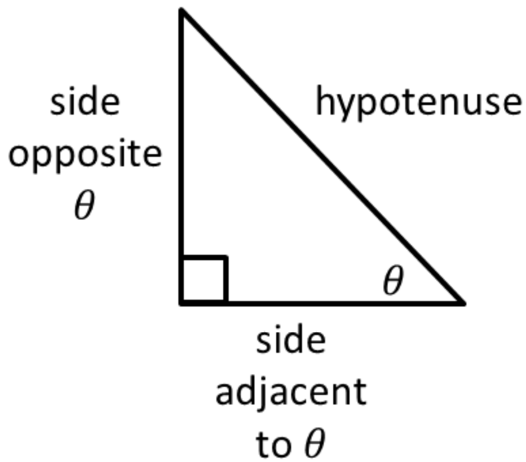
Objective: Solve polynomial equations involving sine, cosine, and tangent.

Concept

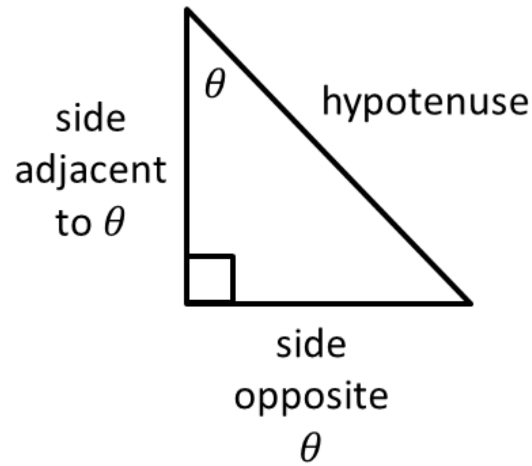
Recall: The three trigonometric functions of an angle θ **(sine, cosine, and tangent) are defined as ratios of the sides of a right triangle**.



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

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

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



SOHCAHTOA can be used as a device to help remember the definitions of sine, cosine, and tangent of an angle.

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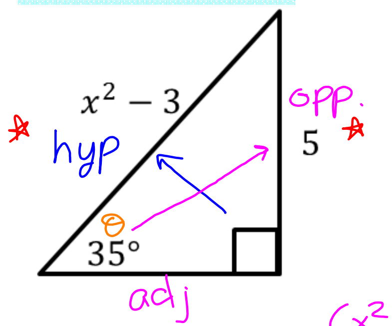
Ex) Find all real values of x that satisfy the given situation. Round to two decimal places if necessary.



$\sin\theta = \frac{opp}{hyp}$

① $\sin 35^\circ = \frac{5}{x^2-3}$

② solve

$(x^2-3)\cdot\sin 35^\circ = \frac{5}{x^2-3}\cdot(x^2-3)$

$\frac{(x^2-3)\cdot\sin 35^\circ}{\sin 35^\circ} = \frac{5}{\sin 35^\circ}$

$x^2 - 3 = \frac{5}{\sin 35^\circ}$

$+3 \qquad +3$

$x^2 = \frac{5}{\sin 35^\circ} + 3$

$\sqrt{x^2} = \pm\sqrt{\frac{5}{\sin 35^\circ} + 3}$

$x = \pm\sqrt{\left(\frac{5}{\sin(35^\circ)} + 3\right)}$

$x \approx -3.42,\ 3.42$

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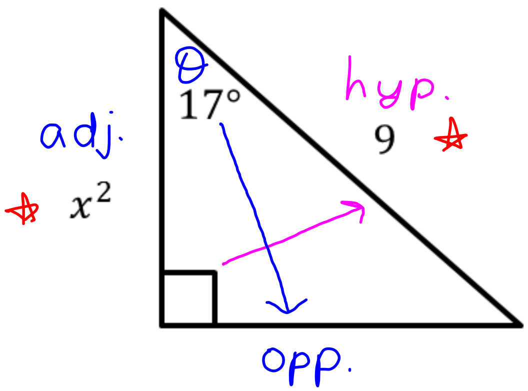


$$\star \ \cos\theta = \frac{\text{adj}}{\text{hyp}}$$

① $$\cos 17^\circ = \frac{x^2}{9}$$

② solve.

$$9 \cdot \cos 17^\circ = \frac{x^2}{9} \cdot 9$$

$$9 \cdot \cos 17^\circ = x^2$$

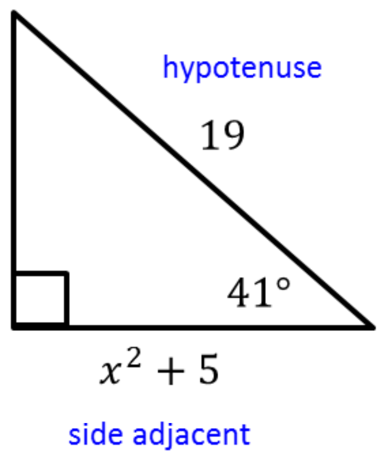
$$\pm\sqrt{9 \cdot \cos 17^\circ} = \sqrt{x^2}$$

$$x = \pm\sqrt{(9 \cdot \cos(17^\circ))}$$

$$x = -2.93,\ 2.93$$

Objective: Solve polynomial equations involving sine, cosine, and tangent.

