Exam 2

Part I: Multiple Choice (2 points each)

Directions: Please circle the *best* answer for each of the following questions.

Question 1. What is the ionic charge of an ion with 13 protons and 10 electrons?

1. -3
2. -2
3. +1
4. +2
5. +3

Question 2. Why is the ionization energy of Ca higher than K?

1. K has a much greater number of neutrons than Ca
2. Because K has less radium and the same number of electrons and protons
3. Because Ca is closer to noble gas in the periodic table
4. Ca has a greater number of protons than K
5. K and Ca have the same ionization energy

Question 3. In ionic compounds, \_\_\_\_ lose their valence electrons to form positively charge \_\_\_\_\_\_\_\_.

1. nonmetals, cations
2. metals, cations
3. metals, polyatomic ions
4. nonmetals, anions
5. metals, anions

Question 4. The number of electromagnetic waves that travel past a certain point in a given time is the \_\_\_\_\_ of the radiation.

1. color
2. speed
3. frequency
4. wavelength
5. count

Question 5. Which of the following functional groups does not contain a carbonyl group?

1. Aldehyde
2. Ketone
3. Carboxylic acid
4. Ester
5. Alkane

Question 6. A chemical equation is balanced when

1. the charge on each atom is the same in reactants and products.
2. the sum of the coefficients of the reactants is equal to the sum of the coefficients of the products.
3. the total number of molecules is the same in reactants and products.
4. the total number of ions is the same in reactants and products.
5. the number of atoms of each element is the same in reactants in products.

Question 7. One mole of particles of any substances contains how many particles?

1. 6.022 x 1023
2. 1
3. 6.0022 x 10-23
4. 1.661 x 10-24
5. 0

Question 8. When methane, CH4, reacts with oxygen gas which of the following is not a product?

1. Carbon dioxide gas
2. Water vapor
3. Heat
4. Nitrogen gas
5. none of the above

Question 9. What is the name of H3PO4 (aq)?

1. Hydrophosphoric acid
2. Phosphoric acid
3. Phosphorous acid
4. Hydrogen phosphate
5. none of the above

Question 10. A beaker should be used to

1. measure the volume of a liquid.
2. transfer liquids.
3. weigh substances.
4. b and c
5. all of the above

Part II: Short Answer

Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work.

Question 1. Nicotine is an alkaloid found in the nightshade family of plants. It is present in small amounts in eggplant and tomato plants, but makes up 0.6-3.0% of the dry weight of tobacco. Nicotine has an empirical formula of C5H7N and a molar mass of about 160 g/mol. What is the molecular formula (4 points)?

$$ratio=\frac{molecular formula}{empirical formula}=\frac{160 g/mol}{83.11 g/mol}=1.925159427≈2$$

Molecular formula = (C5H7N)2 = C10H14N2

Question 2. In an experiment, 3.78 g of iron combines with oxygen to give a compound that has a mass of 5.40 g (14 points).

* 1. What is the mass of oxygen?

moxygen = 5.40 g – 3.78 g = 1.62 g O

* 1. What is the percent iron in the compound?

$$\%Fe=\frac{m\_{iron}}{m\_{compound}}×100=\frac{3.78 g}{5.40 g}×100=70.0\% Fe$$

* 1. If the empirical formula of the compound is Fe2O3, what is the empirical mass (i.e. molar mass)?

Fe: 2(55.845 g/mol) = 111.69 g/mol

O: 3(15.999 g/mol) = 47.997 g/mol

 159.687 g/mol ≈ 159.69 g/mol

* 1. How many atoms of oxygen are in 3.443 moles of iron(III) oxide?

$3.443 mol Fe\_{2}O\_{3}×\frac{3 mol O}{1 mol Fe\_{2}O\_{3} }×\frac{6.022×10^{23} atoms O }{1 mol O}=6.220×10^{24} atoms O $

* 1. If there are 16.75 g of iron, how many grams of iron(III) oxide are there?

$$16.75 g Fe×\frac{1 mol Fe}{55.845 g Fe}×\frac{1 mol Fe\_{2}O\_{3}}{2 mol Fe}×\frac{159.69 g Fe\_{2}O\_{3}}{1 mol Fe\_{2}O\_{3}}=23.95 g Fe\_{2}O\_{3}$$

Question 3. Circle the correct answer (5 points):

1. A s orbital is shaped like a (four leaf clover/sphere).
2. All electromagnetic radiation travels at the same (energy/velocity).
3. Radiation of frequency 700 nm to 400 nm is (visible/ultraviolet) light.
4. The symbol for wavelength is (λ/ν).
5. 106 Hertz (kilohertz/megahertz)

Question 4. Rank Sb, I, Rb, In, and Xe in order of decreasing number of valence electrons (5 points):

 Xe > I > Sb > In >Rb

Question 5. Write balanced chemical equations for each of the following (12 points):

* 1. Solid copper reacts with solid sulfur (S8) to form solid copper(I) sulfide (Cu2S).

