Curl of Electric Field is Zero

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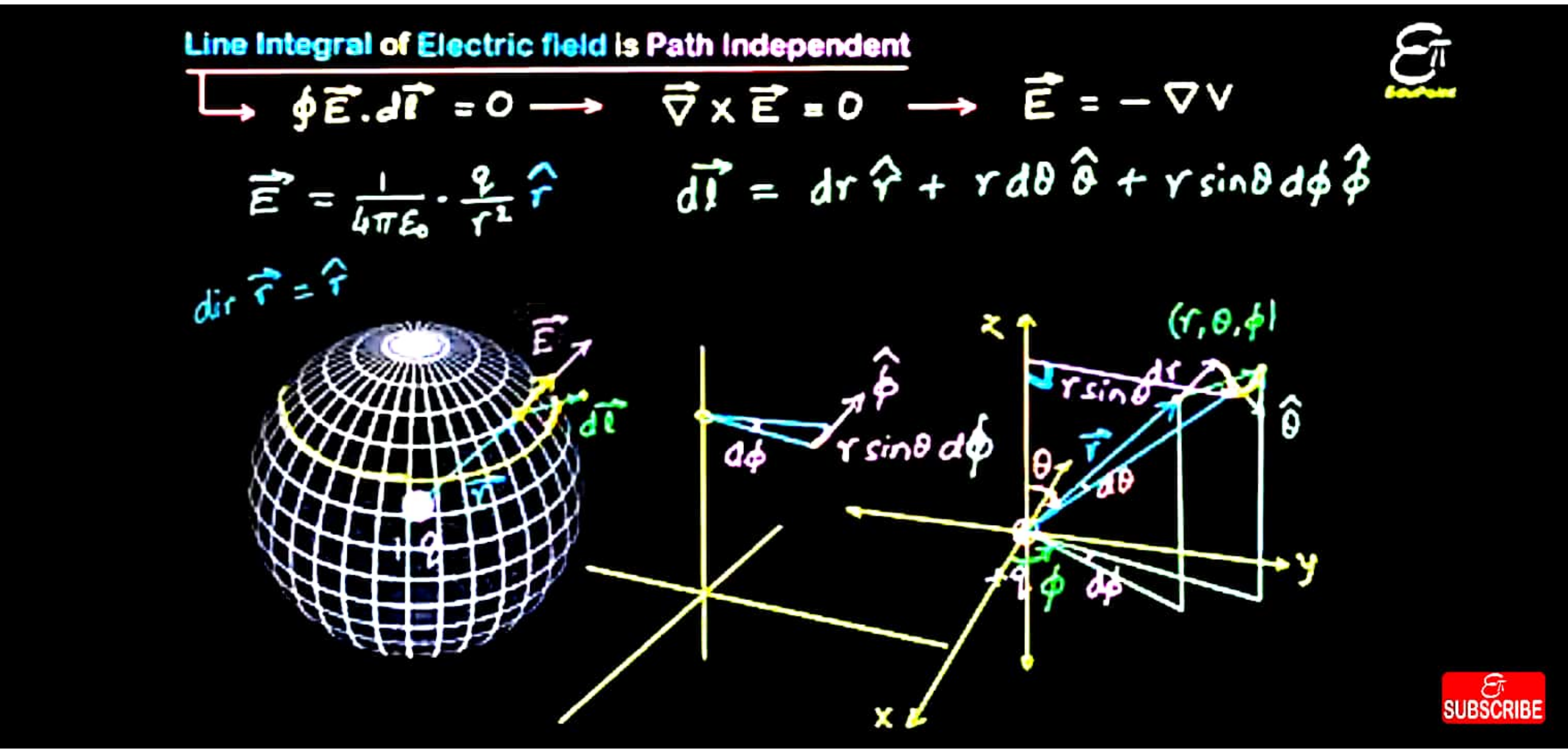

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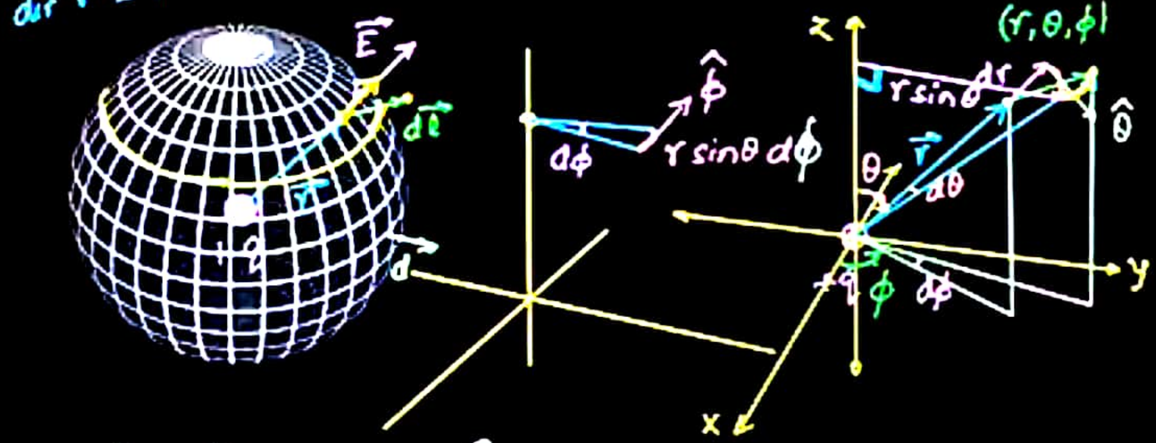
$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{r^2}\hat{r} \qquad \vec{dl} = dr\,\hat{r} + r\,d\theta\,\hat{\theta} + r\sin\theta\,d\phi\,\hat{\phi}$$

