

AP CHEMISTRY SEMESTER 1 EXAM

NAME _____

I. Multiple Choice. Select the BEST answer for each question (1 pt each, 26 pts total)

- _____ 1) Which of the following is (are) considered to be proper laboratory procedure?
 - I. reading the height of a fluid in a buret from a point level with the fluid's meniscus.
 - II. placing a sample to be weighed directly on the pan of a balance.
 - III. stirring a solution constantly during a titration.

a. I only b. III only c. I and III only d. II and III only e. I, II, and III
- _____ 2) An object that was weighed on a balance was later found to be slightly heavier than the weight that was recorded by the balance. Which of the following could have caused the discrepancy?
 - I. there was some foreign matter on the weighing paper along with the object
 - II. the object was hot when it was weighed
 - III. the experimenter neglected to account for the weight of the weighing paper

a. I only b. II only c. I and II only d. I and III only e. I, II, and III
- _____ 3) What piece of glassware is a tall container with many evenly-spaced markings along the side? It would be used to measure the volume of a liquid.

a. volumetric pipet b. beaker c. flask d. graduated cylinder e. Beral pipet
- _____ 4) How many sig figs are there in the number 0.0004300?

a. 2 b. 3 c. 4 d. 7 e. 8
- _____ 5) What would the following number be in scientific notation? 0.0000430

a. 4.3×10^5 b. 4.3×10^{-5} c. 4.3×10^4 d. 4.3×10^{-4} e. 4.30×10^5 f. 4.30×10^{-5}
- _____ 6) Atoms of the same element with different mass numbers (example: $^{235}_{92}\text{U}$ $^{238}_{92}\text{U}$) are called:

a. nucleons b. neutrons c. allotropes d. isotopes e. isomers
- _____ 7) How many neutrons are there in an atom of $^{235}_{92}\text{U}$?

a. 92 b. 112 c. 143 d. 235
- _____ 8) How many electrons are there in an atom of $^{23}_{11}\text{Na}^{+1}$?

a. 10 b. 11 c. 12 d. 22 e. 23 f. 24
- _____ 9) Boron obtained from borax deposits in Death Valley consists of two isotopes. They are boron-10 and boron-11 with atomic masses of 10.013 amu and 11.009 amu respectively. The atomic mass of boron is 10.81 amu. Which isotope of boron is more abundant?

a. boron-10 b. boron-11

c. cannot be determined from this information d. neither, they are both the same
- _____ 10) Which of the following statements is true regarding sodium and chlorine?
 - a. sodium has greater electronegativity and a larger first ionization energy
 - b. sodium has a larger first ionization energy and a larger atomic radius
 - c. chlorine has a larger atomic radius and a greater electronegativity
 - d. chlorine has greater electronegativity and a larger first ionization energy
 - e. chlorine has a larger atomic radius and a larger first ionization energy
- _____ 11) Which of the following could be the quantum numbers for the valence electron in a ground state chlorine atom?

a. (3,0,0,1/2) b. (3,1,1,1/2) c. (4,0,0,1/2) d. (4,1,1,1/2) e. (4,2,1,1/2)
- _____ 12) Which of the following elements is diamagnetic?

a. H b. Li c. Be d. B e. C f. Fe g. Ni
- _____ 13) Which of the following is true of the halogens?
 - a. they usually take the -2 oxidation state
 - b. they form ionic bonds with other nonmetals
 - c. they are generally found in nature as compounds
 - d. they are all lustrous and malleable
- _____ 14) What is the physical state of the element iodine at standard temperature and pressure (STP)?

a. metal b. nonmetal c. metalloid d. android
- _____ 15) How many valence electrons are there in an atom of the element selenium?

