

CHEMISTRY 1220

CHAPTER 13 PRACTICE EXAM



1. A bottled soft drink has a liquid-phase concentration of CO_2 of 0.12 M at 25°C . The partial pressure of CO_2 is 4.0 atm above the liquid at the same temperature. Determine the Henry's law constant for CO_2 at 25°C .
 - a. 4.5×10^{-3} mol/L-atm
 - b. 8.5×10^{-3} mol/L-atm
 - c. 3.0×10^{-2} mol/L-atm
 - d. 8.4×10^{-2} mol/L-atm
 - e. 4.8×10^{-1} mol/L-atm

2. Which of the following concentration units is dependent on temperature?
 - a. Mass %
 - b. Parts per million (ppm)
 - c. Molarity
 - d. Molality
 - e. Parts per trillion (ppt)

3. How many grams of KOH are required to prepare a 250.0 mL solution of 0.50 M KOH? (K = 39.10 amu, O = 16.00 amu, H = 1.008 amu)

- a. 16 g
- b. 13 g
- c. 11 g
- d. 9.0 g
- e. 7.0 g

4. A 1.350 g sample of an non-volatile, non-electrolytic organic molecule is dissolved in 10.0 g of benzene and the freezing point is lowered by 3.66°C. What is the molar mass of the molecule (in g/mol)? (Benzene: $K_f = 5.12^\circ\text{C}/\text{m}$)

- a. 189 g/mol
- b. 176 g/mol
- c. 173 g/mol
- d. 243 g/mol
- e. 312 g/mol

5. What is the mole fraction of CBr_4 in the vapor above a solution of 25.00 g of CBr_4 and 50.00 g C_7H_8 at 100°C ? The vapor pressures of pure CBr_4 and pure C_7H_8 are 47.20 and 493.19 torr respectively at 100°C . (C = 12.01 amu, H = 1.008 amu, Br = 79.90 amu)

- a. 0.040
- b. 0.073
- c. 0.090
- d. 0.013
- e. 0.15

6. Rank the following solute-solvent interactions in order of INCREASING strength of attraction.

I. KCl in H_2O

II. $\text{CH}_3\text{CH}_2\text{OH}$ in H_2O

III. CO_2 in CCl_4

- a. $\text{I} < \text{II} < \text{III}$
- b. $\text{III} < \text{II} < \text{I}$
- c. $\text{II} < \text{III} < \text{I}$
- d. $\text{I} < \text{III} < \text{II}$
- e. $\text{III} < \text{I} < \text{II}$

7. The magnitudes of K_f and K_b depend on which of the following?

- a. Nature of the solute
- b. Nature of the solvent
- c. Properties of the solution
- d. Magnitude of intermolecular forces between solvent and solute
- e. All of the above

8. Thyroxine is a hormone present in the thyroid gland. A solution of 1.138 g of thyroxine in 25.0 mL of benzene has an osmotic pressure of 1.24 atm at 20°C. What is the molecular weight of thyroxine?

- a. 883 g/mol
- b. 841 g/mol
- c. 782 g/mol
- d. 902 g/mol
- e. 743 g/mol

9. Which substance is not miscible with water?

- a. CH_3OH
- b. $\text{CH}_3\text{CH}_2\text{OH}$
- c. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- d. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- e. All species a-d are completely immiscible with water

10. Which of following substances become **LESS** soluble in water as temperature **INCREASES**?

NaNO_3 (s)
(I)

$\text{K}_2\text{Cr}_2\text{O}_7$ (s)
(II)

N_2 (g)
(III)

CO_2 (g)
(IV)

- a. I and II
- b. III
- c. III and IV
- d. I, II, III, and IV
- e. None of the substances

11. Which is the following statements about solutions is FALSE?

- a. Two liquids that mix in all proportions are miscible with each other.
- b. Solubility of a gas solute in a liquid is directly proportional to pressure.
- c. A positive value for ΔS_{soln} means the solution is more ordered than the pure solute and pure solvent.
- d. The formation of a solution is possible when ΔH_{soln} is negative and ΔS_{soln} is positive.
- e. The formation of a solution is not possible when ΔH_{soln} is positive and ΔS_{soln} is negative.

