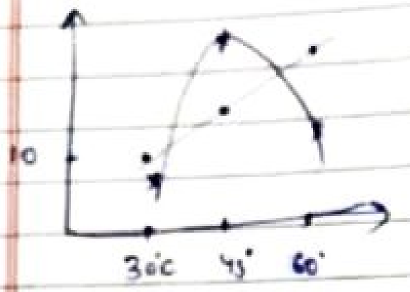
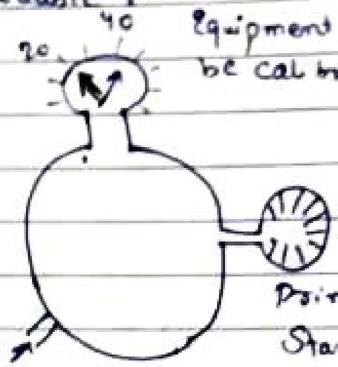
1/11/23.

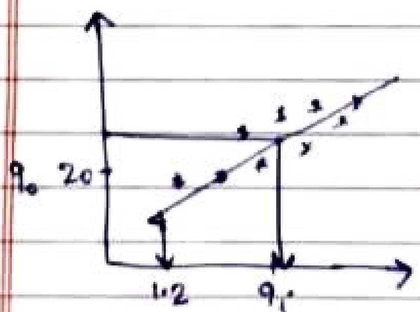


what's wrong?

not taking into a/c errors

Random variable → Whatever we're measuring.





q_0 = random variable

$$\hat{q}_0 = m q_i + b$$

↑ value on the St. line

$$L = \Sigma (q_0 - \hat{q}_0)^2$$

$$\frac{dL}{dm} = 0 \qquad \frac{dL}{db} = 0$$

$$m = \frac{N \Sigma q_i q_0 - \Sigma q_i \Sigma q_0}{[N \Sigma q_i^2 - (\Sigma q_i)^2]}$$

$$b = \Sigma q_0 \Sigma q_i^2 - (\Sigma q_i q_0)(\Sigma q_i) \Big/ n \Sigma q_i^2 - (\Sigma q_i)^2$$

N = Total no. of data points.

\# m & b are f^n of R.V. So, they are R.V itself.

\# For R.V. we have to specify prob. distribution.

classmate

Date

Page

$m = 12.3$ $\quad \delta = 0.05.$

$\Rightarrow$ If we follow normal distribution, $\pm 3\sigma$ (99%)

$m = 12.3 \pm 0.15.$

$$Y = X + C$$
$$E(Y) = E(X) + E(C) \quad \text{Expected value}$$
$$V(Y) = V(X) + V(C) \to 0$$

$$S_m^2 = \frac{N (S_{q_0})^2}{N \Sigma q_r^2 - (\Sigma q_i)^2}$$

$$S_b^2 = \frac{(S_{q_0})^2 \Sigma q_i}{N \Sigma q_i - (\Sigma q_i)^2}$$

$$S_{q_0}^2 = \frac{1}{N-2} \Sigma \left[(mq_i + b) - q_0 \right]^2$$

$m, b = ?$

Obs	q_i	q_0	q_i^2	$q_i q_0$	Res.
1	0.19	3.8	0.0361	0.722	-0.90
2	0.40	10.4	0.16	4.16	1.85
3	0.63	15.1	0.3969	9.513	2.34
4	0.60	9.3	0.36	5.58	-2.91
5	0.78	14.6	0.60	11.388	-0.90
6	1.05	20.9	1.10	21.945	0.47
7	1.74	31.3	3.02	54.462	-1.75
8	1.62	32.7	2.62	52.974	1.24
	7.01	138.1	8.293	160.739	

$$m = \frac{8 \times 160.739 - 7.01 \times 138.1}{8 \times 8.293 - (7.01)^2} = 18.474$$

$b = 138.1 \times 8.293 - 160.739 \times 7.01$

$= 18.482$

9/11/23.

$\hat{q}_0 = m q_i + b$

$m = 18.28$. $S_m =$ ~~1.14~~ 1.4034.

$b = 1.24$ $S_b = 1.3137$.

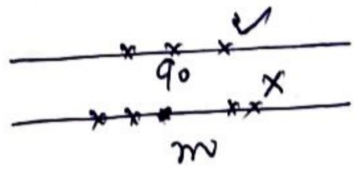
$m = 18.28 \pm 4.2$

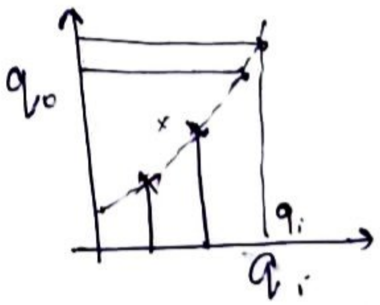
$b = 1.24 \pm 3.9$

$q_0 = 24.61$ $q_i = 1.2781 \pm .339$

$S_{q_i}^2 = \frac{S_{q_0}^2}{m^2}$

measure of spread is Std. Deviation.





