DATE :

Alkalinity is due to HCO_3^- ions only as it gives colorat^n only with Me

Also $N_1V_1 = N_2V_2$

$N_{sample} = 8 \times \frac{N}{50 \times 50} \; 10$

$= 0.002N$

Strength $= 0.002N \times 50 = 0.1$ gm/Lt
$= 100$ ppm

Q.3. 200 ml water sample req. 20 ml $\frac{N}{40}$ HCl using Me as indicator. Another 200 ml of same sample req. 8 ml $\frac{N}{40}$ HCl using HPh as indicator. Calculate alkalinity in terms of $CaCO_3$.

Ans. With Hph.

$H^+ + {}^-OH \longrightarrow H_2O$

$H^+ + CO_3^{2-} \longrightarrow HCO_3^-$

With Me.

$H^+ + HCO_3^- \longrightarrow H_2O + CO_2$

$[CO_3^{2-}] = 2V_{me}$ $\quad [OH] = V_{HPh} - V_{Me}$

---

(4)

Biomolecules

Chemical Properties of glucose

(i) React^n with HCN

$HCN + CHO-(CHOH)_4-CH_2OH \longrightarrow CH(OH)(CN)-(CHOH)_4-CH_2OH$

(ii) $NH_2OH + CHO-(CHOH)_4-CH_2OH \longrightarrow CH{=}N{-}OH-(CHOH)_4-CH_2OH$

(iii) $C_6H_5-NH-NH_2 + CHO-(CHOH)_4-CH_2OH \longrightarrow CH{=}NNHPh-C{=}NNHPh-(CHOH)_3-CH_2OH$

Osazone

(iv) $CHO-(CHOH)_4-CH_2OH \xrightarrow{Reduct^n} CH_2OH-(CHOH)_4-CH_2OH$ Sorbitol

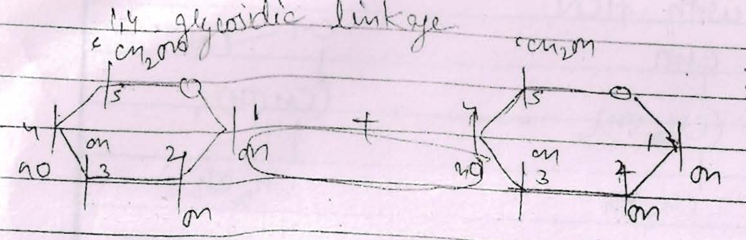
(v) $CHO-(CHOH)_4-CH_2OH \xrightarrow{Br_2} COOH-(CHOH)_4-CH_2OH$ Gluconic acid

(vi) $CHO-(CHOH)_4-CH_2OH \xrightarrow[\text{tollen's reagent}]{HNO_3 / \text{fehling soln.} /} COOH-(CHOH)_4-COOH$

Saccharic acid

CELLULOSE :- $(C_6H_{10}O_5)_n$

1,4 glycosidic linkage



PROTEINS :- These are polyamides. Monomeric unit is α-amino acid.

$$R-\underset{H}{\overset{NH_2}{\underset{|}{\overset{|}{C}}}}-COOH$$

At equivalence pH, α-amino acids form zwitter ions.

$$R-\underset{H}{\overset{\overset{\oplus}{N}H_3}{\underset{|}{\overset{|}{C}}}}-COO^{\ominus} \quad \text{zwitter ion}$$

$\downarrow H^+$ $\qquad\qquad$ $\downarrow {}^{-}OH$

$$R-\underset{H}{\overset{\overset{\oplus}{N}H_3}{\underset{|}{\overset{|}{C}}}}-COOH \qquad\qquad R-\underset{H}{\overset{NH_2}{\underset{|}{\overset{|}{C}}}}-COO^{\ominus}$$

cation moves towards cathode $\qquad$ anion moves towards anode

At isoelectric point, mobility and solubility of zwitter ion is minimum. Protein can be extracted only at this point.

★ All naturally occuring sugars belong to D series, amino acids belong to L series.

