Chem 108 Exam 1: Practice Questions

The following questions are representative of the types of questions that you can anticipate on Exam 1, which will be comprised of 20 multiple choice questions (4pts each), 10 True/False questions (2pts each) and ~5-6 problems of various types: matching, fill-in, and applications of mathematical calculations (~4-6 pts each). The total possible exam points will be ~130 raw points, which will be normalized to 100%.

Answers to the questions are not provided, but you are highly encouraged to bring specific questions for any problems that you have attempted but are uncertain of your answers for discussion.

90 minutes will be allotted for Exam 1. One way to test yourself is to randomly select 20 M/C, 10 T/F and 6 problems from the selections below and time yourself.

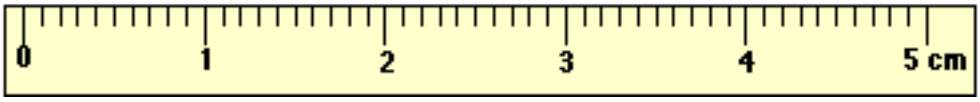
- What is the term for the systematic investigation of nature and the explanation of the recorded observations?

  (a) alchemy
  (b) physics
  (c) chemistry
  (d) science
  (e) none of the above

- What is the term for the study of chemical substances that contain carbon?

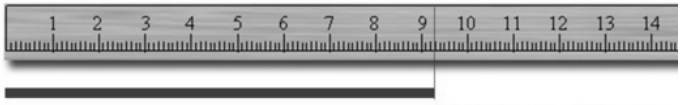
  (a) inorganic chemistry
  (b) biochemistry
  (c) fossil chemistry
  (d) organic chemistry
  (e) none of the above

- Which set of measurements are all consistent with the metric ruler shown below?



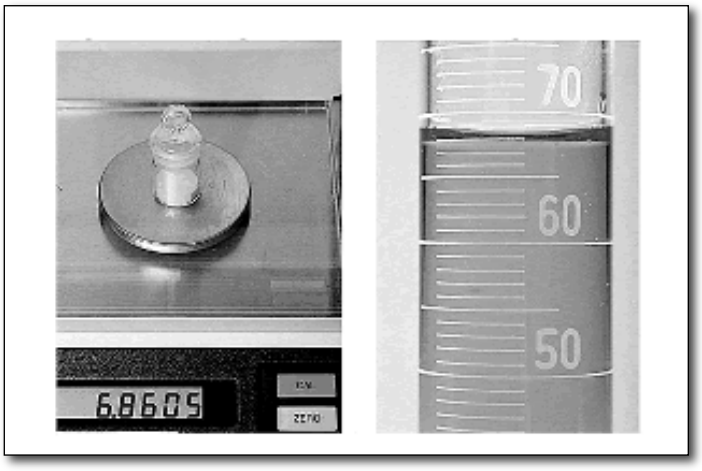
  (a) 1.5 cm, 1.55 cm, 2.35 cm
  (b) 2.400 cm, 3.40 cm, 4.75 cm
  (c) 1.7 cm, 1 cm, 2.40 cm
  (d) 4.50 cm, 1.500 cm, 3.45 cm
  (e) 1.50 cm, 1.55 cm, 2.35 cm

- Which measurement(s) for the bar shown below is/are consistent with the graduated scale on the 14 cm ruler, and acceptable to report?



a) 9.3 cm, 9.30 cm, 9.35 cm; uncertainty +/- 0.1 cm
b) 9.300cm, 9.30 cm, 9.3cm; uncertainty +/- 0.05 cm
c) 9.30 cm or 9.35 cm; uncertainty +/- 0.05 cm
d) only 9.3 cm; uncertainty +/- 0.05 cm
e) 9.3 cm or 9.4 cm; uncertainty +/- 0.1 cm

Refer to the images below for the following questions



- An empty weighing bottle weighs has a mass of 4.6205 g. An unknown solid is added and the bottle reweighed as illustrated above. What is the mass of the unknown solid?.

  (a) 2.2 g
  (b) 2.24 g
  (c) 2.240 g
  (d) 2.2400 g
  (e) none of the above

- Which value best represents the volume of the liquid in the graduated cylinder in the above illustration?

