

Chemistry 200  
Final Exam  
June 25, 1999  
120 minutes

Name: \_\_\_\_\_

ID#: \_\_\_\_\_

Read carefully before you start:

- Calculators are allowed.
- Periodic tables are provided.
- No pencils or red pen.
- No penalty.
- You can also use any white space as scratch.
- Do not detach any page.

Useful information

Gas Constant,  $R = 0.08206 \text{ atm}\cdot\text{L}/\text{Kmol}$ .

Avogadro's number =  $6.022 \times 10^{23} \text{ molec/mol}$ .

1 atm = 760 mm Hg.

Activity series: Li K Ba Ca Na Mg Al Zn Cr Fe Cd Co Ni Sn Pb H<sup>+</sup> Cu Hg  
Ag

- Which of the following molecules is polar?
  - a.  $I_2$
  - b.  $CH_4$
  - c.  $H_2O$
  - d.  $CO_2$
  - e.  $HCl$
  - f. c and d
  - g. c and e
  
- The correct name for  $Mn_2O_7$  is
  - a. dimanganese heptoxide
  - b. manganese oxide
  - c. manganese (VII) oxide
  - d. manganese (II) oxide
  - e. magnesium (VII) oxide
  
- Which is the correct formula for cupric nitrate?
  - a.  $Cu(NO_3)_2$
  - b.  $Cu(NO_3)$
  - c.  $Cu(NO_2)$
  - d.  $Cu(NO_3)_2$
  - e.  $Cu_2(NO_3)$
  
- In the cathode ray tube, which is true?
  - a. A high voltage electric current is driven through a near vacuum in a tube.
  - b. The rays of electrons are known as cathode rays since they travel from the negatively charged anode to the cathode.
  - c. The deflection of the rays by a magnetic field proved the wave theory of electrons.
  - d. All of the above.
  
- Calculate the mass of a fullerene ( $C_{60}$ ) molecule in grams
  - a.  $7.20 \times 10^{-2}$
  - b.  $1.20 \times 10^{21}$
  - c.  $2.00 \times 10^{23}$
  - d.  $1.20 \times 10^{20}$
  - e.  $1.20 \times 10$
  
- Air is 21% v/v Oxygen (volume by volume). Oxygen has a density of 1.31g/L. What is the volume in L of a room that holds enough air to contain 75 Kg of Oxygen?
  - a.  $0.57 \times 10^2$
  - b.  $2.7 \times 10^2$
  - c.  $57 \times 10^5$
  - d.  $2.7 \times 10^5$

- Which of the following ions has largest radius?
  - a.  $\text{Cl}^-$
  - b.  $\text{S}^{2-}$
  - c.  $\text{K}^-$
  - d.  $\text{Na}^+$
  - e.  $\text{O}^{2-}$
  
- Which one of the following elements has the greatest electron affinity?
  - a. K
  - b. Br
  - c. As
  - d. Ar
  - e. I
  
- Which of the following elements has the lowest ionization energy?
  - a. Cl
  - b. Na
  - c. Be
  - d. K
  - e. As
  
- How much of 12.6 M HCl is required to make 75.0 mL of 3.50 M HCl?
  - a. 20.8 mL
  - b. 58.8 mL
  - c. 270 mL
  - d. 0.588 mL
  - e. 41.6 mL
  
- A 0.4785 g sample  $\text{H}_2\text{C}_2\text{O}_4$  (a diprotic acid) is titrated with 35.87 mL of KOH: the normality of the KOH solution is:
  - a. 0.9612 N
  - b. 0.2963 N
  - c. 0.1482 N
  - d. 0.4964 N
  
- When a liquid is heated at its boiling point, which is true?
  - a. The covalent bonds are broken, allowing vaporization to occur.
  - b. The temperature of the liquid increases.
  - c. Temperature of the vapor phase increases.
  - d. Temperature of the liquid remains the same as long as any liquid is present.
  - e. c and d.

• How many grams of hydrogen are there in a drop of water weighing 0.050 g?

- a.  $1.7 \times 10^{21}$
- b.  $1.5 \times 10^{23}$
- c.  $3.3 \times 10^5$
- d.  $2.6 \times 10^{22}$

• Emerald has the chemical formula  $\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$ . If the mass of Beryllium (Be) in Emerald is 5.030%, how many Beryllium atoms are there in one formula unit?

