

No calculators are permitted in answering the following:

1. (10 pts) Name the following compounds:

- a)  $\text{Li}_2\text{O}$  lithium oxide
- b)  $\text{CaCO}_3$  calcium carbonate
- c)  $(\text{NH}_4)_2\text{SO}_3$  ammonium sulfite
- d)  $\text{CuS}$  copper (II) sulfide
- e)  $\text{S}_2\text{Br}_2$  disulfur dibromide

2. (10 pts) Give the molecular formula for each of the following:

- a) magnesium iodide  $\text{MgI}_2$
- b) sodium dihydrogen phosphate  $\text{NaH}_2\text{PO}_4$
- c) potassium nitride  $\text{K}_3\text{N}$
- d) nickel (II) permanganate  $\text{Ni}(\text{MnO}_4)_2$
- e) disilicon hexabromide  $\text{Si}_2\text{Br}_6$

3. (10 pts) Fill in the following blanks with the number 10 raised to a power (e.g.,  $10^{-2}$ ):

- a)  $1 \text{ nm} = 10^{-9} \text{ m}$       c)  $1 \text{ ML} = 10^6 \text{ L}$       e)  $1 \text{ fs} = 10^{-15} \text{ s}$
- b)  $1 \text{ s} = 10^6 \mu\text{s}$       d)  $1 \text{ m} = 10^{12} \text{ pm}$

4. (10 pts) Fill in the following table:

	Symbol	Number of protons	Number of neutrons	Number of electrons
a)	$^{15}\text{N}^{3-}$	7	8	10
b)	$^{50}\text{Cr}^{6+}$	24	26	18
c)	$^{34}\text{S}^{2-}$	16	18	18

5. (10 pts) Multiple Choice. Circle the correct answer.

A. Millikan's oil drop experiment:

- a) determined the charge of the proton
- b) determined the mass-to-charge ratio of the electron
- c) determined the charge of the electron
- d) determined the mass-to-charge ratio of the proton

B. JJ Thompson's experiments with cathode rays:

- a) determined the charge of the proton
- b) determined the mass-to-charge ratio of the electron
- c) determined the charge of the electron
- d) determined the mass-to-charge ratio of the proton

C. Rutherford's gold foil experiment:

- a) was the first proof of radioactivity
- b) proved the existence of the electron
- c) proved the existence of the neutron
- d) showed that the positive charge of the atom is contained in a small space

D. Dalton's atomic theory combined each of the following, except the:

- a) Law of Conservation of Energy
- b) Law of Multiple Proportions
- c) Law of Conservation of Mass
- d) Law of Definite Proportions

E. Which of the following statements from Dalton's atomic theory do we now know to be incorrect?

- a) All matter is made of atoms.
- b) All atoms of a given element are identical.
- c) Compounds are formed by combination of two or more different kinds of atoms.
- d) Atoms of different elements have different masses and different properties.

6. (8 pts) Give the name (not the number) of the family to which each of the following elements belongs:

- |             |                  |              |                             |
|-------------|------------------|--------------|-----------------------------|
| a) neon     | <u>noble gas</u> | c) magnesium | <u>alkaline earth metal</u> |
| b) fluorine | <u>halogen</u>   | d) potassium | <u>alkali metal</u>         |

**Turn in this portion of the exam.**

You are now permitted to use calculators.

7. (8 pts) Convert  $7.89 \times 10^{12} \mu\text{g/mL}$  to  $\text{lb/in}^3$

$$\left(7.89 \times 10^{12} \frac{\mu\text{g}}{\text{mL}}\right) \left(\frac{1 \text{ mL}}{1 \text{ cm}^3}\right) \left(\frac{2.54 \text{ cm}}{1 \text{ in}}\right)^3 \left(\frac{10^{-6} \text{ g}}{\mu\text{g}}\right) \left(\frac{1 \text{ lb}}{453.6 \text{ g}}\right)$$
$$= 2.85 \times 10^5 \text{ lb/in}^3$$