dir $\vec{r} = \hat{r}$



$$\vec{E}\cdot\vec{dl} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\,dr$$

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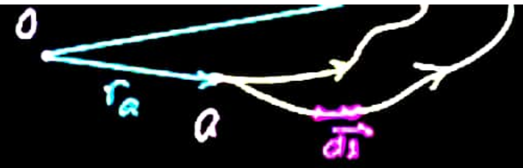
$$\vec{E}\cdot d\vec{l} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\,dr$$



$$\int_a^b \vec{E}\cdot d\vec{l} = \int_{r_a}^{r_b} \frac{1}{4\pi\varepsilon_0}\cdot\frac{q}{r^2}\,dr$$

$$= \frac{q}{4\pi\varepsilon_0}\int_{r_a}^{r_b}\frac{1}{r^2}\,dr$$

$$= \frac{q}{4\pi\varepsilon_0}\left[\frac{r^{-2+1}}{-2+1}\right]_{r_a}^{r_b}$$

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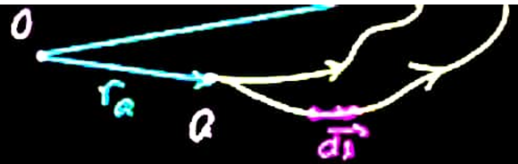
$$\vec{E}\cdot\vec{dl} = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}\,dr$$



$$\int_a^b \vec{E}\cdot\vec{dl} = \int_{r_a}^{r_b} \frac{1}{4\pi\epsilon_0}\cdot\frac{q}{r^2}\,dr$$

$$= \frac{q}{4\pi\epsilon_0}\int_{r_a}^{r_b}\frac{1}{r^2}\,dr$$

$$= \frac{q}{4\pi\epsilon_0}\left[\frac{r^{-2+1}}{-2+1}\right]_{r_a}^{r_b}$$

$$= -\frac{q}{4\pi\epsilon_0}\left[\frac{1}{r}\right]_{r_a}^{r_b} = -\frac{q}{4\pi\epsilon_0}\left[\frac{1}{r_b}-\frac{1}{r_a}\right]$$

$$= \frac{q}{4\pi\epsilon_0}\left[\frac{1}{r_a}-\frac{1}{\boxed{r_b}}\right]$$

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$$\oint \vec{E}\cdot\vec{dl} = \int_a^b \vec{E}\cdot\vec{dl} + \int_b^a \vec{E}\cdot\vec{dl}$$

$$= \frac{q}{4\pi\varepsilon_0}\left[\frac{1}{r_a}-\frac{1}{r_b}\right] + \frac{q}{4\pi\varepsilon_0}\left[\frac{1}{r_b}-\frac{1}{r_a}\right]$$

$$= \frac{q}{4\pi\varepsilon_0}\left[\cancel{\frac{1}{r_a}} - \cancel{\frac{1}{r_b}} + \cancel{\frac{1}{r_b}} - \cancel{\frac{1}{r_a}}\right]$$

$$\Rightarrow \oint \vec{E}\cdot\vec{dl} = 0$$

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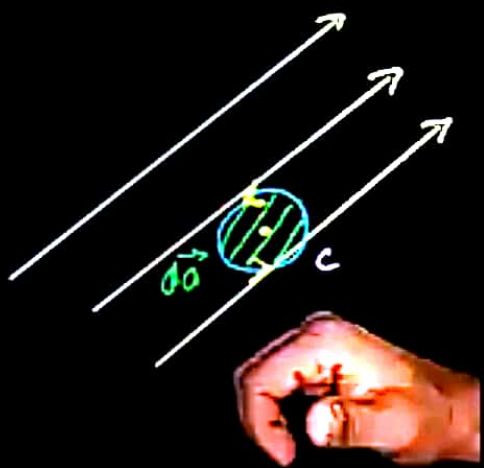
$$\Rightarrow \boxed{\oint \vec{E}\cdot\vec{dl} = 0}$$

magnitude of (curl of $\vec{E}$)

$$= \frac{\oint_c \vec{E}\cdot\vec{dl}}{da}$$



When these four curled fingers of right hand indicates the direction of the line integral, thumb indicates the direction of the curl.

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