INTRODUCTION TO CHEMISTRY FOR DIPLOMA IN ELECTRICAL AND CIVIL ENGINEERING

SUPPLEMENTARY/ SPECIAL EXAMINATION 2015/2016 ACADEMIC YEAR

Attempt All Questions Total marks: 100.

DATE:7-8-2015 **SECTION A**

Answer ALL the questions [40 marks]

1. (a) Define the following terms (12 marks)

(i) Reversible reaction
(ii) metalloid
(iii) Molarity
(iv) anion
(v) Atomic mass
(vi) Empirical formula

(b) Write the electronic configuration for the following using the *spdf* notation [Mg = 12; Cl = 17] (4marks)

(i) Mg^{+} (sodium cation)
(ii) Cl^{-} (chloride anion)

(c) Electromagnetic radiation is one of the evidence for atomic structure. Name any electromagnetic radiation and its use or application (2marks)

(d) Write the formula of the following compounds (2 marks)

(i) Sulphur trioxide
(ii) lead (IV) oxide

(d) Write an equation for the combustion of biogas (ethane) C_2H_6 under two different conditions (4marks)

(i) In the open air
(ii) under limited oxygen

(e) Name any two transition metals and state one economic use for each (3marks)

(f) Draw the shapes of the following orbitals

(i) 3*s* orbital (1mark)

(ii) 4 *P* orbitals (2marks)

(g) Painting can be used to prevent rusting. Explain the principle involved. (3marks)

(h) State an alternative method of preventing rusting (1 mark)

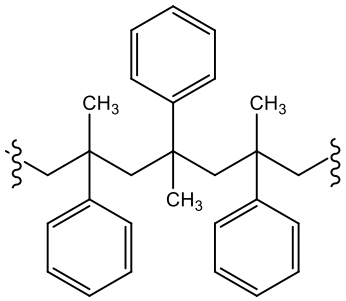
(i) Sisal (cellulose) and nylon 666 polymers, compare and contrast the two (4 marks)

(k) State two applications of radioactivity (2marks)

SECTION B

Answer any THREE questions [60 marks]

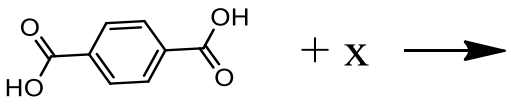
2. (a) Alkenes are known to polymerize . Given the structure of the polymer (below), draw the structure of the structure of the monomer (3 marks)

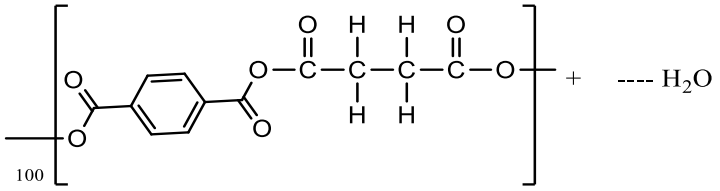


(b) Some polymers are known to form by condensation

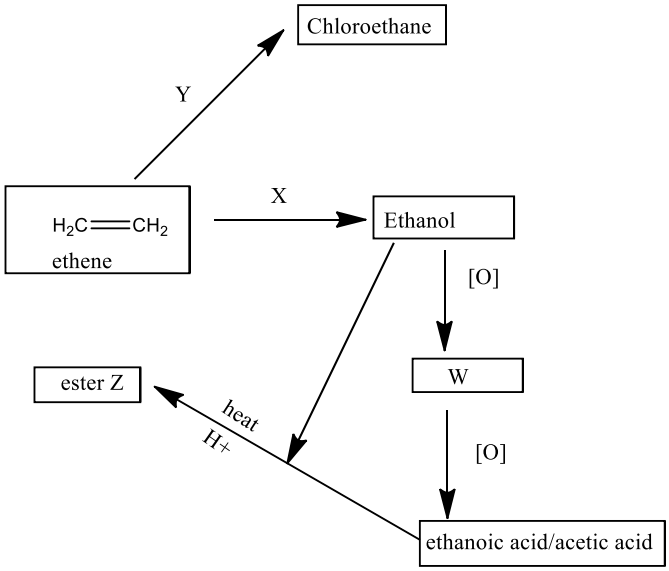
(i) Define the term condensation polymerization (1 mark)

(ii) Complete the condensation equation below if the stoichiometry ratio is 1:1 (3 marks)





(c) The scheme below represents functional group interconvertions amongst organic compounds, answer the questions that follow.

