

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

Answer key

CHEMISTRY 1211

EXAM #2 Version 1

This exam is **eighteen** questions long. Please read through all of the questions first and ask about anything you do not understand. You will have one hour and 15 minutes to complete this exam. Exams will be picked up at the end of the class period. No late exams will be accepted!

You are allowed to use a calculator. If you do not have a calculator, setting up the problem correctly will gain you some points but you will not receive full credit for any question you do not answer completely.

Included in this exam is a periodic table, which should be stapled to the back of the exam.

**CHEATING IS NOT ALLOWED. ANYONE CAUGHT CHEATING WILL RECEIVE A ZERO ON THIS EXAM.**

The exam is worth a total of 100 points. Each question is labeled with its exact point value. Be sure to answer all of the questions on the exam.

Good Luck!

GIVEN INFORMATION

Water Vapor Pressure

25°C 23.80 mmHg

30°C 31.82 mm Hg

Speed of light

$c = 2.998 \times 10^8$  m/s

Ideal Gas Law Constant

$R = 0.0821$  L atm / mol K

Conversion Factors

1 atm = 760 torr = 760 mmHg

1 J = 1 kg m<sup>2</sup>/s<sup>2</sup>

Equations

$c = \lambda \nu$        $E = h \nu$

Plank's Constant

$h = 6.626 \times 10^{-34}$  J s

Rydberg Constant

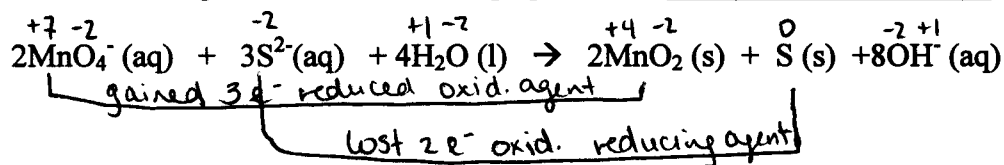
$R = 1.097 \times 10^7$  m<sup>-1</sup>

Rydberg Equation

$\frac{1}{\lambda} = R \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$

4 points

1.) In the following reaction the oxidizing agent is the  $MnO_4^-$  ion.



4 points

2.) With which of the following will copper (II) ion form an insoluble solid?

- a. Sulfate  
b. Carbonate  
c. Chloride  
d. Sulfate and carbonate  
e. None of the above

4 points

3.) Of the following, \_\_\_\_\_ is a characteristic of gases.

- a. There are relatively large distances between molecules  
b. Gases are highly compressible.  
c. A gas expands spontaneously to fill its container.  
d. Gases form homogeneous mixtures regardless of the non-reacting gas components.  
e. All of these

6 points

4.) Identify the transition metal if 0.014 g of Metal X reacts with acid to yield 6.43 mL of hydrogen gas collected over water at atmospheric pressure and 25°C.



- a. Fe  
b. Cu  
c. Mn  
d. Zn  
e. Al

$$n = \frac{PV}{RT} = \frac{(0.9687 \text{ atm})(0.00643 \text{ L})}{(0.0821 \frac{\text{L atm}}{\text{mol K}})(298 \text{ K})}$$

$$n = 0.00025 \text{ moles}$$

$$V = 0.00643 \text{ L}$$

$$T = 298 \text{ K}$$

$$P = 1.0 \text{ atm} - 0.0313 \text{ atm} = 0.9687 \text{ atm}$$

$$n = ?$$

$$\frac{0.014 \text{ g}}{0.00025 \text{ mol}} = 54.99 \text{ g/mole}$$

4 points

5.) An ideal gas differs from a real gas in that the molecules of an ideal gas

- B
- a. Have no volume
  - b. Have no attraction for one another
  - c. Move in a curved path
  - d. Have no kinetic energy
  - e. Have no mass

4 points

6.) Choose the response that contains all of the true statements and no others regarding atomic orbitals.

- I. Each shell (n value) except the first, contains three mutually perpendicular equal sized dumbbell-shaped orbitals known as p orbitals. T
- II. Each set of d orbitals can accommodate a maximum of 12 electrons F
- III. Each shell except the first contains a spherically shaped s orbital F
- IV. No known elements have electrons occupying f orbitals in their ground states. F

- A
- a. I
  - b. I, II, and IV
  - c. I, III, and IV
  - d. I, II and III
  - e. II

4 points

7.) Which of the following atoms have the fewest number of unpaired electrons in its ground state?