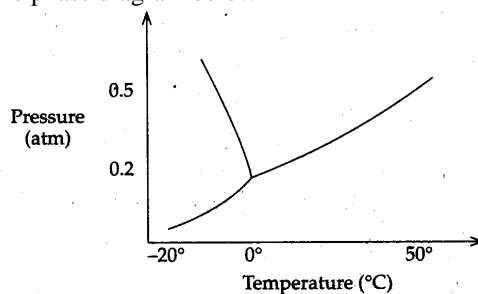
a. 1 b. 2 c. 3 d. 4 e. 5 f. 6 g. 7 h. 8

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- _____ 16) Which of the following elements has the greatest ionization energy (i.e. the most difficult to remove electrons from)?
 a. francium b. lithium c. hydrogen d. fluorine e. helium f. iodine g. radon
- _____ 17) What coefficients would be used to balance the equation:
 $\text{CH}_3\text{OH} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
 a. 1,1,1,1 b. 1,2,1,2 c. 1,3,1,2 d. 2,3,2,4 e. 2,3,2,3
- _____ 18) Which of the following molecules would have the longest NO bond length?
 a. NO_3^{-1} b. NO_2^{-1} c. NO
- _____ 19) Based on its molecular structure, which of the following molecules would be the most soluble in water?
 a. H_2 b. N_2 c. NH_3 d. CH_4 e. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- _____ 20) Which of the following is a saturated hydrocarbon?
 a. $\text{CH}_2=\text{CH}-\text{CH}_3$ b. $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{CH}-\text{CH}_3 \end{array}$ c. $\text{H}-\text{C}\equiv\text{C}-\text{H}$

Questions 21-23 are based on the phase diagram below



- _____ 21) As pressure on the substance depicted in the diagram is increased at constant temperature, which of the following phase changes could NOT occur?
 I. Condensation II. Melting III. Freezing
 a. I only b. II only c. III only d. I and II only e. I and III only
- _____ 22) At a temperature of 50°C and a pressure of 0.2 atm, the substance depicted on the diagram is
 a. a gas b. a liquid c. a solid d. at the triple point e. at the critical point
- _____ 23) Which of the following lists the three phases of the substance shown in the diagram in order of increasing density at -5°C?
 a. solid, gas, liquid b. solid, liquid, gas c. gas, liquid, solid d. gas, solid, liquid
- _____ 24) Which of the following lists of species is in order of increasing boiling point?
 a. Fe, He, CH_3OH b. CH_3OH , He, Fe c. Fe, CH_3OH , He d. He, CH_3OH , Fe
- _____ 25) Under what two conditions will gases NOT behave ideally?
 a. high pressure, high temperature b. high pressure, low temperature
 c. low pressure, high temperature d. low pressure, low temperature
- _____ 26) Which of the following pairs of gases would be the easiest to separate by gaseous effusion?
 a. NH_3 and CH_4 b. Ar and O_2 c. Ne and He d. Cl_2 and Kr e. N_2 and O_2

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II. Short Answer / Essay (point values are marked on the question, 29 pts total)

1. Explain why a plate made of glow-in-the-dark material will glow after it is exposed to violet light, but not a red LASER. (2 pts)

2. Explain why a chlorine atom has a smaller radius than an aluminum atom. (2 pts)

3. Explain why the first three ionization energies for an aluminum atom are comparably small, but the 4th ionization energy is extremely high. (2 pts)

4. What happens to the size of a sodium atom when it becomes an ion? Explain. (2 pts)

5. Give the ground state electron configurations for the following atoms or ions: (2 pts)

_____ a. Fe

_____ b. Mg^{+2}

6. Give the correct name or formula for the following compounds: (4 pts)

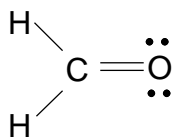
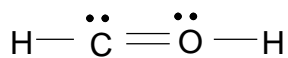
_____ a. sulfuric acid _____ c. $\text{Fe}(\text{OH})_2$

_____ b. tetraphosphorus decoxide _____ d. NiCO_3

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7. Based on the two proposed skeletal structures for formaldehyde (CH_2O), determine the correct structure. Explain your answer. (2 pts)



8. Using your knowledge of the structure of ionic substances, explain why the melting point of magnesium oxide (MgO) is greater than that of sodium chloride (NaCl). (2 pts)

