



# Algebra1Coach.com

## Trigonometric Ratios

Unit 10 Lesson 6

# Trigonometric Ratios

## Students will be able to:

- Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
- Explain and use the relationship between the sine and cosine of complementary angles.
- Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.



# Trigonometric Ratios

## Key Vocabulary:

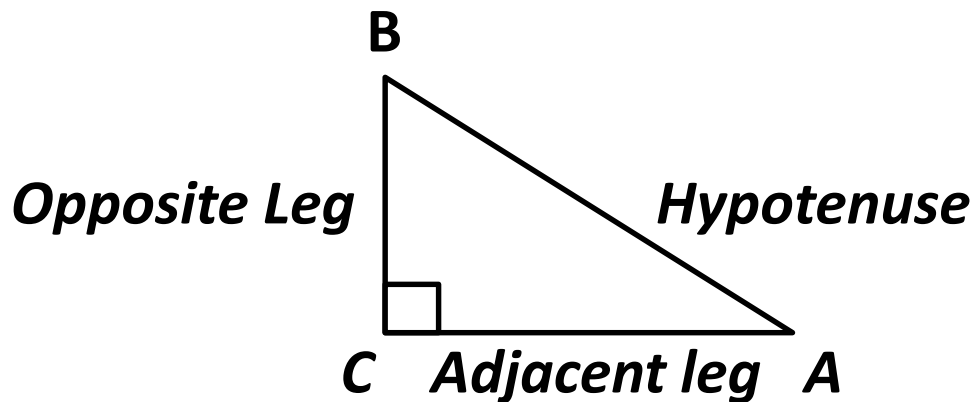
- Right triangle
- Trigonometric Ratios
  - Sine
  - Cosine
  - Tangent
- Complementary Angles



# Trigonometric Ratios

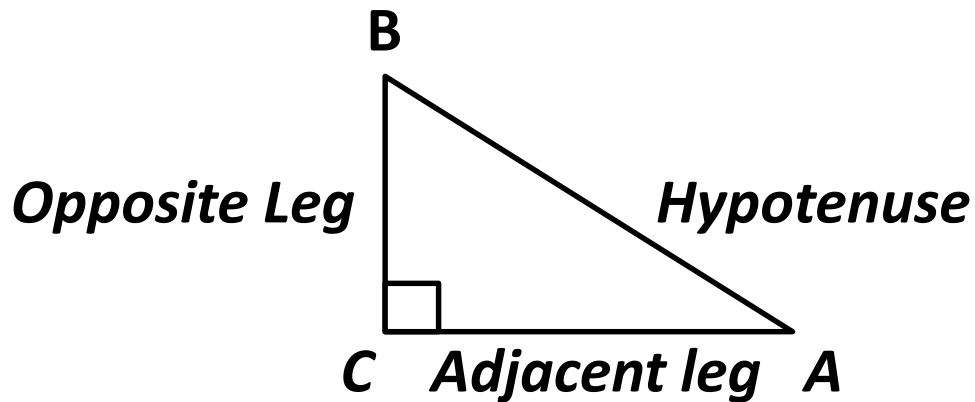
- Trigonometric Ratios are ratios of the measure of two sides of a right triangle.
  - Common trigonometric ratios are: *sine(sin)*, *cosine(cos)*, *tangent(tan)*, *cosecant(csc)*, *secant(sec)* and *cotangent(cot)*.

# Trigonometric Ratios



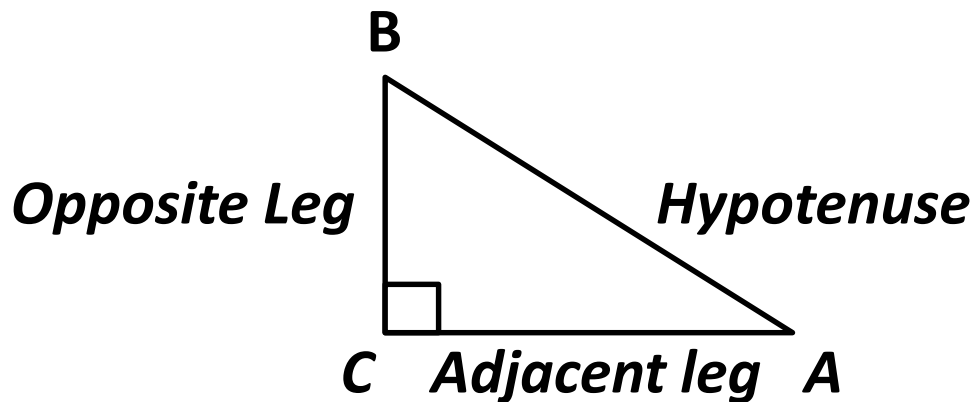
$$\sin \angle A = \frac{\text{measure of leg opposite to } \angle A}{\text{measure of hypotenuse}} = \frac{\overline{BC}}{\overline{AB}}$$

