

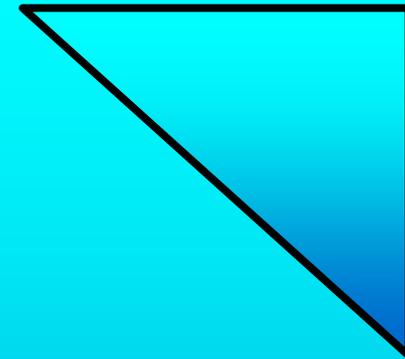
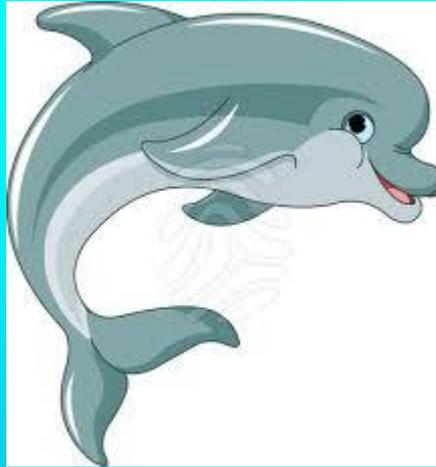
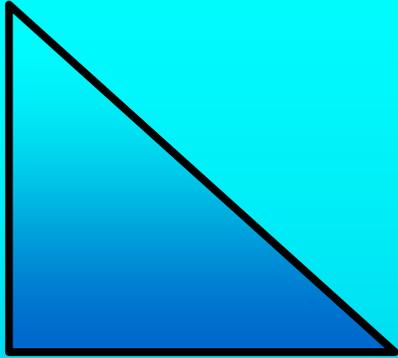
Basics of Trigonometry

by Elise Merritt



Hi, I'm Dolly the Dolphin.
I'm here to teach you trigonometry!

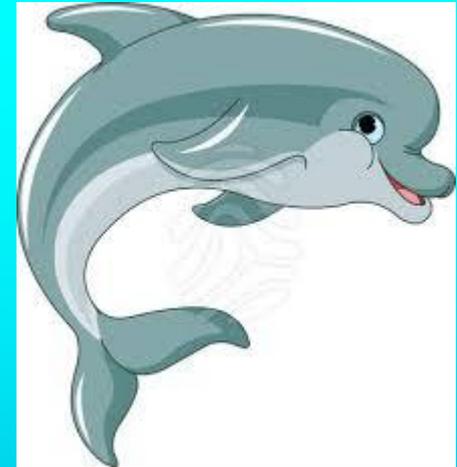
First of all, what is trigonometry?



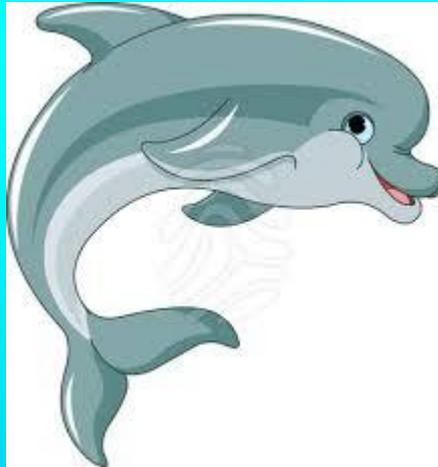
Trigonometry is the study of triangles and their measurements (like side length, area, etc.)

Specifically, we'll be discussing the measurements of right triangles.

Now that we know what trigonometry is, let's start learning some of these measurements!



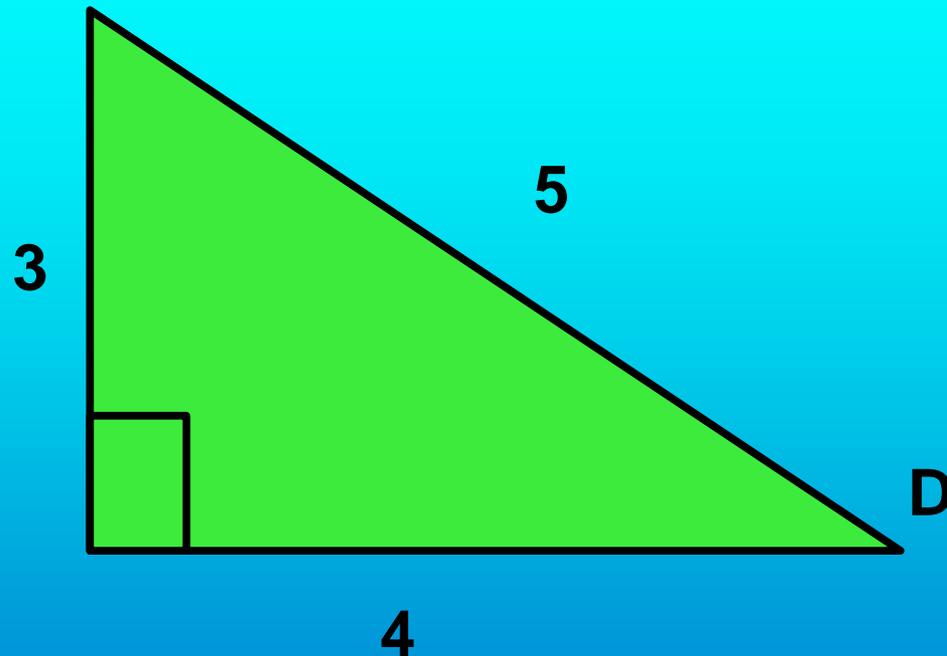
Every angle of a right triangle has six measurements called trigonometric functions.



The first of these trigonometric functions is **sine**, which is abbreviated sin.

It is the length of the side an angle of a right triangle is facing (the sign opposite it), divided by the length of the triangle's longest side (also called the hypotenuse).

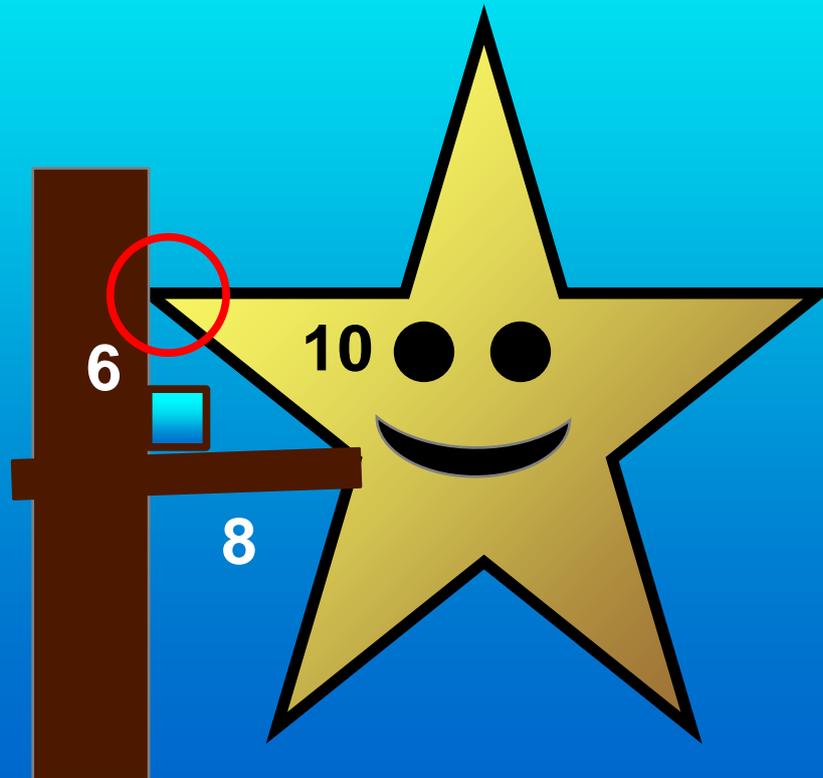
So, the sin of angle D (for Dolphin!) of the triangle below would be . . .



$$\sin D = 3 \text{ (side across from D)} \div 5 \text{ (longest side)}$$
$$= \frac{3}{5}$$

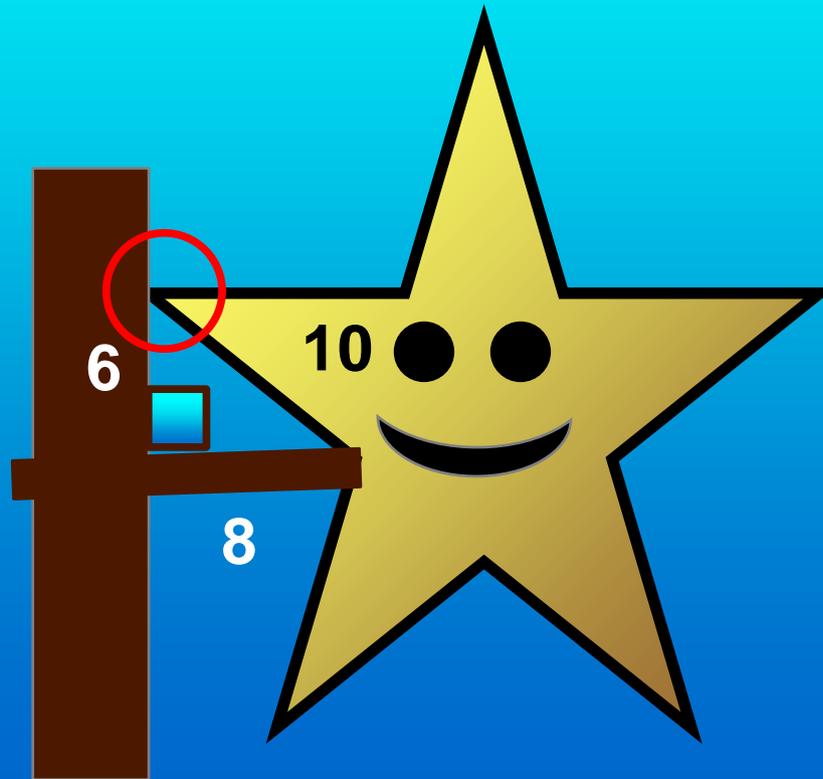
Now it's your turn!

