Exam 1

# Part 1: Multiple Choice (2 points each)

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

1. Which is an alcohol?
2. CH3CH3
3. C2H5OH
4. CH3COOH
5. NH3
6. HCOH
7. Without doing any calculations, list the elements in C2H4O2 in order of decreasing mass percent.
8. H > O > C
9. C > H > O
10. C > O > H
11. O > C > H
12. not enough information
13. Molecules can be described as
    1. mixtures of two or more pure substance.
    2. mixtures of two or more elements that has a specific ratio between components.
    3. two or more atoms chemically joined together.
    4. heterogeneous mixtures.
    5. homogeneous mixtures.
14. Which represents a valid hypothesis?
    1. Neon does not react with oxygen.
    2. Sodium metal reacts violently with water.
    3. Lead is soft and malleable.
    4. Oxygen is a gas at room temperature.
    5. Metals tend to lose electrons.
15. Identify acetic acid:
    1. Strong electrolyte, weak acid
    2. Weak electrolyte, weak acid
    3. Strong electrolyte, strong acid
    4. Weak electrolyte, strong acid
    5. Nonelectrolyte, weak acid
16. Determine the concentration of a solution prepared by diluting 20.0 mL of a 0.200 M cesium chloride solution to 250.0 mL.
    1. 0.160 M
    2. 0.0320 M
    3. 2.50 M
    4. 0.00800 M
    5. 0.0160 M
17. Which statement is false according to Dalton’s Atomic Theory?
    1. Atoms combine in simple whole number ratios to form compounds.
    2. All atoms of chlorine have identical properties that distinguish them from other elements.
    3. One carbon atom will combine with one oxygen atom to form a molecule of carbon monoxide.
    4. Atoms of sodium do not change into another element during chemical reaction with chlorine.
    5. An atom of nitrogen can be broken down into smaller particles that will still have the unique properties of nitrogen.
18. An atom of strontium-90 has
    1. 38 protons, 52 neutrons
    2. 38 protons, 90 neutrons
    3. 52 protons, 38 neutrons
    4. 90 protons, 38 neutrons
    5. 64 protons, 64 neutrons
19. The oxidation state of P in the phosphite ion is
    1. 0
    2. +2
    3. +3
    4. +6
    5. -3
20. Which rule(s) about lab safety is true?
    1. You should always add acid to water.
    2. If you spill chemical on your hand, you should wash it with water for 15 minutes unless the substance is reactive with water.
    3. At a minimum closed toed shoe should be worn in the lab.
    4. all of the above
    5. none 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. Explain how the results of the gold foil experiment led Rutherford to dismiss the plum pudding model of the atom and create his own model based on a nucleus surrounded by electrons (3 points).
2. How are the gains or losses of electrons related to changes in oxidation number (3 points)?
3. Complete the following table (12 points):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Substance** | **Bond Type**  **(Polar covalent, Ionic)** | **Conductivity** | **Ions (None, Few, Many)** | **Major species present in solution** | **Minor species in solution** |
| CH3CO2H (aq) |  | Poor |  |  |  |
| KClO3 (s) |  | None |  |  |  |
| 0.1 M HCl |  | Good |  |  |  |

1. Can extensive properties be used to identify a substance? Explain why or why not (3 points).
2. Explain why the law of constant composition is classified a scientific law, whereas Dalton’s view of the atomic structure of matter is classified a scientific theory (4 points).
3. Combustion analysis of a 13.42 g sample of estriol (which contains only carbon, hydrogen, and oxygen) produced 36.86g CO2 and 10.06 g H2O (15 points).
   1. What is the empirical formula?
   2. The molar mass of estriol is 288.38 g/mol. Find the molecular formula for estriol.
   3. Write the balanced combustion reaction.
4. Sodium thiosulfate, Na2S2O3, is used as a “fixer” in black-and-white photography. Assume you have a bottle of sodium thiosulfate and want to determine its purity. The thiosulfate ion can be oxidized with iodine, I2, to form iodide ions and tetrathionate, S4O62-, ions (12 points).
5. What is the balanced redox reaction (12 points)?
6. If you use 40.21 mL of a 0.246 M I2 solution to react completely with a 4.875 g sample of impure sodium thiosulfate, what is the mass percent of sodium thiosulfate in the sample?

1. Interpretation of Reactions by Ionic Type Equations. Aqueous solutions of the following substances or their mixtures with water if they are only slightly soluble, are mixed. Write first the conventional equation, second the total ionic equation, and lastly the net ionic equation. If you predict no appreciable reaction, indicate this, and state why (12 points).

* Magnesium chloride and sodium carbonate
* Aqueous ammonia and acetic acid
* Barium chloride and calcium nitrate
* Potassium hydrogen carbonate and sulfuric acid

1. A reaction mixture initially contains 0.223 mol iron(II) sulfide and 0.652 mol hydrochloric acid. Once the reaction has occurred as completely as possible (8 points).
2. Write the balanced chemical equation and complete an ICE table.
3. What amount in moles of the excess reactant is left? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. What mass of gas is formed?
5. The widths of copper lines in printed circuit board must be close to a specified value. Three manufacturers were asked to prepare circuit boards with copper lines that are 0.500 μm wide. Each manufacturer’s quality control department reported the following line widths on five sample circuit boards (given in micrometers) (8 points):

|  |  |  |  |
| --- | --- | --- | --- |
|  | Manufacturer #1 | Manufacturer #2 | Manufacturer #3 |
|  | 0.512 | 0.514 | 0.500 |
|  | 0.508 | 0.513 | 0.501 |
|  | 0.516 | 0.514 | 0.502 |
|  | 0.504 | 0.514 | 0.502 |
|  | 0.513 | 0.512 | 0.501 |
| Average |  | 0.5134 | 0.5012 |
| St Dev |  | 0.00089 | 0.00084 |

* 1. Calculate the standard deviation for manufacturer #1.
  2. Can any of the manufacturers justifiably advertise that they produce circuit boards with “high precision”?
  3. Is there an instance where this claim is misleading? If so, explain.