Exam 1

# Part 1: Multiple Choice (2 points each)

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

1. Which of the following represent a valid hypothesis?
2. Metals tend to lose electrons
3. Neon does not react with oxygen gas.
4. Sodium metal reacts violently with water.
5. Lead is soft and malleable.
6. all of the above
7. The boiling point of neon is 27 K or
   1. -401 °F
   2. -105 °F
   3. -246 °C
   4. 300 °C
   5. none of the above
8. Which of the following contains the most atoms?
9. 10.0 g Ne
10. 10.0 g He
11. 10.0g Ar
12. 10.0 g Mg
13. none of the above
14. What species is represented by the following information? p+ = 12, n0 = 14, e- =10
    1. Si4+
    2. Mg
    3. Ne
    4. Mg2+
    5. none of the above

Answer the following questions about: \_Al2S3 (s) + \_H2O (l) 🡪 \_Al(OH)3 (s) + \_H2S (g)

1. What is the coefficient of water?
   1. 1
   2. 2
   3. 3
   4. 4
   5. 6
2. Which classification best describes the reaction:
   1. Synthesis reaction
   2. Oxidation-Reduction reaction
   3. Double replacement reaction
   4. Decomposition reaction
   5. Combustion reaction
3. Determine the theoretical yield of H2S if 4.0 mol Al2S3 and 4.0 mol H2O are reacted.
   1. 12 mol H2S
   2. 4.0 mol H2S
   3. 18 mol H2S
   4. 2.0 mol H2S
   5. none of the above
4. John Dalton postulated that all matter is composed of small particles called atoms. For this proposition to be considered a valid scientific theory,
   1. it must be supported by experimental evidence and testing.
   2. it must be impossible to prove wrong by experiment.
   3. all possible experiments must never find an exception to it.
   4. some, but only a few, experiments may find exceptions to it.
   5. it must be voted on by the scientific community and accepted by all.
5. In the copper experiment, what color was the copper(II) sulfate solution produced in step 4?
   1. Red
   2. Purple
   3. Blue
   4. Colorless
   5. Clear
6. What element appeared on your first graded lab report?
   1. Hydrogen
   2. Oxygen
   3. Tungsten
   4. Iron
   5. Sodium

# 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. List three reasons why the actual yield for a chemical reaction may differ from the theoretical yield (4 points).

(1) The reactants and products reach an equilibrium situation where not all the reactants are consumed but are in equilibrium with the products. (2) The reaction is very slow and not enough time was allowed for all the reactants to be converted to products. (3) Some of the product was lost through careless processing, which lowers the yield. (4) Some impurities were included with the product, which appears to increase the yield. (5) Other reactions (side reactions) consumed some of the reactants.

1. Yeast converts glucose into ethanol and carbon dioxide in a process called fermentation. The unbalanced reaction equation is given below. The reaction if 150.0 g of glucose yields 75.0 mL of ethanol (*d* = 0.789 g/mL) (12 points).

C6H12O6 (aq) → C2H5OH (aq) + CO2 (g)

* 1. Write the balanced equation.

C6H12O6 (aq) → 2 C2H5OH (aq) + 2 CO2 (g)

* 1. What is the theoretical yield of ethanol in grams?
  2. What is the actual yield of ethanol in grams?
  3. What is the percent yield for the reaction?

1. Fill in the missing information in the following table (8 points):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Symbol |  |  |  |  |
| Number of Protons | 56 | 32-16=16 | 42 | 92 |
| Number of Neutrons | 137-56=81 | 16 | 56 | 238-92=146 |
| Number of Electrons | 56-2=54 | 18 | 42 | 92 |
| Mass Number | 137 | 32 | 42+56=98 | 238 |

1. In the movie *The Italian Job*, thieves steal gold bullion. One plan was to carry the ingots of gold off in suitcases. Each suitcase was 19 inches × 14 inches × 10 inches (6 points).
   1. What is the volume of a suitcase in mL?
   2. Approximately how much would each suitcase weigh when filled with gold? The density of gold is 19.3 g/mL.
2. Phthalocyanine is a large molecule used in printing inks and dyes for clothing due to its insolubility in most solvents, its chemical stability, and its intense blue color. Elemental analysis showed that it consists of 74.69% C, 3.525% H, and 21.77% N (10 points).
   1. What is the empirical formula for phthalocyanine?
   2. If phtahlocyanine has a molar mass of 514.54 g/mol, what is the molecular formula for phthalocyanine?
3. Correct the following chemical names and write the chemical formula (6 points):
4. Trisodium phosphate sodium phosphate, Na3PO4
5. Neodymium(III) chlorine hexahydrate neodymium(III) chloride hexahydrate,

