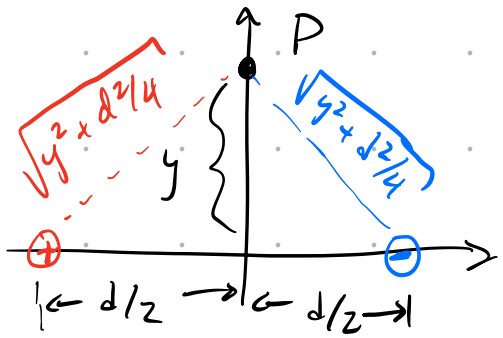
PHYS 301 – Tutorial #4 Quiz Solns Sept. 30, 2024

1.



$$V = \sum \frac{1}{4\pi\varepsilon_0}\frac{q_i}{r_i} = \frac{1}{4\pi\varepsilon_0}\left[\frac{+q}{\sqrt{y^2+d^2/4}} - \frac{q}{\sqrt{y^2+d^2/4}}\right]$$

$$= 0$$

2.

$$V(r) = A\frac{e^{-\lambda r}}{r} \quad \& \quad \vec{E} = -\vec{\nabla}V$$

Since our V depends only on r,

$$\vec{E} = -\frac{dV}{dr}\hat{r}$$

$$\frac{dV}{dr} = \frac{d}{dr}\left(A\frac{e^{-\lambda r}}{r}\right) = A\left[-\lambda\frac{e^{-\lambda r}}{r} - \frac{e^{-\lambda r}}{r^2}\right]$$

$$= -\frac{Ae^{-\lambda r}}{r}\left[\lambda + \frac{1}{r}\right]$$

$$= -V(r)\left[\lambda + \frac{1}{r}\right]$$

$$\therefore \vec{E} = \left(\lambda + \frac{1}{r}\right)V(r)\,\hat{r}$$