[141] SEAT No._____ No. of printed pages: 02

Sardar Patel University Examination 2019
M.Sc. (Semester-III) Inorganic Chemistry, PS03CINC22
Nuclear Chemistry and Reaction Mechanism
20/11/2019 (Wednesday)
Time: 2:00 pm to 5:00 pm

Note: Numbers at the right show full marks. **Total Marks: 70**

Q.1. Select the correct answer from the following: [8]

1) If $^{235}U_{92}$ decays only by emitting 2α & 1β particles, the possible product is _____.
(a) $^{231}Ac_{89}$ (b) $^{235}Ac_{89}$ (c) $^{236}Ac_{89}$ (d) $^{227}Ac_{89}$

2) When $^{35}Cl_{17}$ undergo (n,p) reaction, the radioisotope formed is _____.
(a) $^{32}P_{15}$ (b) $^{35}S_{16}$ (c) $^{34}S_{16}$ (d) $^{34}P_{15}$

3) The corrosion of brass is inhibited by CS_2 due to formation of _____.
(a) CuS (b) ZnS (c) both a & b (d) none of these

4) The rate of exchange for Co/Co^{+2} is much faster with _____.
(a) Cl^- (b) NO_3^- (c) CH_3COO^- (d) ClO_4^-

5) The chromium(III) species formed after electron transfer between $IrCl_6^{-2}$ & $Cr(H_2O)_6^{+2}$ is___.
(a) $[Cr(H_2O)_6]^{+3}$ (b) $[Cr(H_2O)_5Cl]^{+2}$ (c) $CrCl_6^{-1}$ (d) $Cr(H_2O)_3Cl_3$

6) Electron transfer from $Fe(H_2O)_6^{+2}$ to $Fe(H_2O)_6^{+3}$ is likely to occur via _____.
(a) d-d transition (b) inner sphere electron transfer (c) SN^1 (d) outer sphere electron transfer

7) In the first step of dissociative SN^1 mechanism, an octahedral complex (MX_5Y) may produce an intermediate (MX_5) having _____ structure(s).
(a) trigonal bipyramidal (b) spuare pyramidal (c) both a & b (d) none of above

8) The complex $[Co(en)_2(Cl)_2]$ can have____optically active & ____optically inactive isomer(s).
(a) one, two (b) two, one (c) three, no (d) no, three

Q.2. Answer any seven of the following: [14]

i. Calculate molar nuclear binding energy for ^4He. (Isotopic mass = 4.0017 amu, mass of proton = 1.00727 m_u, mass of electron = 0.000548 m_u, mass of neutron= 1.008665 m_u, Avogadro number = 6.02×10^{23} mol^{-1}, speed of light = 2.998×10^8 ms^{-1})
ii. Explain ^{19}F NMR for SF_4 at various temperatures.
iii. Write the process for the separation of radioactive uranium and plutonium.
iv. Explain the prevention of corrosion in brass by CS_2.
v. Write a short note on tracer studies using Tritium.
vi. Write the optical isomers of $[Co(en)(NO_2)_2(NH_3)_2]$.
vii. Explain two electron transfer reaction with suitable examples.
viii. Explain Complementary & Non-Complementary reactions with suitable examples.
ix. Explain why hydrolysis of trans-$[Co(en)_2ClY]^{+2}$ ion leads to mixtures of products?

[P.T.O.]

Q.3. Answer the following:

[A] Explain in detail how stable isotopes are separated. [6]

[B] Write a note on nuclear stability and N/P ratio with suitable graph. [6]

Or

[B] (i) What is nuclear binding energy. Explain with nuclear energy binding curve. [3]

(ii) Write a short note on ortho- and para-hydrogen. [3]

Q.4. Answer the following:

[A] Explain the isotopic exchange by electron transfer mechanism. [6]

[B] What are the reasons for considerable effect of anion on the rate of exchange between metal and their ions? [6]

Or

[B] (i) Write a short note on radiometric method for analysis. [3]

(ii) Write a short note on electrochemical displacement for exchange reaction. [3]

Q.5. Answer the following.

[A] Describe the dissociative (SN^1) & associative (SN^2) mechanisms with examples. [6]

[B] Discuss the kinetics of anation reaction. [6]

Or

[B] (i) A Pt(II) complex of tetramethyldiethylenetriamine is attacked by Cl^- ions 10^5 times less rapidly than the diethylenetriamine analogue. Explain this observation in terms of an associative rate determining step. [3]

(ii) Write the increasing order of the rate of substitution by H_2O in the following complexes giving the reason. [3]

$[Co(NH_3)_6]^{+3}$, $[Rh(NH_3)_6]^{+3}$, $[Ir(NH_3)_6]^{+3}$, $[Mn(H_2O)_6]^{+2}$

Q.6. Answer the following.

[A] Write a short note on electron transfer by inner sphere mechanism. [6]

[B] Discuss isomerization & racemization in octahedral complexes giving suitable examples. [6]

Or

[B] (i) When the pyridine is added to an aqueous solution of Na_3RhCl_6, the reaction stop at $[Rh(py)_3Cl_3]$, but on adding a small amount of ethanol, quantitative formation of $[Rh(py)_4Cl_2]^+$ occurs. Explain this with suitable mechanism. [3]

(ii) For the following general reaction, explain the effect of halides & discuss the mechanism of reaction. [3]

$$[Co(NH_3)_5X]^{+2} + [Cr(H_2O)_6]^{+2} + 5H_3O^+ \rightarrow [Co(H_2O)_6]^{+2} + [Cr(H_2O)_5X]^{+2} + 5NH_4^+$$

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