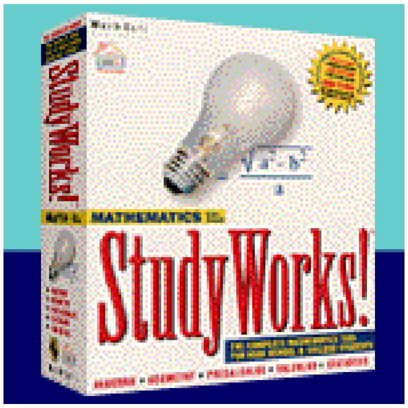
StudyWorks™ for Math



Platform: Windows and Macintosh
Available on CD-ROM only
Available for ground shipment

Imagine a full-screen graphing calculator and a math-smart word processor combined into one integrated tool. Now imagine an electronic encyclopedia of facts and formulas at your fingertips and a built-in Web link that lets you connect with other students and pick up hints on your homework. StudyWorks is an all-in-one study tool that helps you work faster, more accurately -- and learn more at the same time. Calculate, graph, access helpful information -- then create great-looking documents that combine text, formulas and graphics. You'll find hundreds of drag-and-drop equation, in-depth explanations, worked-out examples and lots of great illustrations, graphs, and animations to strengthen problem-solving skills.

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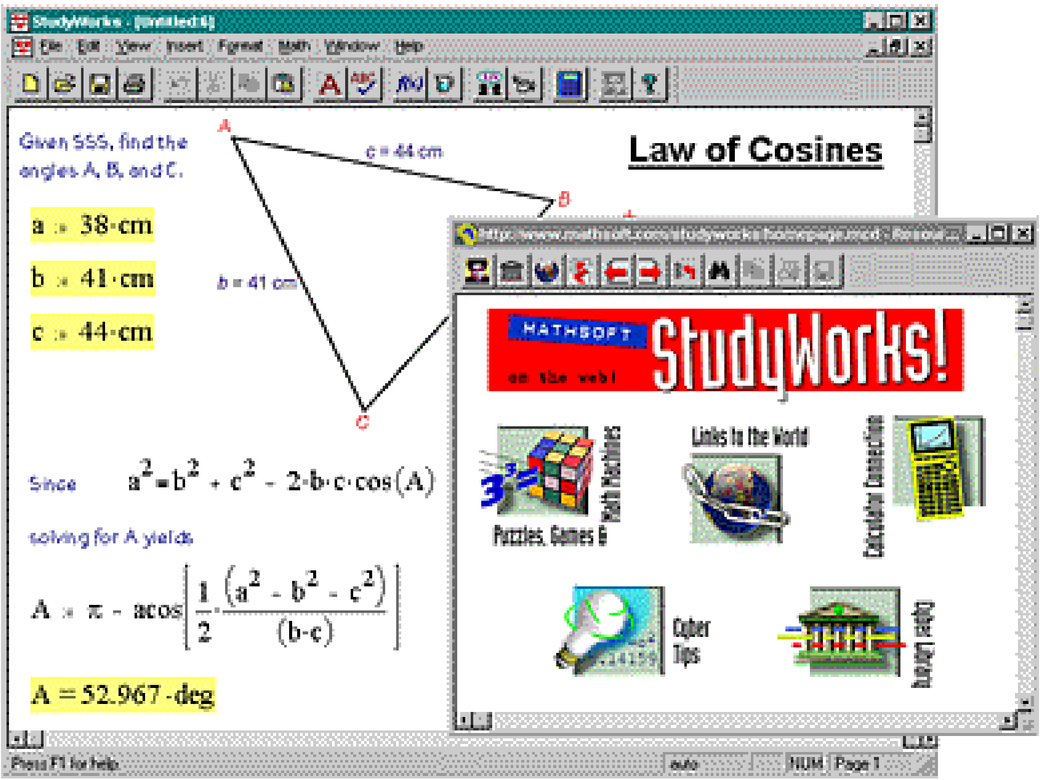

In a StudyWorks worksheet, you can write equations, perform calculations, create graphs, even add text -- anywhere you want.

StudyWorks for Math covers the full range of math curriculum including algebra, geometry, precalculus, and statistics. Topics include: Linear Functions, Polynomials, Areas and Volumes, Parametric Curves, Matrices, Derivatives and Integrals, and more.

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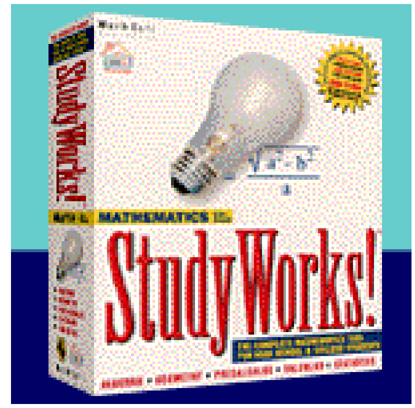

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MathSoft StudyWorks™ for Math covers the full range of the math curriculum including algebra, geometry, precalculus, calculus, and statistics. There are hundreds of drag-and drop equations, worked-out examples, and lots of great illustrations, graphs, and animations that will strengthen your problem-solving skills and encourage deeper understanding. Some of the topics include:

Linear functions
Factoring
Quadratic equations
Graphing
Polynomials
Inequalities
Systems of equations
Conic sections
Areas and volumes
Polar coordinates
Logs and exponential functions
Sequences and series
Circular functions
Trigonometric identities
Parametric curves
Vectors
Matrices
Probability
Data Analysis
Complex numbers
Limits
Derivatives and integrals

Perform all the numeric and symbolic calculations you'll ever need

- Work with numbers, variables, functions, equations, vectors, matrices.
- Units of measurement and dimension checking.
- Statistics and data analysis functions.
- Matrix operations including determinants, dot products, cross-products, inverse, and transpose.
- Derivatives, integrals, summations and products.
- Find roots of a polynomial.

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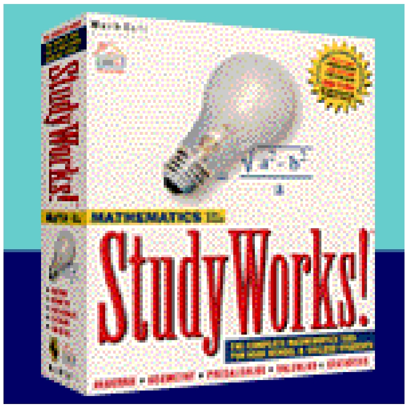

FEATURES & SPECS (page 2 of 3)

- Solve equations and systems of equations.
- Trigonometric, exponential and hyperbolic functions.
- Symbolic integration and differentiation.
- Expand, simplify and factor expressions.