# Trigonometric Ratios



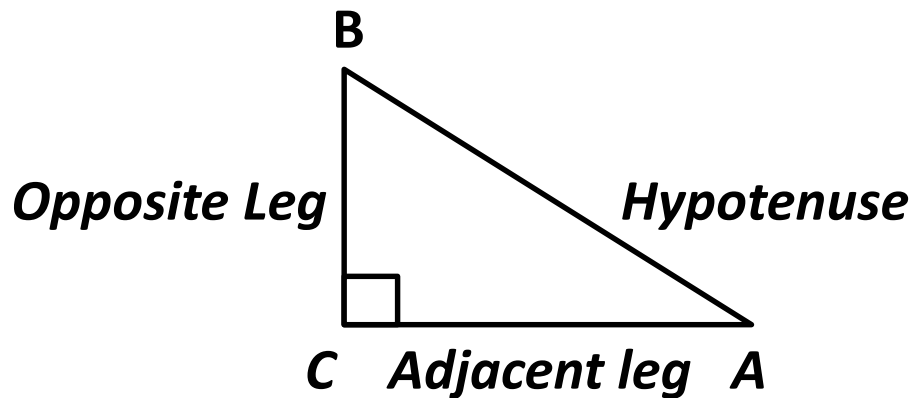
$$\cos \angle A = \frac{\text{measure of leg adjacent to } \angle A}{\text{measure of hypotenuse}} = \frac{\overline{CA}}{\overline{AB}}$$

# Trigonometric Ratios



$$\tan \angle A = \frac{\text{measure of leg opposite to } \angle A}{\text{measure of leg adjacent to } \angle A} = \frac{\overline{BC}}{\overline{CA}}$$

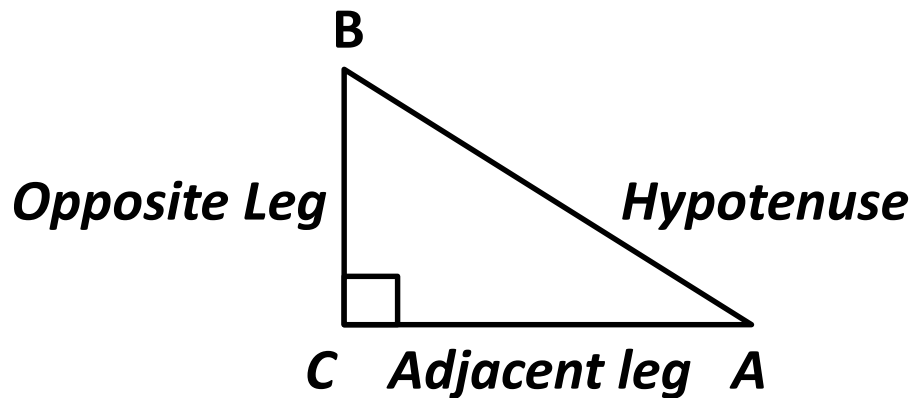
# Trigonometric Ratios



$$\csc \angle A = \frac{1}{\sin \angle A} = \frac{\text{measure of hypotenuse}}{\text{measure of leg opposite to } \angle A} = \frac{\overline{AB}}{\overline{BC}}$$