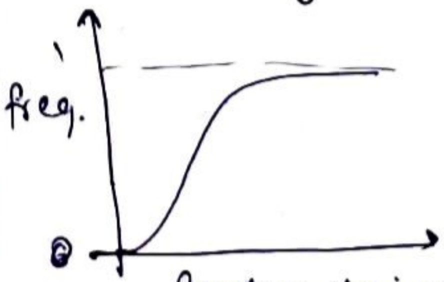
Spread of q_i
m = slope.

\# $S_{q_i} = \frac{S_{q_0}^2}{m^2} = 0.13$.

Probability curve (plot)

Z = normalised culumative freq

Zn



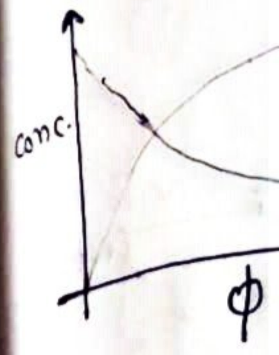
Norms inv => stretch y-axis so that plot look linear.

Differential Algebraic Eqn

Flux = velocity × density.

Pb
H^+
$CH_3SO_3^-$

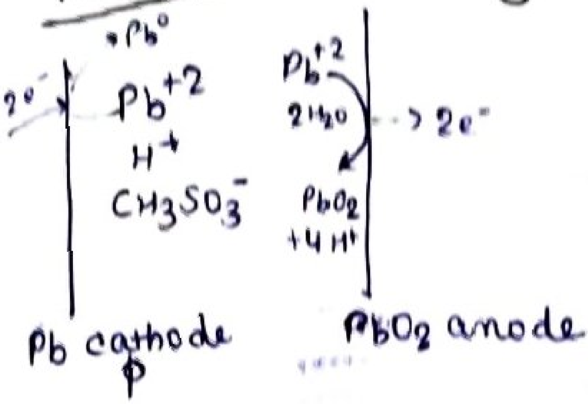
Pb cathode
ϕ



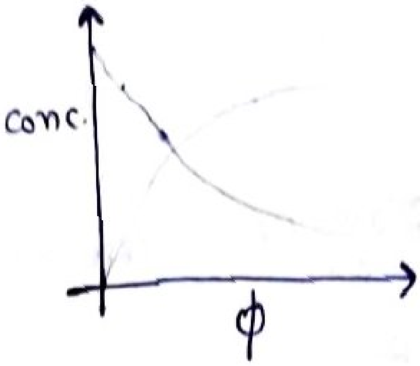
10/11/23.

Drag force
→ viscosity.
on giving
towards e
~~Under~~ After
ions bec
chemical
\# Movemen
2 poten
→ 2 fluxe
→ diffusive
→ Migrati
$-Z_i e$
Valence of ion

Lead - acid Battery



$\phi \rightarrow$ potential



10/11/23.

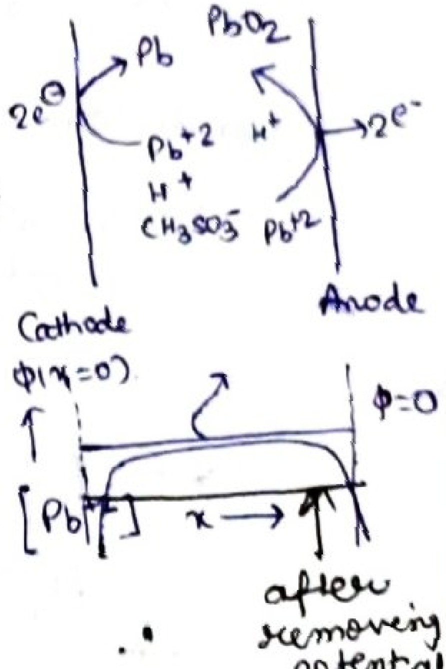
Develop model eqⁿ.

Drag force affected by.
→ viscosity.

On giving potential, ions move towards electrode because of gradient potential

→ ~~Under~~ After removing electric potential. ions become uniform coz of chemical potential.

Movement of ions governed by 2 potential .i.e, chemical & electric.



