MAT 119 Formula Sheet

Pythagorean Identities

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

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

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

Sum and Difference Identities

$\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$

$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$

$\tan(\alpha \pm \beta) = \dfrac{\tan\alpha \pm \tan\beta}{1 \mp \tan\alpha\tan\beta}$

Cofunction Identities

$\sin\left(\frac{\pi}{2} - u\right) = \cos u$ $\qquad$ $\cos\left(\frac{\pi}{2} - u\right) = \sin u$

$\tan\left(\frac{\pi}{2} - u\right) = \cot u$ $\qquad$ $\cot\left(\frac{\pi}{2} - u\right) = \tan u$

$\sec\left(\frac{\pi}{2} - u\right) = \csc u$ $\qquad$ $\csc\left(\frac{\pi}{2} - u\right) = \sec u$

Double Angle Identities

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

$\tan(2x) = \dfrac{2\tan x}{1 - \tan^2 x}$

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

$\cos(2x) = 2\cos^2 x - 1$

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

Half-Angle Identities

$\sin\frac{x}{2} = \pm\sqrt{\dfrac{1 - \cos x}{2}}$

$\cos\frac{x}{2} = \pm\sqrt{\dfrac{1 + \cos x}{2}}$

$\tan\frac{x}{2} = \dfrac{\sin x}{1 + \cos x}$

$\tan\frac{x}{2} = \pm\sqrt{\dfrac{1 - \cos x}{1 + \cos x}}$

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

Arclength and Area of a Sector

$s = \alpha r$ $\qquad$ $A = \dfrac{\alpha r^2}{2}$

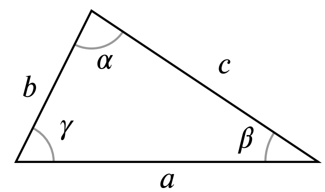
Even and Odd Identities

$\sin(-x) = -\sin x$ $\quad$ $\cot(-x) = -\cot x$

$\csc(-x) = -\csc x$ $\quad$ $\cos(-x) = \cos x$

$\tan(-x) = -\tan x$ $\quad$ $\sec(-x) = \sec x$

Standard Labeling of an Oblique Triangle



Law of Sines

$$\frac{\sin\alpha}{a} = \frac{\sin\beta}{b} = \frac{\sin\gamma}{c}$$

Law of Cosines

$c^2 = a^2 + b^2 - 2ab\cos\gamma$

$a^2 = b^2 + c^2 - 2bc\cos\alpha$

$b^2 = a^2 + c^2 - 2ac\cos\beta$

Area of a Triangle

$A = \frac{1}{2}ab\sin\gamma$ or $A = \sqrt{S(S-a)(S-b)(S-c)}$

where $S = (a+b+c)/2$

Dot Product

If $\mathbf{A} = \langle a_1, a_2\rangle$ and $\mathbf{B} = \langle b_1, b_2\rangle$ are vectors, then the dot product of **A** and **B** is

$$\mathbf{A}\cdot\mathbf{B} = a_1b_1 + a_2b_2.$$

Angle Between Two Vectors

If **A** and **B** are nonzero vectors and α is the smallest positive angle between them, then

$$\cos\alpha = \frac{\mathbf{A}\cdot\mathbf{B}}{|\mathbf{A}||\mathbf{B}|}.$$

Linear and Angular Velocity

$\omega = \dfrac{\alpha}{t}$ $\qquad$ $v = \dfrac{s}{t}$ $\qquad$ $v = r\omega$

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Polar-Rectangular Conversion Rules

To convert (r, θ) to rectangular coordinates (x, y), use

$$x = r\cos\theta \text{ and } y = r\sin\theta$$

To convert (x, y) to polar coordinates (r, θ), use $r = \sqrt{x^2 + y^2}$ and any angle θ in standard position whose terminal side contains (x, y).