Turn data and functions into powerful graphs

- X-Y and polar plots, vector plots, 3-D scatter, bar, contour, surface and parametric surface plots.
- Annotate and format graphs.
- Trace and zoom.
- Animation.

StudyWorks is live and interactive

- Change inputs and watch StudyWorks recalculate the result.
- A unique environment for exploring and understanding math and science concepts.

Get the online help you need

- Online math reference book includes standard formulas, research material and information on algebra, geometry, precalculus, calculus, and statistics.
- Move information from the reference book to a StudyWorks worksheet with drag-and-drop ease.
- Online animated tutorial and context-sensitive help provide answers to a wide range of questions and problems.
- A special section offers help in preparing for the SAT II tests.

Create great-looking documents in seconds

- WYSIWYG report writer makes it easy to prepare presentation-quality homework papers and lab reports.
- Includes print preview and technical spell checker.
- Export worksheets to Microsoft Word for full word-processing capabilities.

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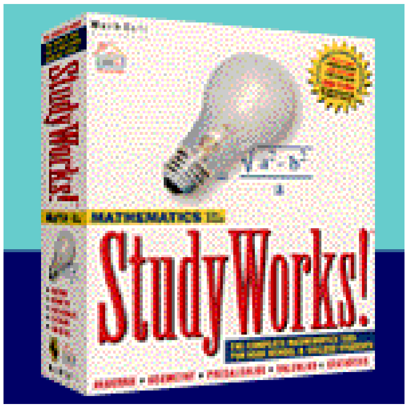

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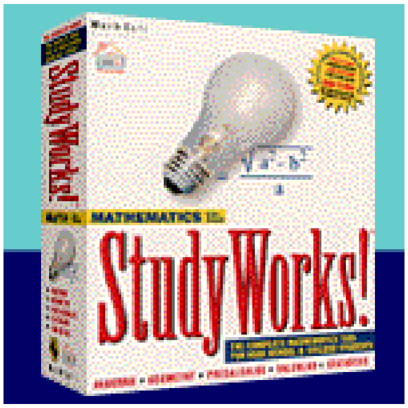
System Requirements

Windows

IBM PC or compatible (486 or higher)
Microsoft Windows 3.1 (or higher) or Windows '95, 8 MB of RAM and 10 MB of swap space
14 MB of free disk space
SVGA color monitor
CD-ROM drive
Web link requires internet access

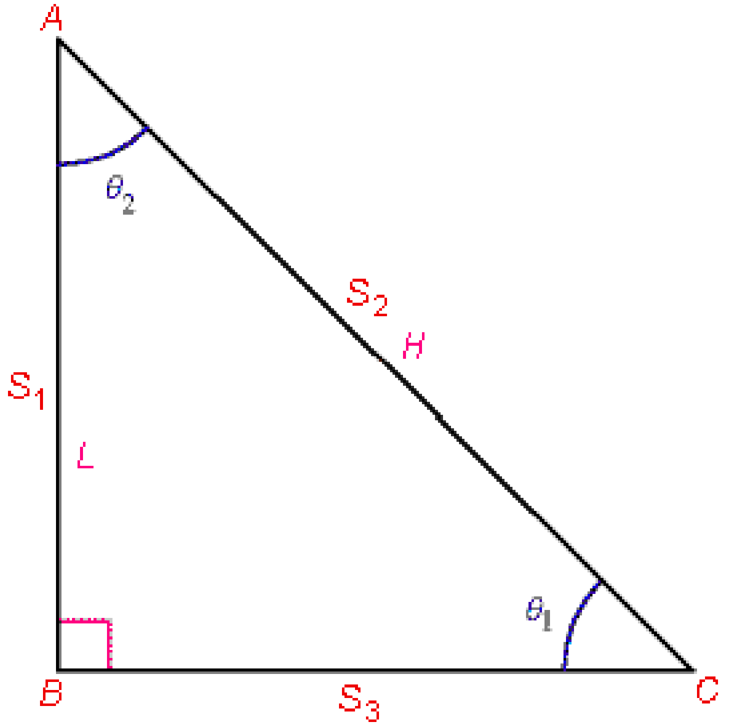
Macintosh

PowerMac or 68040 (PowerMac recommended)
8 MB of RAM
16 MB of disk space
CD-ROM drive
Macintosh System 7.1 or later
Web link requires internet connection and MacTCP



Trigonometry: Law of Sines and Law of Cosines

If you've already taken a geometry course you know that in order to construct a triangle there is a minimum amount of information that you need to know about the triangle. You must know one of the following:



SSS	three sides
ASA	two angles and the included side
SAS	two sides and the included angle
AAS	two angles and a non-included side
HL	the hypotenuse and one leg of a right triangle

If you are given two sides and a non-included angle (SSA), this information is *not sufficient* to define a unique triangle.

The Law of Cosines is a formula that you can use to determine the remaining legs or angles of a triangle if you are given SSS, SAS, or HL. Similarly, the Law of Sines can be used if you are given ASA, AAS or HL. See **Tips and Techniques** for more on working with trigonometric laws in StudyWorks.

