

## Chemistry 200

Final

3 Feb. 1998

1.5 Hrs.

First Name:

Family Name:

ID No.:

Section: A [42 marks]      Circle the correct answer

The solubility of CoS is  $1.57 \times 10^{-11}$  g/L at  $18^\circ\text{C}$ . The  $K_{sp}$  of CoS is

- a  $2.99 \times 10^{-22} \text{ mol}^2/\text{L}^2$
- b  $2.98 \times 10^{-26} \text{ mol}^2/\text{L}^2$
- c  $2.46 \times 10^{-22} \text{ mol}^2/\text{L}^2$
- d  $0.0516 \times 10^{-26} \text{ mol}^2/\text{L}^2$

The following are the solubility product constants for various slightly soluble salts in water at  $20^\circ\text{C}$

Salt	$K_{sp}$
AgI	$8.5 \times 10^{-17}$
AgBrO <sub>3</sub>	$6.0 \times 10^{-5}$
BaCO <sub>3</sub>	$7.0 \times 10^{-9}$
CaF <sub>2</sub>	$3.9 \times 10^{-11}$

The least soluble salt is:

- a AgI
- b BaCO<sub>3</sub>
- c CaF<sub>2</sub>
- d AgBrO<sub>3</sub>

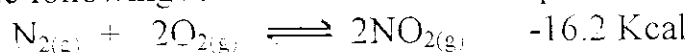
For a solution that contains equimolar amounts of NH<sub>3</sub> and NH<sub>4</sub>Cl

- a its pH increases drastically by slight addition of NaOH
- b its pH decreases drastically by slight addition of NaOH
- c its pH changes slightly by addition of small amount of HCl
- d we cannot talk about pH of the above system since it does not contain any H<sup>+</sup> ions

The concentration of hydroxyl (OH<sup>-</sup>) ions in a solution which has a pH=5.0 is

- a  $1.0 \times 10^{-5}$
- b  $9.0 \times 10^{-14}$
- c  $1.0 \times 10^{-9}$
- d none of the above

For the following reaction that involves equilibrium



- a if pressure is increased, equilibrium shifts to the left
- b if volume is increased, equilibrium shifts to the left
- c if temperature is increased, equilibrium shifts to the left
- d if temperature is decreased, equilibrium shifts to the right

The percent ionization of 2.00 M formic acid ( $\text{HCO}_2\text{H}$ ) at  $50^\circ\text{C}$  is:

$$K_a \text{ of } \text{HCO}_2\text{H} = 1.65 \times 10^{-4} \text{ mole/litre}$$

- a  $1.82 \times 10^{-2} \%$
- b  $1.28 \times 10^{-2} \%$
- c  $1.82 \%$
- d  $0.910 \%$

Given the following weak acids with their ionization constants

Acid	$K_a$
Acetic acid	$1.76 \times 10^{-5}$
Barbituric acid	$9.8 \times 10^{-5}$
Lactic acid	$1.37 \times 10^{-4}$
Sulfurous acid	$1.72 \times 10^{-2}$

If 1.0 M of each is prepared, which will have the highest pH?

- a Acetic acid
- b Barbituric acid
- c Lactic acid
- d Sulfurous acid

Of the following compounds, the only one that cannot act as a Lowry-Bronsted acid and Lowry-Bronsted base at the same time is:

- a  $\text{HSO}_4^-$
- b  $\text{CN}^-$
- c  $\text{HCO}_3^-$
- d  $\text{NH}_3$

Which of the following statements does not apply to the following compounds:  $\text{HClO}$ ,  $\text{HClO}_2$ ,  $\text{HClO}_3$  and  $\text{HClO}_4$

- a all the above compounds are Lowry-Bronsted acids
- b the oxidation number of O is not the same in all the above structures
- c the oxidation number of Cl increases as the number of O atoms increases in the above structures
- d the oxidation number of O is the same in all the given structures

Among the following given compounds, the only one that is insoluble in water is:

- a  $\text{NaO}$
- b  $\text{NH}_4\text{PO}_4$
- c  $\text{CCl}_4$
- d  $\text{C}_2\text{H}_5\text{OH}$

Among the following given molecules, the only one that is non-polar is:

- a  $\text{PCl}_2\text{F}$
- b  $\text{BCl}_3$
- c  $\text{SO}_2$
- d  $\text{CH}_2\text{Cl}_2$

Given the following compounds with their boiling points at 1 atm.

Compound	Boiling point ( $^{\circ}\text{C}$ )
$\text{HF}$	19.7
$\text{HCl}$	-85.0
$\text{HBr}$	-66.8
$\text{H}_2\text{O}$	100

- a water has the highest boiling point because it has the highest molecular weight
- b we can generalize that the higher the extent of hydrogen bonding for comparable structures, the lower the boiling point
- c hydrogen bonding in  $\text{HCl}$  and  $\text{HBr}$  is negligible
- d the extent of hydrogen bonding in  $\text{HF}$  is more than that in  $\text{H}_2\text{O}$ , because F is more electronegative than O

Cyanogen, a highly poisonous gas gave on analysis 46.2% C and 53.8% N.  
What is the molecular formula of cyanogen? its density at STP=2.32g/L

- a CN
- b C<sub>2</sub>N
- c C<sub>4</sub>N<sub>4</sub>
- d C<sub>2</sub>N<sub>2</sub>

The number of oxygen molecules in 4.5 L of oxygen gas at 27°C and 800 torr is

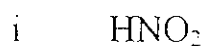
- a  $1.15 \times 10^{23}$
- b 6.14
- c 0.192
- d none of the above

Section B Show all your calculations

[9 marks] Given that magnesium hydroxide is a strong electrolyte, calculate the solubility of magnesium hydroxide ( $K_{sp}=8.9 \times 10^{-12}$ ) in

- i in water
- ii in 0.05 M sodium hydroxide
- iii is the magnesium hydroxide more soluble in i or ii

[8 marks] Draw Lewis structures and give the correct IUPAC names to each of the following:



[4 marks] Fill in the missing blanks

\_\_\_\_\_ predicted the existence of electromagnetic waves

there are \_\_\_\_\_ electrons in the **i** energy sublevel

\_\_\_\_\_ calculated the mass of the electron

when an electron is at an energy level above its lowest level, the atom is said to be in an \_\_\_\_\_

[10 marks] If 50.0 ml of a solution containing 0.001 mole of  $\text{Ag}^+$  ion is mixed with 50.0 ml of 0.10 M  $\text{HCl}$ , how much silver ion remain in solution ( $K_{\text{sp}}$  for  $\text{AgCl}$  is  $1 \times 10^{-10}$ )

[7 marks] What weight of  $\text{CaCl}_2$  is needed to react with sufficient silver nitrate to make 10 g of silver chloride.

[ 6 marks] Predict the compound that is most likely to be formed from each of the following pairs of elements:

i Na and O

ii Cs and S

iii Fr and N

[7 marks] The following reaction was carried out:



The molecular masses in amu are:

$$A=50$$

$$B=100$$

$$C=65$$

if 25g of A is allowed to react with 50g of B. Calculate the following:

- i How many grams of C would be produced?
- ii The number of moles of the excess reagent remain unreacted

[7 marks] The acidic substance in vinegar is acetic acid. When 6.0g of vinegar was titrated with 0.10 M sodium hydroxide, 40.0 ml of base had to be added to reach the equivalence point. What percent by weight of this sample of vinegar is acetic acid.