

THE QUADRATIC FORMULA

The roots of the quadratic equation $ax^2 + bx + c = 0$ are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

DETERMINANTS

$$\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = a_1b_2 - a_2b_1$$

Cramer's rule: The solution to the system

$$\begin{cases} a_1x + b_1y = c_1 \\ a_2x + b_2y = c_2 \end{cases} \text{ is } x = \frac{\begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}} \quad y = \frac{\begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$$

LAWS OF LOGARITHMS (where $\log_b x = y$ means $x = b^y$)

$$\log_b(M \cdot N) = \log_b M + \log_b N, \quad \log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$$

$$\log_b(M^x) = x \cdot \log_b M,$$

ANALYTIC GEOMETRY

Straight line: slope = $m = \frac{y_2 - y_1}{x_2 - x_1}$; $y = mx + b$; $y - y_1 = m(x - x_1)$

Circle: $x^2 + y^2 = r^2$; $(x - h)^2 + (y - k)^2 = r^2$

Parabola: Vertical axis: $x^2 = 4ay$; $(x - h)^2 = 4a(y - k)$

Horizontal axis: $y^2 = 4ax$; $(y - k)^2 = 4a(x - h)$

Ellipse: Vert. major axis: $\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$; $\frac{(x - h)^2}{b^2} + \frac{(y - k)^2}{a^2} = 1$

Hor. major axis: $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$; $\frac{(x - h)^2}{a^2} + \frac{(y - k)^2}{b^2} = 1$

Hyperbola: Vert. transverse axis: $\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$; $\frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1$

Hor. transverse axis: $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$; $\frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2} = 1$

TRIGONOMETRY IDENTITIES

$$1. \sin A = \frac{1}{\csc A}$$

$$2. \cos A = \frac{1}{\sec A}$$

$$3. \tan A = \frac{1}{\cot A}$$

$$4. \tan A = \frac{\sin A}{\cos A}$$

$$5. \cot A = \frac{\cos A}{\sin A}$$

$$6. \sin^2 A + \cos^2 A = 1$$

$$7. 1 + \tan^2 A = \sec^2 A$$

$$8. 1 + \cot^2 A = \csc^2 A$$

$$9. \sin(A + B) = \sin A \cos B + \cos A \sin B$$

$$10. \sin(A - B) = \sin A \cos B - \cos A \sin B$$

$$11. \cos(A + B) = \cos A \cos B - \sin A \sin B$$

$$12. \cos(A - B) = \cos A \cos B + \sin A \sin B$$

$$13. \tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$14. \tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

$$15. \sin 2A = 2 \sin A \cos A$$

$$16. \cos 2A = \cos^2 A - \sin^2 A = 2 \cos^2 A - 1 = 1 - 2 \sin^2 A$$

$$17. \tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

$$18. \sin \frac{1}{2}A = \pm \sqrt{\frac{1 - \cos A}{2}}$$

$$19. \cos \frac{1}{2}A = \pm \sqrt{\frac{1 + \cos A}{2}}$$

$$20. \tan \frac{1}{2}A = \frac{\sin A}{1 + \cos A}$$

$$21. \sin A + \sin B = 2 \sin \frac{1}{2}(A + B) \cos \frac{1}{2}(A - B)$$

$$22. \sin A - \sin B = 2 \cos \frac{1}{2}(A + B) \sin \frac{1}{2}(A - B)$$

$$23. \cos A + \cos B = 2 \cos \frac{1}{2}(A + B) \cos \frac{1}{2}(A - B)$$

$$24. \cos A - \cos B = -2 \sin \frac{1}{2}(A + B) \sin \frac{1}{2}(A - B)$$

$$25. \sin A \cos B = \frac{1}{2} \{ \sin(A + B) + \sin(A - B) \}$$

$$26. \cos A \sin B = \frac{1}{2} \{ \sin(A + B) - \sin(A - B) \}$$

$$27. \cos A \cos B = \frac{1}{2} \{ \cos(A + B) + \cos(A - B) \}$$

$$28. \sin A \sin B = \frac{1}{2} \{ \cos(A - B) - \cos(A + B) \}$$