



## MERU UNIVERSITY COLLEGE OF SCIENCE & TECHNOLOGY

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### University Examinations 2011/2012

FIRST YEAR, SECOND SEMESTER EXAMINATIONS FOR CERTIFICATE IN  
AGRICULTURE/DIPLOMA IN AGRICULTURAL EDUCATION AND EXTENSION

### CHE 0100: CHEMISTRY

DATE: AUGUST 2011

TIME: 1½ HOURS

INSTRUCTIONS: Answer question *one* and any other *two* questions

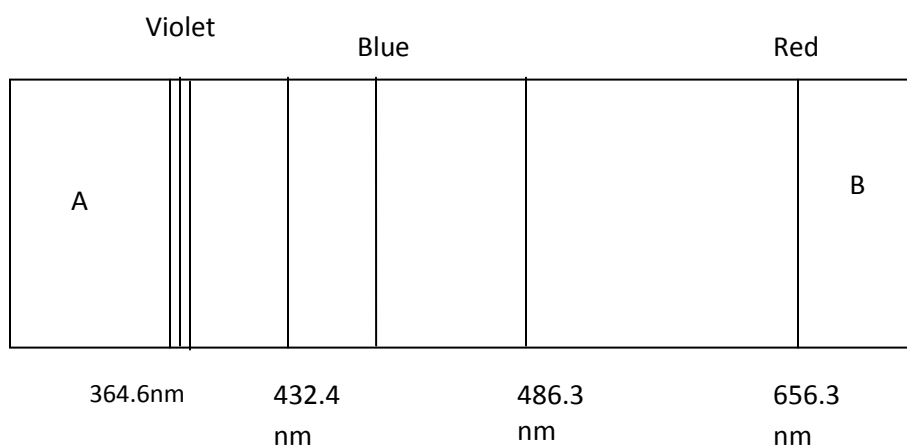
#### QUESTION ONE – (30 MARKS)

- (a) What are the four quantum numbers used to describe an electron in an orbital? (4 Marks)
- (b) Give the electronic configuration of the following atoms whose atomic numbers Z are given below
- (i) Z = 13 (2 Marks)
  - (ii) Z = 24 (2 Marks)
  - (iii) Z = 17 (2 Marks)
- (c) One of the isotopes of Boron may be represented as  ${}^{11}_5\text{B}$ .
- (i) How many protons are in this isotope? (2 Marks)
  - (ii) How many neutrons are present in the same isotope? (Show how you arrive at your answers). (2 Marks)
- (d) How many atoms are present in 22.4g of iron? (Fe = 55.847,  $N_A = 6.02 \times 10^{23}$ ) (4 Marks)
- (e) Draw the orbital diagram for an element whose atomic number is 7. (2 Marks)
- (f) The compound, Methylbenzoate is used in the manufacture of perfumes. Experimental analysis shows that the compound consists of 70.58% carbon; 5.93% hydrogen; 23.49% Oxygen by mass. Given that the molecular weight of the compound is 136,
- (i) What is the empirical formula of the compound. (3 Marks)
  - (ii) What is the molecular formula of the compound? (3 Marks)
- (NB: C = 12, O = 16, H = 1)

- (g) Explain why the atomic radius of atoms decrease across any given period. (2 Marks)
- (h) Draw the molecular structure of the following compounds
- (i) 2-Methylpentane. (1 Mark)
- (ii) Butan-3-ol (1 Mark)

**QUESTION TWO – (15 MARKS)**

- (a) (i) Briefly discuss J.J. Thomson’s proposed model of the atom. (4 Marks)
- (ii) How does J.J. Thomson’s model differ from Rutherford’s model of the atom? (4 Marks)
- (b) The diagram below represents the line spectra for hydrogen atom



- (i) Identify the type of radiation found at positions A and B respectively. (2 Marks)
- (ii) The wavelength of all lines in the visible part of the line spectrum is given by:  

$$\frac{1}{\lambda} = R_H \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$
, Where  $R_H = 10967758m^{-1}$   
 Calculate the wavelength when  $n_2 = 3$  (3 Marks)
- (iii) Which part of the spectrum does this radiation correspond to? Give reasons for your answer. (3 Marks)

**QUESTION THREE – (15 MARKS)**

- (a) The group VII A elements may generally be represented with symbol X
- (i) Write the electronic configuration of the element Chlorine Z = 17, which is a group VIIA element. (2 Marks)
- (ii) Explain briefly why group VIIA elements have high ionization energies. (3 Marks)
- (iii) Using the symbol X, write an equation to show how elements in this group form ions. (2 Marks)

(iv) In terms of the physical state, the melting point and the metallic character, briefly discuss the variations down the group in these properties among the elements of group VIIA. (4 Marks)

(b) Explain the anomalous properties of Fluorine. (4 Marks)

#### QUESTION FOUR – (15 MARKS)

(a) State Hund's rule (2 Marks)

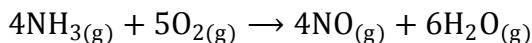
(b) Use the noble gas core notation to write the electronic configuration of

(i) F(9)

(ii) Si(14)

(iii) Sc(21) (3 Marks)

(c) Ammonia reacts with oxygen as shown



(i) How many moles of  $\text{O}_2$  are needed to produce 2.68 moles of  $\text{NO}_2$ ? (2 Marks)

(ii) How many moles of  $\text{NH}_3$  will react with 3.22 moles of oxygen. (2 Marks)

(iii) How many moles of  $\text{NO}$  will be produced together with 0.753 moles of  $\text{H}_2\text{O}$  (2 Marks)

(d) Nitrogen dioxide gas dissociates as shown in the equation below at equilibrium



What is the effect of

(i) Removing  $\text{O}_2(\text{g})$  from the system? (2 Marks)

(ii) Increasing the pressure in the system? (2 Marks)

#### QUESTION FIVE – (15 MARKS)

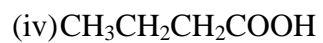
(a) Differentiate between saturated and unsaturated aliphatic hydrocarbons. Give relevant examples of each type. (4 Marks)

(b) Give IUPAC (Systematic) names of the following compounds (8 Marks)

(i)  $\text{CH}_3\text{CHCHCH}_3$

(ii) 
$$\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3\text{CHCH}_3 \end{array}$$

(iii) 
$$\begin{array}{c} \text{OH} \\ | \\ \text{CH}_3\text{CH}_2\text{CHCH}_3 \end{array}$$



(c) (i) Draw the orbital diagram to show the  $\text{SP}^2$  hybridization of the carbon atom in the formation of ethene molecule. (1 Mark)

(ii) Draw all the structural isomers of the hydrocarbon, butane whose molecular formula is  $\text{C}_4\text{H}_{10}$  (2 Marks)