

Lesson 4: Calculating the Measure of an Angle in Right Triangles

Friday, August 31, 2018 2:27 AM

Trigonometry Lesson #4: Calculating the Measure of an Angle in Right Triangles

Review

In Lesson #2 we learned how to determine the measure of an angle, when given a trigonometric ratio for the angle. For review, complete the following example.

- Determine, to the nearest degree, the acute angle for which
- a) $\sin x^\circ = 0.45$ b) $\cos y^\circ = 0.1624$ c) $\tan z^\circ = 5.2$
- $x^\circ = 27^\circ$ $y^\circ = 81^\circ$ $z^\circ = 79^\circ$

Calculating the Measure of an Angle

In order to use the trigonometric ratios to determine the measure of an angle in a right triangle, we need to know the lengths of two of the sides of the triangle.

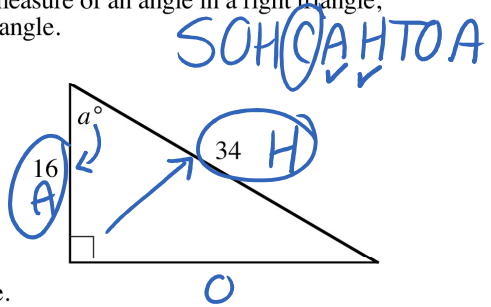
Complete the following work for the diagram shown.

Relative to the angle a° , 16 is the length of the ADJACENT side and 34 is the length of the hyp.

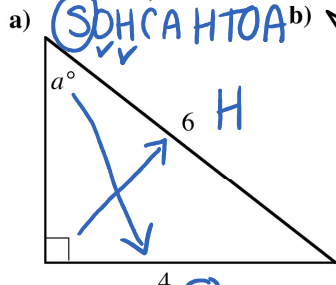
The trigonometric ratio which involves the ADJACENT and the hyp is the cosine ratio.

$\cos a^\circ = \frac{16}{34}$, so $a^\circ = 62$ to the nearest degree.

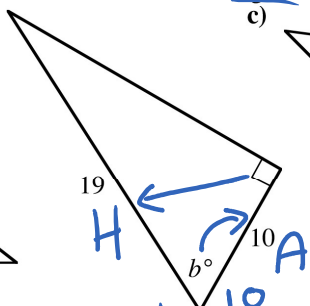
$\cos^{-1}(16 \div 34)$



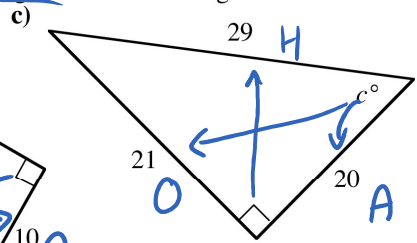
In each case, calculate the measure of the indicated angle to the nearest degree.



