Key

E1-09F

Student: _____

1 mol = 6.022x10²³

Part I: Multiple Choice (14 points)   *2pts ea.*

1. How many significant figures are in 0.006570?
A. 3
(B) 4
C. 5
D. 6
E. 7

2. Atoms X, Y, Z, and R have the following nuclear compositions:

$^{410}_{186}X$ $^{410}_{183}Y$ $^{412}_{186}Z$ $^{412}_{185}R$

Which two are isotopes?
A. X and Y
B. X and R
C. Y and R
D. Z and R
(E) X and Z

3. Which of the following elements are the least reactive?
A. alkali metals
(B) noble gases
C. halogens
D. alkaline earth metals
E. metalloids

4. A row of the periodic table is called a:
A. group
(B) period
C. isotopic mixture
D. family
E. subshell

5. Which of these elements is chemically similar to magnesium?
A. sulfur
(B) calcium
C. iron
D. nickel
E. potassium

Name:_____ *Key*

M.C. 2 pts. each

6. An anion is defined as
(A) a charged atom or group of atoms with a net negative charge.
B. a stable atom.
C. a group of stable atoms.
D. an atom or group of atoms with a net positive charge.
E. neutral.

7. What is the formula for the ionic compound formed by calcium and selenium?
(A) CaSe
B. Ca_2Se
C. $CaSe_2$
D. Ca_3Se
E. $CaSe_3$

Part II: Short Answer

8. (4 points) Give an example of::

a) a physical change

   melting, boiling, crushing, etc.

b) a chemical change

   many possible

9. (4 points) Give an example of :

a) an *extensive* property.

   mass, length, volume, etc.

b) an *intensive* property.

   density, temperature, hardness etc.

10. (4 points) Explain the difference between accuracy and precision.

   precision: how close repeated measurements are to each other.
   accuracy: how close avg. of repeated measurements is to
        "true" value

11. (2 points) _element_ is the term used to describe a substance that cannot be separated into simpler substances by chemical means.

12. (3 points) What are the three types of radiation produced by the decay of substances like uranium?

α, β, γ

13. (12 points) For the following three *neutral* atoms (i.e. not ions), fill in the blank spaces and write out all the symbols in the left hand column (including Au) in full, in the form $^A_Z X$ (i.e., include the appropriate values of Z and A as well as the correct symbol X).

$^{35}_{17}Cl$

Symbol	# protons	# neutrons	# electrons
$^{...}_{...}$ ...	17	18	17
$^{197}_{79}$ Au	79	118	79
$^{40}_{20}$ Ca	20	20	20

14. (2 points)Describe the difference between an empirical formula and a molecular formula.

Empirical : #s of each element reflect simplest ratio.

molecular # " " are actual # of atoms per molecule

15. (2 points) isotopes_____ are atoms that have the same atomic number (Z) but different mass numbers (A).

16.(2 points) allotropes_____ are one of two or more distinct forms of an element.

not on exam's P.T. → bonus points if right.

17. (2 points)What is the name given for the elements in Group 7A in the periodic table?

halogens

18. (7 points) Write the balanced equation for the combustion of C_8H_{18} gas ((g) in equation not required for full score)

$$2C_8H_{18} + 25O_2 \longrightarrow 16CO_2 + 18H_2O$$

19. (6 points) Give names fort the following compounds:
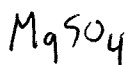a) $FeCl_2$ iron (II) chloride
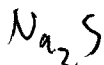
b) H_2SO_4 sulfuric acid

c) CS_2 carbon disulfide

20. (6 points) Give chemical formulas for the following compound names:
a) copper (II) phosphate $Cu_3(PO_4)_2$

b) magnesium sulfate

$MgSO_4$

c) sodium sulfide

Na_2S

Name:_____

Key

III Calculations.   SHOW YOUR WORK for full credit.   *Show your final answers with the correct number of significant figures.*

21. (2 points) Calculate $(3.8621 \times 1.5630) - 5.98$.

$$6.03\overset{\bullet}{6}46 - 5.98$$

$$0.0\overset{\bullet}{5}6$$

$$0.06$$

22. (2 points) Calculate $(13.7 + 0.027) \div 8.221$.

$$13.\overset{\bullet}{7}27 \div 8.221$$

$$1.6\overset{\bullet}{6}97$$

$$1.67$$

23. (3 points) How many micrograms are in 65.3kg?

$$65.3 kg \times \frac{1000g}{kg} \times \frac{1 \times 10^6 \mu g}{g} = 65.3 \times 10^9 \mu g$$

$$= 6.53 \times 10^{10} \mu g$$

(other ways possible, e.g. $\frac{1g}{10^{-3}kg}$ conversion factor etc.)

