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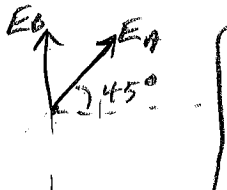


a)

$\theta = 45°$ by inspection.

$r_A = \sqrt{r_B^2 + d^2} = \sqrt{(1m)^2 + (1m)^2}$

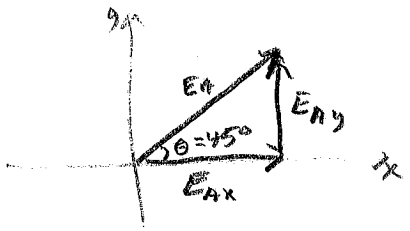
$r_A = 1.414m$

$E_A = \frac{kq_A}{r_A^2} = \frac{\left(8.99\times10^9 \frac{N\cdot m^2}{C^2}\right) 1.00C}{(1.414m)^2}$

$E_A = 4.495\times10^9 \frac{N}{C}$

$E_B = \frac{kq_B}{r_B^2} = \frac{\left(8.99\times10^9 \frac{N\cdot m^2}{C^2}\right) 1.00C}{(1.00m)^2}$

$E_B = 8.99\times10^9 \frac{N}{C}$



$E_{Ax} = E_A \cos\theta = 4.495\times10^9 \frac{N}{C} \cos 45°$

$E_{Ax} = 3.178\times10^9 \frac{N}{C}$

$E_{Ay} = E_{Ax} = 3.178\times10^9 \frac{N}{C}$

↑ by inspection since $\theta = 45°$

$E_{Bx} = 0$

$E_{By} = E_B$

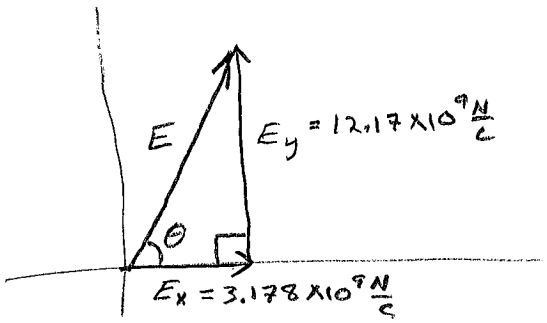
$E_{By} = 8.99\times10^9 \frac{N}{C}$

$E_x = E_{Ax} + E_{Bx} = 3.178\times10^9 \frac{N}{C} + 0$

$E_x = 3.178\times10^9 \frac{N}{C}$

$E_y = E_{Ay} + E_{By} = 3.178\times10^9 \frac{N}{C} + 8.99\times10^9 \frac{N}{C}$

$E_y = 12.17\times10^9 \frac{N}{C}$



$E = \sqrt{E_x^2 + E_y^2} = \sqrt{\left(3.178\times10^9 \frac{N}{C}\right)^2 + \left(12.17\times10^9 \frac{N}{C}\right)^2}$

$E = 1.258\times10^{10} \frac{N}{C}$

$\tan\theta = \frac{E_y}{E_x}$

$\theta = \tan^{-1}\frac{E_y}{E_x} = \tan^{-1}\frac{12.17\times10^9 N/C}{3.178\times10^9 N/C}$

$\theta = 75.36°$

To 3 sig figs

* $\vec{E} = 1.26\times10^{10} \frac{N}{C}$ in the plane of the 3 given points at 75.4° Counterclockwise from the direction from A toward B.

b) $\varphi_p = \varphi_A + \varphi_B = \frac{kq_A}{r_A} + \frac{kq_B}{r_B}$

$q_A = q_B = q \Rightarrow \varphi_p = \frac{kq}{r_A} + \frac{kq}{r_B}$

$\varphi_p = kq\left(\frac{1}{r_A} + \frac{1}{r_B}\right)$

$\varphi_p = \left(8.99\times10^9 \frac{N\cdot m^2}{C^2}\right) 1.00C \left(\frac{1}{1.414m} + \frac{1}{1.00m}\right)$

$\varphi_p = 1.535\times10^{10}$ volts

To 3 sig figs. $\varphi_p = 1.53\times10^{10}$ volts

c) $\vec{F} = q\vec{E}$

Magi: $F = qE = (.500C)\, 1.258\times10^{10} \frac{N}{C} = 6.29\times10^9 N$

$F = 6.29\times10^9 N$ in same direction as $\vec{E}$ (see *)

d) $U = q\varphi_p = (.500C)\, 1.535\times10^{10}$ volts

$U = 7.68\times10^9 J$