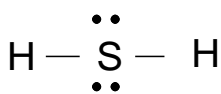
9. Give the correct Lewis structures for the following molecules and polyatomic ions: (3 pts)

a. NH_3

b. nitrate: NO_3^{-1}

c. BrF_5

10. Fill in the following information about the hydrogen sulfide (H_2S) molecule: (4 pts)



Shape _____

Type of hybrid orbital _____ # of sigma bonds _____

Polarity _____

11. Explain why the volume of a balloon at room temperature will decrease when placed in liquid nitrogen. (2 pts)

12. Explain why a student in the front row will detect the odor of ammonia (NH_3) vapor before detecting the odor of a sample of perfume ($\text{C}_{12}\text{H}_{35}\text{N}_3\text{S}_2$) when bottles of both are opened at the same time. (2 pts)

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III. Write the formulas to show the reactants and products for all of the laboratory situations described below. In all cases, a reaction occurs. Assume that all solutions are aqueous unless otherwise indicated. Represent substances in solution as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. (4 pts each, 20 pts total)

- 1) Propane gas is heated in air.

- 2) A piece of solid nickel is placed in a solution of silver nitrate.

- 3) Solutions of sodium chromate and lead(II) nitrate are mixed.

- 4) A piece of solid sodium is placed in cold distilled water.

- 5) Solutions of ammonia and hydrofluoric acid are mixed.

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IV. Problems (point values are marked on the question, 36 pts total)

1. Calculate the following. Be sure your answer has the proper number of sig figs. (2 pts)

$$\frac{3.77 \times 10^{-8}}{(6.02 \times 10^{-23})(6.0 \times 10^9)} =$$

2. If an empty beaker has a mass of 35.04g and its mass increases to 105.66g when you add 100.0 mL of the liquid, what is the density of the liquid? (2 pts)

3. If Detroit is 157 miles away, how many centimeters is that? (2 pts)
1 km = 0.6214 mi

3. Calculate the formula mass of acetic acid CH_3COOH . (2 pt)

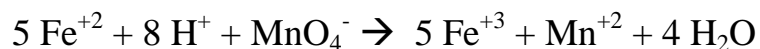
4. How many sulfur atoms are there in 21.0g of aluminum sulfide (Al_2S_3)? (3 pts)

5. How many grams of magnesium are there in 75.0g of $\text{Mg}(\text{NO}_3)_2$? (3 pts)

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6. According to the following reaction:

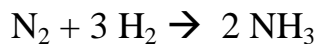


If it requires 26.2 mL of a 0.100M KMnO_4 solution to titrate 10.0 mL of a FeSO_4 solution of unknown concentration, what is the concentration of the FeSO_4 ? (3 pts)

7. At a water treatment plant, the concentration of iron(III) ions in the water can be determined by doing a gravimetric analysis in which the iron(III) ions are precipitated with sodium carbonate. If you take a 50.0 mL sample of the water, and it requires 2.50 mL of a 1.000M sodium carbonate solution to precipitate the iron(III), what is the concentration of iron(III) ions in the water sample? (3 pts)

8. In the laboratory, you are trying to determine the concentration of an unknown sodium hydroxide solution by titrating it with potassium hydrogen phthalate ($\text{KHC}_8\text{H}_4\text{O}_4$), a solid, monoprotic acid often used for this task. If you test a 50.0 mL sample of the unknown sodium hydroxide, and it takes 1.6243g of the KHP solid to titrate it to the equivalence point, what is the concentration of the sodium hydroxide solution? (3 pts)

9. Observe the following equation:

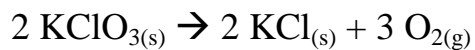


If you begin with 5.00g of nitrogen and 5.00g of hydrogen, how many grams of ammonia should you expect? (3 pts)

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10. Use the following equation:



The reaction took place beginning with 2.500g of potassium chlorate, and the oxygen gas was collected over water at a temperature of 29°C and a pressure of 755 mmHg. The vapor pressure of water at 29°C is 30.0 mmHg. What would the volume of oxygen gas produced by the reaction be? (3 pts)

11. If you have a balloon which occupies 3.68 L under 456 mmHg of pressure at a temperature of 73°C, what will the volume be at standard temperature and pressure (STP)? (3 pts)

12. Discuss your feelings about this class thus far. Is it what you expected? How is the pace? What areas of improvement would you recommend? What aspects of this class are done well? (4 pts)