

Chemistry 20 - Unit C - Review Booklet

Name: _____

1. Identify the solvent and the solute in the following solutions

a. 18 mL of water in 38 mL of methanol

solute

Solvent

b. 0.283 g of sugar in 100 mL of water

solute

Solvent

} the substance with more moles.

2. Write dissociation equations for each of the following solid ionic compounds

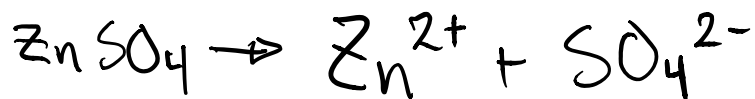
a. Sodium sulfate



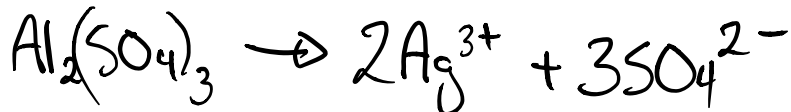
b. Calcium chloride



c. Zinc sulfate



d. Aluminium sulfate



e. Magnesium iodide

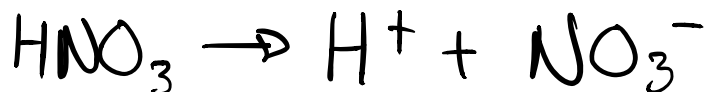


3. Write ionization equations for each of the following compounds (acids....)

a. $\text{HI}_{(g)}$

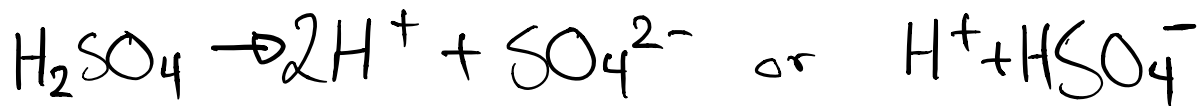
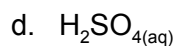


b. $\text{HNO}_{3(aq)}$



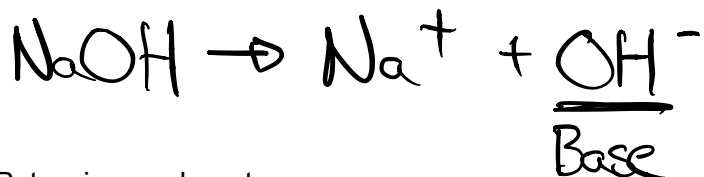
c. $\text{HClO}_{3(aq)}$



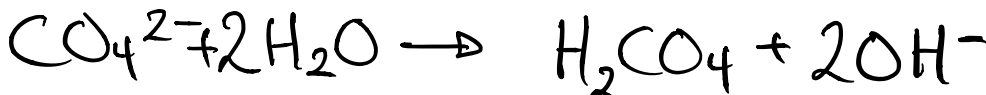
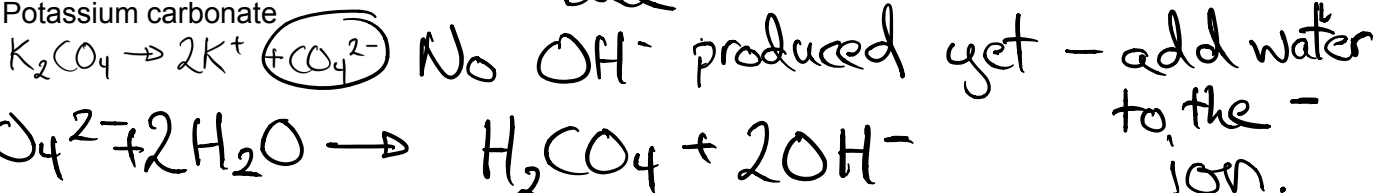


4. Write dissociation equations for the following ionic solids dissolving in water (bases....)

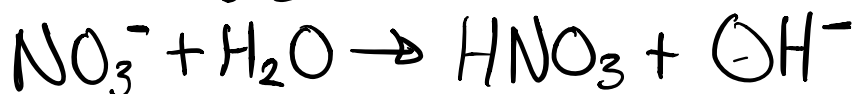
a. Sodium hydroxide



b. Potassium carbonate



c. Aluminium nitrate



5. Predict whether the following solutes will be electrolytes or nonelectrolytes

a. Potassium chloride

Electrolyte ... ionic

b. Hydrogen chloride

Electrolyte ... acid

c. Carbon dioxide

Non electrolyte ... non polar

d. Sulfur dioxide

Non electrolyte ... not acid or ionic.