$\sin a = \frac{4}{6}$
 $a = \sin^{-1}(4 \div 6)$
 $a^\circ = 42^\circ$



$\cos b = \frac{10}{19}$
 $b = \cos^{-1}(10 \div 19)$
 $b = 58^\circ$



$\sin c = \frac{21}{29}$
 $\cos c = \frac{20}{29}$
 $\tan c = \frac{21}{20}$

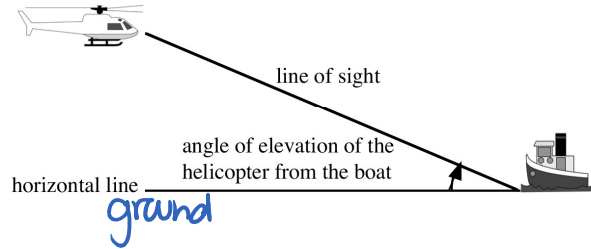
} 46°

Complete Assignment Questions #1 - #5

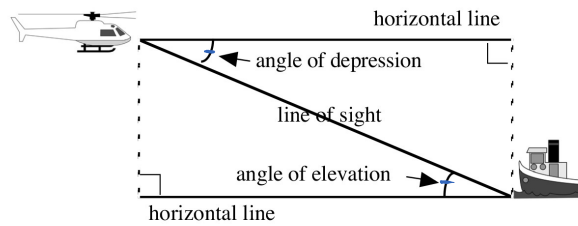
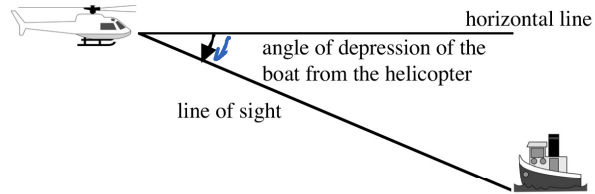
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Angle of Elevation, Angle of Depression

- The **angle of elevation** is measured **upwards** from the **horizontal**. The sketch at the right illustrates the angle of elevation of the helicopter from the boat.



- The **angle of depression** is measured **downwards** from the **horizontal**. The sketch at the right illustrates the angle of depression of the boat from the helicopter.



- Note that angles of elevation and angles of depression are determined from the horizontal and NOT from the vertical.
- The sketch above shows that: angle of elevation of the helicopter from the boat = angle of depression of the boat from the helicopter



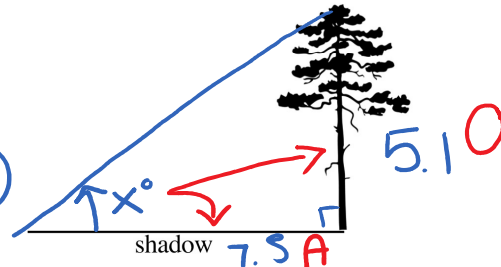
A tree 5.1 m tall casts a shadow 7.5 m long. Calculate the angle of elevation of the sun to the nearest tenth of a degree.

SOHCAHTOA

$$\tan x = \frac{5.1}{7.5}$$

$$x = \tan^{-1}(5.1 \div 7.5)$$

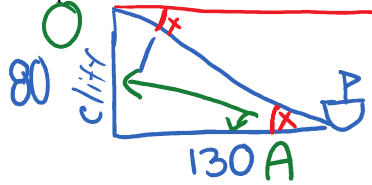
$$= 34.2^\circ$$





A boat is 130 m from the base of a cliff. The cliff is 80 m high.

- a) Draw a diagram to represent this scenario and mark the **angle of depression** of the boat from the top of the cliff.



- b) Determine, to the nearest degree, the angle of depression of the boat from the top of the cliff.

(TOA)

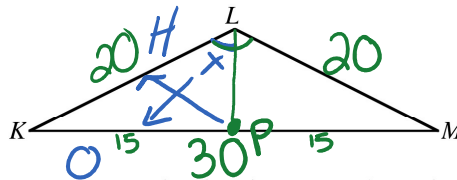
$$\tan x = \frac{80}{130}$$

$$x = \tan^{-1}(80 \div 130) = 32^\circ$$

Isosceles Triangles



Consider isosceles triangle KLM in which $KL = 20$ cm, $LM = 20$ cm, and $KM = 30$ cm.



- a) Why can't we use SOHCAHTOA in triangle KLM to determine the measure of angle KLM ?

$\triangle KLM$ is not a right triangle

- b) Determine, to the nearest degree, the measure of angle KLM by splitting triangle KLM into two congruent triangles.

(SOHCAHTOA)

