MURANG'A UNIVERSITY COLLEGE

(A constituent College of Jomo Kenyatta University of Agriculture & Technology)

University Examinations 2015/2016

FIRST YEAR FIRST SEMESTER FIRST SEMESTER EXAMINATION FOR THE DIPLOMA IN ELECTRICAL ENGINEERING/DIPLOMA IN CIVIL ENGINEERING

SEC 1109: INTRODUCTION TO CHEMISTRY

DATE: 14TH DECEMBER 2015 TIME: 2 HOURS

INSTRUCTIONS: Answer question **ONE** and **TWO** of the other three questions. Question One carries 30 marks and the rest carry 20 marks

Use the data provided: T=298K, R=8.31JK^{-1}, h=6.626×10^{-34} Js, c=3.0×10^{8} ms^{-1}

Question ONE

a) For each of the following determine the number of protons, electrons and neutrons (6 mks)

i) $^{30}_{65}zn$ (ii) $^{35}_{79}Br$ (iii) $^{27}_{59}Co$

b) State the differences between the following terms:

(i) Electronegativity and electron affinity (2 mks)

(ii) Electrovalent bond and covalent bond (2 mks)

c) Write the electronic configuration for the element with the following atomic numbers using s,p,d,f, etc orbitals (6 mks)

(i) 13 (ii)20 (iii)30

d) Using water as an example, explain the phenomenon of hydrogen bonding (4 mks)

e) Calculate the volume in mL of a 2.840M NaOH solution required to titrate the following solutions (10 mks)

(i) 25 Ml of a 4.86 M HCl

(ii) 25 mL of a 2.25M H_2SO_4

(iii) 25 ml of 3.0 M H_3PO_4

QUESTION TWO

a) Write a balanced half-reaction equation and overall balanced equation for the reaction between manganate(VII), MnO_4^-, and iodide in acidic solution (6 mks)

$MnO_4^-(s) + I^-(aq) \rightarrow MnO_2(s) + I_2(s)$

b) The dry cell used in battery-operated devices uses the following redox reaction to generate electricity

$Cd(s) + NiO_2(s) + H_2O(l) \rightarrow Cd(OH)_2(s) + Ni(OH)_2(s)$

(i) Identify the substances which are oxidized and reduced

(ii) Indicate substances which are oxidizing and the reducing agents (4 mks)

C) What is the oxidation number of chromium in each of the following (6mks)

(i) CrO_3 (ii)Cr_2O_3

(iii) $(NH_4)\ CrO_4$ (iv) Na_2CrO_4

c) Explain the following:

(i) Atomic radius increase down a group in the periodic table (2 mks)

(ii) There is a large decrease in electron affinity between Li and Be (2 mks)

QUESTION THREE

a) Calculate the smallest increment of energy (a quantum) that can be emitted or absorbed at a wavelength of 438nm (3 mks)

b) Calculate the energy of a photon of frequency $6.75 \times 10^{12}\ s^{-1}$ (3 mks)

c) What wavelength of radiation has photons of energy 2.87×10^{-18} J? In what portion of the electromagnetic spectrum would this radiation be formed (4 mks)

d) Complete and balance the following nuclear equations by supplying the missing particle (2 mks)

(i) $^{32}_{16}S + {}^{1}_{0}n \rightarrow {}^{1}_{1}p + ?$

(ii) $^{7}_{4}Be + {}^{0}_{-1}(orbital\ electron) \rightarrow ?$

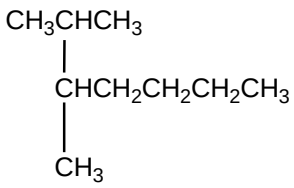
e) It takes 5.2 minutes for a 1.00-g sample of 210_{Fr} to decay to 0.250 g. What is the half-life of 210_{Fr} (4 mks)

f) The half-life of tritium (hydrogen-3) is 12.3 yr. If 48.0 mg of tritium is released from a nuclear power plant during the course of an accident, what mass of this nuclide will remain after 49.2 yr (4 mks)

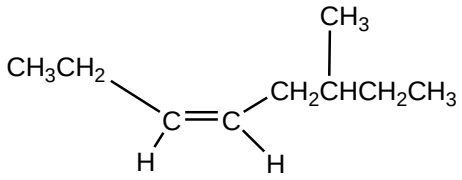
Question FOUR

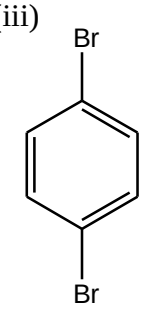
a) Name the following compounds (5 mks)

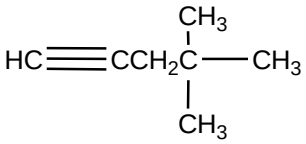
(i)

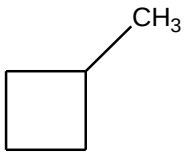


(ii)



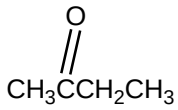
(iii) 

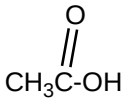
(iv) 

(v) 

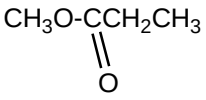
b) Identify the functional groups in each of the following compounds

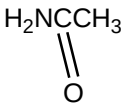
(5 mks)

(i) 

(ii) 

(iii) $HOCH_2CH_2CH_3$

(iv) 

(v) 

c) For the following processes, calculate the change in internal energy (ΔE) of the system and determine whether the process is endothermic or exothermic

(i) A balloon is heated by adding 900J of heat. It expands doing 422 J of work on the atmosphere

(ii) A 50 mg sample of water is cooled from $30^{O}C$ to $15^{o}C$, thereby losing approximately 3140J of heat

(iii) A chemical reaction releases 8.65kJ of heat and does no work on the surroundings

(6 mks)

d) From the enthalpies of reaction

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ $\Delta H = -483.6KJ$

$3O_2 \rightarrow 2O_3(g)$ $\Delta H = +284.6\ KJ$

Calculate the heat of the reaction

$3H_2 + O_3 \rightarrow 3H_2O(g)$ (4 mks)