

6)

$$\int_S d\vec{\sigma} \cdot (\vec{\nabla} \times \vec{F}) = \oint_{\partial S} \vec{F} \cdot d\vec{r}$$

Integrand:  $\int_S (\nabla \times \vec{v}) \cdot \vec{n} \cdot d\vec{\sigma}$

$$\text{so: } \oint_0^{2\pi} \vec{v} \cdot \vec{n} \cdot d\vec{\sigma}$$

$$= \frac{3\pi}{2}$$

$$\vec{v}(t) = (\cos t, \sin t, 0)$$

$$\vec{v}'(t) = (-\sin t, \cos t, 0) \cdot dt$$

$$z=0!$$

$$\nabla \times (\vec{v} \cdot \vec{v}) = \nabla \times \vec{v} \cdot \vec{v} + \vec{v} \cdot \nabla \times \vec{v}$$

$\vec{v} \cdot \vec{v}$

$$(\alpha^2 - \beta^2) \cdot (1, 1, 1) = (\alpha^2 - \beta^2, \alpha^2 - \beta^2, \alpha^2 - \beta^2)$$

$$= (\cos^2 t - \sin^2 t, \cos^2 t - \sin^2 t, \cos^2 t - \sin^2 t)$$