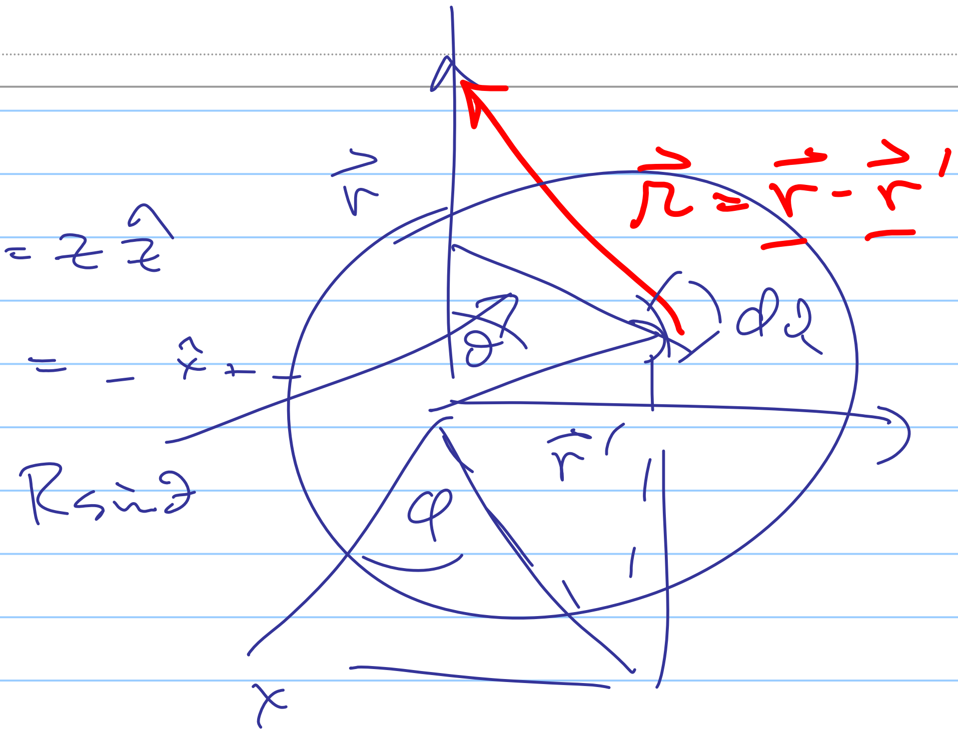
lecture 5

Note Title 1/20/2006

$\vec{r} = z\hat{n} = z\hat{z}$

$\vec{r}\,' = R\hat{n} = \_\ \hat{x} + \_$



$$d\vec{E} = k\frac{dQ}{\mathscr{r}^2}\hat{\mathscr{r}}$$

Conservation laws: energy

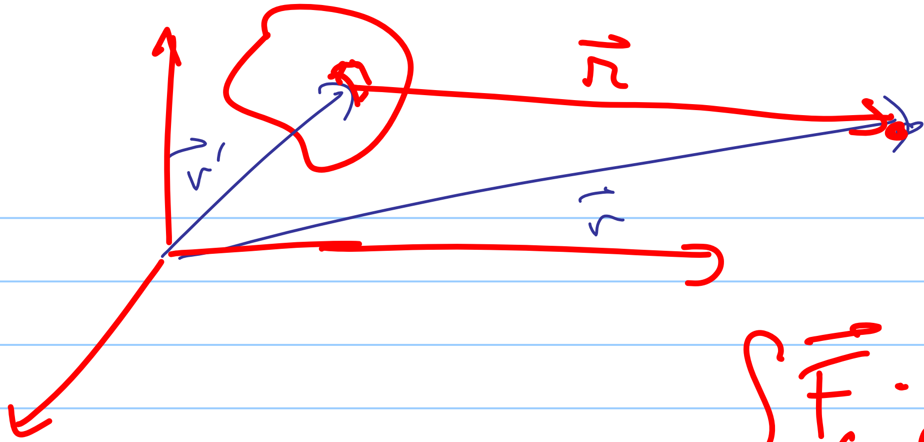
$$W_{net} \equiv \int \vec{F}_{net} \cdot d\vec{\ell} = \Delta KE$$

$$W_{nc} + W_{cons} = \Delta KE$$

W_{cons} ← path indep.

