Q.P. Code : 20447

[Time: 2:30 Hours]   **[Marks:75]**

Please check whether you have got the right question paper.

N.B: 1) All questions are compulsory.

            2) Figures to the right indicate full marks.

            3) Use of log tables/ non-programmable calculator is allowed.

<u>Physical constants:</u>

$N=6.022 \times 10^{23}$ mol^{-1} $h=6.626 \times 10^{-34}$ J s $\frac{2.303\,R\,T}{F} = 0.0592$ at 298 K

$F = 96500$ C $k=1.38 \times 10^{-23}$ K^{-1}

$R = 8.314$ JK^{-1} mol^{-1} l a. m. u. = 1.66×10^{-27} kg

$c= 3 \times 10^{8}$ ms^{-1} H= 1 a.m.u.

$\pi =3.142$ I = 127 a.m.u.

Q.1.   Attempt **any three** of the following:

A) Explain the isotopic shift in rotational spectra.   **5**

B) Explain the P and R branch lines in rotational -vibrational spectra.   **5**

C) Explain the IR spectra of water molecule.   **5**

D) What is Raman effect and Raman shift? Explain stokes and anti-stokes lines.   **5**

E) What is zero point energy? The vibrational frequency of a molecule 8×10^{5} m^{-1} Calculate zero point energy.   **5**

F) The frequency separation in rotational spectra of HI is 1280 m^{-1}. Calculate the bond length for the diatomic molecule.   **5**

Q.2.   Attempt **any three** of the following:

A) Derive an expression for emf of electrolyte concentration cell with transference reversible to anion.   **5**

B) Derive Nernst equation for a galvanic cell.   **5**

C) What are the conventions used for representing the galvanic cell?   **5**

D) Derive an expression for emf of electrolyte concentration cell without transference reversible to cation.   **5**

E) Calculate the mean activity coefficient of NaCl in a solution containing 0.1 m NaCl and 0.2m K$_2$SO$_4$ (A=0.509)   **5**

F) Calculate the emf of the cell   Pt,H$_{2(g)}$ / HCl | HCl / H$_{2(g)}$,Pt   **5**
                                                m= 0.12 | m = 0.2
                                               $\gamma = 0.78$ | $\gamma = 0.76$

If transport number of hydrogen is 0.85.

Q.3. Attempt **any three** of the following:

A) Derive Clapeyron equation. 5

B) Derive Van't Hoff equation for osmotic pressure. 5

C) Explain the phase diagram of lead-silver system. 5

D) Explain the application of phase rule to water system. 5

E) Explain the phenomenon of reverse osmosis. 5

F) Define molal elevation constant. A solution containing 2g of a non-volatile solute in 100g water boils at 373.14K. Calculate the molecular weight of the solute. Boiling point of water=373K, K_b=0.512 kg mol^{-1}. 5

Q.4. Attempt **any three** of the following:

A) Derive Langmuir's adsorption isotherm. 5

B) State BET equation and explain the terms involved. 5

C) Describe the characteristic features of catalysis. 5

D) Write a note on colloidal electrolytes. 5

E) Explain Donnan Membrane equilibrium. 5

F) The volume of a gas forming monolayer on 1g charcoal is 130dm^3. Calculate the surface area of adsorbent if area occupied by each gas molecule is 17×10^{-20} m^2. 5

Q.5. A) State true or false: 4

a) Unit of dipole moment is Debye.

b) BF_3 has planar structure.

c) CO_2 has 4 degrees of freedom.

d) HF is microwave inactive.

OR

A) Match the following: 4

p) Raman effect	i) Tetrahedral
q) CH_4	ii) Basic quantum theory
r) Rotational spectra	iii) In-plane vibration
s) Rocking	iv) Microwave spectra
	v) Linear

B) State true or false: 4

a) Reduction is gain of electrons.

b) At left hand electrode oxidation takes place in galvanic cell.

c) Salt bridge contains agar-agar and KNO_3.

d) LJP cannot be minimized using salt bridge.

OR

B) Choose the correct answer: **4**

p) For uni-univalent electrolyte activity a is _____.
($m^2\gamma^2, 4m^3\gamma^3, 27m^4\gamma^4$)

q) Pt I Fe^{+2}, Fe^{+3} is _____ electrode.
(redox, gas, amalgam)

r) Salt bridge contains _____.
(KCI, NaCl, $BaSO_4$)

s) The ionic strength of 0.1 M KCl is _____.
(0.1, 0.02, 0.03)

Q.5. C) State true or false: **4**
a) Reverse osmosis is used to purify water.
b) K_f is molal depression constant.
c) Condensed phase rule is F =C-P+2
d) Pb-Ag system is one component system.

OR

Q.5. C) Match the following: **4**

p) Raoult's law	i) cryoscopic constant
q) K_f	ii) lowering of vapour pressure
r) NaCl	iii) one component
s) Sulphur system	iv) uni-univalent electrolyte
	v) uni-bivalent electrolyte

Q.5. D) State true or false: **3**
a) Surfactants are used in ice-cream.
b) Lyophilic sols are stable
c) Catalyst are selective

OR

Q.5. D) Match the following: **3**

p) Chemical adsorption	i) maltase
q) Enzyme catalysis	ii) same charge
r) Colloidal particles	iii) Chemical bond
	iv) acid

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