

Set A: Definitions

**Objective:** By defining these words, you should become more familiar with solubility related terms and their definitions.

Define, neatly and clearly, the following solubility related terms.

1. Aqueous solution
2. Homogeneous mixture
3. Solute
4. Solvent
5. Solubility
6. Soluble
7. Insoluble
8. Miscibility
9. Miscible
10. Immiscible

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Set B: Solute and solvent of solutions

**Objective:** To test your ability to determine name and formula of solute and solvent of a solution

For each solution name or symbol, write the name and the formula of solute and solvent.

Solution symbol or name	Solute formula and name	Solvent formula
-------------------------	-------------------------	-----------------

- |     |  |  |
|-----|--|--|
| 11. | MgBr <sub>2</sub> (aq)                               |  |
| 12. | K <sub>2</sub> SO <sub>4</sub> (aq)                  |  |
| 13. | (NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub> (aq) |  |
| 4.  | Iron (III) chloride solution                         |  |
| 5.  | Copper (II) sulfate solution                         |  |
| 5.  | Barium nitrate solution                              |  |

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**Set C: Facts related to solubility factors**

*Objective: To test your knowledge of solubility factors*

*Answer questions below on factors that affect solubility.*

17. List three factors that can affect solubility of a substance.
18. How does temperature affect the solubility of solid solutes?
19. How does temperature affect the solubility of gaseous solutes?
20. How does pressure affect the solubility of solid solutes?
21. How does pressure affect the solubility of gaseous solutes?
22. What type of a substance is water?
23. What kinds of solutes dissolve well in water? Explain your answer.

**Set D: Solubility**

*Objective: To test your ability to determine which temperature and pressure a substance will have the highest or lowest solubility.*

*Below, solutes that will dissolve in water are given to the left. Four different temperature or pressure values are given. Answer the questions below based on the type of solute that is given.*

- |                     |   |                             |
|---------------------|---|-----------------------------|
| 24. $\text{NH}_3$   | 32°C   36°C   40°C   44°C   | 1 atm   1.3 atm   1.6 atm   |
|                     | Does temperature change has effect on the solubility of $\text{NH}_3$ ?<br>If Yes, at which temperature would $\text{NH}_3$ be most soluble?      |                             |
|                     | Does pressure change has effect on the solubility of $\text{NH}_3$ ?<br>If yes, at which pressure would $\text{NH}_3$ be most soluble?            |                             |
| 25. $\text{LiNO}_3$ | 40°C   50°C   60°C   64°C   | .2 atm   .4 atm   .6 atm    |
|                     | Does temperature change has effect on the solubility of $\text{LiNO}_3$ ?<br>If Yes, at which temperature would $\text{LiNO}_3$ be least soluble? |                             |
|                     | Does pressure change has effect on the solubility of $\text{LiNO}_3$ ?<br>If yes, at which pressure would $\text{LiNO}_3$ be least soluble?       |                             |
| 26. $\text{CaBr}_2$ | 60°C   65°C   70°C   75°C   | 100 kPa   150 kPa   200 kPa |
|                     | Does temperature change has effect on the solubility of $\text{CaBr}_2$ ?<br>If Yes, at which temperature would $\text{CaBr}_2$ be most soluble?  |                             |
|                     | Does pressure change has effect on the solubility of $\text{CaBr}_2$ ?<br>If yes, at which pressure would $\text{CaBr}_2$ be most soluble?        |                             |
| 27. $\text{CO}$     | 273 K   283 K   293 K   303 K   | 2 atm   2.2 atm   2.4 atm   |
|                     | Does temperature change has effect the solubility of $\text{CO}$ ?<br>If Yes, at which temperature would $\text{CO}$ be least soluble?            |                             |
|                     | Does pressure change has effect on the solubility of $\text{CO}$ ?<br>If yes, at which pressure would $\text{CO}$ be least soluble?               |                             |

**Set E: Soluble and insoluble compounds**

*Objective: To test your ability to use the Solubility Guideline Table F to determine soluble and insoluble compounds*

Write **"soluble"** next to those compounds that are soluble in water.  
Write **"insoluble"** next those compound that are insoluble in water.

