Chemistry Exam
November 24, 2009
Chapters 12-13

1. Which of the following will NOT dissolve in water?
   a. ethanol, C₂H₅OH, a substance in mouthwash
   b. octane, C₈H₁₈, a compound in gasoline
   c. KCl

2. Which of the following molecules can form hydrogen bonds?
   a. BH₃
   b. NaCl
   c. CH₃OH
   d. HI
   e. NaH

3. A solution is prepared by dissolving 2.00 g of KCl in 100 g of H₂O. In this solution, KCl is the
   a. solvent.
   b. solution.
   c. solute.
   d. solid.
   e. ionic compound.

4. The slow migration of water and small molecules and/or ions through a porous membrane is called:
   a. dialysis
   b. diffusion
   c. osmosis
   d. registration
   e. filtration

5. A certain solid brass alloy contains 80.2% copper, 12.0% zinc, and various other metals. Which one is the
   solvent, and why?
   a. There is no “solvent since solids can’t dissolve in each other.
   b. Copper is, because it is the major component.
   c. Zinc is, because it has a higher molar mass than copper.
   d. Zinc is, because it dissolves more materials than copper.
   e. Copper is, because its d orbitals are incompletely filled.

6. If you dissolve the maximum amount of table sugar in water at a specific temperature, the resulting mixture
   would be classified as
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   b. A suspension.
   c. A dispersion.
   d. An emulsion.
   e. A dilute solution.

7. If you mix dirt and water and vigorously shake it for 2 minutes, the resulting mixture would be classified as
   a. A saturated solution.
   b. A suspension.
   c. A dispersion.
   d. An emulsion.
   e. A colloid
8. Which one of the following compounds is NOT soluble in water?
   a. KNO₃
   b. CH₃CH₂OH
   c. CH₃CH₂CH₃
   d. CH₃NH₂
   e. HCl

9. A cellophane bag, which acts as a membrane permeable only to water, contains a 2 M sugar solution. The bag is immersed in a 1 M sugar solution. What will happen?
   a. There will be no change.
   b. Water will flow out of the bag creating a solution that will be more concentrated than 2 M.
   c. Water will flow into the bag creating a solution that will be less concentrated than 2 M.
   d. The bag will lose sugar and the solution in it will become less concentrated.
   e. The sugar will solidify in the bag.

10. Physiological saline (0.92% NaCl) and a 5.5% glucose solution are isotonic with the fluid inside red blood cells. A 3% NaCl solution surrounding the cell would be considered
    a. hypotonic
    b. isotonic
    c. hypertonic

11. When a cell (0.92% NaCl) is surrounded by a solution that contains 0.50% NaCl, there would be
    a. no effect on the cell.
    b. a net flow of water into the cell and the cell would burst.
    c. a net flow of water out of the cell and the cell would shrivel.
    d. a net flow of water out of the cell and the cell would burst.
    e. a net flow of water into the cell and the cell would shrivel.

12. Suppose that you added some more NaC₂H₃O₂ seed crystals to a saturated solution of NaC₂H₃O₂ in water. What would happen?
    a. The NaC₂H₃O₂ would at first dissolve, but then the excess would recrystallize.
    b. None of the additional NaC₂H₃O₂ would dissolve.
    c. The additional NaC₂H₃O₂ would dissolve.
    d. Only some of the additional NaC₂H₃O₂ would dissolve.
    e. All of the NaC₂H₃O₂ in solution would immediately crystallize out.

13. When a can of warm soda is opened, foam may bubble out because
    a. Less liquid can be held by the container when it is opened.
    b. Carbon dioxide gas is less soluble when the pressure decreases.
    c. Carbon dioxide gas is less soluble when air is introduced.
    d. Carbon dioxide gas is more soluble when the pressure decreases.

14. Nitrogen, which dissolves in the blood, causes deep sea divers to get "the bends" if they surface too quickly due to gas bubbles forming in the blood. This occurs because nitrogen
    a. is more soluble in sea water.
    b. is less soluble in the blood at lower pressures.
    c. reacts with hemoglobin at low pressures.
    d. reacts with air when the diver reaches the atmosphere.

15. Which is soluble in oil?
    a. Water
    b. C₂H₄
    c. KNO₃
    d. Salt (NaCl)
    e. CuSO₄
16. The concentration term that gives moles of solute per liter of solution is
   a. Parts by volume.
   b. Molarity.
   c. Molarity.
   d. Percent by volume.
   e. Percent by mass

17. This graph shows how the solubility of ordinary cane sugar (sucrose) in water changes with the temperature.
    The solubility is expressed as the number of grams of sugar dissolved per 100 g of water in a saturated solution.
    What is the solubility in grams of sugar per 100 g of water at 60°C?

   a. Above 400 g
   b. 355 g
   c. 290 g
   d. 60 g
   e. 0 g

18. What volume of 6.00 M sulfuric acid would be required to make 2.00 L of 2.50 M sulfuric acid?

   a. 4.80 L
   b. 2.40 L
   c. \( \frac{2.40 L}{6.00 M} \times \frac{M}{L} = \frac{2.40 M}{6.00} \times \frac{L}{L} = \frac{0.40 L}{1} \)
   d. 0.417 L

