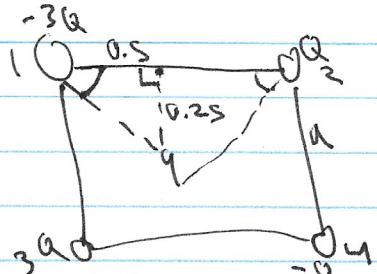
Josh Whitehead
U10693143

Physics Midterm 1

1.)

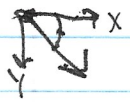


$a = 0.2\ m$

$Q = 5.00\ \mu C$

$q = -2\ \mu C$

$Q = .000005 = 5.0 \times 10^{-6}\ C$



$0.25^2 + 0.25^2 = c^2$

$c = 0.298\ m$

a) $E_{net} = \sum \frac{k q_i}{r_i^2} \cdot \hat{r} \rightarrow E_{1x} = \frac{k\,(15\ \mu C)}{0.089} \cos\left(\frac{\pi}{4}\right)$

$E_{1x} = \frac{8.99 \times 10^9\,(15 \times 10^{-6}\ C)}{0.089\ m^2} \cos\left(\frac{\pi}{4}\right) = -1.07 \times 10^{6}\ \frac{N}{C}$

$E_{2x} = \frac{8.99 \times 10^9\,(5 \times 10^{-6}\ C)}{0.089\ m^2} \cos\left(\frac{\pi}{4}\right) = -3.57 \times 10^{5}\ \frac{N}{C}$

$E_{3x} = $ ~~8.99×10^9~~ $(5$ $|E_{3x}| = |E_{2x}| \therefore E_{3x} = +3.57 \times 10^5\ \frac{N}{C}$

$|E_{4x}| = \frac{1}{3}|E_{1x}| \rightarrow E_{4x} = \frac{+1.07 \times 10^6\ \frac{N}{C}}{3} = +3.57 \times 10^5\ \frac{N}{C}$

$|E_{1y}| = \frac{8.99 \times 10^9\,(15 \times 10^{-6}\ C)}{0.089\ m^2} \sin\left(\frac{\pi}{4}\right) = |E_{1x}| = 1.07 \times 10^6\ \frac{N}{C}$

$|E_{2y}| = |E_{3y}| = |E_{4y}| = \frac{1}{3}|E_{1y}| = 3.57 \times 10^5\ \frac{N}{C}$

$E_{2y} = -3.5 \times 10^5\ \frac{N}{C}$, $E_{3y} = +3.5 \times 10^5\ \frac{N}{C}$, $E_{4y} = -3.5 \times 10^5\ \frac{N}{C}$

$E_{tot} = \sqrt{\left(\sum E_x\right)^2 + \left(\sum E_y\right)^2}$

$E_{x\,tot} = -1.07 \times 10^6 - 3.57 \times 10^5 + 3.57 \times 10^5 + 3.57 \times 10^5 = -7.13 \times 10^5\ \frac{N}{C}$

$E_{tot} = \sqrt{5.08 \times 10^{11} + (E_{y\,tot})^2}$ $\quad E_{y\,tot} = 7.20 \times 10^5\ \frac{N}{C}$

$= 1.01 \times 10^6\ \frac{N}{C}$

direction: $\tan^{-1}\left(\frac{7.20 \times 10^5}{-7.13 \times 10^5}\right) = 45^\circ$

Josh whitehead
V1069343

1 b) $\Sigma F = q\Sigma E$ $\therefore F_x = -2\times10^{-6}(-7.13\times10^{5}) = 1.426\ N$

$F_y = -2\times10^{-6}(+7.2\times10^{5}) = -1.44\ N$

$|F| = \sqrt{1.43^2 + 1.44^2} = \sqrt{2.07 + 2.07}$ $= 2.03\ N$

direction: $\tan^{-1}\left(\frac{-1.44}{1.43}\right) = -45^\circ$

---

a)

c)

Josh Whitehead
4069343

c) ~~$KE_1 + PE_1 = KE_2 + PE_2$~~ (KE = 0, PE = 0)

$W = \Delta U = U_f - U_i \rightarrow U_i = 0$

~~$U_f = k\frac{q_1 q_2}{r}$~~

$$U_f = \frac{k}{r}\left(q_1q_2 + q_1q_3 + q_1q_4 + q_1q_5\right) = \frac{k}{r}\left(30 + -10 - 10 + 10\right)$$

$$\therefore U_f = \frac{k}{r}(20\ \mu C) = \frac{8.99 \times 10^9}{0.298} \times 20\ \mu C$$