# Calculus 1 Formulas

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Version Final

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# 1 Trigonometric Identities

**Theorem 1 (Pythagorean Identity)**

- $\cos^2\theta + \sin^2\theta = 1$
- $\sec^2\theta - \tan^2\theta = 1$

**Theorem 2 (Range)**

- $-1 \leq \cos\theta \leq 1$
- $-1 \leq \sin\theta \leq 1$

**Theorem 3 (Periodicity)**

- $\cos(\theta \pm 2\pi) = \cos\theta$
- $\sin(\theta \pm 2\pi) = \sin\theta$

**Theorem 4 (Symmetry)**

- $\cos(-\theta) = \cos\theta$
- $\sin(-\theta) = -\sin\theta$

**Theorem 5 (Sum and Difference Identities)**

- $\cos(A+B) = \cos A\cos B - \sin A\sin B$
- $\cos(A-B) = \cos A\cos B + \sin A\sin B$
- $\sin(A+B) = \sin A\cos B + \cos A\sin B$
- $\sin(A-B) = \sin A\cos B - \cos A\sin B$

**Theorem 6 (Complementrary Angle Identities)**

- $\cos(\frac{\pi}{2} - \theta) = \sin\theta$
- $\sin(\frac{\pi}{2} - \theta) = \cos\theta$

**Theorem 7 (Double Angle Identities)**

- $\cos 2\theta = \cos^2\theta - \sin^2\theta$
- $\sin 2\theta = 2\sin\theta\cos\theta$

**Theorem 8 (Half-Angle Identities)**

- $\cos^2\theta = \frac{1+\cos 2\theta}{2}$
- $\sin^2\theta = \frac{1-\cos 2\theta}{2}$

## 2 Derivatives

**Theorem 9 (Differentiation Rules)**

| Function | Derivative |
|---|---|
| $f(x) = cx^a, a \neq 0, c \in \mathbb{R}$ | $f'(x) = cax^{a-1}$ |
| $f(x) = \sin(x)$ | $f'(x) = \cos(x)$ |
| $f(x) = \cos(x)$ | $f'(x) = -\sin(x)$ |
| $f(x) = \tan(x)$ | $f'(x) = \sec^2(x)$ |
| $f(x) = \sec(x)$ | $f'(x) = \sec(x)\tan(x)$ |
| $f(x) = \arcsin(x)$ | $f'(x) = \frac{1}{\sqrt{1-x^2}}$ |
| $f(x) = \arccos(x)$ | $f'(x) = -\frac{1}{\sqrt{1-x^2}}$ |
| $f(x) = \arctan(x)$ | $f'(x) = \frac{1}{1+x^2}$ |
| $f(x) = e^x$ | $f'(x) = e^x$ |
| $f(x) = a^x$ with $a > 0$ | $f'(x) = a^x \ln(a)$ |
| $f(x) = \ln(x)$ for $x > 0$ | $f'(x) = \frac{1}{x}$ |

**Theorem 10 (Antiderivatives)**

| |
|---|
| $\int x^n dx = \frac{x^{n+1}}{n+1} + C$ |
| $\int \frac{1}{x} dx = \ln(\|x\|) + C$ |
| $\int e^x dx = e^x + C$ |
| $\int \sin(x) dx = -\cos(x) + C$ |
| $\int \cos(x) dx = \sin(x) + C$ |
| $\int \sec^2(x) dx = \tan(x) + C$ |
| $\int \frac{1}{1+x^2} dx = \arctan(x) + C$ |
| $\int \frac{1}{\sqrt{1-x^2}} dx = \arcsin(x) + C$ |
| $\int \frac{-1}{\sqrt{1-x^2}} dx = \arccos(x) + C$ |
| $\int \sec(x)\tan(x) dx = \sec(x) + C$ |

**Theorem 11 (n-th degree Taylor Polynomial for $f$ centered at $x = a$)**

$$\begin{aligned} T_{n,a}(x) &= \sum_{k=0}^{n} \frac{f^{(k)}(a)}{k!}(x-a)^k \\ &= f(a) + f^{'}(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + ... + \frac{fn(a)}{n!}(x-a)^n \end{aligned}$$