$$\sin x = \frac{15}{20}$$

$$x = \sin^{-1}(15 \div 20)$$

$$x = 48.59... \cdot 2$$

→ double to get the whole angle

$\angle KLM = 97^\circ$

Complete Assignment Questions #6 - #14

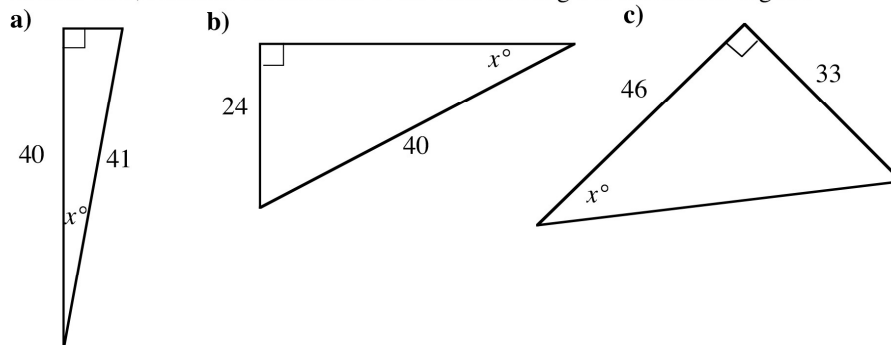
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(1-3)b, 4, 5, 6, 7b, 10

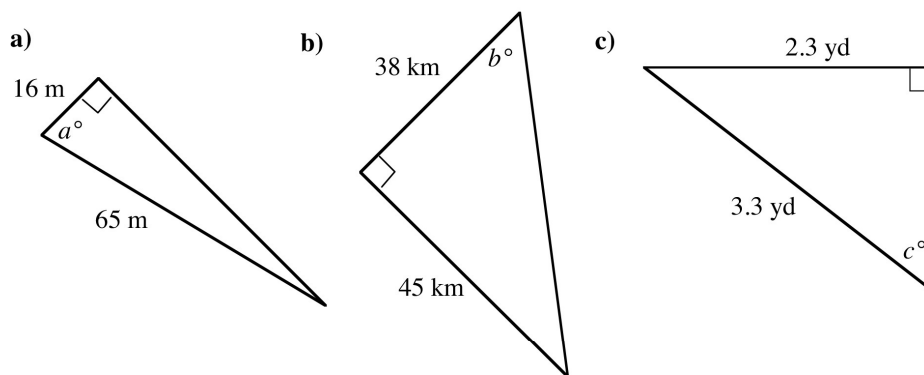
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Assignment

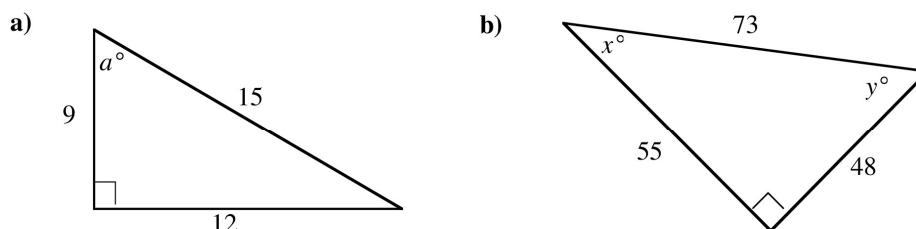
1. In each case, calculate the measure of the indicated angle to the nearest degree.



2. In each case, calculate the measure of the indicated angle to the nearest tenth.

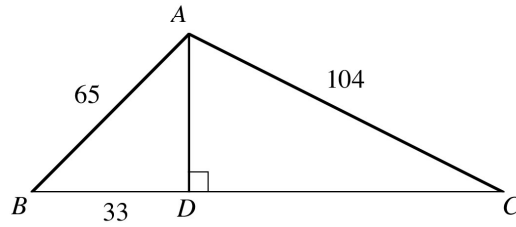


3. In each case, calculate the measure of the indicated angle to the nearest degree.



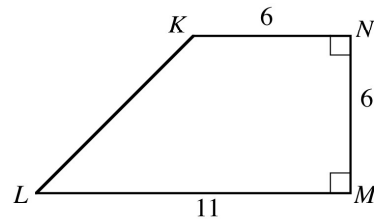
4. Consider the diagram consisting of two right triangles with a common side AD .

a) Use the Pythagorean Theorem to calculate the length of AD .



b) Determine, to the nearest degree, the measure of angle BCA .

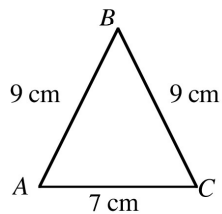
5. Determine the measure of angle LKN to the nearest degree.



