

Sample exam 1: Chapters 1 and 2

*Closed book; open homework, handouts, lab book, notes and calculators; no collaboration, including using other people's materials. You have **fifty minutes** to complete the quiz; don't forget to turn in your chapter 2 homework. There are 50 points possible.*

1. Select the number of the choice that goes best with each of the lettered words (2 points each). Note that some of the numbers will be used once, twice or not at all.

1. chemical change 2. physical change 3. pure substance 4. mixture

a. freezing

b. saltwater solution B from lab 1

c. hydrogen peroxide gas

d. helium gas

e. combustion (burning)

2. A compound is formed by reacting unknown element Q with nitrogen gas; elemental analysis of the product reveals that the compound has the formula Q_3N_2 . The **cation** is determined to have 28 electrons.

a. (3 points) What is **element Q**?

b. (3 points) The element also reacts with chlorine to make QCl_x . What value is x?

5. Continuing our discussion of nuclear technology: in a nuclear reactor, uranium undergoes fission into several radioactive "daughter" isotopes. By far the most dangerous "daughter" isotope generated is **cesium-137**.

a. (2 points) Write the **symbol** for this **isotope**.

b. (2 points) How many **electrons** does each atom of this isotope have?

c. (2 points) How many **neutrons** does each atom of this isotope have?

4. a. (5 points) The planet Mercury has a mean (average) radius of 2439 km and a density of 5.43 g/cm^3 . What is the **mass** of Mercury in kilograms? Assume Mercury is spherical and uniform, with a volume of $(4/3) \pi r^3$. Be careful about units and significant figures!

b. (4 points) The central core of most planets and satellites is spherical, made of primarily iron, and has a density of 11.0 g/cm^3 . Callisto, a satellite of Jupiter, has a radius of 2400 km and a mass of $1.077 \times 10^{23} \text{ kg}$. Is the core of Callisto bigger than, smaller than or of similar size to the core of Mercury? Justify your answer. You don't need to provide a formal mathematical derivation, but you **must** use the information above. Assume that the other non-core materials of both worlds are similar.

5. The **uncertainty** in reading a graduated cylinder's volume is $\pm 0.05 \text{ mL}$ (1 standard deviation). A student is trying to measure 10.00 mL of water in a graduated cylinder. She fills the graduated cylinder to what she thinks is exactly 10.00 mL and then uses a pipetter (a device with a much smaller volume uncertainty) to check her volume. Her volume measurements for six trials:

10.22 mL 10.20 mL 10.23 mL 10.24 mL 10.24 mL 10.24 mL

a. (3 points) **Explain** whether the student suffered a **systematic** or a **random** error. Note: this should **not** be a one or two word answer.

b. (3 points) Explain whether the uncertainty in the graduated cylinder is **enough** to explain the **range** of her mass data.

c. (extra credit - 3 points) Suggest a **source of error** for her mass data.

6. (2 points each) Write the **chemical formula** for the following compounds. Don't forget the phase of matter where there is ambiguity. (2 points each) Hint: NO_2^- = nitrite ion; NO_3^- = nitrate ion; MnO_4^- = permanganate ion; $\text{Cr}_2\text{O}_7^{2-}$ = dichromate ion

a. nitrous acid

b. potassium dichromate

7. (2 points each) Give the systematic **name** of the following chemical compounds:

a. CrCl_6 (s) (you will need to specify the charge on the metal)

b. NI_3 (g)

8. 2.000 g of element D reacts with 0.500 g of element E to form a compound.

a. (3 points) Suggest **another** amount of element D that would react with 0.500 g of element E to form a compound.

b. (2 points) **Must** the reaction you suggested in part a happen? Explain why or why not.

c. (extra credit — 2 points) Suppose 2.000 g of D and 0.500 g of E were placed in a sealed tube and the contents were forced to react. Analysis shows that the compound you suggested in part a is made. What is the **mass** of the contents of the sealed tube?