BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSC **SEMESTER : VI**
BRANCH: CHEMISTRY **SESSION : SP/19**

SUBJECT: IMC6001 PHYSICAL CHEMISTRY-II

TIME: 3.00 Hrs. **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Write down the Planck's distribution law for blackbody radiation. [2]

Q.1(b) Find de Broglie wavelength of an electron of kinetic energy (a) 1 keV; (b) 1 MeV [4]

Q.1(c) X-rays of wavelength 1 Å are scattered by a carbon block. The scattered radiations are viewed at an angle of 90 degree to the direction of incidence. Calculate the Compton shift and the energy imparted to the recoil electron in joules. Assume that rest mass of electron, velocity of light and Planck's constant are known. [6]

Q.2(a) What are the basic differences between the theories of Einstein and Debye molar heat capacities? [2]

Q.2(b) The work function for the platinum metal is 8×10^{-19} J. Will a radiation of wavelength 200 nm be able to cause photoelectric effect in it? If so, what will be the velocity of the electron ejected from the surface? (Given: 10^{-19} J = 5035.7 cm^{-1}, and mass of the electron = 9.1×10^{-31} kg, c = 3×10^{10} cm s^{-1}) [4]

Q.2(c) Write down the postulates of quantum mechanics. [6]

Q.3(a) Show that the wave function $\Psi = A \exp(ikx)$ for a free particle cannot be normalised. [2]

Q.3(b) Calculate the spacing between energy level for (i) an electron (mass ≈ 10^{-30} kg) in a one dimensional box of 1.0 Å length, and (ii) a ball bearing (mass = 1 g) in box of 10 cm length. Comment on the energy gaps in the two cases. [4]

Q.3(c) Derive the time-independent Schrodinger equation and explain its importance. [6]

Q.4(a) Are matter waves electromagnetic? Explain. [2]

Q.4(b) Calculate the probability of locating the particle in the ground state one-dimensional box between a/4 and 3a /4, where 'a' is the width of the box. [4]

Q.4(c) Explain the different factors influence the line width of spectral line. [6]

Q.5(a) State the selection rule for rotational spectroscopy. [2]

Q.5(b) How will you classify the molecules on the basis of principal moments of inertia? [4]

Q.5(c) The separation between adjacent rotational transitions in $^{12}C^{16}O$ is 4.0 cm^{-1}, estimate the bond length of CO. [6]

Q.6(a) Discuss the essential condition of a molecule to be IR-active. [2]

Q.6(b) Draw and explain the Morse potential energy diagram for an anharmonic diatomic oscillator. [4]

Q.6(c) The force constant of CO is 1840 N m^{-1}. Calculate the vibrational frequency in cm^{-1} and the spacing between the vibrational energy levels in ev. Compare this spacing with the thermal energy at room temperature and comment on your result. [^{12}C = 19.9×10^{-27} kg; ^{16}O = 26.6×10^{-27} kg; 1 ev = 8080cm^{-1}]. [6]

Q.7(a) How will you differentiate between Raman scattering and Compton scattering? [2]

Q.7(b) Describe the Raman scattering with suitable diagram? [4]

Q.7(c) The exciting line in an experiment is 5660 Å and the Stokes line is 5800 Å. Calculate the wavelength of the anti-Stokes line. [6]

:::::22/04/2019 E::::