

Complete in pencil. Erase mistakes completely. If you need more space, use the back of the sheets as are necessary. For problems involving calculations, **no credit will be given if work is not shown**. Use sig figs for atomic masses as recorded on the Periodic Table given to you. Final answers should include units and be boxed.

(12 pts) Although Questions #1-6 are Multiple Choice, you must show work to demonstrate why you think the answer you chose is correct. You only need to show work (calculations and/or words) for the answer you choose. For each: 1 pt work, 1 pt correct answer)

1. Which of the following conclusions can be drawn from Ernst Rutherford's gold foil experiments?
- Atoms contain electrons.
  - Practically all the mass of an atom is contained in its nucleus.
  - Atoms contain protons, neutrons, and electrons.
  - The charge of the electron is approximately  $1.6 \times 10^{-19}$  coulombs.
  - No two electrons in one atom can have the same four quantum numbers.

WORK:

ANSWER:

2. In which of the following compounds is the mass ratio of chromium to oxygen closest to 2.17 to 1.00?
- $\text{CrO}_3$
  - $\text{CrO}_2$
  - $\text{CrO}$
  - $\text{Cr}_2\text{O}$
  - $\text{Cr}_2\text{O}_3$

WORK:

ANSWER:

3. Given a 3.00-m (yes, lower-case "m") aqueous solution of sucrose by mass, what additional information is necessary to calculate the molarity of the solution?
- The density of water
  - The density of the solution
  - The molar mass of sucrose
- I only
  - II only
  - I and III
  - II and III
  - More information than the above is needed.

WORK:

ANSWER:

4. If 369 grams of  $\text{Na}_3\text{PO}_4$  (assume molar mass is 164 grams) is dissolved in enough water to make 750 milliliters of solution, which of the option sets below has the concentrations of the potassium and the sulfate ions in solution?

- |    | $[\text{Na}^+]$ | $[\text{PO}_4^{3-}]$ |
|----|-----------------|----------------------|
| a. | 0.030 M         | 0.030 M              |
| b. | 1.0 M           | 3.0 M                |
| c. | 3.0 M           | 1.0 M                |
| d. | 3.0 M           | 3.0 M                |
| e. | 9.0 M           | 3.0 M                |

**WORK:**

**ANSWER:**

5. The mass of Element "Q" found in 1.00 mole of each of four different compounds is 30.0 grams, 45.0 grams, 60.0 grams, and 75.0 grams respectively. A possible atomic weight of "Q" is
- 10.0
  - 15.0
  - 25.0
  - 30.0
  - 45.0

**WORK:**

**ANSWER:**

6. When a hydrate of  $\text{K}_2\text{SO}_4$  is heated until all the water is removed, it retains 65.9 percent of its mass. The formula of the hydrate is
- $\text{Na}_2\text{CO}_3 \cdot 10 \text{H}_2\text{O}$
  - $\text{Na}_2\text{CO}_3 \cdot 3 \text{H}_2\text{O}$
  - $\text{Na}_2\text{CO}_3 \cdot 7 \text{H}_2\text{O}$
  - $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
  - $\text{Na}_2\text{CO}_3 \cdot 5 \text{H}_2\text{O}$

**WORK:**

**ANSWER:**

7. (20 pts) Provide the name or chemical formula (as needed) for the following compounds. (2 pts each: some partial credit available).

- Gold (III) fluoride \_\_\_\_\_
- Barium hydrogen sulfate \_\_\_\_\_
- Lead (III) oxalate \_\_\_\_\_
- Mercurous bromate \_\_\_\_\_
- Ammonium peroxide \_\_\_\_\_
- $\text{Ni}(\text{NO})_2$  \_\_\_\_\_
- $\text{B}_2\text{O}_6$  \_\_\_\_\_
- $\text{HFO}_4$  \_\_\_\_\_
- $\text{Rb}_2\text{S}$  \_\_\_\_\_
- $\text{Mn}(\text{OH})_4 \cdot 8 \text{H}_2\text{O}$  \_\_\_\_\_

8. (8 pts) Complete the reaction for the combustion of isobutanol, then perform the indicated calculations.
- (2 pts)  $C_4H_{10}O(g) + O_2(g) \rightarrow ?$
  - (6 pts) If 12.00 g of isobutanol reacts with 12.00 g of oxygen gas, determine the limiting reactant and calculate the mass of the product that contains hydrogen produced in the reaction. (2 pts work, 1 pt correct limiting reactant, 1 pt correct answer, 1 pt correct sig figs)
9. (15 pts) Use appropriate ionic and molecular formulas to show the reactants and the products for the following, each of which results in a reaction occurring in aqueous solution except as indicated. Omit formulas for any ionic or molecular species that do not take part in the reaction. You need not balance. In all cases a reaction occurs. (3 pts each, some partial credit available)
- Dilute strontium hydroxide is added to a solution of cobalt (II) nitrate.
  - Ammonia gas is bubbled into a solution of chromic acid.
  - Lithium oxide powder is sprinkled into distilled water.
  - A saturated solution of sodium hydroxide is mixed with a solution of iron(II) sulfate.
  - Water is added to a sample of pure aluminum nitride.