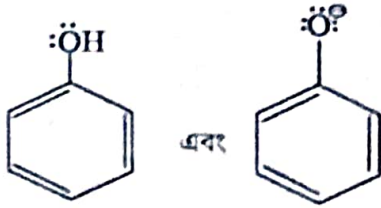


(গ) (অ) ব্যাখ্যাসহ নিম্নলিখিত অণুগুলির (species) স্থায়িত্বের তুলনা করো :



(আ) নিম্নলিখিত যৌগটিতে বেঞ্জিন শৃঙ্খলের উপর N পরমাণুর নিসেস ইলেকট্রনজোড় সীমাবদ্ধ থাকে (not delocalised) কেন — ব্যাখ্যা করো।



$(1\frac{1}{2} + 1\frac{1}{2} + 1) + 0 + (1\frac{1}{2} + 1\frac{1}{2})$

[ English Version ]

The figures in the margin indicate full marks.

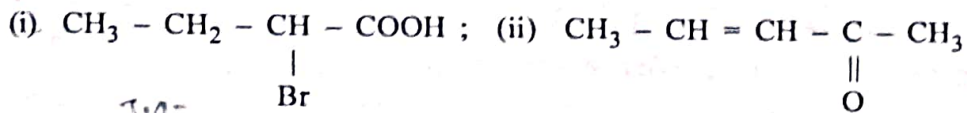
Answer question nos. 1, 2, 3, 4 (compulsory) and any four from the rest (question nos. 5 to 10).

1. Answer any ten questions :

2×10

(a) Elements of which groups show inert pair effect? Name any two elements showing this effect.

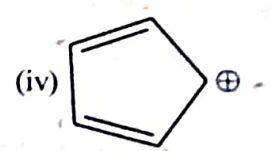
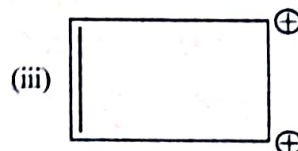
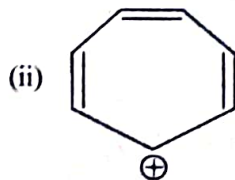
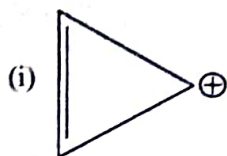
(b) Write down the IUPAC nomenclature of the molecules shown below :



(c) Show that isothermal free expansion of an ideal gas is adiabatic.

(d) Arrange the s, p, d and f electrons in increasing sequence of their screening effect. Justify your answer.

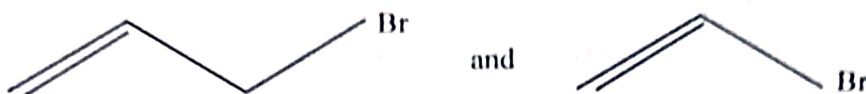
(e) Classify the following species as aromatic or antiaromatic :



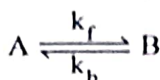
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(1234)

- (f) Write down the mathematical expression of the first law of thermodynamics, explaining each term.
- (g) Name any two liquid elements in the periodic table.
- (h) Tertiarybutanol is miscible in water in all proportions but *n*-butanol is partly miscible.— Explain.
- (i) The half-life period of a zero order reaction is directly proportional to the initial concentration of the reactant. — Justify or criticise.
- (j) The valence shell electronic configuration of both Ca and Zn is  $4s^2$  but the first ionisation energy of Ca is lower than that of Zn.— Explain.
- (k) Which of the following pair of molecules has the higher dipole moment and why?



- (l) Draw the concentration versus time curve for the following first-order opposing reaction :



2. Write short notes on :

(a) de Broglie Hypothesis using the following points :

- (i) Statement with mathematical expression  
 (ii) Significance.

Or,

(b) Electron affinity of an atom using the following points :

- (i) Definition  
 (ii) Variation along a period and a group  
 (iii) Comparison of electron affinity between fluorine and chlorine.

3. Write short notes on :

(a) Inductive effect using the following points :

- (i) Three salient features of inductive effect.  
 (ii) Comparison of acidity order of chloroacetic acid, bromoacetic acid and iodoacetic acid. 3+2

- (b) (i) Full forms of HOMO, LUMO and SOMO. *high order molecular orbital*  
 (ii) Characteristics of  $\sigma$ ,  $\sigma^*$ ,  $\pi$ ,  $\pi^*$  and  $n$  molecular orbitals. *high order molecular orbital*  
 (iii) Arrangement of  $\sigma$ ,  $\pi$ , and  $\pi^*$  molecular orbitals in increasing order of energy. *high order molecular orbital*

$$1\frac{1}{2} + (\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2}) + 1$$

4. Write short notes on :

(a) Heat capacity using the following points :

(i) Thermodynamic definitions of  $C_p$  and  $C_v$ .

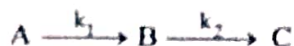
(ii) Derivation of  $C_p - C_v = T \left( \frac{\partial P}{\partial T} \right)_V \cdot \left( \frac{\partial V}{\partial T} \right)_P$

(1+1)+3

Or,

(b) Consecutive reaction using the following point :

(i) For the first-order consecutive reaction



Concentration of B at time t.

(ii) Concentration versus time curves for A, B and C.