Mr. Starfish is leaning against a piece of driftwood. What is the sin of the angle between his arm and the upright piece of driftwood? (The angle is circled in red)?



Now let's see if you're right!

$\sin x = 8 \div 10 = 4/5$ (x is what we're calling the angle)

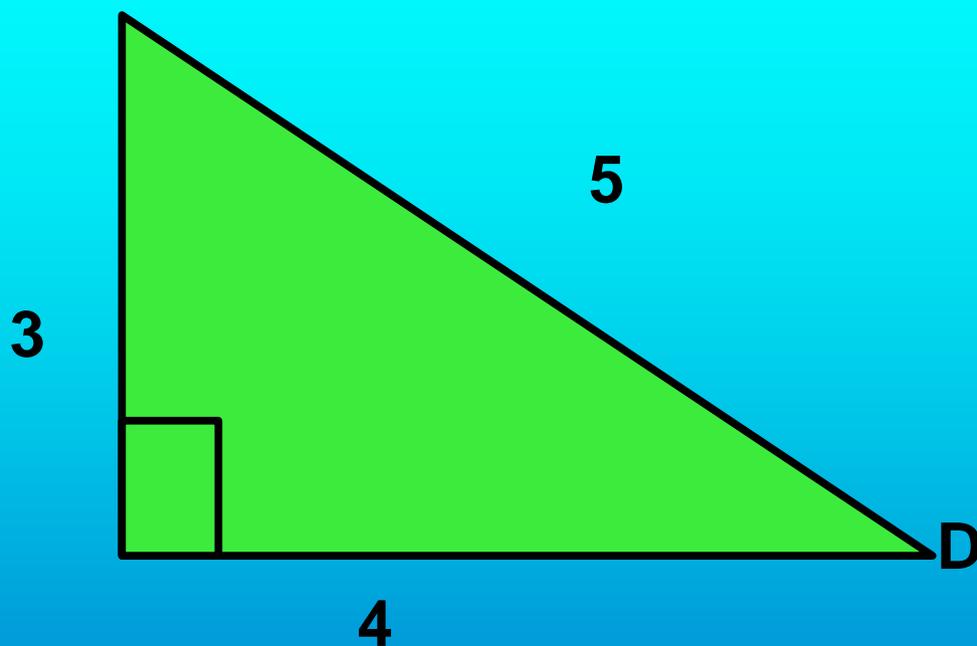




The next trigonometric function is **cosine**, abbreviated cos.

It is the length of the side next to or adjacent to an angle of a right triangle (not the hypotenuse) divided by the hypotenuse's length.

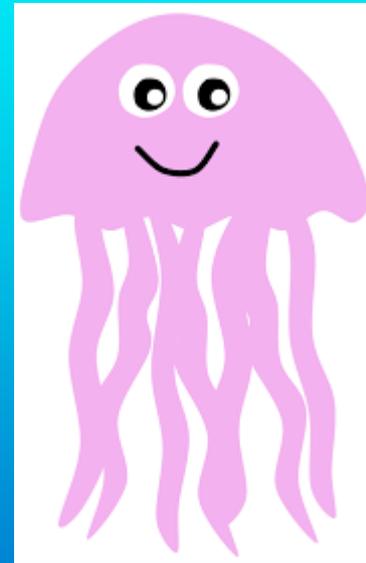
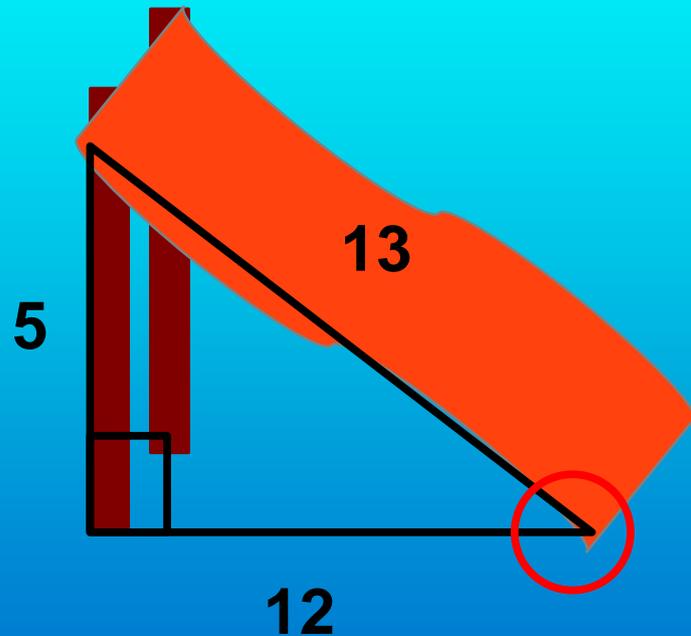
So the cosine of angle D would be . . .



$$\text{Cos}D = 4 \div 5 = 4/5$$

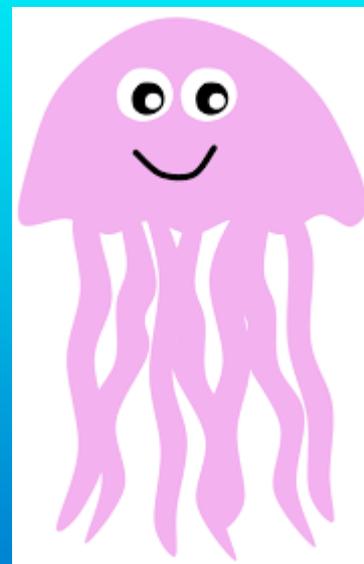
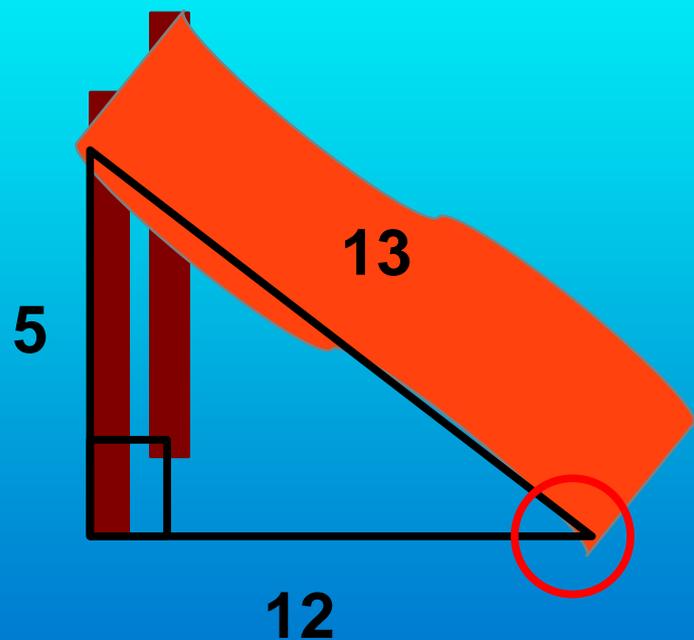
Jello the Jellyfish's favorite slide is shown.

What is the cosine of the angle the slide makes with the ground (marked with a red circle)?



