NAME
Ms. Kresovic
Adv Geo –
Fri 21 March 2013

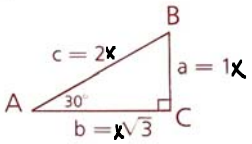
9.9: Introduction to Trigonometry

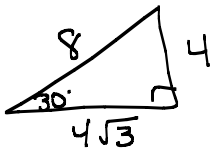
Objective

After studying this section, you will be able to

- Understand three basic trigonometric relationships

Consider the (30°, 60°, 90°) ⇔ (x, x√3, 2x) right triangle.





What is the ratio of the leg opposite 30° to the hypotenuse? $\frac{1x}{2x} = \frac{1}{2}$, $\frac{4}{8} = \frac{1}{2}$ Always

What is the ratio of the leg adjacent 30° to the hypotenuse? $\frac{x\sqrt{3}}{2x} = \frac{\sqrt{3}}{2}$, $\frac{4\sqrt{3}}{8} = \frac{\sqrt{3}}{2}$ Always

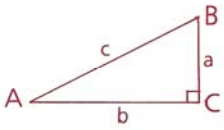
What is the ratio of the leg opposite 30° to the leg adjacent to 30°? $\frac{1}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{3}$ Always

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

No → scalar reduces/cancels

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

Definition **Three Trigonometric Ratios**



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

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

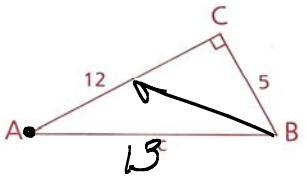
$$\textit{tangent} \text{ of } \angle A = \tan \angle A = \frac{\text{opposite leg}}{\text{adjacent leg}}$$

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** $\cos \angle A$ **b** $\tan \angle B$

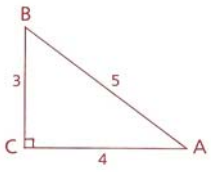


$\text{cosine } A = \frac{\text{Adj}}{\text{Hyp}}$

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

$\tan \angle B = \frac{\text{OPP}}{\text{ADJ}} = \frac{12}{5}$

Problem 2 Find the three trigonometric ratios for $\angle A$ and $\angle B$.

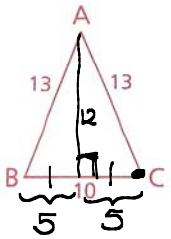


$\sin A = \frac{O}{H} = \frac{3}{5}$ $\quad \sin B = 4/5$

$\cos A = \frac{A}{H} = 4/5$ $\quad \cos B = 3/5$

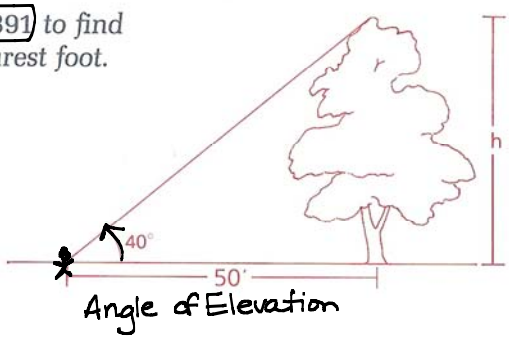
$\tan A = \frac{O}{A} = 3/4$ $\quad \tan B = 4/3$

Problem 3 $\triangle ABC$ is an isosceles triangle as marked. Find $\sin \angle C$.



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

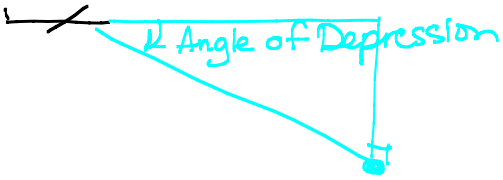
Problem 4 Use the fact that $\tan 40° \approx 0.8391$ to find the height of the tree to the nearest foot.



$\tan 40° = \frac{O}{A}$

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

$h = 41.955 \approx 42 \text{ ft}$



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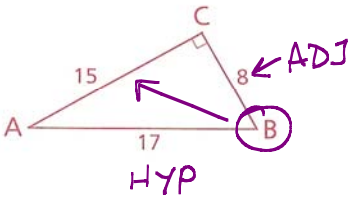
9.9 Practice: 1-16, 18

