Exam 2

Part I: Multiple Choice (2 points each)

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

Question 1. The compound CH3CH2NHCH3 is classified as an \_\_\_\_\_.

1. amine
2. ammonium
3. alkene
4. alkane
5. amide

Question 2. Which of the following polyatomic ions has a positive charge?

1. Ammonium
2. Nitrate
3. Hydrogen carbonate
4. Hydroxide
5. Cyanide

Question 3. The octet rule indicates that

1. all of the noble gases have eight total electrons.
2. the noble gases react with other compounds to get 8 valence electrons.
3. all of the Group A elements have 8 valence electrons.
4. all of the shells in an atom hold a maximum of 8 electrons.
5. atoms lose, gain, or share valence electrons to have 8 valence electrons.

Question 4. Which of the following forms two or more ions with different ionic charges?

1. Ag
2. Fe
3. F
4. K
5. Ca

Question 5. Which of the following is true of nonane, C9H20, which has a density of 0.79 g/mL, melts at -51 °C, and boils at 157 °C?

1. Nonane is a gas a room temperature.
2. Nonane is not a hydrocarbon.
3. Nonane does not undergo combustion.
4. Nonane floats on the surface of water.
5. All of the above

Question 6. Given the following equation, what is the correct form of the conversion factor needed to convert the number of moles of O2 to the number of moles Fe2O3 produced?

4 Fe (s) + 3 O2 (g) 🡪 2 Fe2O3 (s)

1. $\frac{3 mol O\_{2}}{2 mol Fe\_{2}O\_{3}}$
2. $\frac{4 mol Fe}{3 mol O\_{2}}$
3. $\frac{2 mol Fe\_{2}O\_{3}}{4 mol Fe}$
4. $\frac{2 mol Fe\_{2}O\_{3}}{3 mol O\_{2}}$
5. $\frac{4 mol Fe}{2 mol Fe\_{2}O\_{3}}$

Question 7. When 1.00 mol of barium chloride reacts with 1.00 mol of silver nitrate, the theoretical yield of silver chloride is

BaCl2 (aq) + 2 AgNO3 (aq) 🡪 2 AgCl (s) + Ba(NO3)2 (aq)

1. 0.500 mol
2. 1.00 mol
3. 1.50 mol
4. 2.00 mol
5. 2.50 mol

Question 9. When an electric current is passed through molten salt, this reaction takes place:

2 NaCl (l) 🡪 2 Na (l) + Cl2 (g)

1. Synthesis
2. Combustion
3. Decomposition
4. Single Replacement
5. Double Replacement

Question 10. In the chemistry laboratory, you should never

1. taste the reagents.
2. put your scoopula in the reagent bottles.
3. move the reagent bottles from their designated area.
4. put chemicals directly on the balance pan.
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. Match each of the descriptions with a corresponding term in the following list: alkane, alkene, alkyne, alcohol, ether, aldehyde, ketone, carboxylic acid, ester, amine, functional group, or isomers (5 points).

|  |  |  |
| --- | --- | --- |
|  | An organic compound in which the hydrogen atom of a carboxyl group is replaced by a carbon atom | Ester |
|  | A 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 make 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 |

Question 2. In a lab, silver nitrate, AgNO3, is dissolved in water until no solid is observed in the container. Then a solution of sodium chloride, NaCl, is added to the container. When you combine these aqueous solutions, there is no noticeable change in temperature; however, a solid precipitates and there is a slight change of color. Which statements about the lab experiment involving silver nitrate and sodium chloride solution are true (6 points)?

* 1. A chemical reaction did occur when the solutions were combined.\_\_\_\_\_true\_\_\_\_\_
	2. The lack of temperature change indicates a chemical reaction didn’t occur. false\_\_
	3. A chemical reaction occurred when silver nitrate was added to water.\_false\_\_\_\_\_
	4. The color change of the solution indicates a chemical reaction occurred.\_true\_\_\_\_
	5. Formation of a solid indicates a chemical reaction occurred. \_\_\_\_\_true\_\_\_\_\_
	6. The initial disappearance of silver nitrate in water indicates a chemical reaction occurred. \_\_\_\_\_false\_\_\_\_\_

Question 3. Give the IUPAC name for each of the following alkanes. Spell out the full name of the compound (3 points).

1. CH3-CH3 ethane
2. CH3-CH2-CH­2-CH2-CH2-CH2-CH2-CH2-CH3 nonane
3. CH3-CH2-CH2-CH2-CH2-CH3 hexane

Question 4. Identify of the following pairs of elements form ionic or covalent compounds (6 points).