NdCl3·6 H2O

1. Sulfur hexaflouride sulfur hexafluoride, SF6
2. Copperous nitrite cuprous nitrite or copper(I) nitrite, CuNO2
3. Cyanic acid hydrocyanic acid, HCN (aq)
4. Complete the following calculations (6 points):
5. The 1997 mission to Mars included a small robot, the *Sojourner,* that analyzed the composition of Martian rocks. Magnesium oxide from a boulder dubbed “Barnacle Bill” was analyzed and found to have the following composition:

|  |  |
| --- | --- |
| Mass (amu) | Natural Abundance (%) |
| 39.9872 | 78.70 |
| 40.9886 | 10.13 |
| 41.9846 | 11.17 |

If essentially all of the oxygen in the Martian MgO sample is oxygen-16 (which has an exact mass of 15.9948 amu), is the average atomic mass of magnesium on Mars the same as on Earth (24.31 amu) (10 points)?

+

**24.31**69514 amu ≈ 24.32 amu

Yes 24.32 amu is about the same as 24.31 amu.

Or another way to solve the problem:

+

Yes 24.32 amu is about the same as 24.31 amu.

1. Write the a) conventional, b) total ionic and c)net ionic equations for the reactions which occur when the following aqueous solutions are mixed (6 points):
   1. hydrobromic acid and calcium bisulfite

2 HBr (aq) + Ca(HSO3)2 (aq) → CaBr2 (aq) + 2 H2SO3 (aq) decomposes:

2 HBr (aq) + Ca(HSO3)2 (aq) → CaBr2 (aq) +2 H2O (l) +2 SO2 (g)

2 H+ (aq) + 2 Br- (aq) + Ca2+ (aq) + 2 HSO3- (aq) → Ca2+ (aq) + 2 Br- (aq) + 2 H2O (l) +2 SO2 (g)

2 H+ (aq) + 2 HSO3- (aq) → 2 H2O (l) +2 SO2 (g) simplifies to:

H+ (aq) + HSO3- (aq) → + H2O (l) +SO2 (g)

* 1. iron(III) nitrate and ammonia

Fe(NO3)3 (aq) + NH3 (aq) replace NH3 with NH4OH to complete double displacement rxn

Fe(NO3)3 (aq) + 3 NH4OH (aq) → 3 NH4NO3 (aq) + Fe(OH)3 (s) replace NH4OH with NH3 and H2O

Fe(NO3)3 (aq) + 3 NH3 (aq) + 3 H2O (l) → 3 NH4NO3 (aq) + Fe(OH)3 (s)

Fe3+(aq) + 3 NO3- (aq) + 3 NH3 (aq) + 3 H2O (l) → 3 NH4+ (aq) + 3NO3- (aq) + Fe(OH)3 (s)

Fe3+(aq) + 3 NH3 (aq) + 3 H2O (l) → 3 NH4+ (aq) + Fe(OH)3 (s)

1. Ammonia gas is produced via the Haber process when hydrogen gas is reacted with nitrogen gas (12 points).
   * + - 1. Write a balanced chemical equation for the reaction.

3 H2 (g) + N2 (g) → 2 NH3 (g)

* + - * 1. Identify the type of reaction: \_\_\_\_\_\_\_combination reaction\_\_\_\_\_\_\_\_
        2. Complete an ICE table when 30.0 g of nitrogen react with 5.02 g of hydrogen.

|  |  |  |  |
| --- | --- | --- | --- |
|  | N2 (g) + | 3 H2 (g) → | 2 NH3 (g) |
| I |  |  | 0 mol |
| C | -x | -3x | +2x |
| E | 1.07 mol – x =  1.07 mol – 0.830 mol =  0.24 mol | 2.49 mol – x =  0 mol | 2x =  2(0.830 mol) =  1.66 mol |

Compare ratios:

Therefore, hydrogen is the limiting reagent. 2.49 mol – 3 x = 0 mol

x = 0.830 mol

* + - * 1. Calculate the grams of ammonia produced.
        2. How many grams of the excess reactant remain at the end of the reaction?