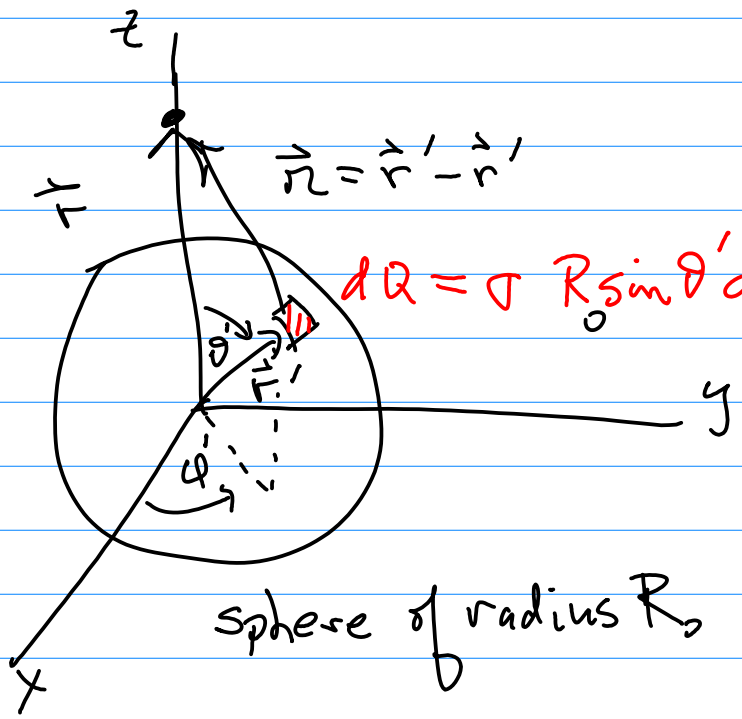
Shadowitz

Monday Jun13 : Sec 1-2, part of 1-5, 2-3

Ink Survey Feedback



$\hat{r} = \hat{r}'$

$\hat{x} = \hat{x}'$

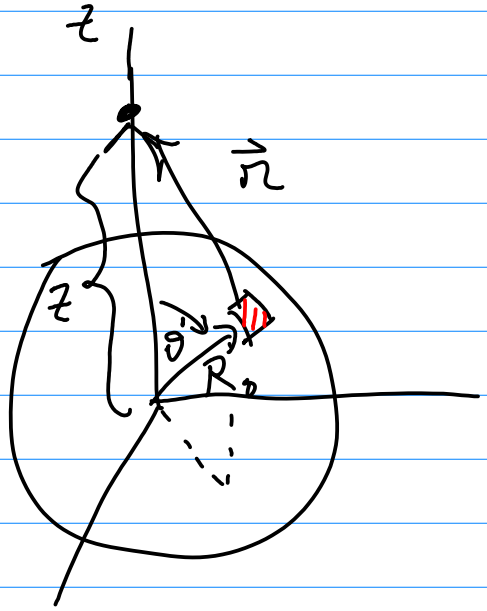
$\vec{r} = z\hat{z}$ $\quad \vec{r}' = R_0\hat{r} = R_0(\sin\theta'\cos\varphi'\hat{x} + \sin\theta'\sin\varphi'\hat{y} + \cos\theta'\hat{z})$

$\vec{R} = \vec{r} - \vec{r}' = -R_0\sin\theta'\cos\varphi'\hat{x} - R_0\sin\theta'\sin\varphi'\hat{y} - (R_0\cos\theta' - z)\hat{z}$

$$|\vec{R}| = \sqrt{R_0^2\sin^2\theta'\underbrace{(\cos^2\varphi' + \sin^2\varphi')}_{1} + z^2 - 2zR_0\cos\theta' + R_0^2\cos^2\theta'}$$

$$|\vec{R}| = \sqrt{R_0^2 + z^2 - 2zR_0\cos\theta'}$$

Law of Cosines



InkSurvey response comments

$$\vec{E} = \int d\vec{E} = \int \frac{k\, dQ}{r^2}\hat{r} = \int_0^{2\pi}\int_0^{\pi} \frac{k\,\sigma\, R\sin\theta'\, d\varphi'\, R\, d\theta'}{r^2}\hat{r}$$

→ $\sigma(\theta', \varphi')$?

