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@ 2018-2020

PRESIDENT'S OFFICE
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT
ILBORU SECONDARY SCHOOL
FORM SIX PRE-NATIONAL EXAMINATION SERIES –I-
CHEMISTRY -1-

TIME: 3:00HOURS **October 17, 2019**

INSTRUCTIONS:

1. This paper consists of fourteen (14) questions in section A, B, AND C.
2. Answer four (4) questions from section A and three (3) question from each of section B and C.
3. Each question caries ten (10) marks
4. Mathematical tables and non- programmable calculators may be used.
5. Cellular phones are not allowed in the examination room.
6. For your calculations you may be use the followings constants:
   - Gas constants, $R = 8.31\ J\ mol^{-1}\ K^{-1}$ or $R = 0.0821\ atm.\ mol^{-1}\ K^{-1}\ dm^3$
   - Planck constant, $h = 6.63 \times 10^{-34}\ Js$
   - Freezing depression constant of ethanoic acid, $kf = 3.9\ ^0C.mol^{-1}kg$
   - Rydberg's constant, $R_H = 1.097 \times 10^7\ M^{-M}$ or $R_M = 2.18 \times 10^{-18}\ J$
   - Velocity of Light, $C = 3.0 \times 10^8\ m/s$
   - Avogadro's constant, $N = 6.022 \times 10^{23}\ mol^{-1}$
   - Atomic masses: H= 1, C = 12, N = 14, 0 = 16, Na = 23, S = 32, K = 39, 1 = 127

SECTION A (40 Marks)

Answer four (4) questions from this section.

1. (a) State what is meant by the following statement
   (i) When is an atom said to be in the excited state.
   (ii) How an atom may emit photons of radiation. (2 marks)
   (b) Briefly explain the model of atom according to
   I. Dalton model
   II. Rutherford mode (5marks)
   (c) The α – particles emitted from radium have wavelength of 8. 21nm. Calculate the frequency in s^{-1} (3 marks)

2. (a) Distinguish between the following:
   i. Covalent bond and coordinate bond
   ii. Ionic and metallic bond.
   iii. Van der Waal forces and hydrogen bonding. (03 marks)
   (b) Write the summarized three major assumptions of the Valence Shell Electron Pair Repulsion (VSEPR) theory.
   (c) Describe the hybridization and give the name of geometrical structure of the following molecules;
   i. Ammonia (NH_3)
   ii. Sulphur dioxide (SO_2) (4 marks)

3. (a) By using the fundamental gas equation, deduce
   (i) Graham's law
   (ii) Ideal of gas equation (4marks)
   (b) (i) $200cm^3$ of oxygen took 250 seconds to diffuse through a porous diaphragm, under the same conditions the same amount of a gas made up of nitrogen and oxygen took 242 seconds to diffuse. Determine the formula of the oxide of nitrogen.
   (ii) Which oxide of nitrogen will have the same rate of diffusion as carbon dioxide? Why? (4 marks)
   (c) At 0 ^{0}C and 506.5kpa, sample of gas occupies 75.5 liters. The gas is compressed at a final volume of 30.5 liters at 0 ^{0}C. Calculate the final pressure. (4 marks)

4. (a) Outline any four (4) properties of the Negative deviation of Non – Ideal solution. (2 marks)
   (b) Compare and contrast between steam and fraction distillation. (3 marks)
   (c) A 0. 003kg of acetic acid (CH_3COOH) is added to $500cm^3$ of water if 23 % of acid is a dissociated. Calculate the depression in freezing point. (K_f for water = 1. 86 ^{0}Ckg / mol, density of water = 0.997 g/cm^3) (5marks)

5. (a) State the Van't Hoff law of solution. (2 marks)
   (b) How much glucose ($C_6H_{12}O_6$) per liter should be used for an intravenous solution to much the osmotic pressure of blood of 7.65 atm at 37^{0}C? (3 marks)
   (c) The immiscible liquid system aniline – water boils at 98^{0}C under a pressure of 760mmHg. At this temperature the vapour pressure of water is 707mmHg. If this system is Distilled in steam, what fraction of the total weight of the distilled will be aniline, ($C_6H_5NH_2$) (5 marks)

6. (a) Define the following terms:

(i) Cryoscopic constant.

(ii) Molal solution. (02 marks)

(b) A chemist weighs 8.35×10^{-3}g of a compound, and mixes it with 0.153g of camphor and the mixture is put into a melting temperature tube which read 165.9°C. If the melting temperature and cryoscopic constant of camphor are 179.5°C and 40°C kgmol^{-1} respectively, what is the molar mass of the compound? (03 marks)

(c) A 2g solution of polyethene in 1.00dm^3 of water has an osmotic pressure of 300Nm^{-2} at 20°C. Calculate:

(i) Molar mass of the polymer. (03 marks)

(ii) Explain why this method of determining molar mass is ideal for polymers. (02 marks)

SECTION B (30 marks)

Answer **three (3)** questions from this section.

