


























## Differentiation Rules

- |   |  |  |   |
|---|--|--|---|
| 1. $\frac{d}{dx}(cx) = c$   | 10. $\frac{d}{dx}(a^x) = \ln a \cdot a^x$                        | 19. $\frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}}$                           |  |
| 2. $\frac{d}{dx}(u \pm v) = u' \pm v'$                            | 11. $\frac{d}{dx}(\ln x) = \frac{1}{x}$                          | 20. $\frac{d}{dx}(\cos^{-1} x) = \frac{-1}{\sqrt{1-x^2}}$                          |  |
| 3. $\frac{d}{dx}(u \cdot v) = uv' + u'v$                          | 12. $\frac{d}{dx}(\log_a x) = \frac{1}{\ln a} \cdot \frac{1}{x}$ |  |  |
| 4. $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{vu' - uv'}{v^2}$ | 13. $\frac{d}{dx}(\sin x) = \cos x$                              | 22. $\frac{d}{dx}(\sec^{-1} x) = \frac{1}{ x \sqrt{x^2-1}}$                        |  |
| 5. $\frac{d}{dx}(u(v)) = u'(v)v'$                                 | 14. $\frac{d}{dx}(\cos x) = -\sin x$                             | 23. $\frac{d}{dx}(\tan^{-1} x) = \frac{1}{1+x^2}$                                  |  |
| 6. $\frac{d}{dx}(c) = 0$  | 15. $\frac{d}{dx}(\csc x) = -\csc x \cot x$                      |  |  |
| 7. $\frac{d}{dx}(x) = 1$  | 16. $\frac{d}{dx}(\sec x) = \sec x \tan x$                       |  |  |
| 8. $\frac{d}{dx}(x^n) = nx^{n-1}$                                 | 17. $\frac{d}{dx}(\tan x) = \sec^2 x$                            |  |  |
| 9. $\frac{d}{dx}(e^x) = e^x$                                      | 18. $\frac{d}{dx}(\cot x) = -\csc^2 x$                           |  |  |

## Integration Rules

- |  |   |   |
|--|---|---|
| 1. $\int c \cdot f(x) dx = c \int f(x) dx$                 | 11. $\int \tan x dx = -\ln  \cos x  + C$  | 22. $\int \frac{1}{\sqrt{a^2-x^2}} dx = \sin^{-1}\left(\frac{x}{a}\right) + C$                |
| 2. $\int f(x) \pm g(x) dx = \int f(x) dx \pm \int g(x) dx$ | 12. $\int \sec x dx = \ln  \sec x + \tan x  + C$                                    | 23. $\int \frac{1}{x\sqrt{x^2-a^2}} dx = \frac{1}{a} \sec^{-1}\left(\frac{ x }{a}\right) + C$ |
| 3. $\int 0 dx = C$   | 13. $\int \csc x dx = -\ln  \csc x + \cot x  + C$                                   |          |
| 4. $\int 1 dx = x + C$                                     | 14. $\int \cot x dx = \ln  \sin x  + C$   |          |
| 5. $\int x^n dx = \frac{1}{n+1} x^{n+1} + C, n \neq -1$    | 15. $\int \sec^2 x dx = \tan x + C$   |          |
| 6. $\int e^x dx = e^x + C$                                 | 16. $\int \csc^2 x dx = -\cot x + C$  |          |
| 7. $\int a^x dx = \frac{1}{\ln a} \cdot a^x + C$           | 17. $\int \sec x \tan x dx = \sec x + C$  |          |
| 8. $\int \frac{1}{x} dx = \ln  x  + C$                     | 18. $\int \csc x \cot x dx = -\csc x + C$   |          |
| 9. $\int \cos x dx = \sin x + C$                           |  |          |
| 10. $\int \sin x dx = -\cos x + C$                         |  |          |
|  | 21. $\int \frac{1}{x^2+a^2} dx = \frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + C$ |          |

## Additional Formulas

### Summation Formulas:

$$\sum_{i=1}^n c = cn$$

$$\sum_{i=1}^n i^2 = \frac{n(n+1)(2n+1)}{6}$$

$$\sum_{i=1}^n i = \frac{n(n+1)}{2}$$

$$\sum_{i=1}^n i^3 = \left(\frac{n(n+1)}{2}\right)^2$$

### Trapezoidal Rule:

$$\int_a^b f(x) dx \approx \frac{\Delta x}{2} [f(x_1) + 2f(x_2) + 2f(x_3) + \dots + 2f(x_n) + f(x_{n+1})]$$

$$\text{with Error} \leq \frac{(b-a)^3}{12n^2} [\max |f''(x)|]$$

### Simpson's Rule:

$$\int_a^b f(x) dx \approx \frac{\Delta x}{3} [f(x_1) + 4f(x_2) + 2f(x_3) + 4f(x_4) + \dots + 2f(x_{n-1}) + 4f(x_n) + f(x_{n+1})]$$