→ ½ spherical shell

→ volume charge density $\rho\, da\, dr$

→ $\vec{E}$ from dQ on bottom go thru charge on top hemisphere?

→ simpler way to get $\hat{r} = \_\hat{x} + \_\hat{y} + \_\hat{z}$ without all the trig?

→ $\hat{r} = \hat{r}'$ $\hat{x} = \hat{x}'$

→ electrostatic scrubbers http://en.wikipedia.org/wiki/Electrostatic_precipitator

http://en.wikipedia.org/wiki/Del_in_cylindrical_and_spherical_coordinates

$$\hat{x} = \sin\theta\cos\varphi\,\hat{r} + \cos\theta\cos\varphi\,\hat{\theta} - \sin\varphi\,\hat{\varphi}$$

$$\hat{y} = \sin\theta\sin\varphi\,\hat{r} + \cos\theta\sin\varphi\,\hat{\theta} + \cos\varphi\,\hat{\varphi}$$

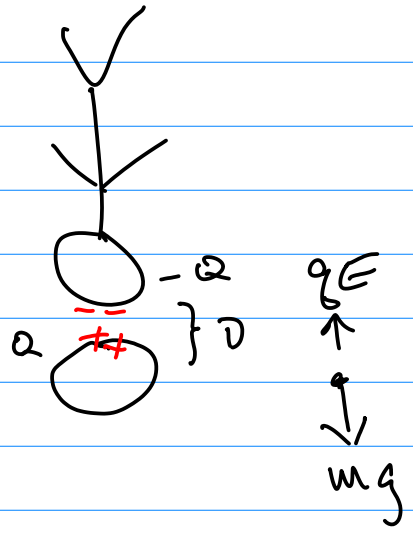
$$\hat{z} = \cos\theta\,\hat{r} - \sin\theta\,\hat{\theta}$$

$\hat{r} = \hat{r}\cdot\hat{x}\,\hat{x} + \hat{r}\cdot\hat{y}\,\hat{y} + \hat{r}\cdot\hat{z}\,\hat{z}$ apply this to the above relations

If you don't understand these InkSurvey answers ask me.

Ballon charge

$$mg = \frac{kQ^2}{D^2}$$



$$10^{-2}\ 10 = \frac{10^{10}\ Q^2}{10^{-4}}$$

$$10^{-5}\ 10^{-10} = Q^2 \qquad Q \simeq 10^{-7} \to 10^{-8}$$

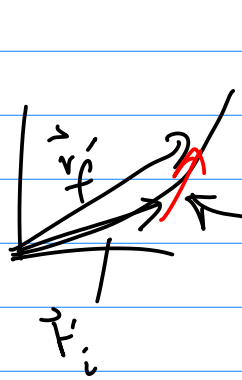
$$q \sim 1.6 \times 10^{-19} \qquad \#\text{electrons} = \frac{Q}{q} \simeq 10^{12}\ \text{elect}$$

How are electrons removed?

Like friction the stripping process is not very well understood (no actual model)

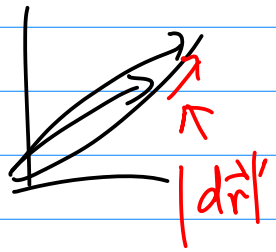
$$\vec{F} = q\vec{E} \qquad \vec{E} = \int k \frac{dQ}{r^2}\hat{r}$$

