CHEM 1412. chapter 13. Properties of Solutions (Homework) Ky

1. 0.102 g of an unknown compound dissolved in 100. mL of water has an osmotic pressure of 28.1 mmHg at 20 ℃. Calculate the molar mass of the compound.
   A) 663 g/mol
   B) 0.872 g/mol
   C) 1.15 g/mol
   D) 727 g/mol
   E) 1.10×10^2 g/mol

2. Explain the following, on the basis of osmosis or osmotic pressure: Drinking salt water actually dehydrates our tissues.

3. Dissolving a solute such as KOH in a solvent such as water results in
   A) an increase in the melting point of the liquid.
   B) a decrease in the boiling point of the liquid.
   C) a decrease in the vapor pressure of the liquid.
   D) no change in the boiling point of the liquid.

4. The solubility of oxygen in water is about 4.5×10^{-2} g/L. The water portion of an adult's total blood supply is about 5 liters. How many grams of oxygen could dissolve in 5 liters of water?

5. What is the osmotic pressure of a solution that contains 13.7 g of propyl alcohol (C_3H_7OH) dissolved in enough water to make 500. mL of solution at 27 ℃?
   A) 0.014 atm
   B) 0.037 atm
   C) 0.456 atm
   D) 0.01 atm
   E) 11.2 atm

6. A saturated solution
   A) contains more solute than solvent.
   B) contains more solvent than solute.
   C) contains equal moles of solute and solvent.
   D) contains the maximum amount of solute that will dissolve in that solvent at that temperature.
   E) contains a solvent with only sigma bonds and no pi bonds (i.e. only single bonds, with no double or triple bonds).

7. What is the concentration of $O_2(g)$ in water at 25 ℃ exposed to a partial pressure of oxygen of 325 mmHg? The Henry's law constant for oxygen gas at 25 ℃ is 1.3×10^{-3} mol/L atm.

8. For dilute aqueous solutions, the concentration units molarity and molality have almost the same values.
   A) True
   B) False

9. The solubility of oxygen in lakes high in the Rocky Mountains is affected by the altitude. If the solubility of O_2 from the air is 2.67×10^{-4} M at sea level and 25 ℃, what is the solubility of O_2 at an elevation of 12,000 ft where the atmospheric pressure is 0.657 atm? Assume the temperature is 25 ℃, and that the mole fraction of O_2 in air is 0.209 at both 12,000 ft and at sea level.
   A) 1.75×10^{-4} M
   B) 2.67×10^{-4} M
   C) 3.66×10^{-5} M
   D) 4.06×10^{-4} M
   E) None of the above.

10. What volume of ethanol (density = 0.7893 g/cm^3) should be added to 450. mL of water in order to have a solution that freezes at –15.0 ℃? (For water, K_f = 1.86 ℃/m.)
    A) 371 mL
    B) 470 mL
    C) 212 mL
    D) 132 mL
    E) 167 mL

11. Calculate the approximate freezing point of a solution made from 21.0 g NaCl and 1.00 $\times 10^2$ g of H_2O. [K_f of water is 1.86 ℃/m.]
    A) 3.59 ℃
    B) 6.68 ℃
    C) –13.4 ℃
    D) –6.68 ℃
    E) –3.59 ℃

12. The solubility of CO_2 gas in water
    A) increases with increasing temperature.
    B) decreases with decreasing temperature.
    C) decreases with increasing temperature.
    D) is not dependent on temperature.

