

5/H-23 (v) (Syllabus-2015)

2 0 1 7

(October)

CHEMISTRY

(Honours)

(Chem-H-501)

Marks : 75

Time : 4 hours

*The figures in the margin indicate full marks
for the questions*

(Part—A : Inorganic Chemistry—I)

(Marks : 38)

1. (a) Find out the symmetry point group in PF_5 and B_2H_6 by indicating clearly in the structures the symmetry elements present in them. 2+2=4
- (b) The following replicate results were obtained in measuring iron content of a sample :

22.23%, 22.18%, 22.25%, 22.09%, 22.15%

Establish whether the result 22.09 is a valid measurement or not, given that

(2)

corresponding rejection quotient at 90% confidence limit for 5 observations is 0.64.

3

OR

2. (a) List down all the symmetry operations and symmetry elements present in $[\text{CO}(\text{NH}_3)_6]^{3+}$ ion.

5

(b) What type of error would you expect to occur while taking weight of a hygroscopic compound? What precautions may be taken to minimize such an error?

2

3. (a) Give the structural and chemical formulae of oxine and α -nitroso- β -naphthol. Discuss the applications of α -nitroso- β -naphthol in both qualitative and quantitative analyses.

2+2=4

(b) Outline the advantages and limitations of organic precipitants.

1½

(c) What is argentometric titration? How is chloride determined by Volhard's method?

2½

OR

4. (a) Give the chemical and structural formulae of cupron and dimethylglyoxime. Write some of the

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(3)

important applications of both in qualitative and quantitative analyses.

2+2=4

(b) What is meant by masking and demasking of cations? Give examples.

1½

(c) What type of indicators is used in complexometric titration involving EDTA? How does this indicator function?

2½

5. (a) What is Q -value of a nuclear reaction? What happens to Q -value when—

(i) $m_R > m_P$;

(ii) $m_R < m_P$?

(where m_R = mass of the reactants and m_P = mass of the products)

1+2+2=5

(b) How are radioisotopes separated by gaseous diffusion method?

3

OR

6. (a) Calculate the binding energy per nucleon (in MeV/nucleon) for the isotope $^{56}_{26}\text{Fe}$.

Given the masses of

^{56}Fe : 55.93494 a.m.u.

neutron : 1.008665 a.m.u.

proton : 1.00783 a.m.u.

electron : 0.00054859 a.m.u.

5

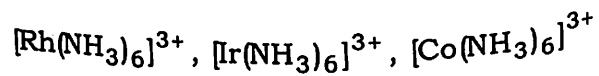
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(4)

- (b) What are magic numbers? Why are the nuclei with magic number either proton or neutron or both extrastable? $1+2=3$
7. (a) What are the factors that affect the magnitude of crystal field stabilization energy parameter (Δ_0) in complexes? 2

- (b) Arrange the following complexes in increasing order of CFSE (Δ_0) values and give explanation for your answer : $1+1+1=3$



- (c) Make the plot of hydration energies of M^{2+} ions of first row transition metals and explain the important features. 2

OR

8. (a) Draw the splitting of d -orbital in a square planar system. Explain the magnetic behaviour of $\text{K}_2[\text{Ni}(\text{CN})_4]$ with its help. $1\frac{1}{2}+1\frac{1}{2}=3$

- (b) Calculate the CFSE (Δ_0) for Fe^{2+} ion in high spin and low spin octahedral complexes. $1+1=2$

- (c) Taking a suitable example explain the Jahn-Teller effect. 2

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(5)

9. (a) Describe the magnetic behaviour of $\text{K}_3[\text{FeF}_6]$ and $\text{K}_3[\text{Fe}(\text{CN})_6]$ and explain their behaviour with help of crystal field theory. 4
- (b) What is Curie law? Why was it modified to give Curie-Weiss law? Explain. 2
- (c) Draw qualitative diagrams indicating magnetic susceptibility as a function of temperature for (i) simple paramagnetic, (ii) ferromagnetic and (iii) antiferromagnetic substances. 2

OR

10. (a) Give example of one paramagnetic and one diamagnetic complex of Co^{3+} and calculate their spin-only magnetic moment μ_s . 4
- (b) The μ_{eff} for $\text{Cu}(\text{II})$ is normally 1.8–1.9 BM at room temperature but in dicopper tetraacetate dihydrate the experimental value of μ_{eff} is 1.4 BM. Explain. $2\frac{1}{2}$
- (c) What is meant by magnetic susceptibility? How is it related to magnetic moment? $1\frac{1}{2}$

