

Mathematics

Quarter 4 – Module 1: Trigonometric Functions (SOH-CAH-TOAH)



**Mathematics – Grade 9
Alternative Delivery Mode
Quarter 4 – Module 1: Trigonometric Functions (SOH-CAH-TOAH)
First Edition, 2020**

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Mathematics

Quarter 4 – Module 1:

Trigonometric Functions

(SOH-CAH-TOAH)

Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

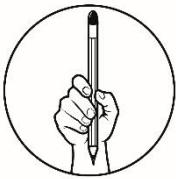
Thank you.



What I Need to Know

The learners will be able to:

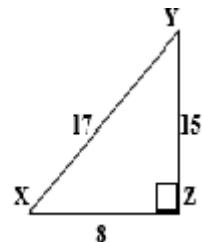
- illustrate the six trigonometric functions: **sine**, **cosine**, **tangent**, secant, cosecant, and cotangent. **M9GE-IVa-43.1**



What I Know

DIRECTION: Encircle the letter of the correct answer.

For item numbers 1 – 6, refer to the figure at the right.



Given the right ΔXYZ with side lengths 8 cm, 15 cm, and 17 cm.

1. What is the value of **sin X**?

- a. $\frac{15}{17}$ b. $\frac{17}{15}$ c. $\frac{8}{15}$ d. $\frac{17}{8}$

2. What is the value of **cos X**?

- a. $\frac{15}{17}$ b. $\frac{17}{15}$ c. $\frac{8}{17}$ d. $\frac{17}{8}$

3. What is the value of **tan X**?

- a. $\frac{15}{17}$ b. $\frac{15}{8}$ c. $\frac{8}{17}$ d. $\frac{17}{8}$

4. What is the value of **csc X**?

- a. $\frac{15}{17}$ b. $\frac{15}{8}$ c. $\frac{8}{17}$ d. $\frac{17}{15}$

5. What is the value of **sec X**?

- a. $\frac{15}{17}$ b. $\frac{15}{8}$ c. $\frac{8}{17}$ d. $\frac{17}{8}$

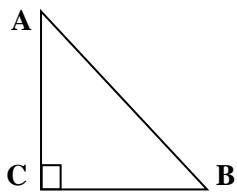
6. What is the value of **cot X**?

- a. $\frac{15}{17}$ b. $\frac{8}{15}$ c. $\frac{8}{17}$ d. $\frac{17}{8}$

7. If $f(\theta) = \frac{\text{length of adjacent side}}{\text{length of hypotenuse}}$, then $f(\theta)$ is _____.

- a. sine b. cosine c. tangent d. secant

8. If $f(\theta) = \frac{\text{length of hypotenuse}}{\text{length of opposite side}}$, then $f(\theta)$ is _____.
 a. cosecant b. cotangent c. tangent d. secant
9. If $f(\theta) = \frac{\text{length of hypotenuse}}{\text{length of adjacent side}}$, then $f(\theta)$ is _____.
 a. cosecant b. cotangent c. tangent d. secant
10. If $f(\theta) = \frac{\text{length of adjacent side}}{\text{length of opposite side}}$, then $f(\theta)$ is _____.
 a. cosecant b. cotangent c. tangent d. secant
11. With respect to the given angle, what trigonometric function is the ratio of the hypotenuse to the opposite side?
 a. sine b. cosine c. tangent d. cosecant
12. Based on the right triangle ACB below, which of the following has the same value as $\sin A$?



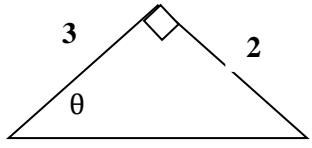
a. $\cos A$

b. $\sin B$

c. $\cos B$

d. $\tan A$

13. Which of the following trigonometric functions of θ has the value $\frac{2}{3}$?



a. \tan

b. \cot

c. \cos

- 14-15. In a right triangle PQR, $|PQ| = 12$ cm and $|QR| = 5$ cm. What is the value of $\cos R$?

a. $\frac{12}{13}$

b. $\frac{5}{13}$

c. $\frac{5}{12}$

d. $\frac{12}{5}$

Lesson 1

Trigonometric Functions (SOH-CAH-TOAH)

In this module, you will learn the three basic trigonometric functions such as the **sine**, **cosine**, and **tangent** from among the **six trigonometric functions** of an angle. The **trigonometric functions** are referred to as **trigonometric ratios** because the value of each function is expressed as the ratio of the lengths of the two sides of a right triangle for a specific angle θ . The other three functions such as secant, cosecant, and cotangent will be discussed later in Module 2.



