

Right Triangle Trigonometry

Solving Right Triangles

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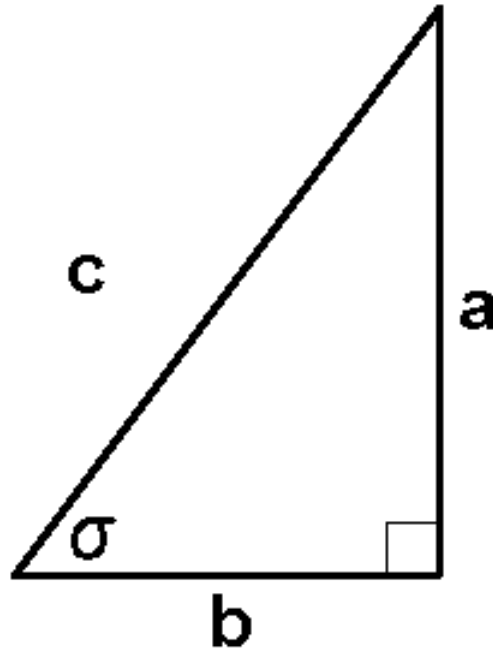
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Consider a Right Triangle.



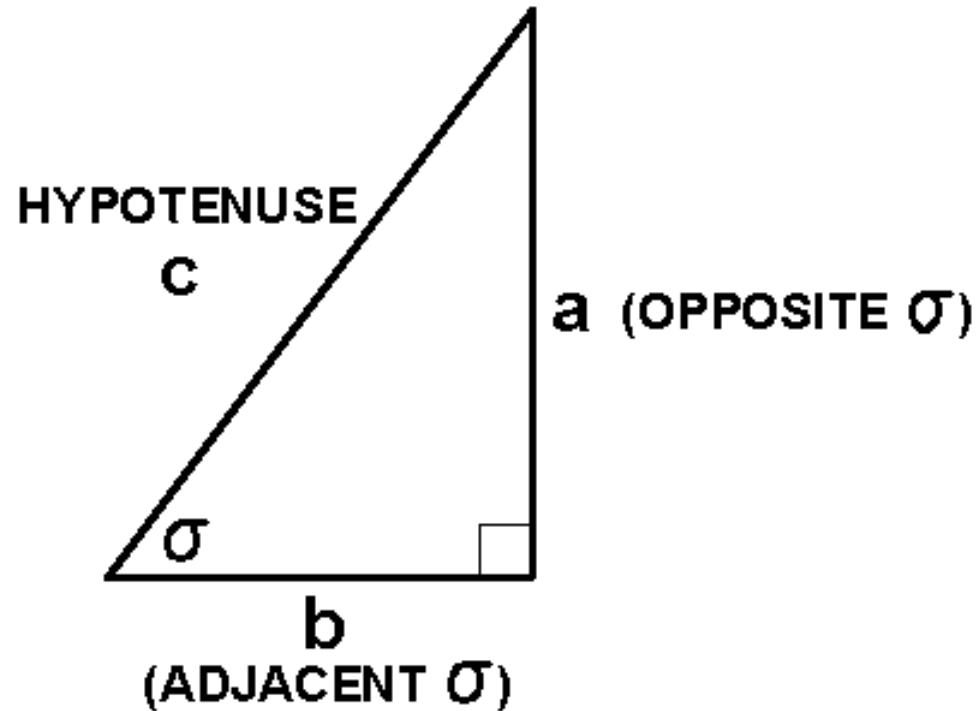
Note – a is the leg opposite σ
c is the leg opposite our right angle
b is the leg adjacent to σ

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So that we have the following right triangle.



