Key

Chem 1A Test 1
Sept. 2, 2005

Always show your work. Always include units and pay attention to significant figures.
Common units of volume: milliliter = mL = cm^3 = cc
liter = L
Temperature Information:
0 K (Kelvins) corresponds to –273.15 °C
0 °C corresponds to 32°F (exactly)
100 °C corresponds to 212°F (exactly)

1. The density of a particular brand of gasoline (a mixture) at room temperature is 0.70 g/mL. If the gas tank of a car holds 10.0 gallons (conversion factor: 3.7854 L/gallon), what is the mass of a tankful of gasoline?

$$10.0\ gal \times 3.7854 \frac{L}{gal} \times \frac{1000\ mL}{L} \times 0.70 \frac{g}{mL} = 2.6 \times 10^4\ g$$

or 26. kg

2. Assuming the following numbers are measured quantities, **perform the following calculations and express the answer in scientific notation** with the correct number of sig. figs.:

a. $4.0 \times 10^7 - 2.1000 \times 10^5 = 4.0 \times 10^7 - 0.021000 \times 10^7 \sim 4.0 \times 10^7$

b. $9.10 \times 10^{12} / 2.0 \times 10^{-3} = \frac{9.10}{2.0} \times 10^{12+3} = 4.6 \times 10^{15}$

c. $(3.0 \times 10^4) \times (8.200 \times 10^{-3}) = 3.0 \times 8.200 \times 10^4 \times 10^{-3} = 25 \times 10 = 2.5 \times 10^2$

d. $3.3 \times 10^{-4} + 2.52 \times 10^{-2} = 0.033 \times 10^{-2} + 2.52 \times 10^{-2} = (0.033 + 2.52) \times 10^{-2}$
$= 2.55 \times 10^{-2}$

3. Human body temperature is 98.6 °F. Convert this to °C (degrees Celsius) and K (Kelvins).

$$^\circ C = (^\circ F - 32)\frac{5}{9} = 66.6 \times \frac{5}{9} = 37.0\ ^\circ C$$

$$K = ^\circ C + 273.15 = 310.2\ K$$

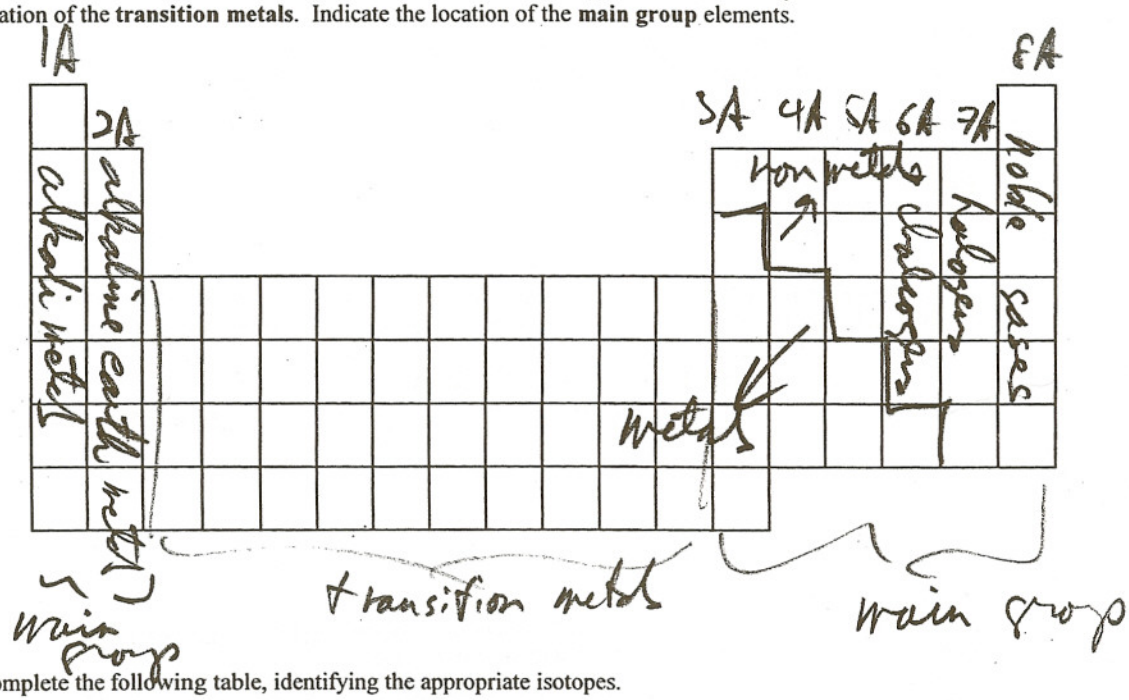
4. In your own words, describe how **Dalton's theory** explains the **law of conservation of mass** and the **law of definite proportions**. (Use the back of this page if necessary.)

Theory explains Law

1) Atoms are not created or destroyed in chemical rxns. → Mass doesn't change during a reaction.

2) Atoms of a particular element have unique properties like mass. Compounds are combinations of atoms in fixed number → Any compound has a fixed mass ratio between any two constituent elements

5. In the following cartoon of the periodic table, **label columns 1A , 2A, 7A, and 8A with their family names .** Indicate the location of the **metals** and the **nonmetals** and the approximate boundary between them. Indicate the location of the **transition metals**. Indicate the location of the **main group** elements.



