

# Integral

Defining  $u(t)$  and  $v(t)$  as functions of  $t$  the following rules apply:

- $\int u + v \, dt = \int u \, dt + \int v \, dt$
- $\int au \, dt = a \int u \, dt$
- $\int a \, dt = at$
- $\int \frac{d}{dt} u \cdot u^n \, dt = \frac{u^{n+1}}{n+1}$
- $\int \frac{d}{dt} u \cdot e^u \, dt = e^u$
- $\int \frac{d}{dt} u \cdot a^u \, dt = \frac{a^u}{\ln(a)}$
- $\int \frac{\frac{d}{dt} u}{u} \, dt = \ln|u|$
- $\int \frac{\frac{d}{dt} u}{1+u^2} \, dt = \tan^{-1}(u)$
- $\int \frac{\frac{d}{dt} u}{\sqrt{1+u^2}} \, dt = \sin^{-1}(u)$

## Trigonometric

- $\int \frac{d}{dt} u \cdot \sin(u) \, dt = -\cos(u)$
- $\int \frac{d}{dt} u \cdot \cos(u) \, dt = \sin(u)$
- $\int \frac{d}{dt} u \cdot \tan(u) \, dt = -\ln|\cos(u)|$
- $\int \frac{d}{dt} u \cdot \cot(u) \, dt = -\ln|\sin(u)|$
- $\int \frac{d}{dt} u \cdot \sec(u)^2 \, dt = \tan(u)$
- $\int \frac{d}{dt} u \cdot \csc(u)^2 \, dt = -\cot(u)$
- $\int \frac{d}{dt} u \cdot \sec(u) \, dt = \ln|\sec(u)| + \tan(u)$
- $\int \frac{d}{dt} u \cdot \csc(u) \, dt = \ln|\csc(u)| + \cot(u)$

*Leibniz Integral Rule:*

$$\int u \cdot \frac{d}{dt} v \, dt = u \cdot v - \int v \cdot \frac{d}{dt} u \, dt$$

*Substitution Integral Rule:*  $\int u(t) \, dt = \int u(v(t)) \cdot \frac{d}{dt} v(t) \, dt$

*Trigonometric substitutions:*

$\sqrt{a^2 - t^2}$	$t = a \cdot \sin(x)$
$\sqrt{a^2 + t^2}$	$t = a \cdot \tan(x)$
$\sqrt{t^2 - a^2}$	$t = a \cdot \sec(x)$