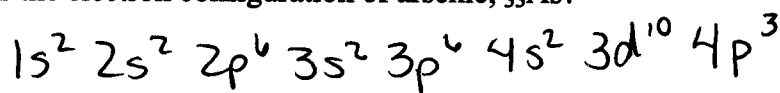
- B
- a. N  $\rightarrow$  3
  - b. Cl  $\rightarrow$  1
  - c. S  $\rightarrow$  2
  - d. Ti  $\rightarrow$  2
  - e. V  $\rightarrow$  3

4 points

8.) Identify the following orbital.

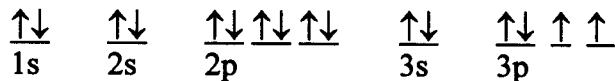
4 points

9.) What is the electron configuration of arsenic,  ${}_{33}\text{As}$ ?



3 points

10.) The electron configuration



represents the element S.

4 points

11.) How many valence electrons does a nitrogen atom have? Name a cation that is isoelectronic with nitrogen.

N 5 valence electrons

$\text{O}^+$  is isoelectronic with Nitrogen

6 points

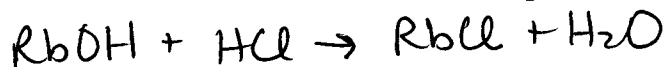
12.) What mass of  $\text{CaCl}_2$  must be dissolved in enough water to produce 2500. mL of 3.25 M  $\text{CaCl}_2$ ?

$$\frac{2500 \text{ mL}}{1000 \text{ mL}} \times \frac{1 \text{ L}}{1 \text{ L}} \times \frac{3.25 \text{ mol}}{1 \text{ L}} \times \frac{110.9 \text{ g CaCl}_2}{1 \text{ mol}} = 901.06 \text{ g CaCl}_2$$

901 g  $\text{CaCl}_2$

6 points

13.) What is the molarity of a rubidium hydroxide solution if 28.42 mL of this  $\text{Rb}(\text{OH})_2 \leftarrow$  typo! solution requires 45.64 mL of 0.4419 M HCl for titration to the equivalence point?



$$\frac{45.64 \text{ mL}}{1000 \text{ mL}} \times \frac{1 \text{ L}}{1 \text{ L}} \times \frac{0.4419 \text{ mol}}{1 \text{ L}} \times \frac{1 \text{ mol RbOH}}{1 \text{ mol HCl}} \times \frac{1}{0.02842 \text{ L}} = 0.7096 \text{ M RbOH}$$

0.7096 M RbOH

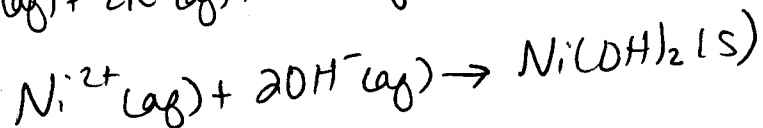
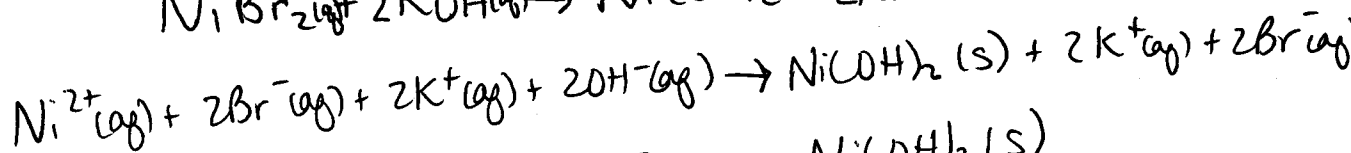
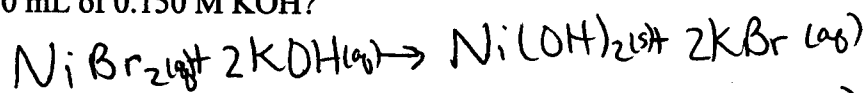
due to typo answer could be

$$\frac{45.64 \text{ mL}}{1000 \text{ mL}} \times \frac{1 \text{ L}}{1 \text{ L}} \times \frac{0.4419 \text{ mol}}{1 \text{ L}} \times \frac{1 \text{ mol Rb}(\text{OH})_2}{2 \text{ mol HCl}} \times \frac{1}{0.02842 \text{ L}} = 0.3548 \text{ M Rb}(\text{OH})_2$$

0.3548 M Rb(OH)<sub>2</sub>

12 points

14.) Write the molecular, total and net ionic equations for the complete reaction of nickel(II)bromide with potassium hydroxide. What mass of nickel(II)bromide would react with 200.0 mL of 0.150 M KOH?