$$W_{cons} = -\Delta PE$$

$$W_{nc} = \Delta(KE + PE)$$

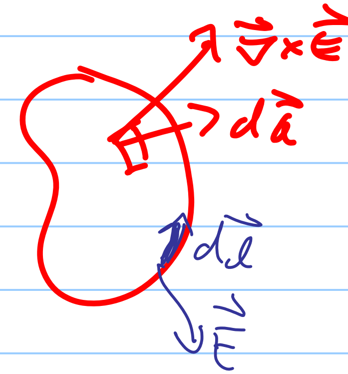


$$\vec{E} = \int \frac{1}{4\pi\epsilon_0} \frac{dq}{\mathscr{r}^2}\,\hat{\mathscr{r}}$$

$dq = \rho\, d\tau$, $\quad d\tau = dx'dy'dz'$

$$\int \vec{F}_{coul} \cdot d\vec{l} = \int q\vec{E} \cdot d\vec{l}$$

$$\oint \vec{E} \cdot d\vec{l} = \int \underline{\vec{\nabla} \times \vec{E}} \cdot d\vec{a}$$



$$\vec{\nabla} \times \vec{E} = \underline{\vec{\nabla} \times} \int \frac{1}{4\pi\epsilon_0} \rho\, d\tau \frac{\hat{\mathscr{r}}}{\mathscr{r}^2}$$

$$= \frac{1}{4\pi\epsilon_0} \int \rho\, d\tau\, \vec{\nabla} \times \frac{\hat{\mathscr{r}}}{\mathscr{r}^2}$$

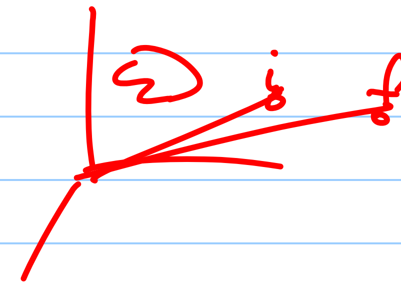
$$\vec{\imath} = \vec{r} - \vec{r}\,' = (x\hat{x} + y\hat{y} + z\hat{z}) - (x'\hat{x} + y'\hat{y} + z'\hat{z})$$

$$= \imath_x \hat{x} + \imath_y \hat{y} + \imath_z \hat{z}$$

$$\text{" } (x - x')$$

$$\vec{\nabla} \times \frac{\hat{\imath}}{\imath^2} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ \frac{\imath_x}{\imath^3} & \frac{\imath_y}{\imath^3} & \frac{\imath_z}{\imath^3} \end{vmatrix} = 0$$

$$\oint q\vec{E}\cdot d\vec{l} = 0 = \oint \vec{F}_{cons}\cdot d\vec{l}$$



$$W_{cons} = -\Delta PE = q\int \vec{E}\cdot d\vec{l}$$

$$\Delta PE = -q\underbrace{\int_i^f \vec{E}\cdot d\vec{l}}_{\Delta V} = -q\Delta V = -q(V_f - V_i)$$

$$\vec{\nabla} \times \vec{E} = 0$$

$$\vec{\nabla} f \equiv \hat{x}\frac{\partial f}{\partial x} + \hat{y}\frac{\partial f}{\partial y} + \hat{z}\frac{\partial f}{\partial z}$$

$$\vec{\nabla} \times \vec{\nabla} f = 0$$

↖ scalar function

$$\begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ \frac{\partial f}{\partial x} & \frac{\partial f}{\partial y} & \frac{\partial f}{\partial z} \end{vmatrix} = \hat{x}\underbrace{\left(\frac{\partial}{\partial y}\frac{\partial f}{\partial z} - \frac{\partial}{\partial z}\frac{\partial f}{\partial y}\right)}_{=0} + \hat{y}\,0 + \hat{z}\,0$$