OPTIONAL PRACTICE PROBLEMS

DIMENSIONAL ANALYSIS AND PROPERTIES OF MATTER

(1) List the base (fundamental) SI units: _____

_____

(2) Fill in the following table:

Object	Weight, g	Mass, g
Piece of iron	50 g	?
Huge container of hydrogen gas	50 g	?
A beaker with water	50 g	?

(3) Which kind of lab equipment can be used to <u>most accurately</u> measure the volume of a liquid?

_____

(4) Which kind of lab equipment can be used to <u>most accurately</u> measure the mass of a substance?

_____

(5) Use formula equation $K = {}^0C + 273$ to convert degrees Celsius to degrees Kelvin and vice versa

(a) 20 ^{0}C to K:

(b) 0 K to ^{0}C:

(6) Use the formula equations $^0F = 1.8\ {}^0C + 32$ and $^0C = 5/9\ (\ ^0F - 32)$ to convert the following:

(a) 20 ^{0}C to ^{0}F:

(b) 32 ^{0}F to ^{0}C:

(7) What is the density of a substance which has a mass of 20 g and a volume of 40 cm^3? <u>Show work.</u>

(8) An insoluble solid has a mass of 5.00 g. When it was placed in a graduated cylinder containing 20.0 cm^3 of water the final volume was read as 28.0 cm^3. What is the volume of the solid? <u>Show work.</u>

(9) How can you find the density of the insoluble solid in the last question? <u>Show work.</u>.

(10) The table below shows some information for four different elements.

Element	Classification	Density (g/cm^3)
Barium (Ba)	metal	3.6
Beryllium (Be)	metal	1.8
Chromium (Cr)	metal	7.2
Phosphorus (P)	nonmetal	1.8

A cube of an unknown element has a shiny, silvery color. The side of the cube measures 2.0 cm and the cube has a mass of 14.56 g. Based on the information in the table, which element makes up the cube? (Hint: Calculate the volume and density of the element)

(11) Which is an example of a chemical change (underline): melting ice, burning wood, boiling

water, cutting paper, grinding pepper, something exploding, freezing water, evaporating perfumes

(12) Which substance in the list below contains only one kind of atoms?
(A) hydrochloric acid, HCl (B) nitrogen dioxide, NO_2 (C) iron, Fe (D) carbon monoxide CO

(13) Calculate the % of sulfur in H_2SO_4:

(14) Which technique would you use to separate a suspended solid from a liquid? (A) distillation (B) chromatography (C) filtration

(15) Choose the equipment (from the list below) which you would use to separate a suspended solid from a liquid: graduated cylinder, scale, beaker, tripod or ring stand with a ring, funnel, filter paper.

(16) How can you find the density of irregular piece of iron by displacement of water? Name each kind of equipment used. You can use diagrams in your answer.

(17) Express the measurement of 556677 L in correct scientific notation:

(18) Convert 20. mL to L

(19) Convert 20. L to mL

ATOMIC STRUCTURE AND NUCLEAR CHEMISTRY

(1) Which subatomic particles are located in the nucleus of an atom?_____

(2) Which subatomic particles are located in the electron cloud of an atom?_____

(3) Which subatomic particles are located in the nucleus and do not have a charge?_____

(4) Which subatomic particles are located in the nucleus and have a positive charge?_____

(5) Where is the most of an atom mass concentrated?_____

(6) The identity of an atom depends on (A) number of electrons (B) number of protons

(C) number of neutrons

(7) Fill in the table below

Symbolic notation, ${}^{A}_{Z}Symbol$	Atomic number	Mass number	# of p^+	# of e^-	# of n^0	Charge of the nucleus
${}_{56}{}^{140}Ba$						
			13		15	
		38	17			

(8) In which way are hydrogen-1, hydrogen-2, and hydrogen-3 different? _____

_____

(9) In which way are hydrogen-1, hydrogen-2, and hydrogen-3 similar? _____

_____

(10) Use another kind of symbolic notation to show hydrogen-1, hydrogen-2, and hydrogen-3

_____

(11) What is the composition of an atom of copper- 69?

(A) 69 protons, 69 neutrons, 69 electrons (B) 29protons, 29 neutrons, 29 electrons

(C) 29 protons, 29 neutrons, 40 electrons (D) 29 protons, 40 neutrons, 29 electrons

(12) In which of the potassium isotopes is the number of neutrons the same as the number of protons?