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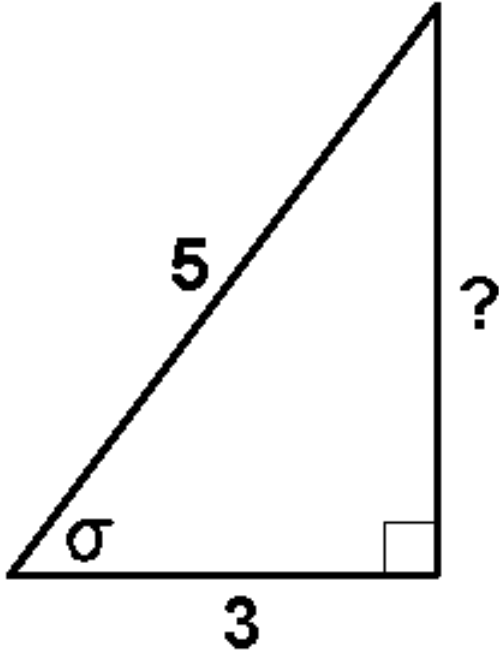
The six trigonometric ratios are defined as follows:

$$\sin (\sigma) = \frac{\text{opp } \sigma}{\text{hyp}} \quad ; \quad \csc (\sigma) = \frac{\text{hyp}}{\text{opp } \sigma}$$

$$\cos (\sigma) = \frac{\text{adj } \sigma}{\text{hyp}} \quad ; \quad \sec (\sigma) = \frac{\text{hyp}}{\text{adj } \sigma}$$

$$\tan (\sigma) = \frac{\text{opp } \sigma}{\text{adj } \sigma} \quad ; \quad \cot (\sigma) = \frac{\text{adj } \sigma}{\text{opp } \sigma}$$

What are the six trigonometric ratios for σ ?



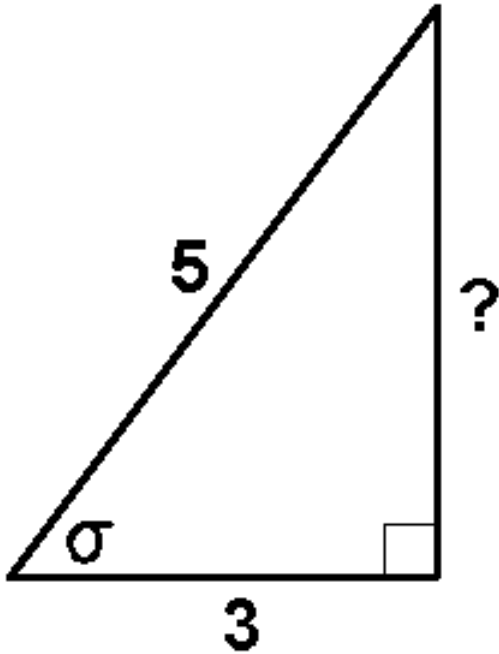
Note – We need the length of one of the legs of our right triangle.

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Use the Pythagorean Theorem . . .