→ 2 fluxes
→ diffusive (conc. diff)
→ Migratory. (potential diff)

$$-Ze\frac{\partial \phi}{\partial x} = 6\pi R_s u \mu \rightarrow \text{drag force}$$

electric potential; Valence of ion

$$\frac{\partial C_i}{\partial t} = -\frac{\partial N_i}{\partial x} \rightarrow \text{Net flux.}$$

conc. of ith ion

$$N_i = \underbrace{-D\frac{\partial C_i}{\partial x}}_{\text{Diffusive flux}} + (\qquad)$$

$\frac{kg}{s}\ \frac{kg}{ms}\ kg\frac{m}{s^2}$

$$D_i = \frac{RT \rightarrow \text{temp.}}{6\pi\mu R_s}$$

$$-z_i e\frac{\partial\phi}{\partial x} = \frac{RT}{D_i}u.$$

$$u = -\frac{z_i D_i e}{RT}\frac{\partial\phi}{\partial x}.$$

$$\text{Migration flux} = -\frac{z_i D_i F}{RT}\frac{\partial\phi}{\partial x}C_i \qquad (Ne = F).$$

$$= \cancel{-\frac{z_i D_i F}{RT}}$$

$$\frac{\partial C_i}{\partial t} = -\frac{\partial}{\partial x}\left[-D_i\frac{\partial C_i}{\partial x} - \frac{z_i C_i D_i F}{RT}\frac{\partial\phi}{\partial x}\right]$$

$i = 1, 2, 3.$

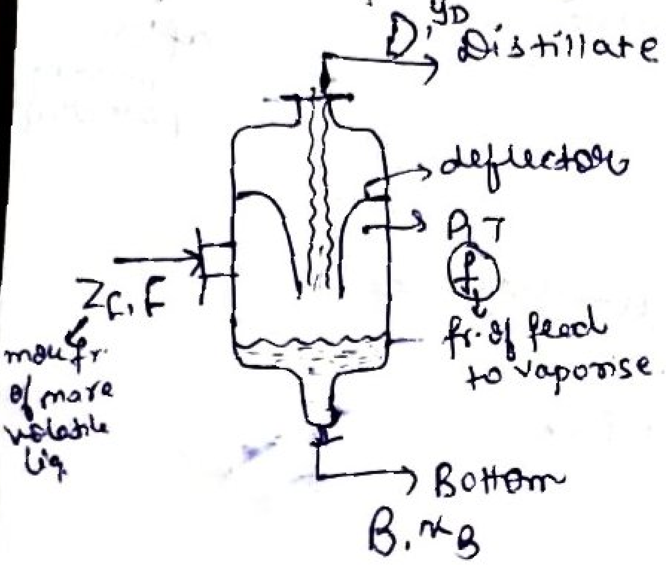
Condition of ElectroNeutrality:

Poisson's Eqn

$$\nabla^2\phi = -\frac{F}{\epsilon}\sum z_i C_i$$

$\frac{F}{\epsilon}$ very large ($\sim 10^{14}$)

$$\Rightarrow \boxed{\sum z_i C_i \cong 0.}$$



$$F = D + B$$

$$F Z_F = D y_D + B x_B \qquad \text{[comp balance]}$$

$$Z_F = f y_D + (1-f)x_B.$$

$\frac{B}{F} = \frac{F-D}{F}$
$(1-f)$

Assumption:-

① F is given (Z, f) abos.
② Relative volatility is constant.

$y_D, x_B = ?$

$$f = \frac{D}{F}.$$

$$\alpha_{ij} = \frac{y_i \, x_j}{x_i \, y_j}$$

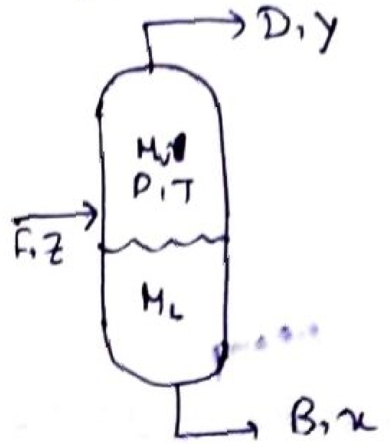
$$y_D = K_i \, x_B.$$

$$y_D = \frac{\alpha x_B}{1+(\alpha-1)x_B}.$$

Transient state model

change : conc.

$$\frac{d}{dt}(\quad) = F z_F - (D y_D + B x_B)$$



$$\frac{d}{dt}(M_V + M_L) = F - D - B.$$

$$\frac{d}{dt}(M_i) = F z_i - D y_i - B x_i$$

Transient mass balance for this flash vessel &
formulate close set of DAE.

At Steady state, $\frac{\partial C_i}{\partial t} = 0$. net flux = constant.

$$~~D_i \frac{\partial C_i}{\partial x} + Z_i C_i~~$$

$$D_1 \frac{dC_1}{dx} + \frac{Z_1 C_1 D_1 F}{RT} \frac{d\phi}{dx} = K_1$$

$$D_2 \frac{dC_2}{dx} + \frac{Z_2 C_2 D_2 F}{RT} \frac{d\phi}{dx} = K_2$$

$$D_3 \frac{dC_3}{dx} + \frac{Z_3 C_3 D_3 F}{RT} \frac{d\phi}{dx} = K_3$$

$$Z_1 C_1 + Z_2 C_2 + Z_3 C_3 = 0.$$