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Adv Geo –
Fri 21 March 2013

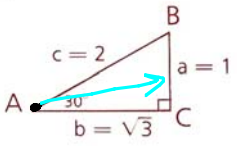
9.9: Introduction to Trigonometry

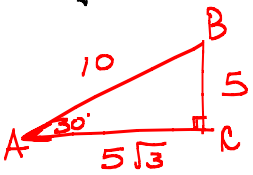
Objective

After studying this section, you will be able to

- Understand three basic trigonometric relationships

Consider the $(30^\circ, 60^\circ, 90^\circ) \Leftrightarrow (x, x\sqrt{3}, 2x)$ right triangle.





$5(1, \sqrt{3}, 2)$ ← Scalar

What is the ratio of the leg opposite 30° to the hypotenuse? $\frac{1}{2}$ $\frac{5}{10} = \frac{1}{2}$ Always

What is the ratio of the leg adjacent 30° to the hypotenuse? $\frac{\sqrt{3}}{2}$ $\frac{5\sqrt{3}}{10} = \frac{\sqrt{3}}{2}$ Always

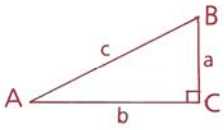
What is the ratio of the leg opposite 30° to the leg adjacent to 30°? $\frac{1}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \boxed{\frac{\sqrt{3}}{3}}$ $\frac{5}{5\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{5\sqrt{3}}{15} = \boxed{\frac{\sqrt{3}}{3}}$ Always

Will these ratios change if a scalar is applied? Why or why not?

No Scalar reduced out

The story of Chief SOH CAH TOA (video): http://www.youtube.com/watch?v=nrMEvrvVBhk

Definition **Three Trigonometric Ratios**



$$\textit{sine} \text{ of } \angle A = \sin \angle A = \frac{\text{opposite leg}}{\text{hypotenuse}}$$

$$\textit{cosine} \text{ of } \angle A = \cos \angle A = \frac{\text{adjacent leg}}{\text{hypotenuse}}$$

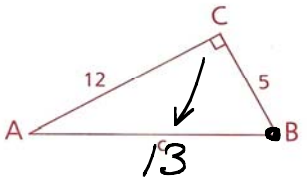
$$\textit{tangent} \text{ of } \angle A = \tan \angle A = \frac{\text{opposite leg}}{\text{adjacent leg}}$$

Mnemonics (memory devices) for
Sine (Opposite over Hypotenuse), Cosine (Adjacent over Hypotenuse), Tangent (Opposite over Adjacent):

- Some Old Horse Caught Another Horse Taking Oats Away
- Think of someone kicking a soccer ball with their toe: Soccer-Toa
- Two Old Angels Skipped Over Heaven Carrying A Harp

Maths Tutorial (video) Trigonometry SOH CAH TOA (trigonometric ratios): http://www.youtube.com/watch?v=5tp74g4N8EY
Song (video): http://www.youtube.com/watch?v=8Gkz2OzKyH4
Additional resource (website): http://www.mathwords.com/s/sohcahtoa.htm
Connection to Unit Circle (video): http://www.youtube.com/watch?v=1-hrT1Ys390

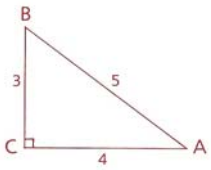
Problem 1 Find: **a** cos ∠A
b tan ∠B



$\cos\angle A = \frac{ADJ}{HYP} = \frac{12}{13}$

$\tan\angle B = \frac{OP}{AD} = \frac{12}{5}$

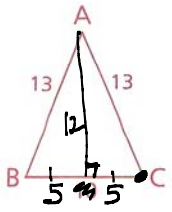
Problem 2 Find the three trigonometric ratios for ∠A and ∠B.



$\sin A = \frac{O}{H} = \frac{3}{5}$
$\cos A = \frac{A}{H} = \frac{4}{5}$
$\tan A = \frac{O}{A} = \frac{3}{4}$

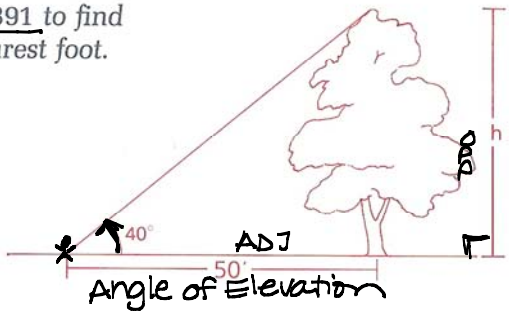
$\sin B = \frac{O}{H} = \frac{4}{5}$
$\cos B = \frac{A}{H} = \frac{3}{5}$
$\tan B = \frac{O}{A} = \frac{4}{3}$

Problem 3 △ABC is an isosceles triangle as marked. Find sin ∠C.



$\sin C = \frac{O}{H} = \frac{12}{13}$

Problem 4 Use the fact that tan 40° ≈ 0.8391 to find the height of the tree to the nearest foot.

