SEAT No._____ No. of Printed Pages: 3

[52]

Sardar Patel University

M. Sc. (Sem. III) Physical Chemistry Examination, January 2021

PS03CPHC 22, Nuclear and Radiation Chemistry

Saturday, 2nd January 2021

10.00 a.m. 12.00 noon

N. B. Attempt all questions

(Figures to the right indicate marks)

[08]

1. A . Multiple Choice Questions (Tick (√) the right choice)

i) $^{63}Cu(p,p\ 3n\ 9\ \alpha)$ **?** , the missing element is:
a) ^{24}Mg b) ^{24}Na c) ^{23}Na d) ^{25}Mg

ii) The nuclear attractive force is proportional to:
a) $A^{1/3}$ b) Z^2 c) $Z^2 / A^{1/3}$ d) $A^{2/3}$

iii) Implosion under laser action leads to:
a) Spontaneous fusion b) Activated fusion c) Controlled fusion
d) Uncontrolled fusion

iv) For composite nucleus, the velocity is given by:
a) (m+M) V b) mV c) MV d) mv / (m + M)

v) Which of the following nuclide is useful as a whole body tracer ?
a) ^{32}P b) ^{24}Na c) both a and b d) ^{90}Sr

vi) For the reaction to prove that the five P-Cl bonds are different,
$PCl_5 + H_2O \rightarrow POCl_3 + 2\ HCl$, which of them are to be active ?
a) PCl_5 & $POCl_3$ b) H_2O and HCl c) PCl_5 and HCl d) All the four

vii) Which of the following is true for α-particle radiation?
a) The degree of ionization is not constant over its path
b) Ionization is not measured in terms of ion pairs produced per unit path length
c) They cause only ionization d) They move in zig-zag manner or path

viii) $H_2O^{\cdot +} \rightarrow H^+ + ?$, the missing species is:
a) OH^- b)$HO^{\cdot}$ C) $H^{\cdot}$ d) $HO^{-\cdot}$

1. B Objective questions (One mark each or otherwise stated)

i) Identify the missing number:

Reaction	Change in A	Change in Z
(n,α)	?	-2

[04]

ii) Match the following:

I	II
A) ^{9}Be (γ, n) 2 ^{2}He	a) Particle – particle reaction
B) d (d, p) t	b) Photonuclear reaction
C) ^{107}Ag (n, n`) ^{107}Ag	c) Inelastic scattering
D) ^{9}Be (d, ^{3}He) ^{8}Li	d) Pickup reaction

[02]

iii) Define fission parameter

iv) Give the relation for reaction rate, R

v) Define confinement time

[02]

vi) What is the difference between the tracer and dating technique ?

[02]

vii) Define biological half life

viii) Is the following ***true or false*** for titration of a nonradioactive substance with a radioactive substance ? $^{*}AB + BC \rightarrow {}^{*}AB + CD$

ix) Give the missing product in reaction, $NaS^{*}_{2}O_3 + 2\ AgNO_3 + HNO_3 \rightarrow$ **??** + Na_2SO_4 + other products

x) Friedel Crafts reaction follows_____ mechanism

[14]

2. Short answer questions (Any Seven)

i) Give the differences between stripping and pick up reactions

ii) Show the schematics of fission of ^{235}U after a neutron capture

iii) What is the special importance of (d,t) reaction ?

iv) How energy balance is useful in calculating Q value of a nuclear reaction ?

v) Give radiometric titration curve when both the titrant and titrated substance are active

vi) Give two typical characteristic of a tracer element

vii) Using DIDA equation calculate the weight of benzoic acid in a mixture given the activities of a labelled benzoic acid and a saturated one to be 500 and 250 cmp mg^{-1}.

viii) How energy E and range R are related for a beta particle ?

ix) What is the main drawback of ionization chamber ?

[04]

3. a) Discuss the differences between the elastic and inelastic scattering type reactions.

[04]

b) Show alternate fusion reactions involving C, N and O nuclei.

OR

[08]

3. What is a fission barrier? and discuss fission curves.

[04]

4. a) Enlist reactions of primary interest for controlled fusion.

[04]

b) Write a note on fission energy.

OR

[08]

4. Describe and explain the methods used for controlled fusion.

[04]

5. a) Explain effective half-life of a nucleus ?

[04]

b) How radiotracer method helps in determining correct formula of nickel cyanide.

OR

[08]

5. How one can establish the correct reaction mechanism of i) Esterification and ii) Oxidation of CO by air.

[04]

6. a) What is a Bragg curve ? explain the same for alpha particles.

[04]

b) Why absorption curves are important for beta radiation ?

OR

[08]

6. Explain various stages in a signal count per sec vs applied voltage curve and discuss the detailed features of a GM Chamber.