1. Sodium and potassium \_\_\_\_\_ionic\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Helium and oxygen \_\_\_\_\_covalent\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Nitrogen and oxygen \_\_\_\_\_covalent\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Magnesium and chlorine \_\_\_\_\_ionic\_\_\_\_\_\_\_\_\_\_\_\_
5. Chlorine and bromine \_\_\_\_\_covalent\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Potassium and sulfur \_\_\_\_\_ionic\_\_\_\_\_\_\_\_\_\_\_

Question 5. Determine the empirical formula of benzyl acetate, the scent of jasmine. It is composed of 71.98%C, 6.71%H, and 21.31%O (10 points).

$$71.98 g C×\frac{1 mol C}{12.011 g C}=\frac{5.992839897 mol C}{1.331958247 mol }=4.499270086×2=8.998540173≈9$$

$$6.71 g H×\frac{1 mol H}{1.008 g H}=\frac{6.656746032 mol H}{1.331958247 mol }=4.997713738×2=9.995427476≈10$$

$$21.31 g O×\frac{1 mol O}{15.999 g O}=\frac{1.331958247 mol O}{1.331958247 mol }=1×2=2$$

 Empirical formula C9H10O2

Question 6. Write balanced chemical equations for each of the following (20 points):

1. Solid copper reacts with solid sulfur (S8) to form solid copper(I) sulfide.
2. Cu (s) + S8 (s) 🡪 8 Cu2S (s)
3. Sulfur dioxide gas reacts with oxygen gas to form sulfur trioxide gas.

2 SO2 (g) + O2 (g) 🡪 2 SO3 (g)

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

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

1. Solid calcium reacts with aqueous nitric acid to form aqueous calcium nitrate and hydrogen gas.

Ca (s) + 2 HNO3 (aq) 🡪 Ca(NO3)2 (aq) + H2 (g)

1. Aqueous solutions of cobalt(III) nitrate react with ammonium sulfide to produce solid cobalt(III) sulfide and aqueous ammonium nitrate.

2 Co(NO3)3 (aq) + 3 (NH4)2S (aq) 🡪 Co2S3 (s) + 6 NH4NO3 (aq)

Question 7. Acontic acid is used as a plasticizer (10 points).

* 1. It has a molecular formula of C6H6O6. Calculate the molar mass.

C: (12.011 g/mol)6 = 72.066 g/mol

H: (1.008 g/mol)6 = 6.048 g/mol

O: (15.999 g/mol)6 = 95.994 g/mol

 = 174.108 g/mol

* 1. What is the empirical formula? \_\_\_\_\_CHO\_\_\_\_\_
	2. What is percent oxygen in acontic acid?

$\%O=\frac{95.994 g/mol}{174.108 g/mol}×100=55.13474395\% O ≈55.135\% O$

Question 8. Answer the following questions (20 points):

1. Balance the following chemical equation:

3 CoCl2 (aq) + 2 Na3PO4 (aq) 🡪 Co3(PO4)2 (s) + 6 NaCl (aq)

1. Identify the type of chemical reaction: \_double replacement\_\_\_\_\_\_\_\_
2. How many atoms of chlorine are in 259 formula units of cobalt(II) chloride?

$259 formula units CoCl\_{2}×\frac{2 atoms Cl}{1 formula unit CoCl\_{2}}=518 atoms Cl $

1. How many moles of sodium phosphate are required to completely react with 7.41 moles of cobalt(II) chloride?

$$7.41 mol CoCl\_{2}×\frac{2 mol Na\_{3}PO\_{4}}{3 mol CoCl\_{2}}=4.94 mol Na\_{3}PO\_{4}$$

1. How many grams of cobalt(II) phosphate (molar mass 366.739 g/mol) can be produced by the reaction of 91.6 g of cobalt(II) chloride (molar mass 129.839 g/mol)?

$91.6 g CoCl\_{2}×\frac{1 mol CoCl\_{2}}{129.839 g CoCl\_{2}}×\frac{1 mol Co\_{3}(PO\_{4})\_{2}}{3 mol CoCl\_{2}}×\frac{366.739 g Co\_{3}(PO\_{4})\_{2}}{1 mol Co\_{3}(PO\_{4})\_{2}}=86.2 g Co\_{3}(PO\_{4})\_{2}$

1. If 74.552 g of cobalt(II) phosphate are produced by the reaction in question 4, what is the percent yield?

$$\%yield=\frac{m\_{actual}}{m\_{theoretical}}×100=\frac{74.552 g}{86.2 g }×100=86.4\%$$

1. How many grams of sodium phosphate (molar mass 163.94 g/mol) are required to produce 6.3157 x 1026 formula units of sodium chloride?

$6.3157×10^{26} formula units NaCl×\frac{1 mol NaCl}{6.022 ×10^{23} formula units NaCl}×\frac{2 mol Na\_{3}PO\_{4}}{6 mol NaCl}×\frac{163.940 g Na\_{3}PO\_{4}}{1 mol Na\_{3}PO\_{4}}=57310 g Na\_{3}PO\_{4}$