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NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

DEPARTMENT OF CHEMISTRY

End Semester Examination, Winter Semester, April 2013

S2 B. Tech., CY1001 – Chemistry

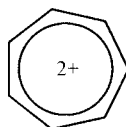
Time: 3 hours

Max. Marks: 50

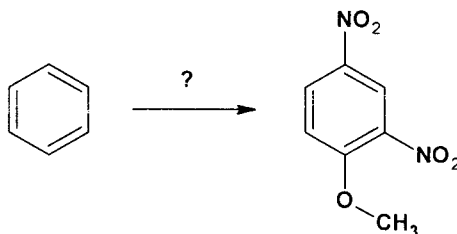
Answer All Questions

Section-A (10 x 3 Marks = 30 Marks)

1. Explain the hybridisation of sulphur in the given molecules and identify their structure: (i) SF_4 (ii) $(\text{CH}_2)\text{SF}_4$
2. Two complexes, viz., $[\text{Fe}(\text{CN})_6]^{4-}$ and $[\text{Co}(\text{NH}_3)_6]^{3+}$ absorb radiations at $32,850 \text{ cm}^{-1}$ and $23,000 \text{ cm}^{-1}$. If the pairing energies are $P_{\text{Fe}^{2+}} = 17,600 \text{ cm}^{-1}$ and $P_{\text{Co}^{3+}} = 21,000 \text{ cm}^{-1}$, calculate the CFSE and compare their stability.
3. Construct the π -MO energy levels for the given molecule by using the Frost diagram, and predict its aromaticity.

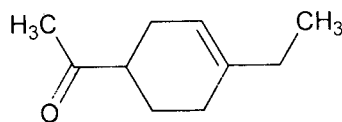


4. Draw the shapes of MOs for all the bonding and antibonding combinations of P_x orbitals.
5. How will you carry out the following multistep conversion? Detail the steps involved.



6. Solutions of three molecules, viz., anthracene, naphthalene and tetracene were analysed using a UV-visible spectrophotometer to attain their electronic spectra. Predict the approximate range of wavelength of their $\pi \rightarrow \pi^*$ transitions and arrange the molecules in the increasing order of λ_{max} values.

7. Explain how square planar complexes are derived from octahedral complexes?
Sketch the d orbital splitting in square planar complexes.
8. The mass spectrum of the given molecule shows a very intense peak at $m/z = 70$.
Draw the mechanism of fragmentation and identify the fragment corresponding to the peak.

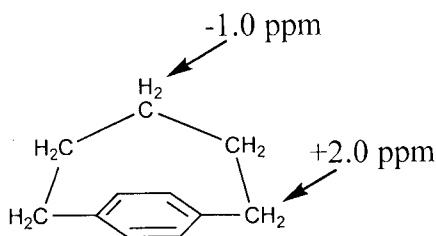


9. Explain the microwave activity of homonuclear and heteronuclear diatomic molecules with examples.
10. Draw the structure and describe the aromaticity of [14]-annulene.

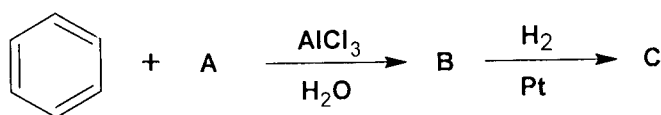
Section-B

(4 x 5 Marks = 20 Marks)

11. (a) Discuss the shape of $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ complex based on crystal field theory. (3 Marks)
- (b) Comment on the ^1H NMR chemical shift values of the marked protons in the molecule given below: (2 Marks)



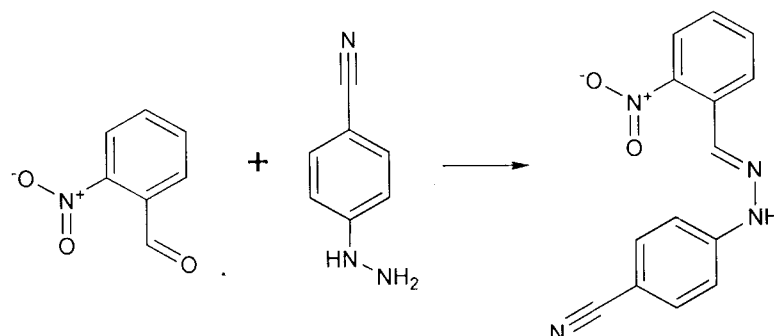
12. (a) In the given reaction, ^1H NMR spectrum of compound C was recorded.



The spectral data of C reveal the NMR peaks at $\delta = 0.9$ ppm (3H, triplet), 1.31 ppm (2H, multiplet/sextet), 1.59 ppm (2H, multiplet/quintet), 2.62 ppm (2H, triplet) and a multiplet centered around 7.2 ppm (5H). Identify A, B and C.

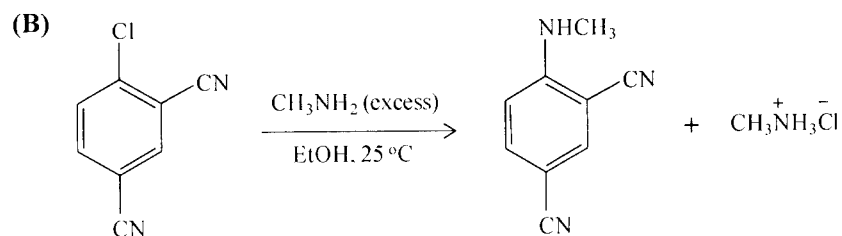
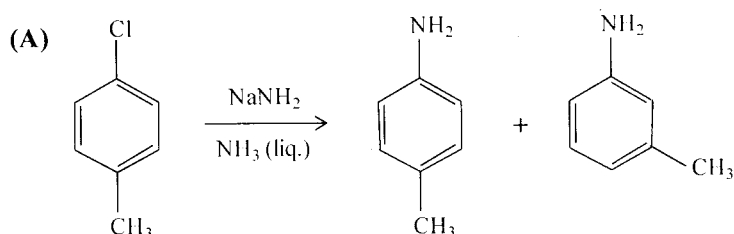
(4 Marks)

(b) Starting materials for the following condensation reaction are slightly coloured, while the product shows an intense orange red colour. Account for this observation. (1 Mark)



13. Detail the mechanisms in the reactions given below:

(5 Marks)



14. An organic compound with molecular formula $\text{C}_5\text{H}_7\text{NO}_2$ gives the following spectral data: (a) IR: 2960, 2270 and 1720 cm^{-1} ; (b) ^1H NMR: $\delta = 1.2\text{ ppm}$ (3H, triplet), 3.4 ppm (2H, singlet) and 4.2 ppm (2H, quartet) and (c) Mass spectra: m/z peaks at 29, 68, 86 and 113.

(i) Identify the molecule

(2 Marks)

(ii) Assign all the peaks

(3 Marks)

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