

Multiple Choice & True/False

- Which of the following concentration measures will change in value as the temperature of a solution changes?
 - mole fraction
 - molality
 - mass percent
 - molarity
 - all of these

- If 2.00 g of helium gas and 4.00 g of oxygen gas are mixed together what is the mole fraction of helium in the solution?
 - 0.800
 - 0.666
 - 0.500
 - 0.333
 - 0.200

- Rank the following compounds according to increasing solubility in water.
 - $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3$
 - $\text{CH}_3\text{-CH}_2\text{-O-CH}_2\text{-CH}_3$
 - $\text{CH}_3\text{-CH}_2\text{-OH}$
 - $\text{CH}_3\text{-OH}$
 - $\text{III} < \text{IV} < \text{II} < \text{I}$
 - $\text{I} < \text{II} < \text{III} < \text{IV}$
 - No order is correct.
 - $\text{I} < \text{II} < \text{IV} < \text{III}$
 - $\text{I} < \text{III} < \text{IV} < \text{II}$

- A correct statement of Henry's law is:
 - the concentration of a gas in solution is directly proportional to the mole fraction of solvent.
 - the concentration of a gas in a solution is inversely proportional to pressure.
 - the concentration of a gas in solution is inversely proportional to temperature.
 - the concentration of a gas in solution is independent of pressure.
 - none of these

- A solution contains 1 mole of liquid A and 3 mol of liquid B. This solution has a vapor pressure of 314 torr at 25°C. At 25°C, liquid A has a vapor pressure of 265 torr and liquid B has a vapor pressure of 355 torr. Which of the following is true?
 - This solution exhibits a positive deviation from Raoult's Law.
 - This solution is ideal.
 - This solution exhibits a negative deviation from Raoult's Law.

6. A salt solution sits in an open beaker. Assuming constant temperature and pressure, the vapor pressure of the solution
- stays the same over time.
 - Need to know which salt is in the solution to answer this.
 - increases over time.
 - Need to know the temperature and pressure to answer this.
 - decreases over time.
7. To calculate the freezing point of an ideal dilute solution of a single, nondissociating solute of a solvent, the minimum information one must know is:
- the molality (of the solute).
 - the molality (of the solute) and the freezing point depression constant of the solvent.
 - the same quantities as in b plus the freezing point of the pure solvent.
 - all of the quantities in c plus the molecular weight of the solute.
 - all of the quantities in c plus the weight of the solvent.
8. All of the following are colligative properties except:
- density elevation
 - osmotic pressure
 - freezing point depression
 - boiling point elevation
 - none of these
9. When a nonvolatile solute is added to a volatile solvent, the solution vapor pressure _____, the boiling point _____, the freezing point _____, and the osmotic pressure across a semipermeable membrane _____.
- decreases, increases, decreases, decreases
 - decreases, increases, decreases, increases
 - decreases, decreases, increases, decreases
 - increases, increases, decreases, increases
 - increases, decreases, increases, decreases
10. A solute added to a solvent raises the boiling point of the solution because
- the solute particles raise the solvent's vapor pressure, thus requiring a higher temperature to cause boiling.
 - the solute increases the volume of the solution, and an increase in volume requires an increase in the temperature to reach the boiling point (derived from $PV = nRT$).
 - two of these are correct.
 - the solute particles lower the solvent's vapor pressure, thus requiring a higher temperature to cause boiling.
 - the temperature to cause boiling must be great enough to boil not only the solvent but also the solute.

AP Chemistry Unit 3 Test

11. A cucumber is placed in a concentrated salt solution. What will most likely happen?
- A) Water will flow from the cucumber to the solution.
 - B) No change will occur.
 - C) Water will flow from the solution to the cucumber.
 - D) Salt will precipitate out.
 - E) Salt will flow into the cucumber.
12. Osmotic pressure depends on all but which of the following?
- A) the molarity of the solution
 - B) temperature
 - C) the ratio of moles of solute to solution volume
 - D) atmospheric pressure
 - E) none of these
13. A solution of water and a nonvolatile, nonionizing compound is placed in a tube with a semipermeable membrane on one side. The tube is placed in a beaker of pure water. What initial net effect will occur?
- A) Equilibrium is immediately established.
 - B) The compound will pass through the membrane into the solution.
 - C) Nothing will move through the membrane either way.
 - D) Water will flow from the tube to the beaker.
 - E) Water will flow from the beaker to the tube.
14. Solutions that have identical osmotic pressures are called _____ solutions.
- A) dialytic
 - B) isotonic
 - C) hypotonic
 - D) hemolytic
 - E) hypertonic
15. Consider pure water separated from an aqueous sugar solution by a semipermeable membrane, which allows water to pass freely but not sugar. After some time has passed, the concentration of sugar solution:
- A) will have decreased.
 - B) might have increased or decreased depending on other factors.
 - C) will not have changed.
 - D) will be the same on both sides of the membrane.
 - E) will have increased.

