Total number of printed pages–4

3 (Sem–1) CHM M 1

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2021

(Held in 2022)

CHEMISTRY

(Major)

Paper : 1·1

(Physical Chemistry)

Full Marks : 60

Time : Three hours

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

1. Answer the following as directed : 1×7=7

   (i) What is open system ?

   (ii) What is the work done for free expansion ?

   (iii) Write the mathematical form of Gibbs-Duhem equation.

   (iv) Under what conditions is the heat of reaction equal to enthalpy change ?

   (v) What is first-order reaction ?

Contd.

(vi) Randomness increases, entropy increases. *(Write true **or** false)*

(vii) Write the integrated rate expression for zero-order reaction.

2. Answer the following questions : 2×4=8

(i) State and explain the first law of thermodynamics.

(ii) Give the differences between molecularity and order of a reaction.

(iii) What is temperature coefficient ? What is the effect of temperature on the rate of a reaction ?

(iv) What is the significance of Gibbs energy ?

3. Answer ***any three*** from the following questions : 5×3=15

(i) Define reversible and isothermal processes. Derive the expression for work done in reversible isothermal process. 2+3=5

(ii) Derive a relationship between K_P and K_C. 5

(iii) What is half-life period ? A zero-order reaction is 50% complete in 20 minutes. What percentage would be completed at the end of 30 minutes ? 1+4=5

(iv) Establish the relation $C_p - C_v = R$ for one mole of ideal gas. 5

(v) For a mole of van der Waals gas, calculate $(\partial S/\partial V)_T$. 5

4. Answer ***any three*** from the following questions : 10×3=30

(i) What is chain reaction ? Name the steps involved in chain reaction. Discuss the kinetics of H_2–Br_2 reaction. 1+1+8=10

(ii) What is enzyme catalysis ? Discuss Michaelis-Menten mechanism for an enzyme catalysis reaction. How will rate vary for low and high concentration of substrate ? 1+7+2=10

(iii) What is chemical potential ? How is chemical potential varying with temperature ? Derive Gibbs-Duhem equation. 2+2+6=10

(iv) Using combined form of the 1st and 2nd laws of thermodynamics and appropriate Maxwell relations, derive the two thermodynamic equations of state. 5+5=10

(v) What is 1st order reaction ? Derive the integrated rate law for 1st order reaction. Show that half-life of 1st order reaction is independent of initial concentration of reactant. Give *one* example of 1st order reaction. 1+6+2+1=10

(vi) Define Joule-Thomson effect and inversion temperature. Derive a relation of Joule-Thomson coefficient for ideal gas. 2+1+7=10