) = x (250 \text{ mL})$$

$$x = 2.07 \text{ M}$$

5. How much water would I need to add to 500 mL of a 2.4 M KCl solution to make a 1.0 M solution?

$$C_1 V_1 = C_2 V_2$$

$$M_1 V_1 = M_2 V_2$$

$$(2.4 \text{ M})(500 \text{ mL}) = (1.0 \text{ M}) x$$

$$x = 1200 \text{ mL}$$

1200 mL will be the final volume of the solution. However, since there's already 500 mL of solution present, you only need to add 700 mL of water to get 1200 mL as your final volume. The answer: 700 mL.

- \*1. 6. Calculate the number of mL of 2.00 M HNO<sub>3</sub> solution required to react with 216 grams of Ag according to the equation:



$$1.34 \times 10^3 \text{ mL HNO}_3$$

7. Calculate in mL the volume of 0.500 M NaOH required to react with 3.0 grams of acetic acid. The equation is: NaOH(aq) + HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>(aq) → NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>(aq) + H<sub>2</sub>O(l)

$$0.0999 \text{ L or } 100 \text{ mL NaOH}$$

8. Calculate the number of grams of AgCl formed when 0.200 L of 0.200 M AgNO<sub>3</sub> reacts with an excess of CaCl<sub>2</sub>. The equation is:



$$5.73 \text{ g AgCl}$$

9. Calculate the mass of AgCl formed when an excess of 0.100 M solution of NaCl is added to 0.100 L of 0.200 M AgNO<sub>3</sub>.

$$2.87 \text{ g AgCl}$$

10. Calculate: a) the mass of  $\text{BaSO}_4$  formed when excess 0.200 M  $\text{Na}_2\text{SO}_4$  solution is added to 0.500 L of 0.500 M  $\text{BaCl}_2$  solution, and

**58.3 g  $\text{BaSO}_4$**

b) the minimum volume of the  $\text{Na}_2\text{SO}_4$  solution needed to precipitate the  $\text{Ba}^{2+}$  ions from the  $\text{BaCl}_2$  solution.

**1.25 L  $\text{Na}_2\text{SO}_4$**

11. A sample of impure sodium chloride weighing 1.00 grams is dissolved in water and completely reacted with silver nitrate solution. The dried precipitate of  $\text{AgCl}$  has a mass of 1.48 grams. Calculate the percentage of  $\text{NaCl}$  in the original impure sample.

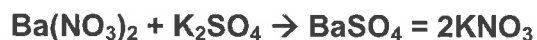
**$(0.603 \text{ g pure NaCl} / 1.00 \text{ g impure NaCl}) \times 100\% = 60\%$**

12. To neutralize the acid in 10.0 mL of 18.0 M  $\text{H}_2\text{SO}_4$  that was accidentally spilled on a laboratory bench top, solid sodium bicarbonate was used. The container of sodium bicarbonate was known to weigh 155.0 g before this use and out of curiosity its mass was measured as 144.5 g afterwards. The reaction that neutralizes sulphuric acid this way is as follows:  $\text{H}_2\text{SO}_4 + 2 \text{NaHCO}_3 \rightarrow \text{Na}_2\text{SO}_4 + 2 \text{CO}_2 + 2 \text{H}_2\text{O}$

Was sufficient sodium bicarbonate used? Calculate the limiting reactant and the maximum yield in grams of sodium sulphate.

**Sufficient  $\text{NaHCO}_3$  was used because all the  $\text{H}_2\text{SO}_4$  was used up in this reaction.  $\text{H}_2\text{SO}_4$  is the limiting reagent (L.R.) and 0.18 mol was used up. The maximum yield of  $\text{Na}_2\text{SO}_4$  is 25.6 g.**

\*2. 13. Barium nitrate and potassium sulphate solutions react and form a precipitate. What is the precipitate? How many mL of 0.40 M  $\text{Ba}(\text{NO}_3)_2$  solution are required to precipitate completely the sulphate ions in 25 mL of 0.80 M  $\text{K}_2\text{SO}_4$  solution?



**50 ml  $\text{Ba}(\text{NO}_3)_2$**

14. What mass of silver chloride can be precipitated from a silver nitrate solution by 200 mL of a solution of 0.50 M  $\text{CaCl}_2$ ?

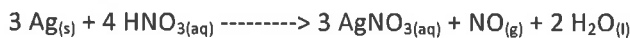


**28.7 g  $\text{AgCl}$**

## Stoichiometry Involving Solutions Worksheet

\*1.

1. Calculate the number of mL of 2.00 M HNO<sub>3</sub> solution required to react with 216 grams of Ag according to the equation. [ 1.33L]



Mass of Ag = 216g      C = 2.00M   V = ?

Molar Mass = 107.18g/mol

$n = m / \text{MM}$

$n = 2.002 \text{ mols}$

Mass of HNO<sub>3</sub> = 2.002 mols of Ag  $\times \frac{4 \text{ mol HNO}_3}{3 \text{ mol Ag}} = 2.66 \text{ mols}$

$V = n / c$     $V = 2.66 \text{ mol} / 2.00 \text{ M}$

$V = 1.33 \times 1000$     $V = 1330 \text{ mL}$

2. Calculate in mL the volume of 0.500 M NaOH required to react with 3.0 grams of acetic acid. [ 0.10L]

The equation is:



Mass of HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> = 3.0g      C = 0.500M

Molar Mass = 48.00 g/mol      V = ?

$n = m / \text{MM}$

$n = 0.049 \text{ mols}$

moles of NaOH = 0.049 mols of HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>  $\times 1 \text{ mol NaOH} / 1 \text{ mol HC}_2\text{H}_3\text{O}_2 = 0.049 \text{ mols}$

$V = n / c$

$V = 0.049 \text{ mol} / 0.500 \text{ M} = 0.10 \text{ L}$

3. Calculate the number of grams of AgCl formed when 0.200 L of 0.200 M AgNO<sub>3</sub> reacts with an excess of CaCl<sub>2</sub>. The equation is: [5.73g]



$V = 0.200 \text{ L}$

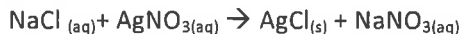
$C = 0.200 \text{ M}$

$n = 0.200 \text{ L} \times 0.200 \text{ M} = 0.04 \text{ mols}$

Mass of AgCl = 0.04 mols of AgNO<sub>3</sub>  $\times 2 \text{ mol AgCl} / 2 \text{ mol AgNO}_3 = 0.04 \text{ mol}$

$m = \text{MM} \times n = 0.04 \text{ mol} \times (107.87 + 35.45) \text{ g/mol} = 5.73 \text{ g}$

4. Calculate the mass of AgCl formed when an excess of 0.100 M solution of NaCl is added to 0.100 L of 0.200 M AgNO<sub>3</sub>. [ 2.87g]



$V = 0.100 \text{ L}$

$C = 0.200 \text{ M}$

$n = C \times V$

$n = 0.200 \text{ M} \times 0.100 \text{ L} = 0.02 \text{ mols}$

moles of AgCl = 0.02 mols of AgNO<sub>3</sub>  $\times 1 \text{ mol AgCl} / 1 \text{ mol AgNO}_3 = 0.02 \text{ mols} \times 143.32 \text{ g/mol AgCl} = 2.87 \text{ g}$

mass of AgCl = 0.02 mols  $\times 143.32 \text{ g/mol AgCl} = 2.87 \text{ g}$