$$\text{with Error} \leq \frac{(b-a)^5}{180n^4} [\max |f^{(4)}(x)|]$$

### Arc Length:

$$L = \int_a^b \sqrt{1 + (f'(x))^2} dx$$

### Surface of Revolution:

$$S = 2\pi \int_a^b (x) \sqrt{1 + (f'(x))^2} dx$$

where  $f(x) \geq 0$

$$S = 2\pi \int_a^b (x) \sqrt{1 + (f'(x))^2} dx$$

where  $a, b \geq 0$

### Work Done by a Variable Force:

$$W = \int_a^b F(x) dx$$

### Force Exerted by a Fluid:

$$F = \int_a^b \rho g h(y) dy$$

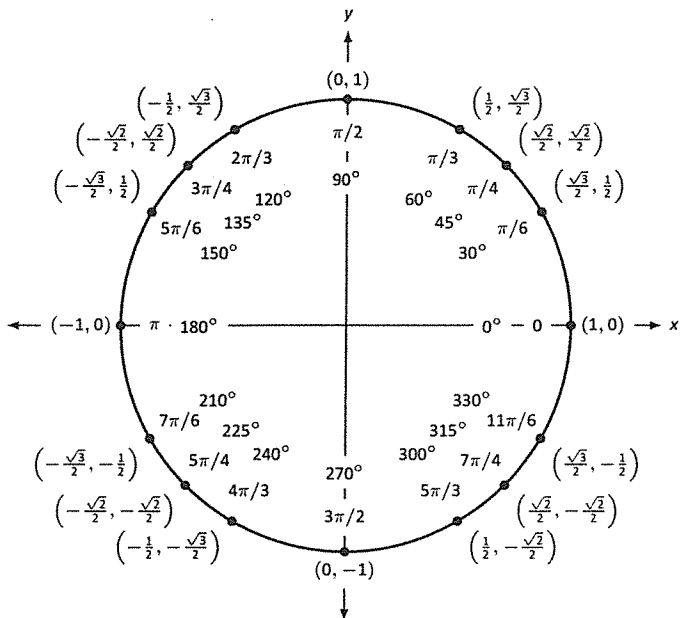
### Taylor Series Expansion for $f(x)$

$$f(x) = f(c) + f'(c)(x-c) + \frac{f''(c)}{2!}(x-c)^2 + \frac{f'''(c)}{3!}(x-c)^3 + \dots + \frac{f^{(n)}(c)}{n!}(x-c)^n$$

### Maclaurin Series Expansion for $f(x)$ where $c = 0$

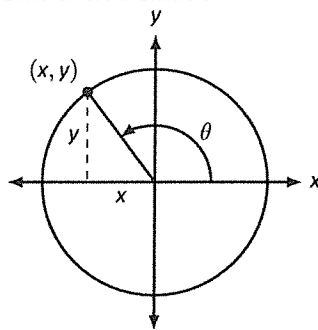
$$f(x) = f(0) + f'(0)x + \frac{f''(0)}{2!}x^2 + \frac{f'''(0)}{3!}x^3 + \dots + \frac{f^{(n)}(0)}{n!}x^n$$

## The Unit Circle



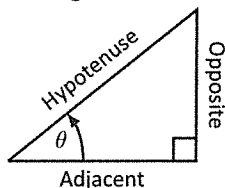
## Definitions of the Trigonometric Functions

### Unit Circle Definition



$$\begin{aligned} \sin \theta &= y & \cos \theta &= x \\ \csc \theta &= \frac{1}{y} & \sec \theta &= \frac{1}{x} \\ \tan \theta &= \frac{y}{x} & \cot \theta &= \frac{x}{y} \end{aligned}$$

### Right Triangle Definition



$$\begin{aligned} \sin \theta &= \frac{O}{H} & \csc \theta &= \frac{H}{O} \\ \cos \theta &= \frac{A}{H} & \sec \theta &= \frac{H}{A} \\ \tan \theta &= \frac{O}{A} & \cot \theta &= \frac{A}{O} \end{aligned}$$

## Common Trigonometric Identities

### Pythagorean Identities

$$\sin^2 x + \cos^2 x = 1$$

$$\tan^2 x + 1 = \sec^2 x$$

$$1 + \cot^2 x = \csc^2 x$$

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### Double Angle Formulas

$$\sin 2x = 2 \sin x \cos x$$

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### Sum to Product Formulas

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### Power-Reducing Formulas

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

$$\cos^2 x = \frac{1 + \cos 2x}{2}$$

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*Handwritten scribbles covering the text for other formulas.*

### Product to Sum Formula

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