

## Chapter 13 Homework

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**Part A multiple choice (select the one that is best in each case. 1 point/question)**

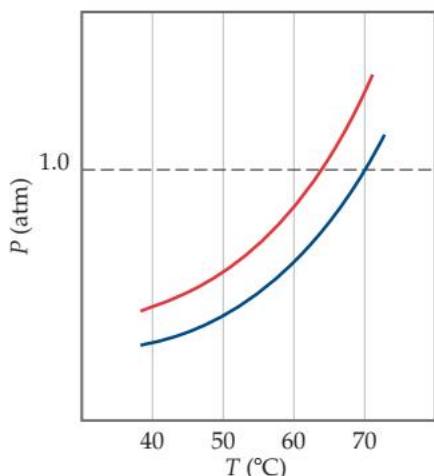
1. Which one of the following is incorrect?
  - A) Emulsifiers have the ability to keep substances in suspension as a colloid.
  - B) Coagulation is often induced by heating.
  - C) Hydrophobic colloids like to be associated with water.
  - D) The diameter of colloidal particles is usually in the range 5 – 1000 nm.
  - E) Colloids will not pass through semi-permeable membranes.
  
2. Indicate the main type of solute–solvent interaction HCl in acetonitrile ( $\text{CH}_3\text{CN}$ ).
  - A) ion-ion forces
  - B) ion-dipole
  - C) London dispersion
  - D) dipole-dipole
  - E) hydrogen bonding
  
3. Of the following, a 0.1 M aqueous solution of \_\_\_\_\_ will have the lowest freezing point.
  - A) NaCl
  - B) Al(NO<sub>3</sub>)<sub>3</sub>
  - C) K<sub>2</sub>CrO<sub>4</sub>
  - D) Na<sub>2</sub>SO<sub>4</sub>
  - E) sucrose
  
4. Pressure has an appreciable effect on the solubility of \_\_\_\_\_ in liquids.
  - A) gases
  - B) solids
  - C) liquids
  - D) salts
  - E) solids and liquids
  
5. The concentration of CO<sub>2</sub> in a soft drink bottled with a partial pressure of CO<sub>2</sub> of 6.5 atm over the liquid at 29 °C is  $2.2 \times 10^{-1}$  M. The Henry's law constant for CO<sub>2</sub> at this temperature is \_\_\_\_\_.
  - A)  $2.2 \times 10^{-1}$  mol/L-atm
  - B)  $7.6 \times 10^{-3}$  mol/L-atm
  - C)  $5.6 \times 10^{-3}$  mol/L-atm
  - D)  $3.4 \times 10^{-2}$  mol/L-atm
  
6. The process of a substance sticking to the surface of another is called \_\_\_\_\_.
  - A) absorption
  - B) diffusion
  - C) effusion
  - D) adsorption
  - E) coagulation
  
7. Seawater contains 3.4 g of salts for every liter of solution. Assuming that the solute consists entirely of NaCl (in fact, over 90% of the salt is indeed NaCl), calculate the osmotic pressure of seawater at 20 °C. ( $R = 0.0821 \text{ L} \cdot \text{atm} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$ )
  - A) 272 atm
  - B) 2.8 atm
  - C) 2.69 atm
  - D) 20.4 atm
  - E) 817 atm
  
8. Which of the following substances is more likely to dissolve in H<sub>2</sub>O?
  - A) CCl<sub>4</sub>
  - B) Ar
  - C) C<sub>6</sub>H<sub>6</sub>
  - D) CH<sub>3</sub>OH

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E) I<sub>2</sub>

9. This portion of a phase diagram shows the vapor-pressure curves of a volatile solvent and of a solution of that solvent containing a nonvolatile solute. The \_\_\_\_\_ line represents the solution. And the normal boiling points of the solution is \_\_\_\_\_.



- A) red, 64°C      B) red, 70°C      C) blue, 64°C      D) blue, 70°C

10. Indicate which statement is false in the formation of a solution.

- A) A solute will dissolve in a solvent if solute-solute interactions are smaller than solute-solvent interactions.  
B) An increase in entropy favors mixing.  
C) In making a solution, the enthalpy of mixing is always a positive number  
D) NaCl dissolves in water but not in benzene because the water-ion interactions are stronger than benzene-ion interactions.