$$3^2 + ?^2 = 5^2$$

$$9 + ?^2 = 25$$

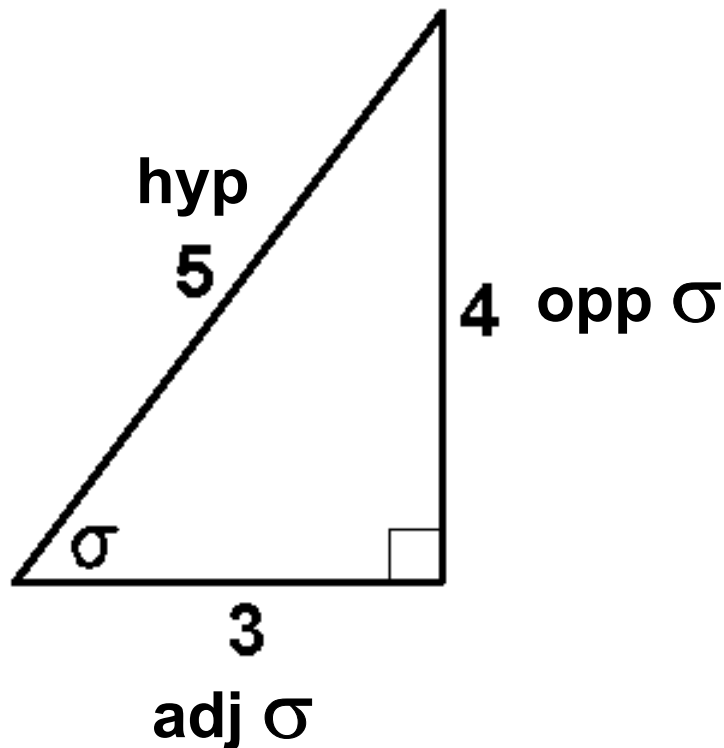
$$?^2 = 16 ; ? = \pm 4 ; ? = 4$$

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For this triangle we get:



$$\sin(\sigma) = \frac{4}{5} ; \quad \csc(\sigma) = \frac{5}{4}$$

$$\cos(\sigma) = \frac{3}{5} ; \quad \sec(\sigma) = \frac{5}{3}$$

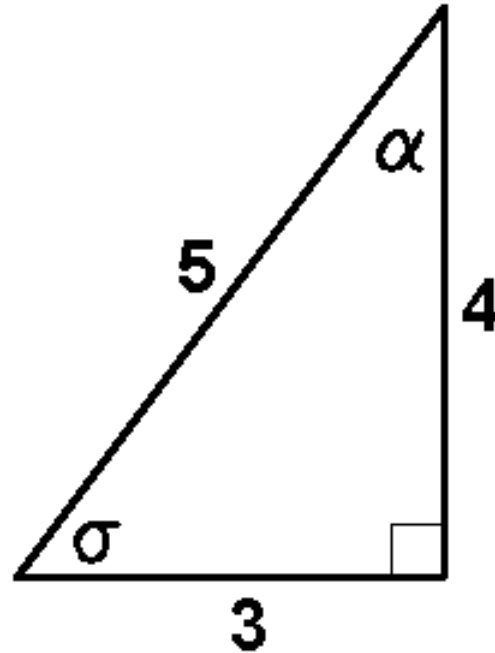
$$\tan(\sigma) = \frac{4}{3} ; \quad \cot(\sigma) = \frac{3}{4}$$

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Notice we have another angle at α .

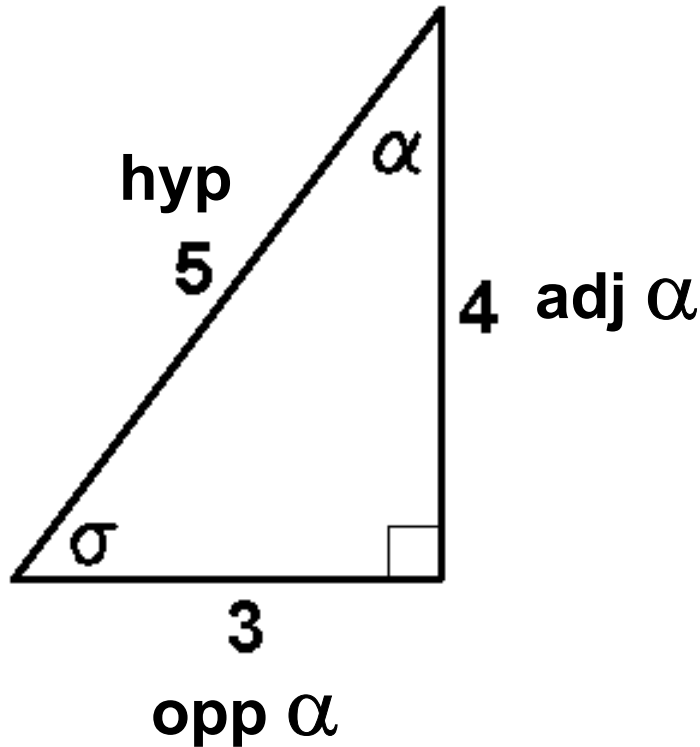


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We can obtain the six trigonometric ratios for α ,