For neutral amino acids, I.P. < 7

e.g., 6.1 for glycine $R = H$

alanine $R = CH_3$

For acidic amino acids, I.P. 3.2–3.8

e.g., Aspartic $R = CH_2COOH$

Glutamic $R = CH_2CH_2COOH$

For basic amino acids I.P. 10.8

e.g.,

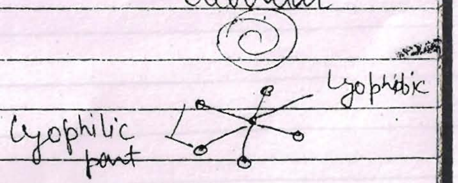
PEPIDE BOND ($-CONH-$)

$$-(\overset{O}{\overset{\|}{C}}-N-H-)$$

Classification of proteins:-

(a) On basic of structure

Fibrous $\qquad\qquad$ Globular



∴ Globular proteins are water soluble.

PAGE NO.
DATE :

On basis of chemical composition
Simple, conjugated, derived.

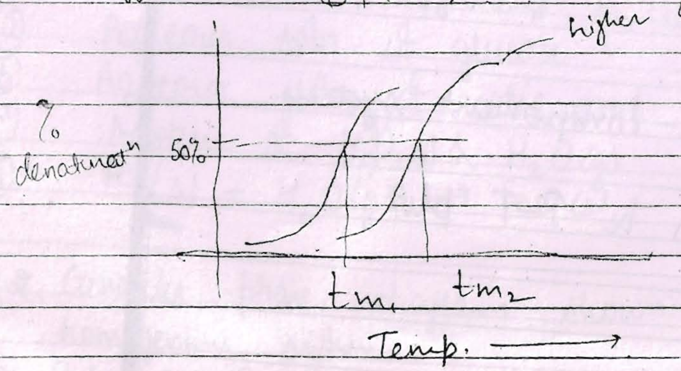
Simple ⟶ Hydrolysis ⟶ Amino acid
Conjugated ⟶ AA + non-protein part
Prosthetic group
Complex ⟶ More than one A.A.

NUCLEIC ACIDS :-

Bases — Purine, Pyrimidine
AG, CTU

Sugar — Ribose, deoxyribose
A = T   G ≡ C

Higher GC content provides higher m.pt. to a D.N.A.



PHASE RULE

a PHASE :- Phase is a chemically homogenous, physically distinct and mechanically separable part of a system.

Phase rule deals with system in equilib.

3 phase: ice(s) ⇌ water(l) ⇌ vapour (g).
4 phase: $S_{rhombic}$ ⇌ $S_{monoclinic}$ ⇌ S_{liquid} ⇌ S_{vapour}

↳ Every single ~~solid~~ substance constitutes a single phase. $F = C - P + 2$

$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$.
3 phases as $CaCO_3$ & CaO are two diff. phases.

↳ ~~Liquids~~ / gases don't ~~constit~~ consists of single phase.

$H_2(g) + O_2(g) \longrightarrow H_2O$
1 phase as all are gases

↳ In liquids, two or more miscible solvents, single phase, two immiscible, two diff. phase
$H_2O(l)$ + alcohol   1 phase
$H_2O(l)$ + benzene   2 phase.
aq. soln — 1 phase
saturated soln — 2 phase

PAGE NO.
DATE :

Components :- It is smallest no. of independent variable constituents present at equilibrium which must be specified to express the compositⁿ of each phase present during the eqlbm. either directly or with the help of a simple chemical rxn.

3 phase rxn

$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$.

Case I. Take $CaCO_3$ & CaO as 2 components.

$CaCO_3 = CaCO_3 + 0\ CaO$

$CaO = 0\ CaCO_3 + CaO$

$CO_2 = CaCO_3 - CaO$

Case II Take CaO & CO_2 as 2 comp.

||ly. case III Take $CaCO_3$ & CO_2.

In all case minimum no. of independents variables are 2.

Hence no. of components = 2.

