

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.

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)

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

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) $\text{Sr}(\text{C}_2\text{H}_3\text{O}_2)$

(c) HClO_3

(d) $(\text{NH}_4)_2\text{SO}_4$

(e) Carbonic acid

(f) Sodium bicarbonate

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 manufacture. 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 ?

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				

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

(a) 58.58 ms to Ms

(b) 129.1 mm² to km²

(c) 8.16 dag/L to dg/mL

(d) 1 ML to m³

(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?

1 H Hydrogen 1.008																		2 He Helium 4.003																			
3 Li Lithium 6.94		4 Be Beryllium 9.012																		9 F Fluorine 18.998	10 Ne Neon 20.180																
11 Na Sodium 22.990		12 Mg Magnesium 24.305																		17 Cl Chlorine 35.45	18 Ar Argon 39.948																
19 K Potassium 39.098		20 Ca Calcium 40.078		21 Sc Scandium 44.956		22 Ti Titanium 47.867		23 V Vanadium 50.942		24 Cr Chromium 51.996		25 Mn Manganese 54.938		26 Fe Iron 55.845		27 Co Cobalt 58.933		28 Ni Nickel 58.693		29 Cu Copper 63.546		30 Zn Zinc 65.38		31 Ga Gallium 69.723		32 Ge Germanium 72.630		33 As Arsenic 74.922		34 Se Selenium 78.97		35 Br Bromine 79.904		36 Kr Krypton 83.798			
37 Rb Rubidium 85.468		38 Sr Strontium 87.62		39 Y Yttrium 88.906		40 Zr Zirconium 91.224		41 Nb Niobium 92.906		42 Mo Molybdenum 95.95		43 Tc Technetium [97]		44 Ru Ruthenium 101.07		45 Rh Rhodium 102.906		46 Pd Palladium 106.42		47 Ag Silver 107.868		48 Cd Cadmium 112.414		49 In Indium 114.818		50 Sn Tin 118.710		51 Sb Antimony 121.760		52 Te Tellurium 127.60		53 I Iodine 126.904		54 Xe Xenon 131.293			
55 Cs Cesium 132.905		56 Ba Barium 137.327		57 - 70 *		71 Lu Lutetium 174.967		72 Hf Hafnium 178.49		73 Ta Tantalum 180.948		74 W Tungsten 183.84		75 Re Rhenium 186.207		76 Os Osmium 190.23		77 Ir Iridium 192.217		78 Pt Platinum 195.084		79 Au Gold 196.997		80 Hg Mercury 200.592		81 Tl Thallium 204.38		82 Pb Lead 207.2		83 Bi Bismuth 208.980		84 Po Polonium [209]		85 At Astatine [210]		86 Rn Radon [222]	
87 Fr Francium [223]		88 Ra Radium [226]		89 - 102 **		103 Lr Lawrencium [262]		104 Rf Rutherfordium [267]		105 Db Dubnium [270]		106 Sg Seaborgium [269]		107 Bh Bohrium [270]		108 Hs Hassium [270]		109 Mt Meitnerium [278]		110 Ds Darmstadtium [281]		111 Rg Roentgenium [281]		112 Cn Copernicium [285]		113 Nh Nihonium [286]		114 Fl Flerovium [289]		115 Mc Moscovium [289]		116 Lv Livermorium [293]		117 Ts Tennessine [293]		118 Og Oganesson [294]	
				Lanthanide series																																	
57 La Lanthanum 138.905				58 Ce Cerium 140.116		59 Pr Praseodymium 140.908		60 Nd Neodymium 144.242		61 Pm Promethium [145]		62 Sm Samarium 150.36		63 Eu Europium 151.964		64 Gd Gadolinium 157.25		65 Tb Terbium 158.925		66 Dy Dysprosium 162.500		67 Ho Holmium 164.930		68 Er Erbium 167.259		69 Tm Thulium 168.934		70 Yb Ytterbium 173.045									
89 Ac Actinium [227]				90 Th Thorium 232.038		91 Pa Protactinium 231.036		92 U Uranium 238.029		93 Np Neptunium [237]		94 Pu Plutonium [244]		95 Am Americium [243]		96 Cm Curium [247]		97 Bk Berkelium [247]		98 Cf Californium [251]		99 Es Einsteinium [252]		100 Fm Fermium [257]		101 Md Mendelevium [258]		102 No Nobelium [259]									
				Actinide series																																	