

CHEMISTRY 16

EXAM I

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An optical scoring machine will grade this examination. The machine is not programmed to accept the correct one of two sensed answers and will not sense answers which are lightly marked. Mark your answer sheet carefully with a No. 2 soft lead pencil and erase any undesired marks COMPLETELY. Avoid making any extraneous marks on the answer sheet other than the information requested below.

On the answer sheet:

1. Print your name in the space for NAME (last name first, circle your last name).
2. In the space marked SUBJECT print your student number.
3. In the space marked HOUR print Summer II '98.

Check to see that you have 20 examination questions and a periodic table when the exam begins.

HAND IN ONLY THE ANSWER SHEET.

Useful Equations and Constants:

$$K_f(\text{H}_2\text{O})=1.86 \text{ kg}\cdot^\circ\text{C}/\text{mol}$$

$$K_b(\text{H}_2\text{O})=0.52 \text{ kg}\cdot^\circ\text{C}/\text{mol}$$

$$1 \text{ atm}=760 \text{ torr}=760 \text{ mm Hg}$$

$$R=0.08206 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}=8.314 \text{ J}/\text{mol}\cdot\text{K}$$

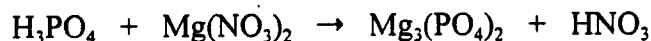
CHEMISTRY 16
HOUR EXAM I

CHOOSE THE ONE BEST ANSWER.

1. What volume (in mL) of a solution that is 0.750 M $\text{Al}(\text{NO}_3)_3$ will provide 0.0500 mol of nitrate ions?

A. 22.2 mL
B. 200. mL
C. 112 mL
D. 70.7 mL
E. 15.0 mL

2. Write the net ionic equation for the following reaction that occurs in aqueous solution. Ions that **do not appear** in the net ionic equation (ie. spectator ions) are:



A. Mg^{+2} and PO_4^{-3}
B. H^+ and NO_3^-
C. NO_3^- only
D. Mg^{+2} and H^+
E. All ions are spectator ions.

3. Which of the following compounds acts as a **weak electrolyte** when dissolved in water?

A. CaCl_2
B. NaOH
C. H_2SO_4
D. $\text{HC}_2\text{H}_3\text{O}_2$
E. All of the above.

4. A solution is 0.1 M in Pb^{+2} and Sr^{+2} . Addition of $\text{HBr}(\text{aq})$ will precipitate _____ while addition of $\text{K}_2\text{SO}_4(\text{aq})$ will precipitate _____.
(HINT: Predict products and solubility)

A. PbBr_2 and SrBr_2 ; PbSO_4
B. PbBr_2 and SrBr_2 ; PbSO_4 and SrSO_4
C. PbBr_2 ; PbSO_4
D. PbBr_2 ; PbSO_4 and SrSO_4
E. Nothing; Nothing

5. Which of the following mixtures have components which can be separated by filtration?
- A. Milk
 - B. Blood
 - C. Seawater
 - D. Lemonade
 - E. Wine
6. Which should be **least soluble** in water?
- A. C_4H_{10} (butane)
 - B. $H-\overset{\overset{O}{\parallel}}{C}-O-H$ (formic acid)
 - C. CH_3OH (methanol)
 - D. H_2N-CH_3 (methylamine)
 - E. KBr
7. A temperature increase causes the solubility of gaseous O_2 in freshwater to _____; while a temperature increase causes the solubility of solid NH_4NO_3 in water to _____. (The dissolution of NH_4NO_3 in water is endothermic)
- A. increase; decrease
 - B. decrease; increase
 - C. decrease; decrease
 - D. increase; increase
 - E. decrease; temperature has no effect on the solubility of an ionic compound in water.
8. The Henry's Law constant of gaseous methyl bromide CH_3Br is $k=0.159$ mol/L-atm at $25^\circ C$. What mass of gaseous CH_3Br will dissolve in 225 mL of water at $25^\circ C$ and at a CH_3Br partial pressure of 250. mm Hg? (Molar Mass $CH_3Br = 94.93$)
- A. 5.23 g
 - B. 3.40 g
 - C. 8.49 g
 - D. 22.1 g
 - E. 1.12 g
9. A 1.30 M solution of $CaCl_2$ in water has a density of 1.11 g/mL. The molality of $CaCl_2$ is: (Molar Mass $CaCl_2=110.99$)
- A. 1.17 m
 - B. 1.44 m
 - C. 1.30 m
 - D. 0.854 m
 - E. 1.35 m