11. The solubility of MnSO<sub>4</sub> monohydrate in water at 20 °C is 70.0 g per 100.0 mL of water. A solution at 20 °C that is 4.22 M in MnSO<sub>4</sub> monohydrate is best described as a(n) \_\_\_\_\_ solution. The formula weight of MnSO<sub>4</sub> monohydrate is 150.99 g/mol.

- A) hydrated  
B) solvated  
C) saturated  
D) supersaturated  
E) unsaturated

12. What is/are the intermolecular attraction(s) that occur between a water molecule and a glycerol molecule (CH<sub>2</sub>(OH)CH(OH)CH<sub>2</sub>OH).

- A) hydrogen bond  
B) dispersion  
C) dipole-dipole  
D) all of the above

13. Which of the following cannot be a colloid?

- A) an emulsion  
B) an aerosol  
C) a homogeneous mixture  
D) a foam  
E) All of the above are colloids.

14. Indicate whether each of the following is a hydrophilic or a hydrophobic colloid:

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- (i) butterfat in homogenized milk;
  - (ii) hemoglobin in blood;
  - (iii) vegetable oil in an oil and vinegar salad dressing
- A) (i) hydrophilic (ii) hydrophilic (iii) hydrophilic  
B) (i) hydrophobic (ii) hydrophilic (iii) hydrophobic  
C) (i) hydrophilic (ii) hydrophobic (iii) hydrophobic  
D) (i) hydrophilic (ii) hydrophobic (iii) hydrophilic  
E) (i) hydrophobic (ii) hydrophobic (iii) hydrophobic

15. An “emulsifying agent” is a compound that helps stabilize a hydrophobic colloid in a hydrophilic solvent (or a hydrophilic colloid in a hydrophobic solvent). Which of the following choices is the best emulsifying agent?

- A)  $\text{CH}_3\text{COOH}$   
B)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$   
C)  $\text{CH}_3(\text{CH}_2)_{11}\text{COOH}$   
D)  $\text{CH}_3(\text{CH}_2)_{11}\text{COONa}$

**Part B short questions--Write legibly and show all work for all steps in the problem. For mathematical relationships show both the equations used and substitution of values into the equation. Maintain correct units throughout your calculations and report your answers with the correct significant figures. (20 points)**

16. The solubility of Xe in water at 1 atm pressure and 20 °C is approximately  $5 \times 10^{-3} \text{ M}$ .  
(a) Compare this with the solubilities of Ar and Kr in water (in order of increase solubility). (b) What properties of the rare gas atoms account for the variation in solubility?

17. When ammonium chloride dissolves in water, the solution becomes colder. (a) Is the solution process exothermic or endothermic? (b) Why does the solution form?

18. A solution is made containing 14.6 g of  $\text{CH}_3\text{OH}$  in 184 g of  $\text{H}_2\text{O}$ . Calculate (a) the mole fraction of  $\text{CH}_3\text{OH}$ , (b) the mass percent of  $\text{CH}_3\text{OH}$ , (c) the molality of  $\text{CH}_3\text{OH}$ .

19. (a) Calculate the vapor pressure of water above a solution prepared by dissolving 28.5 g of glycerin ( $\text{C}_3\text{H}_8\text{O}_3$ ) in 125 g of water at 343 K. (The vapor pressure of water is 233.7 torr at 343 K.) (b) Calculate the mass of ethylene glycol ( $\text{C}_2\text{H}_6\text{O}_2$ ) that must be added to 1.00 kg of ethanol ( $\text{C}_2\text{H}_5\text{OH}$ ) to reduce its vapor pressure by 10.0 torr at 35 °C. The vapor pressure of pure ethanol at 35 °C is  $1.00 \times 10^2$  torr.

20. (a) Does a 0.10 *m* aqueous solution of NaCl have a higher boiling point, a lower boiling point, or the same boiling point as a 0.10 *m* aqueous solution of  $\text{C}_6\text{H}_{12}\text{O}_6$ ? Explain.  
(b) The experimental boiling point of the NaCl solution is lower than that calculated assuming that NaCl is completely dissociated in solution. Why is this the case?

## **Chapter 13 Homework Answer Sheet**

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Name: \_\_\_\_\_ Student ID: \_\_\_\_\_ Instructor: \_\_\_\_\_ Score: \_\_\_\_\_

**Part A multiple choice (15 points)**

1-5 \_\_\_\_\_ 6-10 \_\_\_\_\_ 11-15 \_\_\_\_\_

**Part B short question (20 points)**

**16. (4 points)**

**17. (3 points)**

**18. (6 points)**

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19. (4 points)

20. (3 points)