$Na_2SO_4 \cdot 10H_2O \longrightarrow Na_2SO_4 + 10H_2O$

3 phase & 2 comp.

Degree of freedom :- It is the independent variables such as temp, pressure & compositⁿ which must be specified to defined a system. It is represented by "f".

PAGE NO.
DATE :

GIBB'S PHASE RULE :- If a heterogeneous system is in eqlbm. & is not affected by gravitational, electric and magnetic forces then total number of degrees of freedom can be calculated using total no. of phases and total no. of components using a simple equation,

$$F = C - P + 2$$

Degrees of freedom also termed as variant. It can never be -ve.

If, F = 0 System is non-variant. — Representⁿ in P-T system: • point

F = 1 " " uni " — curve/line

F = 2 " " bi " — area

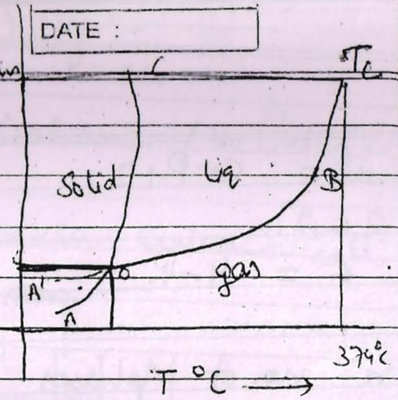
↳ 1 comp. System :-

Water is one-component system.

Phase digram is a P-T plot

DATE :

AOC is solid area
AOB gas
COB liquid.



AO is sublimatⁿ curve
CO is melting pt. curve.
BO is vaporizatⁿ curve.

O is triple pt.
OA' is a meta-stable ~~curve~~ conditⁿ & soln. is supercooled water. Even on touching, it converts quickly to solid.

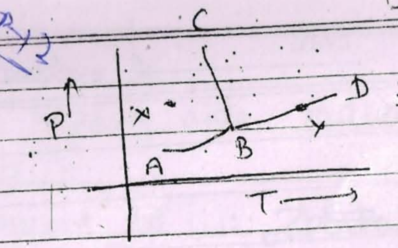
\# Critical temp. :- Highest temp. at which liquid can exist. We can't distinguish b/w liquid & vapour

Q.1. Calculate no. of components & degree of freedom
(a) Aqueous soln. of glucose.
(b) Aqueous soln. of acetic acid.
(c) Mixture of $H_2O_2(g)$ & $H_2O(g)$
(d) $Fe(s) + H_2O(g) \rightarrow FeO(s) + H_2$

Q.2. Consider phase diagram shown for one comp. homogenous system
(a) Calculate F at X, B and Y.

DATE :

$F = (-P+2)$



(b) How many phases exist along AB, BC & BD.

Ans1(a). $P = 1$
$C = 1$
$F = 2$

(b) $P = 1$
$C = 1$
$F = 2$

(c) $P = 1$
$C = 2$
$F = 1$

(d) $P = 3$
$C = 3$
$F = 2$

Ans2.(a) $P_X = 1$, $C_X = 1$ ∴ $F_X = 2$.
$P_B = 3$, $C_B = 1$, $F_B = 0$.
$P_Y = 2$, $C_Y = 1$, $F_Y = 1$

(b) 2 each.

DATE :

