[176] SEAT No._____ **No. of Printed Pages : 3**

Sardar Patel University

M. Sc THIRD SEMESTER (**Physical Chemistry**) Examination – 2018

Thursday, 25th October 2018

2.00 p.m. to 5.00 p.m.

PS03CPHC 22, Nuclear and Radiation Chemistry

N. B. (i) Attempt all questions

(ii) Figures to the right indicate full marks

(iii) $u = 1.6605 \times 10^{-27}$ kg, $h = 6.6262 \times 10^{-34}$ J.s, $1eV = 1.6022 \times 10^{-19}$ J

$m^1H = 1.0078$ u, $m^2D = 2.0141$ u, $m^3H = 3.0160$ u

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1. Multiple Choice Questions

(i) Activity of radioactive nuclei is proportional to:

(a) λ (b) N_0 (c) N_t (d) both λ and N_t

(ii) $p + e^- \rightarrow n + \nu$ is an example of

(a) β^- decay (b) EC (c) β^+ decay (d) none

(iii) Which of the products formed by fusion of two ^3He atoms ? :

(a) $^4_2He, p$ b) $^3_2He, 2p$ c) $^3_2He, p$ d) $^4_2He, 2p$

(iv) The super hot particles in an inertial confinement are held by:

(a) mass (b) velocity (c) momentum (d) inertia

(v) Which of the following is not a tracer ? :

(a) ^{13}C (b) ^{17}N (c) ^{15}N (d) ^{18}O

(vi) Which of the following is not true for a tracer ?

(a) Tracer should be chemically equivalent to its stable isotope

(b) Tracer must have enough half life so that its activity can be monitored

(c) Minimum amount of tracer is required

(d) Tracer decays faster than its stable isotope

(vii) Direct radiolysis of water initially yields:

(a) $H_2O^{\cdot}$ (b) $H_2O^{\cdot+} + e^-$ (c) $H^{\cdot} + OH^-$ (d) $OH^{\cdot} + e^-$

(viii) Which radiation particles move in a straight line?

(a) negatron (b) Gamma particles (c) positrons (d) Alpha particles

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2. Attempt **ANY SEVEN**:

(i) Fission is a self sustaining reaction. Why and How ?

(ii) Suppose following reaction: $^{14}N(^{14}N,^{13}N)^{15}N$ is carried out at 125 MeV. Which ion is formed and list the particles obtained by its stripping.

(iii) Give the example of a reaction involving hydrogen isotopes only.

(iv) Give two major differences between chemical and nuclear reactions.

(v) Determine correct structure of nickel cyanide using tracer method.

(vi) How technicium is useful in detecting thyroid ?

(vii) $A_t = N \phi \sigma (1 - e^{-\lambda t})$ – define the terms
(viii) What are Bragg curves ?
(ix) What is gas multiplication factor.

6

3.(a) What are pick up reactions ? How they differ from stripping reactions. Give two examples for each.

3

(b) (i) Enlist various units of radioactivity

3

(ii) What is $t_{½}$? and how it can be calculated ? .

OR

3

(b) (i) Calculate the wave length of a γ-photon of 8 keV energy.

3

(ii) What are pions ? How they induce fission ?

6

4. (a) Discuss reactions of prime interest for controlled fusion.

3

(b) (i) Find the energy of reaction:

$$_1^2D + {}_1^2D \rightarrow {}_1^1H + {}_1^3H$$

3

(ii) What are the threshold conditions for controlled fusion ?

OR

6

(b) Write a note on pinch effect.

6

5. (a) Establish the correct mechanism of Friedel – Crafts reaction using tracer technique.

6

(b) Suppose a ruby sample has 0.0025 g of ^{50}Cr and upon irradiation a specific activity of 20 Cpm mg^{-1} was registered. If a sample with unknown ^{50}Cr gave 3000 Cpm g^{-1}, then calculate the unknown ^{50}Cr.

OR

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(b) Thiosulphate, $[S_2O_3]^{-2}$ has a non-equivalent structure – prove with tracer technique.

6. (a) What are γ – rays ? and discuss three main processes that result from interaction of γ-rays with matter. **6**

(b) (i) Enlist variety of possible reactions between $OH^{\bullet}$, $H^{\bullet}$ and e^{-}_{aq}. **3**

(ii) How scintillation counters differ from simple ionization counters ? **3**

OR

(b) Discuss the features in **i) Gas ionization chamber and ii) The liquid counter.** **6**

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