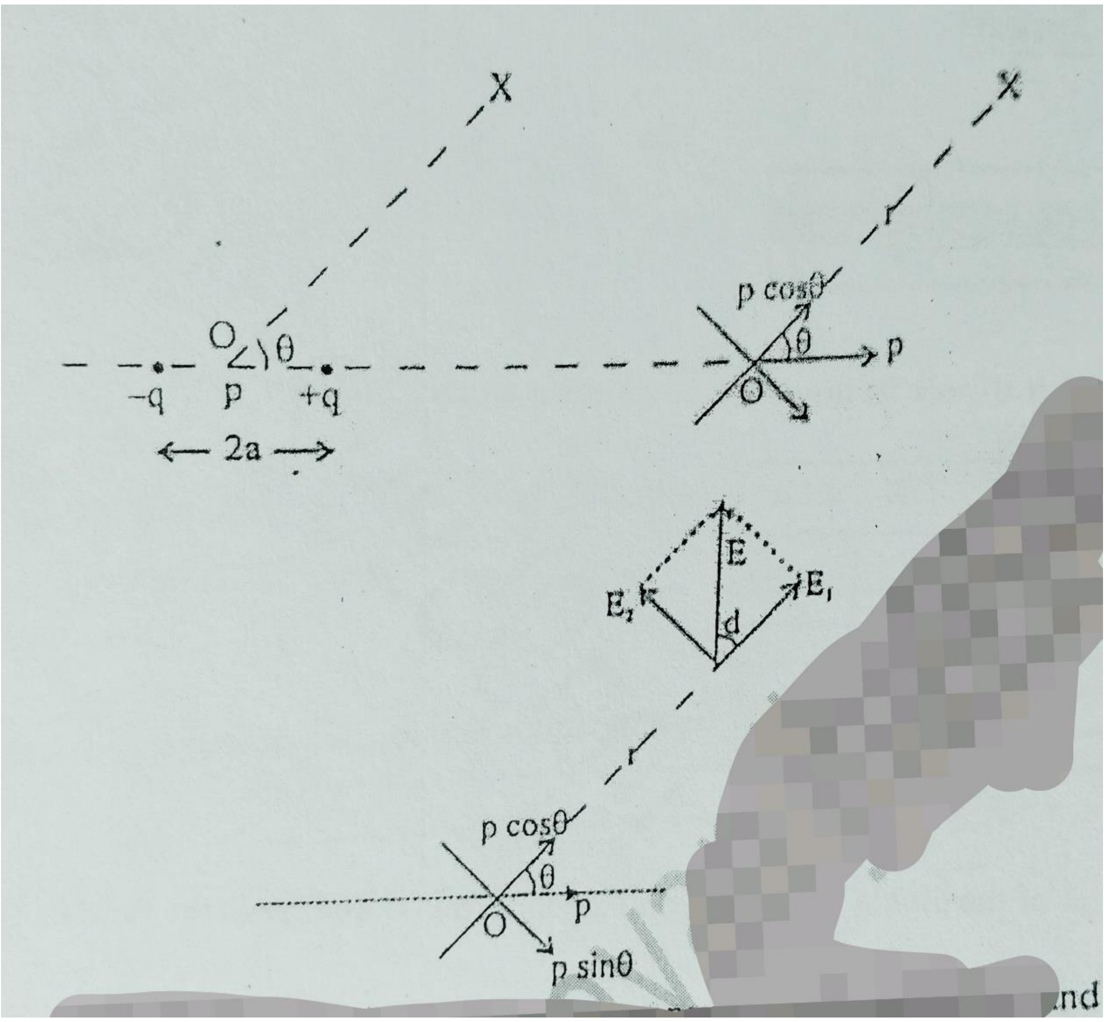
Electric field intensity at any point due to a short electric dipole -

As shown in fig. AB represent a short electric dipole of dipole moment $\vec{p}$ along $\overrightarrow{AB}$. we have to find the electric field at point x which is at distance 'r' from the centre 'o' of the dipole .



The dipole moment of the dipole is resolved in two components , p cosϴ along the $\vec{r}$ and p sinϴ perpendicular to $\vec{r}$ as shown in figure .

For p cosϴ component the point x acts as an axial point and p sinϴ as equatorial point

So,the field intensity at x due to p cosϴ component is $E_1 = \frac{1}{4\prod\epsilon 0} \cdot \frac{2pcos\theta}{r3}$ in the direction of p cosϴ

the field intensity at x due to p sinϴ component is $E_1 = \frac{1}{4\prod\epsilon 0} \cdot \frac{p\ sin\theta}{r3}$ opposite to p sinϴ

therefore the net field at x is given as $E= (E_1^2+ E_2^2)^{1/2}$

after solving we get ; $E = p(4cos^2\Theta + sin^2\Theta)^{1/2} / 4\prod\epsilon_0 r^3$ or $E = p (3cos^2\Theta+ 1)^{1/2} /4\prod\epsilon_0 r^3$

and direction may be find using , $Tan\alpha= (tan\Theta) / 2$;for axial point $\Theta = 0^0$ so $E_{axial} = \frac{1}{4\prod\epsilon 0} \cdot \frac{2p}{r3}$

and for equatorial $\Theta= 90^0$ so $E_{equatorial} = \frac{1}{4\prod\epsilon 0} \cdot \frac{p}{r3}$;