

2022

Time - 3 hours

Full Marks - 60

*Answer all groups as per instructions.
Figures in the right hand margin indicate marks.*

GROUP - A

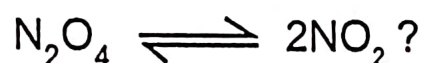
1. Answer all questions and fill in the blanks as required. [1 × 8]
- (a) State Le-Chatelier's principle.
 - (b) Define enthalpy of combustion.
 - (c) What is molar volume of water ?
 - (d) Give the physical significance of Helmholtz free energy.
 - (e) Define Van't Hoff factor.
 - (f) What is molal freezing point depression constant of a solvent ?
 - (g) If $\Delta H < 0$ and $\Delta S < 0$, then the reaction proceeds at _____ temperature.
 - (h) State zeroth law of thermodynamics.

[2]

GROUP - B

2. Answer any eight of the following within two or three sentences each. [1½ × 8

- (a) Define partial molar free energy.
- (b) Write one statement of 2nd law of thermodynamics.
- (c) What is the relationship between K_p and K_c for



- (d) How is chemical potential related to free energy of a system ?
- (e) What is intensive property ? Give an example.
- (f) What is the work done when a gas expands against vacuum ?
- (g) What is the condition under which Raoult's law becomes same as Henry's law ?
- (h) What is fugacity ?
- (i) Define adiabatic flame temperature.
- (j) What should be the value of ΔG for a spontaneous process ?

GROUP - C

3. Answer any eight of the following within 75 words each. [2 × 8

- (a) What are isotonic and hypertonic solutions ?
- (b) What is abnormal molecular mass ? Define Van't-Hoff factor.

- (c) Explain thermodynamic scale of temperature.
- (d) Briefly describe explosion temperature.
- (e) Calculate ΔH^0 for the decomposition of CaCO_3 . Given that $\Delta_f H^0$ for CaO , CaCO_3 and CO_2 are -635.5 kJ , -1207 kJ and -393.5 kJ respectively.
- (f) State two different forms of 1st law of thermodynamics.
- (g) Differentiate between bond dissociation energy and bond energy.
- (h) Write the Gibb's Helmholtz equation. Specify the different terms involved.
- (i) Show that K_p and K_c are same for $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$.
- (j) Define reaction quotient. How does it predict the direction of the reaction ?

GROUP - D

Answer any four questions within 500 words each.

4. Derive the relation between C_p and C_v for 1 mole of an ideal gas. Derive the relation between q , w and ΔU . [6]
5. Derive an expression for work done in a reversible isothermal expansion of an ideal gas. [6]
6. Derive an expression for Joule Thomson coefficient (μ_{JT}). What is inversion temperature ? [6]

[4]

7. Define Gibb's free energy. How does it vary with temperature and pressure ? What is residual entropy. [6]
8. Derive Gibb's Duhem equation. [6]
9. Thermodynamically derive the relation between Gibb's free energy of a reaction and reaction quotient. [6]
10. How can molecular mass of a solute be determined by elevation in boiling point method ? Derive an expression for it. [6]