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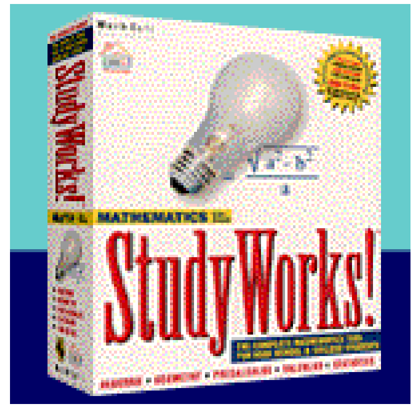


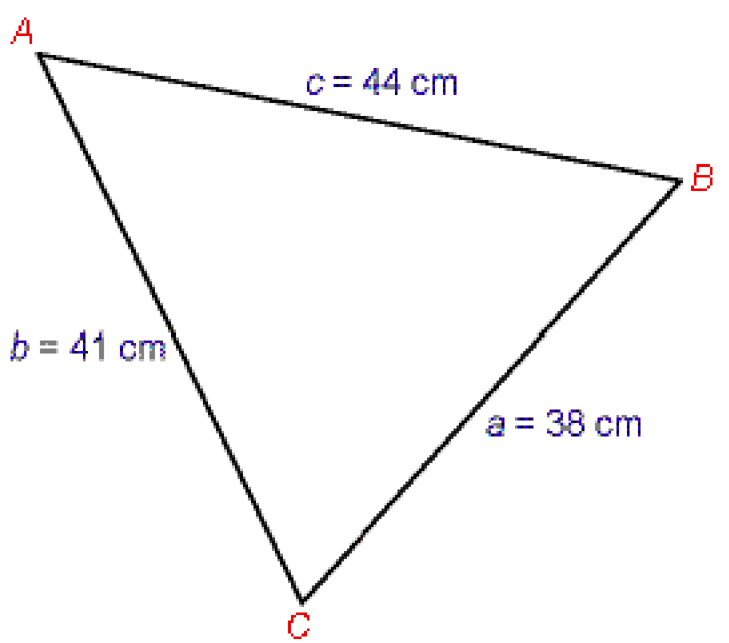
Equations

Law of Cosines: $a^2 = b^2 + c^2 - 2 \cdot b \cdot c \cdot \cos(A)$

Law of Sines: $\dfrac{\sin(A)}{a} = \dfrac{\sin(B)}{b} = \dfrac{\sin(C)}{c}$

Example 1

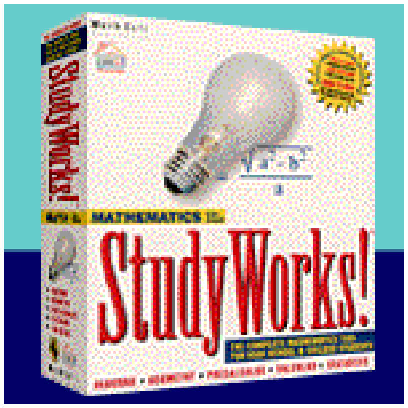
Given SSS, find the angles A, B, and C.



$a := 38 \cdot cm$ $\quad b := 41 \cdot cm$ $\quad c := 44 \cdot cm$

Since

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



solving for A yields

$$A := \pi - \operatorname{acos}\left[\frac{1}{2}\cdot\frac{\left(a^2 - b^2 - c^2\right)}{(b\cdot c)}\right] \qquad A = 52.967\cdot\text{deg}$$

Since

$$b^2 = a^2 + c^2 - 2\cdot a\cdot c\cdot\cos(B)$$

solving for B yields

$$B := \pi - \operatorname{acos}\left[\frac{1}{2}\cdot\frac{\left(b^2 - a^2 - c^2\right)}{(a\cdot c)}\right] \qquad B = 59.464\cdot\text{deg}$$

Therefore

$$C := 180\cdot\text{deg} - A - B \qquad C = 67.568\cdot\text{deg}$$

Where does the p come from in the results above for A and B? If we check by solving for the cosine of A instead of A, we get

$$a^2 = b^2 + c^2 - 2\cdot b\cdot c\cdot \text{CosineA}$$

has solution(s)

$$\frac{-1}{2}\cdot\frac{\left(a^2 - b^2 - c^2\right)}{(b\cdot c)}$$

O.K. so far. The difference comes in applying the acos function to each side. The symbolic processor uses the identity acos(-x) = p - acos(x) and returns its preferred representation of the solution.

$$\operatorname{acos}(\cos(A)) = \operatorname{acos}\left[\frac{-1}{2}\cdot\frac{\left(a^2 - b^2 - c^2\right)}{(b\cdot c)}\right]$$

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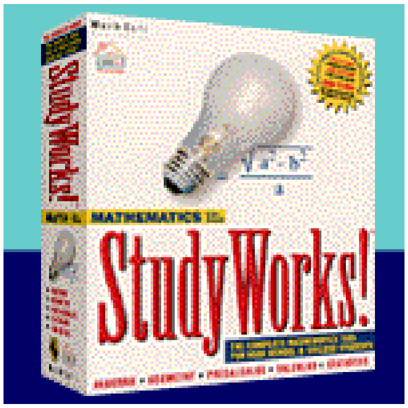
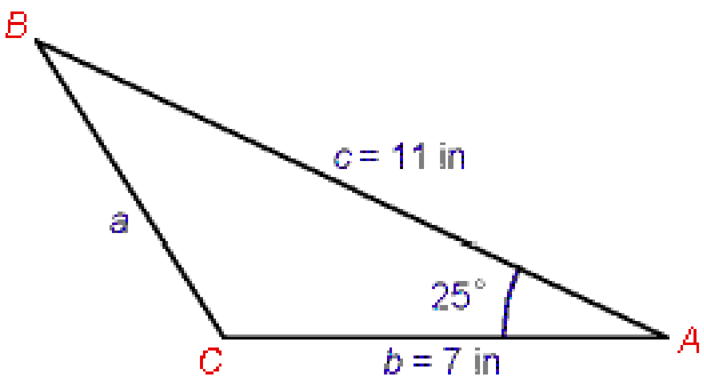


simplifies to

$$A = \pi - \operatorname{acos}\left[\frac{1}{2}\cdot\frac{\left(a^2 - b^2 - c^2\right)}{(b\cdot c)}\right]$$

Example 2

Given SAS, find the length of the remaining side and angles.



$b := 7\cdot in$ $\qquad$ $c := 11\cdot in$ $\qquad$ $A := 25\cdot deg$

Since

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

solving for a yields

$$a := \begin{bmatrix} \frac{1}{2}\cdot\sqrt{4\cdot b^2 + 4\cdot c^2 - 8\cdot b\cdot c\cdot\cos(A)} \\ \frac{-1}{2}\cdot\sqrt{4\cdot b^2 + 4\cdot c^2 - 8\cdot b\cdot c\cdot\cos(A)} \end{bmatrix}$$

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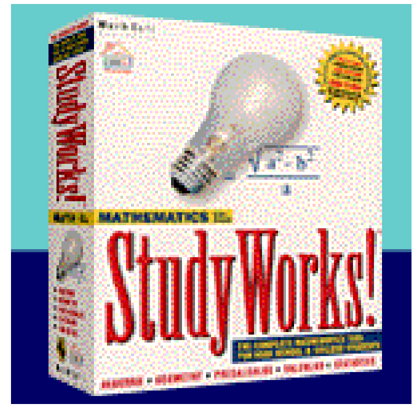


(Only the positive value makes sense!)

