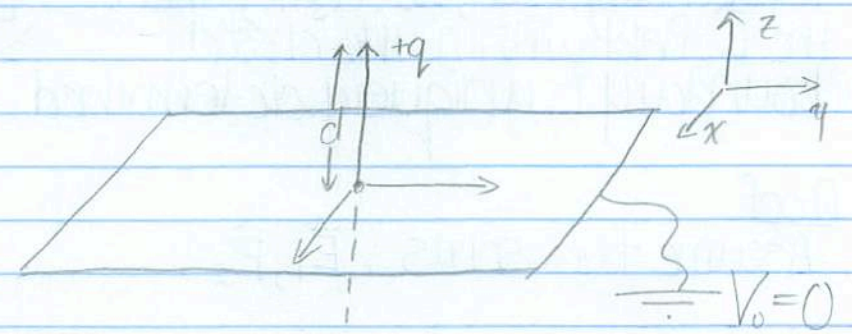
$$\int \vec{\nabla}\cdot(V_3\vec{E})\,dV$$

$$\Rightarrow \vec{\nabla}\cdot(V_3\vec{E}_3) = V_3(\vec{\nabla}\cdot\vec{E}_3) + \vec{E}_3\cdot(\vec{\nabla}V)$$

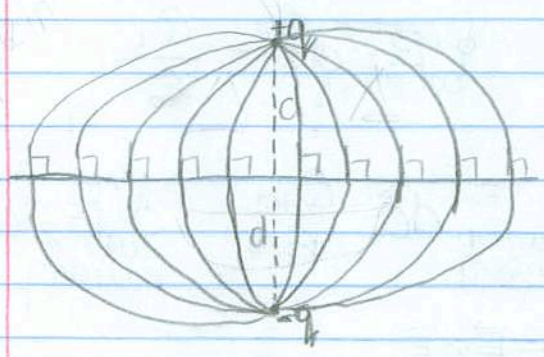
(A) $\to 0$

$$= -|\vec{E}_3|^2 \qquad \vec{\nabla}V_3 = -\vec{E}_3$$

$$\Rightarrow \oint V_3\vec{E}_3\cdot d\vec{a} = V_3\oint\vec{E}\cdot d\vec{a} = 0 = \int(-|\vec{E}_3|^2)\,dV$$



What is $\vec{E}$ above the plate.
What is V above the plane?
What is the distribution of charge on the surface of the plate?



Method of Images

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

$$V(x,y,z) = V_q(x,y,z) + V_{-q}(x,y,z)$$

$$= \frac{1}{4\pi\varepsilon_0}\left(\frac{q}{\sqrt{x^2+y^2+(z-d)^2}} + \frac{-q}{\sqrt{x^2+y^2+(z+d)^2}}\right) + V_0$$