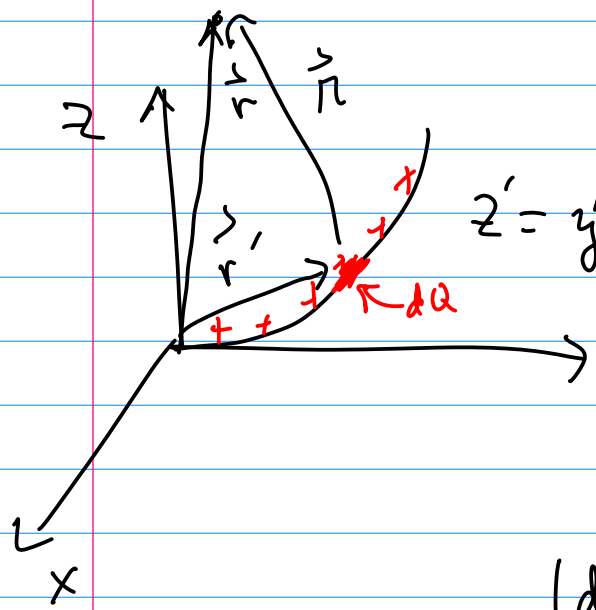
Questions?



$$\vec{r}' = x'\hat{x} + y'\hat{y} + z'\hat{z}$$

$$= y'^2$$





$$|d\vec{r}'| = dl$$

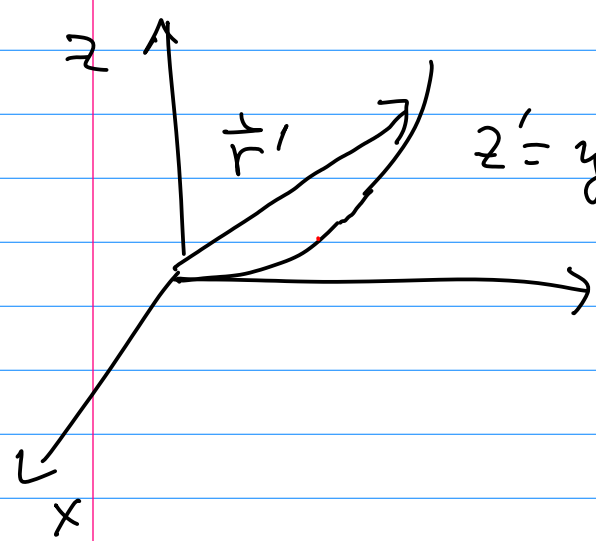
$$dQ = \lambda\, dl$$

$$d\vec{r}' = dx'\hat{x} + dy'\hat{y} + 2y'dy'\hat{z}$$

$$|d\vec{r}'| = \sqrt{dx'^2 + dy'^2 + dy'^2 4y'^2}$$

$dx' = 0$ since change is in the yz plane

$$|d\vec{r}'| = dy'\sqrt{1 + 4y'^2} = dl$$



Flux : $\Phi_E \equiv \int \vec{E} \cdot d\vec{a}$

Questions :

Incongruous :