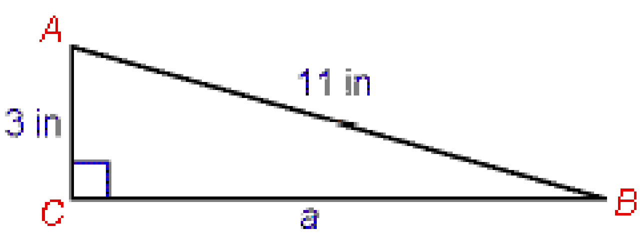
$$a = \begin{bmatrix} 5.516 \\ -5.516 \end{bmatrix} \cdot in \qquad a := a_1 \qquad a = 5.516 \cdot in$$

$$b^2 = a^2 + c^2 - 2 \cdot a \cdot c \cdot \cos(B)$$

$$B := \pi - \operatorname{acos}\left[\frac{1}{2} \cdot \frac{\left(b^2 - a^2 - c^2\right)}{(a \cdot c)}\right] \qquad B = 32.432 \cdot deg$$

$$C := 180 \cdot deg - A - B \qquad C = 122.568 \cdot deg$$

Example 3



$$b := 3 \cdot in \qquad c := 11 \cdot in \qquad C := 90 \cdot deg$$

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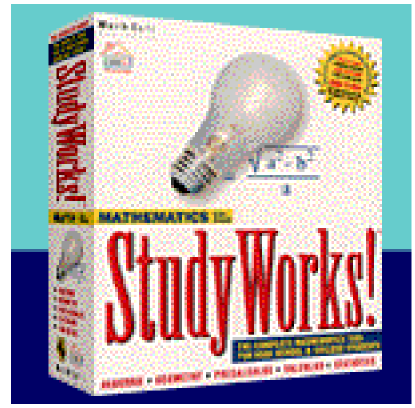


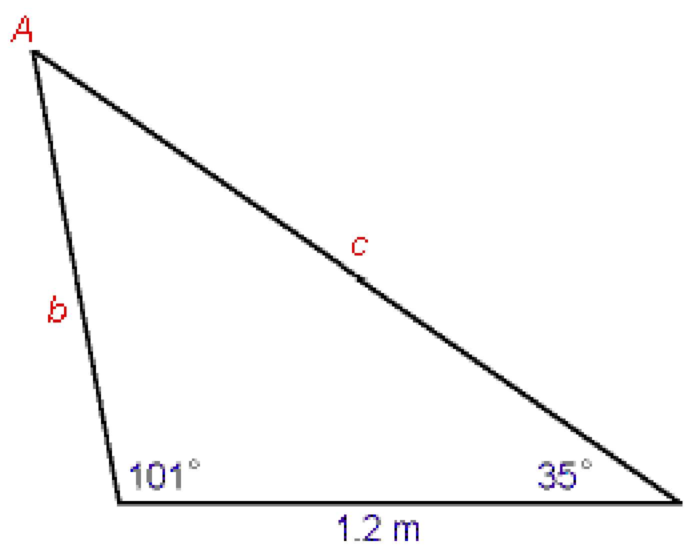
Once you find side a (using the **Pythagorean Theorem**) you then have SAS. From there you can proceed with the Law of Cosines.

$a := \sqrt{c^2 - b^2}$ $\quad$ $a = 10.583 \cdot in$

$B := \pi - acos\left[\frac{1}{2} \cdot \frac{\left(b^2 - a^2 - c^2\right)}{(a \cdot c)}\right]$ $\quad$ $B = 15.827 \cdot deg$

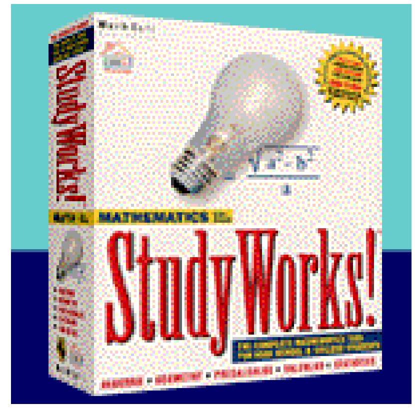
$A := 90 \cdot deg - B$ $\quad$ $A = 74.173 \cdot deg$

Example 4



$a := 1.2 \cdot m$ $\quad$ $B := 35 \cdot deg$ $\quad$ $C := 101 \cdot deg$

$A := 180 \cdot deg - B - C$ $\quad$ $A = 44 \cdot deg$



Use the Law of Sines to find b and then c. Since

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

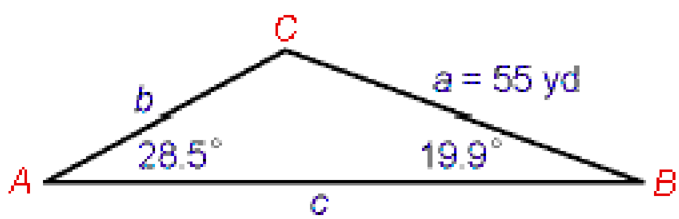
Solving for b and c yields

$$b := \sin(B)\cdot\frac{a}{\sin(A)} \qquad b = 1\cdot m$$

$$c := \sin(C)\cdot\frac{a}{\sin(A)} \qquad c = 1.7\cdot m$$

Example 5

Given AAS, find the remaining angle and sides.



$$A := 28.5\cdot deg \qquad B := 19.9\cdot deg \qquad a := 55\cdot yd$$

The third angle is $C := 180\cdot deg - A - B$

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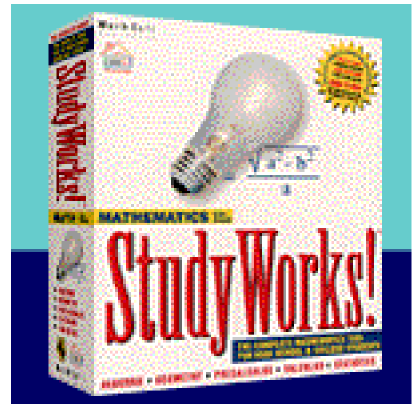