6. Complete the following table, identifying the appropriate isotopes.

Element name	Nuclear symbol	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons (neutral atom)
carbon 12	^{12}C	6	12	6	6	6
carbon 13	^{13}C	6	13	6	7	6
carbon 14	^{14}C	6	14	6	8	6
chlorine 36	^{36}Cl	17	36	17	19	17
Uranium 235	^{235}U	92	235	92	143	92
Neon 20	^{20}Ne	10	20	10	10	10
Potassium 39	^{39}K	19	39	19	20	19

7. **Molar mass**, like density, is an **intensive quantity** and a **conversion factor**. Atomic mass is the molar mass of an element and is expressed in units of grams per mole (g/mol, as is any molar mass). From the periodic table, the atomic mass of plutonium is 244.06 g/mol (or 244.06 amu/atom)

   a. How many moles are in 1.00×10^{-6} gram of plutonium? How many Pu atoms?

$1.00 \times 10^{-6}\ g \times \frac{1\ mol}{244.06\ g} = 4.10 \times 10^{-9}\ mol$ $\quad 2.47 \times 10^{15}$ Pu atoms

   b. How many grams are in 1.00×10^{-6} mole of plutonium? How many Pu atoms?

$1.00 \times 10^{-6}\ mol \times 244.06\ \frac{g}{mol} = 2.44 \times 10^{-4}\ g$ $\quad 6.02 \times 10^{17}$ Pu atoms

8. Indicate the implied absolute uncertainty, implied relative uncertainty, implied % uncertainty and the number of significant figures in each of the following quantities:

	measured quantity	implied absolute uncertainty	implied relative uncertainty	implied % uncertainty	# sig. figs.
a.	0. 501 kg	0.001 kg	0.002	0.2	3
b.	0.06300 m	0.00001 m	0.0002	0.02	4
c.	4.8009 L	0.0001 L	0.00002	0.002	5

9. Now convert the above quantities to g, cm, and mL. Again indicate the implied absolute uncertainty, implied relative uncertainty, and number of sig. figs.

		measured quantity	implied absolute uncertainty	implied relative uncertainty	# sig. figs.
a.	(g)	501.g	1 g	0.002	3
b.	(cm)	6.300 cm	0.001 cm	0.0002	4
c.	(mL)	4800.9 mL	0.1 mL	0.00002	5

10. Classify each of the following samples as a **substance or a mixture.** If a substance classify as **element or compound.** If a mixture classify as **heterogeneous mixture or homogeneous mixture.**

a. filtered sea water (no solids) — homogeneous mixture

b. distilled water — pure substance - compound

c. a chocolate chip cookie — heterogeneous mixture

d. ethyl alcohol — pure substance compound

e. beer — homogeneous mixture (to Ruth)

f. diamond — pure substance - element

g. dry ice — pure substance — compound

11. Only two isotopes of copper occur naturally. ^{63}Cu (mass = 62.9296 amu; abundance 69.17%) and ^{65}Cu (mass = 64.9278 amu; abundance 30.83%). Calculate the abundance weighted atomic mass of Copper.

0.6917 × 62.9296 amu + 0.3083 × 64.9278 amu

= 63.55 amu

12. A student measures the density of pure acetone (fingernail polish remover) using a 25-mL graduated cylinder (uncertainty is ± 0.1mL) and an analytical balance (uncertainty is ± 0.0001 g).

Mass of empty graduated cylinder: 63.5489 g
Mass of graduated cylinder and acetone: 64.7309 g
Volume of acetone in the graduated cylinder: 1.5 mL

64.7309 g
− 63.5489 g
1.1901 g

a. Based on this data, calculate the density of acetone in g/mL.

$$\rho = \frac{1.1901\ g}{1.5\ mL} = 0.79\ \frac{g}{mL}$$

b. Using exactly the same equipment, what could the student do differently to determine the density more precisely (to more significant figures)? Explain.

Use more than 10 mL of acetone.

13. Using the attached periodic table and table of polyatomic ions **write the correct chemical formula** or **give the correct name** for the following compounds. (Manganese = Mn , Magnesium = Mg)

a. manganese IV sulfate $Mn(SO_4)_2$
b. manganese III nitrate $Mn(NO_3)_3$
c. manganese II carbonate $MnCO_3$
d. magnesium carbonate $MgCO_3$
e. Cr_2O_3 chromium III oxide
f. K_2Se potassium selenide
g. AlF_3 aluminum fluoride
h. Al_2S_3 aluminum sulfide
i. N_2O_4 dinitrogen tetroxide

Which if any of the above compounds **would be classified as a strictly molecular compound?**

N_2O_4

14. Extra: The smell of the sea comes from a gas called dimethyl sulfide, $(CH_3)_2S$, produced by dying phytoplankton, tiny plants that are the base of the ocean's food chain.

a. What is the molecular mass of dimethyl sulfide to at least four signifigant figures? 62.14 g/mol

b. How many moles of dimethyl sulfide are in a 1.0×10^{-6}g (1.0 µg or 1.0 microgram) sample?

$$1.0 \times 10^{-6}\ g \times \frac{1\ mol}{62.14\ g} = 1.6 \times 10^{-8}\ mol$$

c. How many molecules are in the sample?

$$1.61 \times 10^{-8}\ mol \times 6.022 \times 10^{23}\ \frac{molecules}{mol} = 9.7 \times 10^{15}\ molecules$$

d. How many carbon atoms are in the sample?

$$9.69 \times 10^{15}\ molecules \times \frac{2\ C\ atoms}{molecule} = 1.9 \times 10^{16}\ C\ atoms$$