$$\sin(\alpha) = \frac{3}{5} ; \quad \csc(\alpha) = \frac{5}{3}$$

$$\cos(\alpha) = \frac{4}{5} ; \quad \sec(\alpha) = \frac{5}{4}$$

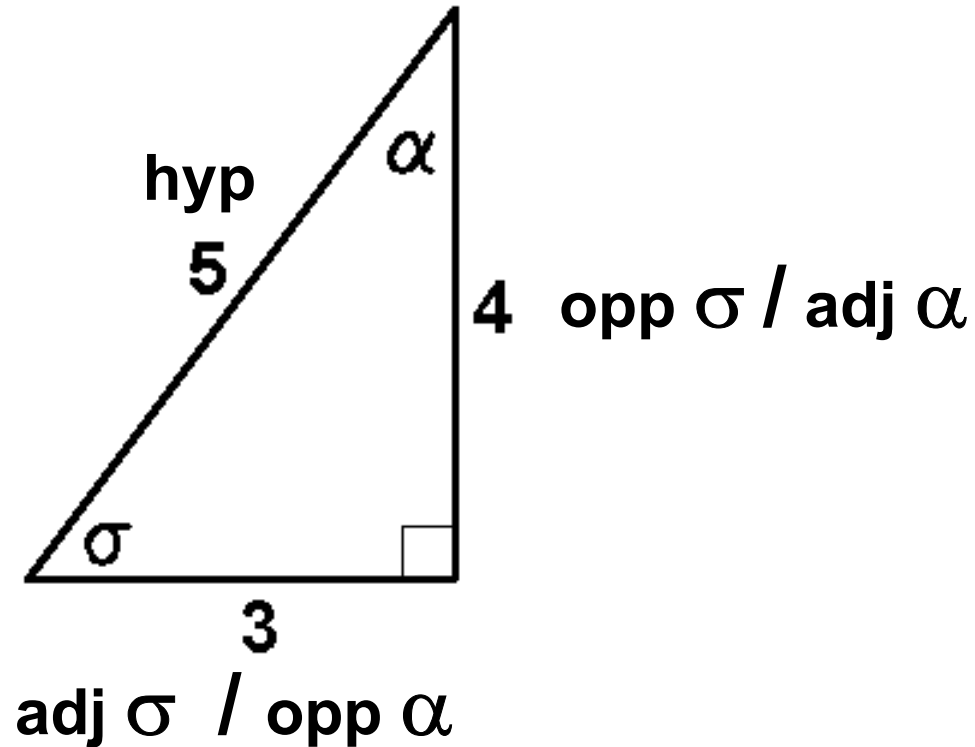
$$\tan(\alpha) = \frac{3}{4} ; \quad \cot(\alpha) = \frac{4}{3}$$

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Together the model looks as follows.



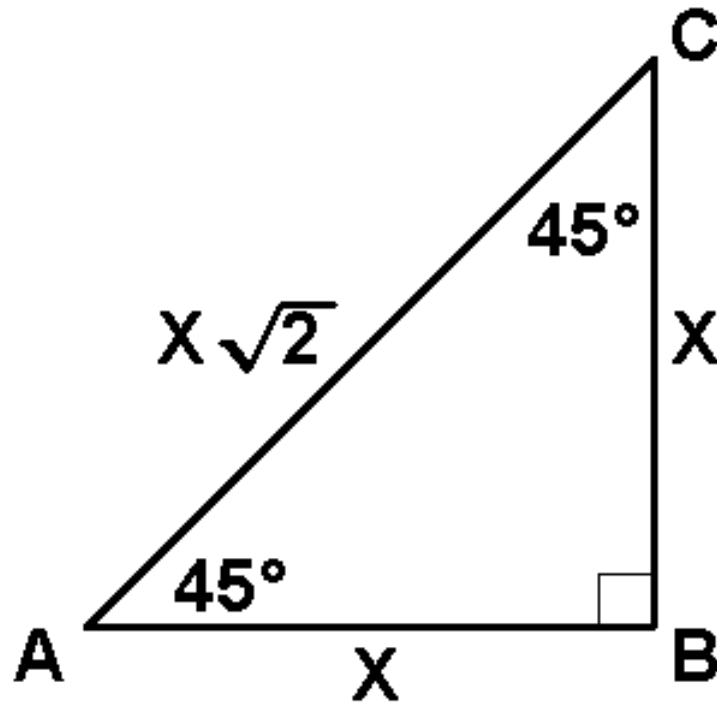
With $\sigma + \alpha = 90^\circ$

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Recall the $45^\circ - 45^\circ - 90^\circ$ Special Triangle.