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Since

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

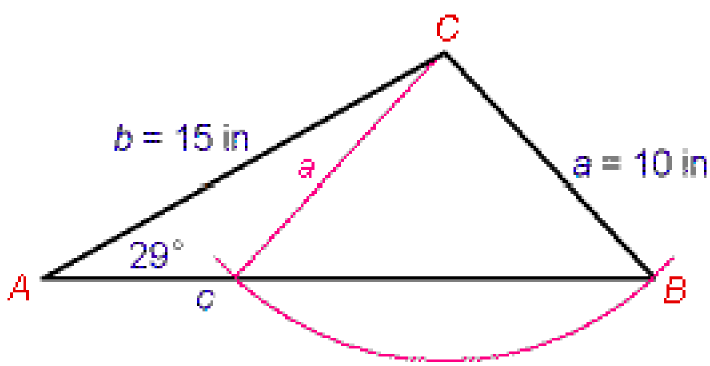
solving for b and c yields

$$b := \sin(B)\cdot\frac{a}{\sin(A)} \qquad b = 39.234\cdot yd$$

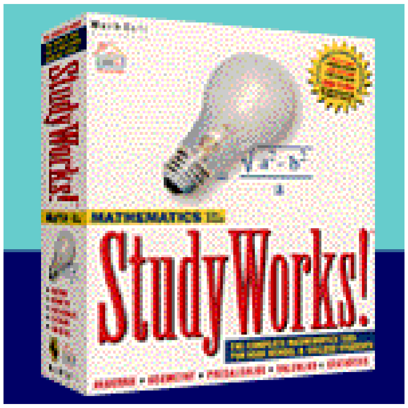
$$c := \sin(C)\cdot\frac{a}{\sin(A)} \qquad c = 86.195\cdot yd$$

It is important that you understand why SSA is insufficient to determine a unique triangle. To gain a better understanding of this, read the following carefully.

Given SSA, use the Law of Cosines to find the possible lengths of c.



$$a := 10\cdot in \qquad b := 15\cdot in \qquad A := 29\cdot deg$$



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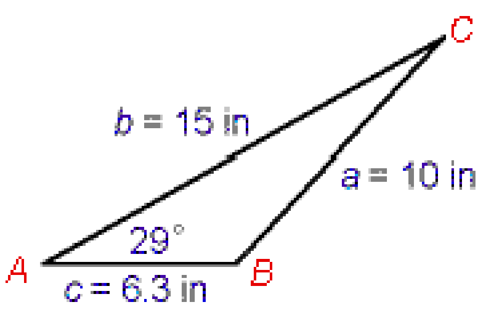
Using the Law of Cosines to solve for c yields

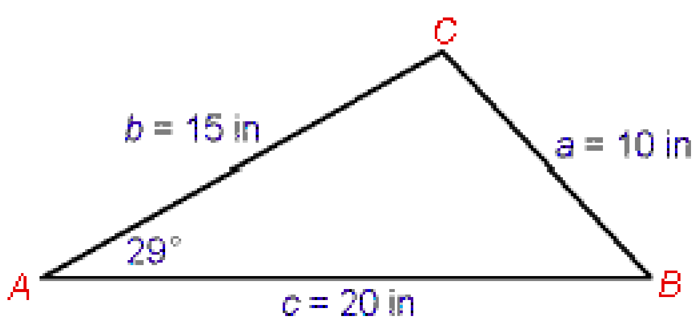
$$c := \begin{bmatrix} b\cdot\cos(A) - \frac{1}{2}\cdot\sqrt{4\cdot b^2\cdot\cos(A)^2 + 4\cdot a^2 - 4\cdot b^2} \\ b\cdot\cos(A) + \frac{1}{2}\cdot\sqrt{4\cdot b^2\cdot\cos(A)^2 + 4\cdot a^2 - 4\cdot b^2} \end{bmatrix}$$

Therefore, there are two different solutions for c!

$$c = \begin{bmatrix} 6.3 \\ 20 \end{bmatrix}\cdot\text{in}$$

And the triangle could have two different shapes:





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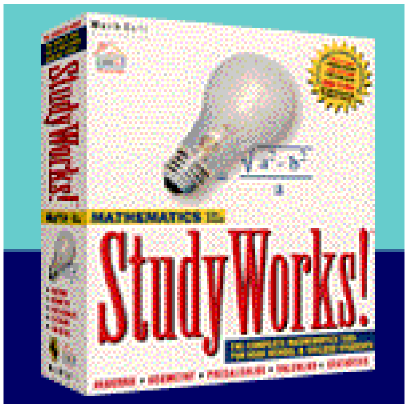
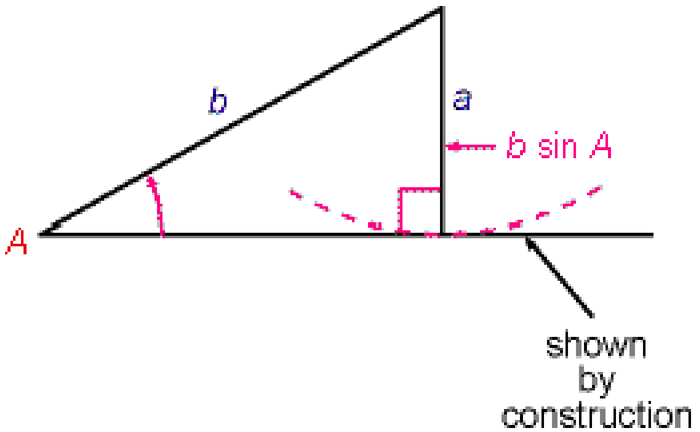


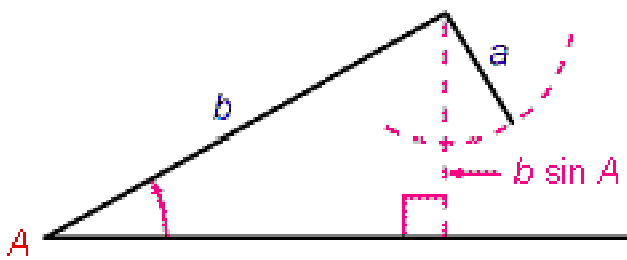
There is a way of determining how many solutions there will be for SSA. There are several cases:

