CHM 211 Test 1 Name: _____
Fall 2024 (Please print)

Multiple Choice: (4 points each. Put answers in left margin as capital letters.)

1. Which of these is an extensive property?

   A) boiling point C) density E) volume
   B) color D) hardness

2. Which of the following responses has the correct number of significant digits:
   distance (ft)=(1.642 inches) $\left(\frac{1\text{ ft}}{12\text{ in}}\right)$?

   A) 0.1 ft B) 0.14 ft C) 0.137 ft D) 0.1368 ft E) 0.13683 ft

3. Which of the following is **false**?

   A) Accuracy refers to how closely individual measurements agree with each other.
   B) Compounds are pure substances made up of atoms of two or more different elements chemically bonded together.
   C) Elements are substances that cannot be decomposed into simpler substances.
   D) Matter is anything that has mass and occupies space.
   E) Numbers obtained by measurement are always inexact.

4. One millimeter equals 10^x meters. What is x?

   A) -6 B) -3 C) -2 D) -1 E) 3

5. Which of the following is most likely a gas at 25 ºC?

   A) $CaCl_2$ B) Cl_2O_3 C) $Fe(NO_3)_2$ D) Mn E) None are gases

6. An alpha (α) particle is a(n)?

   A) electron C) helium atom E) proton
   B) energy wave D) helium nucleus

7. The correct number of protons, neutrons, and electrons in Pt^{2+} (Pt-195) is:

   A) 78p, 117n, 76e C) 78p, 117n, 78e E) 81p, 114n, 78e
   B) 78p, 117n, 74e D) 80p, 115n, 78e

8. What percentage of nitrogen in $Ca(NO_3)_2$?

   A) 13.7% B) 17.1% C) 18.9% D) 25.9% E) 28.0%

9. Which of the formulas must be a molecular formula?

   A) Al_2O_3 B) CH_2O C) $C_3H_4O_3$ D) H_2O_2 E) PO

Discussion Questions: (**You must show your work to receive credit**.)

1. Define: (12 points)

   extensive property – properties that depend on the amount of the material present

   compound – a pure substance made up of atoms of two or more different elements chemically bonded together

   isotope – atoms of the same element possessing differing numbers of neutrons

2. Classify these substances. Select all classifications that apply to each substance. (8 points)

   N_2, H_2O, air (write all into appropriate lines, leave lines blank where no substance applies)

   element N_2
   compound H_2O
   pure substance N_2, H_2O
   homogeneous mixture air
   heterogeneous mixture
   solution air

3. List 4 properties typically associated with nonmetals. (10 points).

   brittle, electrical and thermal insulators, variable colors, low melting point/solid, dull, forms anions

4. For the following, give the name or formula where appropriate: (15 points)

   CH_3CO_2H – acetic acid
   Na_2S – sodium sulfide
   Fe_2O_3 – iron(III) oxide
   calcium nitrate – $Ca(NO_3)_2$
   hydrobromic acid – $HBr_{(aq)}$

5. On another planet, the isotopes of titanium have the natural abundances in the table below.

Isotope	Abundance	Mass (amu)
Ti-46	72.000%	45.95263
Ti-48	15.200%	47.94795
Ti-50	12.800%	49.94479

   What is the average atomic mass of titanium on that planet? (9 points)

   average atomic mass = (0.72000)(45.95263 amu) + (0. 15200)(47.94795 amu) + (0.12800)(49.94479 amu)

   = 46.767 amu

6. Benzoic acid is a common preservative in many processed foods. It contains 68.8% carbon, 4.95% hydrogen, 26.2% oxygen by mass. It has a molar mass of about 120 g/mol. What is its empirical and molecular formulae. (**You may not work backwards from its molar mass**.) (10 points)

Assume 100 g of compound:

$$\text{mol}_C = (68.8\ g_C)\left(\frac{1\ \text{mol}_C}{12.011\ g_C}\right) = 5.73\ \text{mol}_C \qquad \frac{5.73\ \text{mol}_C}{1.64\ \text{mol}_O} = 3.49\ \text{mol}_C \text{ per mol}_O$$

$$\text{mol}_H = (4.95\ g_H)\left(\frac{1\ \text{mol}_H}{1.0079\ g_H}\right) = 4.91\ \text{mol}_H \qquad \frac{4.91\ \text{mol}_H}{1.64\ \text{mol}_O} = 2.99\ \text{mol}_H \text{ per mol}_O$$

$$\text{mol}_O = (26.2\ g_O)\left(\frac{1\ \text{mol}_O}{15.9994\ g_O}\right) = 1.64\ \text{mol}_O \qquad \frac{1.64\ \text{mol}_O}{1.64\ \text{mol}_O} = 1$$

Because 3.49 is not close to a whole number, all ratios by 2 to yield whole numbers of each atom

$\Rightarrow$ empirical formula = $C_7H_6O_2$

Empirical weight = 122 g/eu

$$\frac{\text{MW}}{\text{EW}} = \frac{120\ \text{g/mol}}{122\ \text{g/eu}} = 0.98\ \text{eu/mol}$$

$\Rightarrow$ molecular formula = $C_7H_6O_2$