

# Unit 5

# Test

MNO: Solutions, Solubility, Acids and Bases

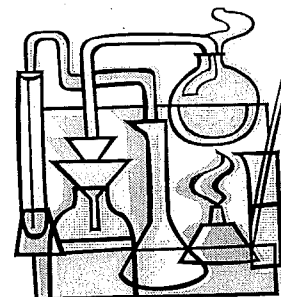
Total Marks: 50

Name KEY

1. Which of the following would form an ionic solution when dissolved in water?

I	Br <sub>2</sub>
II	NH <sub>4</sub> Cl ✓
III	SCl
IV	NaOH ✓

- A. IV  
 B. II, IV  
 C. I, II, IV  
 D. I, II, III, IV

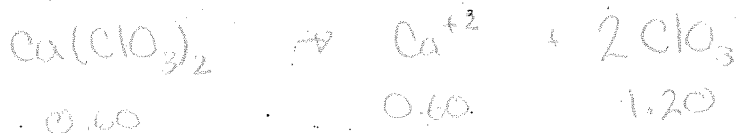


2. Which of the following units can be used to describe solubility?

- A. g  
 B. mol  
 C. g/mol  
 D. mol/L

3. A solution contains 1.75 L of 0.60 M Ca(ClO<sub>3</sub>)<sub>2</sub>. The [ClO<sub>3</sub><sup>-</sup>] is:

- A. 0.34 M  
 B. 0.60 M  
 C. 1.2 M  
 D. 2.9 M



4. From the list of salts below how many will form a precipitate in water at 25°C?

CuCl<sub>2</sub>

KOH

Cs<sub>3</sub>PO<sub>4</sub>

Ca(OH)<sub>2</sub>

KNO<sub>3</sub>

- A. One  
 B. Two  
 C. Three  
 D. Four

5. When 12.0 L of water is added to 8.0 L of 3.0 M Al(NO<sub>3</sub>)<sub>3</sub> the resulting ion concentrations are:

	[Al <sup>3+</sup> ]	[NO <sub>3</sub> <sup>-</sup> ]
A.	3.6 M	1.2 M
B.	3.0 M	9.0 M
C.	1.2 M	1.2 M
D.	1.2 M	3.6 M

$C_f = C_i \frac{V_i}{V_f}$   
 $Al(NO_3)_3 \rightarrow Al^{3+} + 3NO_3^-$   
 $= 3 \times \frac{8}{20}$   
 $= 1.2 M$

6. Which of the following occurs when equal volumes of 0.30 M  $\text{Ba}(\text{NO}_3)_2$  and 0.30 M  $\text{K}_2\text{SO}_4$  are mixed?

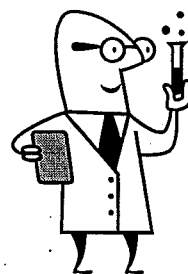
- A. A precipitate does not form
- B. A precipitate of  $\text{KNO}_3$  forms
- C. A precipitate of  $\text{BaSO}_4$  forms
- D. Precipitates of  $\text{BaSO}_4$  and form

7. A precipitation reaction occurs when equal volumes of 0.2 M  $(\text{NH}_4)_2\text{S}$  and 0.2M  $\text{AgNO}_3$  are mixed. The net ionic equation for the reaction is:

- A.  $2\text{Ag}^+(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{Ag}_2\text{S}(\text{s})$
- B.  $\text{Ag}_2\text{S}(\text{s}) \rightarrow 2\text{Ag}^+(\text{aq}) + \text{S}^{2-}(\text{aq})$
- C.  $\text{NH}_4^+(\text{aq}) + \text{NO}_3^-(\text{aq}) \rightarrow \text{NH}_4\text{NO}_3(\text{s})$
- D.  $\text{NH}_4\text{NO}_3(\text{s}) \rightarrow \text{NH}_4^+(\text{aq}) + \text{NO}_3^-(\text{aq})$

8. The acid found in vinegar will:

- A. Turn red litmus blue
- B. Taste bitter
- C. React with Mg to form  $\text{H}_2$
- D. Feel slippery



9. Which of the following is used in drain and oven cleaners?

- A.  $\text{HCl}$
- B.  $\text{NaOH}$
- C.  $\text{H}_3\text{PO}_4$
- D.  $\text{Al}(\text{OH})_3$

10. What is the pH of a solution of  $\text{H}_2\text{SO}_4$  in which the  $[\text{H}_3\text{O}^+] = 3.79 \times 10^{-4} \text{ M}$ ?

