Math 112 Formula Sheet

$\cos\theta = \frac{x}{r} = \frac{\text{adj}}{\text{hyp}}$

$\sin\theta = \frac{y}{r} = \frac{\text{opp}}{\text{hyp}}$

$\tan\theta = \frac{y}{x} = \frac{\text{opp}}{\text{adj}} = \frac{\sin\theta}{\cos\theta}$

$\cot\theta = \frac{x}{y} = \frac{\text{adj}}{\text{opp}} = \frac{\cos\theta}{\sin\theta}$

$\sec\theta = \frac{r}{x} = \frac{\text{hyp}}{\text{adj}} = \frac{1}{\cos\theta}$

$\csc\theta = \frac{r}{y} = \frac{\text{hyp}}{\text{opp}} = \frac{1}{\sin\theta}$

$\sin^2\theta + \cos^2\theta = 1 \qquad \tan^2\theta + 1 = \sec^2\theta \qquad 1 + \cot^2\theta = \csc^2\theta$

$\sin(-\theta) = -\sin(\theta) \qquad \cos(-\theta) = \cos(\theta) \qquad \tan(-\theta) = -\tan(\theta)$

For s an arc on a circle of radius r

$$s = r\theta \qquad \text{Area} = \frac{1}{2}\theta r^2 \qquad v = \omega r$$

For a general triangle with sides a, b, c and angles opposite these sides A, B, C respectively

$$a^2 = b^2 + c^2 - 2bc\cos(A)$$

$$\text{Area} = \tfrac{1}{2}bc\sin(A)$$

$$s = \tfrac{1}{2}(a + b + c)$$

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

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\sin(x \pm y) = \sin(x)\cos(y) \pm \cos(x)\sin(y)$$

$$\cos(x \pm y) = \cos(x)\cos(y) \mp \sin(x)\sin(y)$$

$$\tan(x \pm y) = \frac{\tan(x) \pm \tan(y)}{1 \mp \tan(x)\tan(y)}$$

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

$$\sin\left(\tfrac{u}{2}\right) = \pm\sqrt{\frac{1-\cos(u)}{2}}$$

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

$$\cos\left(\tfrac{u}{2}\right) = \pm\sqrt{\frac{1+\cos(u)}{2}}$$

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

$$\tan\left(\tfrac{u}{2}\right) = \frac{1-\cos(u)}{\sin(u)} = \frac{\sin(u)}{1+\cos(u)}$$

$$
\begin{aligned}
\sin(u)+\sin(v) &= 2\sin\left(\tfrac{u+v}{2}\right)\cos\left(\tfrac{u-v}{2}\right)\\
\sin(u)-\sin(v) &= 2\cos\left(\tfrac{u+v}{2}\right)\sin\left(\tfrac{u-v}{2}\right)\\
\cos(u)+\cos(v) &= 2\cos\left(\tfrac{u+v}{2}\right)\cos\left(\tfrac{u-v}{2}\right)\\
\cos(u)-\cos(v) &= -2\sin\left(\tfrac{u+v}{2}\right)\sin\left(\tfrac{u-v}{2}\right)\\
\sin(\alpha)\cos(\beta) &= \tfrac{1}{2}[\sin(\alpha-\beta)+\sin(\alpha+\beta)]\\
\cos(\alpha)\sin(\beta) &= \tfrac{1}{2}[-\sin(\alpha-\beta)+\sin(\alpha+\beta)]\\
\cos(\alpha)\cos(\beta) &= \tfrac{1}{2}[\cos(\alpha-\beta)+\cos(\alpha+\beta)]\\
\sin(\alpha)\sin(\beta) &= \tfrac{1}{2}[\cos(\alpha-\beta)-\cos(\alpha+\beta)]
\end{aligned}
$$

$$A\sin(x)+B\cos(x)=k\sin(x+\phi)$$

where $k=\sqrt{A^2+B^2}$, $\cos\phi=\frac{A}{k}$, and $\sin\phi=\frac{B}{k}$.

$$z=a+ib=r(\cos\theta+i\sin\theta)=r\mathrm{cis}(\theta)=re^{i\theta}$$

where $r=\sqrt{a^2+b^2}$, $\cos\theta=\frac{a}{r}$, and $\sin\theta=\frac{b}{r}$.

$$
\begin{aligned}
z_1z_2 &= r_1r_2\,\mathrm{cis}(\theta_1+\theta_2)\\
\frac{z_1}{z_2} &= \frac{r_1}{r_2}\,\mathrm{cis}(\theta_1-\theta_2)\\
z^n &= r^n\,\mathrm{cis}(n\theta)\\
z^{1/n} &= r^{1/n}\,\mathrm{cis}\left(\tfrac{\theta+2\pi k}{n}\right)\\
&\qquad \text{for} \quad k=0,1,2\ldots
\end{aligned}
$$

For $\vec{u}=\langle a_1,b_1\rangle$ and $\vec{v}=\langle a_2,b_2\rangle$:

$$
\begin{aligned}
|\vec{u}| &= \sqrt{a_1^2+b_1^2}\\
\vec{u}\cdot\vec{v} &= a_1a_2+b_1b_2 \quad = |\vec{u}||\vec{v}|\cos\theta_{uv}\\
\text{work} &= \vec{F}\cdot\vec{d}
\end{aligned}
$$