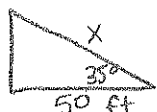


Day 9: Evaluating Trig Functions

Warm-Up:

1. A water skier must be at least a horizontal distance of 50 feet from the boat in order to safely avoid undertow from the propeller. If the angle of elevation is 35° from the skier to the pole how long is the rope?

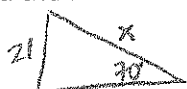


$$\cos(35) = \frac{50}{x}$$

$$x = \frac{50}{\cos(35)}$$

$$x = 61.04$$

2. A 21-foot tree needs trimming. Safety guidelines say the angle made by the ladder and the ground should be 70° . How long should the ladder be to reach the top of the tree?



$$\sin(70) = \frac{21}{x}$$

$$x = \frac{21}{\sin(70)}$$

$$x = 22.35 \text{ ft}$$

Day 9 (Part 1): Exploring Sine, Cosine, and Tangent Angle Restrictions

Using your calculator, complete the chart. Round to the nearest thousandth.

Angle	sin(angle)	cos(angle)	tan(angle)
0	0	1	0
30	0.5	0.866	0.577
60	0.866	0.5	1.732
90	1	0	undefined
120	0.866	-0.5	-1.732
150	0.5	-0.866	-0.577
180	0	-1	0
210	-0.5	-0.866	0.577
240	-0.866	-0.5	1.732
270	-1	0	undefined
300	-0.866	0.5	-1.732
330	-0.5	0.866	-0.577
360	0	1	0

1. What do you notice about the sine column? Describe the pattern.
Starts at zero and goes between 1 and -1
2. What do you notice about the cosine column? Describe the pattern.
Starts at 1 and goes between -1 and 1
3. What do you notice about the tangent column? Describe the pattern.
 $\frac{\sin}{\cos} = \tan$ * tangent is undefined when $\cos = 0$

Remember!!

- a. Angles are measured in radians or degrees
- b. We have to check our mode to make sure the calculator knows what measure we are using!
 - i. In this class, we will always use degrees, but you should know that radians exist!

 → Make sure Degree is highlighted! (in calculator)

Day 9 (Part 2): Solving Trig Equations

1. Use the inverse trig functions on your calculator to solve the following equations:

a. $\sin(x) = 0.3 \quad x = \sin^{-1}(0.3) = 17.46^\circ$

b. $\sin(x+2) = 1.5$ no solution - sine is always between -1 and 1

c. $3 \sin(x) = 2 \quad \sin(x) = \frac{2}{3} \rightarrow x = \sin^{-1}(\frac{2}{3}) = 41.81^\circ$

** Extra tougher examples in ppt (on next page of notes)*
Solving Sine, Cosine and Tangent Equations

1. We can solve equations involving sine, cosine and tangent just like any other equation!

2. Inverse operations of sine, cosine and tangent

i. Sine → sin⁻¹

ii. Cosine → cos⁻¹

iii. Tangent → tan⁻¹

3. Solve the equations and express your answer to the nearest tenth degree:

1. $\sin(x) = 0.6$
 $x = \sin^{-1}(0.6)$
 $x = 36.9^\circ$

2. $\cos(x) = 1.5$
 $x = \cos^{-1}(1.5)$
 no solution

3. $\tan(x) = -6.7$
 $x = \tan^{-1}(-6.7)$
 $x = -81.5^\circ$

4. $\cos(x) = -0.87$
 $x = \cos^{-1}(-0.87)$
 $x = 150.5^\circ$

5. $3 \sin(x) = 1.5$
 $\sin(x) = 0.5$
 $x = \sin^{-1}(0.5)$
 $x = 30^\circ$

6. $4 \sin(x) = 1.2$
 $\sin(x) = 0.3$
 $x = \sin^{-1}(0.3)$
 $x = 17.5^\circ$

Extra Examples - 1st 4 of the HW!