Case 1: A < 90°

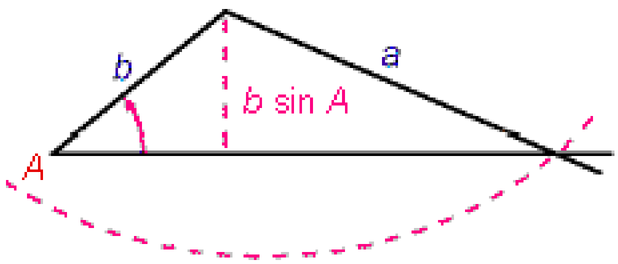
If $a = b \cdot \sin(A)$, one solution exists, a right triangle:



If $a < b \cdot \sin(A)$, there is no solution:



When $a > b$ and $a > b \cdot \sin(A)$, there is one solution:



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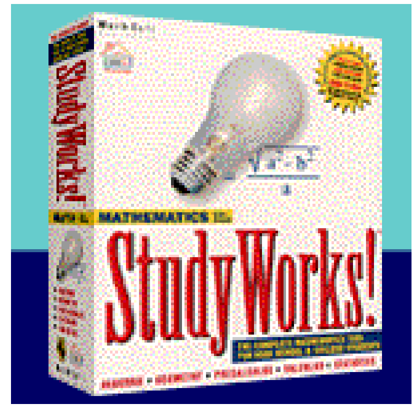

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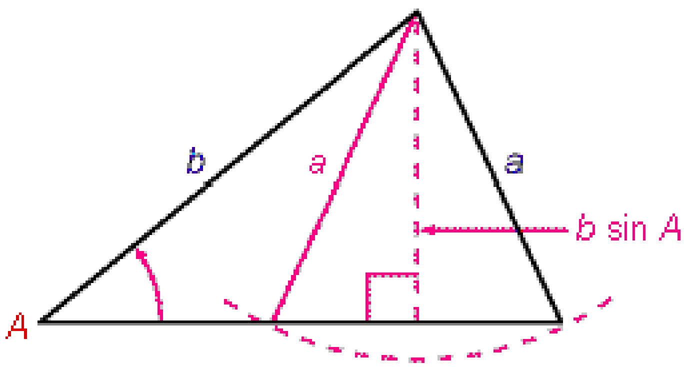
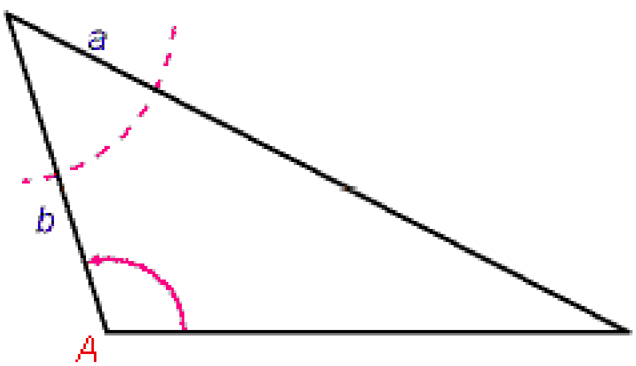
If $b \cdot \sin(A) < a < b$, there are two solutions:

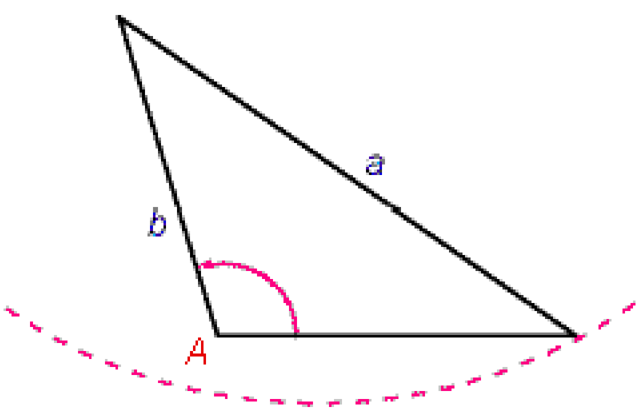


Case 2: A <= 90°

When $a \le b$, there is no solution:



When $a > b$, one solution exists:



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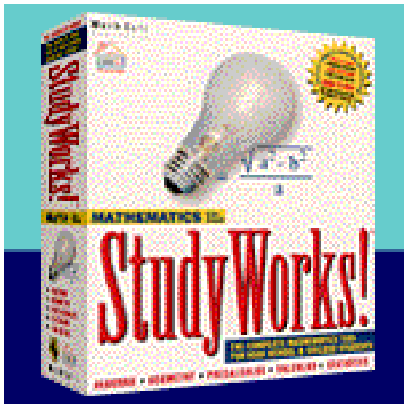