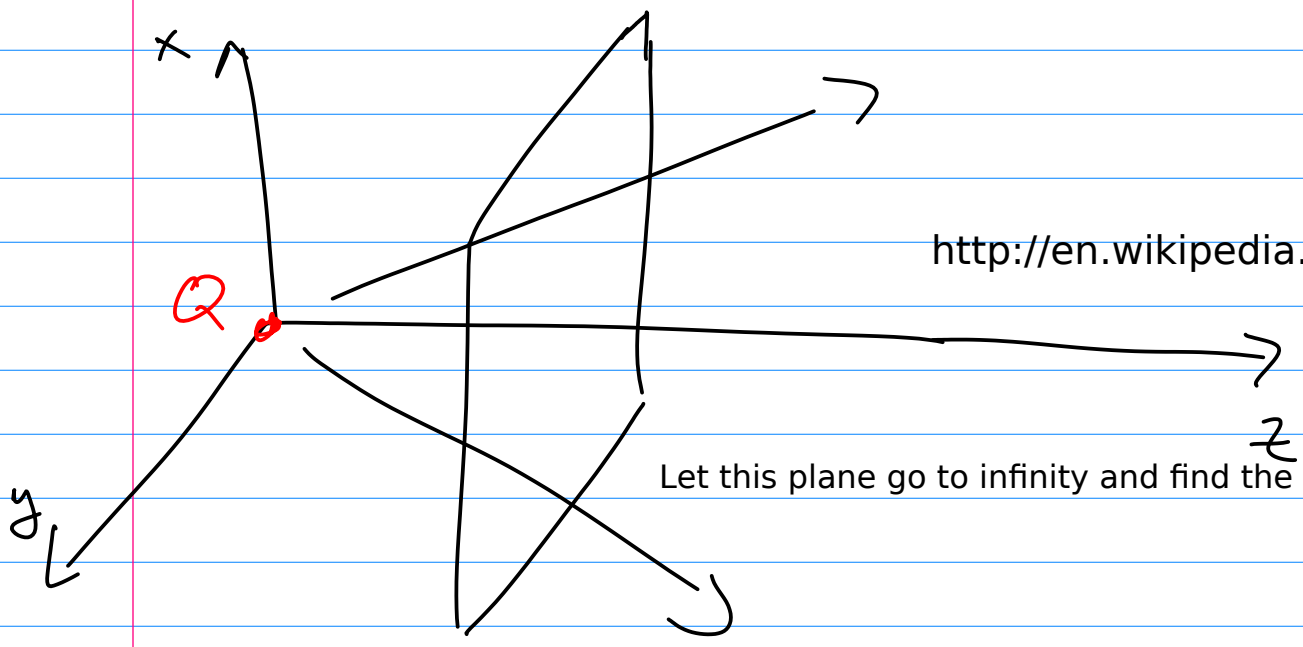
Congruous : How do calculate da for a cylinder?

Modifying : What if the dot product is replaced by a cross product?

Generalizing/analogy : How is flux used in quantum mechanics?

Causal/Creative : If the charge moves how does this affect the flux?

Informational : Why are we calculation the electric field flux?

