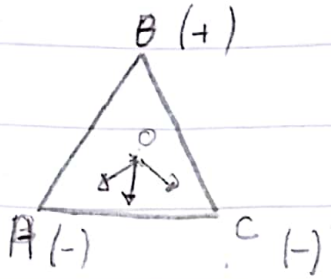
Physics

Ex 1 :



1) Sketch

2) $\|\vec{E_0}(A)\| = \|\vec{E_0}(B)\| = \|\vec{E_0}(C)\| = \dfrac{kq}{\left(\frac{\frac{a}{2}}{\frac{\sqrt{3}}{2}}\right)^2} = \dfrac{3kq}{a^2}$

3) $\vec{E}(O) = \vec{E_B}(O) + \vec{E_{A,C}}(O)$

$$E_{A,C}(O)^2 = \|\vec{E_A}(O) + \vec{E_C}(O)\|^2$$
$$= \|\vec{E_A}(O)\|^2 + \|\vec{E_C}(O)\|^2 + 2\|E_A(O)\|\|E_C(O)\|\cos(120)$$
$$= 2\|\vec{E_A}(O)\|^2 + 2\|\vec{E_A}(O)\|^2\left(\frac{-1}{2}\right)$$

$$\|E_A(O)\|^2 = \left(\frac{3kq}{a^2}\right)^2 \rightarrow E_{A,C}(O) = \frac{3kq}{a^2}$$

$$E(O) = 2\left(\frac{3kq}{a^2}\right) = \frac{6kq}{a^2}$$

4) $\vec{F} = q\vec{E} = (-q)\left(\dfrac{6kq}{a^2}\right)(-\vec{U_x}) = -\dfrac{6kq^2}{a^2}\cdot(-\vec{U_x})$

$\vec{U_x}$ being a unitary vector pointing to B

$$\vec{F} = \frac{6kq^2}{a^2}\vec{U_x}$$

5) $V(A) = V_b(A) + V_B(A) + V_c(A)$

$$= \frac{-kq}{\frac{a}{\sqrt{3}}} + \frac{kq}{a} - \frac{kq}{a} = \frac{-\sqrt{3}kq}{a}$$

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$$V(B) = V_C(B) + V_A(B) + V_B(B)$$

$$= \frac{-kq}{a} - \frac{kq}{a} - \frac{kq\sqrt{3}}{a} = \frac{-kq}{a}(2+\sqrt{3})$$

6) a) $$V(O) = V_C(O) + V_A(O) + V_B(O)$$

$$= \frac{-kq\sqrt{3}}{a}$$

b) $$E(O) = -qV(O) = -q\left(\frac{-kq\sqrt{3}}{a}\right) = \frac{kq^2\sqrt{3}}{a}$$

Ex 3 :

I. 1) $\vec{E} = -\overrightarrow{grad}(V) \rightarrow$ $$E = -\begin{vmatrix} 4xy + \frac{3y^3}{x^2} \\ 2x^2 - \frac{3y^2}{x} \\ -\frac{y^3}{x} \end{vmatrix}$$

2) At $(1,1,1)$: $\|\vec{E}\|^2 = 25 + 2$

$$\Rightarrow \|E\| = \sqrt{27} = 3\sqrt{3}$$

II 1) $$\vec{E} = -\begin{vmatrix} \partial_r V \\ \frac{1}{r}\partial_\theta V \end{vmatrix} = -kqa \begin{vmatrix} -\frac{2\cos\theta}{r^3} \\ -\frac{\sin\theta}{r^3} \end{vmatrix}$$

2) $$\vec{E}(M_0) = kqa\left(2\frac{\sqrt{2}}{2}\frac{1}{r_0^3}\vec{u}_r + \frac{\sqrt{2}}{2}\frac{1}{r_0^3}\vec{u}_\theta\right)$$

$$= kQa\frac{\sqrt{2}}{2}\frac{1}{r_0^3}\left(2\vec{u}_r + \vec{u}_\theta\right)$$

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