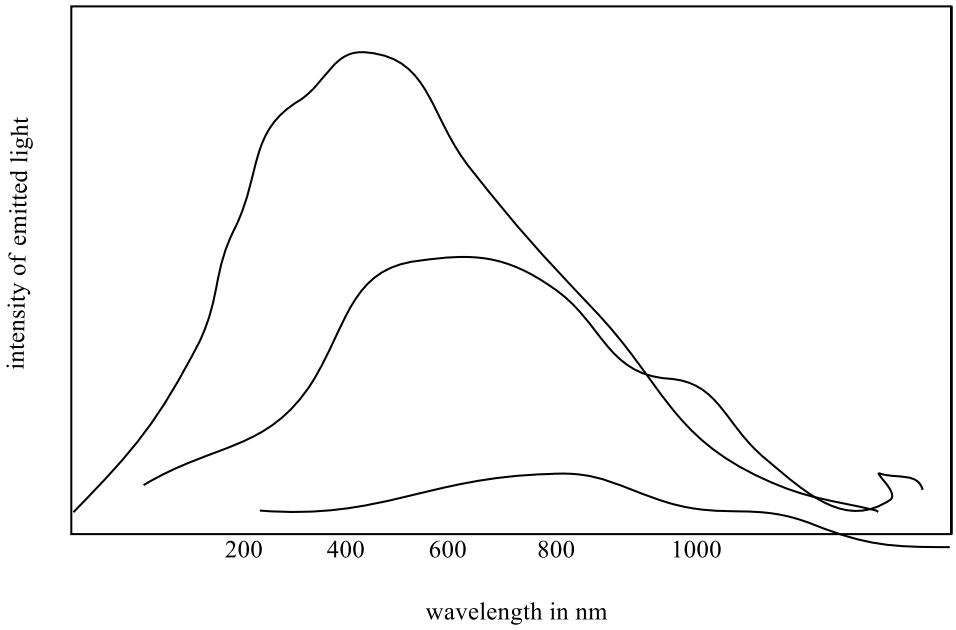


(i) Name the reagents **X** , **Y** and **W** (4 marks)

(ii) Draw the structures of **Z** (2 marks)

(d) Apart from making alcoholic beverages, state any other commercial use of ethanol (1 mark)

(e) Below is a plot representing electromagnetic radiations (EMR) given off by a heated object?



(i) Given that the visible EMR starts from 400 to 700 nm. State the colors of the radiations at each of the three temperatures. (3 marks)

(ii) At which temperature is there the highest frequency? Explain. (3 marks)

3. (a) A sample of eucalyptus fossil wood was found to have an activity of 7.04 dpm (disintegrations per minute) per gram of carbon-14. If the original carbon -14 activity (A_0) of wood from a live eucalyptus tree was found to be 12.4 dpm. Calculate the age of the eucalyptus fossil. If the half life of carbon is 5730 years [$k = 0.693/t_{1/2}$ $\ln (A/A_0) = -Kt$] (4 marks)

(b) Complete the equation below (1 mark)

$$^{40}_{19}K \longrightarrow {}^{0}_{-1}B + \text{------}$$

(c) (e) The most prominent line of emission of chromium is found at 425.4nm other lines are found at 357.9nm, 359.3nm, 360.5nm, 427.5nm 429.0nm and 520.8nm.

(i) Which of these lines represent the most energetic light, explain (2 marks)

(ii) What colour is the light of wavelength 425.4nm (1 mark)

(d) A standard solution is prepared by dissolving 10g of sodium hydroxide and made upto one litre solution. The solution is then titrated against phosphoric acid of unknown concentration. If 25.5ml of sodium hydroxide and 12.0ml of phosphoric acid were used for complete neutralization (Na =23; O = 16; H = 1; P = 32)

(i) Define the term standard solution (1 mark)

(ii) Calculate the concentration of the standard solution (2 marks)

(iii) Write a balanced equation for the reaction (1 mark)

(iv) Calculate the moles of base and the moles of acid used in the reaction (2 marks)

(v) Calculate the concentration of the acid (1 mark)

(e) Below is the data on isotopes of X. Calculate the elements atomic mass of the first isotope (3 marks)

Isotope	*relative abundance*
$^{23}{}_{11}X$	-----
$^{24}{}_{11}X$	11%

(f) Explain the rationale or reasoning behind the periodic Table's structure (2 marks)

4. Uranium 235 radioactive decay series beginning with $^{235}U_{92}$ and ending up with $^{207}Pb_{82}$ occurs in the following sequence: α, β, α, β, α, α, α, α, β β, α. Write an equation for each step in the series. (20 marks)

5. (a) Study the redox reaction represented by the equation below then answer the questions that follow.

$Fe\ (s) + CuSO_4\ (aq) \rightarrow Fe_2(SO_4)_3\ (aq) + Cu\ (s)$

(i) Write the ionic equation for the reaction (2 marks)

(ii) Identify the reducing agent (1mark)

(iii) Identify the reduced species (1 mark)

(iv) Write the half equation for the reduction process (1 mark)

(v) Write the half equation for the oxidation process (1 mark)

(b) Hippuric acid has a molar mass of 179.17/mol and it contains 60.33% carbon; 5.06 % hydrogen; 7.82% nitrogen and the remainder is oxygen. (C= 12.001; H = 1.002; N = 14; O = 15.99)

(i) Determine its empirical formula (5 marks)

(ii) Determine its molecular formula (2 marks)

(c) Hydrated nickel (II)chloride when heated strongly is dehydrated . If 0.235g of $NiCl_2XH_2O$gives 0.128g of the dehydrated salt what is the value of X (Ni = 58.7; Cl = 35.5; H = 1.002 and O = 15.99)

[5 marks]

(d) Write the formula and name of one basic polyatomic ion (2 marks)