Sulphur System :-

$S_R \rightleftharpoons S_M \rightleftharpoons S_L \rightleftharpoons S_V$

1 phase 1 comp. system

$F = C - P + 2$

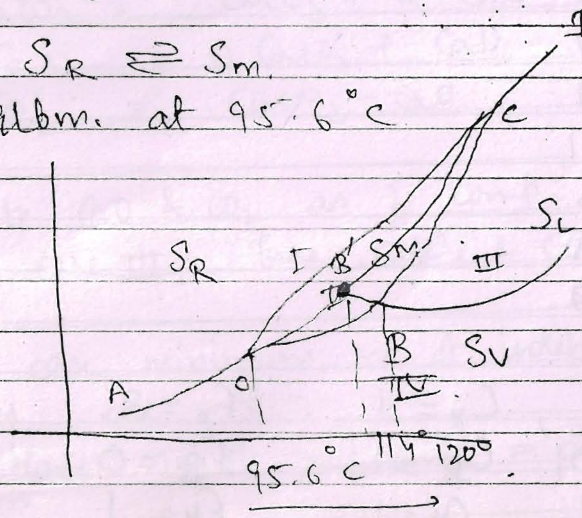
Here $C = 1$

$F = 3 - P$ ← Pressure, Temp, Conc

Enantiotrophy :-

$S_R \rightleftharpoons S_M$

eqlbm. at 95.6°C



~~Area~~ + ~~Curve~~ & triple pt. O, B, B', C

TWO - COMPONENT SYSTEMS :- Generally alloys

Reduced phase rule is used $\boxed{F = 3 - P}$

PAGE NO.

DATE :

As $F = C - P + 2$.

As $C = 2$.

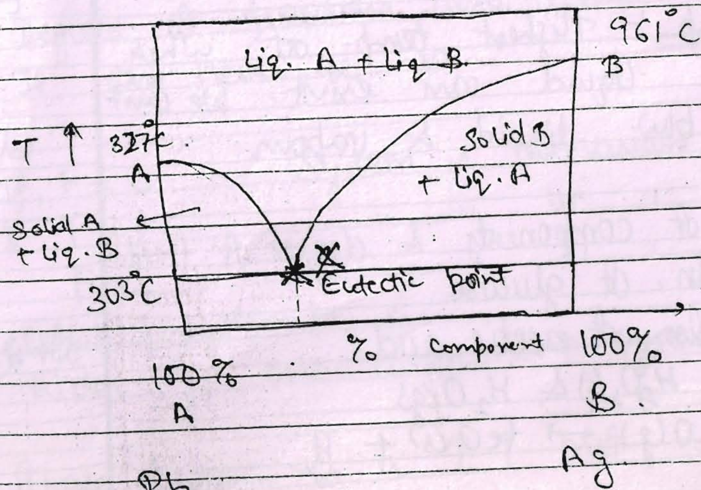
$F = 4 - P$.

Min no. of phases = 1

∴ $F = 3$.

As $F = 3$ is not possible. Hence we use reduced phase rule.

Eutectic Mixture :- Two solids are not reacting. But their melts form a homogenous mixture.



X is 2.6 % of Ag.

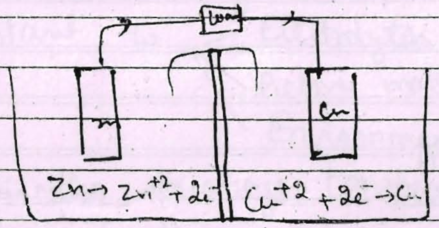
☆ Use :- Pattinson's process or desilverisation of lead.

Electrochemistry :-

(i) Electrolytic cell ΔG +ve

(ii) Electrochemical / Galvanic / Voltaic cell. ΔG -ve

Daniel cell is Zn-Cu Galvanic cell.



Characteristics of a battery :-

(a) Type 1° / 2°

1° battery features

- Not rechargeable
- Electrochemical rxns. are not reversible
- disposed off when ~~used~~ all the stored energy is used.
- Fixed energy is stored.
- They are dry cells.
- High initial voltage ~~is supp~~ & energy density than 2° cells.

Applications :-

Toys, hearing aids, radios, etc

Merits :-

Convenient to use, portable and inexpensive.

Demerits :-

Non-rechargeable, difficult to dispose as cause severe diseases.

