Exam 3

# Part 1: Multiple Choice (2 points each)

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

1. Which of the following are empirical formulas: C10H8, CH2, Al2O6, NO2, Hg2Cl2
	1. C10H8
	2. C10H8, CH2
	3. CH2, NO2
	4. C10H8, CH2, Hg2Cl2
	5. Al2O6, NO2, Hg2Cl2
2. How many atoms of each elements are in a formula unit of magnesium phosphate?
	1. 3 magnesium atoms, 2 phosphorus atoms, 8 oxygen atoms
	2. 2 magnesium atoms, 3 phosphorus atoms, 12 oxygen atoms
	3. 1 magnesium atoms, 1 phosphorus atoms, 4 oxygen atoms
	4. 2 magnesium atoms, 1 phosphorus atoms, 4 oxygen atoms
	5. 1 magnesium atoms, 2 phosphorus atoms, 8 oxygen atoms
3. Which of the following statements is incorrect?
	1. Molecular mass is expressed in atomic mass units.
	2. Formula mass compares the mass of one formula unit of a substance to the mass of one atom of carbon-12.
	3. Atomic mass has units of grams per atom.
	4. Both molecular mass and formula mass use carbon-12 as a reference standard.
	5. Sodium chloride, an ionic compound, is said to have a formula weight, but not a molar weight.
4. Consider the following particulate-level representation of a reaction. How would this reaction be classified?
	1. Combination
	2. Decomposition
	3. Single Replacement
	4. Double Replacement
	5. Acid-base neutralization
5. Some solute have solutions that conduct electricity, but poorly. Which of the following terms best describes these solutes?
	1. Highly charged ions
	2. Ions with fractional charges
	3. Nonconductor
	4. Weak electrolyte
	5. Cation solutions
6. What ions are present in what ratio in a solution of aqueous ammonium sulfate, (NH4)2SO4?
	1. (NH4)22+ (aq) + SO42- (aq)
	2. 2 NH4+ (aq) + SO42- (aq)
	3. NH4+ (aq) + SO4- (aq)
	4. 2 N3- (aq) + 8 H+ (aq) + 4 SO2- (aq)
	5. 2 N3- (aq) + 8 H+ (aq) + S2- (aq) + 4 O2- (aq)
7. Aqueous hydrochloric acid is added to an aqueous solution of sodium hydroxide at 25 °C, upon mixing the temperature of the resulting solution is 29.3 °C. Which of the following correctly characterizes this reaction?
	1. The reaction is exothermic.
	2. The ΔH for the reaction has a + sign.
	3. Energy could be considered a reactant in the equation for the reaction.
	4. This reaction consumes energy.
	5. all of the above
8. Which of the following best describes a limiting reactant?
	1. The reactant that limits the rate (or speed) of a chemical reaction.
	2. The reactant the limits the position of equilibrium in a reversible chemical change.
	3. The reactant that remains at the end of the reaction.
	4. The reactant that can produce the greatest amount of product.
	5. The reactant that is completely used up by a reaction.
9. Silver nitrate and magnesium chloride solutions are mixed. What is the per expression that allowing one to convert moles of silver nitrate to moles of magnesium chloride? Given the unbalanced equation:

AgNO3 (aq) + MgCl2 (aq) → Mg(NO3)2 (aq) + AgCl (s)

* 1. none of the above
1. The best rule for disposal of waste from a chemistry lab is
	1. down the sink unless instructed otherwise.
	2. into trash cans unless instructed otherwise.
	3. into chemical waste receptacles unless instructed otherwise.
	4. both a and b
	5. all of the above

# Part 2: 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.

* + - 1. Aspartame, C14H18N2O5, is an artificial sweetener sold as NutraSweet (15 points).
	1. What is the molar mass of aspartame?

(12.01 g/mol)(14) + (1.008 g/mol)(18) + (14.01 g/mol)(2) + (15.999 g/mol)(5) =

168.14 g/mol + 18.144 g/mol + 28.02 g/mol + 79.995 g/mol =

294.299 g/mol = 294.30 g/mol

* 1. What is the empirical formula of aspartame? C14H18N2O5
	2. How many moles of nitrogen are in 17.92 moles of aspartame?
	3. How many molecules are present in 1.75 mg of aspartame?

