H-4/11/22

Roll No. .....

IV Semester Examination, 2022

M.Sc.

CHEMISTRY

Paper III

(Physical-Organic and Nuclear Chemistry)

Time : 3 Hours] [Max. Marks : 80

Note : *All questions are compulsory. Question Paper comprises of 3 sections. Section* ***A*** *is objective type/multiple choice questions with no internal choice. Section* ***B*** *is short answer type with internal choice. Section* ***C*** *is long answer type with internal choice.*

SECTION A **1×8=8**

(Objective Type/Multiple Choice Questions)

Note : Attempt all the *eight* question.

Choose the correct answer :

1. When C — H bond is broken in the rate limiting step with a synchronous transition state, the value of k_H/k_D is close to :

(a) 2 (b) 4

(c) 7 (d) 14

P.T.O.

2. Hammett equation is applicable directly to :

(a) *o*- & *p*-substituted benzene derivatives

(b) *m*- & *p*-substituted benzoic acid

(c) *o*- & *m*-substituted benezoic acid

(d) *o*, *p*, *m* substituted benzene derivatives

3. The relationship between the apparent rate constant and equilibrium constant is known as :

(a) Hammond equation

(b) Bronsted equation

(c) Curtin-Hammett equation

(d) Winstein-Holness equation

4. Which of the following has the highest nucleophilicity ?

(a) F^- (b) OH^-

(c) CH_3^- (d) NH_2^-

5. Which of the following acts as ionising gas in GM counter ?

(a) Alcohol (b) Argon

(c) Krypton (d) Hydrogen

6. According to the shell model, the nuclear properties vary periodically when the number of protons or neutrons in the nuclear equals 2, 8, 20, –, –, – .

(a) 38, 56, 90 (b) 42, 80, 120

(c) 40, 92, 100 (d) 50, 82, 126

7. The *Q*-value for the ^{7}Li (*p*, *n*), ^{7}Be reaction is (^{7}Li = 7.01822 & ^{7}Be = 7.019465)

(a) 1.64 eV (b) – 1.64 MeV

(c) 1.64 MeV (d) – 16.4 eV

8. Water used as moderator in nuclear reactor is called :

(a) hard water (b) nucleated water

(c) heavy water (d) critical water

SECTION B **6×4=24**

(Short Answer Type Questions)

Note : Attempt any *four* questions, Selecting *one* question from each unit.

Unit-I

1. What is meant by Tunneling effect ? Explain giving suitable example.

Or

Discuss solvent effect in terms of dielectric constant and E_T & Z parameters.

Unit-II

2. Explain Curtin-Hammett principle and its applications.

Or

Define Acidity function. Dicuss Hammett acidity function and its application.

Unit-III

3. What are the various types of counters and their corresponding principles ?

Or

Discuss the various modes of radioactive decay giving suitable examples.

Unit-IV

4. Discuss Szilard chalmer reaction.

Or

Consider the fission of $^{236}_{92}U$ represented by overall reaction

$$^{236}_{92}U \rightarrow {}^{94}_{40}Zr + {}^{140}_{58}Ce + 6\,{}_{-1}e^{0} + 2\,{}^{1}_{0}n$$

Calculate the total energy released in the fission reaction. The masses in 'amu' are

$^{236}U = 236.0457$

$^{94}Zr = 93.90610$; $_{-1}e^{0} = 0.00055$

$^{140}Ce = 139.9054$; $_{0}n^{1} = 1.00867$

SECTION C **12×4=48**

(Long Answer Type Questions)

Note : Attempt any *four* questions, Selecting *one* question from each unit.

Unit-I

1. Explain the theory of isotope effect and in detail describe primary kinetic isotope effect. Discuss secondary isotope effect briefly.

Or

What is meant by LFER ? Derive Hammett equation and discuss deviation from Hammett equation.

Unit-II

2. What is α-effect ? Describe general and specific acid catalysis.

Or

Discuss various types of steric strain and its effect on reactivity and rate of reaction.

Unit-III

3. What is the analogy of a nucleus with a liquid drop ? Describe the merits of liquid drop model and semi-empirical mass equation & its significance.

Or

Describe radioactive decay kinetics. Discuss secular and transient equilibrium and its features.

Unit-IV

4. What are the various types of nuclear reactions ? Define reaction cross section and discuss its relation rate and neutron energy.

Or

Define delayed & prompt neutrons. Discuss liquid drop model of nuclear fission and controlled chain reaction using reactor.

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