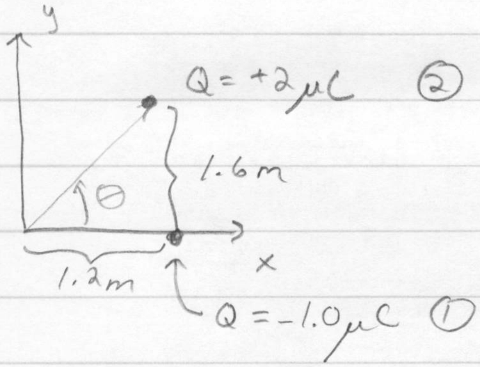
Physics 2b Quiz 1 Solutions #1



What is the x-component of $\vec{E}$ at O?

$$\vec{E}_{tot,x} = \vec{E}_{1,x} + \vec{E}_{2,x} \quad \text{, principle of superposition}$$

$$\vec{E}_{1,x} = \frac{kq_1}{r^2}(-\hat{\imath}) + \frac{k(-1.0\mu C)}{(1.2m)^2}(-\hat{\imath}) = 6250\ N/C\ (\hat{\imath})$$

$$\vec{E}_{2,x} = \frac{kq_2}{r^2}\cos\theta(-\hat{\imath}) = \frac{k(2\mu C)}{((1.2m)^2+(1.6m)^2)}\left(\frac{1.2m}{\sqrt{(1.2m)^2+(1.6m)^2}}\right)(-\hat{\imath})$$

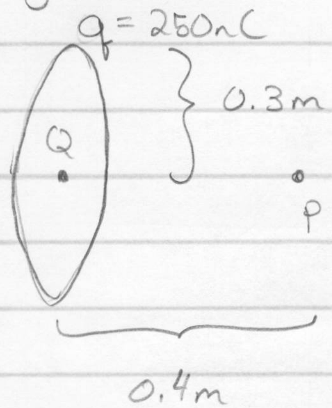
$$= -2700\ N/C$$

$$E_{tot} = +6250\ N/C - 2700\ N/C = +3550\ N/C$$

closest to **+ 3600 N/C**

Don't forget that $\hat{r}$ is $(-\hat{\imath})$ not $(\hat{\imath})$ for both $\vec{E}_{1,x}$ and $\vec{E}_{2,x}$ in this case.

Physics 2b Quiz 1 Solutions #2



$E(P) = 0$, what is Q?

Right away you know $Q < 0$, because it must cancel the field from the ring.

$$E_{tot} = E_{ring} + E_{charge}$$

$$E_{tot}(P) = E_{ring}(P) + E_{charge}(P)$$

$$E_{tot}(P) = 0$$

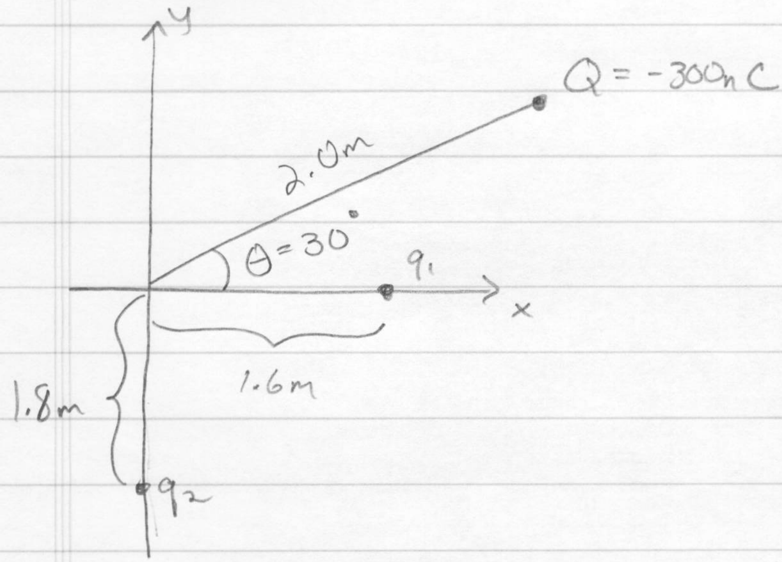
$$E_{ring}(P) = \frac{kxq}{(x^2+a^2)^{3/2}}, \quad a = 0.3\,m, \quad q = 250\,nC$$

$$E_{charge}(P) = \frac{kQ}{x^2} \Rightarrow \frac{kQ}{x^2} = -\frac{kxq}{(x^2+a^2)^{3/2}}, \quad x = 0.4\,m$$

$$Q = -\frac{x^3 q}{(x^2+a^2)^{3/2}} = -1.28 \times 10^{-7}\,C$$

closest to $\boxed{-130\,nC}$

Physics 2b Quiz 1 Solutions # 3



We are told that $\vec{E} = 0$ at O, meaning both E_y and E_x.
Choose one, I will choose E_x.

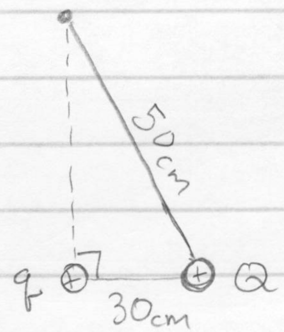
$$E_{Q,x} + E_{q_1,x} = 0$$

$$\frac{kQ}{(2.0m)^2}\cos 30° + \frac{kq_1}{(1.6m)^2} = 0 \text{, solve for } q_1$$

$$q_1 = -\frac{Q\cos 30° \, (1.6m)^2}{(2.0m)^2} = +\frac{300nC \cos 30° \, (1.6m)^2}{(2.0m)^2} = +1.66\times10^{-7} C$$

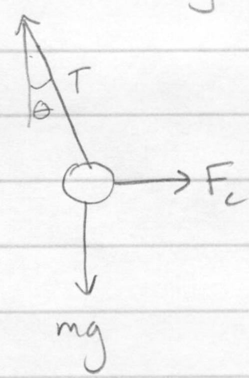
closest to $\boxed{+160nC}$

Physics 2b Quiz 1 Solutions #4



$q = 2\mu C$

Free-body diagram of Q



$$\left.\begin{array}{l} T\sin\theta = F_c \\ T\cos\theta = mg \end{array}\right\} \tan\theta = \frac{F_c}{mg} = \frac{kqQ}{r^2 mg}$$

Solve for Q $\Rightarrow$ $Q = \dfrac{\tan\theta\, r^2 mg}{kq}$, $\tan\theta = \frac{3}{4}$

$$= \frac{3\,(0.3\,m)^2\,(0.08\,Kg)\,(9.8\,m/s^2)}{4k\,(2\times10^{-6}\,C)}$$

$$= 2.94\,\mu C$$

closest to $\boxed{3\mu C}$