* 1. What is the percentage hydrogen in aspartame?
		+ 1. Classify each of the following reactions in a many ways as possible (i.e. type by of reaction (combination, decomposition, single replacement, double replacement, acid-base neutralization reaction) and type of chemistry (oxidation-reduction, precipitation, gas evolution, pH change, heat change)) (8 points):
				1. 2 Al (s) + 3 Cu(NO3)2 (aq) → 2 Al(NO3)3 (aq) + 3 Cu (s)

oxidation-reduction reaction, single displacement

* + - * 1. HBr (aq) + KHSO3 (aq) → H2O (l) + SO2 (g) + KBr (aq)

gas evolution/pH change, acid-base neutralization reaction/double replacement to decomposition

* + - * 1. 2 HI (aq) + Na2S (aq) → H2S (g) + 2 NaI (aq)

gas evolution/pH change, double displacement reaction

* + - * 1. K­2CO3 (aq) + FeBr2 (aq) → FeCO3 (s) + 2 KBr (aq)

precipitation, double displacement

* + - 1. Determine whether each of the following compounds is in the correct column. If not, move it to the correct column (6 points):

|  |  |  |  |
| --- | --- | --- | --- |
| Soluble | Insoluble | Soluble | Insoluble |
| K2S | Na2SO4 | K2S | ~~Na~~~~2~~~~SO~~~~4~~ |
| PbSO4 | Hg2I2 | ~~PbSO~~~~4~~ | Hg2I2 |
| Ba(NO3)2 | Cu3(PO4)2 | Ba(NO3)2 | Cu3(PO4)2 |
| Ni(C2H3O2)2 | MgS | Ni(C2H3O2)2 | MgS |
| NH4Cl | FeCrO4 | NH4Cl | FeCrO4 |

* + - 1. Write the balanced equation for the following reaction (9 points):
				1. Hot lithium metal reacts in nitrogen atmosphere to produce lithium nitride solid.

6 Li (s) + N­2 (g) → 2 Li3N (s)

* + - * 1. The reaction of sodium oxide solid and water produces aqueous sodium hydroxide.

Na2O (s) + H2O (l) → 2 NaOH (aq)

* + - * 1. Diphosphorus pentaoxide solid and water produce phosphoric acid.

P2O5 (s) + 3 H2O (l) → 2 H3PO4 (aq)

* + - 1. Write a balanced net ionic 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** (6 points).
				1. zinc bromide + potassium phosphate →

3 ZnBr2 (aq) + 2 K3PO4 (aq) → 6 KBr (aq) + Zn3(PO4)2 (s)

3 Zn2+ (aq) + 6 Br-(aq) + 6 K+(aq) + 2 PO43- (aq) → 6 K+(aq) + 6 Br-(aq) + Zn3(PO4)2 (s)

3 Zn2+ (aq) + 2 PO43- (aq) → Zn3(PO4)2 (s)

* + - * 1. nitric acid + barium hydroxide →

2 HNO3 (aq) + Ba(OH)2 (aq) → Ba(NO3)2 (aq) + 2 H2O (l)

 2 H+ (aq) + 2 NO3- (aq) + Ba2+ (aq) + 2 OH- (aq) → Ba2+ (aq) + 2 NO3- (aq) + 2 H2O (l)

 H+ (aq) + OH- (aq) → H2O (l)

* + - 1. When red phosphorus, P4, reacts with chlorine gas phosphorus trichloride is produced (14 points).
				1. Write the balanced chemical equation.

P4 (s) + 6 Cl2 (g) → 4 PCl3 (l) ΔHº= -1279 kJ

* + - * 1. Classify the type of chemical reaction taking place. \_combination or synthesis reaction
				2. Is the reaction exothermic or endothermic? \_\_\_\_\_exothermic reaction
				3. How many grams of phosphorus trichloride can be produced if 63.57 g of chlorine gas react with excess phosphorus?
				4. If 75.667 g of phosphorus trichloride is actually produced, what is the percent yield?
			1. When a hydrocarbon burns, water and carbon dioxide are produced. The density of gasoline is 0.79 g/mL. Assume that gasoline is completely made up of octane, C8H18 (12 points).
1. Write the equation for the combustion of octane:

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

1. Calculate the mass of water produced from the combustion of 2.0 L of gasoline.
	* + 1. A 12.5 mg sample of ethene, a hydrocarbon, was burned in air. The products were 39.2 mg of CO2 and 16.1 mg of water. If the molar mass of ethene is about 28 g/mol, what is the molecular formula (10 points)?

CxHy + O2 (g) → CO2 (g) + H2O (g)

Empirical formula is CH2

Molecular formula is (CH2)2 = C2H4