6. Calculate the concentration of the following solutions

a. 29.8 g of NaCl in 250 mL of solution.

$$\frac{\text{mol}}{\text{L}} \text{NaCl} = 29.8\text{g} \times \frac{1\text{mol}}{58.44\text{g}} \times \frac{1}{0.250\text{L}} = \boxed{2.02\text{M}}$$

b. 49.29 g of $C_{12}H_{22}O_{11}$ in 3.3 L of solution

$$\frac{\text{mol}}{\text{L}} C_{12}H_{22}O_{11} = 49.29 \text{g} \times \frac{1 \text{mol}}{342.34 \text{g}} \times \frac{1}{3.3 \text{L}} = \boxed{0.044 \text{M}}$$

7. Calculate the number of moles of solute needed to make the following solutions

a. 45.0 mL of 1.15 M KCl

$$n_{\text{KCl}} = 0.045 \text{L} \times \frac{1.15 \text{mol}}{1 \text{L}} = \boxed{0.0518 \text{mol}}$$

b. 250.0 mL of 0.350 M $CH_3COOH_{(aq)}$

$$n_{\text{CH}_3\text{COOH}} = 0.250 \text{L} \times \frac{0.350 \text{mol}}{1 \text{L}} = \boxed{0.0875 \text{mol}}$$

8. Calculate the mass of solute needed to make the following solutions

a. 30.0 mL of 0.485 M $Na_2CO_{3(aq)}$

$$m_{\text{Na}_2\text{CO}_3} = 0.0300 \text{L} \times \frac{0.485 \text{mol}}{1 \text{L}} \times \frac{105.99 \text{g}}{1 \text{mol}} = \boxed{1.54 \text{g}}$$

b. 125 mL of 0.573 M $Na_2S_{(aq)}$

$$m_{\text{Na}_2\text{S}} = \frac{0.573 \text{mol}}{1 \text{L}} \times 0.125 \text{L} \times \frac{78.05 \text{g}}{1 \text{mol}} = \boxed{5.59 \text{g}}$$

9. Determine the concentration of the solution when

a. 50.0 mL of 1.95 M HCl is diluted to 115.0 mL

$$C_1 V_1 = C_2 V_2$$

$$(1.95 \text{M})(50.0 \text{mL}) = C_2 (115.0 \text{mL})$$

$$C_2 = \boxed{0.848 \text{M}}$$

b. 250.0 mL of 1.48 M $HNO_{3(aq)}$ is diluted to 750.0 mL

$$C_1 V_1 = C_2 V_2$$

$$(1.48 \text{M})(250.0 \text{mL}) = C_2 (750.0 \text{mL})$$

$$C_2 = \boxed{0.493 \text{M}}$$

c. 50.0 mL of 7.90 M KOH is distilled to on 1.0 mL

$$(7.90 \text{M})(50.0 \text{mL}) = C_2 (1.0 \text{mL})$$

$$\boxed{4.0 \times 10^4 \text{M}}$$

10. Calculate the volume of the original solution needed to make the NEW solution

a. 2.50 M NaOH is used to make 490 mL of 1.23 M solution

$$C_1V_1 = C_2V_2$$

$$(2.50M)(V_1) = (1.23M)(490\text{mL})$$

$$V_1 = 241\text{mL}$$

b. 10.0 M AgNO₃ is used to make 990 mL of 2.38 M solution.

$$(10.0M)(V_1) = (2.38M)(990\text{mL})$$

$$V_1 = 236\text{mL}$$

* 11. If 29.7 g of sodium chloride dissolves to make 200.0 mL of a saturated solution at 0C, what is the solubility of sodium chloride at 0C?

$$\frac{\text{mol}}{\text{L}} \text{NaCl} = 29.7\text{g} \times \frac{1\text{mol}}{58.44\text{g}} \times \frac{1}{0.2000\text{L}} = 2.54\text{M}$$

12. Use your solubility table to predict the solubility of the following solids

a. NaNO₃

(aq)

b. AgI

(s)

c. CuBr₂

(aq)

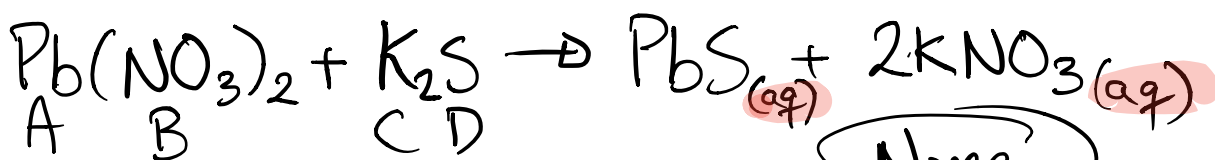
d. BaCl₂

(aq)

