

Precalculus Honors

Modeling with Trigonometry



Using Trigonometry in Navigation

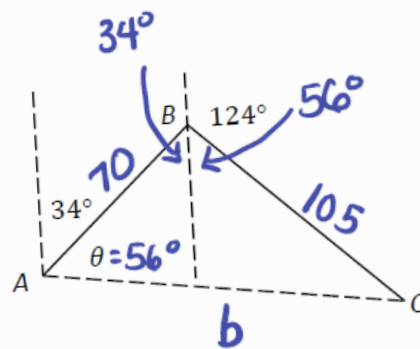
A U.S Coast Guard patrol boat leaves Port Canaveral and averages 35 knots (nautical mph) traveling for 2 hours on a course of 34° and then 3 hours on a course of 124° . What is the boat's bearing and distance from Port Canaveral?

1) Solve $\triangle ABC$
 $AC = \sqrt{70^2 + 105^2}$
 $AC \approx 126.2$ nautical miles

2) Find θ for bearing
 $34^\circ + \theta$
 $\tan \theta = \frac{105}{70}$

$$\theta \approx 56.31^\circ$$

3) Bearing $34^\circ + 56.31^\circ$



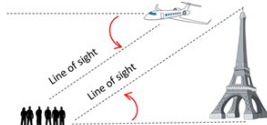
- 1) $180^\circ - 124^\circ = 56^\circ$
- 2) $\triangle ABC$ is right $\triangle$
- 2) 34° Alt. int $\angle$'s

Completely Editable 4.11

Lesson II: Modeling with Trigonometry

In this final lesson, let's put our knowledge of trigonometric functions to work on solving some practical applications.

- An **angle of elevation** is the angle through which the eye moves up from horizontal to look at something above.
- An **angle of depression** is the angle through which the eye moves down from horizontal to look at something below.



EX #1: The angle of depression from the top of the Ponce Inlet lighthouse 170 feet above the surface of the water a buoy is to is 5° . Find the distance x in feet from the base of the lighthouse to the buoy.



EX #2: The Statue of Liberty stands on a 150-ft pedestal. From a point 280 ft from the base of the pedestal, the angle of elevation to the top of Liberty's torch is 47° . Find the height of the statue.



EX #3: Suppose a 50-foot extension ladder is leaning against the side of a two-story house. If the base of the ladder is 6 feet from the base of the house, find the angle formed by the ladder and the house. Would you feel safe climbing the ladder?

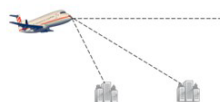
Making Indirect Measurements

EX #4: The angle of elevation of the top of the TV antenna mounted on top of the Eiffel Tower in Paris is measured to be $80^\circ 1'12''$ at a point 185-feet from the base of the tower. How tall is the tower plus TV antenna?



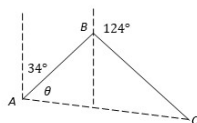
Finding Distance Between Two Points

EX #5: A passenger in an airplane at an altitude of 9 kilometers sees two towns directly to the east of the plane. The angles of depression to the towns are 22° and 46° , respectively. How far apart are the towns to the nearest kilometer?



Using Trigonometry in Navigation

EX #6: A U.S. Coast Guard patrol boat leaves Port Canaveral and averages 35 knots (nautical mph) traveling for 2 hours on a course of 34° and then 3 hours on a course of 124° . What is the boat's bearing and distance from Port Canaveral?



EX #7: A park ranger spots a fire from a 125-ft tower in Great Smoky Mountains National Park. The angle of depression is measured to be $1^\circ 20'$. Find the distance from the tower to the fire in feet and then convert this measurement to miles.

Simple Harmonic Motion

An object that moves on a coordinate axis is in **simple harmonic motion** if its distance from the origin, d , at time t is given by either

$$d = a \cos(\omega \cdot t)$$

$$d = a \sin(\omega \cdot t)$$

The motion has **amplitude**, the maximum displacement of the object from its rest position. The **period** of the motion is, $\frac{2\pi}{\omega}$ where $\omega > 0$. The period gives the time it takes for the motion to go through one complete cycle. The motion has **frequency** $\frac{\omega}{2\pi}$, which is the number of oscillations per unit of time.

EX #8: A point on the tip of a tuning fork vibrates in harmonic motion described by the equation $d = 12 \sin(\omega \cdot t)$. Find ω for a tuning fork that has a frequency of 386 vibrations per second.
Answer in π radians

EX #9: A ball on a spring is pulled 6 inches below its rest position and then released. The period for the motion is 4 seconds. Write the equation for the ball's simple harmonic motion.

EX #10: A mass oscillating up and down on the bottom of a spring (assuming perfect elasticity and no friction or air resistance) can be modeled as harmonic motion. If the weight is displaced a maximum of 4 cm, find the modeling equation if it takes 3 seconds to complete one cycle.

NOTES

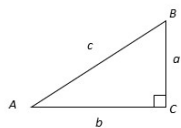
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Modeling with
Trigonometry
Homework

Name _____

Date _____ Period _____

Problems 1 – 2, Use the right triangle shown below, to solve each triangle.