- a. 4
- b. 3
- c. 2
- d. 1

• The elemental analysis of 2.0 g of a compound containing only C, H, and N yielded 1.067 g C, 0.311 g H, and 0.622 g N. Determine the empirical formula of this compound.

- a.  $\text{N}_2\text{H}_7\text{C}$
- b.  $\text{NH}_7\text{C}_2$
- c.  $\text{N}_2\text{H}_{14}\text{C}_4$
- d.  $\text{N}_4\text{H}_{14}\text{C}_2$

• A 5.25g sample of an unknown gas occupies a volume of 1.00 L and exerts a pressure of 1.26 atm at  $-4^\circ\text{C}$ . Which of the following is the molecular formula?

- a. NO
- b.  $\text{N}_2\text{O}_4$
- c.  $\text{NO}_2$
- d.  $\text{N}_2\text{O}_5$
- e.  $\text{NO}_3$

• A mixture of three gases A, B and C has a measured volume of 1.00 L at  $27^\circ\text{C}$ . The partial pressures of A, B and C are 300, 250 and 425 mm Hg, respectively. Calculate the volume of the remaining gases in liters at STP if gas A is removed selectively.

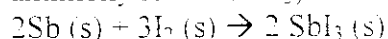
- a. 0.808 L
- b. 0.882 L
- c. 1.17 L
- d. 0.868 L
- e. 0.659 L

- How many coordinate bonds are there in the molecule  $\text{COF}_2$ ?
  - a. 3
  - b. 2
  - c. 1
  - d. 0
  
- Which molecule contains a triple bond?
  - a.  $\text{F}_2$
  - b.  $\text{O}_3$
  - c.  $\text{HCN}$
  - d.  $\text{H}_2\text{CO}$
  
- What is the ground state electron configuration of tellurium?
  - a.  $[\text{Kr}]4d^{10}5s^25p^4$
  - b.  $[\text{Kr}]5s^25p^65d^8$
  - c.  $[\text{Kr}]5s^25p^4$
  - d.  $[\text{Kr}]4f^{14}4d^{10}5s^25p^4$
  
- Which have the largest number of unpaired electrons in p orbitals in their ground-state electron configurations?
  - a. N, P, As
  - b. F, Cl, Br
  - c. Ne, Ar, Kr
  - d. Te, I, Xe
  
- Which one of the following have their valence electrons in the same shell?
  - a. He, Ne, F
  - b. B, Si, Bi
  - c. N, As, Bi
  - d. K, As, Br
  
- What is the ground-state configuration of the ion  $\text{Hg}^{2+}$ ?
  - a.  $[\text{Xe}]4f^{14}5d^{10}$
  - b.  $[\text{Xe}]4f^{14}5d^8s^2$
  - c.  $[\text{Xe}]4f^{14}5d^{10}6s^2$
  - d.  $[\text{Xe}]4f^{14}5d^{10}6s^26p^2$
  
- What is the density of fluorine gas at STP?
  - a. 0.848 g/L
  - b. 1.55 g/L
  - c. 1.70 g/L
  - d. 1.85 g/L

- The balanced chemical equation for the reaction that occurs upon heating strontium carbonate is:

- $2 \text{SrCO}_3 \rightarrow \text{Sr}_2\text{O} + 2 \text{CO}_2$
- $\text{SrCO}_3 \rightarrow \text{SrO}_2 + \text{CO}$
- $\text{SrCO}_3 \rightarrow \text{Sr} + \text{CO} + \text{O}_2$
- $\text{SrCO}_3 \rightarrow \text{SrO} + \text{CO}_2$

- When 1.2 g antimony (Sb) reacts with 2.40 g iodine ( $\text{I}_2$ ), it gives the product antimony iodide ( $\text{SbI}_3$ ) according to the following equation:



The mass of  $\text{SbI}_3$  formed is:

- 0.768 g
- 4.95 g
- 0.43 g
- 3.17 g

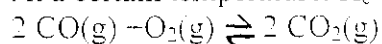
- Aqueous solutions of 30% (by weight) hydrogen peroxide,  $\text{H}_2\text{O}_2$ , are used to oxidize metals or organic molecules in chemical reactions. Calculate the molality of this solution.

- 0.974 m
- 6.78 m
- 9.79 m
- 12.6 m

- $K_p$  is equal to 48.70 at 731 K for the reaction:  $\text{HI (g)} + \text{I}_2 \text{ (g)} \rightleftharpoons 2\text{HI (g)}$ . Initially the mixture contains 0.08592 atm each of  $\text{H}_2$  and  $\text{I}_2$  and 1.00 atm of HI. What is the pressure of HI at equilibrium?

