

In non-right triangles we cannot use the primary trigonometric ratio; there is no  $90^\circ$  angle, so there is no hypotenuse!

However, there still exists relationships between the sides and the angles in the triangle.

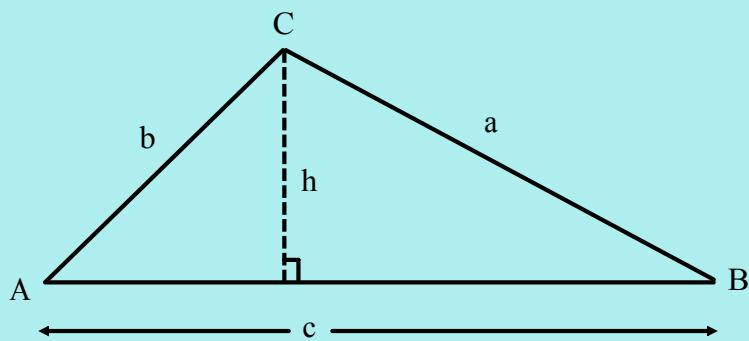
The relationships can be expressed in terms of sine or cosine and are called the Sine Law and the Cosine Law.

We will study these laws over the next few days.

acute  $\rightarrow$  all angles  $< 90^\circ$

May 13-1:31 PM

## Proving the Sine Law:



We can always create right triangles by drawing an altitude from any vertex.

Using trigonometry on each right triangle, we can relate the angles and sides of the overall triangle.

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Diagram showing triangle ABC with base AB = c. A dashed line from vertex C to base AB at point D forms a right angle. The height is labeled h. The base is labeled c. The sides are labeled a, b, and c.

$\sin A = \frac{h}{b}$     $\sin B = \frac{h}{a}$

$b \sin A = h \textcircled{1}$     $a \sin B = h \textcircled{2}$

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

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

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Diagram showing triangle ABC with base AB = c. A dashed line from vertex C to base AB at point D forms a right angle. The height is labeled h. The base is labeled c. The sides are labeled a, b, and c.

$\sin A = \frac{h}{b}$     $\sin B = \frac{h}{a}$

$b \sin A = h$     $a \sin B = h$

set  $h = h$

$b \sin A = a \sin B$

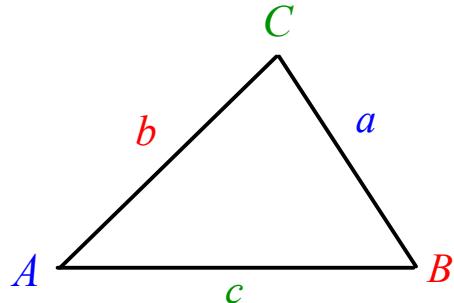
$\frac{b \sin A}{a} = \sin B$

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

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The Sine Law

Dec 14/2011

The Sine Law (2 formats) for  $\triangle ABC$ :

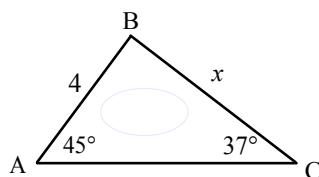
$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

or

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

You decide which format to use depending on what you are solving for.

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Ex.1 Solve for  $x$ .

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

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

$$\frac{x}{\sin 45^\circ} = \frac{4}{\sin 37^\circ}$$

$$x \sin 37^\circ = 4 \sin 45^\circ$$

$$x = \frac{4 \sin 45^\circ}{\sin 37^\circ}$$

$$\boxed{x \approx 4.7}$$

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Ex. 2 Solve for  $\theta$ .

$$\frac{\sin X}{x} = \frac{\sin Y}{y} = \frac{\sin Z}{z}$$

$$\frac{\sin X}{x} = \frac{\sin Y}{y}$$

$$\frac{\sin 52^\circ}{100} = \frac{\sin \theta}{75}$$

$$100(\sin \theta) = 75 \sin 52^\circ$$

$$\sin \theta = \frac{75 \sin 52^\circ}{100}$$

$$\sin \theta \approx 0.5910$$

$$\theta = \sin^{-1}(0.5910)$$

$$\boxed{\theta \approx 36.2^\circ}$$

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Ex. 3 Solve for  $y$ .

$$\frac{x}{\sin X} = \frac{y}{\sin Y} = \frac{z}{\sin Z}$$

Jan 4-2:58 PM

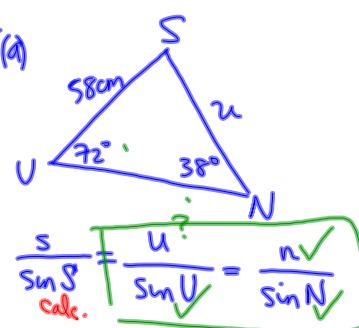
Assigned Work:

p.427 # 2ac

p.432 # 2, 3ace, 5ac, 6, 14, 15

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p. 432



$$\frac{u}{\sin 72^\circ} = \frac{58}{\sin 38^\circ}$$

$$u(\sin 38^\circ) = \frac{58 \sin 72^\circ}{\sin 38^\circ}$$

$$u = \frac{58 \sin 72^\circ}{\sin 38^\circ}$$

$$u = 89.6 \text{ cm}$$

$$\frac{\sin 72^\circ}{\sin 38^\circ} = \frac{72^\circ}{38^\circ} X$$

$$\frac{\sin 72^\circ}{\sin 38^\circ} = \sin\left(\frac{72^\circ}{38^\circ}\right) X$$

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b.

$$A + 32^\circ + 81^\circ = 180^\circ$$

$$A = 180^\circ - 113^\circ$$

$$A = 67^\circ$$

$$\frac{a}{\sin A} = \frac{c}{\sin C} = \frac{t}{\sin T}$$

$$\frac{a}{\sin 67^\circ} = \frac{24.1}{\sin 32^\circ}$$

$$a \sin 32^\circ = 24.1 (\sin 67^\circ)$$

$$a = \frac{24.1 (\sin 67^\circ)}{\sin 32^\circ}$$

$$\frac{t}{\sin T} = \frac{c}{\sin C}$$

$$t = \underline{\hspace{2cm}}$$

$$a = \underline{\hspace{2cm}}$$

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4.

$$\frac{p}{\sin P} = \frac{q}{\sin Q} = \frac{r}{\sin R}$$

①  $\angle R \rightarrow$  angle sum  $180^\circ$

①  $q \rightarrow$  Sine law

②  $r \rightarrow$  Sine law

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