M.Sc. RNLKWC-/CEM-101/22

2022

PHYSICAL CHEMISTRY

M.Sc. First Semester End Examination - 2022

PAPER - CEM-101

Full Marks : 40 ***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.
Illustrate the answers wherever necessary.

Group-A

1. Answer any four from the following : $2\frac{1}{2}\times4=10$

(a) Verify whether the operator ∇^2 is linear.

(b) Discuss the physical meaning of Gibbs-Duhem equation.

(c) $[x,p_y]=0$. State the physical significant it.

(d) Application of Nano structured material for biomedicine.

(e) Difference between ionisation potential and Morse potential.

(f) How does isotopic substitution effect the rotational spectra of a rigid diatomic molecule?

Group - B

Answer any four from following :

2. (a) Write down essential condition for an algebric operator should be quantum mechanical operator. 2

(b) Write down the normalized form of wave function $\psi_n(x)$ for a particle in one dimensional box of length 'l'. Extablish the orthogonality between $\psi_n(x)$ and $\psi_m(x)$ for $n \neq m$. 3

3. (a) Find the maximum populated rotational energy level of $^{12}C^{16}O$ molecule at 25°C for which B=1.93 cm^{-1}. $2\frac{1}{2}$

(b) Phenol is aqueous solution less acidic but acidity increases on absorbtion of radiation –Explain. $2\frac{1}{2}$

4. (a) Express fugacity for real system. 3

(b) Difference between molar volume and partial molar volume. 2

5. (a) Difference between Boson and Femious. 3

(b) What is Gamma space. 2

6. Write three instrumental techniques for the characterization of nanomaterials. 5

7. Factors on which spectral lines in tensity depends – discuss. 5

Group - C

Answer any one from the following. 1×10=10

8. a) The Morse potential is given by the expression $v(r)=De[1-\exp\{-b(r-r_e)]^2$

(i) Sketch the potential schematically and comment on the volume of V at r=0 and r=α.

(ii) Show for small displacement from equilibrium position the above function in approximately by simple harmonic potential. 6

(b) What are stationary state? Show that the function $e^{\frac{-2\pi iEi}{h}}.\psi(x)$ represents a stationary state. 4

9. (a) Derive Bose-Einstein distribution law. 5

(b) Show that in a binary syste, the decrease in free energy of mising is maximum if $x_1=x_2=0.5$ (where x_1 and x_2 are the mole fraction of the 1st and 2nd component respectively. 5