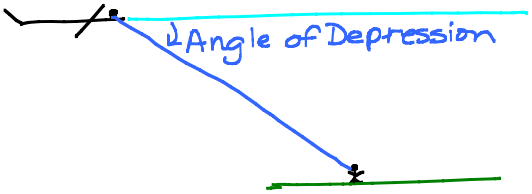


$\tan 40 = \frac{O}{A}$

$0.8391 = \frac{h}{50}$

$h = 50(.8391) = 41.955$

$h = 42$ ft



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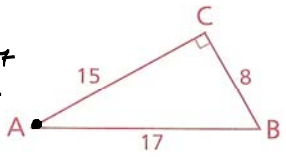
9.9 Practice: 1-16, 18

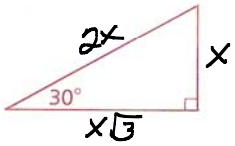
1 Find each ratio.

a $\sin \angle A = \frac{O}{H} = \frac{8}{17}$
b $\cos \angle A = \frac{A}{H} = \frac{15}{17}$
c $\tan \angle A = \frac{O}{A} = \frac{8}{15}$
d $\sin \angle B = \frac{O}{H} = \frac{15}{17}$
e $\cos \angle B = \frac{A}{H} = \frac{8}{17}$
f $\tan \angle B = \frac{O}{A} = \frac{15}{8}$



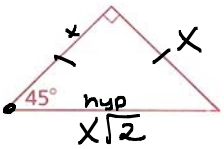
2 Find each ratio.

a $\sin 30° = \frac{O}{H} = \frac{x}{2x} = \frac{1}{2}$
b $\cos 30° = \frac{A}{H} = \frac{x\sqrt{3}}{2x} = \frac{\sqrt{3}}{2}$
c $\tan 30° = \frac{O}{A} = \frac{x}{x\sqrt{3}} = \frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3}$
d sin 60°
e cos 60°
f tan 60°



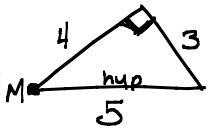
3 Find each ratio.

a $\sin 45° = \frac{O}{H} = \frac{x}{x\sqrt{2}} = \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$
b $\cos 45° = \frac{A}{H} = \frac{x}{x\sqrt{2}} = \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$
c $\tan 45°$
↳ $= \frac{O}{A} = \frac{x}{x} = 1$

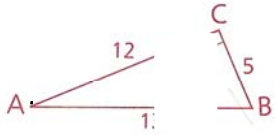


5 If $\tan \angle M = \frac{3}{4}$, find $\cos \angle M$. (Hint: Start by drawing the triangle.)

$\frac{O}{A}$ $\cos M = \frac{A}{H} = \frac{4}{5}$



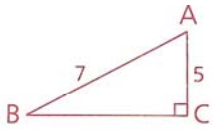
6 Using the figure as marked, name each missing angle.



a $\frac{5}{12} = \tan \angle \underline{A}$
b $\frac{12}{13} = \cos \angle \underline{A}$ ($\frac{A}{H}$)
c $\frac{5}{13} = \sin \angle \underline{?}$

7 Find each quantity.

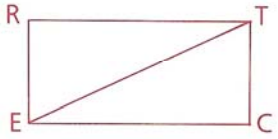
$AC^2 + BC^2 = AB^2$
$5^2 + BC^2 = 7^2$
$BC = \sqrt{49 - 25}$



a $BC = 2\sqrt{6}$
b $\sin \angle A$
c $\tan \angle B$

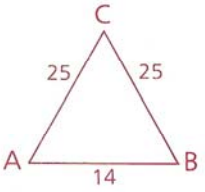
24 | 6 | 4

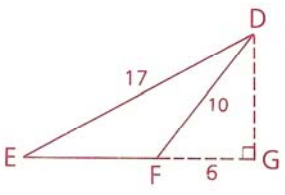
8 Given: RECT is a rectangle.
ET = 26, RT = 24
Find: **a** $\sin \angle RET$ **b** $\cos \angle RET$



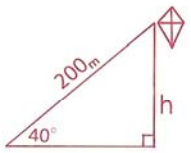
9 Using the given figures, find

a $\cos \angle A$
b $\sin \angle E$
c $\sin \angle DFG$





10 Use the fact that $\sin 40° \approx 0.6428$ to find the height of the kite to the nearest meter.

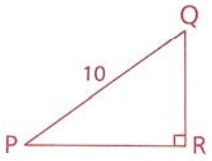


11 **a** If $\tan \angle A = 1$, find $m\angle A$.

b If $\sin \angle P = 0.5$, find $m\angle P$.

12 Given: $\sin \angle P = \frac{3}{5}$, $PQ = 10$

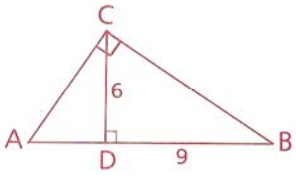
Find: $\cos \angle P$



13 Using the figure, find

a $\tan \angle ACD$

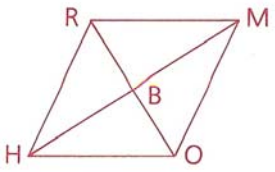
b $\sin \angle A$



14 Given: RHOM is a rhombus.

$RO = 18$, $HM = 24$

Find: **a** $\cos \angle BRM$ **b** $\tan \angle BHO$



15 Given a trapezoid with sides 5, 10, 17, and 10, find the sine of one of the acute angles.

16 Given $\triangle ABC$ with $\angle C = 90°$, indicate whether each statement is true Always (A), Sometimes (S), or Never (N).

a $\sin \angle A = \cos \angle B$ **b** $\sin \angle A = \tan \angle A$ **c** $\sin \angle A = \cos \angle A$

18 If the slope of $\overleftrightarrow{AB}$ is $\frac{5}{8}$, find the tangent of $\angle BAC$.