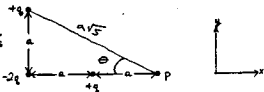


Name: Ave : ~~18~~ 18

Discussion Instructor (CIRCLE ONE): Aamodt    Geller    Giddings    Leaver  
 Discussion Section # \_\_\_\_\_ Mabud    Saffer    Sewell    Stone

Given the charge arrangement shown:



- (a) Find the electric field at point P. Express this using the unit vectors  $\hat{i}$  and  $\hat{j}$ .  
 (b) Find the magnitude of the force on a charge of  $+3q$  placed at P.

A)  $\vec{E} = E_x \hat{i} + E_y \hat{j}$

$E_x = \frac{q}{4\pi\epsilon_0 a^2} - \frac{2q}{4\pi\epsilon_0 (2a)^2} + \frac{q}{4\pi\epsilon_0 (a\sqrt{5})^2} \left(\frac{2a}{a\sqrt{5}}\right)$   
 $= \frac{q}{4\pi\epsilon_0 a^2} \left[ 1 - \frac{1}{2} + \frac{2}{5\sqrt{5}} \right]$

$= \frac{q}{4\pi\epsilon_0 a^2} \left[ \frac{1}{2} + \frac{2}{5\sqrt{5}} \right] = (6.79) \frac{q}{4\pi\epsilon_0 a^2} = (6.1 \times 10^9) \frac{q}{a^2}$   
 $E_y = -\frac{q}{4\pi\epsilon_0 a^2} \left(\frac{1}{\sqrt{5}}\right) = (0.47) \frac{q}{4\pi\epsilon_0 a^2} = (2.0 \times 10^8) \frac{q}{a^2}$

$\vec{E} = \frac{q}{4\pi\epsilon_0 a^2} \left\{ \left[ \frac{1}{2} + \frac{2}{5\sqrt{5}} \right] \hat{i} - \left[ \frac{1}{\sqrt{5}} \right] \hat{j} \right\}$

Errors:  
 signs -1 to -4  
 angles -1 to -4  
 contrib -2 to -5/len  
 not squaring -2/len  
 3 instead of 5-2  
 simplify -1 to -2  
 comput. errors -1 to -  
 consistency of  
 A & B -1 to -3

B)  $\vec{F} = 3q \vec{E} = \frac{3q^2}{4\pi\epsilon_0 a^2} \left\{ \left[ \frac{1}{2} + \frac{2}{5\sqrt{5}} \right] \hat{i} - \left[ \frac{1}{\sqrt{5}} \right] \hat{j} \right\}$

$|\vec{F}| = \sqrt{F_x^2 + F_y^2} = \frac{3q^2}{4\pi\epsilon_0 a^2} \sqrt{\left[ \frac{1}{2} + \frac{2}{5\sqrt{5}} \right]^2 + \left[ \frac{1}{\sqrt{5}} \right]^2}$   
 $= \frac{3q^2}{4\pi\epsilon_0 a^2} (1.68) = (2.06) \frac{q^2}{4\pi\epsilon_0 a^2} = (1.85 \times 10^{10}) \frac{q^2}{a^2}$

$F = 3qE \rightarrow 2.1a + 3pts$   
 $|\vec{F}| = \sqrt{F_x^2 + F_y^2} \rightarrow 7pts$   
 must evaluate to get  $1.68$   
 even those who  
 new the formula  
 blew it.  
 simply divided  
 -2--1