(A) ${}_{19}{}^{40}K$ (B) ${}_{19}{}^{38}K$ (C) ${}_{19}{}^{41}K$

(13) Which bets represents a pair of isotopes?(A) ${}_{88}{}^{226}X$ and ${}_{88}{}^{228}X$ (B) ${}_{88}{}^{226}X$ and ${}_{89}{}^{226}X$

(C) ${}_{88}{}^{226}X$ and ${}_{89}{}^{227}X$

(13) The atomic number of an element indicates which of the following? (A) the number of neutrons in the atom (B) the number of protons in the atom (C) the sum of neutrons and protons in the atom

(D) the sum of electrons and protons in the atom

(14) Determine the average atomic mass of the following mixtures of isotopes.

80% ${}^{127}I$, 17% ${}^{126}I$, 3% ${}^{128}I$

ELECTRON CONFIGURATIONS

(1) Identify the element: $1s^2\ 2s^22p^6\ 3s^23p^1$_____

(2) Calcium, Ca, has an electron configuration $1s^2\ 2s^22p^6\ 3s^23p^6\ 4s^2$. How many valence electrons does it have? _____

(3) How elements are arranged in the Periodic Table? _____

_____

(4) Which elements are the least reactive? _____

(5) Which element has an outer shell configuration of $3s^23p^3$?_____

(6) How many valence electrons does an Ca^{+2} ion have?_____

(7) How many valence electrons does a Cl^{-1} have? _____

(8) How many protons, electrons, and neutrons a Rb^{+1} have? _____

CHEMICAL BONDING

(1) Which compound exhibits ionic bonding?(A) HBr (B) Na_2SO_4 (C) N_2O_5 (D) H_3PO_4

(2) Which compound exhibits covalent bonding?(A) $Fe_3(PO_4)_2$ (B) H_2O (C) Al_2O_3 (D) K_3PO_4

(3) What is the oxidation numbers (charges) of aluminum and chlorine in $AlCl_3$? _____

(4) What is the IUPAC name for the following compounds:

(a) *Na_2SO_4?*_____(b) $(NH_4)_3PO_4$ _____

(c) H_2SO_4?_____(d) $Ca_3(PO_4)_2$ _____

(e) Li_2O _____ (f) Cl_2O_5 _____

(g) Ag_2SO_4 _____ (h) CH_4 _____

(5) (a) What is the correct formula for copper (II) phosphate ?_____

(b) What is the correct formula for nickel (III) phosphate? _____

(6) What is the correct formula for zinc (II) hydroxide ?_____

(7) What is the correct formula for silver (I) oxide? _____

CHEMICAL REACTIONS(TYPES AND BALANCING)

Balance the following reactions

___(1) ____ C_2H_4 + ____ O_2 → ____ CO_2 + ____ H_2O

___(2) ____ H_2SiO_3 +____ $Ca(OH)_2$ → _____ $CaSiO_3$ + _____ H_2O

___(3) ____ H_2CO_3→_____ H_2O + _____ CO_2

___(4) _____ Zn + _____$Hg(NO_3)_2$ → _____ $Zn(NO_3)_2$ + _____Hg

___(5) _____ H_2 + _____ N_2 → _____ NH_3

___(6) ____ $AgNO_3$ + ____ $GaCl_3$→ _____ AgCl + ____ $Ga(NO_3)_3$

___(7) ____ $AlBr_3$ + _____ K_2SO_4→ _____ KBr + _____ $Al_2(SO_4)_3$

___(8) _____ HNO_3 + ____$CaCO_3$ → _____ $Ca(NO_3)_2$ + _____H_2CO_3

___(9) _____ Na + _____$ZnBr_2$ → _____NaBr + _____ Zn

___(10) _____ $NiCl_3$ + _____ KOH → _____ $Ni(OH)_3$ + _____ KCl

___(11) ____ P + _____ O_2 → _____ P_2O_5

___(12) _____ CO_2 + _____ H_2O → _____H_2CO_3

___(13) _____ S + _____ O_2 → _____ SO_2

___(14) ____ KNO_3 →_____ O_2 + _____ KNO_2

MOLE AND STOICHIOMETRY

(1) What is the molar mass of $Co_3(PO_4)_2$?

(2) What is the mass of 10 moles of dihydrogen dioxide?

(3) How many molecules of carbon tetrachloride are present in 2 moles of carbon tetrachloride?

(4) How many atoms of copper are present in a 50.0 g of copper?

(5) Which volume of argon gas at STP has the same number of particles as 5 L of nitrogen gas (N_2)?