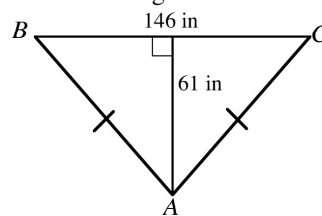
6. An electricity pylon 23.7 m high casts a shadow 46.8 m long. Determine the angle of elevation of the sun to the nearest tenth of a degree.

7. In each case, calculate the size of $\angle BAC$ to the nearest degree.

a)

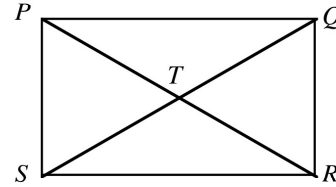


b)



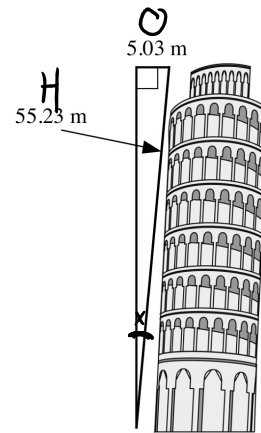
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8. In the rectangle, $PQ = 12.8$ cm and $QR = 7.4$ cm. Determine the measure of angle PTQ to the nearest degree.



9. The term “% grade” is sometimes used to describe the slope of a road. For example, a road with a 7% grade has a vertical rise of 7 m for every horizontal distance of 100 m. Calculate, to the nearest degree, the angle a road with a 7% grade makes with the horizontal.

10. The Leaning Tower of Pisa is a building in Italy which leans due to the instability of the ground underneath it. At different points in history the tower has leaned at different angles. Use the measurements in the sketch to determine the angle of lean from the vertical to the nearest hundredth of a degree.



$$\begin{aligned} & \text{SOHCAHTOA} \\ & \sin x = \frac{5.03}{55.23} \\ & x = \sin^{-1}(5.03 \div 55.23) \\ & x = 5.23^\circ \end{aligned}$$

- Multiple Choice** 11. A set of stairs has a vertical rise of 15 cm for every 28 cm horizontal run. To the nearest degree, the angle between the stairs and the floor is

- A. 28°
- B. 32°
- C. 62°
- D. 64°

Numerical Response 12. A tourist at the top of a lighthouse spots a boat in the water below. The angle of depression of the boat from the tourist is 35° . At the same moment in time, the angle of elevation of the tourist from the boat, to the nearest degree, is _____ $^\circ$.
 (Record your answer in the numerical response box from left to right)

Numerical Response 13. Susan Point, a Coast Salish artist from the Musqueam Nation, created three red cedar portals welcoming visitors to the Brockton Point Centre and the traditional lands of the Coast Salish people located in Vancouver’s Stanley Park. The carvings are the gateway to British Columbia’s most visited tourist attraction, a collection of 9 totem poles.
 (<http://vancouver.ca/parks-recreation-culture/totems-and-first-nations-art.aspx>).
 The height of one of the gateways is approximately 20 feet and it casts a shadow of 34.6 feet. To the nearest degree, the angle of elevation of the sun is _____ $^\circ$.
 (Record your answer in the numerical response box from left to right)

Numerical Response 14. A submarine goes into a dive at a certain angle of depression and travels 275 m during the descent. When the submarine stops its dive, it has dropped a vertical distance of 150 m. To the nearest degree, the angle of depression of the dive is _____ $^\circ$.
 (Record your answer in the numerical response box from left to right)

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Answer Key

1. a) 13° b) 37° c) 36° 2. a) 75.7° b) 49.8° c) 44.2°
3. a) 53° b) $x = 41^\circ, y = 49^\circ$ 4. a) 56 b) 33° 5. 130° 6. 26.9°
7. a) 67° b) 100° 8. 120° 9. 4° 10. 5.23° 11. A
12.

3	5		
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 13.

3	0		
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 14.

3	3	.	1
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