CH11 Rules

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Quotient Identities

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$

$$\cot\theta = \frac{\cos\theta}{\sin\theta}$$

Reciprocal Identities

$$\cot\theta = \frac{1}{\tan\theta}$$

$$\csc\theta = \frac{1}{\sin\theta}$$

$$\sec\theta = \frac{1}{\cos\theta}$$

Pythagorean Identities

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

$$\tan^2\theta + 1 = \sec^2\theta$$

$$1 + \cot^2\theta = \csc^2\theta$$

Sum Identities Addition Formulas

$$\sin(a+b) = \sin a\cos b + \cos a\sin b$$

$$\cos(a+b) = \cos a\cos b - \sin a\sin b$$

$$\tan(a+b) = \frac{\tan a + \tan b}{1 - \tan a\tan b}$$

Difference Identities Subtraction Formulas

$$\sin(a-b) = \sin a\cos b - \cos a\sin b$$

$$\cos(a-b) = \cos a\cos b + \sin a\sin b$$

$$\tan(a-b) = \frac{\tan a - \tan b}{1 + \tan a\tan b}$$

Double Angle Formulas

$$\sin 2a = 2\sin a\cos a$$

$$\cos 2a = \cos^2 a - \sin^2 a$$

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

$$= 1 - 2\sin^2 a$$

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

Co-function Identities

$$\cos\left(\frac{\pi}{2} - \theta\right) = \sin\theta$$

$$\sin\left(\frac{\pi}{2} - \theta\right) = \cos\theta$$

$$\tan\left(\frac{\pi}{2} - \theta\right) = \cot\theta$$

Even-Odd Identities

$$\sin(-\theta) = -\sin\theta$$

$$\cos(-\theta) = \cos\theta$$

$$\tan(-\theta) = -\tan\theta$$

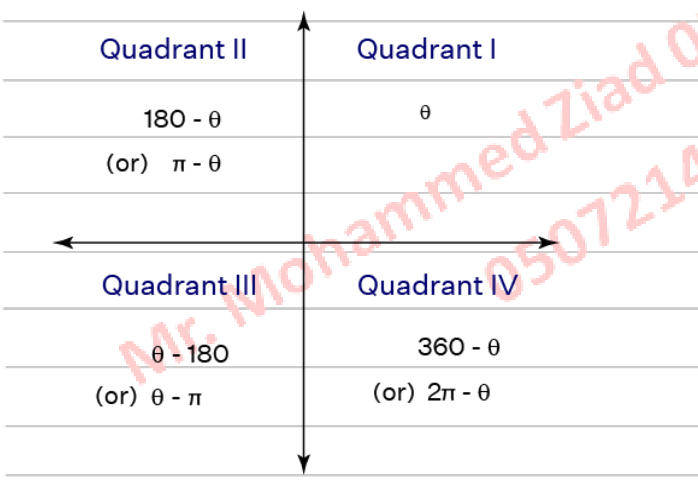
Half-Angle Formulas

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

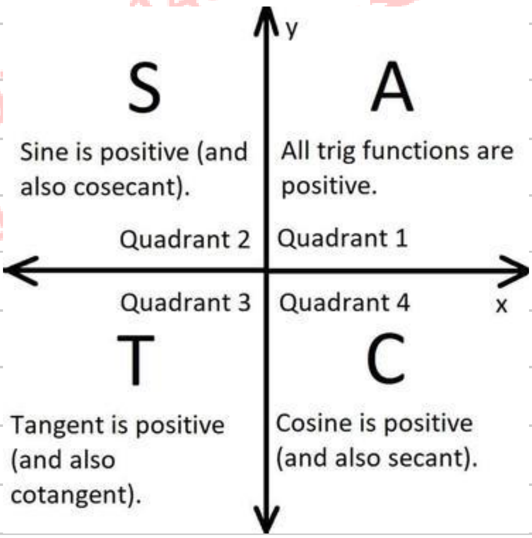
$$\cos\left(\frac{\theta}{2}\right) = \pm\sqrt{\frac{1+\cos\theta}{2}}$$

$$\tan\left(\frac{\theta}{2}\right) = \pm\sqrt{\frac{1-\cos\theta}{1+\cos\theta}}$$

Reference Angle Formula



Trigonometric signs:



CH5 Rules

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1) Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$. A is invertible if and only if $ad - cb \neq 0$.

