

**2 0 1 5**

**( October )**

**CHEMISTRY**

**( Elective/Honours )**

**FIRST PAPER**

**( Inorganic, Organic, Physical )**

**Marks : 56**

**Time : 3 hours**

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

**SECTION—I**

**( Inorganic )**

**( Marks : 19 )**

1. (a) What is meant by 'dual character of matter'? Derive de Broglie relation. 1+2=3
- (b) State group displacement law. What shall be the position in periodic table of the final daughter element obtained after the nuclide  $^{218}_{84}\text{Po}$  undergoes  $\alpha$ -emission followed by two successive  $\beta$ -emissions? 1+1½=2½

( 2 )

- (c) Calculate the energy of a photon corresponding to (i) wavelength 140 nm and (ii) wave number  $10\text{ cm}^{-1}$  ( $h = 6.626 \times 10^{-34}\text{ J-s}$ ).  $1\frac{1}{2} + 1\frac{1}{2} = 3$

- (d) Why is the ionic radius of  $\text{K}^+$  smaller than  $\text{Cl}^-$ , while both are isoelectronic? 1

OR

2. (a) Draw the shape of  $d_{x^2-y^2}$  orbital. 1

- (b) Write the set of four quantum numbers for the unpaired electron in aluminium atom. 2

- (c) What is nuclear binding energy? Calculate the (i) total binding energy and (ii) binding energy per nucleon for  $^{16}_8\text{O}$ , given that the mass of  $^{16}\text{O}$  from mass spectrograph measurement is 15.9949 a.m.u., and that of hydrogen atom and neutron are 1.00783 a.m.u. and 1.00867 a.m.u. respectively.  $1 + 1\frac{1}{2} + 1\frac{1}{2} = 3$

- (d) State modern periodic law. What is the advantage of this law over Mendeleev's periodic law?  $1 + 1 = 2$

( 3 )

- (e) The electronic configuration of boron is  $1s^2 2s^2 2p^1$ . Which of these electrons between 2s and 2p orbitals are more likely to be closer to nucleus and why?  $1\frac{1}{2}$

3. (a) Classify the following as either a p-type or an n-type semiconductor :  $\frac{1}{2} \times 2 = 1$

(i) Ge doped with In

(ii) B doped with Si

- (b) Giving reasons, state which cation in the following pairs will have greater polarizing power : 3

(i)  $\text{Pb}^{2+}$  and  $\text{Pb}^{4+}$

(ii)  $\text{Ca}^{2+}$  and  $\text{Cu}^{2+}$

- (c) Draw the molecular orbital diagram of  $\text{O}_2^-$  and calculate the bond order. 3

- (d) Explain the bonding and geometry of  $\text{BO}_3^{3-}$  ion.  $2\frac{1}{2}$

OR

4. (a) The boiling points of HF and HCl are 293 K and 189 K respectively. Give reasons for the difference. 2

( 4 )

- (b) Discuss the geometry of  $\text{PCl}_5$  on the basis of VSEPR theory and compare its bond angles with  $\text{PCl}_3$ . 3
- (c) What is radius ratio? What will be the structural arrangement in ionic solid with radius ratio in the range 0.155–0.225?  $1+1=2$
- (d) What is lattice energy? Mention the factors on which lattice energy of an ionic crystal is dependent.  $1+1\frac{1}{2}=2\frac{1}{2}$

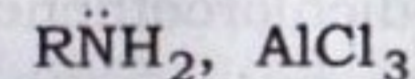
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SECTION—II

( Organic )

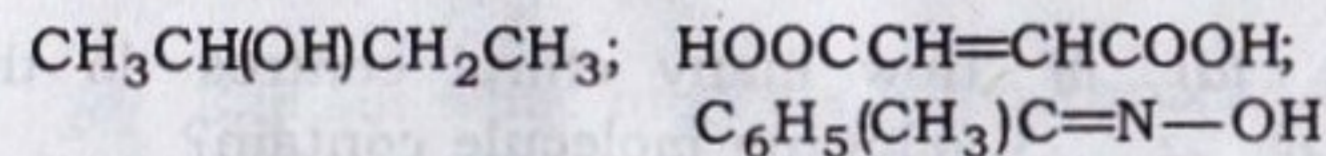
( Marks : 19 )

5. (a) Draw the orbital picture of the following molecules and explain on the basis of their structures, their acidic or basic behaviour : 3

