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Chemistry 107 : Exam 1A

The 100 pts exam consists of 9 questions and students have 1.5 hours to complete the exam. Answers must be written in the box provided or else no credit is provided. Use the empty space provided to do your work. A periodic table is provided at the end. Fill in your name along with your student ID number.

Problem 1 : True/False Determine whether the statement is true or false. (20 pts)

(a) An element is a pure substance that contains only one type of atom.

(b) Atoms are indivisible and indestructible.

(c) The atomic number of a substance is the number of neutrons that an element has.

(d) The mass of an atom is the sum of the masses of neutrons, protons, and electrons.

(e) When a chemical change occurs, matter keeps the same chemical properties.

(f) The total moles of reactants must equal the total moles of products.

(g) Matter and energy are neither created nor destroyed.

(h) All Brønsted acids are Lewis acids.

(i) Given a solution at concentration M, when the volume of the solution is increased by 2 times, then concentration is halved.

(j) Creating metal alloys such as steel and bronze is considered a physical change.

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Problem 2 : Sig Figs Solve the following equations with the appropriate number of significant figures (10 pts)

(a)

$$5.192 \times 10^2 - 1.024 \times 10 =$$

(b)

$$\frac{67.12 + 52.013}{45.1} =$$

(c)

$$\frac{1.25 \times 10^{-3} + 8. \times 10^{-4}}{7.51}$$

(d)

$$\frac{145\text{g}}{80.17\text{mL} - 15.32\text{mL}} =$$

(e)

$$(3.198 \times 10^4)(9.18 \times 10^{-2}) =$$

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Problem 3 : Short Answer Scientists attempt to understand chemical phenomena and solve problems using the scientific method. What is the scientific method ? Describe an everyday example in which you use the scientific method. (8 pts)

Problem 4 : Nomenclature Provide either the molecular formula or compound name for the following. (12 pts)

(a) Vanadium(V) acetate

(b) $Sr(C_2H_3O_2)$

(c) $HClO_3$

(d) $(NH_4)_2SO_4$

(e) Carbonic acid

(f) Sodium bicarbonate

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Problem 5 : Molarity Barium Chloride ($BaCl_2$) is a water-soluble inorganic compound that is toxic and shines yellow-and green under a flame. It has wide applications in the laboratory and in industry such as steel manufracture. Report all results to 3 significant figures. (12 pts)

(a) Determine the mass percent of each element in $BaCl_2$.

(b) A scientist attempts to prepare 1.50L of 1.75M $BaCl_2$. How many grams of $BaCl_2$ is needed ?

(c) Suppose the solution in part b) needs to be diluted to make 3.75L of 0.5M $BaCl_2$, how much volume in L is needed from 1.75M $BaCl_2$?

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Problem 6 : Relative Atomic Mass Boron has only two naturally occurring isotopes (Boron-10 and Boron-11). The mass of Boron-10 is 10.01294 amu and the mass of Boron-11 is 11.00931 amu. Report to 3 significant figures. (10 pts)

(a) Based on the periodic table, which boron isotope has the greater relative abundance ? Explain using words and/or formulas.

(b) Calculate the relative abundance of each isotope. *Hint :* There are two equations required. Set up a system of equations using the relative atomic mass formula and the relative abundance.

Problem 7 : Atoms and Ions Complete the table with the symbol, atomic number Z, atomic mass A, number of protons (p^+), number of electrons e^-, number of neutrons n, and charge. (8 pts)

Symbol	Z	A	p^+	e^-	n	Charge
Si	14		14	14	15	
S^{2-}		32				
	29				13	2+
	15			18	16	
Fe^{2+}		56				

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Problem 8 : Unit Conversion Convert the following units. (12 pts)

(a) 58.58 ms to Ms

(b) 129.1 mm^2 to km^2

(c) 8.16 dag/L to dg/mL

(d) 1 ML to m^3

(e) 43.007 nHz to kHz

(f) 325.48 Kelvin to °C

Problem 9 : Empirical and Molecular Formulas Caffeine, a stimulant in coffee and tea, has a molar mass of 194.19 g/mol and a mass percentage composition of 49.48% C, 5.19% H, 28.85% N, and 16.48% O. (8 pts)

(a) Determine the empirical formula

(b) What is the molecular formula of caffeine ?

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