Formula Collection for Calculus I (640:151), Final Exam

Exponential and Logarithmic Function

Arithmetic

$e^{x+y} = e^x e^y \qquad e^{x-y} = \frac{e^x}{e^y}$

$e^{xy} = (e^x)^y$

$\ln(xy) = \ln(x) + \ln(y) \qquad \ln(\frac{x}{y}) = \ln(x) - \ln(y)$

$\ln(x^y) = y\ln(x)$

Cancellation Laws

$\ln(e^x) = x \qquad e^{\ln(x)} = x$

Other Base

$a^x = e^{\ln(a)\,x} \qquad \log_a(x) = \frac{\ln(x)}{\ln(a)}$

Geometry

Distance

$d = \sqrt{(x_1 - x_0)^2 + (y_1 - y_0)^2}$

Area

Circle: πr^2

Sphere: $4\pi r^2$

Volume

Cylinder: $\pi r^2 h$

Cone: $\frac{\pi}{3} r^2 h$

Sphere: $\frac{4}{3}\pi r^3$

Lines

Point-point: $\frac{y-y_0}{x-x_0} = \frac{y_1-y_0}{x_1-x_0}$

Point-slope: $y - y_0 = m(x - x_0)$

Triangles

Law of Sines: $\frac{\sin(A)}{a} = \frac{\sin(B)}{b} = \frac{\sin(C)}{c}$

Law of Cosines: $c^2 = a^2 + b^2 - 2ab\cos(C)$

Trigonometry

Special Values

x	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$
$\sin(x)$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
$\cos(x)$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
$\tan(x)$	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	$\pm\infty$

Fundamental Identities

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

$\tan(x) = \frac{\sin(x)}{\cos(x)} \qquad \cot(x) = \frac{\cos(x)}{\sin(x)}$

$\sec(x) = \frac{1}{\cos(x)} \qquad \csc(x) = \frac{1}{\sin(x)}$

Double-Angle Formulas

$\sin(2x) = 2\sin(x)\cos(x)$

$$\begin{aligned}\cos(2x) &= \cos(x)^2 - \sin(x)^2 \\ &= 2\cos(x)^2 - 1 = 1 - 2\sin(x)^2\end{aligned}$$

Half-Angle Formulas

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

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

Inverse Trigonometric Functions

Notation for the inverse trigonometric functions:
$\sin^{-1}(x) = \arcsin(x)$, $\tan^{-1}(x) = \arctan(x)$.

Derivatives

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

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

$\frac{d}{dx}\sin^{-1}(x) = \frac{1}{\sqrt{1-x^2}} \qquad \frac{d}{dx}\tan^{-1}(x) = \frac{1}{1+x^2}$

Integrals

$\int \tan(x)\,dx = \ln|\sec(x)| + C$