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KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2017/2018 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF BSc and B.ED (SCIENCE)

COURSE CODE: SCH 100

COURSE TITLE: FUNDAMENTALS OF CHEMISTRY I

DURATION: 2 HOURS

DATE: 15TH JANUARY 2018 TIME: 2 – 5PM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of 4 printed pages. Please Turn Over

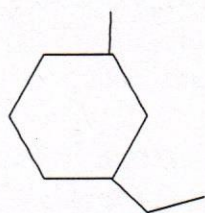


KIBU observes ZERO tolerance to examination cheating

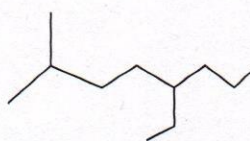
QUESTION 1 COMPULSORY (30 MARKS)

- a) (i) Define the term orbital [1mark]
(ii) State three rules that govern the filling of electrons in atomic orbitals. [3marks]
- b) State four postulates of the Bohr theory of the atom. [4marks]
- c) Arrange the following atoms in order of increasing ionization energy: K, Br and Cs [1 marks]
- d) Draw the chemical structures of the following compounds [4marks]
- (i) Pent - 2- yne
(ii) 2-methylcyclobutanol
(iii) But- 2- ene
(iv) 2-bromo-3-chloro-4,4-dimethylpentane
- e) Give the IUPAC names of the following compounds. [4marks]

(i)



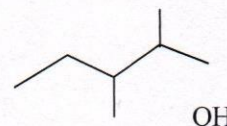
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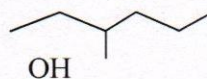
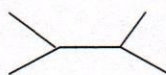
(iii)



(iv)



- f) Write the electronic configuration for the elements with the atomic numbers; 5, 8, 19, 29, 54. [4 marks]
- g) Calculate the magnitude of energy (in erg) of a photon associated with light of wavelength 6057.8 Å [2 marks]
- h) Which of the following molecules has the highest boiling point? Explain [2marks]



- i) The analgesic, aspirin has the following elemental percent composition: 60.0% carbon, 4.48% hydrogen and 35.53% oxygen.
(i) Find the empirical formula of aspirin [2marks]
(ii) If the molar mass of aspirin is 180g/mol; calculate its molecular formula. [2marks]

Question 2 (20 marks)

- (a) Determine the oxidation number of manganese in the following substances. [3marks]

- (i) MnO_4^{2-}
- (ii) MnO_2
- (iii) MnCl_2

(b) The table below gives the Pauling electronegativity values of some elements

Element	Rb	As	F	Cl	Br
electronegativity	0.8	2.0	4.0	3.0	2.8

- (i) Define the term electronegativity [1mark]
- (ii) Use the electronegativity values in the table above to predict the type of bonds (i.e. ionic, polar covalent or non-polar covalent) in the following molecules. Explain. [5marks]
- (I) RbF (II) AsBr_3 (III) Cl_2
- c) Give the Lewis structures for the following molecules (3 marks)
 - i. SO_4^{2-}
 - ii. Nitrogen molecule
 - iii. Ammonia
- (d) Diagrammatically distinguish between a sigma (σ) and a pi (π) bond. (4 marks)
- (e) State the four quantum numbers and what each specifies. (4 marks)

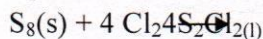
Question 3 (20marks)

- (a) Differentiate between the following [6marks]
 - (i) Oxidising and reducing agents
 - (ii) Alpha and Beta particles
 - (iii) Solute and solvent
- (b) What information must be known to determine
 - (i) The empirical formula of a substance [1mark]
 - (ii) The molecular formula of a substance [1mark]
- (c) An unknown compound contains only the three elements C, H and O. A pure sample of the compound is analysed and found to be 24.96% O and 9.44% H by mass. The compound has a molar mass of 376.432 g/mol
 - (i) Determine the empirical formula of the compound [4marks]
 - (ii) Determine the molecular formula [2marks]
- (d) Balance the equation for the reaction given below taking place in acidic solution. [4marks]

$$\text{Fe}^{2+} + \text{BrO}_3^- \longrightarrow \text{Fe}^{3+} + \text{Br}^-$$
- (e) What are the possible values for the spin quantum number? (2 marks)

Question 4 (20marks)

- (a) (i) Disulphur dichloride is prepared by direct reaction of the elements given in the equation below:



What is the maximum amount of S_2Cl_2 that could be made by the reaction of 64.0 of sulphur with 142g of chlorine? What quantity of which reagent would remain unreacted? [5marks]

- (ii) Describe four factors that may cause percent yields to be less than 100%. [2marks]

- (b) Give the formula of the following compounds [2marks]

- Aluminium sulphate
- Copper (I) oxide
- Copper exists as two isotopes: ${}_{63}Cu(62.9298amu)$ and ${}_{65}Cu(64.9478amu)$. What are the percent abundances of the isotopes? [3marks]

- c) Arrange the following molecules according to increasing:

(i) Ionization energy [1mark]

${}_{18}Ar$, ${}_{19}K$, ${}_{8}O$, ${}_{16}S$

(ii) Atomic radius [1mark]

${}_{12}Mg$, ${}_{5}Be$, ${}_{15}P$, ${}_{10}Ne$

- (d) When an electric discharge is passed through hydrogen gas, four discrete lines are obtained in the Balmer series which include those at 656.3nm(red), 486.3nm(green), and 434.0nm(blue). Account for the presence of the green line in the hydrogen spectrum [3marks]

Question 5 (20marks)

- a) Define the following terms; (5 marks)

- Ionization energy
- Electron affinity
- Pauli's exclusive principle
- Aufbau principle
- Hund's rule

- b) Give four postulates of Dalton atomic theory. (4 Marks)

- c) List the five spectral series in the atomic spectrum of hydrogen and the regions they occur (2 ½ Marks)

- d) State two characteristics of a waves (2 marks)

- e) Calculate the wavelength in the Balmer Series where $n=4$ ($R= 109,676 \text{ cm}^{-1}$) (2 marks)

- f) What is the wavelength of a photon (in nanometers) emitted during a transition from the $n_i = 5$ state to the $n_f = 2$ state in the hydrogen atom? ($R = 2.18 \times 10^{-18} \text{ J}$, $h = 6.626 \times 10^{-34} \text{ Js}$, $c = 2.998 \times 10^8 \text{ m/s}$) (2 marks)

- g) Give three failures of the Rutherford model of the atom. (1½ marks)