Double Replacement
AB + CD → AD + CB

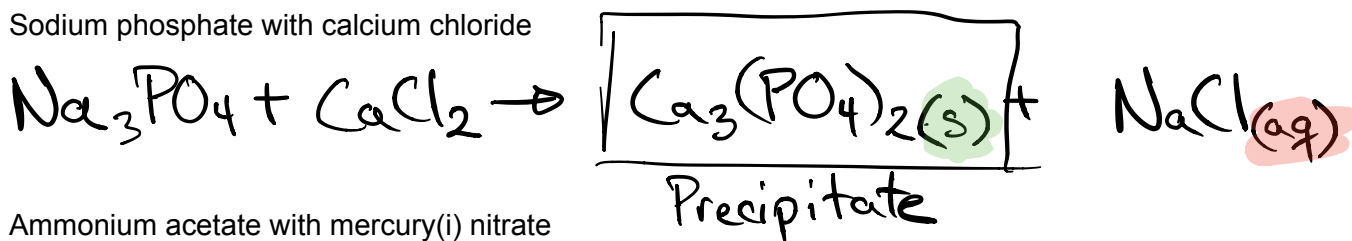
13. Predict what the precipitate will be, if any, when aqueous solutions of the following compounds are mixed.

a. lead(ii) nitrate with potassium sulfide

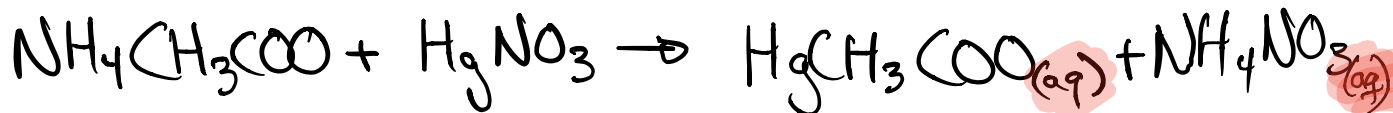


None

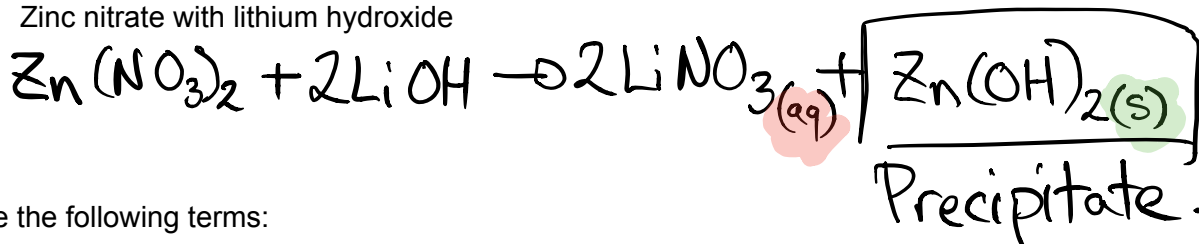
b. Sodium phosphate with calcium chloride



c. Ammonium acetate with mercury(i) nitrate



d. Zinc nitrate with lithium hydroxide



14. Define the following terms:

a. Acid solution

Produces H_3O^+ in solution

b. Base solution

Produces OH^- in solution.

15. The following properties were observed for 5 solutions. From the properties, identify the acids and bases (some might be neither).

Solution	Conductivity	Taste	Reaction with Zinc Metal	Type of Solution
V	Yes	Sour	Gas produced	Acid
W	Yes	Bitter	None	Base
X	Yes	Salty	None	Ionic (salt)
Y	No	Sweet	None	Covalent...
Z	Yes	Sour	Gas produced	Acid

16. State the Arrhenius definition for an acid and base

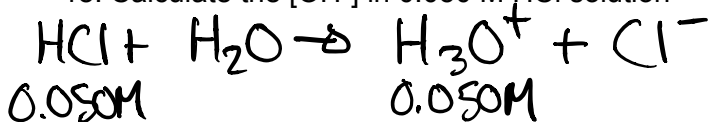
Acid $\rightarrow \text{H}^+$

Base $\rightarrow \text{OH}^-$

17. Explain how a hydronium ion is formed in aqueous solution.

Water surround H^+ ions to make H_3O^+

18. Calculate the $[OH^-]$ in 0.050 M HCl solution



$$[OH^-] = 1.0 \times 10^{-14} \div [H_3O^+] \\ \qquad\qquad\qquad\qquad\qquad\qquad 0.050\text{M}$$

$$[OH^-] = \boxed{2.0 \times 10^{-13}\text{M}}$$

19. What is the pH of the solution in question 5.

$$\text{pH} = -\log(0.050\text{M}) = \boxed{1.30}$$

20. Complete the following table:

Concentration of Hydronium ions	pH	Nature of the solution
0.010M	2.0	Acid
$1.00 \times 10^{-11}\text{M}$	11.000	Base
1.0×10^{-8}	8.00	Base
$1.0 \times 10^{-4}\text{M}$	4.00	Acid
1.0×10^{-7}	7.00	neutral
1.0×10^{-12}	12.00	Base
$1.0 \times 10^{-9}\text{M}$	9.00	Base
1.0×10^{-3}	3.00	Acid