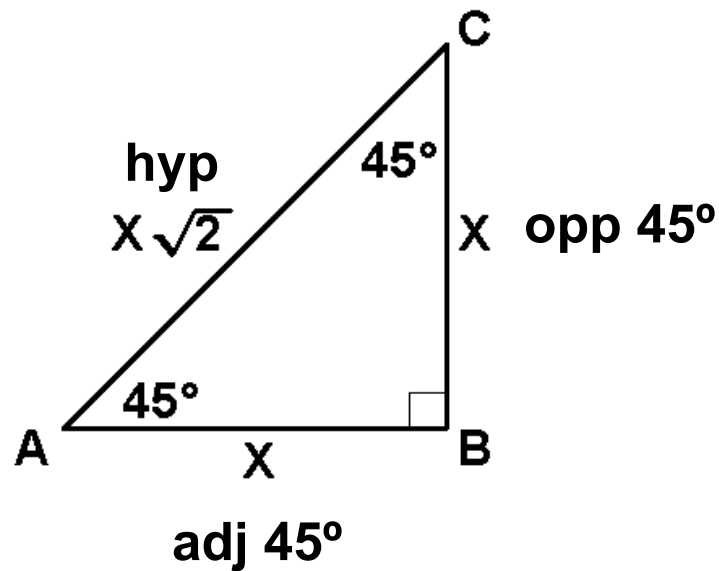


What are the six trigonometric ratios for 45° ?

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$$\sin(45^\circ) = \frac{\text{adj}}{\text{hyp}} ; = \frac{x}{x\sqrt{2}} ; = \frac{1}{\sqrt{2}} ; = \frac{\sqrt{2}}{2}$$

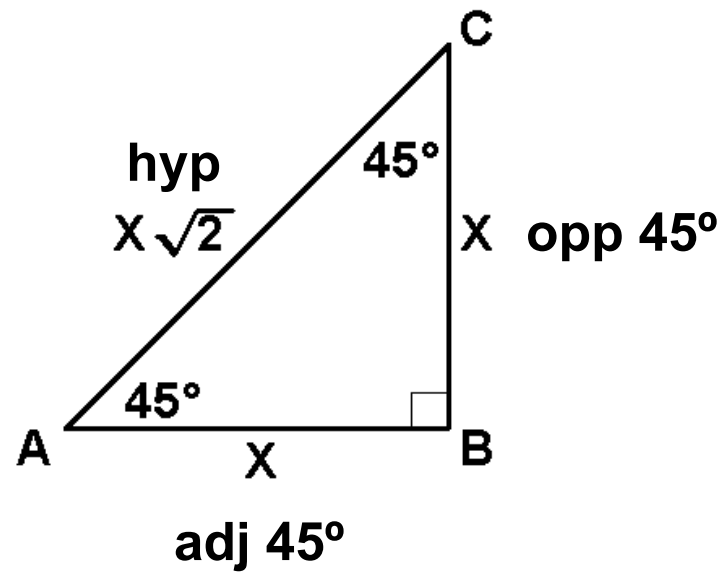
$$\cos(45^\circ) = \frac{\text{adj}}{\text{hyp}} ; = \frac{x}{x\sqrt{2}} ; = \frac{1}{\sqrt{2}} ; = \frac{\sqrt{2}}{2}$$

$$\tan(45^\circ) = \frac{\text{opp}}{\text{adj}} ; = \frac{x}{x} ; = 1$$

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$$\csc(45^\circ) = \sqrt{2}$$

