

For a vector field $\vec{F}(x,y,z) = \langle P(x,y,z), Q(x,y,z), R(x,y,z) \rangle$
 The following conditions are equivalent.

- ① $\vec{F}$ is conservative
- ② $\vec{F}$ has a pot fun f
- ③ $\text{curl } \vec{F}$ is 0

levels of the
 $\text{curl } \vec{F}$

- ④ LI about a closed curve is 0
- ⑤ LI is independent of the path

table

$\vec{F}$ \ C	closed	any
cons	0 ✓	FTLI
any	.	

$$\int \vec{F} \cdot d\vec{n} = f(\vec{r}) \Big|_{\vec{r}(a)}^{\vec{r}(b)}$$

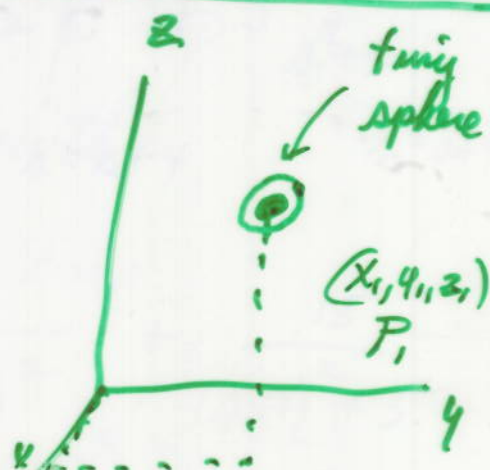
$$\oint \text{curl } \vec{F} \cdot \vec{n} dS = 0$$

We wish to find the "meaning" of the
 $\text{div } \vec{F}$ and $\text{curl } \vec{F}$

P2

$\text{div } \vec{F}$ apply G.D.T.

$$\text{flux} \stackrel{\text{def}}{=} \oint_{\text{Surf}} \vec{F} \cdot \hat{n} dS = \iiint_{\text{Solid}} \text{div } \vec{F} dV$$

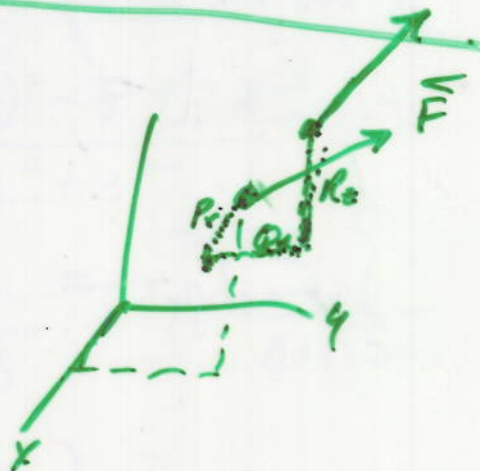


In a small sphere $\text{div } \vec{F} = P_x + Q_y + R_z$ changes little

$$\text{flux} \approx \text{div } \vec{F}(P_1) \iiint_{\text{solid}} dV = \text{div } \vec{F}(P_1) \text{ volume of sphere}$$

$$\text{div } \vec{F}(P_1) = \frac{\text{flux}}{\text{vol}} = \text{strength of the source}$$

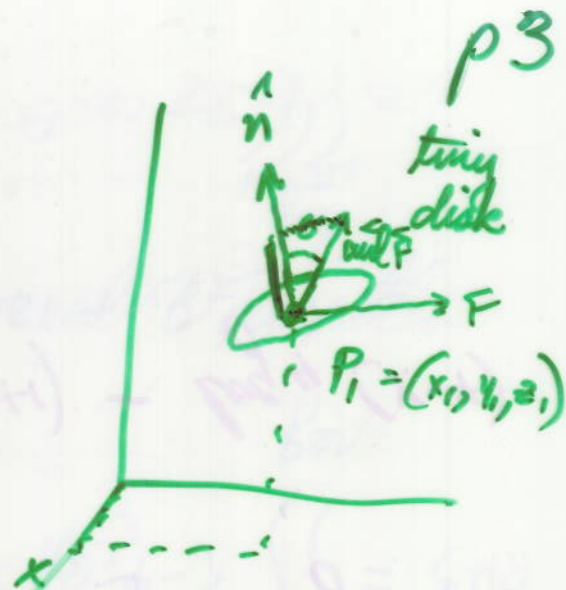
$$\text{div } \vec{F} = P_x + Q_y + R_z$$



$\vec{\text{curl}} \vec{F}$

Use S C Th

$$\text{circ} \stackrel{\text{def}}{=} \oint_C \vec{F} \cdot d\vec{r} = \iint_{\text{Disk}} \vec{\text{curl}} \vec{F} \cdot \hat{n} \, dS$$



Since disk is tiny, $\vec{\text{curl}} \vec{F}$ is nearly const through Disk

$$\text{circ} = \vec{\text{curl}} \vec{F} \cdot \hat{n}(P_1) \iint_{\text{disk}} dS = \vec{\text{curl}} \vec{F} \cdot \hat{n}(P_1) \cdot \text{area of disk}$$

$$\vec{\text{curl}} \vec{F} \cdot \hat{n} = \frac{\text{circ}}{\text{area}} = |\vec{\text{curl}} \vec{F}| \cdot |\hat{n}| \cos \theta$$

$|\vec{\text{curl}} \vec{F}|$ is the $\frac{\text{max circ}}{\text{area}}$

dir of $\vec{\text{curl}} \vec{F}$ is perpendicular to the $\frac{\text{max circ}}{\text{area}}$

To prepare for final exam

Final Exam Here 5:00 - 7:00 Monday May 7

- ① Fill it the 3"x5" all written by hand.
- ② Using the card, re-write all 5 HQ's
- ③ Re-view the 5 PS's
- ④ Eat & Sleep some
- ⑤ Review for the last hour only what you know