- A.  $3.79 \times 10^{-4}$
- B.  $-3.79 \times 10^{-4}$
- C. 3.42
- D. -3.42

# Written Response

**Instructions:** You will be expected to communicate your knowledge and understanding of chemical principles in a clear and logical manner.

Your steps and assumptions leading to a solution must be written in the spaces below the questions.

You must include units where appropriate and answers must be given to the correct number of significant figures.

**For questions involving calculation, full marks will NOT be given for providing only the answer.**

1. Define the term solution (1 mark)

• Homogeneous mixture  
• Solvent & solute.

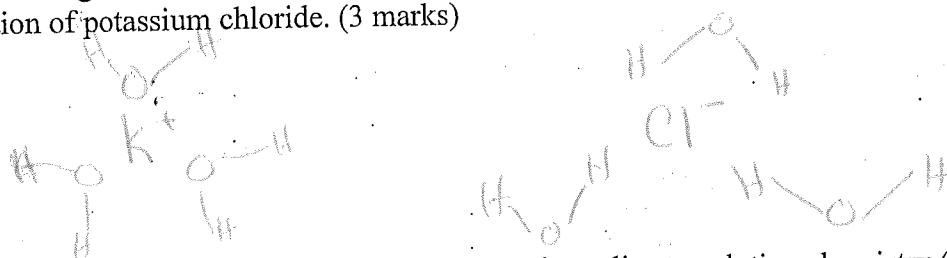
2. State whether the following substances will have high or low conductivity in solution (3 marks)

$C_6H_{12}O_6$  low

$CaNO_3$  high

$NH_4Cl$  high

3. Draw a diagram showing the orientation of water molecules around the ions in an aqueous solution of potassium chloride. (3 marks)



4. Explain the meaning of "like dissolves like" as it applies to solution chemistry (2 marks)

• Polar solvents dissolve polar & ionic solutes.  
• Non polar solvents dissolve non polar solutes.

5. What mass of  $CuCl_2$  is present in 450.0 mL of 0.0200 M  $CuCl_2$ ? (3 marks)

$$n = CV$$

$$= 0.0200 \times 0.4500$$

$$= 0.009 \text{ mol} \times \frac{134.5 \text{ g}}{\text{mol}} = 1.21 \text{ g}$$

6. When 3.0 L of 2.5 M FeCl<sub>3</sub> is mixed with 2.0 L of 3.0 M CaCl<sub>2</sub> no reaction occurs. What is the [Cl<sup>-</sup>] after mixing? (3 marks)

$$C_1 V_1 = C_2 V_2$$

$$2.5 \times 3.0 = 7.5$$

$$3.0 \times 2.0 = 6.0$$

$$7.5 + 6.0 = 13.5$$

$$13.5 / 5.0 = 2.7 \text{ M}$$

7. Write the equation showing the dissociation of calcium nitrate in water. Ensure that the equation is balanced and that states are shown. (3 marks)



8. In an experiment to determine the concentration of magnesium sulphide at a certain temperature, an empty beaker with a mass of 123.62 g is used to evaporate 25.00 mL of a solution of magnesium sulphide. After drying, the mass of the beaker and dried magnesium sulphide is 132.78 g calculate the original concentration in moles per litre. (4 marks)

$$132.78 \text{ g} - 123.62 \text{ g} = 9.16 \text{ g MgS}$$

$$9.16 \text{ g MgS} \times \frac{\text{mol}}{56.4 \text{ g}} = 0.16 \text{ mol} / 0.02500 \text{ L}$$

