

Total No. of Questions :6]

SEAT No. :

P2613

[5023]-32

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 311: Nuclear and Radiation Chemistry

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic table / calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1. Avogadro Number	N	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	=	$1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

Q1) Attempt any three of the following: **[15]**

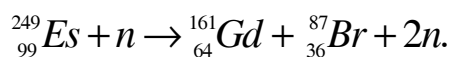
- a) Discuss various types of fission.
- b) Give classification of Nuclear reactors.
- c) Write the salient features of collective model.
- d) Discuss the role of moderator and coolant in nuclear reactors.
- e) How Rutherford's back scattering technique is used for surface analysis?

Q2) Attempt any three of the following: **[15]**

- a) Discuss compound Nucleus theory.
- b) Write a note on Vande Graff generator.
- c) Discuss the working of ceric sulphate dosimetry
- d) Distinguish between somatic and genetic effect of radiation.
- e) Write a note on personal dosimetry.

Q3) Solve any two of the following: **[10]**

- a) ${}^7\text{Li}$ target is bombarded by protons of energy 5MeV. Calculate
 - i) the energy of protons scattered through an angle of 90° and
 - ii) the energy of protons observed at 90° after they have excited the lithium to a level of 0.48 MeV.
- b) Compute the energy released in the following fission.



given the following atomic masses.

$${}^{249}\text{Es} = 249.0762 \text{ amu} \quad {}^{161}\text{Gd} = 160.928 \text{ amu}$$

$${}^{87}\text{Br} = 86.922 \text{ amu} \quad n = 1.0087 \text{ amu}$$

- c) Find out the dose due to $800 \mu\text{Ci}$ ${}^{60}\text{Co}$ source at a distance of 5 meters.
Given $E_\gamma = 1170$ and 1330 keV .

SECTION -II

Q4) Attempt any three of the following: **[15]**

- a) Explain the term quenching, scavenger, G-value and spur.
- b) Discuss the mechanism of air saturated ferrous sulphate solution. Enlist the factors affecting $G(\text{Fe}^{3+})$ in it.
- c) Explain the working of Li drifted germanium detector.
- d) Describe the mechanism of radiation annealing.
- e) What are various radiolytical products of water? Discuss the free radical theory briefly.

Q5) Attempt any three of the following: **[15]**

- a) Discuss the Samuel-Magee model of water radiolysis.
- b) Define RBE and rem. Discuss the factors on which relative hazards of a given nuclide depend.
- c) Write a note on critical size of nuclear reactor.
- d) Discuss the ICRP recommendation for maximum permissible dose
- e) Describe estimated short term effects of various single dose whole body radiation exposure in man.

Q6) Solve any two of the following: **[10]**

- a) Find out the recoil energy of an atom with mass no.80 in K cal/mole for a 5 MeV photon.
- b) Find thickness of lead to reduce a dose due to gamma rays from 3.82 rad/min to 0.1 rad/min.
Given $\mu_{\text{pb}} = 0.57 \text{ cm}^{-1}$
- c) Calculate the activity of Na-22 which gives a dose rate of 4 rem/h at a distance of 2 meters. It emits gamma radiations of energy 1.28 MeV.

