# ALGEBRA

## Exponents and Radicals

$$x^a x^b = x^{a+b} \qquad \frac{x^a}{x^b} = x^{a-b} \qquad x^{-a} = \frac{1}{x^a} \qquad (x^a)^b = x^{ab} \qquad \left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}$$

$$x^{1/n} = \sqrt[n]{x} \qquad x^{m/n} = \sqrt[n]{x^m} = \left(\sqrt[n]{x}\right)^m \qquad \sqrt[n]{xy} = \sqrt[n]{x}\sqrt[n]{y} \qquad \sqrt[n]{x/y} = \sqrt[n]{x}/\sqrt[n]{y}$$

## Factoring Formulas

$a^2 - b^2 = (a - b)(a + b)$ $\qquad$ $a^2 + b^2$ does not factor over real numbers

$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$ $\qquad$ $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

$a^n - b^n = (a - b)(a^{n-1} + a^{n-2}b + a^{n-3}b^2 + \cdots + ab^{n-2} + b^{n-1})$

## Binomials

$(a \pm b)^2 = a^2 \pm 2ab + b^2 \qquad (a \pm b)^3 = a^3 \pm 3a^2b + 3ab^2 \pm b^3$

## Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \cdots + \binom{n}{n-1}ab^{n-1} + b^n,$$

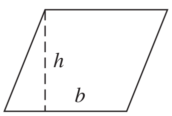
where $\displaystyle\binom{n}{k} = \frac{n(n-1)(n-2)\cdots(n-k+1)}{k(k-1)(k-2)\cdots 3\cdot 2\cdot 1} = \frac{n!}{k!(n-k)!}$

## Quadratic Formula

The solutions of $ax^2 + bx + c = 0$ are $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

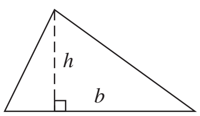
# GEOMETRY

**Parallelogram**



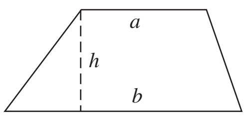

$A = bh$

**Triangle**



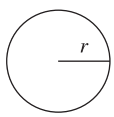

$A = \frac{1}{2}bh$

**Trapezoid**




$A = \frac{1}{2}(a + b)h$

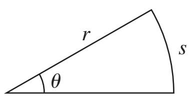
**Circle**




$A = \pi r^2$

$C = 2\pi r$

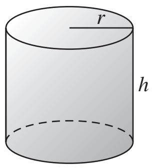
**Sector**




$A = \frac{1}{2}r^2\theta$

$s = r\theta$ ($\theta$ in radians)

**Cylinder**

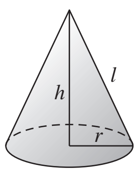



$V = \pi r^2 h$

$S = 2\pi rh$

(lateral surface area)

**Cone**

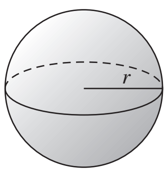



$V = \frac{1}{3}\pi r^2 h$

$S = \pi rl$

(lateral surface area)

