RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SECOND SEMESTER EXAMINATION, SEPTEMBER 2020

FIRST YEAR [BATCH 2019-22]

Date : 25/09/2020 — **INDUSTRIAL CHEMISTRY (Honours)**

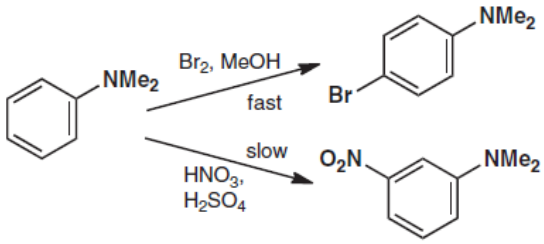
Time : 11.00 am – 7.00 pm — **Paper : III [CC3] & IV [CC4]** — Full Marks : 50+50

Paper : III [CC3]

Unit - I

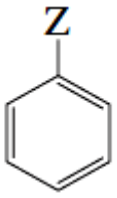
Answer **any five** questions from Question Nos. 1 – 7 : [5×5]

1. a) *N*,*N*- Dimethylaniline gives mainly the *p* -bromination product in a rapid reaction with Br_2 in methanol but mainly the *m* -nitration product in a slow reaction with nitric/sulfuric acid mixtures. Explain the difference in regioselectivity and reactivity in the two reactions. [3]

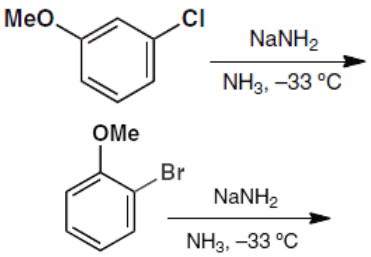


b) Among Acetanilide and aniline which one is more reactive towards electrophilic substitution reaction. How to prepare p-Nitroaniline starting from aniline. [2]

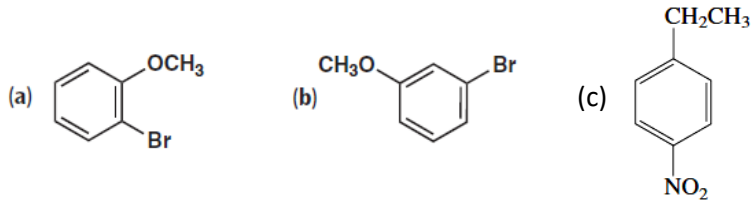
2. a) For each of the statements in Column I, choose a substituent from Column II that fits the description for the compound at the right: [2]

Column-I	Column-II	
a. Z donates electrons inductively, but does not donate OH or withdraw electrons by resonance.	OH	
b. Z withdraws electrons inductively and withdraws electrons by resonance.	Br	
c. Z deactivates the ring and directs ortho–para.	$^{+}NH_3$	
d. Z withdraws electrons inductively, donates electrons by resonance, and activates the ring.	CH_2CH_3	
e. Z withdraws electrons inductively, but does not donate or withdraw electrons by resonance.	NO_2	

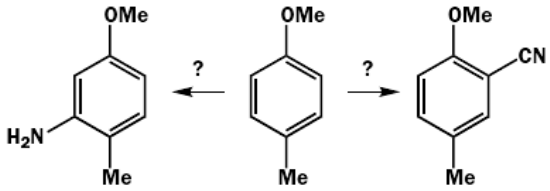
b) Predict the main products of the following reactions. Explain with proper mechanism. [3]



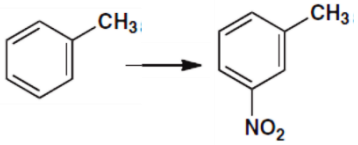
3. a) What would be the main mono-nitration product(s) from each of the following? [2]