19. A solution contains 0.400 g of NaOH in 20.0 mL of solution. What is its molarity?

   a. 2.00 M
   b. 1.00 M
   c. 0.500 M
   d. 0.400 M
   e. 0.250 M

   \( \frac{4,000 g}{\text{NaOH}} \times \frac{M}{mol} = \frac{0.50 L}{0.200 L} = 0.5 M \)
20. The equilibrium below will be shifted to the right by the

\[ \text{PCl}_5(g) \rightarrow \text{PCl}_3(g) + \text{Cl}_2(g) \]

a. removal of PCl5.
b. Addition of a catalyst.
c. removal of Cl2.
d. addition of an inert gas at constant volume.

21. Consider this reversible reaction, which is endothermic to the right. All substances are gases and are in an insulated closed chamber with a constant volume and are at equilibrium.

\[ \text{Heat} + 2\text{H}_2\text{O} + 2\text{Cl}_2 \rightleftharpoons 4\text{HCl} + \text{O}_2 \]

What will be the effect of increasing the temperature?

a. There will be no change.
b. More water will be formed.
c. More Cl2 will be produced.
d. More HCl will be produced.
e. The volume of each of the gases will increase.

22. Which of the following is a homogeneous mixture

a. the ocean
b. an orange
c. A green salad with lettuce, onions, broccoli, tomatoes, cheese, and cauliflower.
d. Kool Aid, Sugar, and water making a clear refreshing drink.

23. What mass of potassium hydroxide (KOH) is needed to prepare 0.500 L of a 0.200 M solution.

\[ (0.500 \text{L})(0.200 \text{M}) = 0.1 \text{mol} \times \frac{56.1 \text{g}}{\text{mol}} = 5.61 \text{g} \]

a. 22.4 g
b. 5.61 g
c. 2.50 g
d. 0.100 g

24. Which of the following is NOT a factor affecting how fast a solute will dissolve in a solvent:

a. stirring
b. particle size
c. temperature
d. all of the above affect the rate of dissolving.

25. Which of the following is a factor affecting the amount of solute that will dissolve in a solvent?

a. stirring
b. temperature
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d. All of the above affect the amount of solute that will dissolve.

26. Which of the following changes of state is exothermic?

a. Solid to liquid
b. Solid to gas
c. Liquid to gas
d. Liquid to solid
27. Bubbles rise in a newly opened bottle of a (drug free) carbonated beverage such as Slice. This action is explained by the fact that carbon dioxide is less soluble in water when
   a. liquid carbon dioxide evaporates.
   b. pressure is increased.
   c. pressure is decreased.
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28. For a chemical system at equilibrium,
   a. The concentrations of the products divided by reactants equals one.
   b. The partial pressures of reactants and products are equal.
   c. The forward and reverse reaction rates are equal.
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29. A liquid with _______ forces should have the lowest boiling point.
   a. Hydrogen bonding
   b. London Dispersion
   c. Dipole-dipole
   d. Ionic

30. The crystal lattice shown below is ________.
   a. Hexagonal closest packing
   b. Body centered cubic
   c. Face centered cubic
   d. Simple cubic

31. Condensation is the process by which a
   a. Liquid changes to a gas
   b. Gas changes to a liquid
   c. Solid changes to a gas
   d. Solid changes to a liquid

32. Vaporization (boiling) is the process by which a
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33. According to the phase diagram below, what change of state(s) will occur as the temperature increases from a very cold -120°C to room temperature (25°C) if the experiment is conducted at standard pressure.
   a. Solid to liquid to gas
   b. Solid to gas
   c. Gas to solid
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![Phase diagram of CO₂](image)
34. Which one of the following substances will exhibit dipole-dipole intermolecular forces?
   a. CO       b. Kr       c. N₂      d. CO₂      e. CCl₄

35. Use the figure below to determine the typical boiling point of water at a vapor pressure of 500 mm Hg.
   a. 100 °C   b. 87 °C   c. 35 °C   d. 24 °C

36. Circle any of these substances that will have dipole-dipole attractive forces between their molecules.

37. Circle any of the following molecules that are capable of intermolecular Hydrogen bonding (hydrogen bonding to another molecule of like kind).

   H₂O
   H₂N⁻
   H₂C=O
   H₂C=O
   H₂C=O
   H₂C=O
38. Show all hydrogen bonding (draw dotted lines) that occurs between these two molecules.

39. How many milliliters of a 12.0 M HCl aqueous solution would be used to prepare 100.0 mL of a 3.00 M HCl solution? How would you prepare the solution if you had a 100 mL volumetric flask and a graduated cylinder? (3 points)

\[ \frac{12 \times V_1}{12} = \frac{100 \times 3}{12} = 25 \]
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![Pressure-Temperature phase diagram for CO₂](image)
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