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OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2018/2019 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: CHE 110

COURSE TITLE: BASIC CHEMISTRY I

DATE: 18TH DECEMBER, 2018 **TIME: 2.00 PM – 5.00 PM**

INSTRUCTION TO CANDIDATES

- SEE INSIDE

THIS PAPER CONSISTS OF 5 PRINTED PAGES PLEASE TURN OVER

CHE 110: BASIC CHEMISTRY I

STREAM: BED (Science) **DURATION: 3 Hours**

INSTRUCTIONS TO CANDIDATES

i. *Answer **ALL** questions from **SECTION A** and any other **THREE** questions from **SECTION B**.*

ii. *Diagrams may be used whenever they serve to illustrate the answer.*

iii. *Do not write on the question paper.*

SECTION A (24 MARKS)

Question One

(Cu=29, Mg=12, Co=27, Na=11)

a) What are the drawbacks of the Rutherford's atomic model? (2 Marks)

b) What are the assumptions on which the Bohr theory of the structure of the hydrogen atom is based? (3 Marks)

c) On what principles is the mechanical model of the atom based? (1 Mark)

d) State the Heisenberg's uncertainty principle. (1 Mark)

e) Give the names and symbols of the four quantum numbers required to define the energy of electrons in atoms. What do these quantum numbers relate to, and what numerical values are possible for each? (4 Marks)

f) Give the equation which explains the different series of lines in the atomic spectrum of hydrogen. Explain the various terms involved. (1 Mark)

Question Two

a) Write the electronic configurations for Rb, Fe^{2+}, Co and Na^{+}. (2 Marks)

b) Why does Helium have a smaller radius than Hydrogen atom? (2 Marks)

c) What is a chemical bond. (1 Mark)

d) Giving examples, discuss three different types of bonds. (3 Marks)

e) What are some of the properties of ionic compounds? (3 Marks)

f) What is a hydrogen bond? (1 Mark)

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SECTION B

Question Three

a) What is meant by the following terms:

(i.) Orbital (1 Mark)

(ii.) Electronegativity (1 Mark)

(iii.) Electron affinity (1 Mark)

(iv.) Ionization energy (1 Mark)

b) Explain why the electron affinity of group IIB elements is greater than zero. (2 Marks)

c) Give the properties of the coordinate covalent bond. (3 Marks)

d) With relevant examples, explain how polarity of bonds varies with electronegativities. (2 Marks)

e) What is London force? (1 Mark)

Question Four

a) Explain why water is a liquid at room temperature while hydrogen sulphide is a gas at room temperature. (3 Marks)

b) Draw the Lewis structures of PCl_5, ClF_3 and SF_6. (3 Marks)

c) What is the valence shell electron pair repulsion (VSEPR) theory? (1 Mark)

d) Predict the shapes of SF_4 and NH_3. (3 Marks)

e) Define oxidation and reduction in terms of oxygen, hydrogen and electrons. (2 Marks)

Question Five

a) A 8.25g of an iron (II) salt was dissolved in 250 cm^3 of pure water. Aliquots of 25.0 cm^3 were pipetted from this stock solution and titrated with 0.0200 mol dm^{-3} potassium manganate (VII) solution. The titration values obtained were 23.95 cm^3, 23.80 cm^3 and 23.85 cm^3.

(i.) What titration value should be used in the calculation and why? (1 Mark)

(ii.) Write a full balanced redox equation for the reaction. (2 Marks)

(iii.) Calculate the moles of manganate (VII) used in the titration. (2 Marks)

(iv.) Calculate the moles of iron(II) ion titrated (1 Mark)

(v.) Calculate the mass of iron(II) titrated (2 Marks)

(vi.) Calculate the total mass of iron in the original sample of the iron(II) salt. (2 Marks)

(vii.) Calculate the % iron in the salt. (2 Marks)

