6)

$$\int_S d\vec{\sigma} \cdot (\vec{\nabla} \times F) = \oint_{C^+} \vec{F} \cdot d\vec{x}$$

In this case: $\int_S (\nabla u \times \nabla v) \cdot n \cdot d\sigma$

$z = 0$!

$\nabla \times (u \nabla v) = \nabla u \times \nabla v + u \cdot \underbrace{\nabla \times \nabla v}_{=0}$

$= (\alpha^3 - y^3) \cdot (1,1,1) = (\alpha^3 - y^3, \dots, \dots)$

$= (\cos^3 t - \sin^3 t, \dots, \dots)$

$n(t) = (\cos t, \sin t, 0)$

$n'(t) = (-\sin t, \cos t, 0) \cdot dt$

$= d\vec{x}$

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