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(Part—B : Organic Chemistry—I)

(Marks : 37)

11. (a) Lower the pK_a value, stronger is the acid. Explain. 2

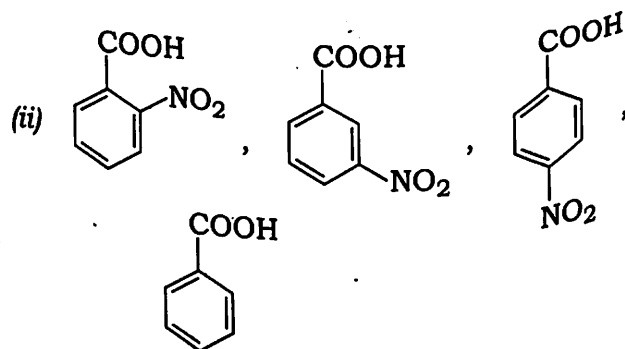
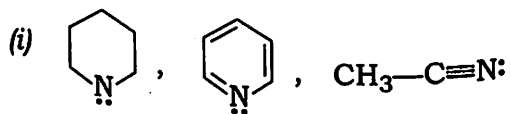
(b) Comment on the following observations : $1\frac{1}{2} \times 2 = 3$

(i) Formic acid is stronger than acetic acid.

(ii) *p*-nitrophenol has higher melting point than *o*-nitrophenol.

(c) Define acids and bases on the basis of Bronsted-Lowry concept. 2

(d) Arrange the following in order of increasing basicity or acidity : 2



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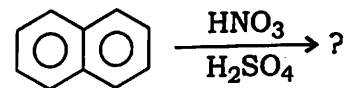
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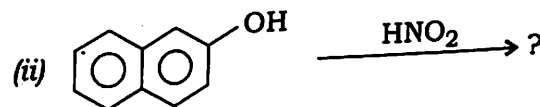
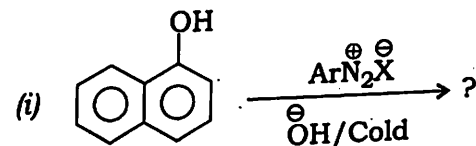
12. (a) Electrophilic substitution reactions in naphthalene occur preferentially at C_1 . Explain. 2

(b) Complete the following reaction with mechanism : 2



(c) Give the Diels-Alder method of preparation of anthracene from 1,4-naphthaquinone. 2

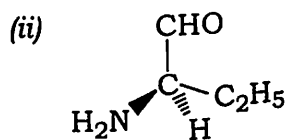
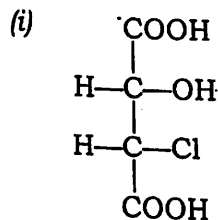
(d) Suggest the products of the following reactions : $1\frac{1}{2} \times 2 = 3$



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13. (a) Assign the *R*- and *S*-configuration of the following optical isomers : 2

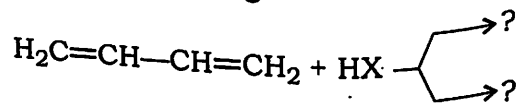


- (b) Draw all the possible conformers of *n*-butane and arrange them in increasing order of energy. 2
- (c) Explain the stereochemical aspect of the bromination of *Z*-butene-2. 2
- (d) Draw the chair conformers of *cis*-1,3-dimethyl cyclohexane. Which one is more stable and why? 3

OR

14. (a) What are the different types of dienes? Give example in each case. 2

- (b) Complete the following reaction :



What happens, when the products is heated above 60 °C? 2+1=3

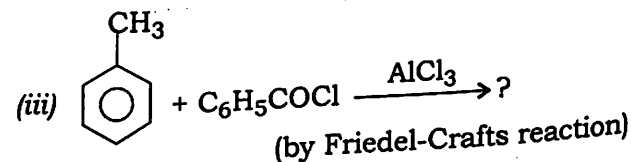
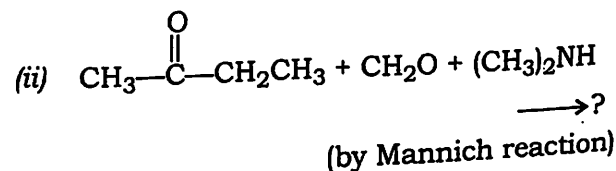
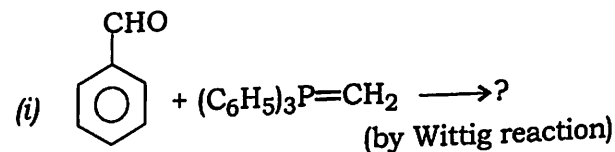
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- (c) What are natural and synthetic rubbers? Give examples. 2