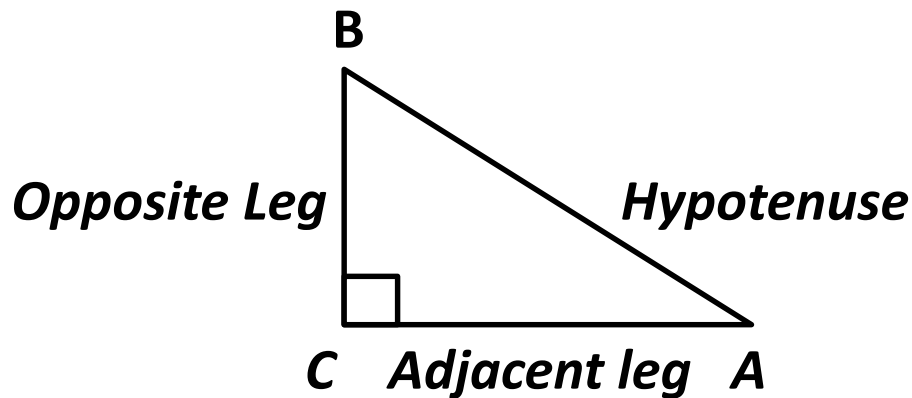


# Trigonometric Ratios



$$\sec \angle A = \frac{1}{\cos \angle A} = \frac{\text{measure of hypotenuse}}{\text{measure of leg adjacent to } \angle A} = \frac{\overline{AB}}{\overline{CA}}$$

# Trigonometric Ratios

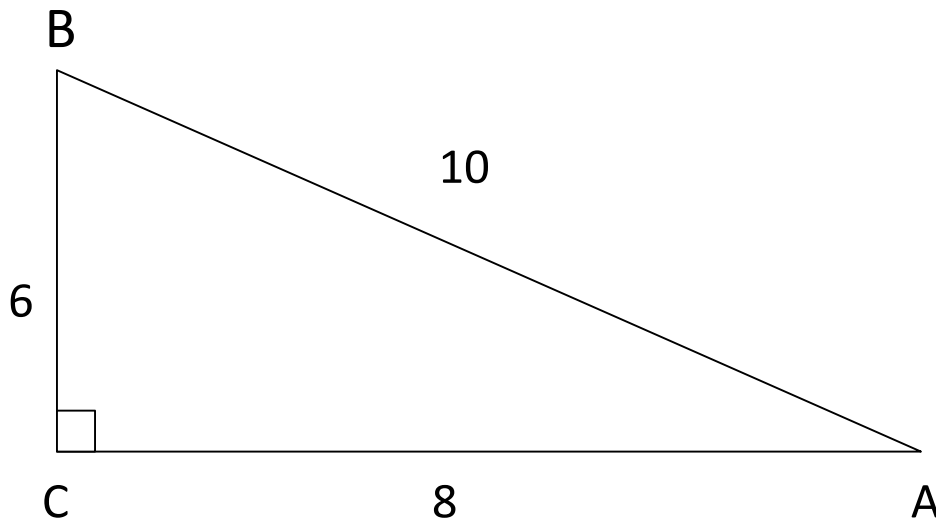


$$\cot \angle A = \frac{1}{\tan \angle A} = \frac{\text{measure of leg adjacent to } \angle A}{\text{measure of leg opposite to } \angle A} = \frac{\overline{CA}}{\overline{BC}}$$

## Trigonometric Ratios

**Sample Problem 1:** Find  $\sin$ ,  $\cos$ ,  $\tan$ ,  $\csc$ ,  $\sec$  and  $\cot$  of each acute angle of the right triangle  $ABC$ .

