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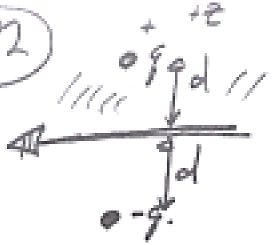
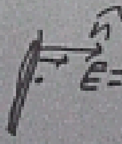


$$V = \frac{kq}{r}$$

$$V = kq\left[\frac{1}{\sqrt{x_p^2+y_p^2+(z_p-d)^2}} - \frac{1}{\sqrt{x_p^2+y_p^2+(z_p+d)^2}}\right]$$

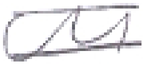
@ $z_p = 0 \Rightarrow V = 0$

$$\sigma = -\varepsilon_0 \vec{E}(x,y)$$



$$\vec{E} = \frac{\sigma}{\varepsilon_0} \Rightarrow$$

$$\sigma = \varepsilon_0 E$$



$\vec{E} = \frac{\sigma}{\epsilon_0} \Rightarrow$

$\sigma = \epsilon_0 E$

$\vec{E} = -\vec{\nabla} V$

$\sigma = -\epsilon_0 \frac{\partial V}{\partial n}$

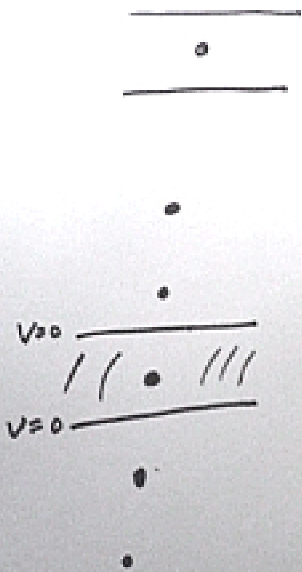
$\sigma = -\epsilon_0 \frac{\partial V}{\partial z}$

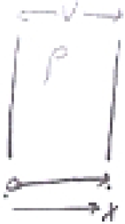
$\iint \sigma(s) \cdot s\,ds\,d\phi = -q$

$2\pi \int_{s=0}^{s=\infty} (-8) \frac{s\,ds}{(s^2+d^2)^{3/2}} = -q$

$\vec{E}_q \to 0 + q \quad q \qquad \vec{F} = q\vec{E}$

$\vec{E} = (\vec{E}_{plane} + \vec{E}_q)$


V>0
V=0



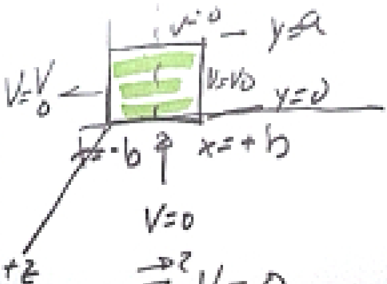
$$\frac{1}{2}mu^2 = eV$$

$$\vec{\nabla}^2 V = -\frac{\rho}{\varepsilon_0}$$

$$J = |\rho u|$$

$$\frac{d^2V}{dx^2} = \frac{J}{\varepsilon_0 u} = \frac{J}{\varepsilon_0\sqrt{\frac{2eV}{m}}}$$

$$\frac{d}{dx}\left(\frac{dV}{dx}\right) = \frac{J}{\varepsilon_0\sqrt{2e}}\sqrt{m}\, V^{-1/2}$$



$$\vec{\nabla}^2 V = 0$$

$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} = 0$$

$$V(x,y) = X(x)\,Y(y)$$

$$Y\frac{\partial^2 X}{\partial x^2} + X\frac{\partial^2 Y}{\partial y^2} = 0$$

$\div X Y$

$$\frac{1}{X}\frac{\partial^2 X}{\partial x^2} + \frac{1}{Y}\frac{\partial^2 Y}{\partial y^2} = 0$$

$$\frac{1}{X}\frac{\partial^2 X}{\partial x^2} = -\frac{1}{Y}\frac{\partial^2 Y}{\partial y^2}$$

