\[ \int_0^1 \int_0^b h(r) \cdot dr = \int_0^b h(r(u)) \cdot r'(u) \, du \quad r(u) = (x(u), y(u), z(u)) \]

\[ \bar{r} = \frac{1}{b} \int_0^b h(r(u)) \cdot r'(u) \, du \]

\[ f: \mathbb{R}^3 \rightarrow \mathbb{R} \]

\[ \int_C \nabla f(\vec{r}) \cdot d\vec{r} = f(\vec{b}) - f(\vec{a}) \]

\[ \text{Green's Thm.} \]

\[ \iint_S \frac{\partial P}{\partial x} (x,y) - \frac{\partial P}{\partial y} (x,y) \, dx \, dy = \oint_C P(x,y) \, dx + Q(x,y) \, dy \]

Surface Area:

\[ \iint_S \| r_u \times r_v \| \, du \, dv \quad \text{where} \quad r_u = \frac{\partial}{\partial u} r(u,v) \]

\[ r_v = \frac{\partial}{\partial v} r(u,v) \]

\[ \iint_S \lambda(x,y,z) \, d\sigma = \iint_S \lambda(x(u,v), y(u,v), z(u,v)) \| r_u \times r_v \| \, du \, dv \]

Flux:

\[ \iint_S \mathbf{v} \cdot \mathbf{n} \, d\sigma = \iint_S \mathbf{v}(x,y,z) \cdot \mathbf{n}(x,y,z) \, d\sigma \]

\[ = \iint_S \mathbf{v}(x(u,v), y(u,v), z(u,v)) \cdot N(x(u,v), y(u,v), z(u,v)) \| r_u \times r_v \| \, du \, dv \]