$$\sec(45^\circ) = \sqrt{2}$$

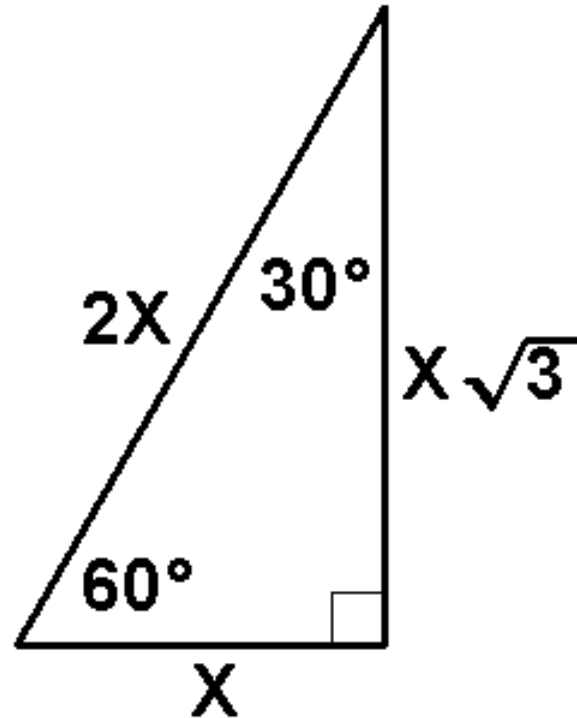
$$\cot(45^\circ) = 1$$

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Recall the $30^\circ - 60^\circ - 90^\circ$ special triangle.



What are the six trigonometric ratios for 30° ?

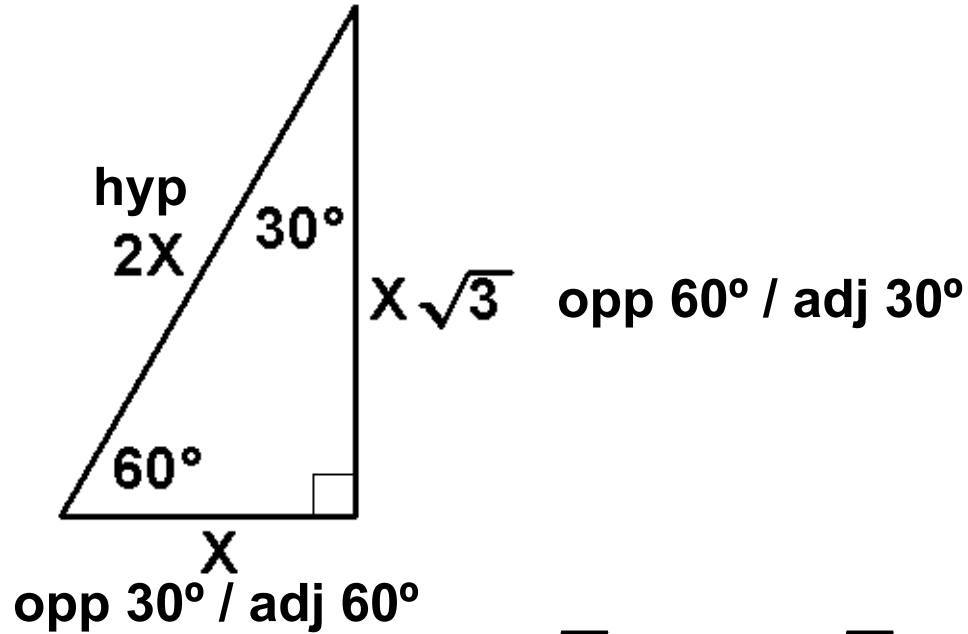
What are the six trigonometric ratios for 60° ?