And the answer is . . .

$$\text{Cos}x = 12 \div 13 = 12/13$$

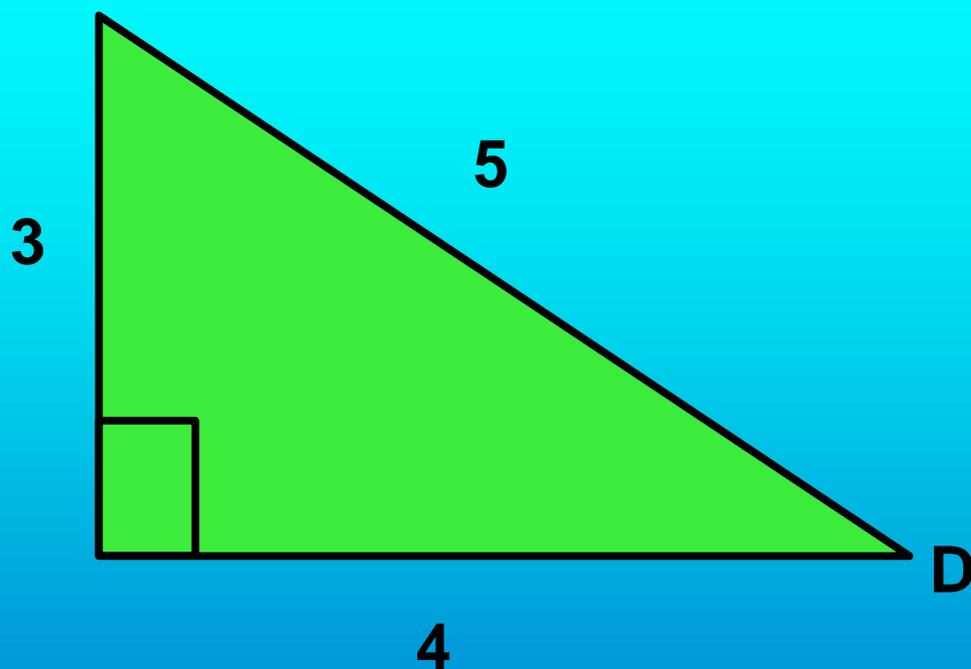


The third trigonometric function is **tangent**, abbreviated tan.



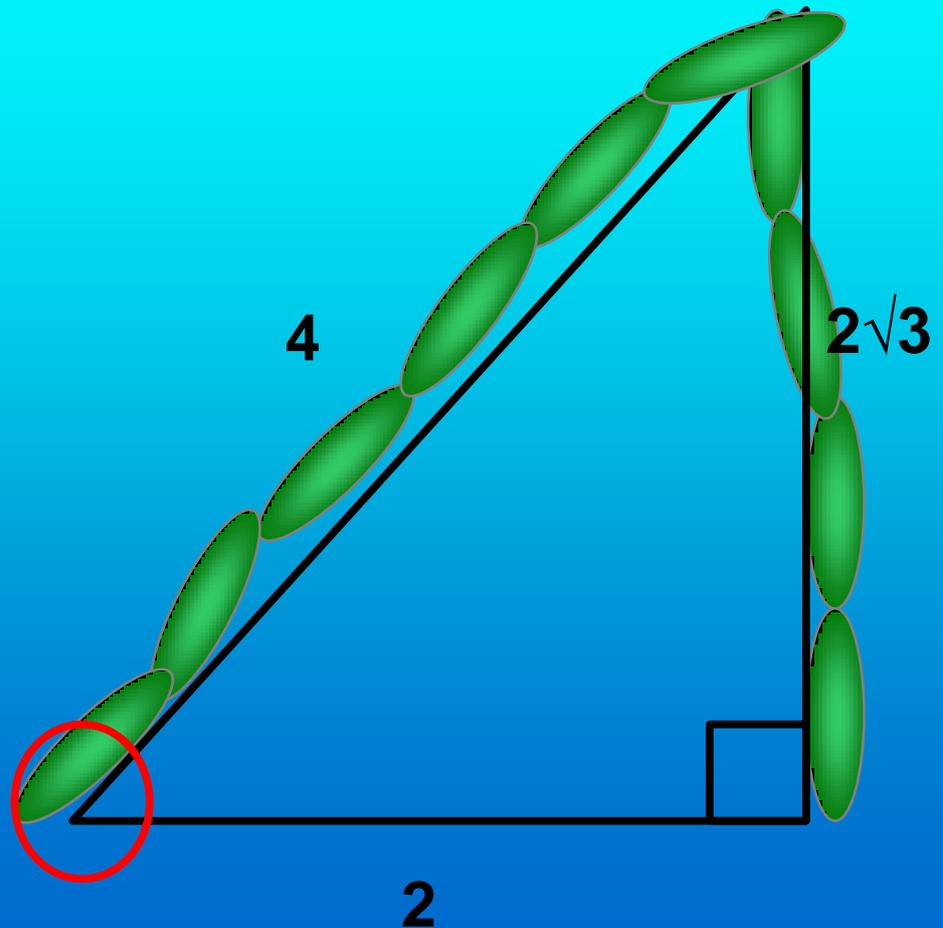
It is the length of the side across from the angle divided by the length of the side next to the angle (neither side lengths are the hypotenuse).

For example, the tangent of angle D would be:



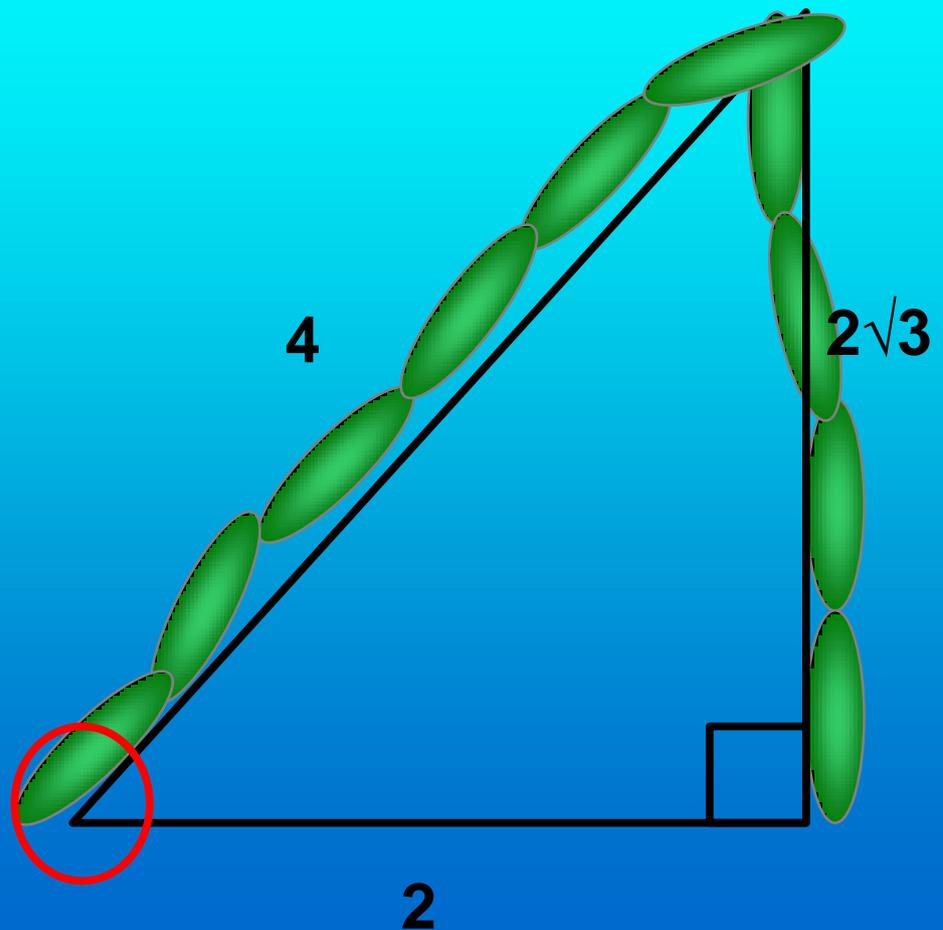
$$\text{TanD} = 3 \div 4 = 3/4$$

My friends and I were exploring and noticed these two pieces of seaweed formed a right triangle. What is the tangent of the angle circled in red?



And the answer is . . .

$$\tan x = 2\sqrt{3} \div 2 = \sqrt{3}$$



One way to remember those three trigonometric functions is by using “SOH CAH TOA”



Sin

Tan

Opposite

Opposite

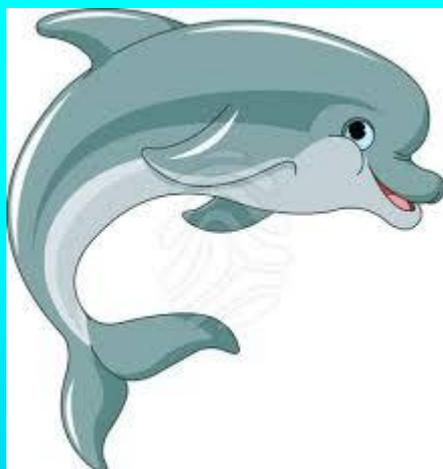
Hypotenuse

Adjacent

Cos

Adjacent

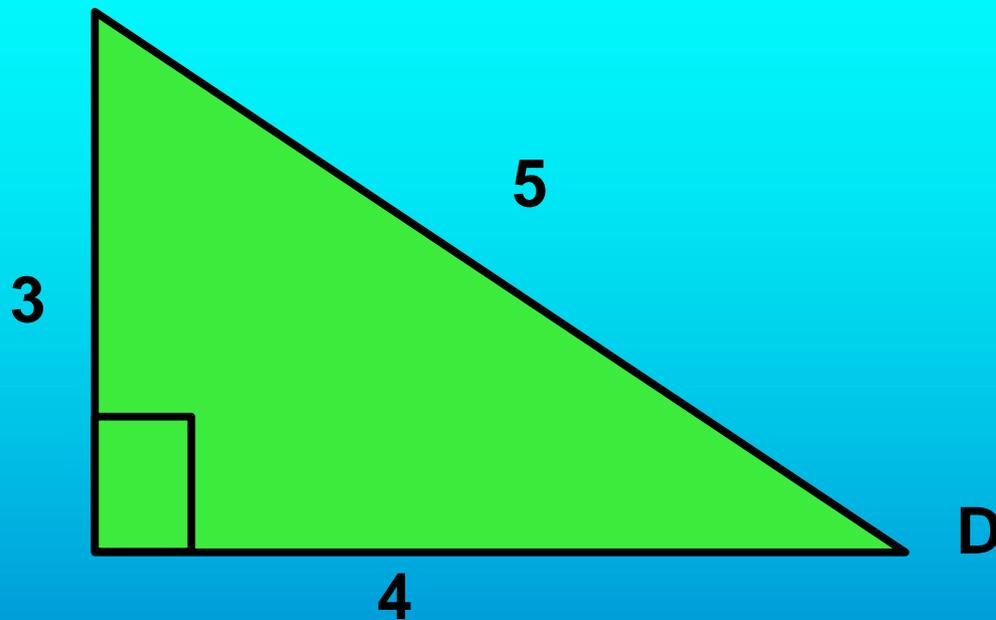
Hypotenuse



The next trigonometric function is **cosecant**, abbreviated csc.