What's In

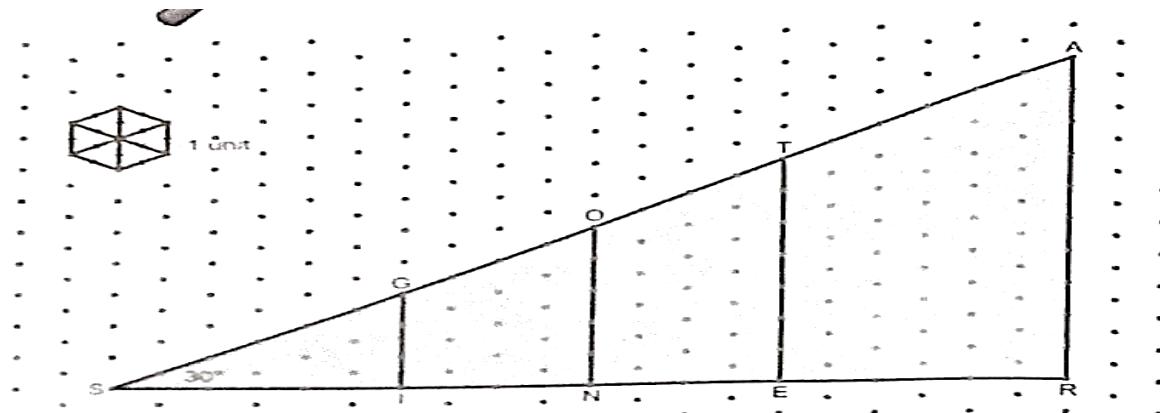
Review:

Consider the right triangle BCA at the right:

1. The opposite side of $\angle A$ is _____.
2. The adjacent side of $\angle A$ is _____.
3. The opposite side of $\angle B$ is _____.
4. The adjacent side of $\angle B$ is _____.



What's New



1. Complete the table below. Find the length of the indicated segments. Use one grid as equivalent to 1 unit.

ΔSIG	ΔSNO	ΔSET	ΔSRA
$ GI =$	$ ON =$	$ TE =$	$ AR =$
$ SG =$	$ SO =$	$ ST =$	$ SA =$
$\frac{ GI }{ SG } =$	$\frac{ ON }{ SO } =$	$\frac{ TE }{ ST } =$	$\frac{ AR }{ SA } =$

2. Compare the ratio of $\frac{\text{length of side adjacent to } 30^\circ}{\text{length of hypotenuse}}$ for each triangle. Compare your result with your classmates.

Upon investigation, we have observed that in a right triangle, the ratio of the length of the shorter leg (opposite the acute angle 30°) to the length of the hypotenuse is $\frac{1}{2}$ regardless of the size of the right triangle. This number is called the sine ratio or sine value of 30° , or simply the sine of 30° . Any acute angle has a constant value for its sine.

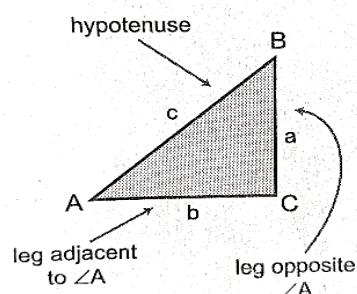
The pattern you discovered describes a trigonometric function. A trigonometric function is the ratio of the lengths of the two sides of a right triangle.



What is It

The trigonometric function upon *investigation* is the sine function.

$$\text{sine of } \angle A = \sin A = \frac{\text{length of side opposite to } \angle A}{\text{length of hypotenuse}}$$



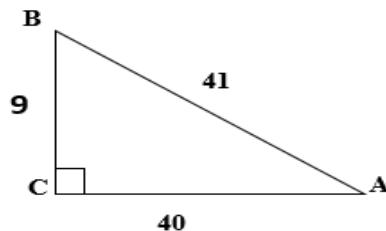
Two other important trigonometric functions associated with right triangles are cosine function and the tangent function.

$$\text{cosine of } \angle A = \cos A = \frac{\text{length of side adjacent to } \angle A}{\text{length of hypotenuse}}$$

$$\text{tangent of } \angle A = \tan A = \frac{\text{length of side opposite to } \angle A}{\text{length of side adjacent to } \angle A}$$

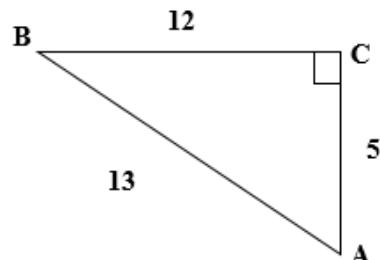
Examples:

