

# Hooghly Mohsin College

## Department of Chemistry

B.Sc. Semester VI (NEP) Internal Assessment – 2026

Course code: CHEM6013 (3 and 4 Years); Course title: Physical Chemistry (Theory)

F.M. 10

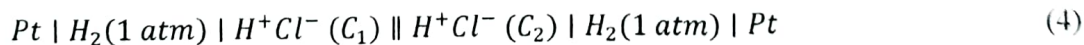
Time: 30 min

**Unit – 1:** Answer any *two* questions from the following (3 x 2 = 6)

1. Draw the labelled phase diagrams for  $H_2O$  and  $CO_2$  systems. Indicate the differences between the two diagrams. (2+1)
2. What is Quinhydrone Electrode? Write down the e.m.f expression of the Electrode. (3)
3. Photochemical equilibrium of dimerization of anthracene ( $2A \rightleftharpoons A_2$ ) may be represented by the following mechanism: (i)  $A \xrightarrow{h\nu} A^*$ , (ii)  $A^* + A \rightarrow A_2$ , (iii)  $A_2 \rightarrow 2A$ , (iv)  $A^* \rightarrow A + h\nu'$ ; Applying steady state approximation on the concentration of  $A^*$  calculate the rate of formation of  $A_2$  when the system is at the photostationary state.  
What is photosensitization? Give an example. (2 + 1)
4. Draw a labelled Jablonski diagram. Hence compare fluorescence and phosphorescence.  
Experimentally found quantum yield may be as low as 0.01 and high as  $10^3$ . Explain whether this contradicts the Sterk-Einstein law. (2 + 1)
5. Derive the expression for rotational quantum number of the level having the maximum population ( $J_{max}$ ). (3)
6. In a 80 MHz NMR instrument Compound 'T' gives two lines at intervals of 188 Hz and 578 Hz in reference to the instrument frequency. What will be values in a 250 MHz instrument? (3)

**Unit – 2:** Answer any *one* question from the following (4 x 1 = 4)

1. Derive Duhem—Margules equation stating clearly the assumptions. Show that if Raoult's law is applicable to one of the constituents of a binary liquid mixture, at all compositions, it must be equally applicable to the other constituent. (2 + 2)
2. Distinguish between cell potential and electromotive force. Write the overall cell reaction of the following cell and derive the e.m.f expression of the cell.



3. When propanaldehyde is irradiated with light of  $\lambda = 3020 \text{ \AA}$ , it is decomposed to form carbon monoxide:  $CH_3CH_2CHO \xrightarrow{h\nu} CH_3CH_3 + CO$ . The quantum yield for the reaction is 0.54 and light energy absorbed is 15000 erg/mol in a given time. Find the amount of carbon monoxide formed (in moles) in the reaction.

Define molar extinction coefficient of a substance stating its unit. What is its significance? (2 + 2)