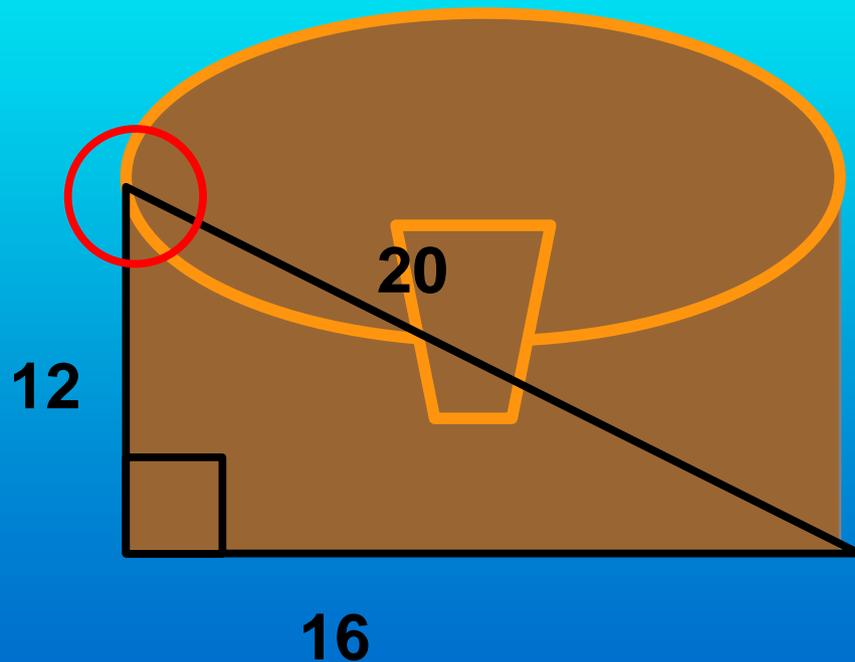
The csc of an angle is the length of the hypotenuse divided by the length of the side across from the angle (Notice it is the reciprocal of sin).

The cosecant of angle D would be . . .



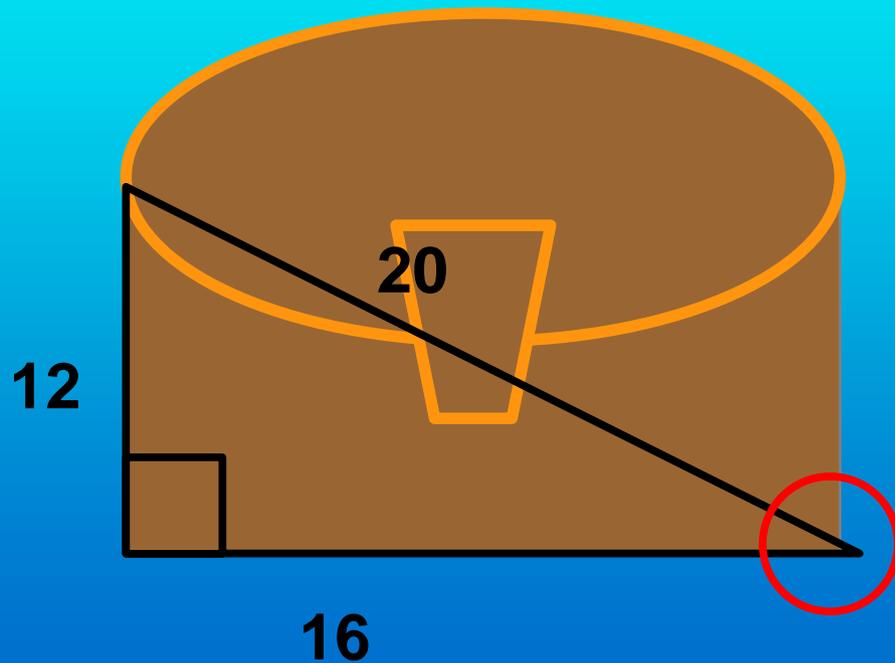
$$\text{Csc}D = 5 \div 3 = 5/3$$

Tut the turtle found a treasure chest while out swimming! What is the cosecant of the angle on the chest shown?



And the answer is . . .

$$\csc x = 20 \div 12 = 5/3$$

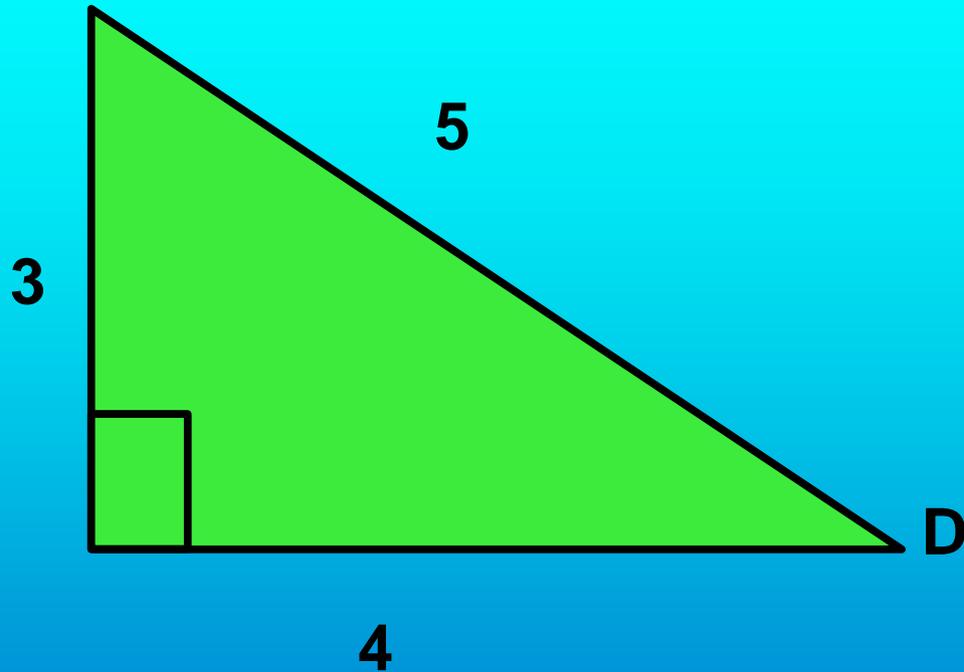




The next trigonometric function is the **secant**.

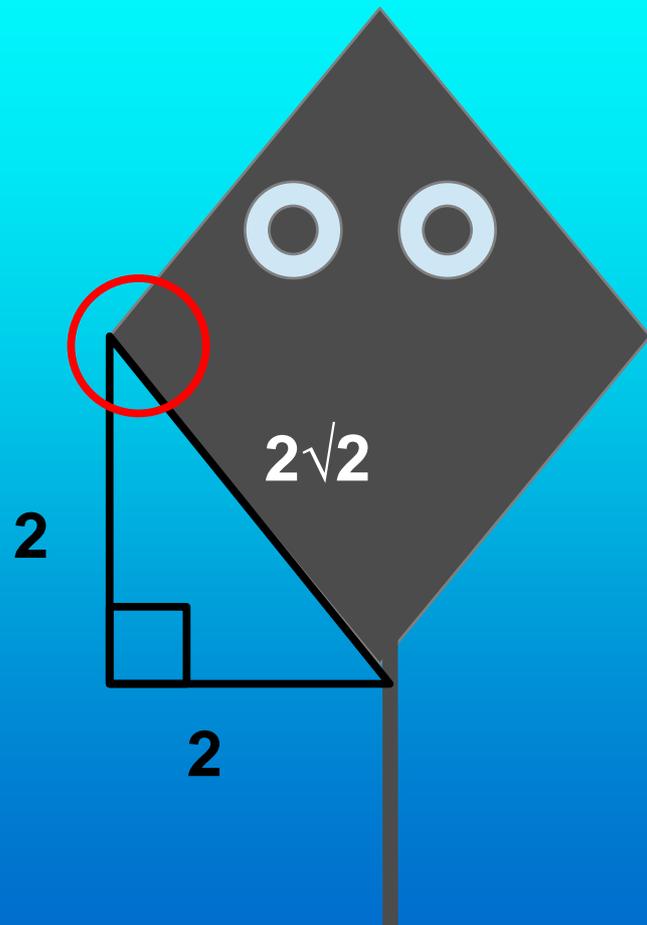
The secant, abbreviated sec, of an angle is the length of the hypotenuse divided by the length of the side next to the angle. It is the reciprocal of cos.