Lead-acid battery :-

Anode - Pb

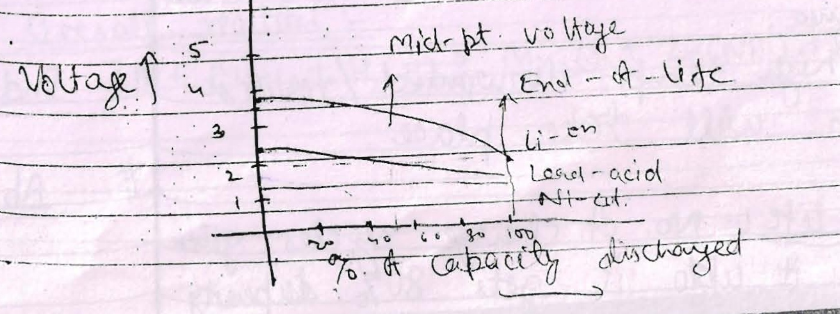
Cathode PbO_2

Anode $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(aq) + 2e^-$

Cathode $PbO_2 + 4H^+ \xrightarrow{+2e^-} PbSO_4 + 2H_2O$

$$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$$

Discharge Curve :- Discharge curve is a plot b/w voltage supplied and % of capacity discharged.



PAGE NO.
DATE :

Capacity :-

$$Q = \underbrace{x}_{\text{No. of moles}} \; \underbrace{n F}_{\text{No. of } e^- \text{ per mole}}$$

Energy density :-

Wt. dependent → Gravimetric or Specific Energy Density

Energy derived per unit wt. of cell

Vol. dependent → Volumetric ED.

Energy derived per unit vol. of cell.

Power density :- wt. dependent.

Energy derived per unit time per unit wt. of cell.

Temperature :- A good battery has a wider temperature range.

At low temp., electrolyte gets freezed ~~Service life~~ :- Thus increase in internal resistance.

At high temp. unwanted / reverse reaction will take place.

Service life :- No. of charge cycles given to it upto it gets 80% capacity is discharged.

PAGE NO.
DATE :

Premature death :-

↳ Causes.

- Overcharging.
- Overdischarging.
- Short circuiting.
- Drawing more current than its capacity
- Physical shock
- Depletion of active materials

Charge / discharge cycle :- Time of charging and discharging.

Physical Req. :-

Size
Shape
Geometry.

Cost :-

Initial cost + Maintenance cost.

Individual Requirements :- Consumer's requirement.

Ability to deep discharge :-

COMPONENTS OF BATTERY :-

1. Container
   - It should be resistant to corrosion.
   - Must be chemically stable.
   - Resistant to — Electrolytes / Active material / Environment

     at the operating temperature.
   - Sometimes container acts as one of active material, e.g. Zn electrode in Leclanche's cell.
   - Sufficiently mechanically strong.
   - Simple way of sealing.

   In acidic cells, polypropylene container is used.
   In alkaline cells, steel container is used.

2. Separator

		Particle cell in b/w pores
	microporous	0.01 – 10 μm
	macroporous	30 – 70 μm

   - wetibility
   - Sensitivity
   - Resistivity
   - flexibility.

3. Current Collector
   Ideally formed of metallic grids & sheets.
   Used to provide path for current flow.

4. Electrolyte
5. Active material.

Zinc – carbon cells (Leclanche's cell)

- formed in 1866.
- Provides 1.5 V.
- Service life 110 min. when used continuously.
- Shelf life ≈ 2 years.
- Zinc as –ve terminal (anode)
- Carbon rod as +ve terminal (cathode).
- MnO_2 & carbon powder used as paste to ↑ electrical conductance.
- Electrolyte is $NH_4Cl - ZnCl_2 - H_2O$ paste.

Anode :-

$$Zn\,(s) \longrightarrow Zn^{+2}\,(aq) + 2e^-$$

Cathode :-

$$2NH_4^+\,(aq) + 2e^- \longrightarrow 2NH_3\,(l) + H_2\,(g)$$

$$2MnO_2\,(s) + H_2\,(g) \longrightarrow Mn_2O_3\,(s) + H_2O\,(l)$$

Overall reaction :-

$$Zn + MnO_2 + H_2 \longrightarrow Mn_2O_3 + Zn(NH_3)_2 + H_2O$$