Properties you should know for Calculus
August 6, 2021

1 Exponential and Logarithm Properties

Suppose a, b, m, n are constant real numbers and $b > 0$.

1.1 Exponential Properties

- $b^0 = 1$
- $b^{-1} = \frac{1}{b}$
- $b^{\frac{1}{n}} = \sqrt[n]{b}$
- $b^m b^n = b^{m+n}$
- $(b^m)^n = b^{mn}$
- $\frac{b^m}{b^n} = b^{m-n}$

1.2 Logarithmic Properties

- $\log_b(1) = 0$
- $\log_b(\frac{1}{b}) = -1$
- $\log_b(\sqrt[n]{b}) = \frac{1}{n}$
- $\log_b(mn) = \log_b(m) + \log_b(n)$
- $\log_b(m^n) = n \log_b(m)$
- $\log_b(\frac{m}{n}) = \log_b(m) - \log_b(n)$

1.3 The Change of Base Formula

$$\log_b(x) = \frac{\log_a(x)}{\log_a(b)}$$

In Calculus, we really only work with e^x and $\ln(x) = \log_e(x)$.
Next to each of the properties above, write their corresponding property with e or ln.

2 Trigonometric Identities

2.1 Unit Circle Identities

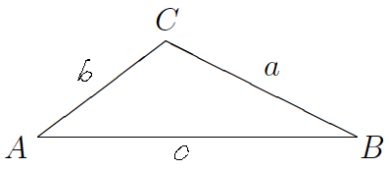
- $\sin^2(x) + \cos^2(x) = 1$ because of the Pythagorean Theorem
- $\tan^2(x) + 1 = \sec^2(x)$ by dividing the first property by $\cos^2(x)$
- $\cot^2(x) + 1 = \csc^2(x)$ by dividing the first property by $\sin^2(x)$
- $\cos(-x) = \cos(x)$ cosine is even
- $\sin(-x) = -\sin(x)$ sine is odd
- $\cos(x) = \sin(\frac{\pi}{2} - x)$ cosine is sine of the complementary angle
- $\sin(x) = \cos(\frac{\pi}{2} - x)$ sine is the cosine of the complement

2.2 Sum and Difference of Angle Trigonometric Identities

- $\cos(x + y) = \cos(x)\cos(y) - \sin(x)\sin(y)$ sum of angles for cosine
- $\sin(x + y) = \sin(x)\cos(y) + \sin(y)\cos(x)$ sum of angles for sine
- $\cos(x - y) = \cos(x)\cos(y) + \sin(x)\sin(y)$ difference of angles for cosine
- $\sin(x - y) = \sin(x)\cos(y) - \sin(y)\cos(x)$ difference of angles for sine
- $\cos(2x) = \cos^2(x) - \sin^2(x)$ double angle for cosine
- $\sin(2x) = 2\sin(x)\cos(x)$ double angle for sine
- $\sin(x) = \frac{\sqrt{1 - \cos(2x)}}{2}$ half angle for sine
- $\cos(x) = \frac{\sqrt{1 + \cos(2x)}}{2}$ half angle for cosine

2.3 Law of Cosine and Sine

Let a, b and c be sides of a triangle and A, B and C be the angles opposite them, respectively. Law of Cosines



$$a^2 + b^2 - 2ab\cos(C) = c^2$$

Law of Sines

$$\frac{\sin(A)}{a} = \frac{\sin(B)}{b} = \frac{\sin(C)}{c}$$