  (a) 72.0 mL
  (b) 72 mL
  (c) 68.0 mL
  (d) 68 mL

- Express 3.62×10^4 m as an ordinary number.
  (a) 3,620,000 m
  (b) 0.000362 m
  (c) 3,620 m
  (d) 36,200 m

- Which statement about the measurement of mass is true?

  a) Mass is measured using a balance and is not affected by gravity.
  b) Both the mass and weight are the same on the moon and on earth.
  c) Mass is measured using a graduated cylinder and is not affected by gravity.
  d) Mass is the force exerted by gravity on an object and is measured using a balance.

- The atomic mass of an aluminum atom is 26.981539 a.m.u. Express this mass to 4 significant digits.

  (a) 26.9815 a.m.u.
  (b) 27.00 a.m.u.
  (c) 26.98 a.m.u.
  (d) 26.99 a.m.u.

- A rock containing gold ore has a mass of 45.36 g, and its volume was found by displacement to be 10.3 mL. Calculate the density of this rock.

  a) 4.404 g/mL
  b) 35.1 g/mL
  c) 4.40 g/mL
  d) 0.227 g/mL

- Air is made up of nitrogen, oxygen, carbon dioxide, and other gases. Air is a(n)

  (a) compound.
  (b) element.
  (c) mixture.
  (d) pure substance.

- Which of the following is not solid at 25°C and normal pressure?

  a) iodine
  b) calcium
  c) krypton
  d) silicon

- Gasoline from a car's tank is burned in the engine, and the car travels down the road. What two forms of energy are described?

  (a) Light energy is converted into electrical energy.
  (b) Chemical energy is converted into mechanical energy.
  (c) Nuclear energy is converted into mechanical energy.
  (d) Mechanical energy is converted into chemical energy.

- Which of the following is NOT an example of *matter*?
  A) a pencil eraser
  B) a balloon full of helium
  C) a dust particle
  D) heat from a burning candle
  E) none of the above

- Which of the following items is a chemical property?
  A) the paint color on a new red Corvette
  B) the odor of spearmint gum
  C) the melting and boiling point of water
  D) the tarnishing of a copper statue
  E) none of the above

- Which of the following statements about physical and chemical changes is FALSE?
  A) In a chemical change, matter changes its composition.
  B) In a physical change, matter does not change its composition.
  C) Phase changes are always physical changes.
  D) Chemical reactions are chemical changes.
  E) All of the above statements are true.

- If you hold a solid piece of pure gallium metal in your hand, your body heat will melt the gallium into its liquid form. This illustrates which of the following?
  A) distillation
  B) physical change
  C) chemical change
  D) chemical property
  E) none of the above

- A hypothetical element, Hy, has 3 isotopes, Hy-299, Hy-300, and Hy-301, which have the following natural abundance respectively: 5.00%, 65.00%, and 30.00%. The atomic masses of the isotopes are 299.0 amu, 300.0 amu, and
  301.0 amu, respectively. Calculate the atomic mass of Hy.
  A. 299.5 amu
  B. 299.8 amu
  C. 300.3 amu
  D. 300.6 amu
  E. 301.1 amu

- Which of the following is characteristic of metals?
  A. Solid at room temperature
  B. Malleable
  C. Ductile
  D. Located toward the left side of the periodic table
  E. All of the above.

- Three liquid samples labeled (A), (B) and (C) were measured using different volumetric tools, which unfortunately were not calibrated using the same unit of volume. There were three different units: cm^3, gallons, and milliliters (mL).
  (1 gal = 3.785 L; 1000 mL = 1 L; 1 mL = 1 cm^3)

  (A) 6.11×10^3 cm^3 (B) 1.75 gal (C) 6,055 mL

  The correct order of increasing volume for the samples is:

  a) (A) < (B) < (C) b) (C) < (B) < (A) c) (B) < (C) < (A) d) (B) < (A) < (C)

- If the volume of a sample of sulfuric acid acid from a battery was 6.00 mL and its density is 1.2 g/mL, what would the correct reported mass in grams with the proper number of significant digits?

  a) 5.00 g b) 5.0 g c) 7.2 g d) 7.20 g

- The melting point of pure aspirin is 135°C. The average melting point and deviation for the respective experimental results of four different student's data are shown below. Which is the best overall result considering both accuracy and precision?

  a) Student #1 (135+/-5.5 ºC) b) Student #2 (132+/-3.7 ºC)

  c) Student #3 (134+/-0.8 ºC) d) Student #4 (129+/-0.6 ºC)

- Melting point can be defined as the temperature when a solid becomes a liquid. The melting point of the chemical *acetone* is -95°C. Which state of matter would you expect to exist for acetone at a temperature of -94°C?
  A) solid
  B) liquid
  C) gas
  D) plasma

