

B.Sc. 4th Semester (Honours) Examination, 2021

CHEMISTRY

(Physical Chemistry-III)

Paper: UG/CHEM/401/C-8

Course ID: 41411

Time: 1 Hour 15 Minutes

Full Marks: 25

*The figures in the right hand side margin indicate marks.
Candidates are required to give their answers in their own words
as far as practicable.*

1. Answer any five of the following questions: 1×5 = 5

- (a) Write down the Schrödinger equation for hydrogen atom in polar coordinates.
- (b) What is critical solution temperature?
- (c) Explain why KCl is preferred to make a salt bridge?
- (d) The value of DH constant $A = 0.51$ at 25°C . Calculate its value at 30°C .
- (e) When can the van't Hoff factor i be integral?
- (f) "EMF is an extensive property." – comment.
- (g) Why quinhydrone electrode does not working above pH 8?
- (h) Find the dimension of (hd/dx) .

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

- (a) In the equation $\bar{V}_1 \pi = RT \ln \frac{P_1^0}{P_1}$, where π is osmotic pressure of a solution, what do \bar{V}_1 , P_1^0 and P_1 actually signify? Arrive at this equation from the definition of chemical potential. 5
- (b) (i) Polarizability of CCl_4 is independent of temperature whereas that of CHCl_3 changes with temperature - explain.
- (ii) Draw a net phase diagram for CO_2 system. 2+3 = 5

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(c) Write down the time-independent Schrödinger equation for H atom. Separate it into three independent equations of polar coordinates r, θ and ϕ . 5

(d) (i) Explain the principle of determination of pH of a solution using quinhydrone electrode.

(ii) Calculate mean ionic activity for a 0.01 molal solution of H_2SO_4 at $25^\circ C$, where the mean activity coefficient is 0.265. 3+2 = 5

3. Answer *any one* of the following questions: 10×1 = 10

(a) (i) Calculate the average value of $(1/r)$ for the 1s orbital of an H-atom and obtain the average potential energy. What is the average kinetic energy? Show that $\left(\overline{\frac{1}{r}}\right) \neq \frac{1}{r}$

(ii) Is azeotrope a true compound? - Explain.

(iii) At $25^\circ C$ the standard electrode potential for the Ag^+/Ag electrode is 0.7991 V and solubility product for AgI is 8.2×10^{-17} . What is the standard electrode potential for $I^-/AgI/Ag$? 5+2+3 = 10

(b) (i) Write the Clausius-Mosotti equation.

(ii) With increase of pressure, the melting temperature of paraffin increases but that of ice decreases - Explain.

(iii) A solution contains 0.01(M) NaCl and 0.02(M) $CaCl_2$. Calculate the mean ionic activity coefficient of NaCl in the solution. Given $A = 0.51$.

(iv) Write down the S.I. unit of ' RT/F ' and its value at 300 K.

(v) Point out the advantages and disadvantages of calomel electrode.

(vi) Calculate the ground state energy of an electron confined to a potential well with a width of 0.2 nm. 1+2+2+1+2+2 = 10
