# U.G. 1st Semester Examination - 2020
# CHEMISTRY

**Course Code : BCEMCCHC102**

**Course Title : Physical Chemistry–I**

Full Marks : 30 Time : 2 Hours

*The figures in the right-hand margin indicate marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

1. Answer any **ten** questions: 1×10=10

a) 'A zero-order reaction can not be a single-step reaction'–Justify.

b) Give example of an intensive and an extensive property.

c) Is $\Delta H$ always equal to $q_p$? Explain.

d) Can order and molecularity be same?

e) When does mean free path become independent of temperature and pressure?

f) Write down the expression of Boyle's temperature using Van der Waals constants.



g) Hess law of constant heat summation is a consequence of First law of thermodynamics. Explain.

h) Calculate the number of binary collison per cc nitrogen gas per second at 2 atm and 30°C. The collision diameter of the molecule is 3.74 Å .

i) The heats of formation of $CO_2$ from diamond and graphite are –94500 and –94050 cal respectively. What is the enthalpy-change is the transformation of diamond to graphite?

j) What is entropy of activation?

k) Show that at a particular temperature $O_2$ has higher average speed than $SO_2$.

l) What is the difference between activation energy and heat of reaction?

m) Write Kirchhoff's equations and mention its significance.

n) Write van der Waals equation for n moles of a gas.

o) Write a limitation of collision theory of a chemical reaction.

2. Answer any **five** questions: 2×5=10

a) Derive the expression of most probable velocity from Maxwell's distribution of molecular velocities.

b) Argon has $T_c$=–122°C, $P_c$=48atm, calculate the radius of the Argon atom.

c) Prove that dT is a perfect differential.

d) Two moles of TNT $\left[CH_3(C_6H_2)(NO_2)_3\right]$ on explosion produces 3 moles of CO and 2 moles of $N_2$. 410 calories of heat is evolved when 0.1135g TNT is exploded at 300K in a constant volume calorimeter. Calculate $\Delta U$ and $\Delta H$ when 2 moles of TNT is exploded at 300K.

e) 1000 litres of gas ($C_v$=3 cal.mol$^{-1}$) was initially at 0°C and 10 atm. Calculate the work done when the gas undergoes adiabetic reversible expansion till the final pressure 1 atm.

f) Write down the difference between order and molecularity.

g) Should an ideal gas have viscosity? Why?

h) Show that for a first order reaction time required for 75% reaction is twice the time for 50%.



3. Answer any **two** of the following: 5×2=10

a) i) One mole of a van der Waals gas expands reversibly at 27°C from 2 litres to 20 litres. Calculate the work done if $a=1.42\times10^{12}$ dynes. cm$^4$.mol$^{-1}$ and b=30cc per mole.

ii) Combustion of heptane ($C_7H_{16}$) is done in a constant volume calorimeter. Calculate the change in enthalpy of the process at 25°C, if $q_p$= –4793kj at 25°C. 3+2

b) i) Activation energy of some reaction may be zero–Justify.

ii) How the activation energy of a reaction may be determined experimentally?

iii) For a reaction with $E_a$=19 kJmol$^{-1}$ by what factor is *k* multiplied when T increases from 300K to 310K? 1+2+2=5

c) i) Derive the expression of collision frequency per cc per second for the mixture of two different gases.

ii) What do you mean by Lennard-Jones potential?

iii) Write Maxwell's kinetic energy distribution in one dimension. 2+2+1=5