PROBLEM SESSION KEY FOR EXAM 3

1. Breathalyzers estimate the amount of alcohol in the blood by measuring the alcohol in the breath. The breathalyzer uses the redox reaction below to determine the amount of alcohol in the blood. Answer the following questions using this balanced chemical equation.

 3 C2H5OH + 10 H2CrO4 🡪 3 CH3CO2H + 8 Cr2(CrO4)3 + 13 H2O + 2674 kJ

 ethanol chromic acid acetic acid chromium(III) chromate water

* 1. How many moles of chromic acid can react with 5.92 moles of ethanol?
	2. How many mg of ethanol are in a sample of a driver’s breath that produces 21.8 mg of acetic acid?
	3. How much energy will be produced if 38.1 grams of chromic acid react with excess ethanol?
	4. If 62.8 grams of ethanol react with excess chromic acid to produce 89.4 grams of water, what is the percent yield of the reaction?
	5. If 9.25 g of ethanol are allowed to react with 62.8 g or chromic acid, how many g of acetic acid should be produced?
1. Write a balanced equation for the reaction, if any that occurs in each of the following cases. Assume that all soluble reactants are added in the form of aqueous solutions. Indicate gases and precipitates that are formed, as well as insoluble solid reactants. If no reaction occurs, then write **NO RXN**, and do not write a balanced equation. Be sure to **balance** your equations and include your **phase labels**.
2. potassium hydroxide + sodium hydroxide 🡪
3. sodium acetate + hydrochloric acid 🡪
4. zinc bromide + potassium phosphate 🡪
5. hydrochloric acid + calcium 🡪
6. nitric acid + barium hydroxide 🡪
7. ammonium nitrate + sodium hydroxide 🡪
8. How many electrons are there in an orbital? \_\_\_\_\_\_\_\_\_\_\_

In an s sublevel? \_\_\_\_\_\_\_\_\_\_\_

A p sublevel? \_\_\_\_\_\_\_\_\_\_\_

A d sublevel? \_\_\_\_\_\_\_\_\_\_\_

1. How is the line spectrum of an atom produced? (Answer this on an atomic level)
2. How do atomic orbitals fill? If a p sublevel has 4 electrons, which orbitals will they occupy? Draw the sublevel using arrows to represent electrons and show spin based on the direction of the arrow.
3. Explain why each of the following electron configurations for a p sublevel is disallowed.
	1. $$
	2. $$
	3. $$
	4. $$
4. Write the complete and shorthand electronic configuration for the following atoms and ions.

|  |  |
| --- | --- |
| shorthand | complete |
| Si: | Si:  |
| Mg+2 :  | Mg+2 :  |
| S‑2:  | S‑2:  |
| V:  | V:  |
| Mn:  | Mn:  |
| Ni +2: | Ni +2:  |

1. Explain why an atom might have an anomalous configuration. Predict which elements might have anomalous configurations.
2. How many valence electrons in an atom of phosphorous? Of barium? Of krypton?

P: Ba: Kr :

1. Explain how an ionic bond differs from a covalent bond.
2. Explain how a pure covalent bond differs from a polar covalent bond.
3. What is the lewis electron dot structure of carbon? Of arsenic? Of potassium?
4. Rank the following atoms in order of increasing radius (1 being smallest and 5 being largest):

\_\_ N \_\_ Sb \_\_ Rb \_\_ Cs \_\_ F

1. Name the element that corresponds to each of the following:
2. alkali metal with the smallest atomic radius
3. Group 5A element with the highest ionization energy
4. [Kr] 5s24d10

1. Give three anions that are isoelectronic with neon?
2. List the following in increasing (L to R) ionization energy.

N, Ca, Cl, Fr, Rb

1. Arrange the following elements in order of increasing atomic size: Ca, B, S, Si, Ge, F
2. Arrange the following elements in order of increasing metallic character: Fr. Sb. In, S, Ba, Se
3. Draw Lewis Electron Dot Structures for the following molecules and tell the orbital and molecular geometries for each

|  |  |
| --- | --- |
| * 1. PH3

Orbital geometry: Molecular geometry:  | * 1. C2H4

Orbital geometry: Molecular geometry:  |
| * 1. CBr4

Orbital geometry: Molecular geometry:  | * 1. C2H6

Orbital geometry: Molecular geometry:  |
| * 1. OF2

Orbital geometry:Molecular geometry:  | * 1. N2H2

Orbital geometry: Molecular geometry:  |
| * 1. SCl2

Orbital geometry: Molecular geometry:  | * 1. C2H2

Orbital geometry: Molecular geometry:  |
| * 1. CO2 (C is central)

Orbital geometry: Molecular geometry:  | * 1. Cl2CO (C is central)

Orbital geometry: Molecular geometry:  |

1. Draw Lewis Electron Dot Structures for the following ions. Include resonance structures as necessary.

|  |  |
| --- | --- |
| * 1. CN-1
 | * 1. NO2-1
 |
| * 1. SO3-2
 | * 1. CO3-2
 |
| * 1. NH4+1
 | * 1. ClO3-
 |

1. Predict the orbital and molecular geometry around each of the starred atoms in the drawing below:



|  |  |  |
| --- | --- | --- |
| Atom | Orbital geometry | Molecular geometry |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |
| 6 |  |  |
| 7 |  |  |
| 8 |  |  |