MIZORAM PUBLIC SERVICE COMMISSION

GENERAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF JUNIOR GRADE OF MIZORAM FOREST SERVICE i.e. ASSISTANT CONSERVATION OF FOREST (ACF) UNDER ENVIRONMENT, FOREST & CLIMATE CHANGE DEPARTMENT, GOVERNMENT OF MIZORAM, 2018

CHEMISTRY

Time Allowed : 3 hours   Full Marks : 100

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

*Answer any <u>10 (ten)</u> questions
taking <u>5 (five)</u> questions from each section.*

<u>SECTION - A</u>

1. (a) State and explain Heisenberg's uncertainty principle. How did Bohr's atomic theory violate the uncertainty principle? **(3+2=5)**

   (b) What is meant by lattice energy? How is lattice energy determined by using Born Haber cycle? **(1+4=5)**

2. (a) Write the molecular orbital energy level diagram of O_2 and compare the bond order of O_2 with O_2^+ and O_2^- . **(3+3=6)**

   (b) Discuss how Joule-Thomson effect has been applied in the liquefaction of gases. **(4)**

3. (a) Briefly explain Schottky defect and point out its effect on density and conductivity of crystals? **(5)**

   (b) How does Nernst heat theorem lead to the enunciation of the third law of thermodynamics? **(5)**

4. (a) Draw and discuss the phase diagram for carbon dioxide system. **(5)**

   (b) What do you mean by electrochemical series? Write the cell reaction and calculate EMF of the following cell: $Cu \,|\, Cu^{2+} \,(1 \text{ M}) \,\|\, Zn^{2+} \,(1 \text{ M}) \,|\, Zn$.

   Given that $E^o_{Zn^{2+}/Zn} = +0.34V$ and $E^o_{Cu^{2+}/Cu} = -0.76V$. **(5)**

5. (a) Discuss the effects of temperature on rates of reaction. **(5)**

   (b) What are the assumptions involved in the derivation of Langmuir adsorption isotherm? **(5)**

6. (a) Explain the role of Na^+–K^+ pump in biological systems. **(5)**

   (b) Write the IUPAC name of $[Co(en)_2Cl_2]^+$. What are the possible geometrical isomers and optical isomers given by this complex? **(1+4=5)**

7. (a) What is lanthanide contraction? What are its direct consequences? **(1+4=5)**

   (b) What are ammono-acids and ammono-bases? Explain neutralization reaction in liquid ammonia giving suitable example. **(2+3=5)**

SECTION - B

8. (a) State Huckel's rule of Aromaticity. Indicate whether the following compounds are aromatic or not giving appropriate reasons. **(2+4.5=6.5)**
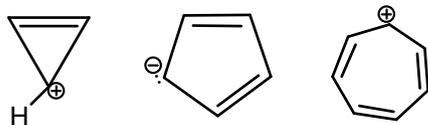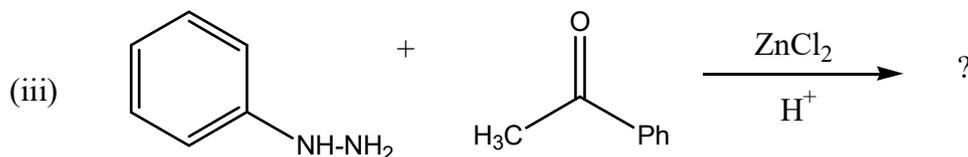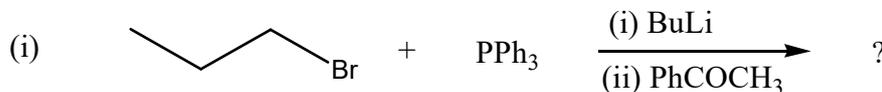

   (b) Carry out the following conversion with suitable mechanism and name the reaction. **(3.5)**
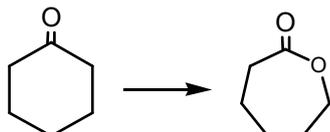
9. (a) Based on Frontier Molecular Orbital approach, predict the structure(s) of the following reaction with proper stereochemistry. **(2×2.5 = 5)**
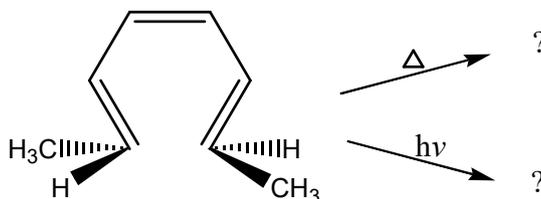
   (b) Predict the product(s) of the following reactions: (Mechanisms not required). **(2+2+1=5)**

   (i)

   (ii)

   (iii)