$\det(A) = |A| = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - cb.$ $\quad A^{-1} = \frac{1}{ad - cb}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}.$

2) Let $A = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$. Then $\det(A) = |A| = a\begin{vmatrix} e & f \\ h & i \end{vmatrix} - b\begin{vmatrix} d & f \\ g & i \end{vmatrix} + c\begin{vmatrix} d & e \\ g & h \end{vmatrix}$.

3)

KeyConcept Cramer's Rule

Let A be the coefficient matrix of a system of n linear equations in n variables given by $AX = B$. If $\det(A) \neq 0$, then the unique solution of the system is given by

$$x_1 = \frac{|A_1|}{|A|},\ x_2 = \frac{|A_2|}{|A|},\ x_3 = \frac{|A_3|}{|A|},\ \ldots,\ x_n = \frac{|A_n|}{|A|},$$

where A_i is obtained by replacing the ith column of A with the column of constant terms B. If $\det(A) = 0$, then $AX = B$ has either no solution or infinitely many solutions.

CH6 Rules

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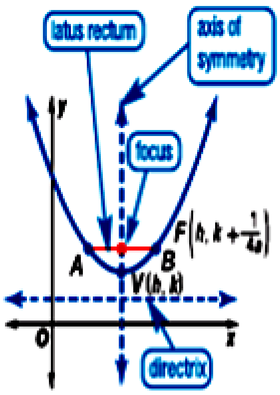
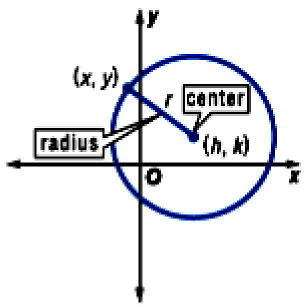
Parabola

Equation of parabolas		
Form	$y = a(x-h)^2 + k$	$x = a(y-k)^2 + h$
Direction of opening	$a > 0$ up	$a > 0$ $right$
	$a < 0$ $down$	$a < 0$ $left$
Vertex	(h, k)	(h, k)
Axis of symmetry	$x = h$	$y = k$
Focus	$(h, k + \frac{1}{4a})$	$(h + \frac{1}{4a}, k)$
Directrix	$y = k - \frac{1}{4a}$	$x = h - \frac{1}{4a}$
Length of latus rectum	$\left\lvert\frac{1}{a}\right\rvert$	$\left\lvert\frac{1}{a}\right\rvert$



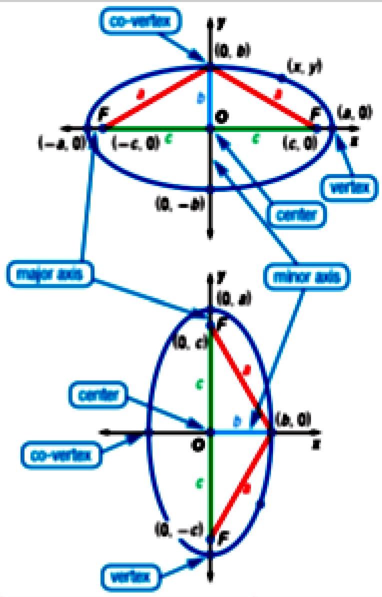
Circle

Standard Form of Equation	$(x-h)^2 + (y-k)^2 = r^2$
Center	(h, k)
Radius	r

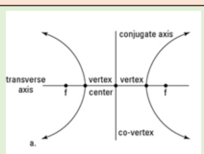
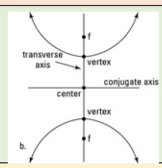