8. (8 pts) The two naturally occurring isotopes of rubidium are rubidium-85, with an atomic mass of 84.91179 amu; and rubidium-87, with an atomic mass of 86.90919 amu. What are the percent natural abundances of these isotopes?

$${}^{85}\text{Rb} = x$$

$${}^{87}\text{Rb} = (1-x)$$

$$\Rightarrow x(84.91179) + (1-x)(86.90919) = 85.47$$

$$x = .7205$$

$$1-x = .2795$$

$$\Rightarrow \boxed{\begin{array}{l} {}^{85}\text{Rb} - 72.05\% \\ {}^{87}\text{Rb} - 27.95\% \end{array}}$$

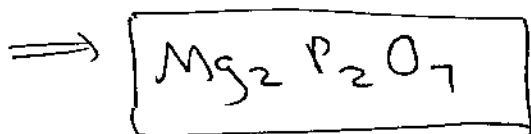
9. (8 pts) A certain compound has a mass percent composition of 21.9 % Mg, 27.8% P, and 50.3 % O. What is its empirical formula?

$$(21.9 \text{ g Mg}) \left( \frac{1 \text{ mol Mg}}{24.31 \text{ g}} \right) = .901 \text{ mol Mg} / .898 = 1$$

$$(27.8 \text{ g P}) \left( \frac{1 \text{ mol P}}{30.97 \text{ g}} \right) = 0.898 \text{ mol P} / .898 = 1$$

$$(50.3 \text{ g O}) \left( \frac{1 \text{ mol O}}{16.00 \text{ g}} \right) = 3.14 \text{ mol O} / .898 = 3.5$$

3.5  
× 2



10. (8 pts) How many oxygen atoms are in 6.00 kg of table sugar,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ?

$$\text{MW} = 12(12.01) + 22(1.008) + 11(16.00) = 342.3 \text{ g/mol}$$

$$(6.00 \text{ kg } \text{C}_{12}\text{H}_{22}\text{O}_{11}) \left( \frac{1000 \text{ g}}{1 \text{ kg}} \right) \left( \frac{1 \text{ mol}}{342.3 \text{ g}} \right) \dots$$

$$\dots \left( \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \right) \left( \frac{11 \text{ O atoms}}{\text{molecule}} \right) = \boxed{1.16 \times 10^{26} \text{ O atoms}}$$

11. (8 pts) A compound has the structural formula  $\text{HOOCCH}_2\text{CH}(\text{CH}_3)\text{COOH}$ . What is the percent composition of each element in the compound?



$$5(12.01) + 8(1.008) + 4(16.00) =$$

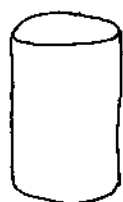
$$60.05 + 8.064 + 64.00 = 132.11 \text{ g/mol}$$

$$\% \text{C} = \frac{60.05}{132.11} \times 100 = 45.45\% \text{ C}$$

$$\% \text{H} = \frac{8.064}{132.11} \times 100 = 6.102\% \text{ H}$$

$$\% \text{O} = \frac{64.00}{132.11} \times 100 = 48.44\% \text{ O}$$

12. (10 pts) Iron has a density of  $7.784 \text{ g/cm}^3$ . A piece of iron in the shape of a cylinder has a diameter of 27.2 mm and contains  $8.37 \times 10^{24}$  atoms. What is the height of the cylinder in meters?



$$(8.37 \times 10^{24} \text{ atoms}) \left( \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}} \right) \left( \frac{55.85 \text{ g}}{1 \text{ mol}} \right)$$

$$= 776.2 \text{ g Fe}$$

$$(776.2 \text{ g Fe}) \left( \frac{1 \text{ cm}^3}{7.784 \text{ g}} \right) = 99.73 \text{ cm}^3 \text{ Fe}$$

$$V = 99.73 \text{ cm}^3 = \pi r^2 h = \pi \left( \frac{2.72 \text{ cm}}{2} \right)^2 h$$

$$h = 17.2 \text{ cm}$$

$$= .172 \text{ m}$$

**Remember to consider the pledge!!**