Exam 2

Part I: Multiple Choice (2 points each)

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

Question 1. How does a molecule differ from a formula unit?

1. A molecule is composed of atoms and a formula unit is not.
2. A molecule is a binary compound and a formula unit is a multi-atom compound.
3. A molecule is always larger than a formula unit.
4. Molecules and formula units are the same.
5. A molecule is generally used to describe the particles in a covalent compound and a formula unit is generally used to describe the components of an ionic compound.

Question 2. A negative monoatomic ion or anion is names as the stem of the parent

1. element with an –ate ending.
2. element with an –ite ending.
3. element.
4. element with an –ide ending.
5. element with an –ous ending.

Question 3. Avogadro’s number of atoms or 1 mole of atoms has a mass equal

1. to the atomic mass in ounces of the element.
2. to the atomic mass in grams of the element.
3. to exactly 10.00 grams.
4. to the atomic number in grams of the element.
5. to the atomic number in ounces of the element.

Question 4. Which is the correct solution map for converting grams of butane, C4H10, to grams of carbon dioxide, CO2?

1. g C4H10 🡪 mol C4H10 🡪 mol CO2 🡪 g CO2
2. g C4H10 🡪 mol C4H10 🡪 g CO2
3. g C4H10 🡪 g CO2
4. mol C4H10 🡪 mol CO2
5. g C4H10 🡪 g O2 🡪 g CO2

Question 5. Which of the following exists in its natural state as a diatomic?

1. Iron
2. Bromine
3. Boron
4. Zirconium
5. all of the above

Question 6. When properly balanced, the sum of the balancing coeffients is

Al (s) + CuSO4 (aq) 🡪 Al2(SO4)3 (aq) + Cu (s)

1. 9
2. 8
3. 7
4. 6
5. 4

Question 7. The reaction:

N2 (g) + O2 (g) + 182.6 kJ 🡪 2 NO(g)

1. Exothermic
2. Endothermic
3. Isothermic
4. Protothermic
5. Redox

Question 9. In all chemical reactions, the reactants are always completely consumed.

1. True
2. False
3. Limiting reactant
4. Excess reactant
5. none of the above

Question 10. What is the most effective method for avoiding exposure by ingestion?

1. Taste only chemicals that your instructor gives you permission to taste.
2. Taste only chemicals that you know are nontoxic.
3. Never eat or drink anything while in a chemistry lab.
4. Only eat food in a lab when you know that it cannot be contaminated with a toxic chemical.
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. Complete the following table (16 points):

|  |  |  |  |
| --- | --- | --- | --- |
| Compound | name | formula for cation | formula for anion |
| HCl (aq) | Hydrochloric acid | H+ | Cl- |
| PbCO3 | lead(II) carbonateplumbous carbonate | Pb2+ | CO32- |
| Co(ClO4)2 | cobalt(II) perchlorate | Co2+ | ClO4- |
| N2O­4 | Dinitrogen tetraoxide | --------------------- | --------------------- |
| Al(NO3)3 | aluminum nitrate | Al3+ | NO3- |
| NaCN | Sodium cyanide | Na+ | CN– |

Question 2. How many years are in a mole of seconds (8 points)?

$1 mol s×\frac{6.022×10^{23} s}{1 mol s}×\frac{1 min}{60 s}×\frac{1 hr}{60 min}×\frac{1 day}{24 hr}×\frac{1 year}{365 days}=1.910×10^{16} years$

Question 3. How many atoms of oxygen are in 2.44 moles of glucose, C6H12O6 (4 points)



Question 4. If 12.4 moles of phosphorus trichloride, PCl3, gas and 10.2 moles of chlorine, Cl2, gas react how many moles of phosphorus pentachloride PCl5, gas can be produced and identify the limiting reagent (8 points).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | PCl3 (g)  | + | Cl2 (g) | 🡪 | PCl5 (g) |
| I | 12.4 mol |  | 10.2 mol |  | 0 mol |
| C | -x |  | -x |  | +x |
| E | 12.4 mol – x =12.4 mol – 10.2 mol =2.2 mol  |  | 10.2 mol –x =10.2 mol – 10.2 mol =0 mol  |  | x = 10.2 mol  |

 12.4 mol – x = 0 mol 10.2 mol – x = 0 mol

 x = 12.4 mol x = 10.2 mol

 therefore, x = 10.2 mol. The limiting reagent is Cl2.