10. A solution of liquid toluene dissolved in liquid benzene has a benzene mole fraction of 0.850. Calculate the vapor pressure of the solution given that the vapor pressures of pure benzene and toluene are 183 mm Hg and 59.2 mm Hg, respectively.
- A. 155 mm Hg
 - B. 206 mm Hg
 - C. 164 mm Hg
 - D. 124 mm Hg
 - E. 50.3 mm Hg
11. A solution is prepared by dissolving 0.131 mol of sugar, $C_{12}H_{22}O_{11}$, in 175 g of water. The amount by which the **vapor pressure is lowered** is:
(The vapor pressure of water is 23.76 mm Hg at 25°C)
- A. 23.00 mm Hg
 - B. 0.316 mm Hg
 - C. 17.8 mm Hg
 - D. 3.11 mm Hg
 - E. 1.33 mm Hg
12. Which one of the aqueous solutions below will have the highest boiling point?
- A. 0.012 m KCl
 - B. 0.0080 m $BaCl_2$
 - C. 0.0080 m K_2SO_4
 - D. 0.0060 m $Al(NO_3)_3$
 - E. All have about the same boiling point.
13. A solution is made by dissolving 20.0 g $C_7H_6O_2$ in 800 g C_6H_6 . The freezing point of the resulting solution is:
($K_f(C_6H_6)=5.10\text{ kg}\cdot^\circ\text{C}/\text{mol}$; $T_f(C_6H_6)=5.50^\circ\text{C}$)
- A. 4.46 °C
 - B. 3.75 °C
 - C. 5.50 °C
 - D. 4.22 °C
 - E. 6.54 °C
14. What is the boiling point of a solution of 0.086 mol NaCl dissolved in 100. g of water?
- A. 100.40 °C
 - B. 101.71 °C
 - C. 100.22 °C
 - D. 100.89 °C
 - E. 99.11 °C

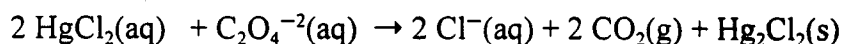
15. A 0.15 g sample of a protein is dissolved in enough water to give 2.0 mL of solution. The osmotic pressure of the resulting solution is 18.6 mm Hg at 25°C. The molar mass of the protein is:

- A. 2.0×10^6 g/mol
- B. 1.3×10^5 g/mol
- C. 99 g/mol
- D. 7.5×10^4 g/mol
- E. 6.3×10^3 g/mol

16. Red blood cells are filled with an aqueous solution of various solutes and the cell walls act as a semipermeable membrane. A red blood cell is taken from the bloodstream and placed into pure water. Which of the following statements is TRUE?

- A. Water molecules flow out of the red blood cells, causing them to collapse.
- B. The osmotic pressure exerted on the cell walls remains constant.
- C. Water flows into the red blood cells, causing them to swell and burst.
- D. Solute flows out of the red blood cells causing a decrease in osmotic pressure.
- E. The osmotic pressure of the pure water is greater than the pressure inside the red blood cells, causing them to constrict.

17. Given the initial rate data shown below, calculate the rate law for the following reaction.



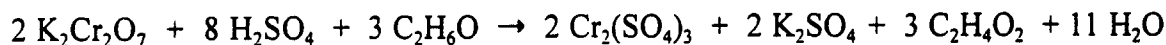
$[\text{HgCl}_2]$	$[\text{C}_2\text{O}_4^{2-}]$	<u>Initial Rate (M/sec)</u>
0.10	0.20	5.20×10^{-7}
0.10	0.40	2.08×10^{-6}
0.30	0.20	1.56×10^{-6}

- A. Rate = $k [\text{HgCl}_2]^2 [\text{C}_2\text{O}_4^{2-}]^2$
- B. Rate = $k [\text{HgCl}_2]^2 [\text{C}_2\text{O}_4^{2-}]$
- C. Rate = $k [\text{HgCl}_2] [\text{C}_2\text{O}_4^{2-}]^2$
- D. Rate = $k [\text{HgCl}_2]^3 [\text{C}_2\text{O}_4^{2-}]^4$
- E. Rate = $k [\text{HgCl}_2] [\text{C}_2\text{O}_4^{2-}]$

18. The reaction shown below has the rate law $\text{Rate} = k[\text{A}][\text{B}]^2$. Which of the following will NOT increase the rate of the reaction?



- A. Increase in concentration of reactant C.
 - B. A temperature change from 100°C to 25°C .
 - C. Doubling of $[\text{B}]$ but a halving of $[\text{A}]$.
 - D. Answers A, B, and C will NOT increase the rate.
 - E. Answers A and B will NOT increase the rate.
19. The reaction below occurs in the Breathalyzer when determining alcohol level in the bloodstream.



Calculate the rate of disappearance of $\text{C}_2\text{H}_6\text{O}$ if the rate of appearance of $\text{Cr}_2(\text{SO}_4)_3$ is 2.48 M/min .

- A. 7.44 M/min
 - B. 3.72 M/min
 - C. 4.96 M/min
 - D. 1.65 M/min
 - E. 0.827 M/min
20. A reaction has the following rate law: $\text{Rate} = k[\text{C}_4\text{H}_9\text{Br}][\text{OH}^-]^0$. If the rate of the reaction is $2.2 \times 10^{-4} \text{ M/sec}$ when $[\text{C}_4\text{H}_9\text{Br}] = 0.50 \text{ M}$ and $[\text{OH}^-] = 0.25 \text{ M}$, what is the value of the rate constant, k ?
- A. $4.4 \times 10^{-4} \text{ sec}^{-1}$
 - B. $1.1 \times 10^{-4} \text{ sec}^{-1}$
 - C. $1.8 \times 10^{-3} \text{ sec}^{-1}$
 - D. $2.8 \times 10^{-5} \text{ sec}^{-1}$
 - E. None of the above.