(6) The equation below represents the complete combustion of butane. Use this equation to answer questions (a) - (d).

$$\mathbf{2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10\ H_2O}$$

(a) What is the number of moles of butane (C_4H_{10}) needed for producing 3 moles of CO_2 ?

(b) How many grams of water will be produced if 10 g of butane were reacted with excess of oxygen?

(c) What volume of butane (C_4H_{10}) at STP needed for producing 20 g of CO_2?

KEY/OPTIONAL PRACTICE PROBLEMS

DIMENSIONAL ANALYSIS AND PROPERTIES OF MATTER

(1) m, kg, s, K, mole

(2) Fill in the following table:

Object	Weight, g	Mass, g
Piece of iron	50 g	50 g
Huge container of hydrogen gas	50 g	50 g
A beaker with water	50 g	50 g

(3) Graduated cylinder or burette

(4) Electronic balances

(5) (a) $20\ ^0C + 273 = 293$ K (b) $0\ K - 273 = -273\ ^0C$

(6) (a) $(1.8 \cdot 20\ ^0C) + 32 = 68\ ^0F$ (b) $5/9\ (32-32) = 0\ ^0C$

(7) $D = 20\ g/\ 40\ cm^3 = 0.5\ g/cm^3$

(8) $V = 28.0\ cm^3 - 20.0\ cm^3 = 8.0\ cm^3$

(9) $D = 5.00\ g/\ 8.0\ cm^3 = 0.63\ g/cm^3$

(10) $V = 2cm \cdot 2cm \cdot 2cm = 8\ cm^3$
$D = 14.56\ g/8\ cm^3 = 1.8\ g/cm^3$. Choose Be because it's supposed to be a metal (silvery color) .

(11) Burning wood, something exploding.

(12) (C) iron, Fe

(13) $\%\ S = (32.1/\ 98.1) \cdot 100\ \% = 32.7\%$

(14) (C) filtration

(15) Beaker, tripod or ring stand with a ring, funnel, filter paper.

(16) Weigh an object and then place it into a graduated cylinder. Find how much water was raised: this difference equals the volume of the object.

To calculate the density of the object, divide mass over the volume.

(17) Express the measurement of $556677L = 5.56677 \cdot 10^5\ L$

(18) $20\ mL \cdot \frac{1L}{1000\ mL} = 0.020\ L$

(19) $20\ L \cdot \frac{1000mL}{1\ L} = 20000\ mL$

ATOMIC STRUCTURE AND NUCLEAR CHEMISTRY

(1) protons and neutrons

(2) electrons

(3) neutrons

(4) protons

(5) In the nucleus

(6) (B) number of protons

(7) Fill in the table below

Symbolic notation, ${}_{Z}^{A}Symbol$	Atomic number	Mass number	# of p^+	# of e^-	# of n^0	Charge of the nucleus
${}_{56}^{140}Ba$	56	140	56	56	140-56= 84	+ 56
${}_{13}^{28}Al$	13	13+15=28	13	13	15	+ 13
${}_{17}^{38}Cl$	17	38	17	17	21	+ 17

(8) They have different number of neutrons (and different mass number; in hydrogen-1, 1 is a mass number).

(9) They have the same number of protons and the same charge of the nucleus.

(10) ${}_{1}^{1}H$ ${}_{1}^{2}H$ ${}_{1}^{3}H$

(11) (D) 29 protons, 40 neutrons, 29 electrons

(12) (B) ${}_{19}^{38}K$

(13) (A) ${}_{88}^{226}X$ and ${}_{88}^{228}X$

(14) $(127 \cdot 0.8) + (126 \cdot 0.17) + (128 \cdot 0.03) = 126.86$ amu

ELECTRON CONFIGURATION AND PERIODICITY

(1) Al

(2) two

(3) (C) Sr

(4) Noble gases

(5) Phosphorus

(6) Eight

(7) Eight

(8) 37 p^+, 36 e^-, 48 n^0

CHEMICAL BONDING

(1) (B) Na_2SO_4

(2) (B) H_2O

(3) $\overset{+3}{Al}\overset{-1}{Cl_3}$

(4) (a) Na_2SO_4 sodium sulfate (b) $(NH_4)_3PO_4$ ammonium phosphate

(c) H_2SO_4 sulfuric acid (d) $Ca_3(PO_4)_2$ calcium phosphate

(e) Li_2O lithium oxide (f) Cl_2O_5 dichlorine pentoxide

(g) Ag_2SO_4 silver sulfate (h) CH_4 carbon tetrahydride

(5) (a) $Cu_3(PO_4)_2$

(b) $Ni(PO_4)$

(6) $Zn(OH)_2$

(7) Ag_2O

CHEMICAL REACTIONS (BALANCING)