Question 5. A compound is found to consist of 1.37 g of iron and 2.62 g of chlorine.

1. Determine the empirical formula of the compound (14 points).

$$1.37 g Fe×\frac{1 mol Fe}{55.845 g Fe}=0.024532187 mol Fe$$

$$2.62 g Cl×\frac{1 mol Cl}{35.453 g Cl}=0.073900657 mol Cl$$

$$Fe\_{\frac{0.024532187 mol}{0.024532187 mol}}Cl\_{\frac{0.073900657 mol}{0.024532187 mol }}=Fe\_{1}Cl\_{3.012395759}=FeCl\_{3}$$

1. If the formula mass of the compound is 162.2 g/mol, what is a formula unit of the compound?

FeCl3

1. Name the compound: \_\_\_iron(III) chloride\_\_\_\_\_\_\_

Latin: \_\_ferric chloride\_\_\_\_\_\_\_\_\_\_

Question 6. In an experiment very similar to Experiment 9: Oxidation-Reduction Reactions a student obtains the following results (12 points):

1. When copper metal is placed into a test tube with hydrochloric acid, HCl, there is

 no change.

2. When aluminum metal is placed into a test tube with copper (II) chloride, CuCl2,

 the aluminum metal becomes a reddish-brown color.

3. When aluminum metal is place into a test tube with hydrochloric acid, bubbles

 are produced.

* 1. Write and balance the three reactions described above

1. Cu (s) + HCl (aq) 🡪 no reaction

2. 2 Al (s) + 3 CuCl2 (aq) 🡪 2 AlCl3 (aq) + 3 Cu (s)

3. 2 Al (s) + 6 HCl (aq) 🡪 2 AlCl3 (aq) + 3 H2 (g)

b. Rank Cu, Al, and H in order of most reactive to least reactive.

 Al > H > Cu

Question 7. Given the following balanced equation (18 points):

2 C8H18 (l) + 25 O2 (g) 🡪 16 CO2 (g) + 18 H2O (g)

1. What type of chemical reaction is this? \_\_\_combustion/oxidation-reduction
2. What is the empirical formula of octane, C8H18? \_\_\_C4H9\_\_\_\_
3. Calculate the molar mass of octane, C8H18.

C: 8(12.011 g/mol) = 96.088 g/mol

H: 18(1.008 g/mol) = 18.144 g/mol

 = 114.232 g/mol ≈ 114.23 g/mol

1. Calculate the percent carbon in octane, C8H18.

$$\%C=\frac{m\_{C}}{m\_{C\_{8}H\_{18}}}×100=\frac{96.088 g/mol}{114.23 g/mol}×100=84.11800753\%≈84.118\% C$$

1. How many grams of water can be produced from the burning of 34.5 g of octane, C8H18?

$$34.5 g C\_{8}H\_{18}×\frac{1 mol C\_{8}H\_{18}}{114.23 g C\_{8}H\_{18}}×\frac{18 mol H\_{2}O}{2 mol C\_{8}H\_{18}}×\frac{18.015 g H\_{2}O }{1 mol H\_{2}O}=48.96837521 g H\_{2}O ≈49.0 g H\_{2}O$$

1. If 32.432 g of water are condensed and collected, what is the percent yield for the reaction?

$$\%yield=\frac{m\_{actual }}{m\_{theoretical}}×100=\frac{32.432 g }{49.0 g}×100=66.1877551\% ≈66.2\%$$