	Line Integral	Surface Integral
Scalar	$\int_C f\,ds$	$\iint_S f\,dS$
Vector	$\int_C \vec{F}\cdot\vec{T}\,ds = \int_C \vec{F}\cdot d\vec{r}$	$\iint_S \vec{F}\cdot\vec{N}\,dS = \iint_S \vec{F}\cdot d\vec{S}$

We want to add up all of the forces NORMAL to the surface

Flux measures flow across the surface

Added all forces tangent to the curve.

Work

$\vec{N}$ = UNIT Normal Vector

$\vec{\nabla}G$ = Normal Vector

$$\iint_S \vec{F}\cdot d\vec{S} \rightarrow d\vec{S} = \vec{N}\,dS$$

$$\vec{N} = \frac{\vec{\nabla}G}{\|\vec{\nabla}G\|}$$

$$dS = \|\nabla G\|\,dA \leftarrow \text{From Surface area}$$

$$\therefore d\vec{S} = \vec{\nabla}G\,dA$$

magnitude

$$\text{Scalar: } \iint_S f\,dS = \iint_D f\,\|\vec{\nabla}G\|\,dA$$

same

$$\text{Vector: } \iint_S \vec{F}\cdot d\vec{S} = \iint_D \vec{F}\cdot\vec{\nabla}G\,dA$$

Vector

-AB 5/11/04