**Use the Solubility Guideline Reference Table F**

28. NaCl \_\_\_\_\_

34. Calcium hydroxide \_\_\_\_\_

29. PbBr<sub>2</sub> \_\_\_\_\_

35. Lithium hydroxide \_\_\_\_\_

30. CaSO<sub>4</sub> \_\_\_\_\_

35. Lead sulfate \_\_\_\_\_

31. NH<sub>4</sub>NO<sub>3</sub> \_\_\_\_\_

36. Ammonium sulfide \_\_\_\_\_

32. MgCO<sub>3</sub> \_\_\_\_\_

37. Lead nitrate \_\_\_\_\_

33. K<sub>3</sub>PO<sub>4</sub> \_\_\_\_\_

38. Potassium chromate \_\_\_\_\_

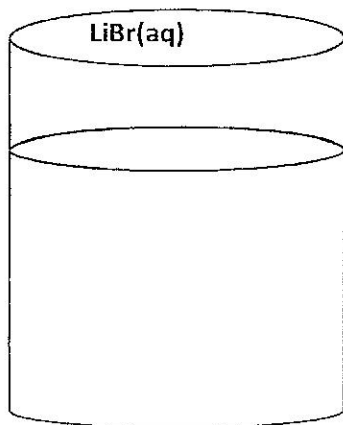
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**Set F: Hydration of ions**

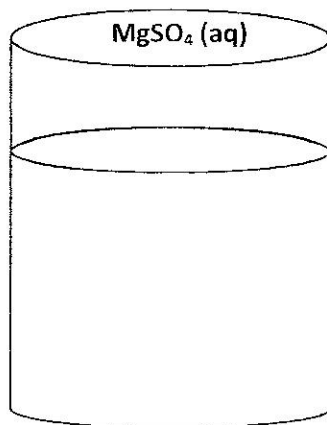
*Objective: To test your ability to show the attraction between water molecules and ions of the solute (molecule-ion attraction)*

*In each of the given solution, draw a diagram showing interaction (or attraction) between the ions of the solute and water molecules. Remember: Opposites attract!*

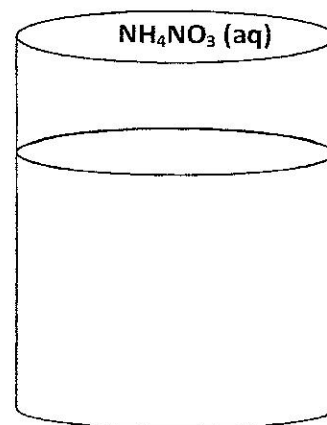
39.



40.



41.



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**Set A : Terms and definitions**

*Objective: By defining these words, you should become more familiar with types of solution term and their definitions*

**Define, neatly and clearly, the following types of solution terms.**

1. Saturation
2. Supersaturated
3. Unsaturation
4. Concentrated
5. Dilute

**Set B: Reading Solubility Curve Reference Table G**

*Objective. To test your ability to read and understand the Solubility Curve Table G*

**Use the Solubility Curve Reference Table G to answer the following questions.**

*Write your answers in the space to the right of each question.*

6. Name three solutes that show increase in solubility as water temperature increases. 6.
7. Name two solutes that show a decrease in solubility as water temperature increases. 7.
8. Which two solutes show the greatest change in solubility as the water temperature changes from 10°C to 50°C? 8.
9. Which two solutes show the least change in solubility as the water temperature changes from 0°C to 100°C? 9.
10. Which solid solute is most soluble at 60°C? 10.
11. Which gaseous solute is least soluble at 40°C? 11.
12. At 90°C, which salt is less soluble than  $\text{KClO}_3$ ? 12.
13. At 20°C, which gaseous solute is more soluble than  $\text{NH}_3$ ? 13.

**Set C : Determining saturated amount**

*Objective: To test your ability to use the Solubility Reference Table G to determine amount of solute that will form a saturated solution.*

**Based on the given information, determine the amount of the solute needed to form a saturated solution. Use Reference Table G.**

- 14. In 100 g of H<sub>2</sub>O at 70°C, what amount of KNO<sub>3</sub> will make a saturated solution? \_\_\_\_\_
- 15. In 100 g of H<sub>2</sub>O at 50°C, what amount of NH<sub>4</sub>Cl will form a saturated solution? \_\_\_\_\_
- 16. In 100 g of H<sub>2</sub>O at 30°C, what amount of HCl will make a saturated solution? \_\_\_\_\_
- 17. In 50 g of H<sub>2</sub>O at 20°C, what amount of NaNO<sub>3</sub> will form a saturated solution? \_\_\_\_\_
- 18. In 200 g of H<sub>2</sub>O at 60°C, what amount of KClO<sub>3</sub> will make a saturated solution? \_\_\_\_\_
- 19. In 50 g of H<sub>2</sub>O at 10°C, what amount of KI will make a saturated solution? \_\_\_\_\_
- 20. In 300 g of H<sub>2</sub>O at 90°C, what amount of NH<sub>3</sub> will form a saturated solution? \_\_\_\_\_
- 21. In 25 g of H<sub>2</sub>O at 80°C, what amount of NaCl will make a saturated solution? \_\_\_\_\_

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**Set D: Determining types of solution**

*Objective: To test your ability to use the Solubility Curve Reference Table G to determine type of solution.*

**Base on the given information, determine the type of solution that is formed.**

Write "*Saturated*", "*Supersaturated*", or "*Unsaturated*" in the line provided.