- Quincy weighed an object, then submerged it in pure water, and measured the water it displaced. Her respective measurements were 6.5 g and 5.0 mL. Her volume was 1. 2% less than her research group's average and her mass was 0. 5% less than the average. What might the object be? (1 kg = 1000 g; 1 $m^3 = 10^6$ cm^3; 1 L = 1000 cm^3)

  a. Quebracho Wood; D (ϱ) =1,235 kg/m^3
  b. Diamond; D (ϱ) = 3.53 g/cm^3
  c. Lead; D (ϱ) = 11.3 kg/L
  d. Cannot determine, because Quinccy's value was less precise than the group's.
  e. Cannot determine, because Quinccy's value was less accurate than the group's.

- Two different cubes were weighed. Both weighed exactly 5.00 kg, and both sank to the bottom of a tank containing 100. L of pure water. The volume of the water + block in the tank increased to 102 L for one block and 101 L for the other. How is this possible?

  a. One is more dense
  b. They are made of the same material
  c. They are made of different material
  d. More than one of these
  e. None of the above

- Two icebergs of approximately the same overall size were in the path of the R.M.S. Titanic in 1912. The helmsman steered a course nearest to the one that appeared smallest from his view of what was above the ocean's surface. Unfortunately, the ship hit the iceberg beneath the ocean's surface and sank. From this information the relative densities of the icebergs and the seawater can be determined. Which statement below is NOT true.

    a. Both icebergs are less dense than seawater.
    b. The iceberg that the Titanic struck was denser than the other iceberg.
    c. The density of the seawater was greater than the both icebergs.
    d. The water displaced by the portion of the iceberg beneath the surface was equal to the total volume of the iceberg.

- Two stable isotopes of an element have isotopic masses of 22 amu and 23 amu. The atomic mass is 22.99. Which isotope is more abundant?

    a) There is insufficient information to answer the question.
    b) There are equal amounts of each isotope.
    c) The isotope with a mass of 22 amu is more abundant.
    d) The isotope with a mass of 23 amu is more abundant.

- Which of the following statements is correct regarding the differences in precision of the experimental density results of two different methods used to analyze a sample of copper? *The methods produced the following results using the same copper sample to determine its density: (A) 8.68 +/- 0.30 g/cm^3 ; (B) 9.44 +/- 0.25 g/cm^3.*

    a) and (B) have the same precision.
    b) is more precise than (B).
    c) is more precise than (A).
    d) Neither (A) nor (B) have any precision.

- Which of the following statements is correct regarding the differences in accuracy of the experimental density results of two different methods used to analyze a sample of copper? *The methods produced the following results using the same copper sample to determine its density: (A) 8.68 +/- 0.30 g/cm^3 ; (B) 9.44 +/- 0.25 g/cm^3. Copper's accepted ("True") density is 8.97 g/cm^3*

    a) and (B) have the same accuracy.
    b) is more accurate than (B).
    c) is more accurate than (A).
    d) Neither (A) nor (B) have any accuracy.

- Using atomic notation, indicate the isotope having 26 p+, 32 n, and 26 e$^-$.

    a) ${}^{32}_{26}Fe$
    b) ${}^{26}_{32}Ge$
    c) ${}^{58}_{26}Fe$
    d) ${}^{58}_{32}Ge$

- The names of the elements whose symbols are Si, P, Mn, and S are respectively:
  A) silicon, potassium, magnesium, and sulfur.
  B) silver, phosphorus, magnesium, and sulfur.
  C) silicon, phosphorus, manganese, and sulfur.
  D) silicon, phosphorus, magnesium, and sulfur.
  E) silicon, potassium, magnesium, and sodium.

- Examine the elements listed below and identify the one element that is from a different periodic table group than the others.
  A) Si
  B) Sn
  C) Ti
  D) Ge
  E) All of these are from the same group.