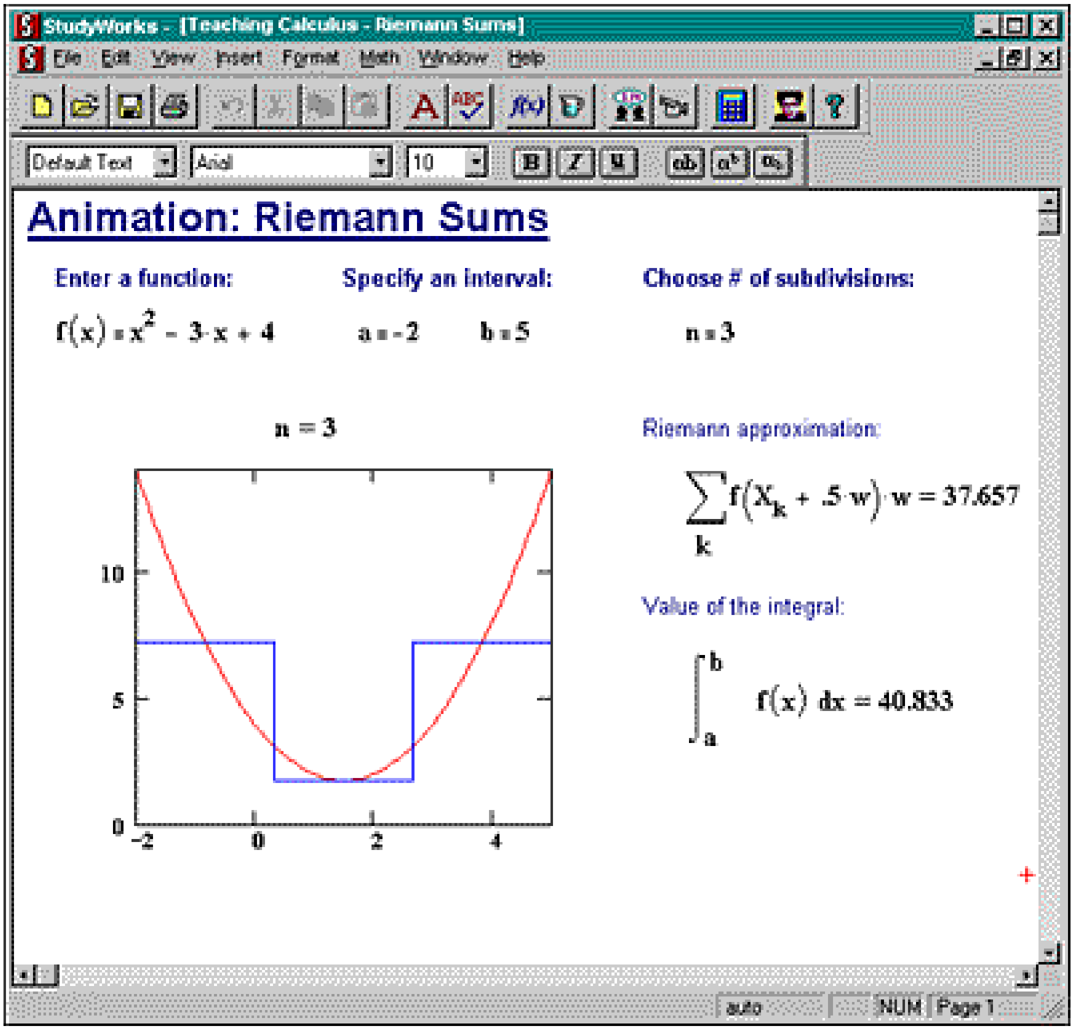

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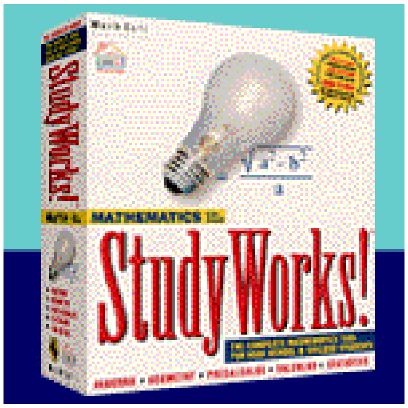

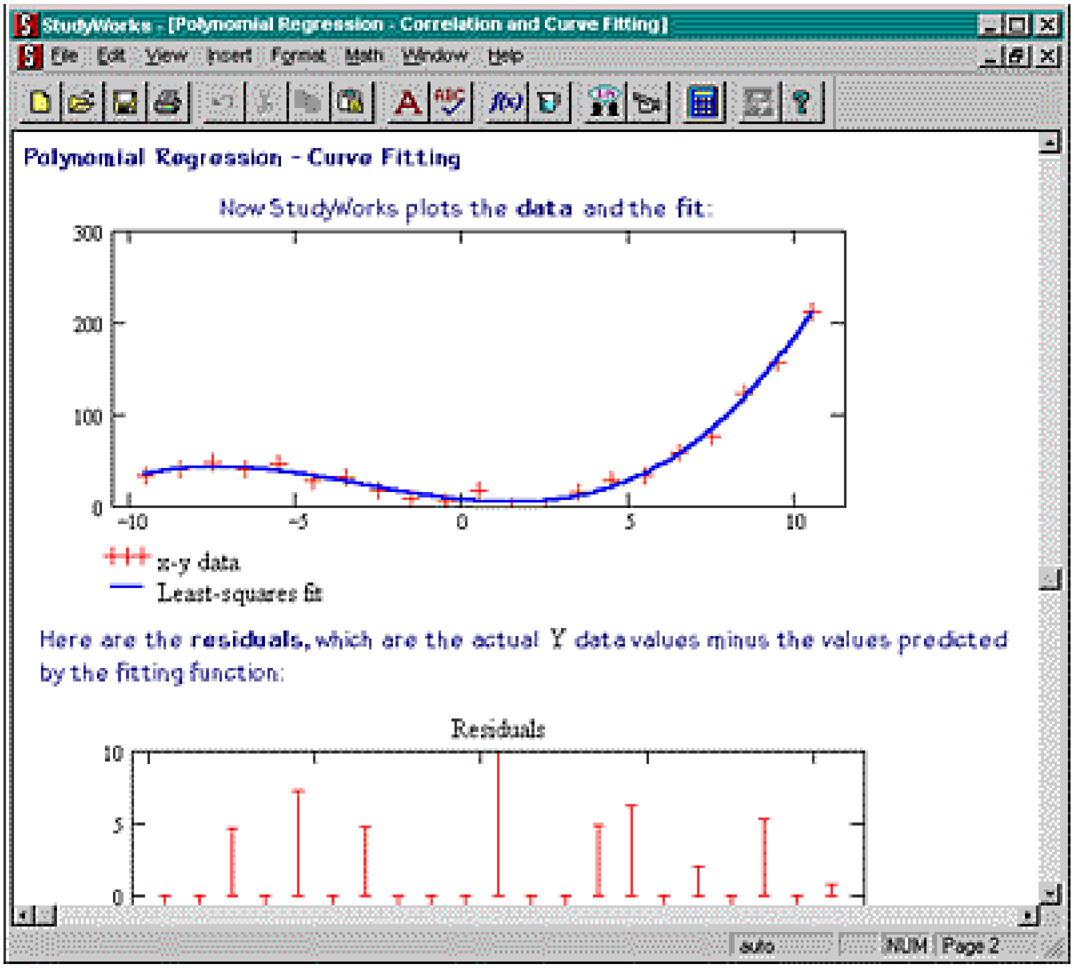

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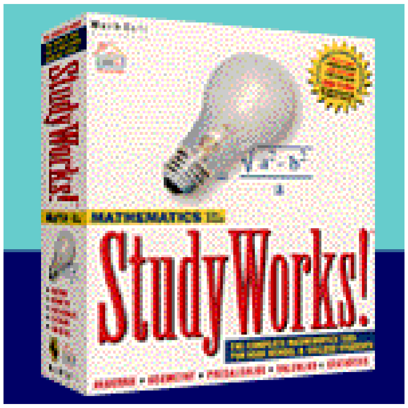