$$1) \sin x - \frac{1}{2} = 0$$

$+1/2$

$$\sin x = 1/2$$

$$\sin^{-1}(\sin x) = \sin^{-1}(1/2)$$

$$x = 30^\circ$$

$$2) 2 \cos x - \sqrt{3} = 0$$

$$+ \sqrt{3} \quad + \sqrt{3}$$

$$2 \cos x = \sqrt{3}$$

$$\frac{2 \cos x}{2} = \frac{\sqrt{3}}{2}$$

$$\cos x = \frac{\sqrt{3}}{2}$$

$$\cos^{-1}(\cos x) = \cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$$

$$x = 30^\circ$$

$$3) 4 \sin x + 3 = 3 \sin x + 2$$

$-3 \sin x$

combine like terms
→ get $\sin x$
parts together!

$$\sin x = -1$$

$$\sin^{-1}(\sin x) = \sin^{-1}(-1)$$

$$x = -90^\circ$$

$$4) 2 \sin x \cos x = \cos x$$

$$- \cos x \quad - \cos x$$

$$2 \sin x \cos x - \cos x = 0$$

factor out

$$\cos x (2 \sin x - 1) = 0$$

GCF of $\cos x$

$$\cos x = 0 \quad 2 \sin x - 1 = 0$$

set each part = 0 + solve

$$x = \cos^{-1}(0) \quad 2 \sin x = 1$$

$$\sin x = 1/2$$

$$x = 90^\circ, 30^\circ \quad x = \sin^{-1}(1/2)$$

Practice

Solve the following equations and express your answer to the nearest tenth degree:

1) $\sin(x) = 0.8$ $x = \sin^{-1}(0.8)$ $x = 53.1$	2) $\cos(x) = -0.78$ $x = \cos^{-1}(-0.78)$ $x = 141.3$	3) $\tan(x) = -9.5$ $x = \tan^{-1}(-9.5)$ $x = -84$	4) $\sin(x) = 0.366$ $x = \sin^{-1}(0.366)$ $x = 21.5$
5) $\sin(x) = -0.768$ $x = \sin^{-1}(-0.768)$ $x = -50.2$	6) $3\tan(x) = -12.8$ $x = \tan^{-1}(-4.2667)$ $x = -76.8$	7) $3\sin(x) + 4 = 1.57$ $-4 \quad -4$ $3\sin(x) = -2.43$ $\sin(x) = -0.81$ $x = \sin^{-1}(-0.81)$ $x = -54.1$	8) $4\cos(x) - 6 = -5.2$ $x = 78.5$

Day 9 (Part 3): Calculator Trig functions

An exploration

Use your graphing calculator to answer the following questions.

1. Use your calculator to find the following trig ratios. Round your answers to the nearest thousandth.

$\sin(20) = 0.342$	$\cos(40) = 0.766$	$\tan(70) = 2.747$
$\sin(83) = 0.616$	$\cos(75) = 0.259$	$\tan(25) = 0.466$

2. Find the sine, cosine, and tangent of a right triangle with a hypotenuse of 1 and angle of elevation of 45° .

- a) What is the sine of 45° , rounded to the nearest thousandth? 0.707
- b) What is the cosine of 45° , rounded to the nearest thousandth? 0.707
- c) What is the tangent of 45° , rounded to the nearest thousandth? 1
- d) What is special about the sine and cosine of 45° ? $\sin(45) = \cos(45)$
- e) What is special about the tangent of 45° ? $\tan(45) = 1$

3. Use your calculator to find the following sine and cosine ratios.

$\cos(20) = 0.94$	$\cos(30) = 0.866$
$\sin(70) = 0.94$	$\sin(60) = 0.866$
$\cos(60) = 0.5$	$\cos(75) = 0.259$
$\sin(30) = 0.5$	$\sin(15) = 0.259$

What do you notice about sine and cosine when the angles add to 90° ?

4. Use your calculator to find the following:

$\tan(40) = 0.839$	$\frac{\sin(40)}{\cos(40)} = 0.839$	$\tan(50) = 1.192$	$\frac{\sin(50)}{\cos(50)} = 1.192$
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What conclusion can you draw about the relationship between the tangent function and sine and cosine?

$$\frac{\sin}{\cos} = \tan$$