Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Summer Quiz (168 points)

Multiple Choice

1. Which one of the following is often easily separated into its components by simple techniques such as filtering or decanting?

A) heterogeneous mixture

B) compounds

C) homogeneous mixture

D) elements

E) solutions

1. If matter is uniform throughout and cannot be separated into other substances by physical means, it is \_\_\_\_\_\_\_\_\_\_.

A) a compound

B) either an element or a compound

C) a homogeneous mixture

D) a heterogeneous mixture

E) an element

1. Which of the following is an illustration of the law of constant composition?

A) Water boils at 100°C at 1 atm pressure.

B) Water is 11% hydrogen and 89% oxygen by mass.

C) Water can be separated into other substances by a chemical process.

D) Water and salt have different boiling points.

E) Water is a compound.

1. Which of the following are chemical processes?

1. rusting of a nail

2. freezing of water

3. decomposition of water into hydrogen and oxygen gases

4. compression of oxygen gas

A) 2, 3, 4

B) 1, 3, 4

C) 1, 3

D) 1, 2

E) 1, 4

1. Which one of the following is not an intensive property?

A) density

B) temperature

C) melting point

D) mass

E) boiling point

1. Which one of the following is the highest temperature?

A) 38 °C

B) 96 °F

C) 302 K

D) none of the above

E) the freezing point of water

1. Which one of the following is true about the liter?

A) It is the SI base unit for volume.

B) It is equivalent to a cubic decimeter.

C) It is slightly smaller than a quart.

D) It contains 106 cubic centimeters.

E) It is slightly smaller than a gallon.

1. Of the objects below, \_\_\_\_\_\_\_\_\_\_ is the most dense.

A) an object with a volume of 2.5 L and a mass of 12.5 kg

B) an object with a volume of 139 mL and a mass of 93 g

C) an object with a volume of 0.00212 m3 and a mass of 4.22 × 104 mg

D) an object with a volume of 3.91 × 10-24 nm3 and a mass of 7.93 × 10-1 ng

E) an object with a volume of 13 dm3 and a mass of 1.29 × 103 g

1. Which of the following has the same number of significant figures as the number 1.00310?

A) 1 × 106

B) 199.791

C) 8.66

D) 5.119

E) 100

1. How many significant figures should be retained in the result of the following calculation?

12.00000 × 0.9893 + 13.00335 × 0.0107

A) 2

B) 3

C) 4

D) 5

E) 6

1. If matter is uniform throughout and cannot be separated into other substances by physical processes, but can be decomposed into other substances by chemical processes, it is called a (an) \_\_\_\_\_\_\_\_\_\_.

A) heterogeneous mixture

B) element

C) homogeneous mixture

D) compound

E) mixture of elements

1. A separation process that depends on differing abilities of substances to form gases is called \_\_\_\_\_\_\_\_\_\_.

A) filtration

B) solvation

C) distillation

D) chromatography

E) All of the above are correct.

1. A molecule of water contains hydrogen and oxygen in a 1:8 ratio by mass. This is a statement of \_\_\_\_\_\_\_\_\_\_.

A) the law of multiple proportions

B) the law of constant composition

C) the law of conservation of mass

D) the law of conservation of energy

E) none of the above

1. Consider the following selected postulates of Dalton's atomic theory:

(i) Each element is composed of extremely small particles called atoms.

(ii) Atoms are indivisible.

(iii) Atoms of a given element are identical.

(iv) Atoms of different elements are different and have different properties.

Which of the postulates is(are) no longer considered valid?

A) (i) and (ii)

B) (ii) only

C) (ii) and (iii)

D) (iii) only

E) (iii) and (iv)

1. Which one of the following is not true concerning cathode rays?

A) They originate from the negative electrode.

B) They travel in straight lines in the absence of electric or magnetic fields.

C) They impart a negative charge to metals exposed to them.

D) They are made up of electrons.

E) The characteristics of cathode rays depend on the material from which they are emitted.

1. Which atom has the largest number of neutrons?

A) phosphorus-30

B) chlorine-37

C) potassium-39

D) argon-40

E) calcium-40

1. Which combination of protons, neutrons, and electrons is correct for the isotope of copper, ?

A) 29 p+, 34 n°, 29 e-

B) 29 p+, 29 n°, 63 e-

C) 63 p+, 29 n°, 63 e-

D) 34 p+, 29 n°, 34 e-

E) 34 p+, 34 n°, 29 e-

1. Silver has two naturally occurring isotopes with the following isotopic masses:

Ar Ar

106.90509 108.9047

The average atomic mass of silver is 107.8682 amu. The fractional abundance of the lighter of the two isotopes is \_\_\_\_\_\_\_\_\_\_.