- 0.7995 atm
- 0.9108 atm
- 0.9140 atm
- 0.9490 atm

- At a certain temperature,  $K_c$  equals  $1.40 \times 10^2$  for the reaction:



If a 2.50 L flask contains 0.400 mol of  $\text{CO}_2$  and 0.100 mol of  $\text{O}_2$  at equilibrium, how many moles of CO are also present in the flask?

- 0.422 moles
- 0.169 moles
- 0.107 moles
- 0.0114 moles

- Given the reaction:  $2 \text{HI}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{I}_2(\text{g})$ . If  $K_c$  for the reverse reaction is  $1.85 \times 10^{-2}$  at  $425^\circ\text{C}$ , what is  $K_c$  for the forward reaction at the same temperature?
  - $-1.85 \times 10^{-2}$
  - $1.85 \times 10^{-2}$
  - $3.70 \times 10^{-2}$
  - 54.1
  
- Which of the following does not affect the rate of a chemical reaction?
  - concentration of the reactants
  - presence of a catalyst
  - volume of the container
  - temperature
  - b and c
  - all of the above affect the rate.
  
- The enthalpy for the following reaction is 136 kJ. If the reaction takes place in a closed container, which one of the following reaction conditions will not decrease the concentration of water vapor?
 
$$2 \text{NaHCO}_3(\text{s}) \rightleftharpoons \text{Na}_2\text{CO}_3(\text{s}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$$
  - Add  $\text{CO}_2$
  - Cool the container
  - Decrease the volume of the container
  - Remove some  $\text{NaHCO}_3$
  
- The decomposition of nitrosyl bromide is exothermic:
 
$$2 \text{NOBr}(\text{g}) \rightleftharpoons 2 \text{NO}(\text{g}) + \text{Br}_2(\text{g})$$
 Which of the following changes in reaction condition will shift the reaction to the left?
  - Add more  $\text{NOBr}$
  - Decrease the temperature
  - Increase the container volume
  - b and c
  - none of the above
  
- What is the pH of a 0.020 M  $\text{Ba}(\text{OH})_2$ ?
  - 1.40
  - 1.70
  - 12.60
  - 13.60

- What is the pH of a solution made by mixing 100.00 mL of 0.200 M HCl with 50.00 mL of 0.100 M HCl?
  - a. 0.17
  - b. 0.52
  - c. 0.78
  - d. 1.70
  - e. 0.2
  
- What is the pH of a 0.100 M acetic acid solution with a  $K_a = 1.8 \times 10^{-5}$ ?  
 The equation of interest is :  $\text{HA} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{A}^-(\text{aq})$ .
  - a. 1.80
  - b. 2.87
  - c. 3.90
  - d. 4.02
  
- What is the  $[\text{A}^-]/[\text{HA}]$  ratio necessary to make a buffer solution with a pH of 4.44?  
 $K_a(\text{HA}) = 1.8 \times 10^{-5}$ .
  - a. 0.30:1
  - b. 0.50:1
  - c. 1.07:1
  - d. 1.33:1
  
- Which statement about buffers is true?
  - a. Buffers have pH = 7.
  - b. Buffers consist of a strong acid and its conjugate base.
  - c. A buffer does not change pH on addition of a strong acid or strong base.
  - d. Buffers resist change in pH upon addition of small amounts of strong acids and strong bases.
  - e. b and d
  
- In an exothermic reaction:
  - a. The enthalpy of the products is greater than the enthalpy of the reactants.
  - b. The internal energy stored in the bonds of the reactants is lower than the energy stored in the bonds of the products.
  - c. If the reaction takes place in a thermally insulated container, the temperature of the system increases.
  - d. If the reaction takes place in a thermally insulated container, the temperature of the system decreases.
  
- What is the solubility of  $\text{CaF}_2$  in 0.1 M NaF solution at 25 °C?  $K_{sp}(\text{CaF}_2) = 1.5 \times 10^{-10}$ 
  - a.  $3.8 \times 10^{-9}$  M
  - b.  $1.5 \times 10^{-8}$  M
  - c.  $1.2 \times 10^{-5}$  M
  - d.  $3.4 \times 10^{-4}$  M