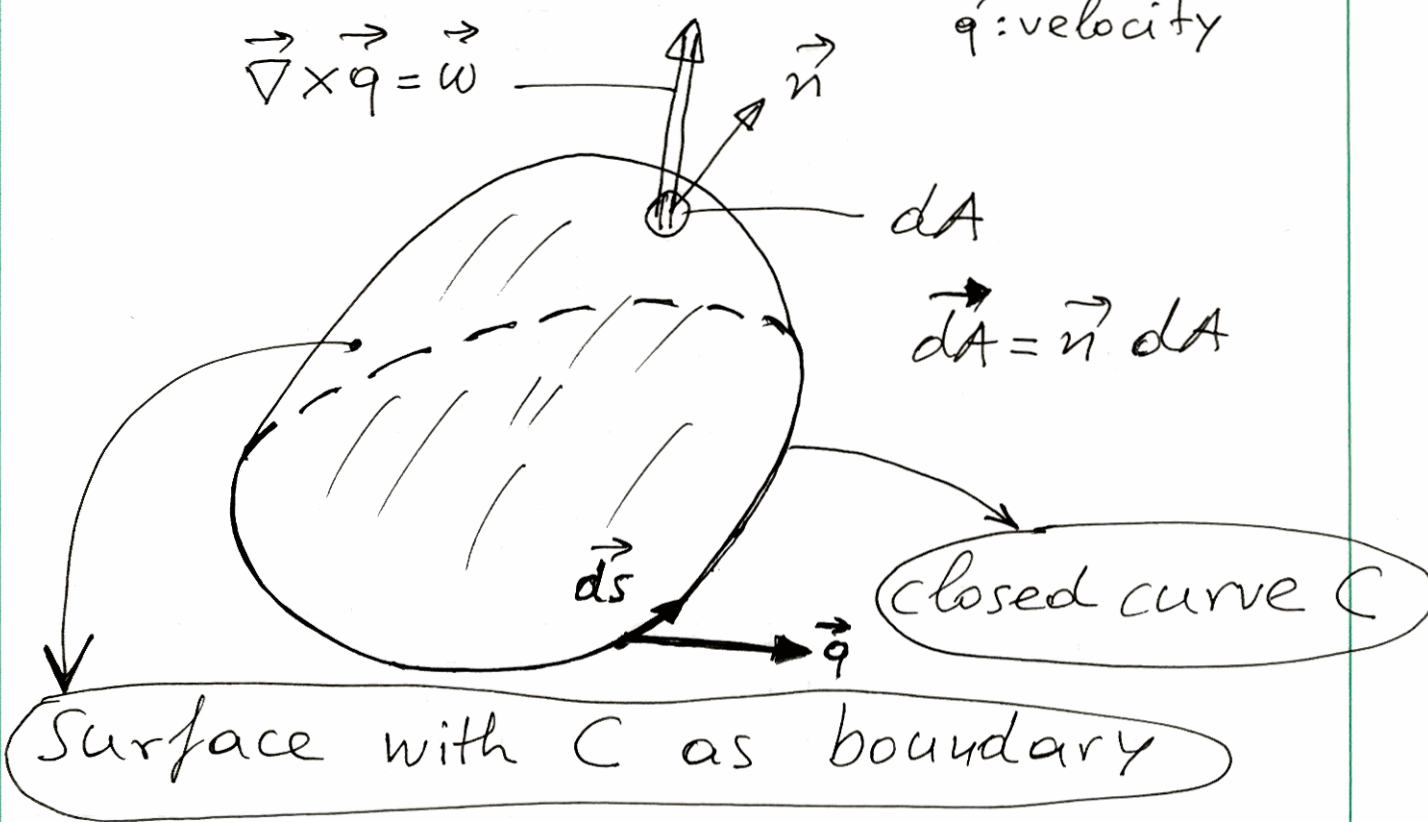


# Stokes' Theorem

$$\vec{\nabla} \times \vec{q} = \vec{\omega}$$

$\vec{q}$ : velocity



$dA$

$$d\vec{A} = \vec{n} dA$$

closed curve C

Surface with C as boundary

circulation around C:  $\Gamma = \oint_C \vec{q} \cdot d\vec{s} = \oint_C q_s ds$

$q_s$ : component of velocity  $\vec{q}$  along direction  $d\vec{s}$

means integral along closed curve C

Stokes' theorem:

$$\oint_C \vec{q} \cdot d\vec{s} = \iint_A (\vec{\nabla} \times \vec{q}) \cdot d\vec{A} = \iint_A \vec{\omega} \cdot d\vec{A}$$

$$\vec{\omega} = \vec{\nabla} \times \vec{q} ; \text{ vorticity}$$