

CEM 151, Exam 1  
September 21, 2011  
Fall 2011

Name: \_\_\_\_\_  
A-PID: \_\_\_\_\_

Multiple choice, mark the correct answer on your scan sheet (5 points each)

1) In the following list, only \_\_\_\_\_ is not an example of matter.

- |            |                         |                      |
|------------|-------------------------|----------------------|
| A) planets | D) elemental phosphorus | G) None of the above |
| B) light   | E) table salt           | H) D and E           |
| C) dust    | F) All of the above     |                      |

2) A small amount of salt dissolved in water is an example of a \_\_\_\_\_.

- |                        |                          |               |
|------------------------|--------------------------|---------------|
| A) homogeneous mixture | D) heterogeneous mixture | G) A, B and E |
| B) compound            | E) pure substance        | H) C and E    |
| C) solid               | F) A and C               |               |

3) Of the objects below, \_\_\_\_\_ is the most dense.

- A) an object with a volume of 2.5 L and a mass of 12.5 kg
- B) an object with a volume of 139 mL and a mass of 93 g
- C) an object with a volume of  $0.00212 \text{ m}^3$  and a mass of  $4.22 \times 10^4 \text{ mg}$
- D) an object with a volume of  $3.91 \times 10^{-24} \text{ nm}^3$  and a mass of  $7.93 \times 10^{-1} \text{ ng}$
- E) an object with a volume of  $13 \text{ dm}^3$  and a mass of  $1.29 \times 10^3 \text{ g}$

4) The number with the most significant zeros is \_\_\_\_\_.

- |               |                           |
|---------------|---------------------------|
| A) 0.00002510 | D) $2.501 \times 10^{-7}$ |
| B) 0.02500001 | E) 2.5100000              |
| C) 250000001  |                           |

5) Which statement below correctly describes the responses of alpha, beta, and gamma radiation to an electric field?

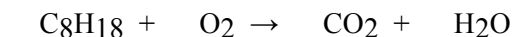
- A) Both beta and gamma are deflected in the same direction, while alpha shows no response.
- B) Both alpha and gamma are deflected in the same direction, while beta shows no response.
- C) Both alpha and beta are deflected in the same direction, while gamma shows no response.
- D) Alpha and beta are deflected in opposite directions, while gamma shows no response.
- E) Only alpha is deflected, while beta and gamma show no response.

6) The gold foil experiment performed in Rutherford's lab \_\_\_\_\_.

- A) confirmed the plum-pudding model of the atom
- B) led to the discovery of the atomic nucleus
- C) utilized the deflection of alpha particles by gold foil
- D) utilized the deflection of beta particles by gold foil
- E) proved the law of multiple proportions
- F) A and B
- G) B and C

7. Mulliken's oil drop experiment measured \_\_\_\_\_.
- The charge to mass ratio of the electron
  - The charge to mass ratio of the proton
  - The charge of the electron
  - The charge on the proton
  - The size of the nucleus
  - The mass of the neutron
  - The charge of a helium nucleus
- 8) Which atom has the largest number of neutrons?
- phosphorus-30
  - chlorine-37
  - potassium-39
  - argon-40
  - calcium-40
  - Potassium-38
- 9) An atom of the most common isotope of gold,  $^{197}\text{Au}$ , has \_\_\_\_\_ protons, \_\_\_\_\_ neutrons, and \_\_\_\_\_ electrons.
- 197, 79, 118
  - 118, 79, 39
  - 79, 197, 197
  - 79, 118, 118
  - 79, 118, 79
  - None of the above
- 10) The elements in groups 1A, 6A, and 7A are called, \_\_\_\_\_, respectively.
- alkaline earth metals, halogens, and chalcogens
  - alkali metals, chalcogens, and halogens
  - alkali metals, halogens, and noble gases
  - alkaline earth metals, transition metals, and halogens
  - halogens, transition metals, and alkali metals
- 11) Which species below is the sulfite ion?
- $\text{SO}_2^{-2}$
  - $\text{SO}_3^{-2}$
  - $\text{S}^{2-}$
  - $\text{SO}_4^{-2}$
  - $\text{HS}^-$
  - $\text{SO}^-$
  - None of the above
- 12) Aluminum reacts with a certain nonmetallic element to form a compound with the general formula  $\text{AlX}$ . Element X is a diatomic gas at room temperature. Element X must be \_\_\_\_\_.
- oxygen
  - fluorine
  - chlorine
  - nitrogen
  - sulfur
  - Phosphorous
  - iron
  - none of the above
  - all of the above
- 13) The correct name for  $\text{CCl}_4$  is \_\_\_\_\_.
- carbon chloride
  - carbon tetrachlorate
  - carbon perchlorate
  - carbon tetrachloride
  - carbon chlorate
  - Carbonium chloride
  - None of the above
- 14) The correct name for  $\text{H}_2\text{CO}_3$  is \_\_\_\_\_.
- carbonous acid
  - hydrocarbonate
  - carbonic acid
  - carbohydrate
  - carbohydric acid
  - hydrogen carbonate
  - hydrocarbonic acid
  - dihydrogen carbon trioxide
  - none of the above

15) When the following equation is balanced, the coefficients are \_\_\_\_\_.