The secant of angle D is . . .



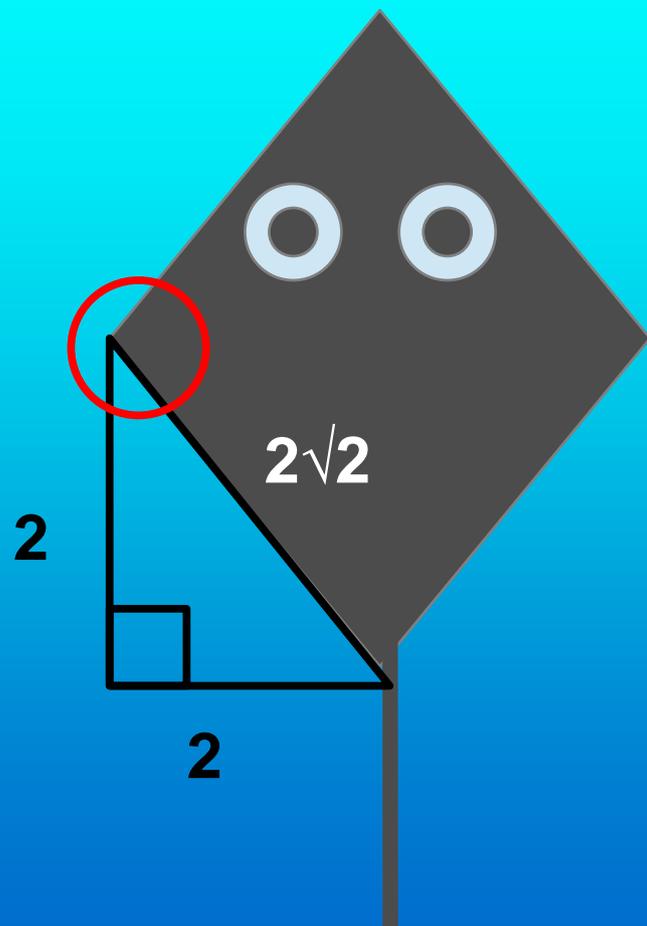
$$\text{Sec}D = 5 \div 4 = \frac{5}{4}$$

This is Stu the stingray. What is the secant of the angle on his fin in the red circle?



The secant is . . .

$$\text{Sec}x = 2\sqrt{2} \div 2 = \sqrt{2}$$

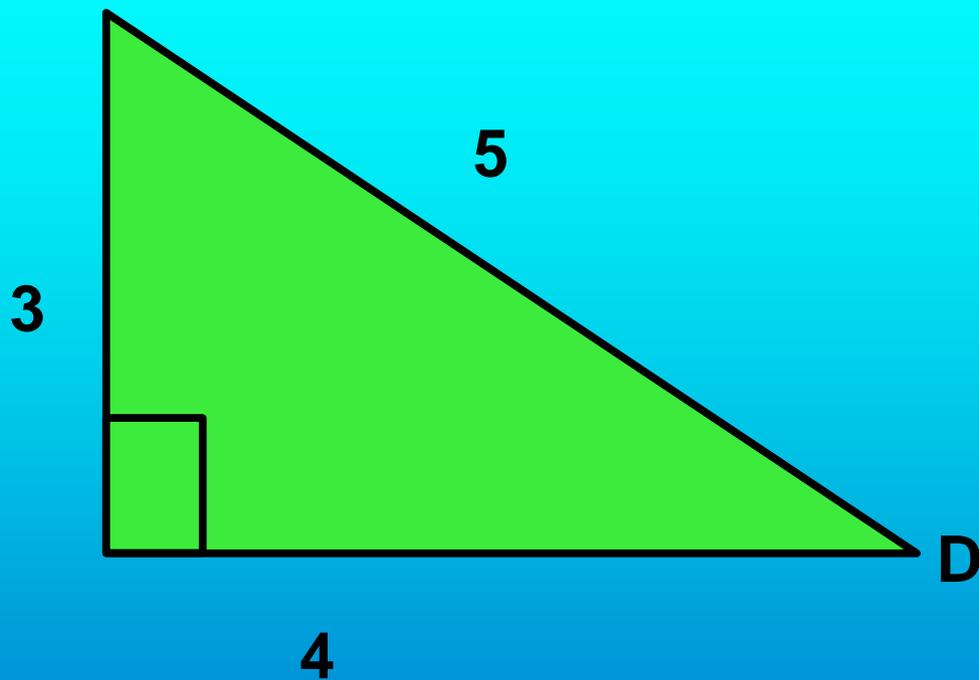


The last trigonometric function is the **cotangent**.



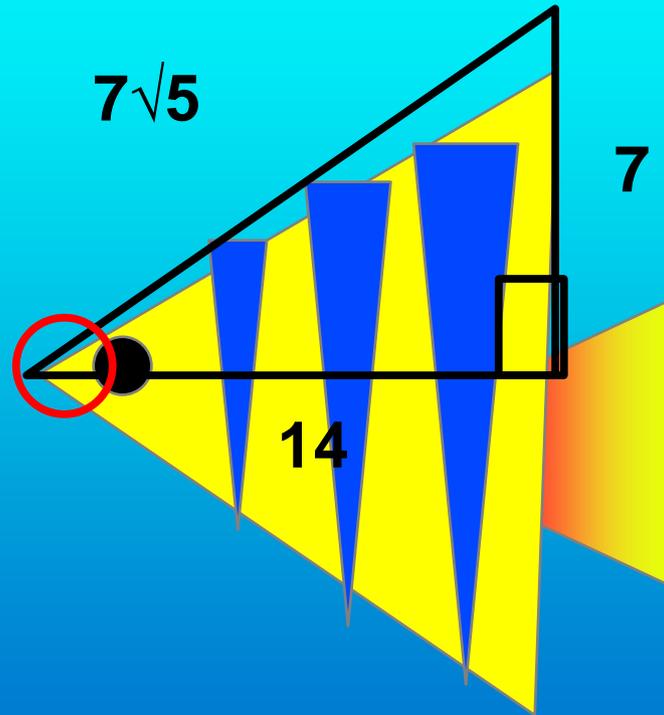
The cotangent of an angle is the length of the side next to the angle divided by the length of the side across from the angle. It is the reciprocal of tangent.

The cotangent of angle D is . . .



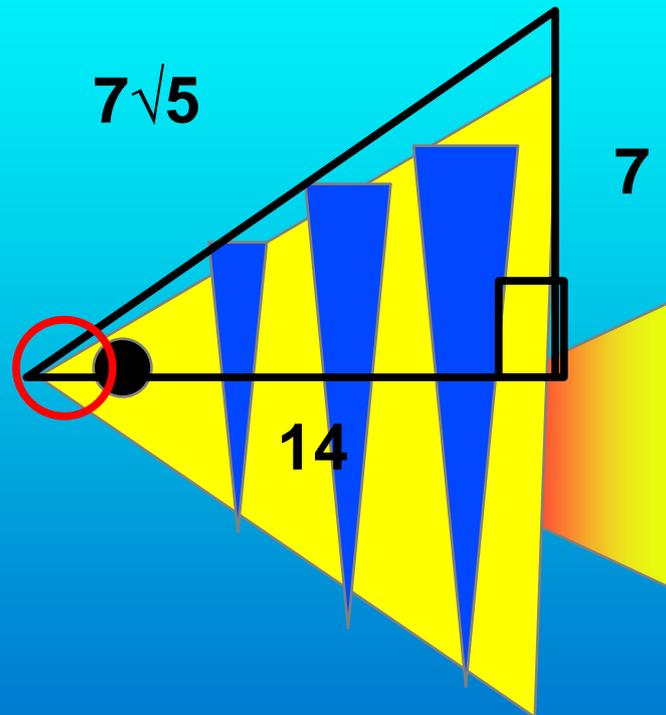
$$\text{Cot}D = 4 \div 3 = 4/3$$

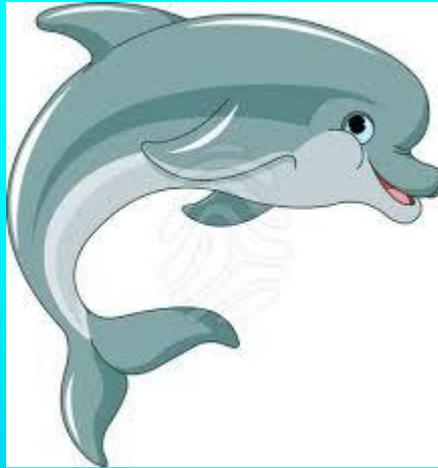
A school of fish were out swimming yesterday.
What is the cotangent of the angle circled in red
on the one shown?