16 Cu (s) + S8 (s) 🡪 8 Cu2S (s)

* 1. Sulfur dioxide gas (SO2) reacts with oxygen gas (O2) to form sulfur trioxide gas(SO3).

2 SO2 (g) + O2 (g) 🡪 2 SO3 (g)

* 1. Aqueous hydrochloric acid (HCl) reacts with solid manganese(IV) oxide (MnO2) to form aqueous manganese(II) chloride (MnCl2), liquid water, and chlorine gas.

4 HCl (aq) + MnO2 (s) 🡪 MnCl2 (aq) + 2 H2O (l) + Cl2 (g)

* 1. Liquid benzene (C6H6) reacts with gaseous oxygen (O2) to form carbon dioxide (CO2) and liquid water (H2O).

2 C6H6 (l) + 15 O2 (g) 🡪 12 CO2 (g) + 6 H2O (l)

* 1. Solid magnesium reacts with aqueous copper(I) nitrate (CuNO3) to form aqueous magnesium nitrate (Mg(NO3)2) and solid copper.

Mg (s) + 2 CuNO3 (aq) 🡪 Mg(NO3)2 (aq) + 2 Cu (s)

* 1. Gaseous dinitrogen pentoxide (N2O5) decomposes to form nitrogen dioxide (NO2) and oxygen (O­2) gases.

2 N2O5 (g) 🡪 4 NO2 (g) + O2 (g)

Question 6. Identify a, d, f as a combination, combustion, decomposition, single replacement, double replacement, or neutralization reaction (3 points).

a. \_\_\_\_\_\_combination\_\_\_\_\_\_ d.\_\_\_\_\_\_combustion\_\_\_\_\_\_f. \_\_\_\_\_decompostion\_\_\_\_\_\_

Question 7. Explain the octet rule (3 points).

 The octet rule indicated that atoms lose, gain, or share valence electrons to have eight valence electrons.

Question 8. Give the symbol of the element with each of the following electron configurations (3 points).

* 1. 1s22s22p63s23p64s23d8 \_\_\_Ni\_\_\_
	2. [Kr]5s24d5 \_\_\_Tc\_\_\_
	3. [Xe]6s24f145d106p3 \_\_\_Bi\_\_\_

Question 9. What do the electron configurations of Ca2+, K+, Sr2-, and Br- have in common (3 points)?

Ca2+ and K+ have an electron configuration of [Ar] or 1s22s22p63s23p6

Sr2- has an electron configuration of [Kr]5s24d2 or 1s22s22p63s23p64s23d104p65s24d2

Br- has an electron configuration of [Kr] or 1s22s22p63s23p64s23d104p6

So the electron configurations of Ca2+, K+, Sr2- and Br- have the electron configuration [Ar] or 1s22s22p63s23p6 in common, but nothing beyond that.

Question 10. Answer the following (3 points):

1. number of valence electron for strontium \_\_\_2\_\_\_
2. electron dot formula for chlorine \_\_\_\_\_\_
3. number of core electrons of aluminum \_\_\_10\_\_\_

Question 11. Name the following compounds (10 points)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cation name | Anion name | Compound name |
| BeCO3 | Beryllium ion | Carbonate ion | Beryllium carbonate |
| V(BrO2)3 | Vanadium(III) ion | Bromite ion | Vanadium(III) bromite  |
| XeF6 |  |  | Xenon hexafluoride |
| Cd3N2 | Cadmium ion | Nitride ion | Cadmium nitride  |

Question 12. Give the correct formula for the following compounds (10 points)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cation formula | Anion formula | Compound formula |
| Cuprous sulfite Copper(I) sulfite | Cu+ | SO32- | Cu2SO3 |
| Potassium phosphate | K+ | PO43- | K3PO4 |
| Chromium(III) nitrite  | Cr3+ | NO2- | Cr(NO2)3 |
| Dibromine octaoxide  |  |  | Br2O8 |

Question 13. Match each of the descriptions with a corresponding term in the following list: alkane, alkene, alkyne, alcohol, aldehyde, ketone, ether, carboxylic acid, ester, amine, functional group, or isomers (5 points).

|  |  |  |
| --- | --- | --- |
|  | Organic compounds with identical molecular formulas that differ only in the arrangement of atoms. | isomers |
|  | An organic compound that contains an oxygen atom bonded to two carbon atoms. | ether |
|  | A hydrocarbon that contains a carbon-carbon triple bond. | alkyne |
|  | A characteristic group of atoms that makes compounds behave and react in a particular way.  | functional group |
|  | An organic compound in which the carbonyl group is bonded to two carbon atoms. | ketone |