13. Which of the following gives the molarity of a 17.0% by mass solution of sodium acetate, CH_3COONa (molar mass = 82.0 g/mol) in water? The density of the solution is 1.09 g/mL.
    A) 2.26×10^{-6} M
    B) 0.207 M
    C) 2.07 M
    D) 2.26 M
    E) 2.72 M

14. Calculate the molality of 6.0 M H_2SO_4 solution. The density of the solution is 1.34 g/mL.
    A) 4.48 m
    B) 7.98 m
    C) 8.10 m
    D) 8.43 m
    E) 10.2 m

15. What is the mole fraction of sodium phosphate in a 0.142 M Na_3PO_4(aq) solution that has a density of 1.015 g/mL?

16. The term "proof" is defined as twice the percent by volume of pure ethanol in solution. A solution that is 95% ethanol is 190 proof. What is the molarity of ethanol in a 92-proof ethanol/water solution? (Given: density of ethanol = 0.80 g/cm^3; density of water = 1.0 g/cm^3)

17. When 20.0 grams of an unknown compound are dissolved in 500. grams of benzene, the freezing point of the resulting solution is 3.77 ℃. The freezing point of pure benzene is 5.444 ℃, and the K_f for benzene is 5.12 ℃/m. What is the molar mass of the unknown compound?

18. A 9.50 % by mass solution of acetone (C_3H_6O) in water has a density of 0.9849 g/mL at 20 ℃. What is the molarity of this solution?
    A) 0.621 M
    B) 1.61 M
    C) 1.66 M
    D) 1.71 M
    E) 16.9 M

19. What is the molarity of a solution that is 7.00% by mass magnesium sulfate and has a density of 1.071 g/mL?
    A) 0.0890 M
    B) 0.496 M
    C) 0.543 M
    D) 0.623 M
    E) 1.32 M

20. Calculate the molality of a 20.0% by mass ammonium sulfate $(NH_4)_2SO_4$ solution. The density of the solution is 1.117 g/mL.
    A) 0.150 m
    B) 1.51 m
    C) 1.70 m
    D) 1.89 m
    E) 2.10 m

21. Calculate the molality of a solution containing 14.3 g of NaCl in 42.2 g of water.
    A) 2.45×10^{-4} m
    B) 5.80×10^{-4} m
    C) 2.45×10^{-1} m
    D) 103 m
    E) 5.80 m

22. When 24.0 g of glucose (a nonelectrolyte) are dissolved in 500. g of water, the solution has a freezing point of –0.47 ℃. What is the molar mass of glucose? K_f of water is 1.86 ℃/m.
    A) 41.9 g
    B) 47.5 g
    C) 54.9 g
    D) 178 g
    E) 190. g

23. Explain the following, on the basis of osmosis or osmotic pressure: Meat that is salted before cooking tends to dry out.

24. A solution of chloroform, $CHCl_3$, and acetone, $(CH_3)_2CO$, exhibits a negative deviation from Raoult's law. This result implies that
    A) chloroform-chloroform interactions are stronger than chloroform-acetone interactions.
    B) chloroform-chloroform interactions are weaker than chloroform-acetone interactions.
    C) acetone-acetone interactions are stronger than chloroform-acetone interactions.
    D) acetone-acetone interactions are weaker than chloroform-acetone interactions.
    E) Both B and D.
    F) Both A and C.

25. Which of the following concentration units will not change with temperature: molarity, percent mass, mole fraction, and molality.

26. Which of the following aqueous solutions has the lowest freezing point?
    A) 0.18 m KCl
    B) 0.15 m Na_2SO_4
    C) 0.12 m $Ca(NO_3)_2$
    D) pure water
    E) 0.20 m $C_2H_6O_2$ (ethylene glycol)

27. Define *solvation*.

28. The solubility of a solid *always* increases with increasing solvent temperature.
    A) True
    B) False

29. The solubility of nitrogen gas at 25 ℃ and a nitrogen pressure of 522 mmHg is 4.7×10^{-4} mol/L. What is the value of the Henry's Law constant in mol/L atm?
A) 6.8×10^{-4} mol/L atm
B) 4.7×10^{-4} mol/L atm
C) 3.2×10^{-4} mol/L atm
D) 9.0×10^{-7} mol/L atm
E) 1.5×10^{3} mol/L atm