1 Find each ratio.

a $\sin \angle A = 8/17$ **d** $\sin \angle B = 15/17$

b $\cos \angle A = 8/17$ **e** $\cos \angle B = 8/17$

c $\tan \angle A = 15/8$ **f** $\tan \angle B = 15/8$

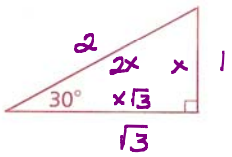


2 Find each ratio.

a $\sin 30° = 1/2$ **d** $\sin 60° = \sqrt{3}/2$

b $\cos 30° = \sqrt{3}/2$ **e** $\cos 60° = 1/2$

c $\tan 30° = \sqrt{3}/3$ **f** $\tan 60° = \sqrt{3}$

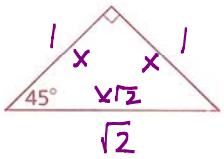


3 Find each ratio.

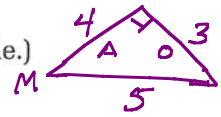
a $\sin 45° = \sqrt{2}/2$

b $\cos 45° = \sqrt{2}/2$

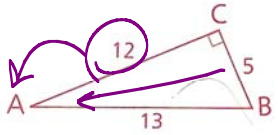
c $\tan 45° = 1$



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



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

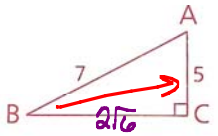


a $\frac{5}{12} = \tan \angle A$ (O/A)

b $\frac{12}{13} = \cos \angle A$ (A/H)

c $\frac{5}{13} = \sin \angle A$ (O/H)

7 Find each quantity.



$5^2 + BC^2 = 7^2$

$BC^2 = 49 - 25$

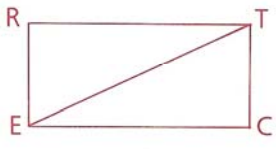
$BC^2 = 24 \Rightarrow BC = \sqrt{4 \cdot 6} = 2\sqrt{6}$

a BC $= 2\sqrt{6}$

b $\sin \angle A = \frac{O}{H} = \frac{2\sqrt{6}}{7}$

c $\tan \angle B = \frac{O}{A} = \frac{5}{2\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} = \frac{5\sqrt{6}}{12}$

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



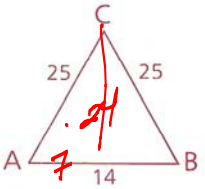
$12/13$ $5/13$

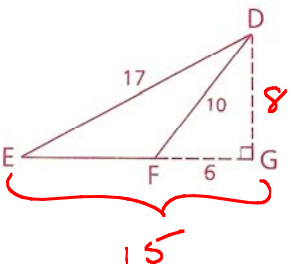
9 Using the given figures, find

a $\cos \angle A = 7/25$

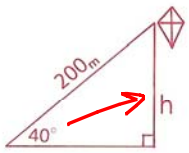
b $\sin \angle E = 8/17$

c $\sin \angle DFG = 4/5$





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



$\sin 40 = \frac{o}{H}$ $0.6428 = \frac{h}{200m}$ → 0.6428(200m) ≈ 129m

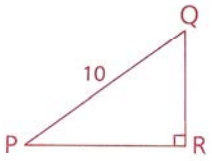
11 **a** If tan ∠A = 1, find m∠A. 45

b If sin ∠P = 0.5, find m∠P. 30

$\tan \angle A = \frac{x}{x}$

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

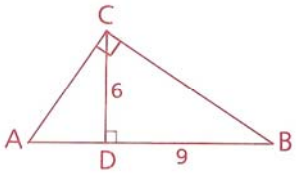
Find: cos ∠P $\frac{4}{5}$



13 Using the figure, find

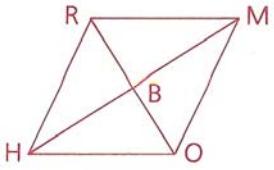
a tan ∠ACD $\frac{2}{3}$

b sin ∠A $\frac{3\sqrt{13}}{13}$



14 Given: RHOM is a rhombus.
RO = 18, HM = 24

Find: **a** cos ∠BRM $\frac{3}{5}$ **b** tan ∠BHO $\frac{3}{4}$



15 Given a trapezoid with sides 5, 10, 17, and 10, find the sine of one of the acute angles. $\frac{4}{5}$

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

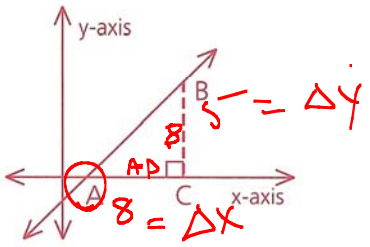
a sin ∠A = cos ∠B A

b sin ∠A = tan ∠A N

c sin ∠A = cos ∠A if 45° S

$\frac{o}{H} = \frac{o}{A}$ $H \neq A$

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



$5 = \Delta y$ $8 = \Delta x$