

$$\begin{aligned}
\frac{d}{dt} \int_V u(x, t) \, dV &= - \int_{\partial V} \vec{q}(x, t) \cdot \vec{n} \, dF && \left| \vec{q}(x, t) = -D \nabla u(x, t) \right. \\
&= \int_{\partial V} D \nabla u(x, t) \cdot \vec{n} \, dF && \left| \text{Divergence theorem} \right. \\
&= \int_V D \nabla \cdot \nabla u(x, t) \, dV \\
\int_V \frac{d}{dt} u(x, t) \, dV &= \int_V D \Delta u(x, t) \, dV
\end{aligned}$$

$$\frac{d}{dt} \int_V u(x, t) \, dV = - \int_{\partial V} \vec{q}(x, t) \cdot \vec{n} \, dF \quad \Bigg| \quad \vec{q}(x, t) = -D \nabla u(x, t)$$

$$= \int_V D \nabla \cdot \nabla u(x, t) \, dV$$

$$\int_V \frac{d}{dt} u(x, t) \, dV = \int_V D \Delta u(x, t) \, dV$$

$$\frac{d}{dt} \int_V u(x, t) \, dV = - \int_{\partial V} \vec{q}(x, t) \cdot \vec{n} \, dF \quad \Bigg| \quad \vec{q}(x, t) = -D \nabla u(x, t)$$

$$\int_V \frac{d}{dt} u(x, t) \, dV = \int_V D \Delta u(x, t) \, dV$$

$$\begin{aligned}
\frac{d}{dt} \int_V u(x, t) \, dV &= - \int_{\partial V} \vec{q}(x, t) \cdot \vec{n} \, dF && \left| \vec{q}(x, t) = -D \nabla u(x, t) \right. \\
&= \int_{\partial V} D \nabla u(x, t) \cdot \vec{n} \, dF && \left| \text{Divergence theorem} \right. \\
&= \int_V D \nabla \cdot \nabla u(x, t) \, dV \\
\int_V \frac{d}{dt} u(x, t) \, dV &= \int_V D \Delta u(x, t) \, dV
\end{aligned}$$