7. (a) For the equilibrium; $2NO_{(g)} + O_{2(g)} \rightleftharpoons NO_{2(g)}$ $\Delta H^{\ominus} = 115kJ$ established in a closed vessel at a fixed Temperature, the equilibrium constant for the reaction is 15Litre. mol^{-1}

i. Write the expression for, the equilibrium constant, K.

ii. What will be the effect of the value of the equilibrium constant, K if the Temperature is increased? Give reason for your answer.

iii. Calculate the equilibrium concentration of $NO_{2(g)}$ when the equilibrium concentration of $NO_{(g)}$ and $O_{2(g)}$ are both 0.10 Litre.Mol^{-1} (5 marks)

(b) Consider the following reversible equilibrium; $2C_2H_{6(g)} + 7O_{2(g)} \longrightarrow 4CO_{2(g)} + 6H_2O_{(l)}$

i. Derive the relationship between K_c and K_p

ii. At 500°C, the combustion reaction (c) above has $K_c = 8.0 \times 10^{-2}$ mol / dm^3. Calculate the K_p at this temperature. (5 marks)

8. (a) State:

i. Raoult's law liquid mixture.

ii. Any four (4) conditions necessary for solvent extraction (3 marks)

(b) Give reason, why solution becomes ideal solution when it is made more dilute. (2 marks)

(c) Calculate the mass of an organic compound "T" that can be extracted from100cm^3 of an aqueous solution containing 5.0g of "T" by shaking with;

i. 100cm^3 of ethoxyethane in one portion.

ii. Two successive 50cm^3 portions of ethoxyethane.

iii. Comment briefly on the results obtained in (i) and (ii) above (Given that partition coefficient, K_d of "T" between ethoxyethane and water is 3. 0) (4 marks)

9. (a) Differentiate between:.

i. Lattice energy and energy of reaction.

ii. Standard molar enthalpy change of dissociation and heat of combustion. (4 marks)

(b) The standard heat of combustion of hydrogen is 286 kJ/mol; carbon is 394kJ/mol; methane is 890kJ/mol; ethane is 1390kJ/mol; heat of formation of ethane is 52.3kJ / mol and heat of formation of ethanol is -276kJ/mol Calculate;

i. Enthalpy change of formation of methane.
ii. Enthalpy change of formation of ethane.
iii. Enthalpy change for the reaction; $CH_2 = CH_{2(g)} + H_2O_{(g)} \longrightarrow CH_3CH_2OH$.
iv. Enthalpy change of combustion of 4.48litres of ethane. (6 marks)

10. Account for the following observations and give chemical reaction whenever necessary

a) Magnesium carbonate decomposes readily when heated while sodium carbonate has no action to heat.

b) Hydrogen gas is evolved when magnesium metal is placed in a beaker containing ammonium chloride.

c) Water is covalent compound but has high boiling point.

d) Hydrogen gas can be used to reduce copper oxide but not zinc oxide.

e) Calcium phosphate is soluble in dilute HCl but calcium sulphate is insoluble in dilute HCl.

(10 marks)

SECTION C (30 Marks)
Answer three (3) questions from this section.

11. (a) How will you convert benzene to,
i. p-nitrobromobenzene
ii. m-nitrochlorobenzene
iii. p-nitrotoluene (6 marks)

(b) Arrange the following set of compounds in order of their decreasing relative reactivity with an electrophile, E^+
i. chlorobenzene,2,4-dinitrochlorobenzene, p-nitrochlorobenzene
ii. toluene, $p\text{-}H_3C - C_6H_4 - CH_3$, $p\text{-}CH_3 - C_6H_4 - NO_2$, $p - O_2N - C_6H_4 - NO_2$
(4 marks)

12. (a) Write the structural formulae of the following :
i. 8 –ethyl -2,5,5- methyl decane.
ii. 2,5 – diethyl phenyl methanol.
iii. 4-hydroxyphenol.
iv. Butane 1,2,3 – triol. (4 marks)

(b) Complete the following reaction:
i. Isopropyl bromide $\xrightarrow[heat]{alc\ KOH}$ A $\xrightarrow[peroxide]{HBr}$ B
ii. n-Propyl alcohol $\xrightarrow[443K]{Conc.H_2SO_4}$ A $\xrightarrow[heat]{O_2Ag}$ B
iii. 1,1,2,2-tetrachloroethane $\xrightarrow[heat]{Zn,alcohol}$ A $\xrightarrow[675K]{iron\ tube}$ B (6 marks)

13. (a) Write the structural formula of five isomers of the compound $C_5H_{11}Cl$ and their corresponding IUPAC names. (5 marks)

(b) Suggest suitable chemical tests to distinguish between the following:

i. Hexane and 2 – hexane.
ii. Propyne and propane.
iii. Benzene and phenol. (3 marks)

(c) Given the following compounds: Ethanol; 2 – methyl phenol; and 2 nitro phenol. Arrange the given compounds in order of;

i. Increasing acidity.
ii. Increasing basic strength (2 marks)

14. (a) Substance X is represented by a molecular formula $C_5H_{12}O$. X undergoes oxidation with acidified potassium permanganate to give compound Y which forms a crystalline derivative with 2,4 dinitrophenyl hydrazine, but does not with a mixture of iodine and sodium hydroxide.

i. Write down the structural formulae of compounds X and Y.
ii. Show by means of an equation, how Y reacts with 2,4 dinitrophenyl hydrazine. (4 marks)

(b) What is ozonolysis? (1 mark)

(c) write a condition under which the following reaction proceeds;

i. $CH_2=CH_2 \rightarrow CH_3-CH_3$
ii. $CH_3COH \rightarrow CH_3CH_2COOH$
iii. $C_6H_6 + CH_3Cl \rightarrow C_6H_5\text{-}CH_3$
iv. $CH_3COH \rightarrow CH_3CH_2OH$
v. $CH_3CH_2CH_2Br \rightarrow CH_3CH=CH_2$ (5 marks)