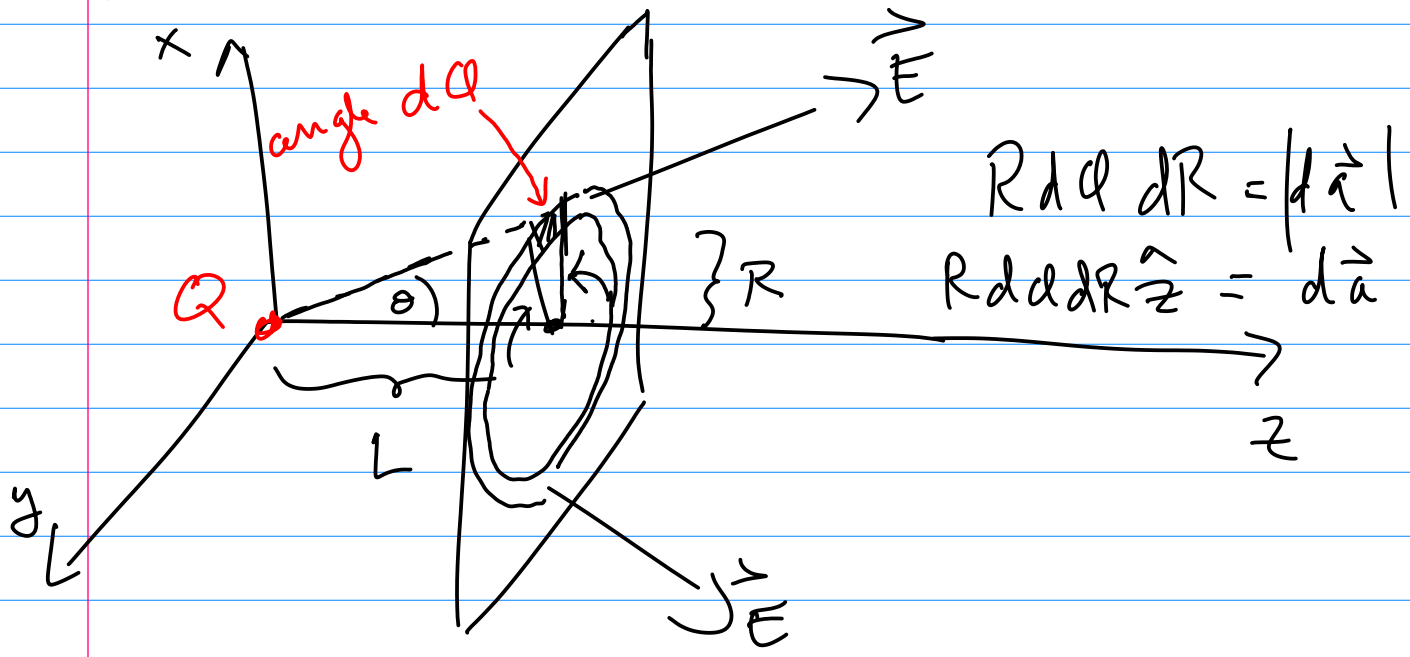


http://en.wikipedia.org/wiki/Flux

Let this plane go to infinity and find the flux thru it.

Use cylindrical coords

http://en.wikipedia.org/wiki/Cylindrical_coordinate_system



$R\,d\theta\,dR = |d\vec{a}|$

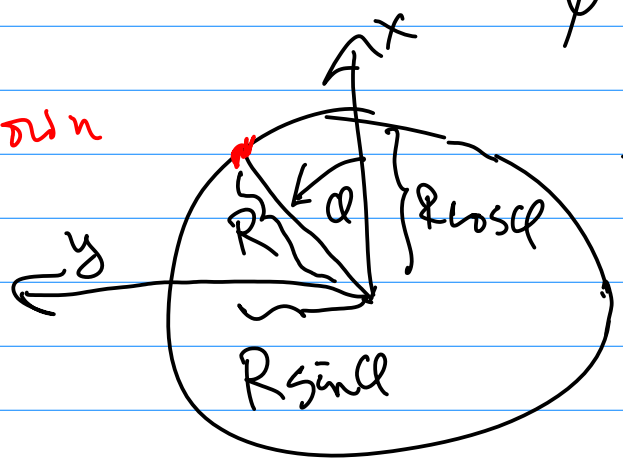
$R\,d\theta\,dR\,\hat{z} = d\vec{a}$

$$\int \frac{kQ}{r^2}\hat{r}\cdot d\vec{a}$$

$\vec{r} = \vec{r} - \vec{r}'$ $\quad \vec{r} =$

$\vec{r}' = 0$ source is at the origin

View down z axis



$\vec{r} = R\cos\theta\,\hat{x} + R\sin\theta\,\hat{y} + L\hat{z}$

$$|\vec{r}| = \sqrt{R^2\cos^2\theta + R^2\sin^2\theta + L^2} = \sqrt{R^2+L^2}$$

$$\Phi = \int_0^{\infty}\int_0^{2\pi} \frac{kQ}{(R^2+L^2)} \underbrace{\frac{R\cos\theta\,\hat{x} + R\sin\theta\,\hat{y} + L\hat{z}}{\sqrt{R^2+L^2}}}_{\hat{r}} \cdot R\,d\theta\,dR\,\hat{z}$$

OFFICE HOURS CHANGE

FROM 11-12 MWF

TO 12-1 MWF

$\frac{1}{2}$ EXAM MONDAY JAN 20

(30 minutes)

- Setting up $\vec{E}$ from a continuous charge distribution: dQ, $\vec{r}$, limits
- Area & volume of cylindrical & spherical geometrical objects