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For 60°



$$\sin(60^\circ) = \frac{\text{opp}}{\text{hyp}} ; = \frac{x\sqrt{3}}{2x} ; = \frac{\sqrt{3}}{2}$$

$$\cos(60^\circ) = \frac{\text{adj}}{\text{hyp}} ; = \frac{x}{2x} ; = \frac{1}{2}$$

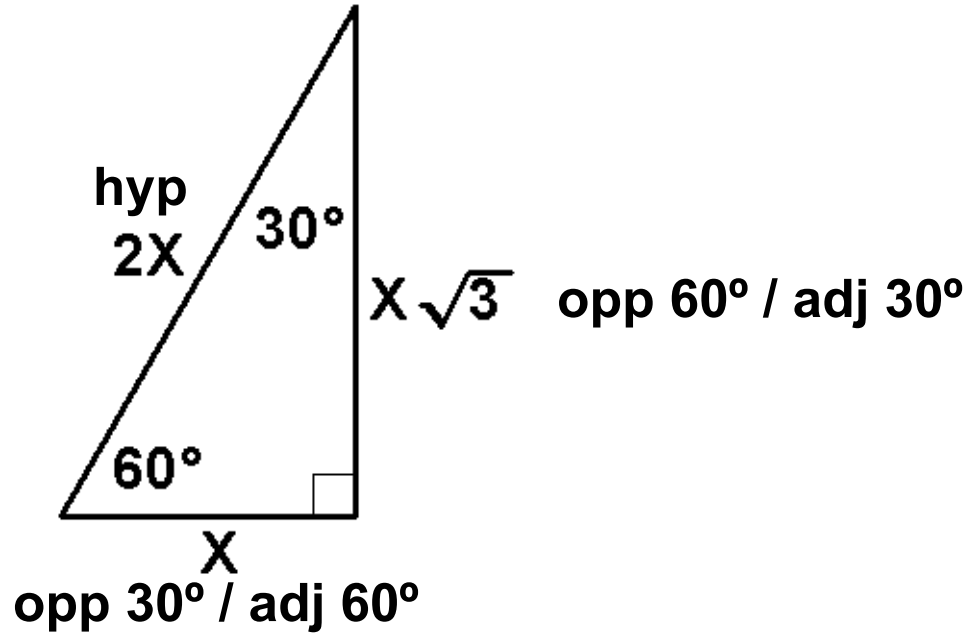
$$\tan(60^\circ) = \frac{\text{opp}}{\text{adj}} ; = \frac{x\sqrt{3}}{x} ; = \sqrt{3}$$

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Thus,



$$\csc(60^\circ) = \frac{2}{\sqrt{3}} ; = \frac{2\sqrt{3}}{3}$$

$$\sec(60^\circ) = 2$$

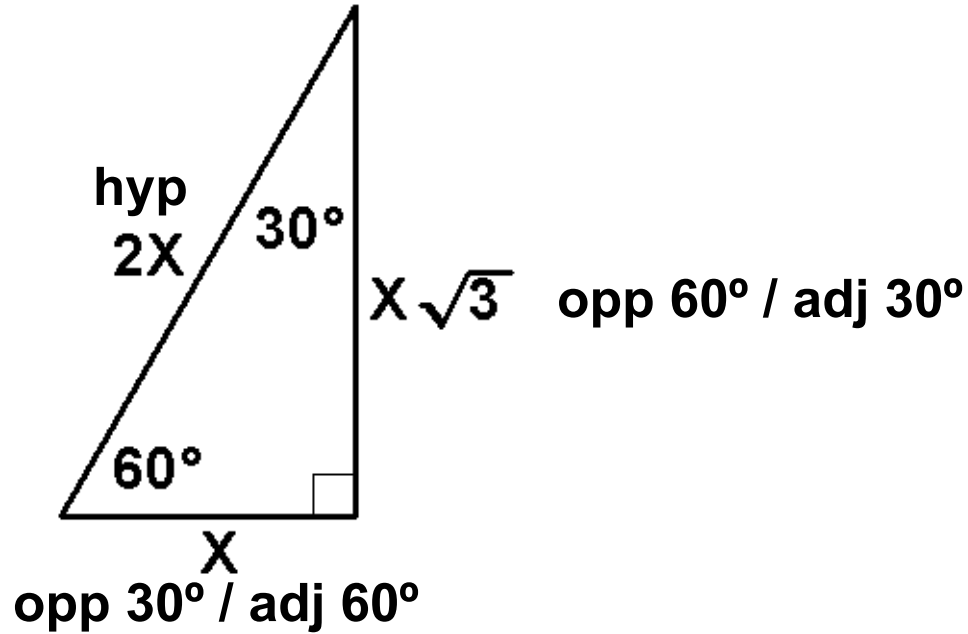
$$\cot(60^\circ) = \frac{1}{\sqrt{3}} ; = \frac{\sqrt{3}}{3}$$

