Objective: Find the Six Trigonometric Ratios of an Angle

Concept

You already know the three primary trigonometric ratios: sine, cosine, and tangent. The reciprocal of each of these ratios is also an important trigonometric ratio. **The reciprocal trigonometric ratios are cosecant (csc), secant (sec) and cotangent (cot).**

For a right triangle with acute angle θ (theta), the six trigonometric ratios of θ are:

$$\sin\theta = \frac{opposite}{hypotenuse} \qquad \csc\theta = \frac{hypotenuse}{opposite}$$

$$\cos\theta = \frac{adjacent}{hypotenuse} \qquad \sec\theta = \frac{hypotenuse}{adjacent}$$

$$\tan\theta = \frac{opposite}{adjacent} \qquad \cot\theta = \frac{adjacent}{opposite}$$

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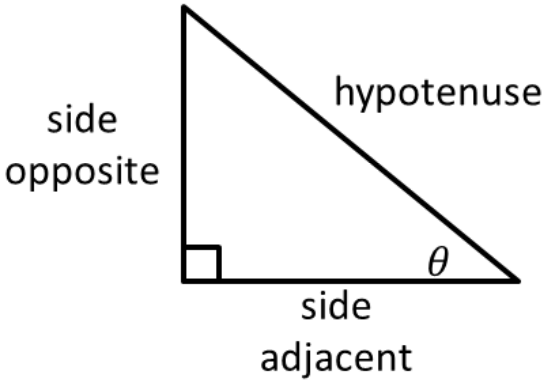

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Another way of looking at the reciprocal trigonometric ratios is:

$$\csc\theta = \frac{1}{\sin\theta} \qquad \sec\theta = \frac{1}{\cos\theta} \qquad \cot\theta = \frac{1}{\tan\theta}$$

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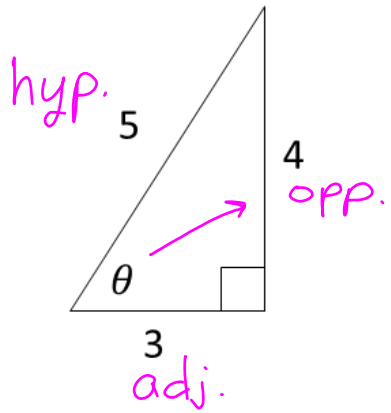
Ex) Find the six trigonometric ratios of angle θ in simplest form.

(1)



(2)

$\sin\theta = \frac{\text{opp}}{\text{hyp}} = \frac{4}{5}$ $\quad \csc\theta = \frac{5}{4}$

$\cos\theta = \frac{\text{adj.}}{\text{hyp.}} = \frac{3}{5}$ $\quad \sec\theta = \frac{5}{3}$

$\tan\theta = \frac{\text{opp.}}{\text{adj.}} = \frac{4}{3}$ $\quad \cot\theta = \frac{3}{4}$

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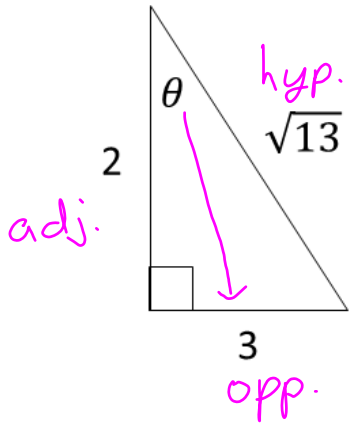
(1)



(2)

$$\sin\theta = \frac{3}{\sqrt{13}} \cdot \frac{\sqrt{13}}{\sqrt{13}} = \frac{3\sqrt{13}}{13}$$

$$\cos\theta = \frac{2}{\sqrt{13}} \cdot \frac{\sqrt{13}}{\sqrt{13}} = \frac{2\sqrt{13}}{13}$$

$$\tan\theta = \frac{3}{2}$$

$$\csc\theta = \frac{\sqrt{13}}{3}$$

$$\sec\theta = \frac{\sqrt{13}}{2}$$

$$\cot\theta = \frac{2}{3}$$

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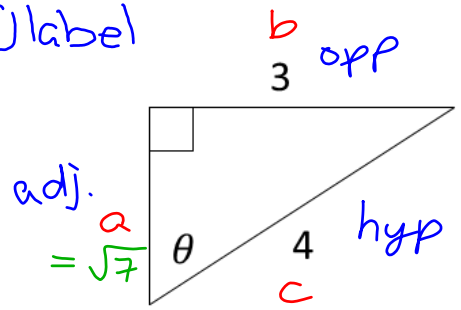
① label



② find side adj. $\angle\theta$

$a^2 + b^2 = c^2$

$a^2 + 3^2 = 4^2$

$a^2 + 9 = 16$

$a^2 = 7$

$a = \sqrt{7}$

③

$\sin\theta = \frac{3}{4}$ $\quad \csc\theta = \frac{4}{3}$

$\cos\theta = \frac{\sqrt{7}}{4}$ $\quad \sec\theta = \frac{4}{\sqrt{7}} = \frac{4\sqrt{7}}{7}$

$\tan\theta = \frac{3}{\sqrt{7}} \cdot \frac{\sqrt{7}}{\sqrt{7}} = \frac{3\sqrt{7}}{7}$ $\quad \cot\theta = \frac{\sqrt{7}}{3}$

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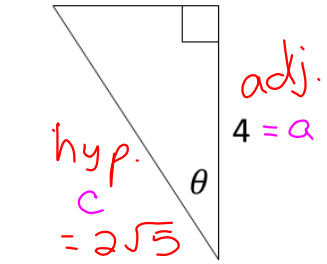

① label opp

② Find the hyp.

$a^2 + b^2 = c^2$

$4^2 + 2^2 = c^2$

$20 = c^2$

$c = \sqrt{20} = \sqrt{4}\cdot\sqrt{5} = 2\sqrt{5}$

③

$\sin\theta = \frac{2}{2\sqrt{5}} = \frac{1}{\sqrt{5}} = \frac{1}{\sqrt{5}}\cdot\frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{5}}{5}$ (reduce)

$\cos\theta = \frac{4}{2\sqrt{5}} = \frac{2}{\sqrt{5}} = \frac{2}{\sqrt{5}}\cdot\frac{\sqrt{5}}{\sqrt{5}} = \frac{2\sqrt{5}}{5}$

$\tan\theta = \frac{2}{4} = \frac{1}{2}$

$\csc\theta = \frac{\sqrt{5}}{1} = \sqrt{5}$

$\sec\theta = \frac{\sqrt{5}}{2}$

$\cot\theta = \frac{2}{1} = 2$

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Closure

Match each trigonometric ratio to its reciprocal.