The answer is . . .

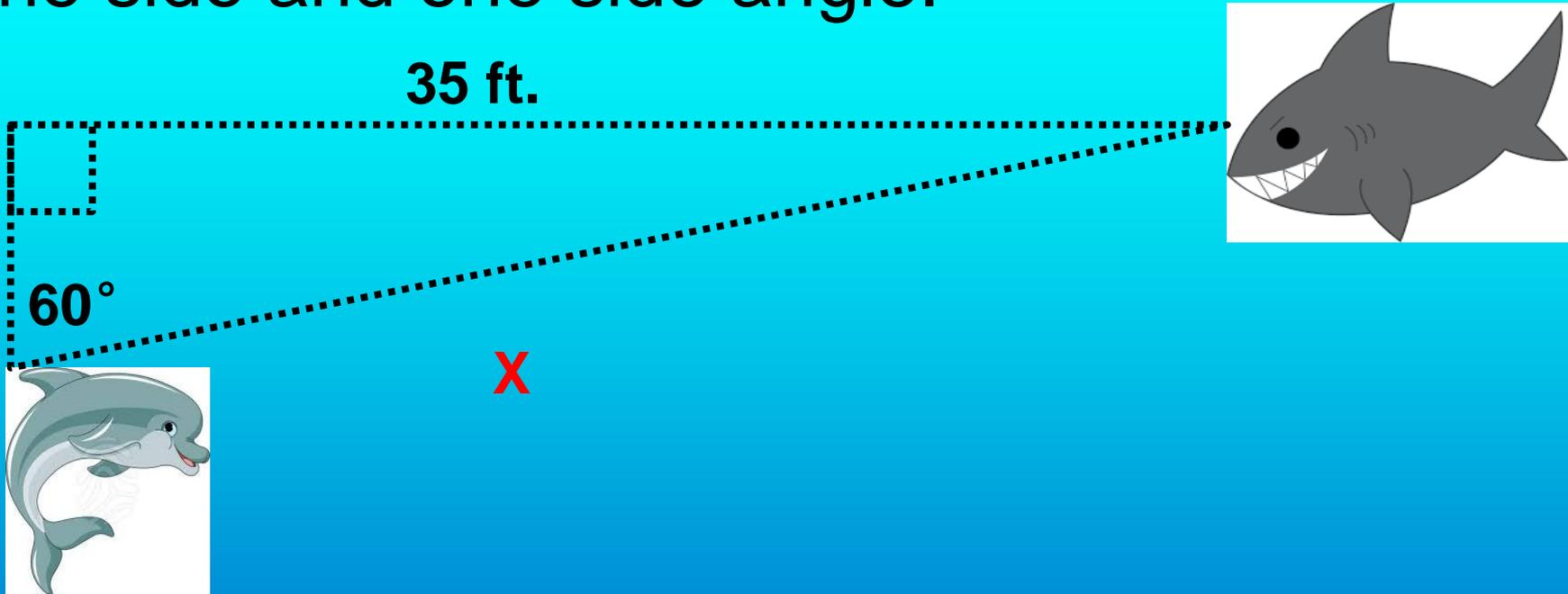
$$\text{Cot}x = 14 \div 7 = 2$$





These six trigonometric functions can be used to find the value of different lengths and angles on right triangles.

For example, I can use sin to find out how far away a shark is from me, if I know the length of one side and one side angle.



$$\sin 60 = 35/X \Rightarrow (X)(\sin 60) = 35$$

$X = 35 / \sin 60 \approx 40.41$ ft. away (calculator used to find approximate value)

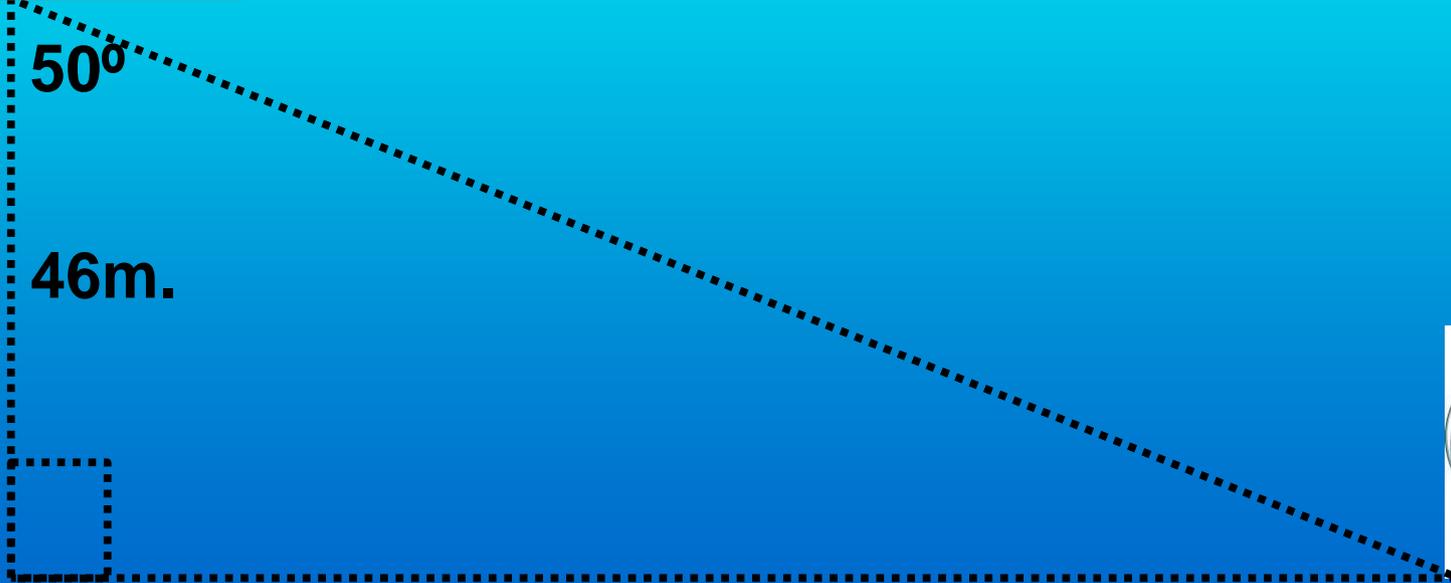
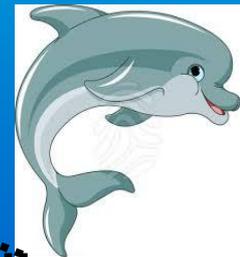
Now it's your turn!

How far do I have to swim to reach the treasure chest?



50°

46m.



Let's see if you're right!

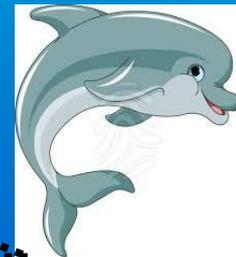
$$\cos 50 = 46/X \Rightarrow (X)(\cos 50) = 46$$

$$X = 46 / \cos 50 \approx 71.56 \text{ m. away}$$

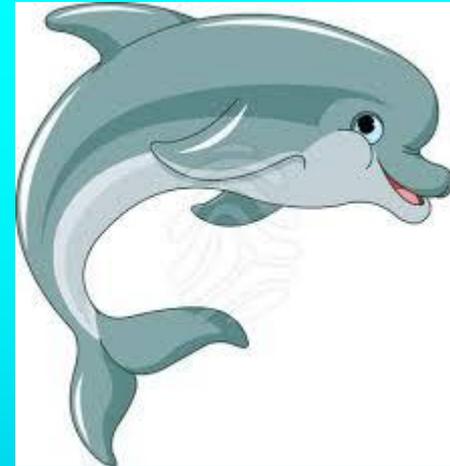


50°

46m.

