[4]

5. What are the salient features of VSEPR ? Use it to explain the structure of SF_4.   2+2

6. a) The radii of Sr^{2+} and F^- are 113 pm and 136 pm respectively. Using radius ratio calculations predict its structure. What is such a structure called ? $1\frac{1}{2}+\frac{1}{2}$

   b) What are the essential aspects in Fajan's rules that predict properties of different chemical compounds.   2

First B. Sc. Examination, 2019

(2nd Semester, Old Syllabus)

Chemistry (Subsidiary)

Paper - III-S

Time : Two hours   Full Marks : 50

Use a separate Answer-Script for each Group.

GROUP - A

1. a) Discuss the criteria for achieving the state of "thermodynamical equilibrium" condition. "The final pressure for an adiabatic expansion is always lower compare to that of corresponding isothermal expansion up to same final volume" – Explain or criticize the statement.   2+2

   b) Explain the significance of Zeroth law of thermodynamics? Explain the fact that the internal energy of an ideal gas only depends on its temperature.   2+2

   c) State Hess's law for constant heat summation. Deduce the relation to calculate the heat of a reaction involving a gaseous reactant or product under a constant pressure condition (assume ideal behavior for the gaseous species).   2+3

   d) Calculate the latent heat of fusion of ice at $-20^{\circ}C$, if that at $0^{\circ}C$ is 1440 cal mol^{-1} the specific heat of ice being 8.7 cal. mol^{-1}.   4
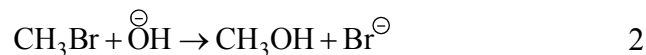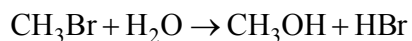
[Turn over

GROUP - B

2. a) Draw the properly labelled orbital picture of 'benzene' showing hybridisation of each carbon atom. Comment on its shape. 3

b) Predict the product of the following reaction. Explain its formation. 3

 — Cl $\xrightarrow{SbCl_5}$
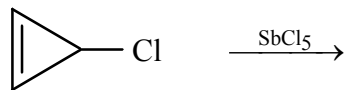
c) Which S_N2 reaction of the following pair will occur more readily?

$$CH_3Br + H_2O \rightarrow CH_3OH + HBr$$

$$CH_3Br + \overset{\ominus}{O}H \rightarrow CH_3OH + Br^{\ominus}$$ 2

d) Predict the reagent(s) required for the following reaction. Write down the mechanism of the reaction with properly labelled energy profile diagram. 5

 $\longrightarrow$ Br
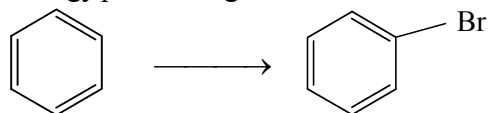
e) Which one of the following pair will undergo faster hydrolysis in aqueous alkali? Suggest the mechanism for the process and justify your answer by compairing the stabilities of the intermediates formed. 4
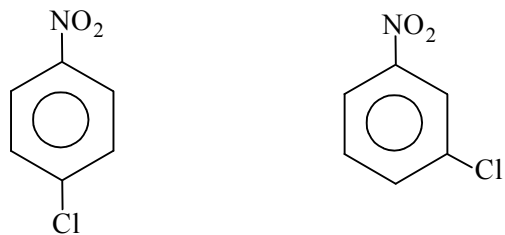
GROUP - C

Answer Question *3* and *any two* from the rest.

3. a) Construct the Born Haber cycle for $MgCl_2$ and hence calculate its lattice energy from the given thermochemical data.

$$\Delta H_{sub}{}^{Mg} = 120 \text{ KJ mol}^{-1} ; \Delta H_{IP}{}^{Mg} = 756 \text{ KJ mol}^{-1} ;$$

$$\Delta H_{IP}{}^{Mg+} = 1490 \text{ KJ mol}^{-1} ; \Delta H_{diss}{}^{Cl_2} = 242 \text{ KJ mol}^{-1};$$

$$\Delta H_{EA}{}^{Cl} = -347 \text{ KJ mol}^{-1} ; \Delta H_{f}{}^{MgCl_2} = -700 \text{ KJ mol}^{-1} ;$$ $2\frac{1}{2} + 1\frac{1}{2}$

b) What is the relationship between ion-pair energy and lattice energy? 1

c) Mention the basic assumptions for deriving the Born-Lande equation. $1\frac{1}{2}$

d) Derive the limiting condition for radius ratio of cation to anion having coordination number eight in a body centered cubic lattice. $1\frac{1}{2}$

4. a) With the help of a suitable example describe the utility of radius-ratio calculations. 2

b) Stannous chloride is a solid while stannic chloride is a liquid. Explain. 2