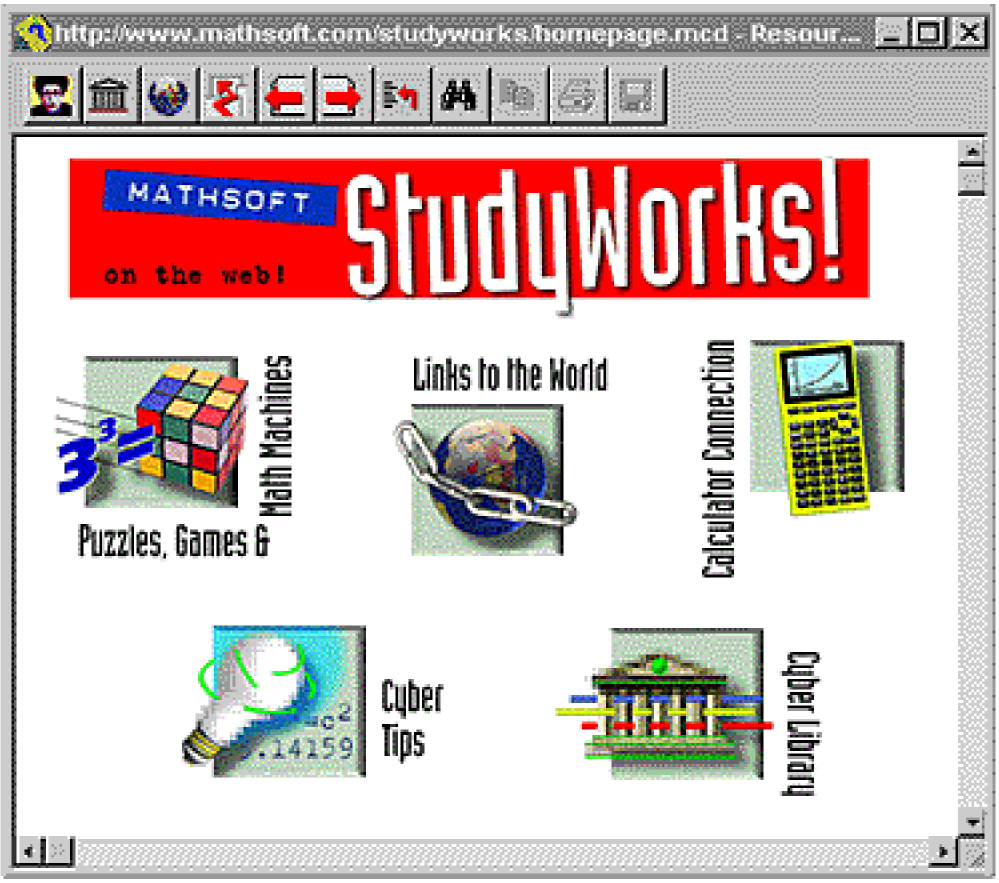

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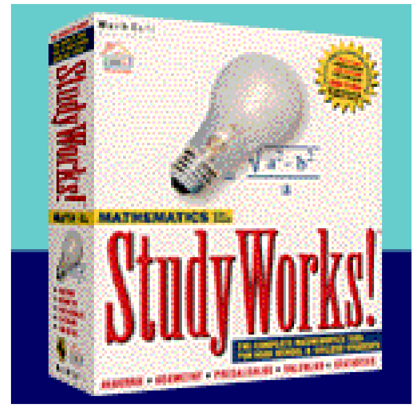
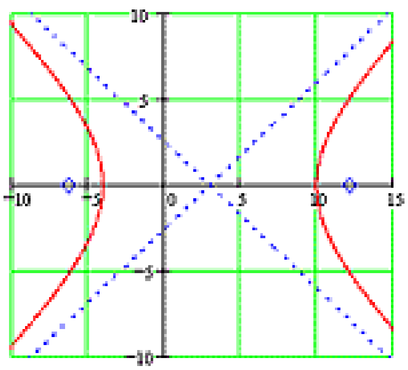


Jennifer Moore Precalculus Assignment 3 10/19/96

I'm going to use the formulas from the section on hyperbolas to set up these homework graphing problems. I'll need both sets because some of these hyperbolas go vertically.

Problem 1. center: $h := 3$ $k := 0$ a and b: $a := 7$ $b := 6$

$$hy(x) := a \cdot \frac{\sqrt{x^2 + b^2}}{b} \qquad F := \sqrt{a^2 + b^2} \qquad y1(x) := \frac{b}{a} \cdot x + \left(k - \frac{b}{a} \cdot h\right) \qquad y2(x) := -\frac{b}{a} \cdot x + \left(k + \frac{b}{a} \cdot h\right)$$



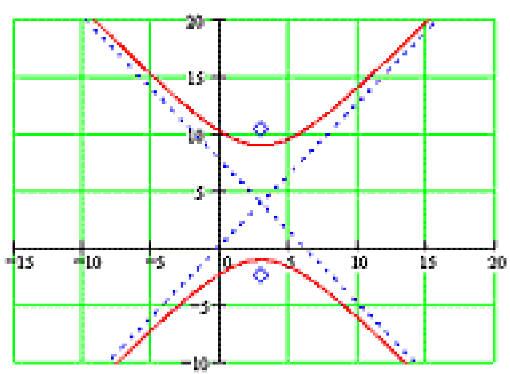
$$\frac{(x-3)^2}{7^2} - \frac{y^2}{6^2} = 1$$

This is a "horizontal" hyperbola.

Problem 2. This one is vertical, so I'll use the other formula.

Center: $h := 3$ $k := 4$ a and b: $a := 5$ $b := 4$

$$hy(x) := a \cdot \frac{\sqrt{x^2 + b^2}}{b} \qquad F := \sqrt{a^2 + b^2} \qquad y1(x) := \frac{a}{b} \cdot x + \left(k - \frac{a}{b} \cdot h\right) \qquad y2(x) := -\frac{a}{b} \cdot x + \left(k + \frac{a}{b} \cdot h\right)$$



$$\frac{(y-4)^2}{5^2} - \frac{(x-3)^2}{4^2} = 1$$

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