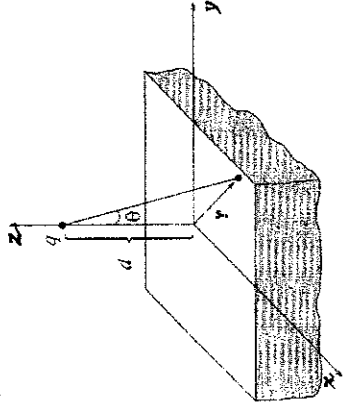


1. (20%) If V is the electric potential for electrostatics and $\nabla^2 V = 0$, prove that the extreme values of V must occur at the boundaries.

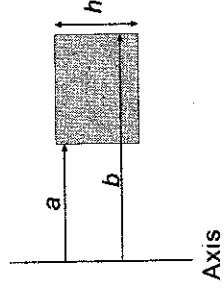
2. (20%) Suppose the entire region below the plane $z = 0$ is filled with uniform linear dielectric material of susceptibility χ_e . Calculate the force on a point charge q situated a distance d above the origin.



3. (20%) Suppose you have two infinite straight line charge λ , a distance d apart, moving along at a constant speed v . How great would v have to be in order for the magnetic attraction to balance the electric repulsion?



4. (15%) Find the self-inductance of a toroidal coil with rectangular cross section (inner radius a , outer radius b , height h), which carries a total of n turns.



5. (a) (15%) What are the Maxwell's equations in regions of space where there is neither charge nor current?
(b) (10%) Derive the wave equations for \mathbf{E} and \mathbf{B} as the case in (a).