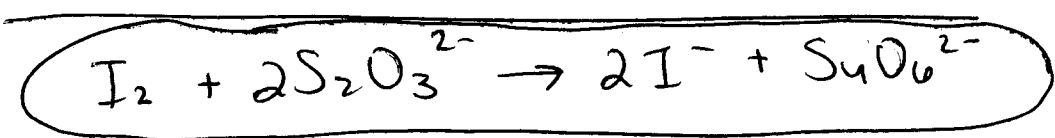
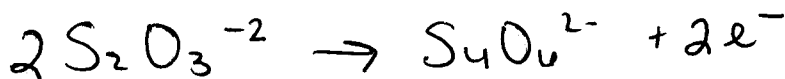
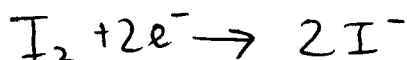
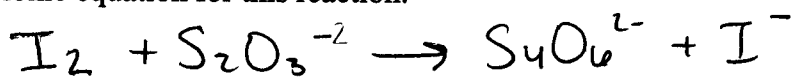


$$\frac{200.0 \text{ mL} \mid 1 \text{ L} \mid 0.150 \text{ mol} \mid 1 \text{ mol NiBr}_2 \mid 218.5 \text{ g NiBr}_2}{1000 \text{ mL} \mid 1 \text{ L} \mid 2 \text{ mol KOH} \mid 1 \text{ mol}} = \boxed{3.28 \text{ g NiBr}_2}$$

10 points

15.) A useful analytical procedure involves the oxidation of iodide ions to free iodine. The free iodine is then titrated with a standard solution of sodium thiosulfate,  $\text{Na}_2\text{S}_2\text{O}_3$ . Iodine oxidizes  $\text{S}_2\text{O}_3^{2-}$  ions to tetrathionate ions,  $\text{S}_4\text{O}_6^{2-}$  and is reduced to  $\text{I}^{-}$  ions. Write the balanced net ionic equation for this reaction.

typo →



5 points

16.) Assume that 545 g of dry ice (solid  $\text{CO}_2$ ) is placed into an evacuated 15.0 L closed tank. What is the pressure in the tank in atmospheres at  $30.0^\circ\text{C}$  after all the solid has vaporized?  $V = 15.0\text{L}$

$$n = \frac{545\text{g CO}_2}{44\text{g}} \times \frac{1\text{mole CO}_2}{1} = 12.386\text{mole CO}_2 \quad T = 303\text{K}$$

$$P = \frac{nRT}{V} = \frac{(12.386\text{mole})(0.0821 \frac{\text{Latm}}{\text{moleK}})(303\text{K})}{15.0\text{L}} = 20.54\text{atm}$$

20.5 atm

8 points

17.) Calculate the wavelength in nanometers of the emission for a hydrogen electron that results from the transition from the  $n = 4$  to the  $n = 1$  state.

$$\frac{1}{\lambda} = 1.097 \times 10^7 \text{m}^{-1} \left( \frac{1}{1^2} - \frac{1}{4^2} \right)$$

$$\frac{1}{\lambda} = 1.097 \times 10^7 \text{m}^{-1} (1 - 0.0625)$$

$$\frac{1}{\lambda} = 10284375 \text{m}^{-1}$$

$$\lambda = \frac{0.000000097\text{m}}{1\text{m}} \times \frac{1 \times 10^9 \text{nm}}{1\text{m}} = 97.2\text{nm}$$

8 points

18.) One of the spectral lines in the emission spectrum of neon has a wavelength of 633 nm. What is the frequency of the line? What is the energy of one mole of photons with this wavelength?

$$\nu = \frac{c}{\lambda} = \frac{2.998 \times 10^8 \text{m/s}}{0.000000633\text{m}} = 4.736 \times 10^{14} \text{s}^{-1}$$

$$E = h\nu = (6.626 \times 10^{-34} \text{J}\cdot\text{s})(4.736 \times 10^{14} \text{s}^{-1}) = 3.138 \times 10^{-19} \text{J/photon}$$

$$\left( \frac{3.138 \times 10^{-19} \text{J}}{\text{photon}} \right) \left( \frac{6.022 \times 10^{23} \text{photons}}{1 \text{mole}} \right) = 188981.8 \text{J/mole}$$

188.9 kJ/mole