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For 30°



$$\sin(30^\circ) = \frac{\text{opp}}{\text{hyp}} ; = \frac{x}{2x} ; = \frac{1}{2}$$

$$\cos(30^\circ) = \frac{\text{adj}}{\text{hyp}} ; = \frac{x\sqrt{3}}{2x} ; = \frac{\sqrt{3}}{2}$$

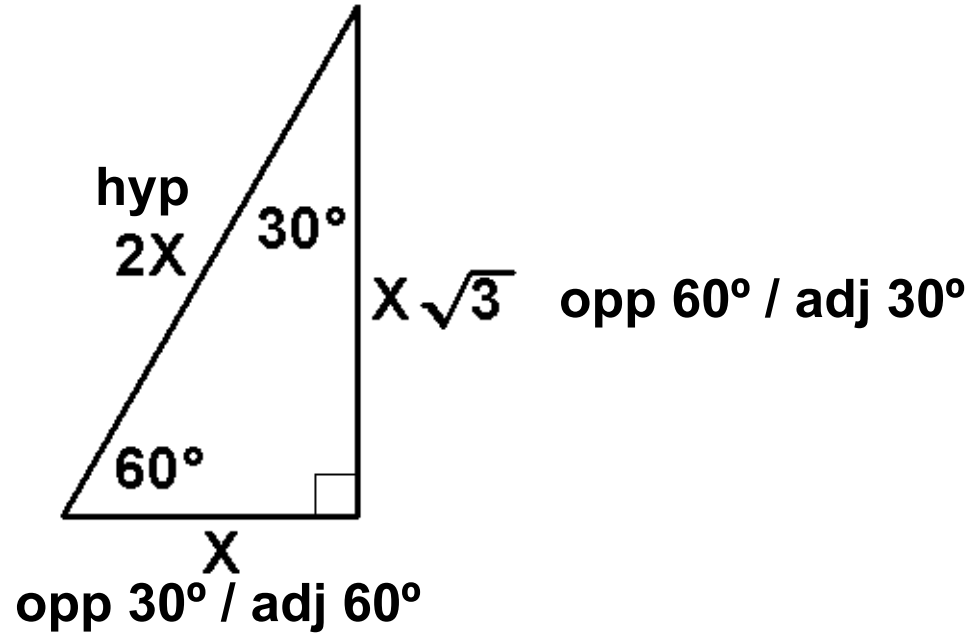
$$\tan(30^\circ) = \frac{\text{opp}}{\text{adj}} ; = \frac{x}{x\sqrt{3}} ; = \frac{1}{\sqrt{3}} ; = \frac{\sqrt{3}}{3}$$

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Thus,



$$\csc(30^\circ) = 2$$

$$\sec(30^\circ) = \frac{2}{\sqrt{3}} ; = \frac{2\sqrt{3}}{3}$$

$$\cot(30^\circ) = \frac{3}{\sqrt{3}} ; = \sqrt{3}$$

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Summary

σ	$\sin(\sigma)$	$\cos(\sigma)$	$\tan(\sigma)$
30°	$1/2$	$\sqrt{3}/2$	$\sqrt{3}/3$
45°	$\sqrt{2}/2$	$\sqrt{2}/2$	1
60°	$\sqrt{3}/2$	$1/2$	$\sqrt{3}$

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End of Right Triangle Trigonometry

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