CHE 151 GENERAL CHEMISTRY FALL, 2004
MARIAN COLLEGE, INDIANAPOLIS

Class test 1 Name:

Questions requiring written answers should be answered as succinctly as possible, in sentences. All work should be shown in problem calculations. Use the factor label method in all numerical calculations. You may (and should) use a scientific calculator and a periodic table.

Useful data: c = 2.9979x10^{8} ms^{-1}; h = 6.626x10^{-34} Js, m_p = 1.67262 x 10^{-27} kg, m_n = 1.67493 x 10^{-27} kg, m_e = 9.10938 x 10^{-31} kg, 1 a.m.u. = 1.66054 x 10^{-27} kg, $A_t/A_0 = (1/2)^n$, where $n = t/t_{1/2}$.

1. Using one or more of the terms *pure substance*, *element*, *compound*, *heterogeneous mixture*, *homogeneous mixture*, *solution*, label the following:

   (a) mineral water

   (b) distilled water

   (c) white coffee

   (d) sugar (assume it is all sucrose)

   (e) silver spoon (not plated)

   (f) chocolate chip cookie

2. (a) A substance consisting of white needle-like crystals is found to melt at 115°C, then at 200°C to evolve a gas and decompose leaving a black tar-like residue. The substance underwent a chemical change and a physical change. Which was which? Describe why you think so.

(b) In this question significant digits are, well, significant. A student measures out 25.0 mL of water into a graduated cylinder, then drops in a metal slug. The water level rises to 31.2 mL. What is the volume of the slug?

(c) The student then dries the slug and weighs it. It has a mass of 70.312 g. Calculate the density of the slug to an appropriate number of significant figures.

(d) The student repeats the weighing several times, and comes up with values of 70.311 g, 70.312 g, 70.312 g, and 70.313 g. If the “true” mass of the slug is 70.305 g, discuss the student’s results in terms of *accuracy* and *precision*.

3. Perform the following conversions. Use the factor label method, and show your working.

(a) 0.075 kg = _____ g

(b) 11250 g = _____ kg

(c) 256 nm = _____ cm

(d) 0.0002 L = _____ µL

(e) 100.0 m^3 = _____ cm^3

4. (a) What type of spectrum does an incandescent light bulb show? You might find it useful to make a drawing.

(b) The spectrum of light bulb A shows a maximum intensity at 700 nm, while that of light bulb B shows a maximum at 500 nm. Describe the appearance of these two light bulbs, and state which bulb has the hotter filament.

(c) Which bulb do you think is a more efficient light source, and why?

(d) What is the energy in J of a photon with wavelength 500 nm?

5. A sample of antimony obtained on a field trip is found to consist of ^{121}Sb (mass 120.9038212 a.m.u.) and ^{123}Sb (mass 122.9042160 a.m.u.) in the percentages 60% ^{121}Sb, 40% ^{123}Sb.

   (a) Calculate the average atomic mass of antimony based on this sample.

   (b) Is this sample of antimony likely to be of terrestrial or extraterrestrial (for example, meteoric) origin? Why?

   (c) Using Einstein's equation $E = mc^2$ and any necessary conversions or corrections, calculate the binding energy per nucleon in *J* for ^{123}Sb.

6. (a) *Explain* why neutron capture is more important than nuclear fusion as a process for synthesis of relatively heavy elements.

(b) Stable natural iodine consists entirely of one isotope, ^{127}I. However, several radioactive nuclides of I exist. Write a nuclear reaction equation for the formation of ^{128}I by neutron capture.

(c) ^{128}I can decay by two separate pathways, electron capture and β-decay. Write equations for these two reactions, clearly showing the product nuclide.

(d) The electron capture process is the faster of the two, and leads to a half-life of 25 minutes for ^{128}I. Given an initial sample of 12 g of ^{128}I, how much remains after 1 hour? (Show your work.)

[100 points total]