Rajiv Gandhi Institute of Petroleum Technology

End-Semester Examination

Course & Code	**Inorganic & Physical Chemistry (CY111)**
Full Marks	**60**
Date	**28/Feb/2023**
Time	**03 Hours**

- **MUST write your answers in the answer-sheet SEQUENTIALLY as provided in the question paper.**
- All the questions (**Total FIVE**) are compulsory.

Q-1.

(I). The particle-in-a-box ground state has quantum number n = 0.

(a) May Be/May Not Be
(b) False
(c) True
(d) Illogical question

1

(II). Uncertainty principle is applicable to

(a) Perfect Gas
(b) Macroscopic particles
(c) Dynamic particles
(d) Static Microscopic particles

1

(III). In a reaction, A + B → Product, rate is doubled when the concentration of B is doubled, and rate increases by a factor of 8 when the concentrations of both the reactants (A and B) are doubled, rate law for the reaction can be written as

(a) Rate = k [A] [B]
(b) Rate = k $[A]^2$ [B]
(c) Rate = k [A] $[B]^2$
(d) Rate = k $[A]^2$ $[B]^2$

1

(IV). What is Potentiostat ?

(a) An instrument that controls the voltage between two electrodes
(b) An instrument that that circulates the solid particles between two electrodes
(c) An instrument that controls the resistance between two electrodes
(d) An instrument that circulates the solution between two electrodes.

1

(V). Dispersion is different from solution at -

(a) Quantum level
(b) Volumetric level
(c) Macroscopic level
(d) Microscopic level

1

Q-2.

(i) What is black body ?

(ii) Write down the Hamiltonian Operator for He atom.

(iii) State the conditions for an acceptable wavefunction.

(iv) Determine the probability of finding electron in a 1Dimensional box from L/2 to L/4 for n=2. Provide a rationale with value (probability) obtained from classical physics.

(V) Draw the energy level diagram (π-MO) showing the HOMO and LUMO one for 1, 3, 5-hrxatriene, C_6H_8. Calculate the wavelength of light required to induce a transition from its ground state to the first excited state. Assume that molecule is linear and use the values 135 and 154 pm for C=C and C-C bond, respectively.

1+2+3+4+5

Q-3.

(i) Determine the no. of vibrational modes for benzene (C_6H_6) molecule

(ii) State Heisenberg Uncertainty Principle. What are the reasons for spectral broadening.

(iii) A microscope using suitable photons is employed to locate an electron in an atom within a distance of 0.1 Å. What is the uncertainty involved in the measurement of its velocity?

(iv) Calculate the molar absorptivity of a 0.01×10^{-3} M solution, which has an absorbance of 0.27, given the path length is 13 mm.

(v) Describe Transition State Theory. The rate of a reaction becomes four times when the temperature changes from 293 K to 313 K. Calculate the activation energy (E_a) of the reaction assuming that it does not change with temperature. [R= 8.314 $JK^{-1}mol^{-1}$, log 4= 0.6021]**.**

1+2+3+4+5

Q-4.

(i) What is triple point?

(ii) Draw the Chemical Potential vs Temperature graph having all three solid, liquid, and gas phases. Explain the origin of different slopes.

(iii) The vapour pressure of dichloromethane at 24.1°C is 53.3 kPa and its enthalpy of vaporization is 28.7 kJ mol^{-1}. Estimate the temperature at which its vapour pressure is 70.0 kPa.

(iv) Draw (pressure vs temperature) and explain (phase boundary, triple point, critical point, degrees of freedom, state at ambient condition) the Phase diagram of Water or CO_2.

1+2+3+4

Q-5.

(i) Define the feasibility of an Electrochemical reaction.

(ii) State the differences between two-electrodes assembly and three-electrodes assembly.

(iii) Calculate the equilibrium constant of the cell reaction $2Ag^+ + Zn \rightleftharpoons 2Ag + Zn^{2+}$ at 25 °C when $[Zn^{2+}]$ = 0.1 M, $[Ag^+]$ = 10 M, and E° of the cell = 1.62 V.

(iv) Sketch the diagram of Fuel Cell. Write down the redox reactions which occur at anode and cathode in Fuel cell.

(v) The following data were obtained on the anodic current through a Pt electrode area of 2 cm^2 in contact with an Fe^{3+}/Fe^{2+} aqueous solution at 25 °C.

η (mV)	50	100	150	200	250
i_a (mA)	8.8	25.0	58.0	131.0	299.0

Calculate the exchange current density and the transfer coefficient for the electrode process using the Tafel plot.

1+2+3+4+5

----------**THANK YOU**----------