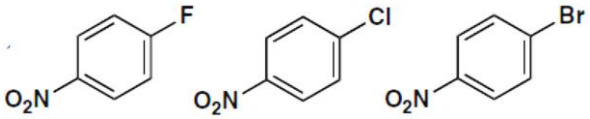
b) How would you convert this aromatic compound into the two derivatives shown below? Mention only suitable reagents and steps. (Mechanism not required). [3]



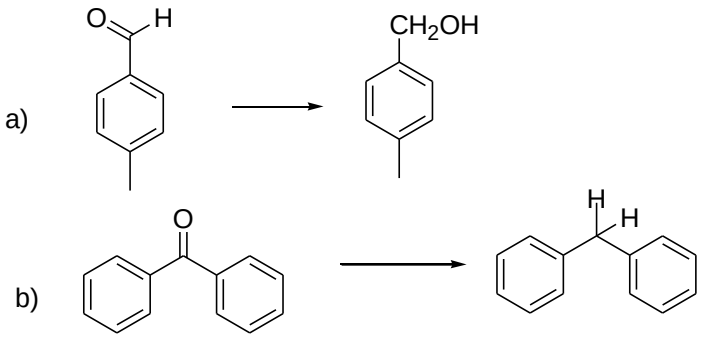
4. a) How to prepare meta-nitrotoluene starting from toluene with an efficient way. Mention only proper reagents with steps. Mechanism not required. [3]



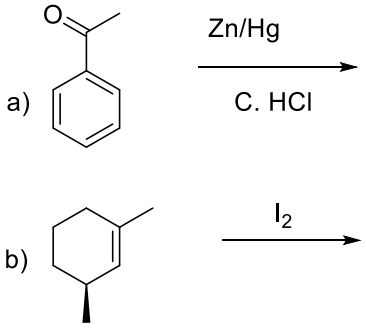
b) Explain the relative reactivities in the following sets of compounds for nucleophilic substitution reactions in methanol containing sodium methoxide. [2]



5. Complete the following reactions with suitable mechanisms : [3+2]



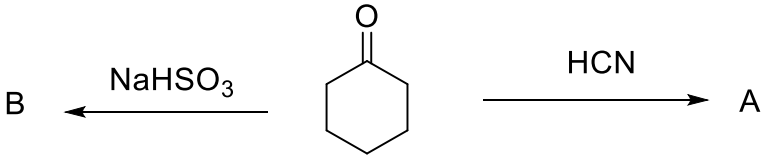
6. Predict the product(s) with suitable mechanism: [3+2]



7.

8.

9. a) Predict A and B with possible mechanism: [2+3]



b) Give one example of 1,2 and 1, 4 addition reaction of a conjugated diene and predict which one is major product and why?

Unit - II

Answer **any five** questions from Question Nos. 8 – 14 : [5×5]

8. a) What do you mean by levelling effect and differentiating effect of solvent?
b) Explain the acidity order of H_3PO_2, H_3PO_3 and H_3PO_4. [2+3]

9. a) PhCOOH is weak acid in water but strong acid in liquid NH_3 - justify or criticise. [2]

b) Which is a stronger base and why? Explain.

I) NH_3, PH_3 II) NH_3, NF_3 [3]

10. Explain redox reactions on the basis of electron transfer. Give suitable examples. [5]

11. Find out the oxidation number of chlorine in the following compounds and arrange them in increasing order of oxidation number of chlorine. (Shows the all calculation)

$NaClO_4$, $NaClO_3$, NaClO, $KClO_2$, Cl_2O_7, ClO_3, Cl_2O, NaCl, Cl_2, ClO_2. [5]

12. a) Give the names of the following co-ordination compounds –

(i) $H[AuCl_4]$

(ii)$Na_2[Fe(CN)_5NO$

b) Describe the some applications of chelating compounds. [2+3]

13. Give the evidence to support Warner's theory of the co-ordination compounds. [5]

14. Calculate the oxidation number of phosphorus and sulphur in the following compound. [1×5]

(i)HPO_3^{2-} (ii)PO_4^{3-} (iii) $Na_2S_2O_3$ (iv) Na_2SO_4 (v) Na_2SO_3

Paper : IV [CC4]