Question Six

a) Define and give examples of state functions. (1 Mark)

b) Define the first law of thermodynamics. (1 Mark)

c) Show that $\Delta E = q_v$ at constant volume (V). (1 Mark)

d) Define standard enthalpy of combustion (ΔH_c^0), standard heat of neutralization (ΔH_n^0) and standard enthalpy of formation (ΔH_f^0). (3 Marks)

e) State Hess law. (1 Mark)

f) A 23.1 L container of He gas has a pressure of 3.54 atm. The gas is transferred to a new container and the pressure in this container is 1.87 atm. What is the volume of the new container? (3 Marks)

g) Explain how the experiments of Boyle, Charles, and Avogadro lead to the formulation of the perfect gas equation of state. (2 Marks)

Question Seven

a) What is equilibrium constant? (1 Mark)

b) What is chemical equilibrium? (1 Mark)

c) What is meant by the term 'common ion effect'? (1 Mark)

d) The solubility product of PbI_2 is 7.1×10^{-9} mol^3 L^{-3}. Calculate its solubility. (3 Marks)

e) Show that for a 1st order reaction, $-\ln(a-x) = kt + C$ (3 Marks)

f) With examples, explain the following radioactive processes;

(i.) Alpha (α) emission (1 Mark)

(ii.) Beta (β) emission (1 Mark)

(iii.) Electron capture (1 Mark)

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- Alkali Metals
- Alkaline Earth Metals
- Transition Metals
- Other Metals
- Nonmetals
- Noble Gases
- Lanthanoids
- Actinoids

key: element name / atomic number / symbol / atomic weight

C	Br	He	Tc
solid	liquid	gas	synthetic

hydrogen 1 H 1.00794																	helium 2 He 4.002602
lithium 3 Li 6.941	beryllium 4 Be 9.012182											boron 5 B 10.811	carbon 6 C 12.0107	nitrogen 7 N 14.00674	oxygen 8 O 15.9994	fluorine 9 F 18.9984	neon 10 Ne 20.1797
sodium 11 Na 22.98977	magnesium 12 Mg 24.3050											aluminium 13 Al 26.981538	silicon 14 Si 28.0855	phosphorus 15 P 30.97376	sulphur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.984
potassium 19 K 39.0983	calcium 20 Ca 40.078	scandium 21 Sc 44.95591	titanium 22 Ti 47.867	vanadium 23 V 50.9415	chromium 24 Cr 51.9961	manganese 25 Mn 54.93805	iron 26 Fe 55.845	cobalt 27 Co 58.9332	nickel 28 Ni 58.6934	copper 29 Cu 63.546	zinc 30 Zn 65.409	gallium 31 Ga 69.723	germanium 32 Ge 72.64	arsenic 33 As 74.9216	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.798
rubidium 37 Rb 85.4678	strontium 38 Sr 87.62	yttrium 39 Y 88.90585	zirconium 40 Zr 91.225	niobium 41 Nb 92.90638	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.9055	palladium 46 Pd 106.42	silver 47 Ag 107.8682	cadmium 48 Cd 112.411	indium 49 In 114.818	tin 50 Sn 118.710	antimony 51 Sb 121.760	tellurium 52 Te 127.60	iodine 53 I 126.9045	xenon 54 Xe 131.293
caesium 55 Cs 132.90545	barium 56 Ba 137.327	lutetium 71 Lu 174.967	hafnium 72 Hf 178.49	tantalum 73 Ta 180.9479	tungsten 74 W 183.84	rhenium 75 Re 186.207	osmium 76 Os 190.23	iridium 77 Ir 192.217	platinum 78 Pt 195.078	gold 79 Au 196.96655	mercury 80 Hg 200.59	thallium 81 Tl 204.3833	lead 82 Pb 207.2	bismuth 83 Bi 208.980	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]
francium 87 Fr [223]	radium 88 Ra [226]	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	darmstadtium 110 Ds [271]	roentgenium 111 Rg [272]	ununbium 112 Uub [285]		ununquadium 114 Uuq [289]				

lanthanum 57 La 138.9055	cerium 58 Ce 140.116	praseodymium 59 Pr 140.90765	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.964	gadolinium 64 Gd 157.25	terbium 65 Tb 158.9253	dysprosium 66 Dy 162.50	holmium 67 Ho 164.930	erbium 68 Er 167.259	thulium 69 Tm 168.934	ytterbium 70 Yb 173.04