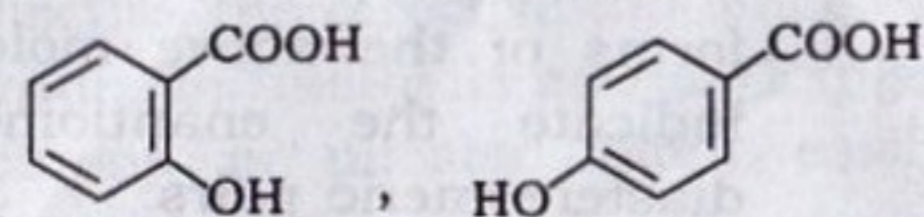


- (b) Write the resonance structures of  $\text{CH}_2=\text{CH}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$  and indicate the relative stabilities of the contributing structures. 2

- (c) Indicate the type of stereoisomerism exhibited by the following molecules. Draw the isomers of each : 3



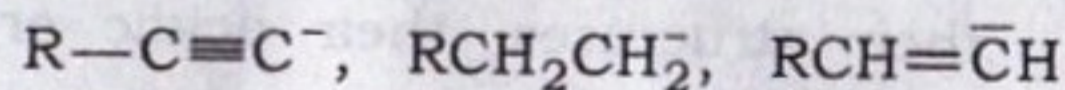
- (d) Which of the following will have higher melting point and why?  $1\frac{1}{2}$



( 6 )

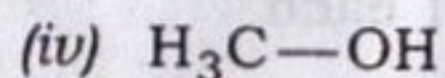
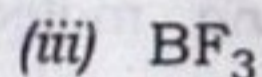
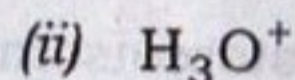
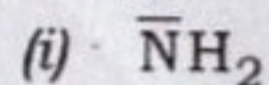
OR

6. (a) How is change in hybridization associated with change in electronegativity? Arrange the following carbanions in decreasing order of their stability with justification : 3

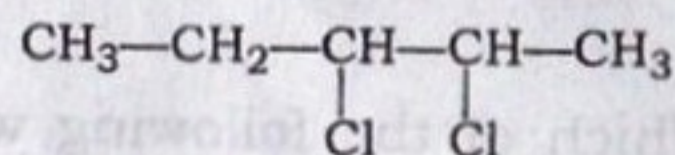


- (b) *Cis*-1,2-dichloroethene has a dipole moment but *trans*-1,2-dichloroethene has zero dipole moment. Explain. 1½

- (c) Classify the following as electrophiles and nucleophiles, and mention specifically the class to which they belong : 1



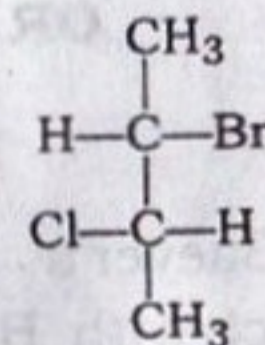
- (d) (i) How many chiral centres do the following molecule contain?



Draw all the possible stereoisomeric forms of the above molecule and indicate the enantiomeric and diastereomeric pairs. 3

( 7 )

- (ii) Draw the Newman projection formula for the following compound : 1



7. (a) How are alkanes prepared through Wurtz reaction? Explain why alkanes with odd number of carbon atoms cannot be prepared by Wurtz reaction. 2

- (b) What happens when cyclopentanone is treated with zinc amalgam and HCl? 1

- (c) What product is obtained when propyne is treated with dilute  $H_2SO_4$  in the presence of  $HgSO_4$  as catalyst? 1

- (d) Explain what happens when benzene is treated with acetyl chloride in the presence of a Lewis acid. Explain with mechanism. 2

- (e) Discuss the directive influence of  $-CH_3$  group in methylbenzene. Explain why toluene is nitrated more easily than benzene. 2

( 8 )

