CH 221 Sample Exam
Exam I Name: _____ Lab Section: _____

Part I: Multiple Choice Questions (100 Points) *Use a scantron sheet for Part I.* There is *only* one best answer for each question.

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1. At 0 °C, a bottle contains 325 mL of water in its liquid state. What is the volume of the water after it freezes (at 0 °C)? The densities of liquid water and ice at 0 °C are 1.000 g/mL and 0.917 g/mL, respectively.

   a. 27.0 mL
   b. 298 mL
   c. 325 mL
   d. 354 mL
   e. 391 mL

2. The radius of a helium atom is 31 pm. What is the radius in nanometers? ($p = 10^{-12}$)

   a. 3.1×10^{-9} nm
   b. 3.1×10^{-6} nm
   c. 3.1×10^{-5} nm
   d. 3.1×10^{-3} nm
   e. 3.1×10^{-2} nm

3. The density of liquid mercury is 13.5 g/cm^3. What mass of mercury (in kg) is required to fill a hollow cylinder having an inner diameter of 2.00 cm to a height of 25.0 cm? ($V = \pi r^2 h$)

   a. 1.06 kg
   b. 4.24 kg
   c. 0.171 kg
   d. 1.71×10^{-4} kg
   e. 4.24×10^{-6} kg

4. The output of a plant is 4335 pounds of ball bearings per work week (five days). If each ball bearing weighs 0.0113 g, how many ball bearings does the plant make in a single day? (453.6 g = 1 pound)

   a. 3.84×10^5
   b. 7.67×10^4
   c. 867
   d. 3.48×10^7
   e. 2.91×10^6

5. The density of mercury is 13.6 g/cm^3. The density of mercury is _____ kg/m^3.

   a. 1.36×10^{-2}
   b. 1.36×10^4
   c. 1.36×10^8
   d. 1.36×10^{-5}
   e. 1.36×10^{-4}

6. The dimensions of a rectangular solid are 8.45 cm long, 4.33 cm wide and 2.85 cm high. If the density of the solid is 9.43 g/cm^3, what is the mass?

   a. 1.12 g
   b. 11.1 g
   c. 154 g
   d. 896 g
   e. 983 g

7. How many protons, neutrons, and electrons are in a neutral oxygen-18 atom?

   a. 6 protons, 8 neutrons, 4 electrons
   b. 6 protons, 10 neutrons, 8 electrons
   c. 8 protons, 8 neutrons, 8 electrons
   d. 8 protons, 10 neutrons, 8 electrons
   e. 8 protons, 10 neutrons, 18 electrons

8. Which of the following atoms contains the largest number of neutrons?

   a. $^{31}_{15}\mathrm{P}$
   b. $^{30}_{14}\mathrm{Si}$
   c. $^{37}_{17}\mathrm{Cl}$
   d. $^{32}_{16}\mathrm{S}$
   e. $^{34}_{16}\mathrm{S}$

9. All of the following statements are true EXCEPT

   a. for any neutral element, the number of protons and electrons are equal.
   b. electrons and protons have equal mass, but opposite charges.
   c. the mass number is the sum of the number of protons and neutrons.
   d. the atomic number equals the number of protons.
   e. isotopes of an element have identical atomic numbers.

10. You have 4.15 g of each of the following elements: Ca, Cu, Ce, Cs, Cf. Which sample contains the largest number of atoms?

    a. Ca
    b. Cu
    c. Ce
    d. Cs
    e. Cf

11. Pennies minted after 1983 are composed of 97% zinc and 3.0% copper and have a mass of 2.46 g. How many moles of copper are in a penny?

    a. 0.0012 mol
    b. 0.014 mol
    c. 0.038 mol
    d. 0.040 mol
    e. 25 mol

12. What mass of He contains the same number of atoms as 5.0 g Kr?

    a. 0.24 g
    b. 0.80 g
    c. 1.2 g
    d. 5.0 g
    e. 1.0×10^2 g

13. The molar mass of cesium is 132.9 g/mol. What is the mass of a single Cs atom?

    a. 2.207×10^{-22} g
    b. 1.249×10^{-26} g
    c. 2.763×10^{-23} g
    d. 4.531×10^{21} g
    e. 1.329×10^{-23} g

