$\nabla^2 V = 0$ Assume $V(x,y,z) = X(x)Y(y)Z(z)$

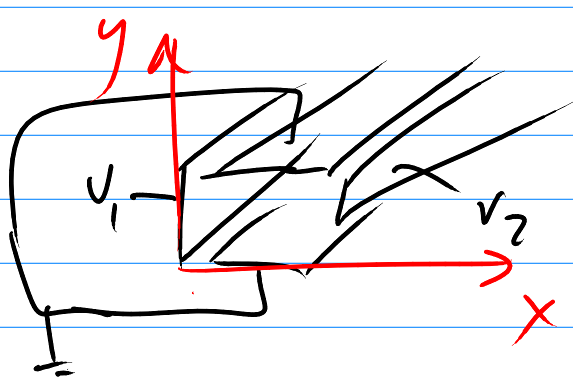
$$\frac{1}{Y}\frac{d^2Y}{dy^2} + \frac{1}{X}\frac{d^2X}{dx^2} + \frac{1}{Z}\frac{d^2Z}{dz^2} = 0$$

$$C_1 + C_2 + C_3 = 0$$

$A\sin ky + B\cos ky$ $\qquad C_2 = -k^2 < 0$

$A' e^{\sqrt{C_2}\,y} + B' e^{-\sqrt{C_2}\,y}$ $\qquad C_2 > 0$

$A'' + B'' y$ $\qquad C_2 = 0$

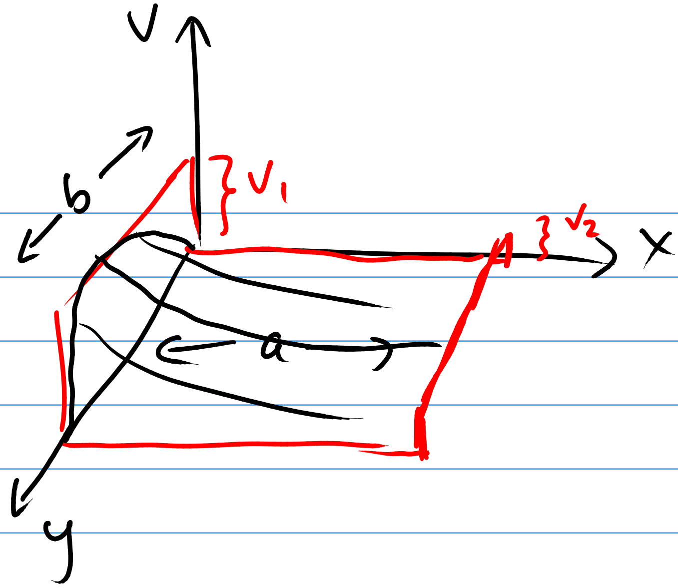


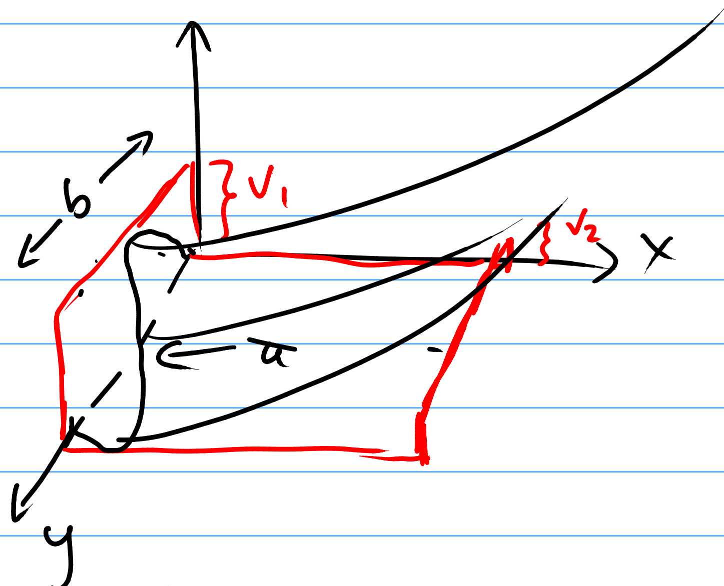
$$V(x,y,z) = \left(G e^{kx} + H e^{-kx}\right)\sin ky \qquad k = \frac{n\pi}{b}$$

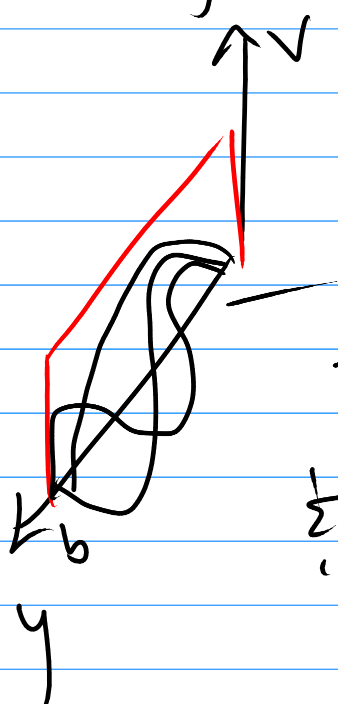
$n = 1$ $\quad G = 0$ $\quad n = 2$ $\quad H = 0$