*a.*



## Trigonometric Ratios

**Sample Problem 1:** Find *sin*, *cos*, *tan*, *csc*, *sec* and *cot* of each acute angle of the right triangle *ABC*.

a.  $\sin \angle A = \frac{\overline{BC}}{\overline{AB}} = \frac{6}{10} = 0,6$

$$\cos \angle A = \frac{\overline{CA}}{\overline{AB}} = \frac{8}{10} = 0,8$$

$$\tan \angle A = \frac{\overline{BC}}{\overline{CA}} = \frac{6}{8} = 0,75$$

## Trigonometric Ratios

**Sample Problem 1:** Find *sin*, *cos*, *tan*, *csc*, *sec* and *cot* of each acute angle of the right triangle *ABC*.

a. 
$$\csc \angle A = \frac{1}{\sin \angle A} = \frac{1}{0,6} = 1,66$$

$$\sec \angle A = \frac{1}{\cos \angle A} = \frac{1}{0,8} = 1,25$$

$$\cot \angle A = \frac{1}{\tan \angle A} = \frac{1}{0,75} = 1,33$$

## Trigonometric Ratios

**Sample Problem 1:** Find *sin*, *cos*, *tan*, *csc*, *sec* and *cot* of each acute angle of the right triangle *ABC*.

*a.*  $\sin \angle B = \frac{\overline{CA}}{\overline{AB}} = \frac{8}{10} = 0,8$

$$\cos \angle B = \frac{\overline{BC}}{\overline{AB}} = \frac{6}{10} = 0,6$$

$$\tan \angle B = \frac{\overline{CA}}{\overline{BC}} = \frac{8}{6} = 1,33$$



## Trigonometric Ratios

**Sample Problem 1:** Find *sin*, *cos*, *tan*, *csc*, *sec* and *cot* of each acute angle of the right triangle *ABC*.

a. 
$$\csc \angle B = \frac{1}{\sin \angle B} = \frac{1}{0,8} = 1,25$$

$$\sec \angle B = \frac{1}{\cos \angle B} = \frac{1}{0,6} = 1,66$$

$$\cot \angle B = \frac{1}{\tan \angle B} = \frac{1}{1,33} = 0,75$$

## Trigonometric Ratios

**Sample Problem 2:** Use your calculator to calculate the following (correct to 2 decimal places).

***a.  $\sin 45^\circ =$***

***b.  $\cos 60^\circ =$***

***c.  $\tan 30^\circ =$***

***d.  $\sin 75^\circ =$***



## Trigonometric Ratios

**Sample Problem 2:** Use your calculator to calculate the following (correct to 2 decimal places).

***a.  $\sin 45^\circ = 0,71$***

***b.  $\cos 60^\circ = 0,50$***

***c.  $\tan 30^\circ = 0,57$***

***d.  $\sin 75^\circ = 0,96$***

## Trigonometric Ratios

**Sample Problem 3:** Use your calculator to calculate the following.

***a.  $\sin \angle B = 0,8660$***

***b.  $\cos \angle A = 0,3090$***

***c.  $\tan \angle B = 1,0000$***

***d.  $\sin \angle A = 0,7071$***



## Trigonometric Ratios

**Sample Problem 3:** Use your calculator to calculate the following.

a.  $\angle B = 60^\circ$

b.  $\angle A = 72^\circ$

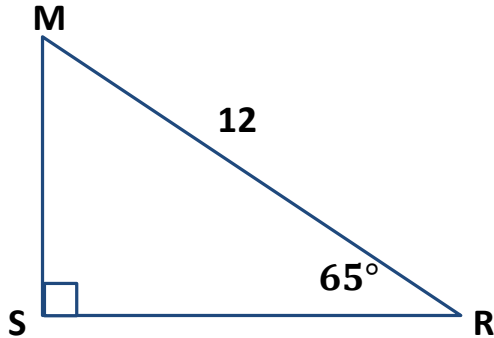
c.  $\angle B = 45^\circ$

d.  $\angle A = 45^\circ$

# Trigonometric Ratios

**Sample Problem 4:** Use trigonometric ratios and Pythagorean Theorem to find the length of missing sides and angles.

**a.**



## Trigonometric Ratios

**Sample Problem 4:** Use trigonometric ratios and Pythagorean Theorem to find the length of missing sides and angles.

$$a. \overline{MR} = 12$$

$$\angle R = 65^\circ$$

$$\overline{MS} = ?$$

$$\angle M = ?$$

$$\overline{SR} = ?$$

## Trigonometric Ratios

**Sample Problem 4:** Use trigonometric ratios and Pythagorean Theorem to find the length of missing sides and angles.

$$a. \sin \angle R = \frac{\overline{MS}}{\overline{MR}}$$

$$\sin 65^\circ = \frac{\overline{MS}}{12}$$

$$\overline{MS} = 12 * \sin 65^\circ$$

$$\overline{MS} = 12 * 0,90$$

$$\overline{MS} = 10,87$$

## Trigonometric Ratios

**Sample Problem 4:** Use trigonometric ratios and Pythagorean Theorem to find the length of missing sides and angles.

**a.**

$$\overline{MR}^2 = \overline{MS}^2 + \overline{SR}^2$$
$$\overline{SR}^2 = \overline{MR}^2 - \overline{MS}^2$$
$$\overline{SR}^2 = 12^2 - 10,87^2$$
$$\overline{SR}^2 = 144 - 118,28$$
$$\overline{SR} = 5,08$$

