

Review for Unit 9: Solutions, Answers

Answers to Multiple Choice Questions:

1. d	9. a	17. c	25. d	33. a
2. c	10. b	18. c	26. b	34. a
3. c	11. d	19. b	27. b	35. a
4. c	12. b	20. b	28. c	36. d
5. a	13. b	21. c	29. b	37. a
6. c	14. b	22. a	30. d	38. b
7. d	15. c	23. d	31. b	39. b
8. c	16. d	24. a	32. c	40. d

1. Definitions:

- a) **Alloy:** a solid in solid solution, usually made of two or more metals that are melted, thoroughly mixed and allowed to harden
- b) **Aqueous solution:** a solution in which the solvent is water
- c) **Compound:** a pure substance that is made up of two or more different types of elements, chemically bonded together
- d) **Concentrated:** a qualitative description of a solution that contains a large proportion of solute
- e) **Dilute:** a qualitative description of a solution that contains a small proportion of solute
- f) **Element:** a pure substance that contains only one type of atom
- g) **Heterogeneous:** not the same throughout; having different regions of matter with different properties
- h) **Homogeneous:** uniform throughout; having constant properties and composition
- i) **Insoluble:** a substance does not dissolve in a certain solvent
- j) **Mechanical mixture:** a heterogeneous mixture. Two or more different substances that are unevenly mixed. Mechanical mixtures have two or more visible phases.
- k) **Mixture:** when a sample of matter contains two or more types of atoms, ions or molecules
- l) **Molar concentration:** concentration of a solution expressed as moles of solute per litre of solution
- m) **Phase:** a visible region of matter that has constant (uniform) characteristics
- n) **Precipitate:** a solid that forms when two solutions are mixed. Precipitates are insoluble substances.
- o) **Saturated solution:** a solution that contains the maximum amount of solute that will dissolve in a certain volume of a certain solvent at a given temperature
- p) **Solubility:** a physical property of a substance; the maximum amount of a solute that will dissolve in a given solvent at a stated temperature
- q) **Soluble:** a substance that does dissolve in a certain solvent
- r) **Solute:** the part of a solution that is dissolved (usually present in the smaller amount)
- s) **Solution:** a homogeneous mixture containing at least one type of solvent and solute
- t) **Solvent:** the part of the solution that does the dissolving (usually present in a larger amount)
- u) **Stock solution:** a solution of known, standard concentration that is used to prepare other solutions by dilution
- v) **Super-saturated solution:** when a solution contains more than the maximum amount of solute than will normally dissolve at that temperature
- w) **Unsaturated solution:** when a solution contains less than the maximum amount of solute than will dissolve at that temperature
- x) **Variable composition:** the proportions of the solute and solvent in a solution can be changed.
eg. a salt water solution can be 5 g / 100 mL, 10 g / 100 mL or 15 g / 100 mL

2. Solutions are homogeneous and permanent (they will not settle out) and have only one visible region of matter. They can have variable composition. Not all solutions are transparent (alloys are solid in solid solutions and they are opaque); however, all **aqueous** solutions are transparent. Solutions can be separated by **physical methods** such as distillation (boil off the substance with the lower boiling point). Solutions can not be separated by filtration.

Examples of different types of solutions are:

- solid in liquid: salt dissolved in water
- gas in liquid: oxygen dissolved in sea water
- gas in gas: air (oxygen, carbon dioxide and other trace gases dissolved in nitrogen) or any other gas in gas mixture
- liquid in liquid: vinegar (acetic acid in water) or alcohol in water
- solid in solid: metal alloys- two or more metals elements mixed into a solution while they are hot and then allowed to cool eg. bronze, brass, yellow gold, pewter, stainless steel

3. As a general rule, the solubility of most solids increases as the temperature increases.
4. As a general rule, the solubility of most gases decreases as the temperature increases.
5. To test to see if a solution is unsaturated, saturated or super-saturated, add a single seed crystal to the solution:
- If the solution is unsaturated, the crystal will dissolve
 - If the solution is saturated, the crystal will sink to the bottom, unchanged
 - If the solution is super-saturated, the crystal will cause additional crystals to precipitate out.
6. Be able to interpret solubility graphs. Refer to the handout: "Practice Questions: Solubility Curves" and answer the following questions:
- What is the solubility of copper sulfate at 90°C? **about 65 g/ 100 mL**
 - What temperature is required to dissolve 90.0 g of lead nitrate in 100.0 mL of water? **about 55°C**
 - What temperature is required to dissolve 120.0 g of copper sulfate in 300.0 mL of water? **about 60°C**
 - 30.0 g of barium hydroxide is dissolved in 100.0 mL of water at 80°C. Would the solution be unsaturated, saturated or super-saturated? **unsaturated**
 - If the solution from "d" were cooled to 40°C, would the solution be unsaturated, saturated or super-saturated? **super-saturated**
 - If a seed crystal were added to the cooled solution from "e", what would you expect to happen? **crystals form**
 - A super-saturated solution of copper sulfate is prepared by heating 60.0 g of copper sulfate in 100.0 mL of distilled water. The solution is cooled to SATP. If a seed crystal is added, what mass of copper sulfate will crystallize out? **about 38 g of crystals will come out of solution.** What will the concentration of the copper sulfate solution be after the copper sulfate crystals have precipitated out? **the solution after the crystals precipitate out will be 22 g/ 100 mL at 25°C (saturated)**
 - Do questions 1a and b on page 316 and 317 of your text.
 - at 70°C, about 20 g of K_2SO_4 can dissolve in 100 mL of water
 - the solubilities of KNO_3 and KCl are approximately equal at 22°C