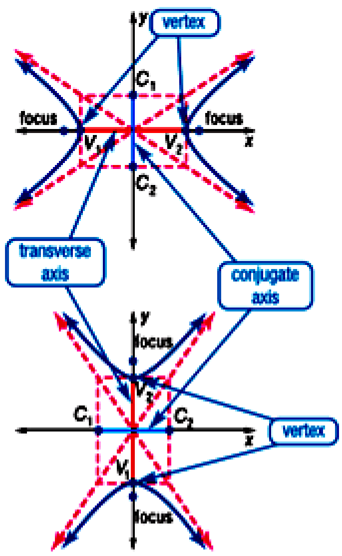
Ellipse

Standard form	$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$	$\frac{(y-k)^2}{a^2} + \frac{(x-h)^2}{b^2} = 1$
Orientation	Horizontal	Vertical
Vertices	$(h \mp a, k)$	$(h, k \mp a)$
Foci	$(h \mp c, k)$	$(h, k \mp c)$
Co- Vertices	$(h, k \mp b)$	$(h \mp b, k)$
Length of major axis	$2a$	$2a$
Length of minor axis	$2b$	$2b$



Hyperbola

Standard form	$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$	$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$
Orientation	Horizontal 	Vertical 
Vertices	$(h \mp a, k)$	$(h, k \mp a)$
Foci	$(h \mp c, k)$	$(h, k \mp c)$
Co- Vertices	$(h, k \mp b)$	$(h \mp b, k)$
Length of Transverse axis	$2a$	$2a$
Length of Conjugate axis	$2b$	$2b$
Equations of asymptotes	$y - k = \mp\frac{b}{a}(x-h)$	$y - k = \mp\frac{a}{b}(x-h)$



CH7 Rules

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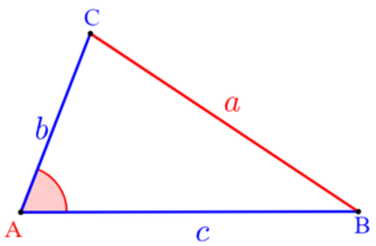
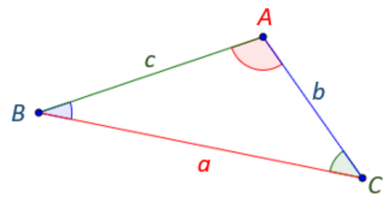
Cosine Rule



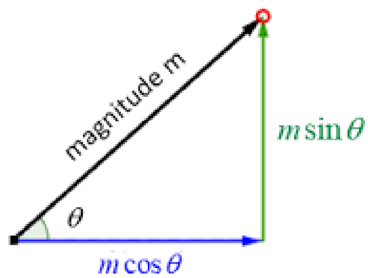
$$a^2 = b^2 + c^2 - 2bc\cos A$$

Sine Rule or Law of Sines



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

Components of a Vector



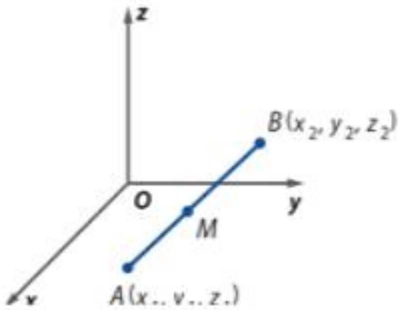
KeyConcept Distance and Midpoint Formulas in Space

The distance between points $A(x_1, y_1, z_1)$ and $B(x_2, y_2, z_2)$ is given by

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}.$$

The midpoint M of $\overline{AB}$ is given by

$$M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}, \frac{z_1 + z_2}{2}\right).$$



KeyConcept Component Form of a Vector

The component form of a vector $\overrightarrow{AB}$ with initial point $A(x_1, y_1)$ and terminal point $B(x_2, y_2)$ is given by

$$\langle x_2 - x_1, y_2 - y_1 \rangle.$$

KeyConcept Magnitude of a Vector in the Coordinate Plane

If **v** is a vector with initial point (x_1, y_1) and terminal point (x_2, y_2), then the magnitude of **v** is given by

$$|\mathbf{v}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$

If **v** has a component form of $\langle a, b \rangle$, then $|\mathbf{v}| = \sqrt{a^2 + b^2}$.

KeyConcept Vector Operations

If $\mathbf{a} = \langle a_1, a_2 \rangle$ and $\mathbf{b} = \langle b_1, b_2 \rangle$ are vectors and k is a scalar, then the following are true.