1. $a = 6, B = 40^\circ$, Find b, c , and A 2. $b = 4, c = 6$, Find a, A , and B

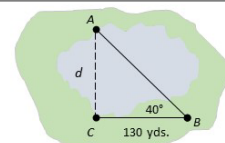
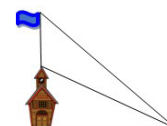
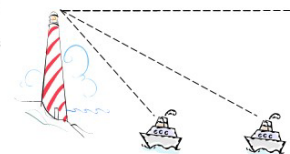
Problems 3 – 6, Solve.

3. A right triangle has a hypotenuse of length 9 inches. If one angle is 35° , find the length of each leg.

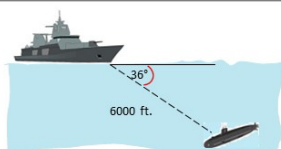
4. The hypotenuse of a right triangle is 13 inches. If one leg is 5 inches, find the degree measure of each angle.

5. A right triangle contains a 52° angle. If one leg is of length 6 inches, what is the length of the hypotenuse. [two possible answers.]6. A right triangle contains an angle of $3\pi/8$ radian. If one leg has a length of 4 meters, what is the length of the hypotenuse? [two possible answers.]

Problems 7 – 14, Solve.

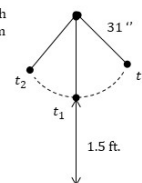
7. A point on the tip of a tuning fork vibrates in harmonic motion described by the equation $d = 15 \sin(\omega \cdot t)$. Find ω for a tuning fork that has a frequency of 375 vibrations per second.
Answer in π radians.8. Find the distance from A to C across the pond.9. From a point 80 feet in front of a library, the angles of elevation to the base of a flagpole, and to the top of the flag are 22° and 43.5° , respectively. Find the height of the flagpole to the nearest foot.10. An observer in a lighthouse 320 feet above sea level observes two ships directly offshore. The angles of depression to the ships are 7° and 10.5° , respectively. How far apart are the ships to the nearest foot?

11. Angular speed is measured in units like revolutions per minute. Linear speed is measured in units like miles per hour. Sam Spade's truck has wheels 32 inches in diameter. If the wheels are rotating at 710 rpm (revolutions per minute), find the truck's speed in miles per hour.

12. You are standing 120 feet from the base of a bungee jumping platform. The angle of elevation from your location to the top of the platform from where your friend is about to jump is 52° . What is the height from which your friend is jumping?13. Sonar from a navy ship detects a submarine that is 6000 ft. from the ship. The angle of depression between the ocean surface and the submarine is 36° . How deep is the submarine?

Free-Response Question

The pendulum on a grandfather clock moves in a sinusoidal fashion. The length of the pendulum is 31 inches at its lowest point. The pendulum is 1.5 feet from the floor.

The pendulum begins to move at t_1 so that the interior angle between t_2 and t_3 is 90° . It takes 0.875 second for the pendulum to swing from t_2 to t_3 .

A. What is the minimum height of the pendulum in inches?

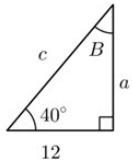
B. What is the maximum height of the pendulum?

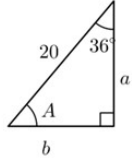
C. Write the sinusoidal equation that models the movement of the pendulum as a cosine function $y = a \cos b(x - h) + k$.

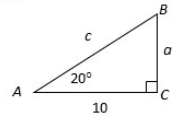
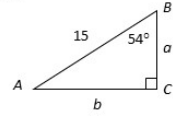
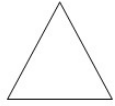
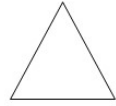
Practice Sets



Lesson Warm-Ups

Name _____ Date _____ Period _____	
Lesson 4.11 - Modeling with Trigonometry	
Warm-Up # 1	
1. Solve the right triangle. 	2. In an isosceles triangle with base angles 34° and a base of 12 inches, find the altitude of the triangle. Round your answer to two decimal places.
3. The sun is 40° above the horizon. Find the length of a shadow cast by a building that is 75 ft tall. Round your answer to the nearest foot.	

Name _____ Date _____	
Lesson 4.11 - Modeling with Trigonometry	
1. Solve the right triangle. 	2. In an isosceles triangle with base angles 36° and a base of 24 inches, find the altitude of the triangle. Round your answer to two decimal places.
3. The sun is 33° above the horizon. Find the length of a shadow cast by a building that is 60 feet tall. Round your answer to the nearest foot.	

4.11 Modeling with Trigonometry Form A Name _____ Date _____ Period _____ 1. Solve the right triangle. 	4.11 Modeling with Trigonometry Form B Name _____ Date _____ Period _____ 1. Solve the right triangle. 
2. In an isosceles triangle with base angles 50° and a base of 4 inches, find the altitude of the triangle. Round your answer to two decimal places. 	2. In an isosceles triangle with base angles 42° and a base of 26 inches, find the altitude of the triangle. Round your answer to two decimal places. 
3. The sun is 25° above the horizon. Find the length of a shadow cast by a building that is 60 feet tall. Round your answer to the nearest foot.	3. The sun is 28° above the horizon. Find the length of a shadow cast by a building that is 50 feet tall. Round your answer to the nearest foot.

Daily Lesson Quiz

Grade: _____	Grade: _____
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