# Math 10B Formula Sheet

**Derivative formulas:**

$$\frac{d}{dx}\left(e^x\right) = e^x$$

$$\frac{d}{dx}\left(\ln|x|\right) = \frac{1}{x}$$

$$\frac{d}{dx}\left(\sin x\right) = \cos x$$

$$\frac{d}{dx}\left(\cos x\right) = -\sin x$$

$$\frac{d}{dx}\left(\tan x\right) = \sec^2 x$$

$$\frac{d}{dx}\left(\sec x\right) = \sec x \tan x$$

$$\frac{d}{dx}\left(\cot x\right) = -\csc^2 x$$

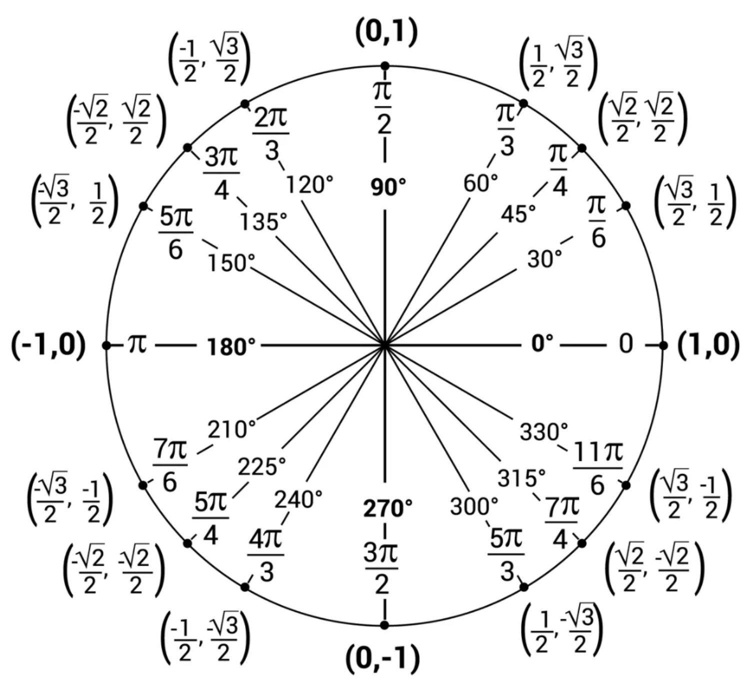
$$\frac{d}{dx}\left(\csc x\right) = -\csc x \cot x$$

$$\frac{d}{dx}\left(\sin^{-1} x\right) = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx}\left(\tan^{-1} x\right) = \frac{1}{1+x^2}$$

$$\frac{d}{dx}\left(b^x\right) = b^x \ln b$$

**Unit circle:**



**$p$-test:**

$$\int_1^\infty \frac{1}{x^p}\,dx$$

- if $p > 1$, convergent
- if $p \leq 1$, divergent

$$\int_0^1 \frac{1}{x^p}\,dx$$

- if $p < 1$, convergent
- if $p \geq 1$, divergent

**Geometric series:** $\displaystyle\sum_{n=0}^{\infty} ar^n$

- $|r| \geq 1$: diverges
- $|r| < 1$: converges to $\dfrac{a}{1-r}$

$n^{\text{th}}$ partial sum $S_n = \dfrac{a(1-r^n)}{1-r}$
(for <u>any</u> $r$ except $r = 1$)

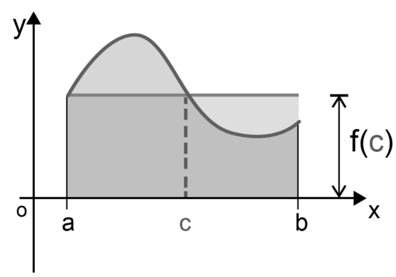
**Riemann sum definition of definite integral** (written here with right endpoints):

$$\int_a^b f(x)\,dx = \lim_{n\to\infty} \sum_{i=1}^{n} f(x_i)\Delta x, \quad \text{where } x_i = a + i\Delta x \quad \text{and} \quad \Delta x = \frac{b-a}{n}$$

**Average value of a function over an interval:**

$$f_{\text{ave}} = \frac{1}{b-a}\int_a^b f(x)\,dx$$

**The Mean Value Theorem for integrals:**
If $f$ is continuous on $[a, b]$, there is at least one $c$ in $[a, b]$ with $f(c) = f_{\text{ave}}$




**Doubling time:** $2 = e^{kt}$ **Half-life:** $\frac{1}{2} = e^{-kt}$

**Newton's Law of Cooling:** $T = (T_0 - T_a)e^{-kt} + T_a$

**Integration by Parts:** Split the integrand into $u$ and $\frac{dv}{dx}$. Good in several cases:

- A polynomial times a function.
- A function whose derivative is simpler.
- The product of two functions whose derivatives loop around.

**Partial Fractions:** Used when you have a rational function. Remember that long-division might be needed.

**Disk method – volumes by slicing:**

$$\int_a^b \pi[f(x)]^2\,dx$$

**Washer method – volumes by slicing:**

$$\int_a^b \pi\left[(f(x))^2 - (g(x))^2\right]\,dx$$