16. The observed van't Hoff factor for an electrolyte is less than the expected factor because of _____.
- A) coagulation
 - B) complete dissociation
 - C) electrolytic repulsion
 - D) gelation
 - E) ion pairing
17. The osmotic pressure of a 0.0100 M solution of NaCl in water at 25°C is found to be different from 372 torr because:
- A) Na^+ and Cl^- ions are strongly hydrated.
 - B) osmotic pressures are hard to measure.
 - C) NaCl does not dissociate in water.
 - D) Na^+ and Cl^- ions can form ion pairs.
 - E) none of these
18. The solubility of a gas usually increases with increasing temperature.
(True A or False B)

Open-Ended & Problems

19. Thyroxine, an important hormone that controls the rate of metabolism in the body, can be isolated from the thyroid gland. If 0.455 g of thyroxine is dissolved in 10.0 g of benzene, the freezing point of the solution is 5.144°C. Pure benzene freezes at 5.444°C and has a value for the molal freezing point depression constant of K_f of 5.12°C/m. What is the molar mass of thyroxine?
3pts
20. Polyethylene is a synthetic polymer or plastic with many uses. 1.40 g of a polyethylene sample was dissolved in enough benzene to make 100. mL of solution, and the osmotic pressure was found to be 1.86 torr at 25°C. What is the molar mass of the polyethylene?
2pts.
21. Determine the osmotic pressure of a solution that contains 0.025 g of a hydrocarbon solute (molar mass = 340 g/mole) dissolved in benzene to make a 350-mL solution. The temperature is 20.0°C.
2pts.
22. Assuming ideality, calculate the vapor pressure of a 1.00 molal solution of a nonvolatile solute in water at 50°C. (The vapor pressure of water at 50°C is 92.5 torr.)
2pts

23. A 0.279m solution of CaCl_2 causes a freezing point depression of 1.330°C in water. Calculate the apparent value of the van't Hoff factor. (K_f of water is $1.86^\circ\text{C}/\text{kg/mol}$.)

2 pts

24. It is found that 3.90 g of benzene, C_6H_6 , dissolved in 100.0 g of a solvent lowers the freezing point to 10.0°C . The pure solvent freezes at 25.0°C . The molal freezing point depression constant of the solvent is

2 pts

25. Which of the following two aqueous solutions has (a) the lower boiling point. (b) the highest vapor pressure. (c) the higher freezing point: .40 m MgCl_2 or 1.00 m glucose. Give reasons for your answers.

3 pts

26. The formula and the molecular weight of an unknown hydrocarbon compound are to be determined by elemental analysis and the freezing-point depression method.

(a) The hydrocarbon is found to contain 93.46 percent carbon and 6.54 percent hydrogen. Calculate the empirical formula of the unknown hydrocarbon.

(b) A solution is prepared by dissolving 2.53 grams of p-dichlorobenzene (molecular weight 147.0) in 25.86 grams of naphthalene (molecular weight 128.2). Calculate the molality of the p-dichlorobenzene solution.

(c) The freezing point of pure naphthalene is determined to be 80.2°C . The solution prepared in (b) is found to have an initial freezing point of 75.7°C . Calculate the molal freezing-point depression constant of naphthalene.

(d) A solution of 2.42 grams of the unknown hydrocarbon dissolved in 26.7 grams of naphthalene is found to freeze initially at 76.2°C . Calculate the apparent molecular weight of the unknown hydrocarbon on the basis of the freezing-point depression experiment above.

(e) What is the molecular formula of the unknown hydrocarbon?

5 pts

27. The freezing point and electrical conductivities of three aqueous solutions are given below.

Solution (0.010 molal)	Freezing Point	Electrical Conductivity
sucrose	-0.0186°C	almost zero
acetic acid	-0.0213°C	low
sodium chloride	-0.0361°C	high

3 pts

Explain the relationship between the freezing point and electrical conductivity for each of the solutions above. Account for the differences in the freezing points among the three solutions.

extra credit

A chemical engineer has been assigned a project to increase the concentration of a solution of a protein in water using osmosis. The original solution of protein is 3.50 molar, the process temperature is 25°C . The engineer has been instructed not to change the semipermeable membrane, which is permeable only to water. He is confused so he decided to ask help from the Advanced Placement Chemistry class at Hackensack High School. For extra credit try to help the chemical engineer. (No monetary exchange for a successful suggestion will be rendered). Show any calculations, diagrams and comments. The more you indicate correctly the more credit.

3 pt MAX