$e^{-\frac{\pi}{b}x}\sin\left(\frac{\pi}{b}y\right)$ or $e^{\frac{2\pi}{b}x}\sin\frac{2\pi}{b}y$

n







add sine function using
Fourier analysis
& make any function

$$V = \sum_i A_i V_i$$

$\uparrow$ soln by sep. variables

$$\nabla^2 V = \sum_i A \underbrace{\nabla^2 V_i}_{0} = 0$$

$$V = \sum_{n=1}^{\infty} \left(A_n e^{-\frac{n\pi x}{b}} + B_n e^{\frac{n\pi x}{b}} \right) \sin \frac{n\pi y}{b}$$

when these are determine were done

bndy at $x = 0$

$$V(0) = V_1 = \sum (A_n + B_n) \sin \frac{n\pi y}{b}$$

$\uparrow$ know

multiply both sides by $\sin \frac{m\pi y}{b}$ & $\int_0^b$

$$V_1 \int_0^b \sin \frac{m\pi y}{b}\, dy = \sum_n (A_n + B_n) \underbrace{\int_0^b \sin \frac{n\pi y}{b} \sin \frac{m\pi y}{b}\, dy}$$

$$V_1\left[-\frac{b}{m\pi}\cos\frac{m\pi y}{b}\right]_0^b = \sum_{n=1}^{\infty}(A_n+B_n)\frac{b}{2}\underbrace{\delta_{nm}}_{\substack{\shortparallel \\ 0 \quad n\neq m \\ 1 \quad n=m}}$$

$$-\frac{bV_1}{m\pi}\left(\cos(m\pi)-1\right) = \left(A_m + B_m\right)\frac{b}{2}$$

$$\left.\begin{array}{ll} m = \text{odd} & +\dfrac{2bV_1}{m\pi} \\ m = \text{even} & 0 \end{array}\right\} \left(A_m+B_m\right)\frac{b}{2}$$

Need other bndry cond $x=a \quad V=V_2$

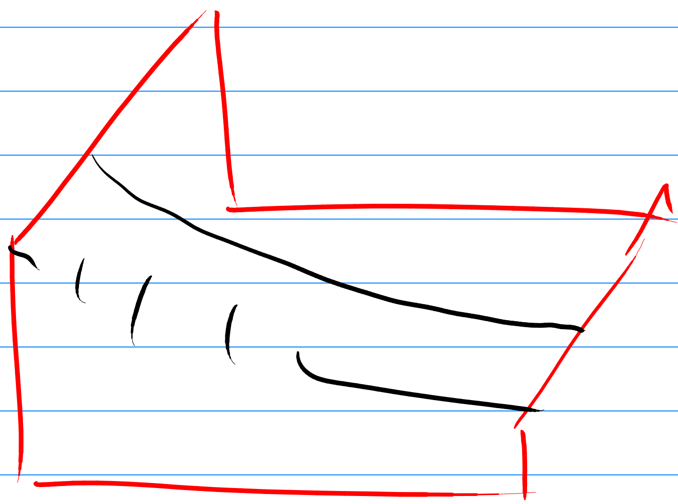
$$A_m e^{-m\pi a/b} + B_m e^{m\pi a/b} = \frac{4V_2}{m\pi} \quad m\ \text{odd}$$

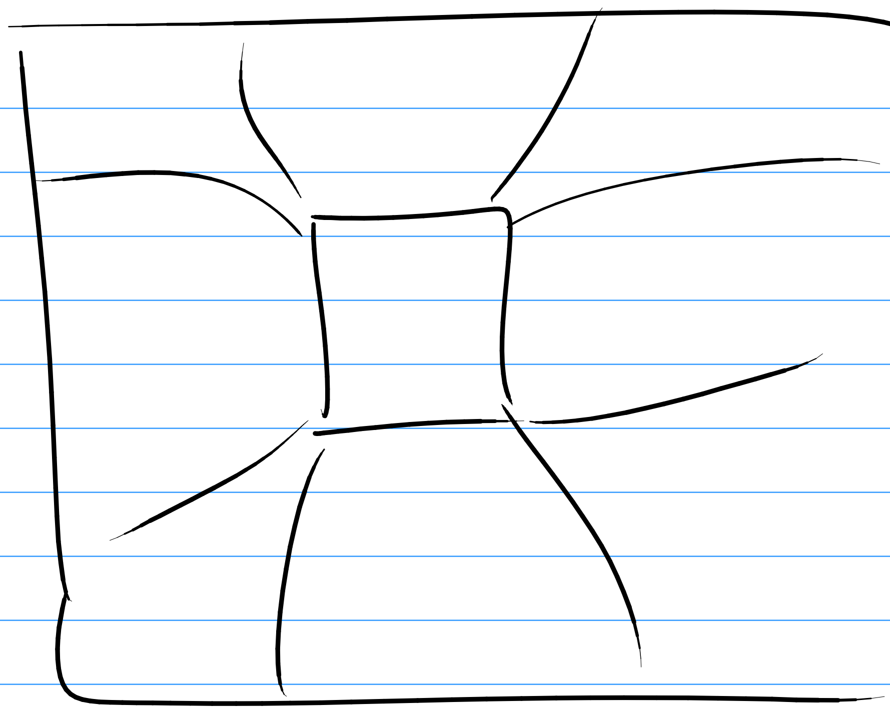
$$= 0 \qquad m\ \text{even}$$

2 eqns in A_m & B_m

$$A_m = \frac{4}{m\pi}\left(\frac{V_1 - V_2 e^{-m\pi a/b}}{1 - e^{-2m\pi a/b}}\right)$$

$$B_m = \frac{4}{m\pi}\left(\frac{V_2 e^{-m\pi a/b} - V_1}{1 - e^{-2m\pi a/b}}\right)$$





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