21. Tomato juice has a pH of approximately 4.20. Find the $[H_3O^+]$, $[OH^-]$ and pOH of the tomato juice.

$$[H_3O^+] = 10^{-4.20}$$

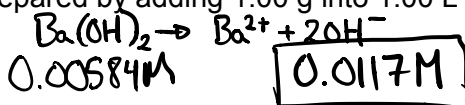
$$\text{pOH} = 14 - 4.20 \\ = 9.80$$

$$[OH^-] = 10^{-9.80}$$

$$[H_3O^+] = 6.3 \times 10^{-5}\text{M}$$

$$\boxed{1.6 \times 10^{-10}\text{M}}$$

22. A solution of $Ba(OH)_2$ was prepared by adding 1.00 g into 1.00 L of water. Find the $[H_3O^+]$, $[OH^-]$, pH and pOH of the solution.



$$\text{pOH} = -\log 0.0117\text{M} \\ = \boxed{1.933}$$

$$[H_3O^+] = 10^{-12.067} \\ \boxed{8.57 \times 10^{-13}\text{M}}$$

$$\text{pH} = 14 - 1.933 \\ = \boxed{12.067}$$

$$\frac{\text{Ba(OH)}_2}{\text{mol}} = 1.00\text{g} \times \frac{1\text{mol}}{171.35\text{g}} \times \frac{1}{1.00\text{L}} \\ = 0.00584\text{M}$$

23. Separate samples of a solution of unknown pH turn phenolphthalein pink, indigo carmine blue and 1,3,5 trinitrobenzene colourless. What is the pH of the solution?

Phenolphthalein > 10
 Indigo carmine < 11.4
 1,3,5 TNB < 12

range 10-11.4

24. Separate samples of a solution of unknown pH turn thymol blue yellow, methyl orange red and chlorophenol red. What is its pH?

Thymol Blue 2.8-8
 Methyl Orange < 3.2
 Chlorophenol > 2.6

Chlorophenol Range
 $> 1.8 - 2.6$

Range 2.6-3.2

25. Calculate the $[H_3O^+]$, $[OH^-]$, pH and pOH of the solutions described below:

a. A solution of HF diluted from 100 mL of 4.5M standard solution to a volume of 900 mL.

$$(4.5M)(100mL) = C_2(900mL) \quad pH = -\log(0.50) \quad [OH^-] = 10^{-13.70}$$

$$C_2 = 0.50M \quad = 0.30 \quad = 2.0 \times 10^{-14}M$$

$$[H_3O^+] = 0.50M \quad pOH = 14 - 0.30$$

$$= 13.70$$

b. A solution of HNO_3 created by adding 1.283 g of solid to 350 mL of water.

$$\frac{mol}{L} = 1.283g \times \frac{1mol}{63.02g} \times \frac{1}{0.350L}$$

$$= 0.0582M \quad [H_3O^+]$$

$$pH = -\log(0.0582) \quad [OH^-] = 10^{-12.765}$$

$$= 1.235 \quad = 1.72 \times 10^{-13}M$$

$$pOH = 14 - 1.235$$

$$= 12.765$$

c. A solution of phosphoric acid diluted from 10 mL of 12.1 M solution diluted by adding 790 mL of solution.

poly protic $H_3PO_4 + 3H_2O \rightarrow 3H_3O^+ + PO_4^{3-}$

$$C_1V_1 = C_2V_2$$

$$(12.1M)(10mL) = C_2(800mL)$$

$$C_2 = 0.15M$$

$$[H_3O^+] = 0.45M$$

$$pH = -\log(0.45M)$$

$$= 0.34$$

$$pOH = 14 - 0.34$$

$$= 13.66$$

$$[OH^-] = 10^{-13.66}$$

$$= 2.2 \times 10^{-14}M$$

d. A solution of $Ba(OH)_2$ created by adding 0.39 g of solid to 15.00 L of solution.

poly protic

$$\frac{mol}{L} = 0.39g \times \frac{1mol}{171.35g} \times \frac{1}{15.00L} = 1.5 \times 10^{-4}M$$

$$[OH^-] = 3.0 \times 10^{-4}M$$

$$pOH = -\log(3.0 \times 10^{-4}) = 3.52$$

$$pH = 14 - 3.52 = 10.48$$

$$[H_3O^+] = 10^{-10.48} = 3.3 \times 10^{-11}M$$