10. (a) Mention two applications each of the following polymers and also write the monomer of each polymer. **(3×1.5=4.5)**
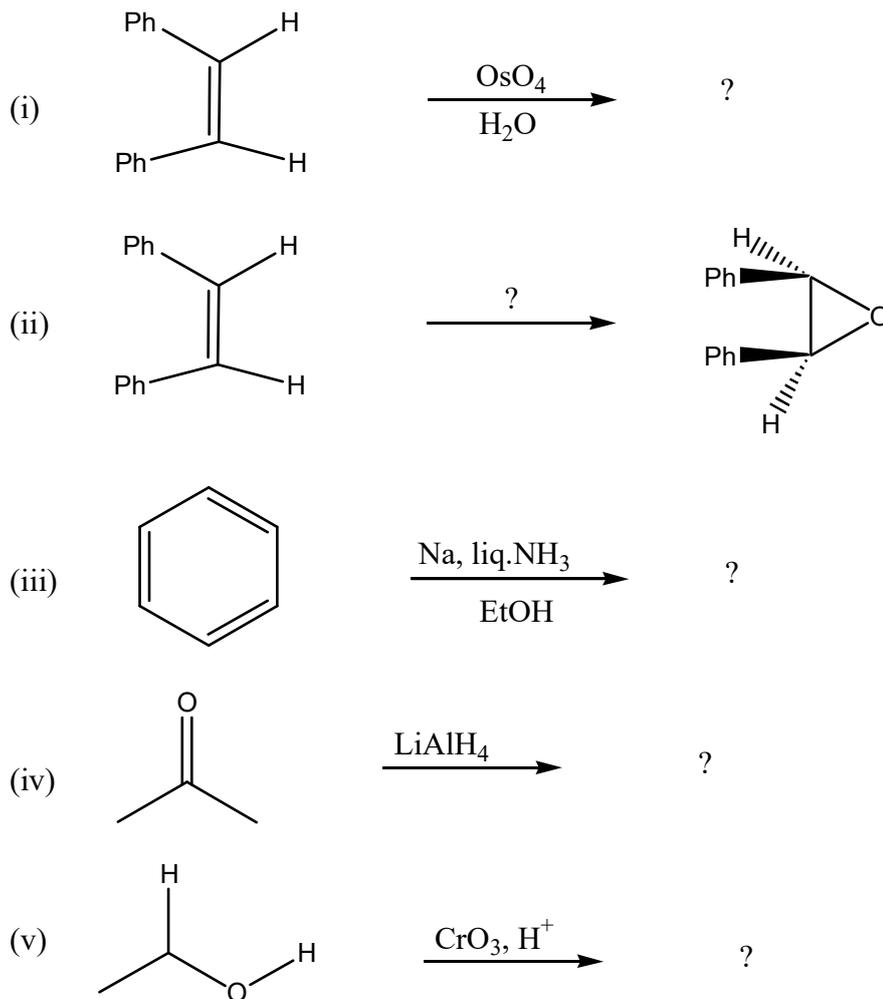
   (i) Polystyrene   (ii) Teflon   (iii) PVC

   (b) Explain Saytzeff and Hoffmann orientation in E2 reaction with suitable examples. **(4)**
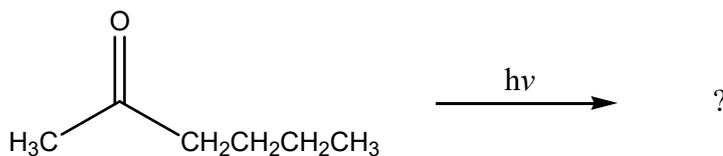
   (c) What do you mean by polymer solutions? **(1.5)**

11. **(b)** Complete the following reactions: **(2×5=10)**

(i)

$$\xrightarrow[\text{H}_2\text{O}]{\text{OsO}_4} \quad ?$$

(ii)

$$\xrightarrow{?}$$

(iii)

$$\xrightarrow[\text{EtOH}]{\text{Na, liq.NH}_3} \quad ?$$

(iv)

$$\xrightarrow{\text{LiAlH}_4} \quad ?$$

(v)

$$\xrightarrow{\text{CrO}_3,\ \text{H}^+} \quad ?$$

12. **(a)** Explain Norrish Type-I and Type-II reactions. Write the Norrish Type-I and Norrish Type-II products of the following photochemical reactions. **(2+2=4)**

$$\xrightarrow{h\nu} \quad ?$$

(b) Explain the following terms by giving suitable examples. **(3×2=6)**

   (i) Singlet and triplet states.

   (ii) Base peak.

   (iii) Chemical Shift.

13. **(a)** Give one example each of the synthetic applications of the following reagents. **(2+2=4)**

   (i) MCPBA   (ii) NaBH$_4$

(b) How is the Molecular weight of polymer determined by viscocity method. **(6)**

14. **(a)** $n \longrightarrow \pi^*$ excitation of carbonyl compounds can bring two types of photochemical fragmentation. What are those? Give examples. **(2+2=4)**

(b) In a normal mass spectrometric measurement, 2-hexanol shows peaks at m/z 102, 87, 84 and 45. Showing the entire fragmentation pattern, determine the structures of these fragments. **(6)**

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