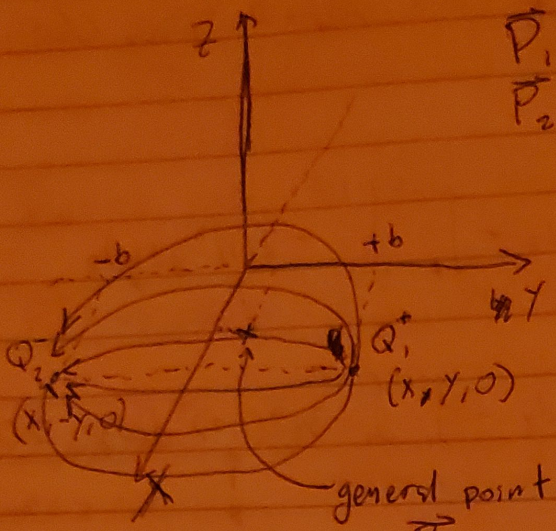
1



$\vec{P}_1 = X\hat{a}_x + Y\hat{a}_y + 0\hat{a}_z$

$\vec{P}_2 = X\hat{a}_x - Y\hat{a}_y + 0\hat{a}_z$

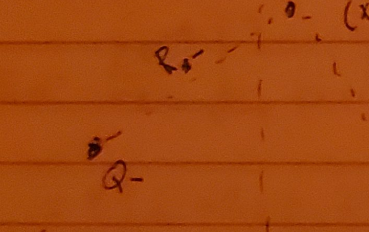
$\vec{E}_1 = \frac{1}{4\pi\varepsilon}\int \frac{\vec{P}_1 - \vec{P}_2}{|\vec{P}_1 - \vec{P}_2|^3} dq_3$

$\vec{E}_1 = \frac{Q}{4\pi\varepsilon} \frac{\vec{P}_1 - \vec{P}_2}{|\vec{P}_1 - \vec{P}_2|^3}$

$\vec{P}_1 - \vec{P}_2 = 0\hat{a}_x + 2\hat{a}_y + 0\hat{a}_z$

$|\vec{P}_1 - \vec{P}_2| = \sqrt{(0)^2 + (2)^2 (0)^2} = \sqrt{(2)^2} = 2$

$\vec{E}_1 = \frac{Q}{4\pi\varepsilon} \cdot \frac{2\hat{a}_y}{8} = \frac{Q\hat{a}_y}{16\pi\varepsilon} \longrightarrow Q = 4\pi\varepsilon \longrightarrow \vec{E}_1 = \frac{1}{4}\hat{a}_y$



$\vec{E}_{t-} = \frac{Q_-}{4\pi\varepsilon} \cdot \frac{P_t - P_-}{|P_t - P_1|^3}$

$\vec{E}_{t+} = \frac{Q_+}{4\pi\varepsilon} \cdot \frac{P_t - P_+}{|P_t - P_+|^3}$

$\vec{P}_t = X_t\hat{a}_x + Y_t\hat{a}_y$

$\vec{P}_- = X_-\hat{a}_x - Y\hat{a}_y$

$\vec{P}_+ = X_+\hat{a}_x + Y\hat{a}_y$

$\vec{E}_t = \vec{E}_{t-} + \vec{E}_{t+} = \frac{Q_-}{4\pi\varepsilon} \cdot \frac{\vec{P}_t - \vec{P}_-}{|\vec{P}_t - \vec{P}_1|^3} + \frac{Q_+}{4\pi\varepsilon} \cdot \frac{\vec{P}_t - \vec{P}_+}{|\vec{P}_t - \vec{P}_+|}$

$= \frac{1}{4\pi\varepsilon}\left[\frac{Q_-(\vec{P}_t - \vec{P}_-)}{|\vec{P}_t - \vec{P}_-|^3} + \frac{Q_+(\vec{P}_t - \vec{P}_+)}{|\vec{P}_t - \vec{P}_+|^3}\right]$

$\vec{P}_t - \vec{P}_- = (X_t - X_-)\hat{a}_x + (Y_t + Y)\hat{a}_y \quad |\vec{P}_t - \vec{P}_-| = \sqrt{(X_t - X_-)^2 + (Y_t + Y)^2}$

$\vec{P}_t - \vec{P}_+ = (X_t - X_+)\hat{a}_x + (Y_t - Y)\hat{a}_y \quad |\vec{P}_t - \vec{P}_+| = \sqrt{(X_t - X_+)^2 + (Y_t - Y)^2}$

$$\vec{E}_t = \frac{1}{4\pi\varepsilon}\left[Q_- \frac{(x_t - x_-)\hat{a}_x + (y_t + y)\hat{a}_y}{\left((x_t - x_-)^2 + (y_t + y_-)^2\right)^{1.5}} + Q_+ \frac{(x_t - x_+)\hat{a}_x + (y_t - y)\hat{a}_y}{\left((x_t - x_+)^2 + (y_t - y)^2\right)^{1.5}}\right]$$

Inputs:

x_t: x-coordinate of test point

y_t: y-coordinate of test point

Q_-: charge of negative end of dipole

x_-: x-coordinate of negative end of dipole

y_-: y-coordinate of negative end of dipole (-b)

Q_+: charge of positive end of dipole

x_+: x-coordinate of positive end of dipole

y_+: y-coordinate of positive end of dipole (b)

Outputs:

$\vec{E}_t$: electric field at test point