**Sphere**

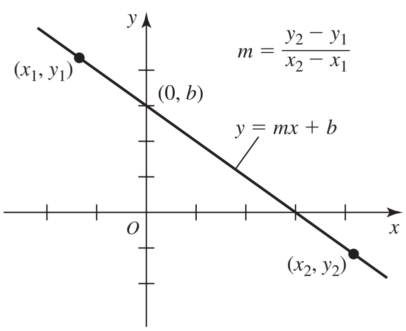


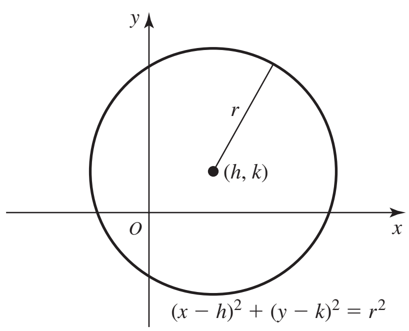

$V = \frac{4}{3}\pi r^3$

$S = 4\pi r^2$

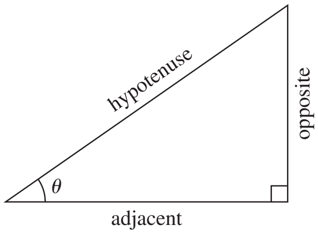
## Equations of Lines and Circles

| | |
|---|---|
| $m = \dfrac{y_2 - y_1}{x_2 - x_1}$ | slope of line through $(x_1, y_1)$ and $(x_2, y_2)$ |
| $y - y_1 = m(x - x_1)$ | point-slope form of line through $(x_1, y_1)$ with slope $m$ |
| $y = mx + b$ | slope-intercept form of line with slope $m$ and $y$-intercept $(0, b)$ |
| $(x - h)^2 + (y - k)^2 = r^2$ | circle of radius $r$ with center $(h, k)$ |



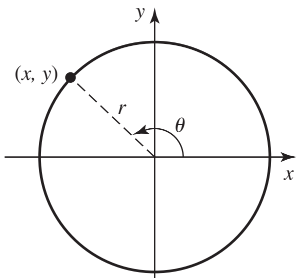



# TRIGONOMETRY




$$\cos\theta = \frac{\text{adj}}{\text{hyp}} \quad \sin\theta = \frac{\text{opp}}{\text{hyp}} \quad \tan\theta = \frac{\text{opp}}{\text{adj}}$$

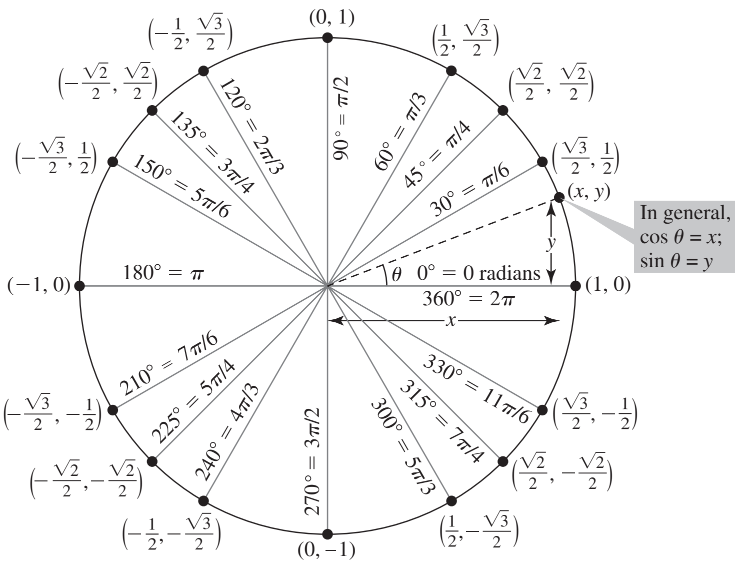
$$\sec\theta = \frac{\text{hyp}}{\text{adj}} \quad \csc\theta = \frac{\text{hyp}}{\text{opp}} \quad \cot\theta = \frac{\text{adj}}{\text{opp}}$$




$$\cos\theta = \frac{x}{r} \quad \sec\theta = \frac{r}{x}$$

$$\sin\theta = \frac{y}{r} \quad \csc\theta = \frac{r}{y}$$

$$\tan\theta = \frac{y}{x} \quad \cot\theta = \frac{x}{y}$$




## Reciprocal Identities

$$\tan\theta = \frac{\sin\theta}{\cos\theta} \quad \cot\theta = \frac{\cos\theta}{\sin\theta} \quad \sec\theta = \frac{1}{\cos\theta} \quad \csc\theta = \frac{1}{\sin\theta}$$

## Pythagorean Identities

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

## Sign Identities

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

$$\csc(-\theta) = -\csc\theta \quad \sec(-\theta) = \sec\theta \quad \cot(-\theta) = -\cot\theta$$

## Addition Formulas

$$\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta \qquad \sin(\alpha - \beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$$

$$\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta \qquad \cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$$

$$\tan(\alpha + \beta) = \frac{\tan\alpha + \tan\beta}{1 - \tan\alpha\tan\beta} \qquad \tan(\alpha - \beta) = \frac{\tan\alpha - \tan\beta}{1 + \tan\alpha\tan\beta}$$

## Double-Angle Identities

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

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

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

## Half-Angle Formulas

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

## Graphs of Trigonometric Functions and Their Inverses