Unit-III

Answer **any five** questions from Question Nos. 15 – 21 : [5×5]

15. (a) How will you estimate the % of Cu in a brass sample? Mention only the principle with requisite chemical reactions.
(b) Write down the complete reaction between Fe^{2+} and $Cr_2O_7^{2-}$ ions in acidic medium and balance it by ion-electron method. [3+2]

16. (a) What is oxine? Draw the structure of Al-oxinate complex. [1+2]

(b) Mention the different successive steps for a gravimetric estimation. [2]

17. Define accuracy and precision. Distinguish between them. [3+2]

18. (a) Distinguish between determinate error and indeterminate error.

    (b) Draw the structure of Ca-EDTA complex.

    (c) Name a metallochromic indicator. [2+2+1]

19. (a) How will you estimate the amount of Ca^{2+} and Mg^{2+} in a sample of dolomite solution?

    (b) Discuss the differences between co-precipitation and post-precipitation. [3+2]

20. (a) Cite an example of self-indicator.

    (b) What is iodimetric titration?

    (c) What do you mean by argentometry? [1+2+2]

21. (a) Mention only the principle for the determination of mercury.

    (b) Name an indicator for the estimation of Cl^-.

    (c) An analyst finds a value of 20.44% iron in a sample, which actually contains 20.34%.

    Calculate (i) absolute error and (ii) relative error in 0/00. [2+1+2]

Unit-IV

Answer **any five** questions from Question Nos. 22 – 28 : [5×5]

22. (a) Briefly explain any two factors on which width of a spectral line depends.

    (b) Also explain nicely the variation of intensity of rotational spectral lines with temperature and rotational quantum number with a proper diagram. [2+3]

23. (a) Write down the gross and specific selection rules for microwave and infra-red spectra considering the Rigid Rotor and S.H.O. model.

    (b) Write down the expression of energy level and derive the expression of two consequent energy levels gap and two consequent spectral lines gap for rotational and vibrational spectra in cm^{-1} considering the Rigid Rotor and SHO model.

    (c) Derive the expression of Dissociation energy of a diatomic molecule in cm^{-1}. [1+2+2]

24. (a) Suppose we have a sample of HCL. Now, how can we use Infrared spectroscopy to determine the presence and abundance of isotopic Chlorine in the sample? Explain nicely with proper diagram.

    (b) What are the effects of anharmonicity for a vibrating molecule? Draw potential energy diagram of harmonic and anharmonic oscillator both.

    (c) Derive the expression of zero-point energy for an anharmonic vibrating oscillator. [2+2+1]

25. (a) What is represented by the terms ‘Fundamental vibration’, ‘Overtones’ and ‘Hot Bands’ in the realm of IR spectroscopy? Why the hot band is called ‘Hot’?

(b) Find the expression of fundamental vibration, 1^{st} and 2^{nd} overtones, and first hot band for a diatomic oscillating molecule considering anharmonicity. [2+3]

26. (a) How many normal modes of vibrations a molecule can have?

(b) What are the normal modes of vibration of CO_2 and water molecule? Depict with suitable pictures and also explain the reason of IR activity/inactivity of these normal modes. [1+4]

27. (a) Explain Raman Effect from classical mechanical point of view.

(b) What is polarizability of a molecule? Explain how polarizibility is related to Raman Spectra.

(c) Write down the gross and specific selection rules for pure rotational Raman spectra. Derive the energy gap between the incident radiation and the first rotational stokes line considering the Rigid Rotor model. [1+2+2]

28. (a) Draw a perfect Jablonski diagram showing all the possible excitation and de-excitation processes.

(b) Briefly explain the occurrence of Fluorescence and Phosphorescence.

(c) Why phosphorescence is a much delayed radiation with respect to fluorescence? [2+2+1]

———— × ————