- A specific isotope of an element is known to have 15 protons and 16 neutrons. Which symbol would properly represent this isotope?
  A) $^{15}_{31}\text{Ga}$
  B) $^{31}_{15}\text{P}$
  C) $^{16}_{15}\text{X}$
  D) $^{31}_{16}\text{S}$

- A fictional element has two naturally occurring isotopes with the natural abundances shown here:

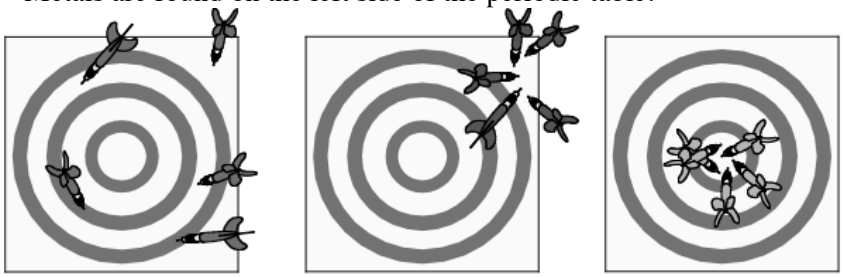
ISOTOPE	ABUNDANCE
18	40.0%
20	60.0%

  Which statement is TRUE for this element?
  A) The atomic mass would be less than 18.
  B) The atomic mass would be closer to 18 than to 20.
  C) The atomic mass would be exactly 19.
  D) The atomic mass would be closer to 20 than to 18.
  E) The atomic mass would be greater than 20.

- A fictional element has two isotopes, each making up 50% of the population. Isotope 1 has a mass of 80.0 amu, Isotope 2 has a mass of 85.0 amu. Calculate the atomic mass of the fictional element.
  A) 82.5 amu
  B) 42.5 amu
  C) 40 amu
  D) 165 amu
  E) none of the above

True/False

- Absolute zero is equivalent to a temperature of -273 K.
- The temperature of 0°F is colder than the temperature of 0°C.
- Water boils at the same temperature value on both the Kelvin and Celsius scales.
- All of the positive charge of an atom is concentrated in the nucleus.
- The nucleus of an atom is a very small, dense region that contains over 99.9% of the atomic mass.
- Protons and electrons each have a mass of 1 amu.
- The charges on electrons and neutrons in an atom cancel each other to give neutral atoms.
- An atom containing 8 protons, 9 neutrons, and 8 electrons would be considered charge-neutral.
- If two atoms each contain different numbers of protons, the atoms must be from different elements.
- All carbon atoms have exactly 6 protons.
- The elements within a group on the periodic table tend to have similar properties.
- The atomic mass of individual atoms of an element may vary.
- The relative amount of each different isotope in a naturally occurring sample of an element is always the same.
- When elements combine to form compounds, their properties only change slightly.
- The properties of a compound are an average of the properties of the individual elements.
- The ratio in a chemical formula is a ratio of atoms, not a ratio of masses.
- Even with the most recent advances in microscopy, it is impossible to image an atom.
- Matter is defined as anything that is visible to the human eye.
- Metals are found on the left side of the periodic table.



- The relative accuracy of the darts is c > b > a.
- The relative precision of the darts is c > b > a.

- Radioactivity is the result of an atom having an unstable nucleus due to an unfavorable ratio of electrons and neutrons.
- The relative sizes of radioactive particles are: alpha is larger than gamma, which is smaller than beta.
- The alpha particle is positively charged and is larger than a neutron.
- A proton has the same atomic mass as a neutron.
- Elements are pure substances that cannot be broken down by physical or chemical means into two or more simpler substances.
- Isotopes are atoms of different elements with the same number of neutrons.
- An electron has an opposite charge than a proton.
- Unstable isotopes can change spontaneously to other nuclei with different atomic numbers.

- Match the following key terms.

____ A nuclear reaction in which small nucleii combine with the release of energy. ____ The number of protons in the nucleus of an atom of a given element. ____ The variation between the values in a set of experimental data. ____ A property that changes as the size of the sample changes. ____ An objective measure such as miles per hour.	A. Accuracy B. Atomic Mass C. Atomic Number D. Extensive E. Fission F. Fusion G. Intensive H. Macroscopic I. Microscopic J. Precision K. Qualitative L. Quantitative

- Indicate whether each of the following is an element, a compound, a homogeneous mixture or a heterogeneous mixture:

A) gasoline _____
B) table salt _____
C) Sand _____
D) vegetable soup _____
E) The air in this room _____
F) carbon _____

- Liquid nitrogen boils at 77 K. What is the boiling point in °C?
  [0 K = -273.15 ºC; ºC = 5/9(ºF -32)]

- Express 3.62×10^3 g as an ordinary number.

