Precalculus Formulas

$$P\left(\frac{\pi}{6}\right)=\left(\frac{\sqrt{3}}{2},\frac{1}{2}\right);\qquad P\left(\frac{\pi}{4}\right)=\left(\frac{\sqrt{2}}{2},\frac{\sqrt{2}}{2}\right);\quad P\left(\frac{\pi}{3}\right)=\left(\frac{1}{2},\frac{\sqrt{3}}{2}\right)$$

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

$$\cos(u\pm v)=\cos u\cos v\mp\sin u\sin v$$

$$\sin(u\pm v)=\sin u\cos v\pm\cos u\sin v$$

$$\tan(u\pm v)=\frac{\tan u\pm\tan v}{1\mp\tan u\tan v}$$

$$\sin 2\theta=2\sin\theta\cos\theta$$

$$\tan 2\theta=\frac{2\tan\theta}{1-\tan^2\theta}$$

$$\cos 2\theta=\cos^2\theta-\sin^2\theta$$
$$=1-2\sin^2\theta$$
$$=2\cos^2\theta-1$$

$$\sin\frac{\theta}{2}=\pm\sqrt{\frac{1-\cos\theta}{2}}\qquad \cos\frac{\theta}{2}=\pm\sqrt{\frac{1+\cos\theta}{2}}$$

Right Triangle:

$$\sin\theta=\frac{\text{Opposite}}{\text{Hypotenuse}}\qquad \cos\theta=\frac{\text{Adjacent}}{\text{Hypotenuse}}\qquad \tan\theta=\frac{\text{Opposite}}{\text{Adjacent}}$$

Law of Sines:

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

Law of Cosines:

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

or

$$\cos C=\frac{a^2+b^2-c^2}{2ab}$$

Heron's Formula:

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

Parabolas: $y^2 = \pm 4px$ or $x^2 = \pm 4py$

Ellipses: Horizontal: $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$; Vertical $\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$

$$a > b > 0, \qquad b^2 = a^2 - c^2$$

Hyperbolas: Horizontal transverse axis; Vertical transverse axis

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1 \qquad \frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$$

$$b^2 = c^2 - a^2$$

Arithmetic Sequence

$$a_1, a_2, a_3, \cdots$$

$$a_n = a_1 + (n-1)d$$

$$S_n = n\left(\frac{a_1 + a_n}{2}\right)$$

Geometric Sequence

$$a_1, a_2, a_3, \cdots$$

$$a_n = a_1 r^{n-1}$$

$$S_n = \frac{a_1(1 - r^n)}{1 - r}, \quad r \neq 1$$

$$s = \frac{a_1}{1 - r} \text{ if } |r| < 1$$

$$\binom{n}{r} = \frac{n!}{r!(n-r)!}, \quad 0! = 1$$

Binomial Theorem: $(x + y)^n = \sum_{r=0}^{n} \binom{n}{r} x^{n-r} y^r$