

S.R. FATEPURIA COLLEGE  
Beldanga, Murshidabad  
B.Sc. Part-III  
*Internal assessment Examination-2020*  
Sub- Chemistry (Hon's)  
Paper-VII  
(Inorganic Chemistry)

F.M. - 20

*The figures in the right-hand margin indicate marks. Candidates are required to give their answers in their own words as far as practicable.*

**1. Answer all questions from the following:**

$$\frac{1}{2} \times 4 = 2$$

- a) What are the qualitative differences between the splitting of d-orbitals in octahedral & tetrahedral fields?
- b) How much rotation in degree is associated with  $C_5^3$  operation?
- c)  $[\text{Ni}(\text{CN})_4]^{2-}$  complex ion, whether it is paramagnetic or diamagnetic and why?
- d) What are niobates and tantalates?

**2. Answer all questions from the following:**

$$1 \times 3 = 3$$

- a) Prove that  $\text{H}_3\text{BO}_3$  belongs to  $C_{3h}$  point group.
- b) What are the main features of CFT?
- c) Explain the nature of J-T distortion expected for an octahedral  $d^9$  metal ion.

**3. Answer all questions from the following:**

$$3 \times 5 = 15$$

- a) Why Fe(II) salts undergo easily oxidized in air but Hb & Mb cannot?
- b) Discuss transmetallation for the synthesis of organometallic compounds.
- c) Compare and contrast the oxides and halides of Mo and W in +5 and +6 oxidation states with reference to types of compounds and their stabilities
- d) Compare the stability of +2 and +4 oxidation states of Pd and Pt.
- e) Wilson's disease (symptoms, cause and prevention).

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F.M. - 20

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**1. Answer all questions from the following:**

**10**

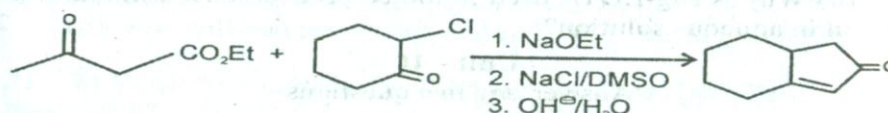
1. (a) Acetolysis of both *cis*- and *trans*-tosylate shown below give the same *trans* diacetate. Explain 3



- (b) *trans*-1,3-Di-*tert*-butylcyclohexane prefers twist boat conformation and readily passes to its *cis*-isomer on heating with Pd/C. Explain. 2

2. (a) Which side reaction prevails with acetoacetic ester but not with DEM during base catalysed alkylation? Discuss the influence of solvent and size of alkyl group on the ratio of C- vs. O- alkylation. 3

- (b) Write down the probable mechanism of the following reaction: 2



3. (a) The *cis*-1,2-dimethylcyclohexane is less stable than its *trans* isomer, but *cis*-1,3-dimethylcyclohexane is more stable than its *trans* isomer. Draw the most stable conformations of both and explain. 3

2. Answer all questions from the following:

10

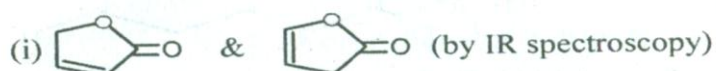
6. (a) An organic compound with molecular formula  $C_{10}H_{12}O_2$  gives positive iodoform test. Its UV, IR and  $^1H$  NMR data are given below ; deduce the structure of the molecule.

IR: 3050, 2950, 1730  $cm^{-1}$ .

$^1H$  NMR :  $\delta$  1.3 (d, 6H), 5.2 (m, 1H), 7.2 (m, 3H), 8.0 (m, 2H). 3

(b) Distinguish vinyl acetate and methyl acrylate by IR spectroscopy. 2

7. (a) How would you distinguish between the members of the following pairs? 3



(ii) *o*-Fluoro phenol and *p*-fluoro phenol (by  $^1H$  NMR spectroscopy)

(b) Why the  $C \equiv C$  *str.* of acetylene is IR inactive? 2

8. (a) The  $\alpha, \beta$  unsaturated ketone, mesityl oxide shows  $\lambda_{max}$  230 nm ( $\epsilon = 12,600$ ) and 329 nm ( $\epsilon = 41$ ) in hexane and  $\lambda_{max}$  243 nm ( $\epsilon = 10,000$ ) and 305 nm ( $\epsilon = 60$ ) in water. Explain. 3

(b) Define the term chemical shift. What difference in chemical shift values are expected for the protons of  $CH_3F$ ,  $CH_3Cl$  and  $CH_3Br$ ? Explain. 2

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Paper-IX  
(Physical Chemistry)

F.M. - 20

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1. Answer all questions from the following:

20

ANSWER *any two* questions

6. (a) Verify that the wave function  $A \exp(-Bx^2/2)$  is an eigenfunction of the Simple Harmonic Oscillator (in one dimension) Hamiltonian. Here  $B = 2\pi\sqrt{mk}/h$  (terms have their usual significance). Find the expression for the eigenvalue. 3

(b) From the eigenvalue obtained above, make an estimate of the positions of the Classical Turning Points  $x_1$  and  $x_2$  i.e., values of  $x$  after which the motion *reverses* its direction. Use proper arguments. 2

7. (a) The 1s wavefunction for the hydrogen is  $\Psi = (\pi a_0^3)^{-1/2} \cdot e^{-r/a_0}$  where  $a_0$  is the Bohr radius. Calculate the probability of finding the electron within a distance  $a_0$  from the nucleus. 3

Given :  $\int_0^{\infty} x^n e^{-bx} dx = n!/b^{n+1}; (n > -1)$

ANSWER *any three* questions

9. (a) Draw the phase diagram ('T' versus mole % of B) of a system consisting of solids A and B forming a stable compound  $A_2B$  with congruent melting point. Show the different phases present in the different regions of the diagram. State the degrees of freedom at eutectic point. [Given: m.p. of  $A_2B >$  m.p. of A  $>$  m.p. of B] 3

(b) Ammonium chloride decomposes on heating to give ammonia and HCl gas. How many components and phases are present if the salt is heated in an otherwise empty container? 2

10. (a) For  $CO$ ,  $B = 5.02 \text{ cm}^{-1}$ . 3  
(b) How many times does a molecule of  $^1\text{H}^{35}\text{Cl}$  rotate per second in the  $J = 1$  rotational level? (Given  $B = 10.6 \text{ cm}^{-1}$ ). Comment: "The speed of rotation of a  $^2\text{H}^{35}\text{Cl}$  molecule will be the same as that of  $^1\text{H}^{35}\text{Cl}$  molecule". 2

24. (a) A linear molecule has the formula  $AB_2$ . Discuss how would you ascertain whether the molecule has the structure BAB or ABB, using its Raman and IR spectra together. 3

(b) If the  $J = 2$  to  $J = 3$  rotational transition for a heteronuclear diatomic molecule occurs at  $\lambda = 20 \text{ mm}$  find the wave number for transition from  $J = 5$  to  $J = 6$  level in the same molecule. 2