- 22. 80 g of NaNO<sub>3</sub> is dissolved in 100 g of H<sub>2</sub>O at 10°C. \_\_\_\_\_
- 23. 75 g of NaNO<sub>3</sub> is dissolved in 100 g of H<sub>2</sub>O at 10°C. \_\_\_\_\_
- 24. 90 g of NaNO<sub>3</sub> is dissolved in 100 g of H<sub>2</sub>O at 10°C. \_\_\_\_\_
- 25. 90 g of KNO<sub>3</sub> is dissolved in 100 g of H<sub>2</sub>O at 50°C. \_\_\_\_\_
- 26. 5 g of KClO<sub>3</sub> is dissolved in 100 g of H<sub>2</sub>O at 5°C. \_\_\_\_\_
- 27. 40 g of KCl is dissolved in 50 g of H<sub>2</sub>O at 60°C. \_\_\_\_\_
- 28. 40 g of NaNO<sub>3</sub> is dissolved in 50 g of H<sub>2</sub>O at 10°C. \_\_\_\_\_
- 29. 120 g of NH<sub>3</sub> is dissolved in 200 g of H<sub>2</sub>O at 10°C. \_\_\_\_\_
- 30. 90 g of NaCl is dissolved in 200 g of H<sub>2</sub>O at 80°C. \_\_\_\_\_

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**Set A: Definitions**

**Objective:** By defining these words, you should become more familiar with concentration related terms and their definitions.

**Define, neatly and clearly, the following concentration related terms.**

1. Molarity
2. Parts per million

**Set B : Calculation of molarity**

**Objective:** To test your ability to calculate molarity concentration using molarity equation

**Calculate the molarity concentration of the solutions based on the information given.**

Use the space to the right to write equation, show set-up, and solve the problem.

3. What is the molarity of 1.0 L NaCl solution containing 1 mole of the solute?
4. What is the concentration of 1.8 L  $\text{KNO}_3$  solution containing 0.5 mole of the solute?
5. What is the concentration of a solution containing 3.3 moles of solute in every 6 L of the solution?
6. What is the concentration of  $\text{NH}_4\text{Cl}$  solution containing 2 moles of the solute in 500 ml of the solution?.
7. What is the molarity of a 1500 ml solution containing 3 moles of the solute?
8. What is the molarity of a solution in which 28 g of NaCl is dissolved 2 liter of the solution.
9. What is the molar concentration of a solution in which 522 grams of  $\text{K}_2\text{SO}_4$  is dissolved in 1.5 liter of solution?
10. What is the molarity of a solution containing 12 g of HCl in 500 ml of solution?

## Set C: Calculation of moles, volume, and mass in solution

Calculate moles, volume, or mass of the solutions based on the information given.

Use the space to the right to write equation, show set-up and solve the problem.

Include the appropriate unit in your final answers.

Write answers in the boxes below.

11. How many moles of a solute are there in a 2 L of 1 M solution?

12. What is the number of moles of LiBr in a 1.5 L of 2 M solution?

13. How many moles of  $\text{NaNO}_3$  must be dissolved in water to make 2 L of 1.5 M solution?

14. What is the number of moles of  $\text{NH}_4\text{Cl}$  in 200 ml of 0.4 M solution?

15. What is the volume of a 1.5 M solution containing 2 moles of solutes?

16. How much volume of a 0.4 M potassium iodide solution would contain 0.12 moles of the solute?

17. What volume of a 3 M  $\text{H}_2\text{SO}_4$  solution will contain 0.75 mole of the solute?

18. How many milliliters of a 2.5 M  $\text{KNO}_3$  solution will contain 1.25 moles of the solute?

19. How many grams of  $\text{CaCl}_2$  are in a 1.0 L sample of a .5 M solution?

20. How many grams of  $\text{NH}_4\text{NO}_3$  are in a 2.3 L sample of a 1.5 molar solution?

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## Set D: Part per million calculations

*Objective: to test your understanding of part per million and your ability to solve part per million related problems.*

**Calculate part per million (ppm) or grams of solute based on the information given about the solution.**

*Use space to the right to write equation, show setup and solve the problem.*

*Include the appropriate unit in your final answers.*

*Write answers in the boxes below*

21. What is the part per million concentration of a 2000 g solution containing 10g of the solute?

22. A 500 gram solution contains 0.02 gram of solute. What is the concentration of the solution in part per million?

23. A 1000 gram sample of  $\text{CO}_2(\text{aq})$  solution contains 0.5 gram of  $\text{CO}_2$ . What is the concentration of the solution in part per million?

24. What is the part per million concentration of a 2500 gram of  $\text{KNO}_3$  solution containing 100 grams of the solute?

25. A 3800 gram of fish tank water contains  $2.7 \times 10^{-2}$  gram of dissolved oxygen. What is the part per million concentration of dissolved oxygen in the fish tank water?