- How many meters are there in 3.62 km (expressed in scientific notation)?
  [1 km = 1000 m]

- Indicate whether each of the following is an element, a compound, a homogeneous mixture or a heterogeneous mixture:

  A) gasoline _____ B) table salt _____

  C) Sand _____ D) vegetable soup _____

- Classify each of the following as a physical (P) or a chemical (C) change.

  A) Boiling water _____ B) Burning gasoline _____

- Indicate the number of significant figures in each of the following numbers
  A) 42,000. B) 0.4010 _____ C) 0.00130 _____

- Express the number 4846 to the given number of significant figures

  A) 1 SF: _____ B) 2 SF: _____ C) 3 SF: _____

- Perform the following operations and write your answer in correct scientific notation and having the correct number of significant figures.

$$\frac{(5.9 \times 10^{-8})(4.77 \times 10^{6})}{4.05 \times 10^{2}} = \_\_\_\_\_$$

$$\frac{(7.8 \times 10^{4})^{2}}{7.2 \times 10^{-2}} = \_\_\_\_\_$$

$12.2 - 1.84 + 8 =$ _____

- Classify the following as a metal, nonmetal, or metalloid.

  A) Oxygen _____ B) Silicon _____

- The Group IA elements are called the _____.

- The Group VIIA elements are called the _____.

- Complete the following table

Element or Ion	Number of protons	Number of electrons	Number of neutrons
^{18}O			
^{36}Cl			
$^{40}Ca^{2+}$			

- 25.4 nanograms = _____ milligrams

- 34.5 mg/s = _____ kg/h 1 h = 3600 s

- 0.066 m^3 = _____ cm^3

SOLVE the following problems showing a clear dimensional analysis set up for your solutions.

_____

For example: The average adult needs at least 1.50 x 10^2 g of carbohydrates in the diet each day. A can of vegetarian refried beans has 19 g of carbohydrate per serving. Each serving is 128 g of beans. If your only dietary source of carbohydrate were vegetarian refried beans, how many pounds of beans would you need to eat each day?

$$\frac{?\,\text{lb beans}}{\text{day}} = \frac{1.50 \times 10^{2}\ \text{g carbo}}{1\ \text{day}} \left(\frac{1\ \text{serving}}{19\ \text{g carbo}}\right)\left(\frac{128\ \text{g beans}}{1\ \text{serving}}\right)\left(\frac{1\ \text{lb}}{453.6\ \text{g}}\right)$$

_____

- The mass of an electron is 9.1093897 x 10^{-31} kg. What is this mass in grams?

- The mass of the ocean is about 1.8 x 10^{21} kg. If the ocean contains 1.076% by mass sodium ions, Na+, what is the mass in kilograms of sodium from the total ions in the ocean?

- A normal hemoglobin concentration in the blood is 15 g / 100 mL of blood. How many kilograms of hemoglobin are there in a person who has 5.3 L of blood?

- A box of crackers has a net weight (crackers only) of 8.0 oz. The following nutritional information is listed on the box:

  Serving size (0.50 oz = 6 crackers)
  Fat 4 g per serving
  Sodium 140 mg per serving

  If you consume 8 crackers a day for 2 weeks, how many grams of sodium will you ingest?

- If a 5.0-carat diamond is worth $75,000, how much is a diamond that weighs 1.0 pounds worth? 1 pound=454g 1 carat = 0.200 g

- According to the U.S. Mint, all of the typical coins in circulation today (except for the penny and the nickel) are composed of the same mixture of two metals, copper and nickel. If a quarter was analyzed and found to contain 0.742 g of nickel and 5.198 g of copper, what is the percentage of nickel in the quarter?

- A quartzite metamorphic rock, which also contained gold, was found in Benicia. The rock has a mass of 54.36 g. Its volume was found by submerging it in a graduated cylinder filled with water: The cylinder contained 50.0 mL of water before and 60.3 mL after the rock was submerged. Calculate the density of this rock.

- The density of quartzite rock is 2.7 g/cm^3. The density of pure gold is 19.3 g/cm^3. Clearly show a mathematical formula to calculate
  the % gold in the rock using the experimental density in your answer and the densities of quartzite and gold.

- The mass of the ocean is about 1.8 ✕ 10^{21} kg. If the ocean contains 1.076% by mass sodium ions, Na^+, what is the mass in kilograms of Na^+ in the ocean?

- In nuclear fusion, about 0.60% of the mass of the fusing substances is converted to energy. What mass in grams is converted into energy when 70.kilograms of substance undergoes fusion?