24. (3 points) How many inches are in 382.5 cm? (1in = 2.54 cm *exactly*)

$$382.5 cm \times \frac{1 in}{2.54 cm} = 150.6 in.$$

25. (4 points) What is the volume of a container that contains 14.3 g of a substance having a density of 0.988 g/cm^3?

$$14.3 g \times \frac{1 cm^3}{0.988 g} = 14.5 cm^3$$

26. (3 points) If the temperature is 38°F then what is the temperature in °C and in Kelvin?

2 ways for $F \rightarrow C$:

a) $F = \frac{9}{5}C + 32$

$38 = \frac{9}{5}C + 32$

$6 = \frac{9}{5}C$

$C = 3.\overset{\bullet}{3}°C$ or $= 3°C$

$K = °C + 273.15$

$= 3.\overset{\bullet}{3} + 273.15$

$= 276 K$

b) $F + 40 = 78$

$78 \times \frac{5}{9} = 43.\overset{\bullet}{3}$

$43.\overset{\bullet}{3} - 40 = 3.\overset{\bullet}{3}$

$= 3°C$

Chatellier's Method

27. (3 points)Determine the average atomic mass of boron if the natural abundance of ^{10}B weighing exactly 10.0129 amu is 19.9% and the natural abundance of ^{11}B weighing exactly 11.0093 amu is 80.1%.

$$\{(0.199 \times 10.0129) + (0.801 \times 11.0093)\} \, amu$$

$$(1.993 + 8.818) \, amu$$

$$10.81 \, amu$$

✷ just answer is <u>zero</u> — can get from periodic table.

28. (3 points) Analysis of a white solid produced in a reaction between chlorine and phosphorus showed that it contained 77.44% chlorine and 22.56% phosphorus by mass. What is its empirical formula?

Assume 100g

77.44g Cl ÷ 35.453g/mol = 2.1843 mol $\frac{2.1843}{0.72838} = \frac{2.999}{1} \approx \frac{3}{1}$

22.56g P ÷ 30.973g/mol = 0.72838 mol

$$PCl_3$$

29. (8 points) Propane, C_3H_8, is commonly provided as a bottled gas for use as a fuel. In 0.200 mol of propane: (Show all your work)

a. what is the mass of propane?

b. what mass of carbon is present?

c. how many molecules of C_3H_8 are present?

d. how many hydrogen atoms are present?

Mw C_3H_8 $(3 \times 12.011 + 8 \times 1.0079 = \cancel{} 44.0962)$ g/mol

a) 0.200 mol × 44.096 g/mol = 8.82g

b) 0.200 mol × $\frac{3 \, atoms \, C}{mol \, propane}$ = 0.600 mol C

$\times 12.011 g/mol = 7.21 g \, C$

c) 0.200 mol propane × 6.022×10^{23} molecules/mol = 1.20×10^{23} molecules

d) 1.20×10^{23} molecules propane × $\frac{8 \, atoms \, H}{molecule \, propane}$ = 9.64×10^{23} atoms H

Key

30. (2 points) Calcium fluoride, CaF$_2$, is a source of fluorine and is used to fluoridate drinking water. Calculate its formula mass.

$40.078 g/mol + 2 \times 18.9984032 g/mol$

$40.078 g/mol + 37.9968064 g/mol$

$78.075 g/mol$

31. (3 points) What is the percent carbon in CH$_3$CH$_2$OH, by mass?

MW of C$_2$H$_6$O : $2 \times 12.011 g/mol + 6 \times 1.0079 g/mol + 15.9994 g/mol = 46.0688 g/mol$

mass of 2C : $2 \times 12.011 g/mol = 24.022 g/mol$

$\frac{24.022}{46.0688} \times 100\% = 52.122\%$

32. (8 points) Terephthalic acid, used in the production of polyester fibers and films, is composed of carbon, hydrogen, and oxygen. When 0.6943 g of terephthalic acid was subjected to combustion analysis it produced 1.471 g CO$_2$ and 0.226 g H$_2$O. What is its empirical formula?

$1.471 g CO_2 \div 44.0098 g/mol = 0.033424 mol$ CO$_2$ = # mol C

$0.226 g H_2O \div 18.0152 g/mol = 0.01254 mol H_2O$

$\times \frac{2 mol H}{mol H_2O} = 0.02509 mol H$

Mass of C in CO$_2$: ~~0.012~~ 0.033424 mol $\times$ 12.011 g/mol = 0.40146 g

Mass of H in H$_2$O : 0.02509 mol $\times$ 1.0079 g/mol = 0.02529 g

Mass of O in sample : 0.6943 g - (0.40146 g + 0.02529 g)

~~0.9~~ 0.26755 g O

Moles of O in sample : 0.26755 g $\div$ 15.9994 g/mol = 0.016723 mol

C $_{~~0.03354~~}$ H $_{0.02509}$ O $_{0.01672}$

$_{0.033424}$

$\sim$ C$_2$ H$_{1.5}$ O$_1$

C$_4$ H$_3$ O$_2$