- A) 2, 3, 4, 4                      D) 4, 4, 32, 36                      G) 2, 4, 8, 10  
B) 1, 4, 8, 9                      E) 2, 25, 16, 18                      H) none of the above  
C) 2, 12, 8, 9                      F) 8, 2, 1, 2

16) One mole of \_\_\_\_\_ contains the largest number of atoms.

- A) S<sub>8</sub>                                      D) Na<sub>3</sub>PO<sub>4</sub>  
B) C<sub>10</sub>H<sub>8</sub>                                E) Cl<sub>2</sub>  
C) Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>                            F) They all have the same number of atoms

17) Of the species below, only \_\_\_\_\_ is/are not an electrolyte.

- A) HCl                                      D) KOH                                      G) C and F  
B) Rb<sub>2</sub>SO<sub>4</sub>                                E) NaCl                                      H) B, C and F  
C) Ar                                        F) CH<sub>4</sub>                                      I) none of the above

18) The net ionic equation for formation of an aqueous solution of Al(NO<sub>3</sub>)<sub>3</sub> via mixing solid Al(OH)<sub>3</sub> and aqueous nitric acid is \_\_\_\_\_.

- A) Al(OH)<sub>3</sub> (s) + 3HNO<sub>3</sub> (aq) → 3 H<sub>2</sub>O (l) + Al(NO<sub>3</sub>)<sub>3</sub> (aq)  
B) Al(OH)<sub>3</sub> (s) + 3NO<sub>3</sub><sup>-</sup> (aq) → 3OH<sup>-</sup> (aq) + Al(NO<sub>3</sub>)<sub>3</sub> (aq)  
C) Al(OH)<sub>3</sub> (s) + 3NO<sub>3</sub><sup>-</sup> (aq) → 3OH<sup>-</sup> (aq) + Al(NO<sub>3</sub>)<sub>3</sub> (s)  
D) Al(OH)<sub>3</sub> (s) + 3H<sup>+</sup> (aq) → 3 H<sub>2</sub>O (l) + Al<sup>3+</sup> (aq)  
E) Al(OH)<sub>3</sub> (s) + 3HNO<sub>3</sub> (aq) → 3 H<sub>2</sub>O (l) + Al<sup>3+</sup> (aq) + NO<sub>3</sub><sup>-</sup> (aq)

19) Which one of the following solutions will have the greatest concentration of hydroxide ions?

- A) 0.300 M rubidium hydroxide                      D) 0.100 M beryllium hydroxide  
B) 0.100 M magnesium hydroxide                      E) 0.100 M hydrochloric acid  
C) 0.100 M ammonia

20) Which of the following are weak acids?

- A) HF, HBr                                D) HF                                      G) nitric acid  
B) HI, HNO<sub>3</sub>, HBr                      E) sulfuric acid                      H) none of the above  
C) HI, HF                                    F) NaOH

Answer the following questions. **Show your work!** Significant figures matter!

21) (15 points) The average atomic weight of copper, which has two naturally occurring isotopes, is 63.5. One of the isotopes has an atomic weight of 62.9 amu and constitutes 69.1% of the copper isotopes. The other isotope has an abundance of 30.9%. The atomic weight (amu) of the second isotope is \_\_\_\_\_ amu.

22)(16 points) Combustion of a 0.9835-g sample of a compound containing only carbon, hydrogen, and oxygen produced 1.900 g of CO<sub>2</sub> and 1.070 g of H<sub>2</sub>O.

a. What is the empirical formula of the compound?

b. If the molecular mass of the compound is 182, what is the molecular formula for the compound?

23)(19 points) A recent discovery has identified a microorganism that will convert cellulose from newspapers directly into butanol,  $C_4H_{10}O$ . Pure butanol can be used in automobiles directly as fuel with little modification.

a. Write a balanced equation for the combustion reaction of butanol

b. A side reaction that occurs in the combustion of butanol in air is the formation of nitric oxide from nitrogen gas and oxygen gas. Write a balanced chemical reaction for this process.

c. Assume that 10% of the oxygen reacts to form nitric oxide. How much carbon dioxide would be produced when 74 g of butanol are reacted with 4 moles of oxygen?

d. What is the percent yield of carbon dioxide from butanol in this reaction?