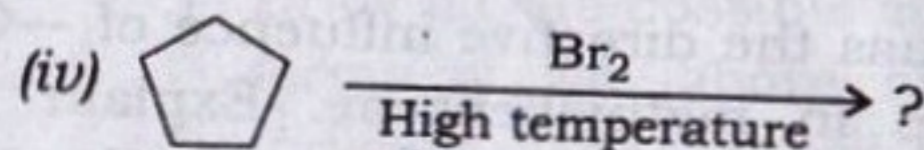
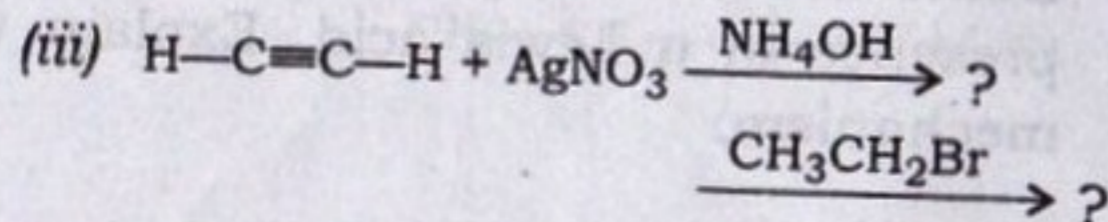
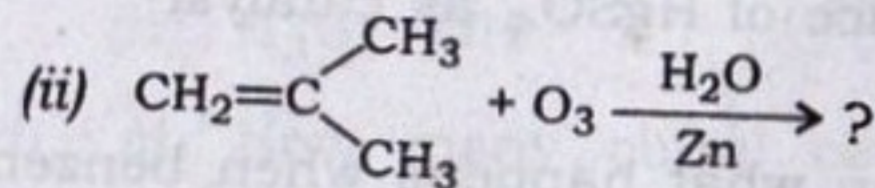
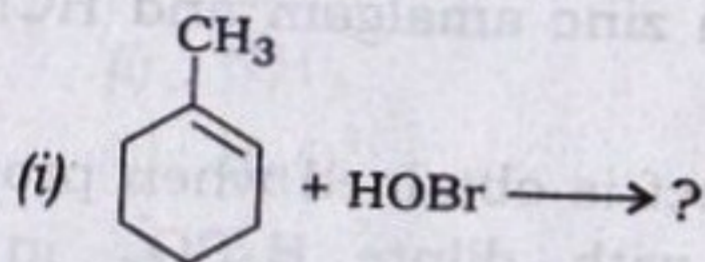
- (f) Explain why peroxide effect is shown by HBr only and not by HCl or HI. 1½

OR

8. (a) What is Baeyer's reagent? How does ethene react with Baeyer's reagent? 1½

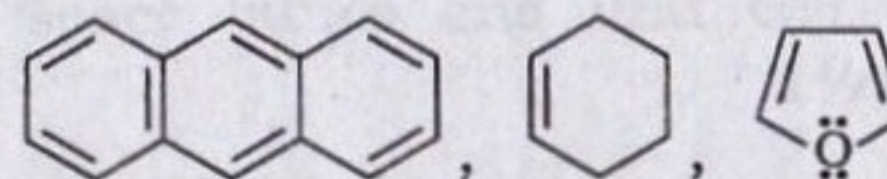
- (b) Explain why electrophilic addition in alkynes are slower than in alkenes. 2

- (c) Write the product(s) of the following reactions : 1×4=4



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- (d) What is Hückel's rule? Which of the following molecules are aromatic and why? 2



## SECTION—III

## ( Physical )

( Marks : 18 )

9. (a) State the postulates of kinetic theory of gases. 3
- (b) Calculate the root-mean-square velocity of oxygen molecule at NTP. 2
- (c) Write short notes on the following :  $2 \times 2 = 4$
- (i) Surface tension
- (ii) Refractive index

OR

10. (a) Derive the van der Waals' equation of state for real gases and mention the significance of the parameters in the equation. 4
- (b) Explain the types of liquid crystals with examples. 4
- (c) Define viscosity of a liquid. 1

11. (a) State the law of constancy of interfacial angles. 2
- (b) Explain space lattice and unit cell of crystals.  $1\frac{1}{2} + 1\frac{1}{2} = 3$
- (c) What are colloids? How would you prepare the colloidal solution of (i)  $\text{Fe}(\text{OH})_3$  and (ii) gold?  $1 + 1\frac{1}{2} + 1\frac{1}{2} = 4$

OR

12. (a) Write short notes on the following :  $2 \times 2 = 4$
- (i) Tyndall effect
- (ii) Protective colloids
- (b) Explain Schottky and Frenkel defects in crystals.  $1\frac{1}{2} + 1\frac{1}{2} = 3$
- (c) Calculate the Miller indices of crystal planes which cut through the crystal axes at  $(2a, 3b, c)$ . The terms have their usual meanings. 2

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