A) 0.24221

B) 0.48168

C) 0.51835

D) 0.75783

E) 0.90474

1. Which one of the following molecular formulas is also an empirical formula?

A) C6H6O2

B) C2H6SO

C) H2O2

D) H2P4O6

E) C6H6

1. Which one of the following species has as many electrons as it has neutrons?

A) 1H

B) 40Ca2+

C) 14C

D) 19F-

E) 14C2+

1. Barium reacts with a polyatomic ion to form a compound with the general formula Ba3(X)2. What would be the most likely formula for the compound formed between sodium and the polyatomic ion X?

A) NaX

B) Na2X

C) Na2X2

D) Na3X

E) Na3X2

1. Which formula/name pair is incorrect?

A) Mn(NO2)4 manganese(IV) nitrite

B) Mg(NO3)2 magnesium nitrate

C) Mn(NO3)2 manganese(II) nitrate

D) Mg3N2 magnesium nitrite

E) Mg(MnO4)2 magnesium permanganate

1. The correct name for HNO2 is \_\_\_\_\_\_\_\_\_\_.

A) nitrous acid

B) nitric acid

C) hydrogen nitrate

D) hyponitrous acid

E) pernitric acid

1. Which metal forms cations of differing charges?

A) K

B) Cs

C) Ba

D) Al

E) Sn

1. When a metal and a nonmetal react, the \_\_\_\_\_\_\_\_\_\_ tends to lose electrons and the \_\_\_\_\_\_\_\_\_\_ tends to gain electrons.

A) metal, metal

B) nonmetal, nonmetal

C) metal, nonmetal

D) nonmetal, metal

E) None of the above, these elements share electrons.

1. The empirical formula of a compound with molecules containing 12 carbon atoms, 14 hydrogen atoms, and 6 oxygen atoms is \_\_\_\_\_\_\_\_\_\_.

A) C12H14O6

B) CHO

C) CH2O

D) C6 H7O3

E) C2H4O

1. The correct name for N2O5 is \_\_\_\_\_\_\_\_\_\_.

A) nitrous oxide

B) nitrogen pentoxide

C) dinitrogen pentoxide

D) nitric oxide

E) nitrogen oxide

1. The correct name for HBrO4 is \_\_\_\_\_\_\_\_\_\_.

A) hydrobromic acid

B) perbromic acid

C) bromic acid

D) bromous acid

E) hydrobromous acid

1. The correct formula for molybdenum(IV) hypochlorite is \_\_\_\_\_\_\_\_\_\_.

A) Mo(ClO3)4

B) Mo(ClO)4

C) Mo(ClO2)4

D) Mo(ClO4)4

E) MoCl4

1. Iron and chlorine form an ionic compound whose formula is FeCl3. The name of this compound is \_\_\_\_\_\_\_\_\_\_.

A) iron chlorine

B) iron (III) chloride

C) moniron trichloride

D) iron (III) trichloride

E) ferric trichloride

1. What is the molecular formula for butane?

A) C2H8

B) C3H6

C) C3H8

D) C4H8

E) C4H10

1. What is the mass % of carbon in dimethylsulfoxide (C2H6SO) rounded to three significant figures?

A) 60.0

B) 20.6

C) 30.7

D) 7.74

E) 79.8

1. How many molecules of CH4 are in 48.2 g of this compound?

A) 5.00 × 1024

B) 3.00

C) 2.90 × 1025

D) 1.81 × 1024

E) 4.00

1. A nitrogen oxide is 63.65% by mass nitrogen. The molecular formula could be \_\_\_\_\_\_\_\_\_\_.

A) NO

B) NO2

C) N2O

D) N2O4

E) either NO2 or N2O4

1. Sulfur and oxygen react to produce sulfur trioxide. In a particular experiment, 7.9 grams of SO3 are produced by the reaction of 5.0 grams of O2 with 6.0 grams of S. What is the % yield of SO3 in this experiment?

S (s) + O2 (g) → SO3 (g) (not balanced)

A) 32

B) 63

C) 75

D) 95

E) 99

Free Response #1

A student is assigned the task of determining the mass percent of silver in an alloy of copper and silver by

dissolving a sample of the alloy in excess nitric acid and then precipitating the silver as AgCl.

First the student prepares 50. mL of 6 *M* HNO3 .