- (d) Write one method of preparation of Nylon-66. 2

15. (a) Write the reaction mechanism of the formation of ester from acids. 3

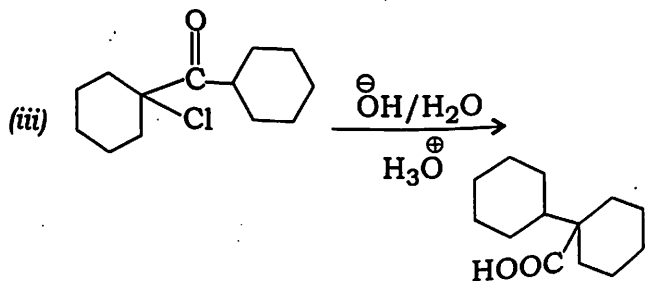
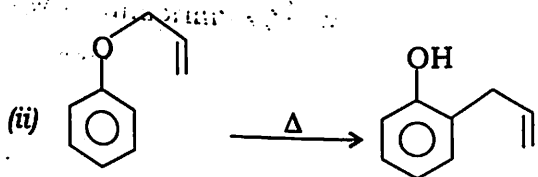
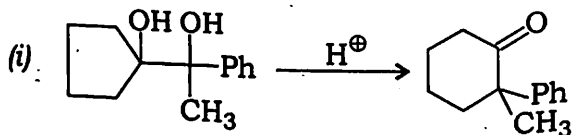
- (b) Predict the product of the following reactions with mechanism : 2×3=6



(10)

OR

16. (a) Suggest a suitable mechanism for the following transformations : $2 \times 3 = 6$



- (b) Why is NaBH_4 more selective than LiAlH_4 ? Give one application of NaBH_4 . $1+2=3$

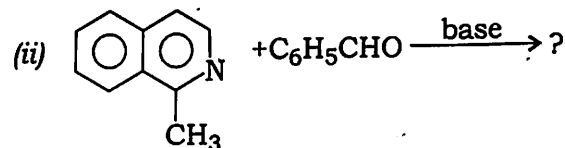
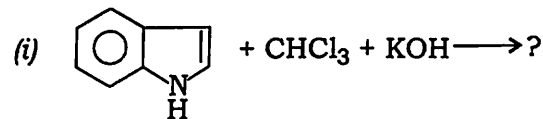
17. (a) How is quinoline prepared by Skraup synthesis? 3

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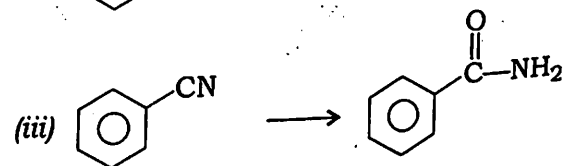
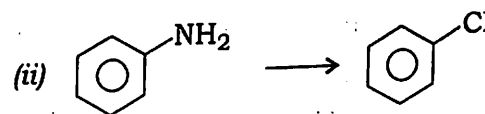
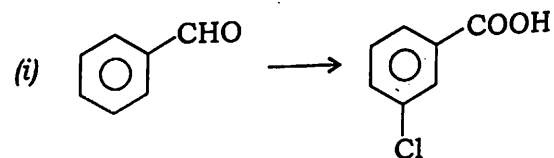
- (b) Predict the correct products for the following reactions with mechanism : $2 \times 2 = 4$



- (c) Write down three basic principles of green chemistry. 3

OR

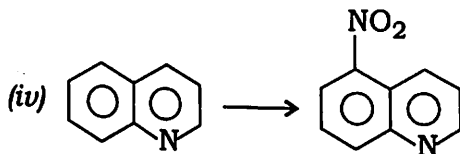
18. (a) How will you carry out the following conversions? $1\frac{1}{2} \times 4 = 6$



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- (b) What do you mean by atom economy reaction? Cite an example. 2
- (c) What are microwave assisted reactions? 2