(1) $1\ C_2H_4 + 3\ O_2 \rightarrow 2\ CO_2 + 2\ H_2O$

(2) $1\ H_2SiO_3 + 1\ Ca(OH)_2 \rightarrow 1\ CaSiO_3 + 2\ H_2O$

(3) $1\ H_2CO_3 \rightarrow 1\ H_2O + 1\ CO_2$

(4) $1\ Zn + 1\ Hg(NO_3)_2 \rightarrow 1\ Zn(NO_3)_2 + 1\ Hg$

(5) $3\ H_2 + 1\ N_2 \rightarrow 2\ NH_3$

(6) $3\ AgNO_3 + 1\ GaCl_3 \rightarrow 3\ AgCl + 1\ Ga(NO_3)_3$

(7) $2\ AlBr_3 + 3\ K_2SO_4 \rightarrow 6\ KBr + 1Al_2(SO_4)_3$

(8) $2\ HNO_3 + 1\ CaCO_3 \rightarrow 1\ Ca(NO_3)_2 + 1H_2CO_3$

(9) $2Na + 1ZnBr_2 \rightarrow 2NaBr + 1\ Zn$

(10) $1\ NiCl_3 + 3\ KOH \rightarrow 1\ Ni(OH)_3 + 3\ KCl$

(11) $4\ P + 5\ O_2 \rightarrow 2\ P_2O_5$

(12) $1\ CO_2 + 1\ H_2O \rightarrow 1\ H_2CO_3$

(13) $1\ S + 1\ O_2 \rightarrow 1\ SO_2$

(14) $2\ KNO_3 \rightarrow 1\ O_2 + 2\ KNO_2$

MOLE AND STOICHIOMETRY

(1) MW $Co_3(PO_4)_2 = (3 \cdot 58.9) + (2 \cdot 31) + (8 \cdot 16) = 366.7$ g/mol

(2) MW $H_2O_2 = (2 \cdot 1) + (2 \cdot 16) = 34.0$ g/mol

$$10 \text{ mol } H_2O_2 \cdot \frac{34.0 \text{ g } H_2O_2}{1 \text{ mol } H_2O_2} = 340.0 \text{ g } H_2O_2$$

(3) MW $CCl_4 = (1 \cdot 12) + (4 \cdot 35.5) = 154.0$ g/mol

$$2\text{mol } CCl_4 \cdot \frac{154.0 \text{ g } CCl_4}{1 \text{ mol } CCl_4} = 308.0 \text{ g } CCl_4$$

$$(4)\ 50.0 \text{ g Cu} \cdot \frac{1 \text{ mol Cu}}{63.5 \text{ g Cu}} \cdot \frac{6.02 \cdot 10^{23} \text{ atoms Cu}}{1 \text{ mol Cu}} = 4.74 \cdot 10^{23} \text{ atoms Cu}$$

(5) According to Avogadro's law, equal volumes of gases at the same temperature and pressure contain equal number of particles. Hence, 5 L of nitrogen and 5 L of argon contain the same number of particles (molecules of N_2 and atoms of Ar) at STP.

$$(6)\quad \underset{2 \text{ mol}}{2C_4H_{10}} + 13O_2 \rightarrow \underset{8 \text{ mol}}{8CO_2} + 10\ H_2O \qquad \text{(X above } 2C_4H_{10}\text{; 3 mol above } 8CO_2\text{)}$$

$$(a)\ 3 \text{ mol } CO_2 \cdot \frac{2 \text{ mol } C_4H_{10}}{8 \text{ mol } CO_2} = 0.75 \text{ mol } C_4H_{10}$$

$$(b)\ 10 \text{ g } C_4H_{10} \cdot \frac{1 \text{ mol } C_4H_{10}}{58 \text{ g } C_4H_{10}} \cdot \frac{10 \text{ mol } H_2O}{2 \text{ mol } C_4H_{10}} \cdot \frac{18 \text{ g } H_2O}{1 \text{mol } H_2O} \qquad X = 15.5 \text{ g } H_2O$$

$$(c)\ 20 \text{ g } CO_2 \cdot \frac{1 \text{ mol } CO_2}{44 \text{ g } CO_2} \cdot \frac{2 \text{mol } C_4H_{10}}{8 \text{ mol } CO_2} \cdot \frac{22.4 \text{ L } C_4H_{10}}{1 \text{mol } C_4H_{10}} \qquad X = 2.55 \text{ L } C_4H_{10}$$