## Trigonometric Ratios

**Sample Problem 4:** Use trigonometric ratios and Pythagorean Theorem to find the length of missing sides and angles.

***a.***

$$\angle M = 90^\circ - 65^\circ$$

$$\angle M = 25^\circ$$

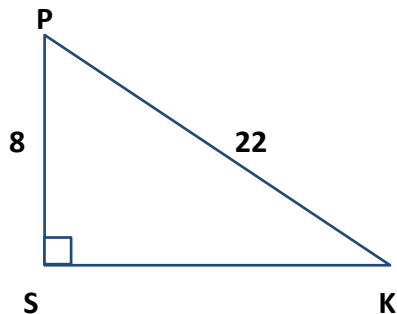




# Trigonometric Ratios

**Sample Problem 4:** Use trigonometric ratios and Pythagorean Theorem to find the length of missing sides and angles.

***b.***



# Trigonometric Ratios

**Sample Problem 4:** Use trigonometric ratios and Pythagorean Theorem to find the length of missing sides and angles.

$$b. \overline{PS} = 8 \qquad \angle P = ?$$

$$\overline{PK} = 22 \qquad \angle K = ?$$

$$\overline{SK} = ?$$

## Trigonometric Ratios

**Sample Problem 4:** Use trigonometric ratios and Pythagorean Theorem to find the length of missing sides and angles.

$$b. \quad \cos \angle P = \frac{\overline{PS}}{\overline{PK}}$$

$$\cos \angle P = \frac{8}{22}$$

$$\cos \angle P = 0,363$$

$$\angle P = 68,67^\circ$$

$$\angle K = 90^\circ - 68,67^\circ$$

$$\angle K = 21,33^\circ$$



# Trigonometric Ratios

**Sample Problem 4:** Use trigonometric ratios and Pythagorean Theorem to find the length of missing sides and angles.

*b.*  $\overline{PK}^2 = \overline{PS}^2 + \overline{SK}^2$

$$\overline{SK}^2 = \overline{PK}^2 - \overline{PS}^2$$

$$\overline{SK}^2 = 22^2 - 8^2$$

$$\overline{SK}^2 = 484 - 64$$

$$\overline{SK} = \sqrt{420}$$

$$\overline{SK} = 20,49$$

## Trigonometric Ratios

If  $\angle A$  and  $\angle B$  are the acute angles of a right triangle,  
then  **$\sin \angle A = \cos \angle B$**

Since the measures of these acute angles of a right triangle add to  $90^\circ$ , we know these acute angles are complementary.

$$\sin \angle A = \cos(90^\circ - \angle A)$$

$$\sin \angle B = \cos(90^\circ - \angle B)$$

$$\cos \angle A = \sin(90^\circ - \angle A)$$

$$\cos \angle B = \sin(90^\circ - \angle B)$$

# Trigonometric Ratios

**Sample Problem 5:** Find the value of  $\theta$  that makes each statement true.

*a.*  $\sin\theta = \cos(\theta + 46^\circ)$

## Trigonometric Ratios

**Sample Problem 5:** Find the value of  $\theta$  that makes each statement true.

a.  $\sin \theta = \cos(\theta + 46^\circ)$

$$\cos(90^\circ - \theta) = \cos(\theta + 46^\circ)$$

$$90^\circ - \theta = \theta + 46$$

$$2\theta = 44^\circ$$

$$\theta = 22^\circ$$



# Trigonometric Ratios

**Sample Problem 5:** Find the value of  $\theta$  that makes each statement true.

***b.***  $\cos\theta = \sin(\theta - 30^\circ)$



# Trigonometric Ratios

**Sample Problem 5:** Find the value of  $\theta$  that makes each statement true.

*b.*

$$\cos\theta = \sin(\theta - 30^\circ)$$

$$\sin(90^\circ - \theta) = \sin(\theta - 30^\circ)$$

$$90^\circ - \theta = \theta - 30^\circ$$

$$2\theta = 120^\circ$$

$$\theta = 60^\circ$$