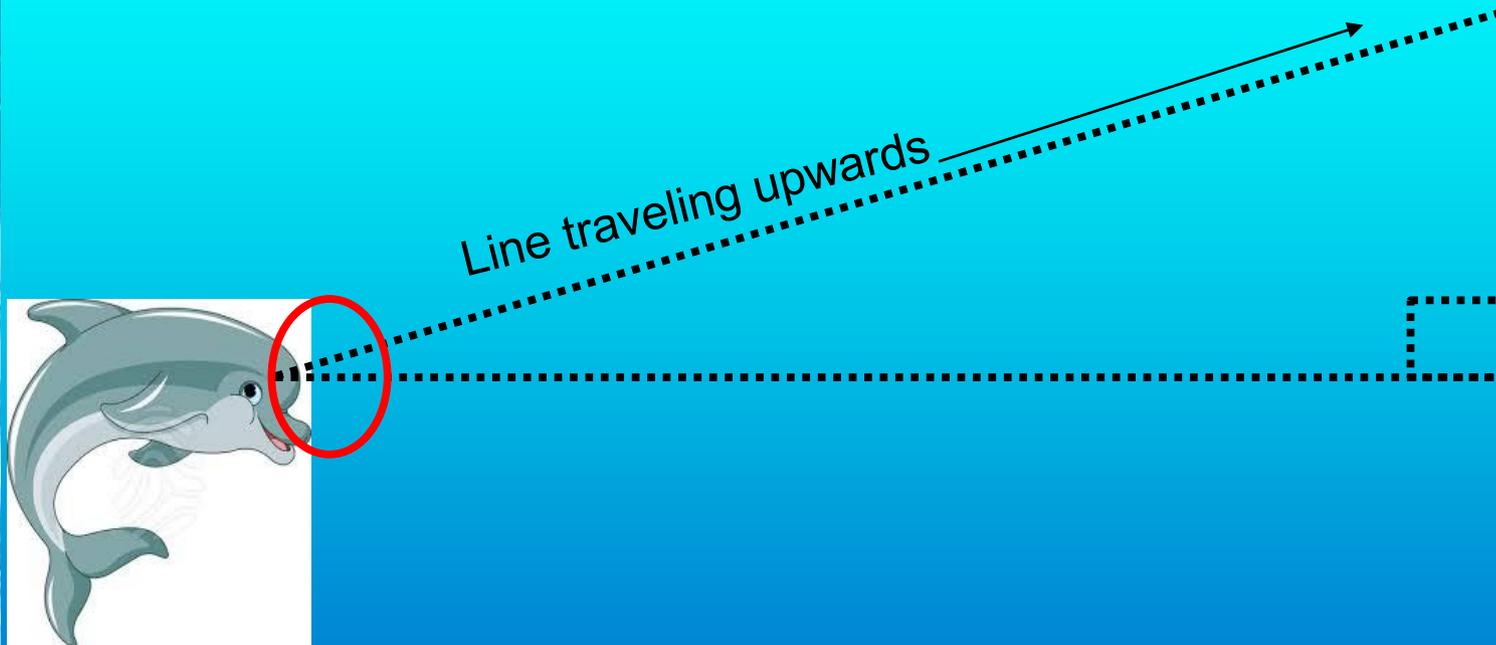


A similar method can be used to find the measurements of angles.

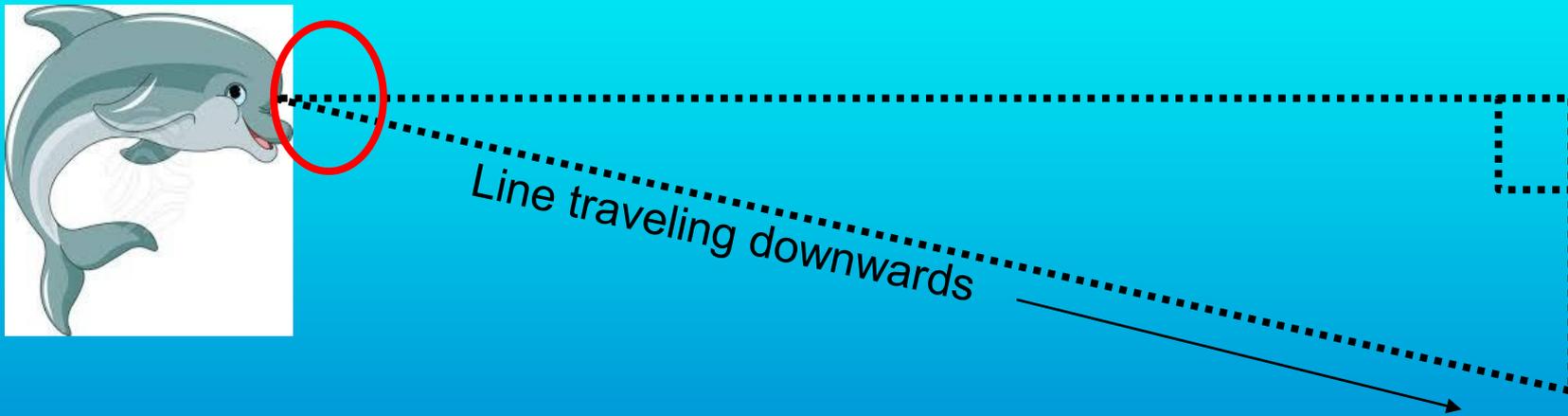


When talking about angles found using trigonometric functions, we often refer to two types: **angles of elevation** and **angles of depression**.

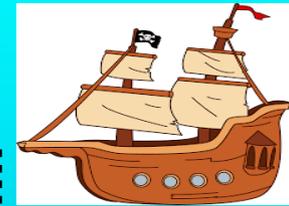
The angle circled is an **angle of elevation**. Notice how the angle is formed with a line traveling upward from my eyes.



The angle circled is an **angle of depression**. Notice how the angle is formed with a line traveling downward from my eyes.

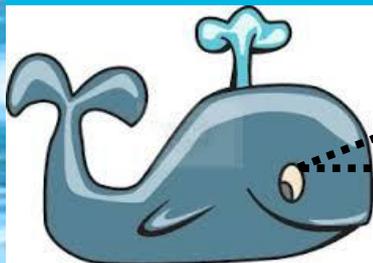


So let's try finding one of these angles!
A whale is staring at a ship on the water's surface. What is the angle of elevation from the ship to the whale?



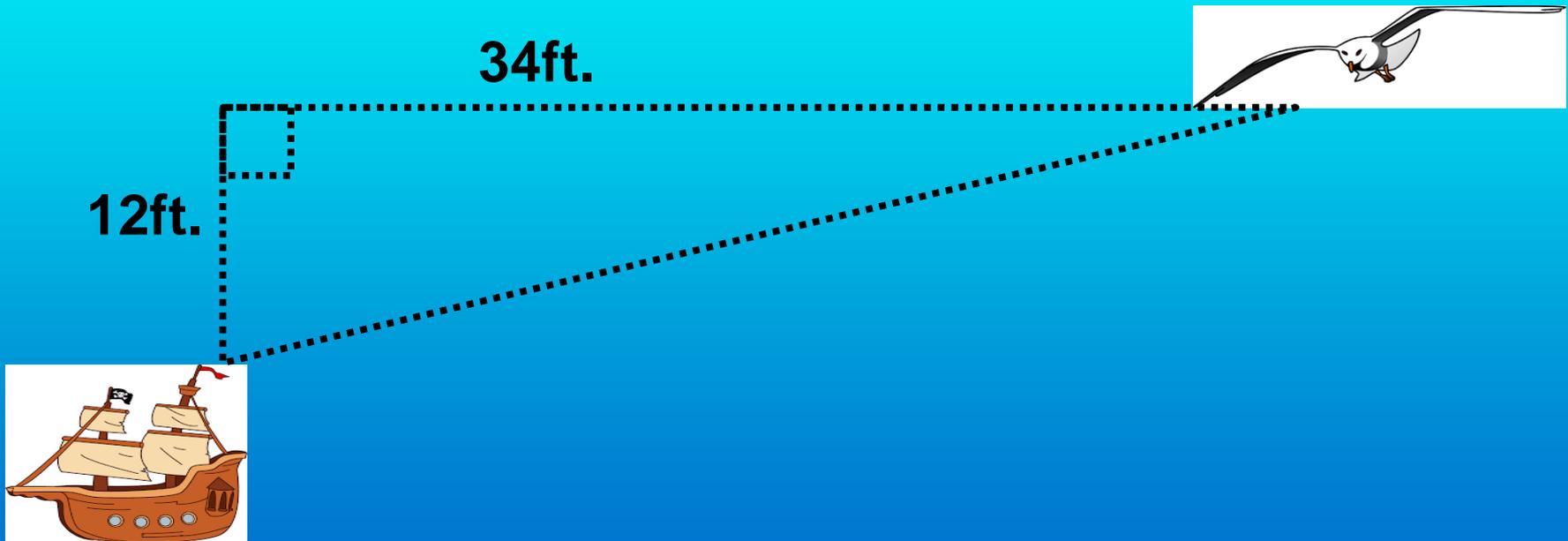
56 mi.

20mi.