3+2

5. (a) State Pauli's exclusion principle and apply this to predict the maximum capacity of 2p subshell for accommodating electrons.

(b) Draw the orbital picture of  $H_3C - C \equiv C - H$  mentioning the hybridisation of each carbon atom.

(c) Derive the expression for work done in an isothermal reversible expansion of n moles of an ideal gas at a given temperature.

4+3+3

6. (a) Draw the molecular orbital (MO) diagram of an allyl cation ( $CH_2 = CH - \overset{\oplus}{C}H_2$ ) mentioning HOMO and LUMO in the ground state and also in the excited state along with electronic arrangements.

(b) At 25°C, the half-life period for the decomposition of  $N_2O_5$  is  $2.05 \times 10^4$  sec and is independent of initial concentration of  $N_2O_5$ .

(i) What is the order of the reaction?

(ii) What length of time is required for 80% of  $N_2O_5$  to decompose?

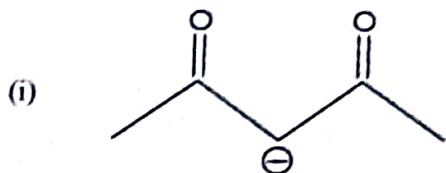
(c)  $Na^+$  is smaller in size than Na whereas  $Cl^-$  is larger in size than Cl.— Explain.

(1/2+1/2+1)+(1+2)+3

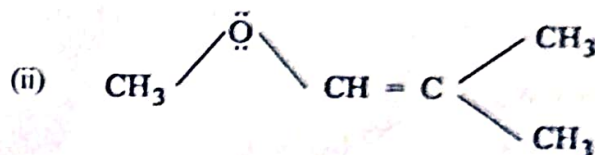
7. (a) What are state functions and path functions? Show that volume of an ideal gas is a state function.

(b) Name the group in the Periodic Table where solid, liquid and gaseous elements are simultaneously present. Mention the physical state of each element in this group.

(c) Draw the resonating structures of the following molecules and designate the contributory resonating structure.



;

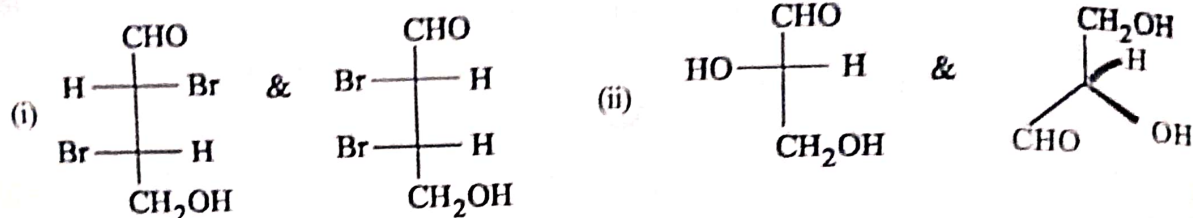


4+3+(1/2+1/2)

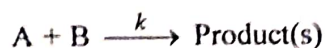
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(1234)

8. (a) Calculate the effective nuclear charge of one 4s and one 3d electrons in Zn (zinc) atom ( $Z = 30$ ).
- (b) Identify the relationship between following pairs of molecule as enantiomer/diastereoisomer.



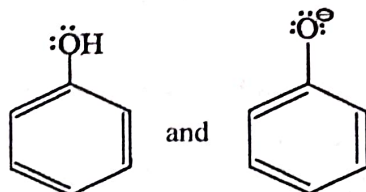
- (c) Consider the following second-order reaction :



Derive an expression for the rate constant  $k$  assuming the initial concentrations of both the reactants are equal.

$4 + (1/2 + 1/2) + 2$

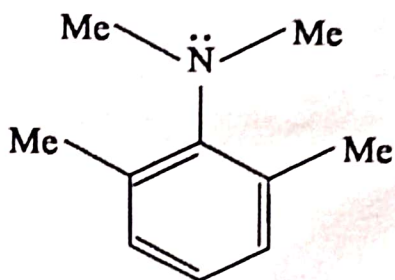
9. (a) (i) Define stereogenic centre with a suitable example.  
 (ii) Compare the dipole moment of chloroethane and chloroethene with explanation.
- (b) Define enthalpy of a closed system. Show that enthalpy change of a system is equal to the amount of heat absorbed by the system at constant pressure.
- (c)  $IE_2$  of an element is more than its  $IE_1$  ( $IE = \text{Ionisation energy}$ )— Explain. (2+2)+3+
10. (a) 2 moles of an ideal monoatomic gas initially at  $100^\circ\text{C}$  and 5 atm pressure expand adiabatically and reversibly to 2 atm pressure. Calculate —
- Work done by the gas
  - Final molar volume
  - Change in enthalpy.
- (b)  $\text{SnCl}_2$  is a reducing agent but  $\text{PbCl}_2$  is not— Explain.
- (c) (i) Compare the stability order of the following species with explanation :



(9)

*B(1st Sm.)-Chemistry-H/MN-1/CCF*

- (ii) Lone pair on the N atom is not delocalised over the phenyl ring for the following compound. Explain why.



$$(1\frac{1}{2}+1\frac{1}{2}+1)+3+(1\frac{1}{2}+1\frac{1}{2})$$