B.Sc. 1st Semester (Honours) Examination, 2020 (CBCS)

Subject: Chemistry

(Physical Chemistry-I)

Paper: CC–2

Time: 2 Hours **Full Marks: 40**

Candidates must give their answer legibly, in their own words as far as practicable.

Answer any *eight* questions from the following: **8 × 5 = 40**

1. Define critical temperature.In helium gas, the value of correction factor '*a*' due to intermolecular attraction tends to zero. The molar volume of He gas at 0°C and 50 atm is 2.1036×10^{-2} times the volume of the gas at N.T.P. Calculate the diameter of He atom.
2. Since $C_V = \left(\frac{\partial U}{\partial T}\right)_V$ by definition,one of ten writes $\Delta U = C_V \Delta T$ without any restriction which is not generally true. Explain why? State the differences between Joule-Thomson cooling and adiabatic cooling. For any system, $\oint dH = 0$ − justify the statement.
3. Plot the reversible Carnot cycle for an ideal gas systemusing(*a*)S-V diagram and (*b*) H-S diagram, labeling clearly all the steps involved in the process.
4. Which one of the differentials (PdV + VdP) and (PdV − VdP) is exact and why?
   Give examples of processes in each of which (*i*) $\Delta G< 0$, $\Delta S< 0$; (*ii*) $\Delta G< 0$, $\Delta S> 0$ and (*iii*) $\Delta G= 0$, $\Delta S< 0$for the system.
5. Explain how the internal energy of a non-linear tri-atomic molecule is partitioned according to the principle of equipartition of energy.Derive the expression for the most probable speed of the molecules of an ideal gas that are confined to move in a plane.
6. The first order rate constant (*k*) of a reaction A $\rightarrow$ P (products) follows the equation$\log k = 33.91 - \frac{18000}{T}$. Calculate the energy of activation at 127°C.Draw the rate versus time profile diagram for (*i*) a zero order reaction and (*ii*) a first order reaction.
7. What is meant by enzyme catalysis? Why are they highly specific in their action? How do you account for the fact that an enzyme-catalyzed reaction has an optimum pH for its maximumactivity?

8. Show that Boyle temperature $T_B = a/Rb$ for a van der Waals gas. If one writes the compressibility factor (Z) by the expression $Z = \alpha_0 + \alpha_1 P$, what can you say about the magnitude of α_0 and the signs of α_1 for different values of P?
9. Discuss the Lindemann theory for unimolecular reaction. How does the theory compare with the experimental results?
10. Point out the differences between the distribution curves for speed and kinetic energy of gas molecules.Prove that the area under the curve representing molecular speeds of an ideal gas is independent of temperature.