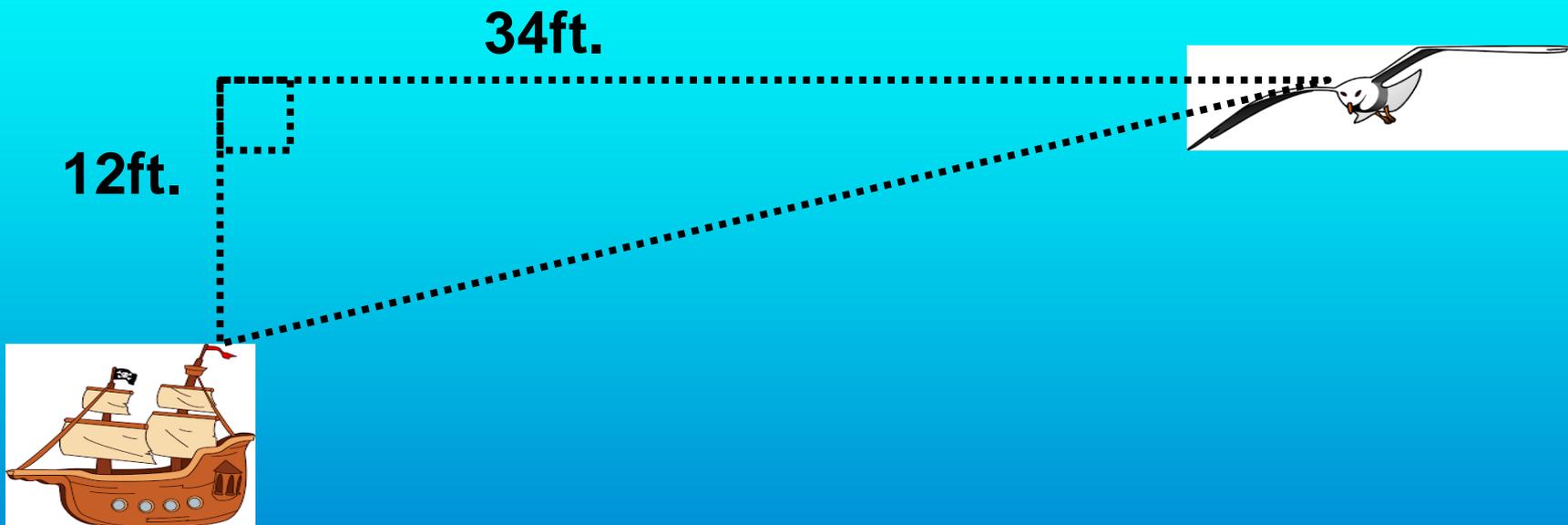
$\sin X = 20/56 \Rightarrow \sin^{-1}(20/56) \approx 20.9^\circ$ (find the approximate value using a calculator)

Now, try this one on your own:
A seagull flying overhead sees a ship below.
What is the angle of depression from the
seagull to the boat?



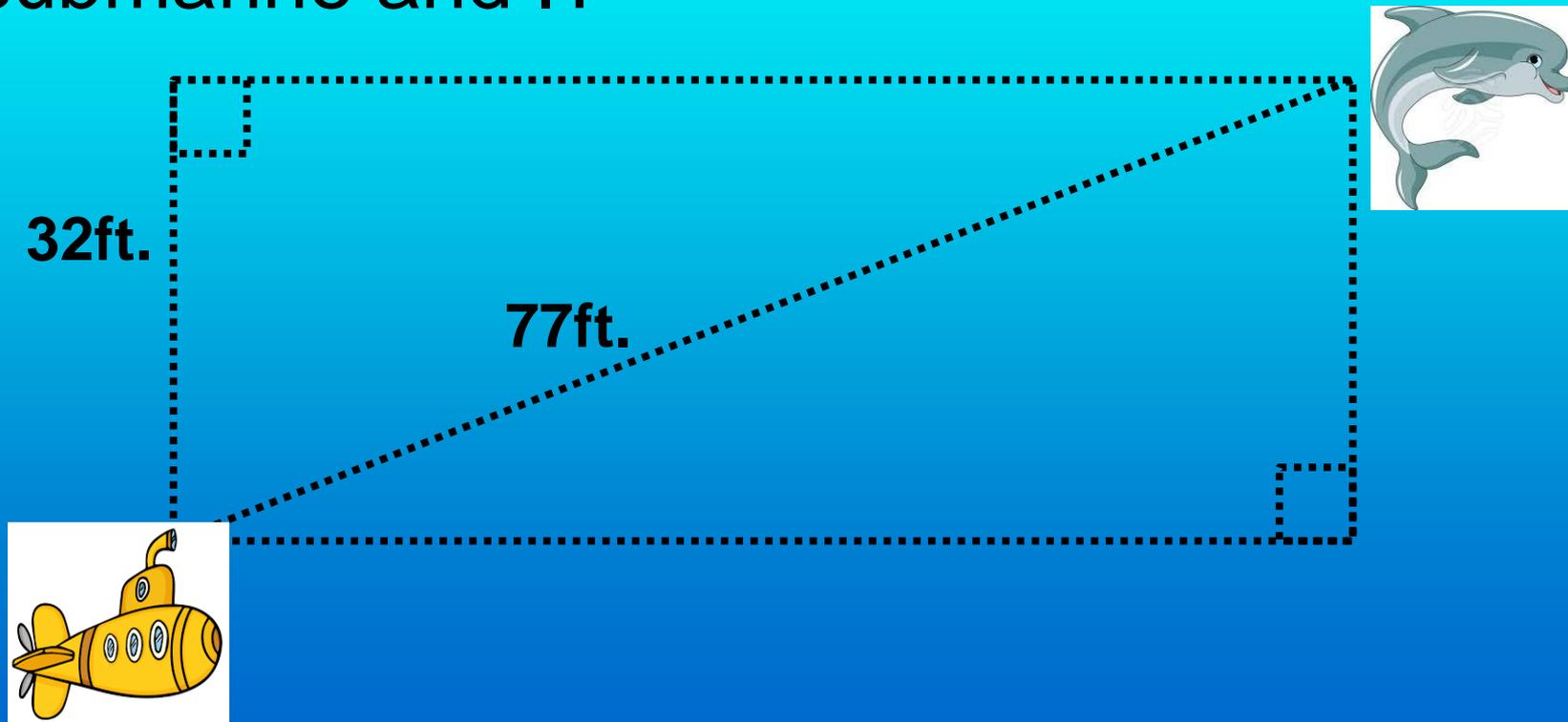
The answer is . . .

$$\tan x = 12/34 \Rightarrow \tan^{-1}(12/34) \approx 19.4^\circ$$



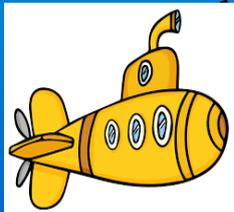
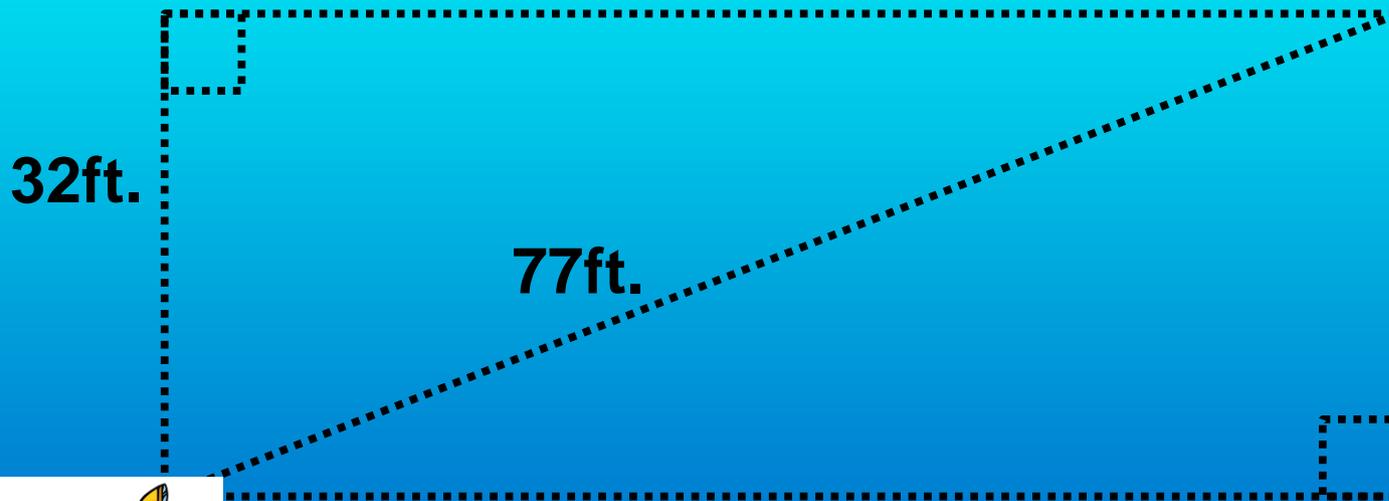
Often, both the angle of depression and the angle of elevation is shown, so be careful with this one!

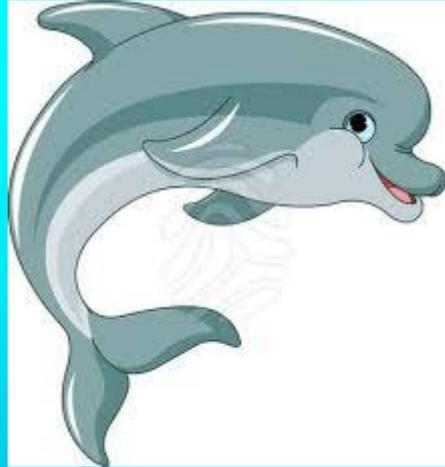
What is the angle of depression between the submarine and I?



Let's see if you got it!

$$\sin x = 32/77 \Rightarrow \sin^{-1}(32/77) \approx 24.6^\circ$$





This concludes our lesson. I hope you enjoyed it!