Vector Addition	$\mathbf{a} + \mathbf{b} = \langle a_1 + b_1, a_2 + b_2 \rangle$
Vector Subtraction	$\mathbf{a} - \mathbf{b} = \langle a_1 - b_1, a_2 - b_2 \rangle$
Scalar Multiplication	$k\mathbf{a} = \langle ka_1, ka_2 \rangle$

$$< a, b, c > = ai + bj + ck$$

2 Unit Vectors A vector that has a magnitude of 1 unit is called a **unit vector**. It is sometimes useful to describe a nonzero vector **v** as a scalar multiple of a unit vector **u** with the same direction as **v**. To find **u**, divide **v** by its magnitude $|\mathbf{v}|$.

$$\mathbf{u} = \frac{\mathbf{v}}{|\mathbf{v}|} \quad \text{or} \quad \frac{1}{|\mathbf{v}|}\mathbf{v}$$

Direction of the vector:

To find the direction of a given vector <a,b>

$$\theta = \tan^{-1}\left(\frac{b}{a}\right) \text{ if a>0} \quad \text{or } \theta = \tan^{-1}\left(\frac{b}{a}\right) + 180°\text{, if a<0}$$

KeyConcept Dot Product of Vectors in a Plane

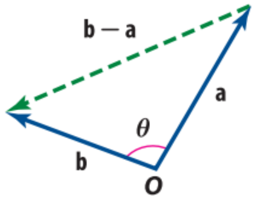
The dot product of $\mathbf{a} = \langle a_1, a_2\rangle$ and $\mathbf{b} = \langle b_1, b_2\rangle$ is defined as $\mathbf{a} \cdot \mathbf{b} = a_1b_1 + a_2b_2$.

KeyConcept Orthogonal Vectors

The vectors **a** and **b** are orthogonal if and only if $\mathbf{a} \cdot \mathbf{b} = 0$.

If θ is the angle between nonzero vectors **a** and **b**, then

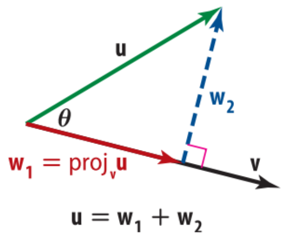
$$\cos \theta = \frac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{a}|\,|\mathbf{b}|}.$$



KeyConcept Projection of u onto v

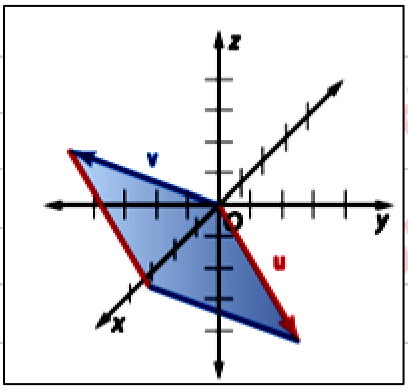
Let **u** and **v** be nonzero vectors, and let $\mathbf{w}_1$ and $\mathbf{w}_2$ be vector components of **u** such that $\mathbf{w}_1$ is parallel to **v** as shown. Then vector $\mathbf{w}_1$ is called the vector projection of **u** onto **v**, denoted $\text{proj}_{\mathbf{v}}\mathbf{u}$, and

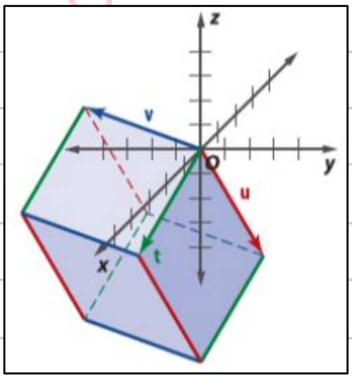
$$\text{proj}_{\mathbf{v}}\mathbf{u} = \left(\frac{\mathbf{u} \cdot \mathbf{v}}{|\mathbf{v}|^2}\right)\mathbf{v}.$$



Work: $W = F.d$ **, Where f: force , d: vector of displacement**

Cross product: $\mathbf{a} \times \mathbf{b} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$





$Area\ of\ Parallelogram = |u \times v|$ Volume of parallelepiped $= t.(u \times v)$