$$\frac{1}{X}\frac{\partial^2 X}{\partial x^2} = C_1$$

$$\frac{1}{Y}\frac{\partial^2 Y}{\partial y^2} = C_2$$

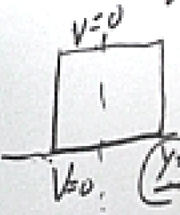
$$C_1 + C_2 = 0$$

$$C_1 = -C_2$$

$$C_1 + C_2 = 0$$

X: $\frac{d^2X}{dx^2} = k^2 X$

Y: $\frac{d^2Y}{dy^2} = -k^2 Y$



$Y = A\sin(ky) + B\cos(ky)$

$y=0 \Rightarrow B=0$

$Y = A\sin(ky)$

@ $y=a$, $Y=0$

$\Rightarrow$ ~~ky~~ $ka = n\pi$

$n = 1, 2, 3, \ldots$

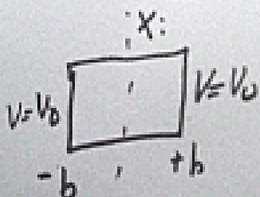
$\Rightarrow B=0$

$$Y = A\sin(ky)$$

@ $y=a,\ Y=0$

$$\Rightarrow \cancel{k y}\ ka = n\pi$$

$$\underline{k_n = \frac{n\pi}{a} : Y = A_n \sin\left(\frac{n\pi y}{a}\right)}$$



$$X = Ce^{-kx} + De^{+kx}$$

$$\frac{d^2X}{dx^2} = k^2X$$

@ $x=-b$: $X = Ce^{+kb} + De^{-kb}$

$x=+b$: $X = Ce^{-kb} + De^{+kb}$

$$\Rightarrow \underline{C = +D}$$

$dx^2 = kx$

② $x = -b: \quad X = Ce^{+kb} + De^{-kb}$

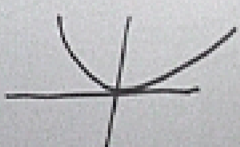
$x = +b: \quad X = Ce^{-kb} + De^{+kb}$

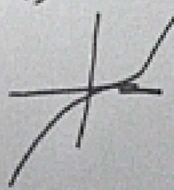
$\Rightarrow \underline{C = +D}$

$X = Ce^{-kx} + Ce^{+kx}$

cosh, sinh

$X = C' \cosh(kx)$





$XY = A_n' \sin\left(n\pi \frac{y}{a}\right) \cosh(kx)$

$k = \frac{n\pi}{a}$

$V = \sum_{n=1}^{\infty} A_n' \sin\left(n\pi \frac{y}{a}\right) \cosh\left(\frac{n\pi x}{a}\right)$

② $y=b$, for all x, $V=V_0$

$$V_0 = \sum_{n=1}^{\infty} A_n' \sin\left(n\pi \frac{b}{a}\right) \cos\left(\frac{n\pi x}{a}\right)$$

$$\int_{x=-b}^{x=+b} \left(\text{multiply by } \cos\left(\frac{m\pi x}{a}\right)\right)$$

$$\int_{-b}^{+b} V_0 \cos\left(\frac{m\pi x}{a}\right) dx$$

$$= \sum_{n=1}^{\infty} A_n' \sin\left(n\pi \frac{b}{a}\right) \times \int_{-b}^{+b} \cos\left(\frac{n\pi x}{a}\right) \cos\left(\frac{m\pi x}{a}\right) dx$$

$\int V_n \cos\left(\frac{n\pi x}{}\right) dx$

$$\int = \frac{x}{2}\Big|_{-b=x}^{+b=x}$$

$$= \frac{b}{2} - \frac{-b}{2} = b$$

$$\int_{-b}^{+b} V_0 \cos\left(\frac{n\pi x}{a}\right) dx$$

$$= \cancel{\Sigma} A_n' \sin\left(n\pi \frac{b}{a}\right) b$$

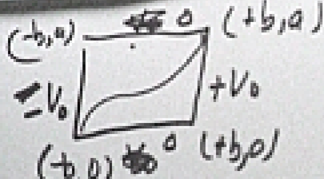
$$\boxed{A_n' = \frac{\int V_0 \cos\left(\frac{n\pi x}{a}\right) dx}{b \sin\left(n\pi \frac{b}{a}\right)}}$$

$\sinh ky$

$= (e^{-ky} - e^{+ky}) C$

$\cosh ky$

$= (e^{-ky} + e^{+ky})$



$$V(x, y) = \sum A_n \sin(ky) \times \sinh(kx)$$

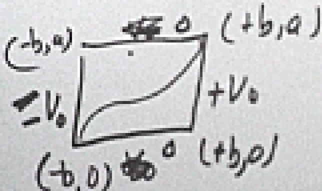
$$\sinh = c(e^{-kx} - e^{+kx})$$

$\sinh ky$

$= (e^{-ky} - e^{+ky})C$

$\cosh ky$

$= (e^{-ky} + e^{+ky})$



$$V(x,y) = \sum A_n \sin(ky) \times$$

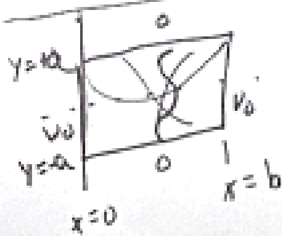
$$\times \sinh(kx)$$

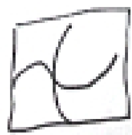
$$\sinh = c(e^{-kx} - e^{+kx})$$

$\sum A_n \sin(k$

$\times \sinh(kx)$

$\sinh = c\left(e^{-kx} - e^{+kx}\right)$





$V(x,y) = \sum A_n \sin(kx)\cosh(ky$