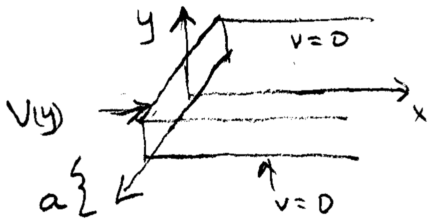
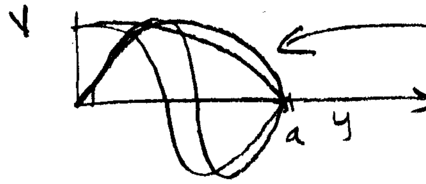
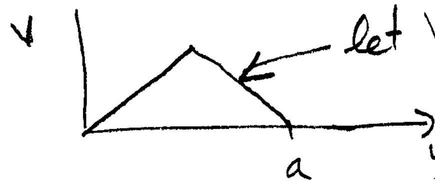
PHGN361 Exam 4: NAME KEY

1. Two infinite grounded metal plates lie parallel to the xz plane, one at $y = 0$ and the other at $y = a$. The left end, at $x = 0$, is closed off with an infinite strip insulated from the two plates and maintained at a specific potential $V(y)$. The separation of variables solution is $V(x, y) = (A\exp[kx] + B\exp[-kx])(C\sin[ky] + D\cos[ky]$ where $k = n\pi/a$. Explain how this solution can satisfy the boundary conditions.





$V(0,y) = E(\sin ky + \cos ky)$ DOES NOT satisfy arbitray $V(y)$.



let $V(y)$ be triangle voltage then we need a sum of sine waves to match this boundary condition

$$V(0,y) = \sum_n c_n \sin\left(\frac{n\pi y}{a}\right)$$

2. Free current, I, flows uniformly down a copper wire of radius a and susceptibility χ_m. Derive an expression for the magnetic field everywhere.

See lecture 37

3. In a hollow coaxial transmission line, a charge per unit length $\lambda = \lambda_0\cos(kx - \omega t)$ travels down the inner conductor at speed $c = \omega/k$. The fields generated are $\vec{E} = \hat{s}A\cos(kx - \omega t)/s$ and $\vec{B} = \hat{\phi}A\cos(kx - \omega t)/(cs)$. (a) To apply the integral forms of BOTH Ampere's and Faraday's laws what paths or surfaces should be chosen to make the application as simple as possible? (b) Write integral expressions for both (do not approximate or evaluate the integrals), specify the $\vec{dl}$ and $\vec{da}$ in variables of the coordinate system, use the fields given, and put limits on the integrals. Show work on the back.