12. A bottle containing 0.500 L water is pressurized with a mixture of 77.5% helium in nitrogen (by mass) to a total pressure of 5.50 atm at 30°C. The Henry's law constants for He in water at 30°C is 3.7×10^{-4} M/atm and the constant for N₂ in water at 30°C is 6.0×10^{-4} M/atm. How many mg of helium and nitrogen dissolve in water at 30°C?

- a. 3.9 mg He and 1.8 mg N₂
- b. 2.0 mg He and 0.13 mg N₂
- c. 5.3 mg He and 0.22 mg N₂
- d. 4.2 mg He and 8.7 mg N₂
- e. 1.3 mg He and 4.2 mg N₂

13. A recent analysis of drinking water in central Ohio revealed the presence of chloroform (CHCl_3) at a concentration of 19.5 ppb (parts per billion). What is the molarity of chloroform at 20°C if the water sample has a density of 0.9983 g/mL at 20°C ?

- a. $1.63 \times 10^{-2}\text{ M}$
- b. $1.63 \times 10^{-4}\text{ M}$
- c. $1.63 \times 10^{-6}\text{ M}$
- d. $1.63 \times 10^{-7}\text{ M}$
- e. None of the above

14. Concentrated hydriodic acid, HI (aq.), is 47.0% HI by mass and has a density of 1.50 g/mL . What is the MOLARITY and MOLALITY of this solution?

- a. 5.52 M , 3.67 m
- b. 5.52 M , 6.93 m
- c. 10.4 M , 3.67 m
- d. 10.4 M , 6.93 m
- e. 2.45 M , 6.93 m

15. The vapor pressure of pure carbon tetrachloride (CCl_4) at 65°C is 531 mm Hg. 20.0 g of a non-volatile, non-electrolyte but otherwise unknown solute is added to 154.0 g of CCl_4 at 65°C , which reduces the vapor pressure by 27 mm Hg. What is the molecular weight of the solute?

- a. 343 g/mol
- b. 359 g/mol
- c. 374 g/mol
- d. 399 g/mol
- e. 415 g/mol

16. A solution at 0°C consists of 40.0 g of CH_2Cl_2 and 60.0 g of CH_2Br_2 . The vapor pressures of pure CH_2Cl_2 and CH_2Br_2 are 0.175 atm and 0.015 atm respectively at 0°C . What is the total pressure of the vapor above the solution?

- a. 0.138 atm
- b. 0.132 atm
- c. 0.125 atm
- d. 0.117 atm
- e. 0.107 atm

17. What is the freezing point of a solution of 0.640 g of azulene ($C_{10}H_8$) in 100.0 g of camphor ($C_{10}H_{16}O$)? The molal freezing point constant of camphor is $40.0^\circ\text{C}/m$ and its freezing point is 179.75°C .

- a. 176.85°C
- b. 177.75°C
- c. 178.25°C
- d. 181.75°C
- e. 182.25°C

18. Lysozyme is an enzyme that cleaves cell walls. A 0.100 L aqueous solution of lysozyme that contains 75.0 mg of the enzyme has an osmotic pressure of 1.00 torr at 25°C . What is the molecular weight of lysozyme?

- a. $1.02 \times 10^3 \text{ g/mol}$
- b. $1.39 \times 10^3 \text{ g/mol}$
- c. $1.06 \times 10^5 \text{ g/mol}$
- d. $1.39 \times 10^4 \text{ g/mol}$
- e. $1.06 \times 10^7 \text{ g/mol}$

19. Which of the following correctly identifies the most important solute-solvent attraction in the given solution?

- a) CH_3OH in C_6H_6 hydrogen bonding
- b) $\text{Cu}(\text{NO}_3)_2$ in H_2O London
- c) CHBr_3 in $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$ dipole
- d) CH_3NH_2 in $\text{C}_2\text{H}_5\text{OH}$ dipole
- e) Choose this answer if all statements, a-d, are correct.