26. How many grams of  $\text{O}_2$  will be in a 1000 g of 2 ppm  $\text{O}_2$  solution?

27. A 2200 gram  $\text{NH}_3(\text{aq})$  solution has a part per million concentration of 0.5 ppm. How many grams of  $\text{NH}_3$  are in this solution?

28. What is the total number mass of  $\text{NH}_4\text{Cl}(\text{s})$  found in a 1500 gram of a 1.5 ppm solution?

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**Set A: Terms, definitions and facts**

*Objective: By defining these words and answering questions below, you should become more familiar with facts and terms related to vapor pressure.*

**Define, neatly and clearly, the following vapor pressure related terms.**

1. Vapor
2. Vapor pressure
3. Boiling
4. Boiling points

**Answer questions below.**

5. Vapor pressure of a liquid depends on what factor?
6. Which of the four liquids on Table H has the weakest intermolecular forces between its molecules?
7. Which of the four liquids on Table H has the strongest intermolecular forces between its molecules?
8. Explain why water boils at 100°C at normal atmospheric pressure.

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**Set B: Vapor pressure and temperature**

*Objective: To test your ability to use Reference Table H to answer questions relating temperature to vapor pressure.*

**Use Reference Table H**

**Determine vapor pressure of the substances at the given temperature.**

- |                            |                                  |
|----------------------------|----------------------------------|
| 9. Propanone at 30°C _____ | 11. Ethanoic acid at 115°C _____ |
| 10. Water at 75°C _____    | 12. Ethanol at 58°C _____        |

**Determine the boiling point of each substance at the given atmospheric pressure.**

- |                               |                                   |
|-------------------------------|-----------------------------------|
| 13. Propanone at 50 kPa _____ | 15. Ethanoic acid at 80 kPa _____ |
| 14. Water at 120 kPa _____    | 16. Ethanol at 60 kPa _____       |

**Determine the normal boiling point of each substance below.**

- |                     |                         |
|---------------------|-------------------------|
| 17. Propanone _____ | 19. Water _____         |
| 18. Ethanol _____   | 20. Ethanoic acid _____ |

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## Set A: Comparing Freezing and Boiling points

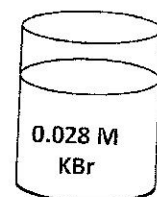
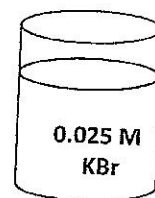
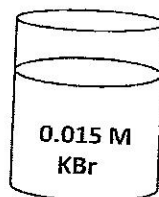
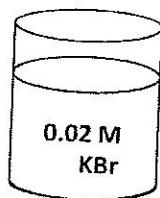
**Objective:** To test your ability to determine which solution will have the lowest and the highest freezing and boiling points.

For each solution, the concentration and solute of the solution are given. For each set of solutions:

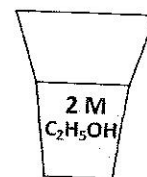
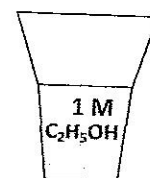
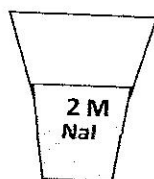
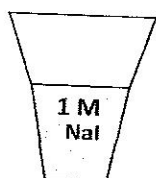
Write "highest FP and Lowest BP" underneath the beaker whose solution will freeze at the highest temperature and boils at the lowest temperature.

Write "Lowest FP and Highest BP" underneath the beaker whose solution will freeze at the lowest temperature and boils at the highest temperature.

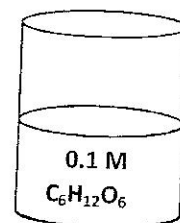
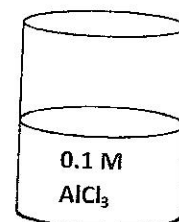
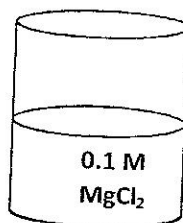
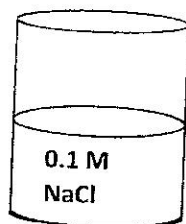
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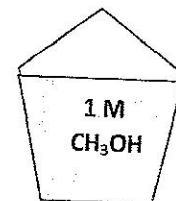
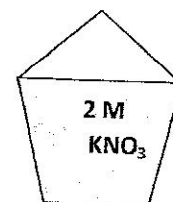
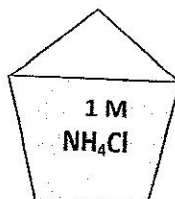
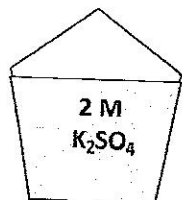
Set 2.



Set 3.



Set 4.



Set 5.