30. At 10°C one volume of water dissolves 3.10 volumes of chlorine gas at 1.00 atm pressure. What is the Henry's Law constant in mol/L atm?
A) 3.8
B) 0.043
C) 36.
D) 3.1
E) 0.13

31. What is the freezing point of a solution that contains 10.0 g of glucose ($C_6H_{12}O_6$) in 100. g of H_2O? K_f for water is 1.86 ℃/m.
A) –0.186 ℃
B) +0.186 ℃
C) –0.10 ℃
D) +0.10 ℃
E) –1.03 ℃

32. Calculate the molality of a 15.0% by mass solution of $MgCl_2$ in H_2O. The density of this solution is 1.127 g/mL.
A) 0.157 m
B) 11.8 m
C) 1.86 m
D) 0.0134 m
E) 1.58 m

33. A 100.-mL sample of water is taken from the Pacific Ocean, and the water is allowed to evaporate. The salts that remain (mostly NaCl) have a mass of 3.85 g. Calculate the original concentration of NaCl, in g per liter, in the water sample.

34. A solution is 40.0% by volume benzene (C_6H_6) in carbon tetrachloride at 20 ℃. The vapor pressure of pure benzene at this temperature is 74.61 mmHg and its density is 0.87865 g/cm^3; the vapor pressure of pure carbon tetrachloride is 91.32 mmHg and its density is 1.5940 g/cm^3. If this solution is ideal, its total vapor pressure at 20 ℃ is
    A) 84.64 mmHg
    B) 84.30 mmHg
    C) 82.96 mmHg
    D) 81.63 mmHg
    E) 165.93 mmHg

35. An aqueous dextrose solution having a density of 1.04 g/cm^3 freezes at –1.15 ℃. Find the osmotic pressure of this solution at 25 ℃. K_f of water is 1.86 ℃/m; molecular mass of dextrose = 180.16 g/mol.
    A) 13.8 atm
    B) 14.1 atm
    C) 15.1 atm
    D) 12.9 atm
    E) 120 atm

36. Explain the following, on the basis of osmosis or osmotic pressure: An effective way to kill a snail or slug in your garden is to sprinkle it with salt.

37. To interconvert the concentration units molarity (M) and mass percent, you must also know the density of the solution.
    A) True
    B) False

38. Which of the following liquids would make a good solvent for iodine, I_2?
    A) HCl
    B) H_2O
    C) CH_3OH
    D) NH_3
    E) CS_2

39. What is the approximate Na^+ ion concentration in a 0.75 M Na_2CO_3 solution?
    A) 0.375 M
    B) 0.75 M
    C) 1.25 M
    D) 1.50 M
    E) 2.25 M

40. During osmosis
    A) pure solvent diffuses through a membrane but solutes do not.
    B) pure solutes diffuse through a membrane but solvent does not.
    C) pure solvent and a solution both diffuse at the same time through a membrane.
    D) gases diffuse through a membrane into a solution and build up pressure.

Answer Key… CHEM 1412. chapter 13. Properties of Solutions (Homework) Ky

1. A
2. The water passes from cells, trying to dilute the salt water.
3. C
4. 0.2 g
5. **E**
6. D
7. 5.6×10^{-4} M
8. A
9. A
10. **C**
11. C
12. C
13. D
14. B
15. **0.00257**
16. 8.0 M
17. 120 g/mol
18. B
19. D
20. **D**
21. E
22. E
23. The water passes through the muscle cells to the outside, trying to dilute the salt.
24. E
25. Percent mass, mole fraction, and molality will not change with temperature.
26. B
27. Solvation is the process in which an ion or a molecule is surrounded by solvent molecules arranged in a specific manner.
28. B
29. A
30. **E**
31. E
32. C
33. 38.5 g/L
34. B
35. **B**
36. The water leaves the snails cells to dilute the salt, and the snail becomes dehydrated and dies.
37. A
38. E
39. D
40. **A**