20. Rank the following compounds in order of decreasing solubility in water.

- I. $\text{CH}_3\text{-CH}_2\text{-OH}$
- II. $\text{CH}_3\text{-CH}_2\text{-O-CH}_2\text{-CH}_3$
- III. $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3$
- IV. $\text{CH}_3\text{-OH}$

- a) II, III, I, IV
- b) III, II, I, IV
- c) IV, I, II, III
- d) I, II, III, IV
- e) No order is correct

21. The density of a 48.0% by weight aqueous solution of sulfuric acid, H_2SO_4 , is 1.3783 g/cm^3 ? What is the molality (m) of this solution? (Atomic weights: S = 32.07, H = 1.008, O = 16.00)

- a) 4.88 m
- b) 7.52 m
- c) 2.53 m
- d) 0.551 m
- e) 9.42 m

22. A 5.52 M NaBr solution has a density of 1.42 g/mL . What is the molality of this solution? (Atomic weights: Na = 23.0, Br = 79.9)

- a) 5.58 m
- b) 5.82 m
- c) 6.01 m
- d) 6.21 m
- e) 6.48 m

23. A 2.48 L sample of He at 739 torr and 25°C is mixed with a 6.08 L sample of Ar at 325 torr and 25°C. Then, the mixture is placed in a 4.80 L container at 25°C. What is the partial pressure (atm) of He? (Atomic weights: He = 4.00, Ar = 39.95)

- a) 0.48
- b) 0.50
- c) 0.42
- d) 0.54
- e) 0.38

24. Which of the following of each pair is expected to be more soluble in water?

CH₃OH or CH₃Br; SiO₂ or H₂CO₃; C₆H₁₂ or C₆H₁₂O₆

- a) CH₃OH SiO₂ C₆H₁₂O₆
- b) CH₃OH H₂CO₃ C₆H₁₂O₆
- c) CH₃Br SiO₂ C₆H₁₂
- d) CH₃Br SiO₂ C₆H₁₂O₆
- e) CH₃OH H₂CO₃ C₆H₁₂

25. What is the molality of a 1.06 M aqueous solution of sugar ($C_6H_{12}O_6$, 342.3 g/mol) which has a density of 1.14 g/mL?

- a) 1.36 molal
- b) 1.06 molal
- c) 0.927 molal
- d) 0.634 molal
- e) 0.442 molal

26. Calculate the mole fraction of ethanol in the vapor phase at 63.5°C for an ideal solution containing 96.0 gm of pure methanol (CH_3OH , 32.0 g/mol) and 92.2 gm of pure ethanol (CH_3CH_2OH , 46.1 g/mol). The vapor pressure of methanol and ethanol at 63.5°C is 717.2 mm and 400.0 mm mercury, respectively.

- a) 0.943
- b) 0.701
- c) 0.466
- d) 0.271
- e) none of the above

27. What is the boiling point change for a solution containing 0.328 moles of naphthalene (a nonvolatile, nonionizing compound) in 250. g of liquid benzene ($K_b = 2.53 \text{ }^\circ\text{C}/\text{m}$, BP = 80.1°C)

- a) 3.32°C
- b) 7.41°C
- c) 1.93°C
- d) 4.31°C
- e) 10.7°C

28. When a 20.0 g sample of an unknown compound is dissolved in 500.0 g of benzene, the freezing point of the resulting solution is 3.77°C . The freezing point of pure benzene is 5.48°C and the K_f for benzene is $5.12^\circ\text{C}/\text{m}$. Calculate the molar mass of the unknown compound.

- a) 160. g/mol
- b) 80.0 g/mol
- c) 100. g/mol
- d) 140 g/mol
- e) 120 g/mol

29. The molar mass of a solid as determined by freezing point depression is 10% higher than the true molar mass. Which of the following experimental errors could not account for this discrepancy?

- a) Not all the solid was dissolved.
- b) More than the recorded amount of solvent was pipetted into the solution.
- c) The solid dissociated slightly into two particles when it dissolved.
- d) Some solid was left of the weighing paper.
- e) Before the solution was prepared, the container was rinsed with solvent and not dried.

30. Cox-1 is a protein that acts as an enzyme to speed up the production of prostaglandins. A solution contains 2.88 g of Cox-1 in 125 mL of water. This solution has an osmotic pressure of 24.8 mm Hg at 27°C. What is the molecular weight of this sample of Cox-1?

- a) 4.81×10^3 g/mol
- b) 3.20×10^4 g/mol
- c) 8.05×10^5 g/mol
- d) 5.75×10^3 g/mol
- e) 1.74×10^4 g/mol