Practice) Find all real values of x that satisfy the given situation. Round to two decimal places if necessary.



$$\cos 41^\circ = \frac{x^2+5}{19}$$

$$(19)\cdot\cos 41^\circ = \frac{x^2+5}{19}\cdot(19)$$

$$19\cdot\cos 41^\circ = x^2+5$$

$$-5 \qquad -5$$

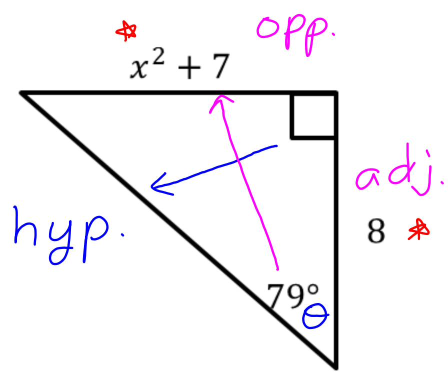
$$x^2 = 19\cdot\cos(41^\circ) - 5$$

$$x = \pm\sqrt{19\cdot\cos(41^\circ) - 5}$$

$$\boxed{x \approx -3.06,\ 3.06}$$

Objective: Solve polynomial equations involving sine, cosine, and tangent.

Ex) Find all real values of x that satisfy the given situation. Round to two decimal places if necessary.



$\star \tan\theta = \frac{opp}{adj}$

① $\tan 79^\circ = \frac{x^2+7}{8}$

② solve.

$8 \cdot \tan 79^\circ = \frac{x^2+7}{8} \cdot 8$

$8 \cdot \tan 79^\circ = x^2 + 7$

$\quad -7 \qquad\qquad -7$

$8 \cdot \tan 79^\circ - 7 = x^2$

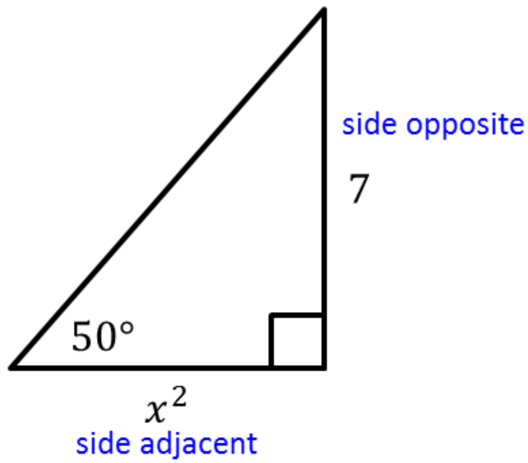
$\pm\sqrt{8 \cdot \tan 79^\circ - 7} = \sqrt{x^2}$

$x = \pm\sqrt{(8 \cdot \tan(79^\circ) - 7)}$

$x \approx -5.84, 5.84$

Objective: Solve polynomial equations involving sine, cosine, and tangent.

Practice) Find all real values of x that satisfy the given situation. Round to two decimal places if necessary.



$$\tan 50^\circ = \frac{7}{x^2}$$

$$(x^2)\cdot \tan 50^\circ = \frac{7}{x^2}\cdot(x^2)$$

$$x^2 \cdot \tan 50^\circ = 7$$

$$\frac{x^2 \cdot \tan 50^\circ}{\tan 50^\circ} = \frac{7}{\tan 50^\circ}$$

$$x^2 = \frac{7}{\tan 50^\circ}$$

$$x = \pm\sqrt{\frac{7}{\tan 50^\circ}}$$

$$\boxed{x \approx -2.42, 2.42}$$

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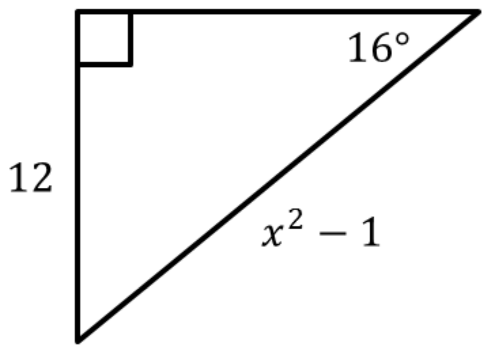
Closure

Demetri solved the problem shown. He made two errors. Explain his errors and then find the correct solution.



$$\tan 16^\circ = \frac{12}{x^2 - 1}$$

$$(12) \cdot \tan 16^\circ = \frac{12}{x^2-1} \cdot (12)$$

$$12 \cdot \tan 16^\circ = x^2 - 1$$

$$+1 \qquad +1$$

$$x^2 = 12 \cdot \tan\left(16^\circ\right) + 1$$

$$x = \pm\sqrt{12 \cdot \tan\left(16^\circ\right) + 1}$$

$$\boxed{x \approx -2.11, 2.11}$$

$$\sin 16^\circ = \frac{12}{x^2 - 1}$$

$$(x^2 - 1) \cdot \sin 16^\circ = \frac{12}{x^2 - 1} \cdot (x^2 - 1)$$

$$\left(x^2 - 1\right) \cdot \sin 16^\circ = 12$$

$$\frac{\left(x^2 - 1\right) \cdot \sin 16^\circ}{\sin 16^\circ} = \frac{12}{\sin 16^\circ}$$

$$x^2 - 1 = \frac{12}{\sin 16^\circ}$$

$$+1 \qquad +1$$

$$x^2 = \frac{12}{\sin 16^\circ} + 1$$

$$x = \pm\sqrt{\frac{12}{\sin 16^\circ} + 1}$$

$$\boxed{x \approx -6.67, 6.67}$$

Demetri's first error is he used tangent instead of sine. His second error is in the next step where he multiplied both sides by 12 instead of $x^2 - 1$. The correct solutions are about -6.67 and 6.67.