(a) The student is provided with a stock solution of 16 *M* HNO3 , two 100 mL graduated cylinders that can be read to ±1 mL, a 100 mL beaker that can be read to ±10 mL, safety goggles, rubber gloves, a glass stirring rod, a dropper, and distilled H2O.

(i) Calculate the volume, in mL, of 16 *M* HNO3 that the student should use for preparing 50. mL of 6 *M* HNO3 .

(ii) Briefly list the steps of an appropriate and safe procedure for preparing the 50. mL of 6 *M* HNO3. Only materials selected from those provided to the student (listed above) may be used.

(iii) Explain why it is not necessary to use a volumetric flask (calibrated to 50.00 mL ±0.05 mL) to perform the dilution.

(iv) During the preparation of the solution, the student accidentally spills about 1 mL of 16 *M* HNO3 on the bench top. The student finds three bottles containing liquids sitting near the spill: a bottle of distilled water, a bottle of 5 percent NaHCO3(*aq*), and a bottle of saturated NaCl(*aq*). Which of the liquids is best to use in cleaning up the spill? Justify your choice.

Then the student pours 25 mL of the 6 *M* HNO3 into a beaker and adds a 0.6489 g sample of the alloy. After the

sample completely reacts with the acid, some saturated NaCl(*aq*) is added to the beaker, resulting in the

formation of an AgCl precipitate. Additional NaCl(*aq*) is added until no more precipitate is observed to

form. The precipitate is filtered, washed, dried, and weighed to constant mass in a filter crucible. The data are

shown in the table below.

Mass of sample of copper-silver alloy 0.6489 g

Mass of dry filter crucible 28.7210 g

Mass of filter crucible and precipitate

(first weighing) 29.3587 g

Mass of filter crucible and precipitate

(second weighing 29.2599 g

Mass of filter crucible and precipitate

(third weighing) 29.2598 g

(b) Calculate the number of moles of AgCl precipitate collected.

(c) Calculate the mass percent of silver in the alloy of copper and silver.

AP #2

CH4(g) + 2 Cl2(g) → CH2Cl2(g) + 2 HCl(g)

Methane gas reacts with chlorine gas to form dichloromethane and hydrogen chloride, as represented by the equation above.

(a) A 25.0 g sample of methane gas is placed in a reaction vessel containing 2.58 mol of Cl2(*g*).

(i) Identify the limiting reactant when the methane and chlorine gases are combined. Justify your answer with a calculation.

(ii) Calculate the total number of moles of CH2Cl2(*g*) in the container after the limiting reactant has been totally consumed.

Initiating most reactions involving chlorine gas involves breaking the Cl–Cl bond, which has a bond energy

of 242 kJ mol-1.

(b) Calculate the amount of energy, in joules, needed to break a single Cl–Cl bond.

AP #3

1. A compound containing the elements C, H, N, and O is analyzed. When a 1.2359g sample is burning in excess oxygen, 2.241f of CO2(g) is formed. The combustion analysis also showed that the sample contained 0.0648g of H.
2. Determine the mass, in grams, of C in the 1.2359g sample of the compound.
3. When the compound was analyzed for N content only , the mass percent of N is found to be 28.84 percent. Determine the mass, in grams, of N in the original 1.2359g sample of the compound.
4. Determine the mass, in grams, of O in the original 1.2359g sample of the compound.
5. Determine the empirical formula of the compound.
6. A different compound, which has the empirical formula CH2Br, has a vapor density of 6.00g/L at 375K and 0.983atm. Using these data, determine the following.
7. The molar mass of the compound.
8. The molecular formula of the compound.

Non AP questions:

1. “No matter how careful you measure anything, there is always an error.”

Explain why this is true. (4 pts)

1. Describe the Rutherford’s gold foil experiment and explain his conclusion. (5 pts)
2. Fungal laccase, a blue protein found in wood-rotting fungi, is 0.390% Cu by mass. If a fungal laccase molecule contains 4 copper atoms, what is the molar mass of fungal laccase? (5 pts)
3. Chromium with an atomic mass of 51.996 consists of four isotopes of mass 51.9405, 52.9407, 49.9461 and 53.9389. The lightest isotope has an abundance of 4.31% and the heaviest isotope has an abundance of 2.38. Find the abundance of the other two to the nearest hundredth. (5 points)
4. A 0.755g sample of hydrated copper (II) sulfate CuSO4**.**xH2O was heated carefully until it had changed completely to anhydrous copper (II) sulfate with a mass of 0.483g. Determine the value of x. (4 points)