

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATION
RESIT/SUPPLEMENTARY / SPECIAL EXAMINATIONS
EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN
AGRICULTURAL EDUCATION AND EXTENSION, BACHELOR OF SCIENCE IN
AGRICULTURAL ECONOMICS, AGRICULTURE, BACHELOR OF SCIENCE IN
FOOD SCIENCE AND TECHNOLOGY, BACHELOR OF SCIENCE IN
ENVIRONMENTAL SCIENCE, BACHELOR OF SCIENCE IN NATURAL
RESOURCES, BACHELOR OF SCIENCE IN WILDLIFE ENTERPRISE &
MANAGEMENT AND BACHELOR OF SCIENCE IN ANIMAL SCIENCE AND
HORTICULTURE

CHEM 102: GENERAL INORGANIC AND PHYSICAL CHEMISTRY

STREAMS: AS ABOVE

TIME: 2 HOURS

DAY/DATE: WEDNESDAY 11/08/2021**11.30 A.M - 1.30 P.M.****INSTRUCTIONS**

- Answer all questions

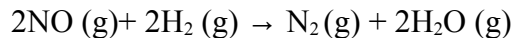
QUESTION ONE (30 MARKS)

- a) State the Pauli's exclusion principle. (1 mark)
- b) Write the ground state electronic configuration of; (2 marks)
- i. Carbon atom (C =6)
 - ii. Sulfur atom (S=16)
- c) Write the nuclear symbol for the element used in diagnostic bone scans. It has 31 protons and 38 neutrons. (1 marks)
- d) Silver has two naturally occurring isotopes. ^{107}Ag (106.90509 amu; 51.84%) and ^{109}Ag (108.90476 amu; 48.16%). Calculate the atomic mass of silver. (3 marks)

- e) Calculate the mass percent of each element in acetaminophen ($C_8H_9NO_2$), the active ingredient of some common pain killers. (3 marks)
- f) State the four quantum numbers and describe their significance. (4 marks)
- g) An organic compound contains 74.0% C, 8.60% H and 17.4% N. determine the empirical formula for the compound. (4 marks)
- h) Consider the following reaction.
 $H_2(g) + I_2(g) \rightleftharpoons 2 HI(g)$
- (i) Write the expression for the equilibrium constant (K_c). (1 mark)
- (ii) Calculate K_c using the following concentrations of each substance at equilibrium: $[H_2] = 0.95 \text{ M}$; $[I_2] = 0.78 \text{ M}$; $[HI] = 0.27 \text{ M}$. (2 marks)
- i) Calculate the pH of a urine sample that has an H_3O^+ concentration of $1.0 \times 10^{-5} \text{ M}$. and classify the solution as acidic, basic, or neutral. (3 marks)
- j) A 5.0ml sample of CO_2 gas is enclosed in a gas tight syringe at $22^\circ C$. If the syringe is immersed in an ice bath ($0^\circ C$), calculate the new gas volume, assuming that pressure is held constant (2 marks)
- k) A sample of gas has an initial volume of 158 mL at a pressure of 735 mm Hg and a temperature of $34^\circ C$ If the gas is compressed to a volume of 108 mL and heated to a temperature of $85^\circ C$, calculate its final pressure in millimeters of mercury. (3 marks)

QUESTION TWO (20 MARKS)

- a) Calculate the number of molecules that are contained in a 325-mg tablet of aspirin ($C_9H_8O_4$, molar mass 180.2 g/mol). (2 marks)
- b) Calculate the pH of a urine sample that has an H_3O^+ concentration of $1.0 \times 10^{-5} \text{ M}$. and classify the solution as acidic, basic, or neutral. (3 marks)
- c) Calculate the pH of 0.0356 M $Ca(OH)_2$ solution. (3 marks)
- d) The following data were measured for the reduction of nitric oxide with hydrogen

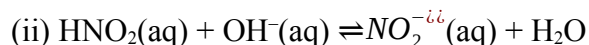
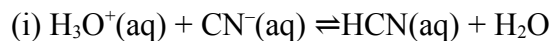


Initial concentration (mol L ⁻¹)		Initial rate of formation of (CH ₃) ₃ COOH (mol L ⁻¹ S ⁻¹)
[NO]	[H ₂]	
0.10	0.10	1.23 × 10 ⁻³
0.10	0.20	2.46 × 10 ⁻³
0.20	0.10	4.92 × 10 ⁻³

Determine the rate law for the reaction (6 marks)

- e) Explain how the real gases deviate from the ideal gases in obeying the ideal gas law (2 marks)
- f) For each of the following reactions, indicate the Brønsted-Lowry acid, base, conjugate acid and conjugate base.

(4 marks)



QUESTION THREE (20 MARKS)

- a) Explain briefly how the following properties of the elements vary across a period and down a group in the periodic table (6 marks)
- Atomic radius
 - Ionization energy
 - Electronegativity
- b) State the postulates of Bohr's model of an atom. (3 marks)
- c) Calculate the wavelength in nanometers of a transition in a hydrogen atom from n=5 to n=2 (RH = 1.097 × 10⁻² nm⁻¹) (3 marks)
- d) Calculate the concentration of H₃O⁺ and OH⁻ in a beverage that has a pH of 3.15. (5 marks)
- e) Calculate the volume occupied by 25g of CO₂ gas at 1.00 atm and 37°C. (3 marks)

1 H Hydrogen 1.008	2 He Helium 4.003	<p>metals </p> <p>nonmetals </p> <p>metalloids </p> <p>Average Atomic Mass — C — Carbon — 12.011</p>																																																																																				
3 Li Lithium 6.94	4 Be Beryllium 9.012	5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180	11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.06	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 131.288	55 Cs Cesium 132.905	56 Ba Barium 137.327	57-70 * Lanthanum 174.967	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 192.227	78 Pt Platinum 195.084	79 Au Gold 196.967	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 ** 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

*Lanthanide series

**Actinide series