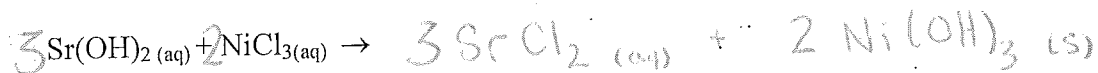
$$= 6.50 \text{ M}$$

9. Refer to the solubility chart for the following questions. State whether each of the following is soluble (S) or has low solubility (LS). (5 marks)

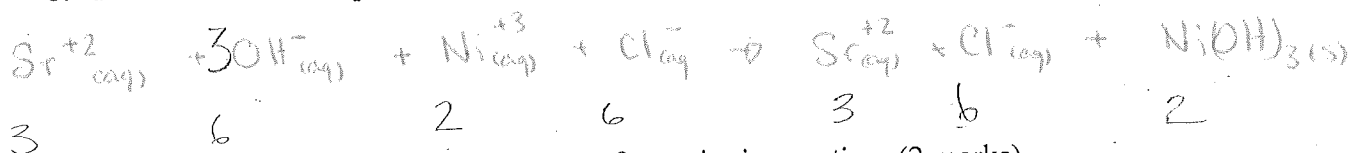
a) SrSO <sub>4</sub>	b) CaCO <sub>3</sub>	c) Li <sub>3</sub> PO <sub>4</sub>	d) PbBr	e) CuI <sub>2</sub>
<u>LS</u>	<u>LS</u>	<u>S</u>	<u>LS</u>	<u>LS</u>

10. When 0.2 M  $\text{Sr}(\text{OH})_2$  and 0.2 M  $\text{NiCl}_3$  are mixed together one of the products is a solid and the other is aqueous.

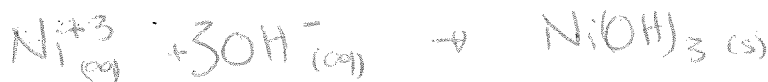
a. Complete the formula equation. Take care to write each formula correctly, balance the equation and show all states. (2 marks)



b. Rewrite the above equation in the form of a complete ionic equation. (2 marks)



c. Rewrite the above equation in the form of a net ionic equation. (2 marks)



11. What are the Arrhenius definitions for an acid and a base? (2 marks)

Acid - Release  $\text{H}^+$  in solution.

Base - release  $\text{OH}^-$  in solution.

12. What is the  $[\text{H}_3\text{O}^+]$  in a solution of  $\text{H}_3\text{PO}_4$  that has a  $\text{pH} = 2.3 \times 10^{-5}$  (1 mark)

$$[\text{H}_3\text{O}^+] = 10^{-2.3 \times 10^{-5}}$$

$$= 0.00001 \text{ M}$$

$$1.0 \text{ M}$$



13. The concentration of a solution of  $\text{H}_2\text{SO}_4$  is determined by acid base titration. Three trial are performed and each time a 25.00 mL sample of  $\text{H}_2\text{SO}_4$  is titrated with 0.300 M NaOH. The volume of NaOH used each trial is given below.

Trial	Volume of NaOH added (mL)
1	12.28
2	12.21
3	12.59

avg = 12.25 mL = 0.01225 L  
 reject

Using the data above calculate the  $[\text{H}_2\text{SO}_4]$  (4 marks)

$$n \text{ NaOH} = c v$$

$$= 0.300 \text{ M} \times 0.01225 \text{ L}$$

$$= 0.003675 \text{ mol}$$



$$0.003675 \text{ mol NaOH} \times \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol NaOH}} = 0.0018375 \text{ mol H}_2\text{SO}_4$$

$$c = \frac{n}{v} = \frac{0.0018375 \text{ mol}}{0.02500 \text{ L}} = \underline{\underline{0.07350 \text{ M}}}$$



**The End !!!**