14. Identify the ions present in $KHCO_3$.

    a. $KHCO_3$ is not ionic.
    b. KH^+, and CO_3^{-1}
    c. K^+, H^+, C^{4+}, and O^{2-}
    d. KH^{2+} and CO_3^{2-}
    e. K^+ and HCO_3^{-1}

15. What is the molar mass of cobalt(II) iodide hexahydrate?

    a. 212.8 g/mol
    b. 293.9 g/mol
    c. 312.7 g/mol
    d. 420.8 g/mol
    e. 465.1 g/mol

16. How many oxygen atoms are in 1.50 mol of SO_3?

    a. 7.71×10^{21} atoms
    b. 1.12×10^{22} atoms
    c. 3.01×10^{22} atoms
    d. 9.03×10^{23} atoms
    e. 2.71×10^{24} atoms

17. If 1.00 g of an unknown molecular compound contains 4.55×10^{21} molecules, what is its molar mass?

    a. 44.0 g/mol
    b. 66.4 g/mol
    c. 72.1 g/mol
    d. 98.1 g/mol
    e. 132 g/mol

18. Which of the following quantities of compounds contains the largest total number of atoms?

    a. 1.0 mole of H_3PO_4
    b. 2.0 moles of H_2SO_3
    c. 3.0 moles of $HClO_4$
    d. 4.0 moles of H_2S
    e. 5.0 moles of HBr

19. What is the mass percent of each element in dichloromethane, CH_2Cl_2?

    a. 10.06% C, 60.24% H, 29.70% Cl
    b. 20.00% C, 20.00% H, 60.00% Cl
    c. 24.10% C, 3.11% H, 72.79% Cl
    d. 33.87% C, 0.22% H, 65.91% Cl
    e. 14.14% C, 2.37% H, 83.48% Cl

20. A molecule is found to contain 47.35% C, 10.60% H, and 42.05% O. What is the empirical formula for this molecule?

    a. C_2H_6O
    b. $C_3H_4O_2$
    c. $C_3H_8O_2$
    d. $C_4H_6O_2$
    e. $C_4H_8O_3$

21. A 2.000 g sample of $CoCl_2 \cdot xH_2O$ is dried in an oven. When the anhydrous salt is removed from the oven, its mass is 1.565 g. What is the value of x?

    a. 1
    b. 2
    c. 3
    d. 4
    e. 6

22. Benzene, an organic solvent, has the empirical formula CH. If the molar mass of benzene is 78.11 g/mol, what is the molecular formula of benzene?

    a. C_4H_{30}
    b. C_5H_{18}
    c. C_6H_6
    d. C_7H_8
    e. C_2H_2

23. What is the common name for NH_3?

    a. ammonia
    b. nitrogen trihydride
    c. trihydrogen nitride
    d. ammonium
    e. nitrous

24. How many oxygen atoms are in 0.20 g CO_2?

    a. 2.4×10^{23} oxygen atoms
    b. 2.7×10^{21} oxygen atoms
    c. 5.5×10^{21} oxygen atoms
    d. 1.2×10^{23} oxygen atoms
    e. 9.7×10^{10} oxygen atoms

25. What formula represents the binary compound formed by magnesium and phosphorus?

    a. MgP
    b. Mg_2P
    c. MgP_3
    d. Mg_3P_2
    e. Mg_2P_3

Part II: Short Answer / Calculation. *Show all work!*

1. The density of chromium is 7.19 g/cm^3 at room temperature. How many atoms are in a cube of pure chromium that has an edge of 3.47 inches? (1 inch = 2.54 cm, edge^3 = Volume)

2. A molecule with a molecular weight of 180.18 g/mol is analyzed and found to contain 40.00% carbon, 6.72% hydrogen and 53.28% oxygen. Find the empirical formula and molecular formula for this compound.

3. Silver has two stable isotopes, one (Ag-109) with the exact mass of 108.9047 amu and an abundance of 48.18%. Determine the identity and exact mass of the second isotope. (The atomic mass of silver = 107.87).

4. Write the correct name for each of the following compounds.

Li_2CrO_4 _____

$K_2C_2O_4$ _____

H_3As _____

NCl_3 _____

NH_4ClO _____

SBr_4 _____

$Ca(OH)_2$ _____

H_2O _____

$TiNO_2$ _____

SO_3 _____