Trig Cheat Sheet

Sum and Difference Formulas

$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \sin\beta\cos\alpha$
$\cos(\gamma \pm \delta) = \cos\gamma\cos\delta \mp \sin\gamma\sin\delta$
$\tan(\epsilon \pm \zeta) = \frac{\tan\epsilon \pm \tan\zeta}{1 \mp \tan\epsilon\tan\zeta}$

Double-Angle Formulas

$\sin(2\eta) = 2\sin\eta\cos\eta$
$\cos(2\theta) = \cos^2\theta - \sin^2\theta = 2\cos^2\theta - 1 = 1 - 2\sin^2\theta$
$\tan(2\iota) = \frac{2\tan\iota}{1-\tan^2\iota}$

Power-Reducing Formulas

$\sin^2\kappa = \frac{1-\cos(2\kappa)}{2}$
$\cos^2\lambda = \frac{1+\cos(2\lambda)}{2}$
$\tan^2\mu = \frac{1-\cos(2\mu)}{1+\cos(2\mu)}$

Half-Angle Formulas

$\sin(\nu/2) = \pm\sqrt{\frac{1-\cos\nu}{2}}$
$\cos(\xi/2) = \pm\sqrt{\frac{1+\cos\xi}{2}}$
$\tan(\rho/2) = \frac{1-\cos\rho}{\sin\rho} = \frac{\sin\rho}{1+\cos\rho}$

Product-to-Sum Formulas

$\sin\sigma\sin\tau = \frac{1}{2}[\cos(\sigma-\tau) - \cos(\sigma+\tau)]$
$\cos\upsilon\cos\phi = \frac{1}{2}[\cos(\upsilon-\phi) + \cos(\upsilon+\phi)]$
$\sin\chi\cos\psi = \frac{1}{2}[\sin(\chi+\psi) + \sin(\chi-\psi)]$

Sum-to-Product Formulas

$\sin\omega + \sin\alpha = 2\sin\left(\frac{\omega+\alpha}{2}\right)\cos\left(\frac{\omega-\alpha}{2}\right)$
$\sin\omega - \sin\alpha = 2\cos\left(\frac{\omega+\alpha}{2}\right)\sin\left(\frac{\omega-\alpha}{2}\right)$
$\cos\omega + \cos\alpha = 2\cos\left(\frac{\omega+\alpha}{2}\right)\cos\left(\frac{\omega-\alpha}{2}\right)$
$\cos\omega - \cos\alpha = -2\sin\left(\frac{\omega+\alpha}{2}\right)\sin\left(\frac{\omega-\alpha}{2}\right)$

Law of Sines

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

Law of Cosines

$c^2 = a^2 + b^2 - 2ab\cos\gamma$
$b^2 = a^2 + c^2 - 2ac\cos\beta$
$a^2 = b^2 + c^2 - 2bc\cos\alpha$

Area of a Triangle

From Law of Sines

$A = \frac{1}{2}bc\sin\alpha$

Heron's Formula

$A = \sqrt{s(s-a)(s-b)(s-c)}$
$s = \frac{a+b+c}{2}$

Vector Projection

$\text{proj}_{\vec{u}}\,\vec{v} = \frac{\vec{v}\cdot\vec{u}}{\|\vec{u}\|}\vec{u}$

Complex Roots

The n-th roots of $re^{i\theta}$ are

$$z_k = \sqrt[n]{r}e^{(\theta+2\pi k)i/n}$$

for $k = 0, 1, \ldots, n-1$