1. Refer to ΔABC below. Find the trigonometric function values of $\angle A$.

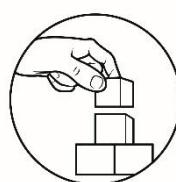


$$\sin A = \frac{9}{41} \quad \cos A = \frac{40}{41} \quad \tan A = \frac{9}{40}$$

2. Refer to ΔABC below. Find the trigonometric function values of $\angle A$.



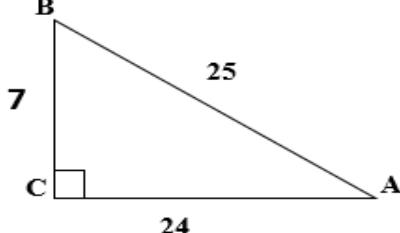
$$\sin A = \frac{12}{13} \quad \cos A = \frac{5}{13} \quad \tan A = \frac{12}{5}$$



What's More

- A. For each triangle, find the indicated trigonometric ratios.

1.

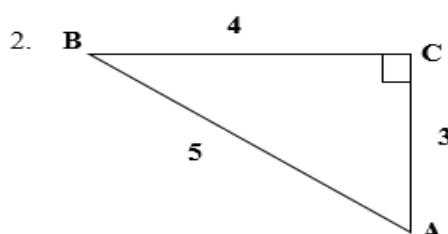


$$\sin A = \underline{\hspace{2cm}}$$

$$\cos A = \underline{\hspace{2cm}}$$

$$\tan A = \underline{\hspace{2cm}}$$

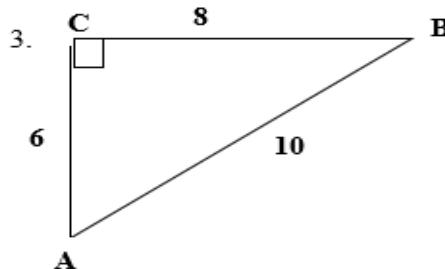
2.



$$\sin B = \underline{\hspace{2cm}}$$

$$\cos B = \underline{\hspace{2cm}}$$

$$\tan B = \underline{\hspace{2cm}}$$



$\sin A = \underline{\hspace{2cm}}$

$\sin B = \underline{\hspace{2cm}}$

$\cos A = \underline{\hspace{2cm}}$

$\cos B = \underline{\hspace{2cm}}$

$\tan A = \underline{\hspace{2cm}}$

$\tan B = \underline{\hspace{2cm}}$



What I Have Learned

Generalization/Summary

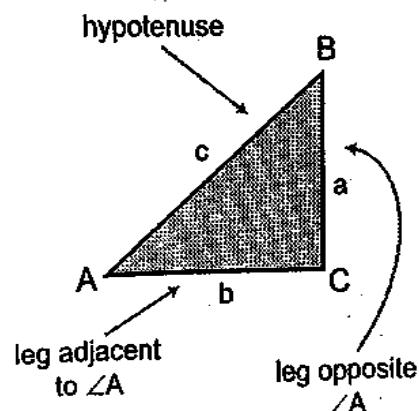
Sine, Cosine, and Tangent

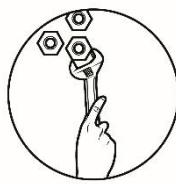
For all right triangles ABC, with acute angle A,

$\text{sine } A = \frac{\text{length of opposite leg}}{\text{length of hypotenuse}} \text{ or } \sin A = \frac{a}{c}$

$\text{cosine } A = \frac{\text{length of adjacent leg}}{\text{length of hypotenuse}} \text{ or } \cos A = \frac{b}{c}$

$\text{tangent } A = \frac{\text{length of opposite leg}}{\text{length of adjacent leg}} \text{ or } \tan A = \frac{a}{b}$

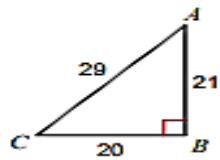




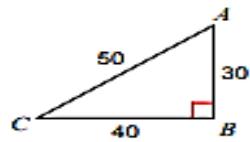
What I Can Do

Find the value of each trigonometric function. Express your answer in simplest fraction form.

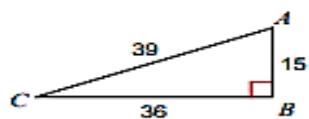
1) $\sin C$



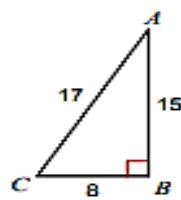
2) $\sin C$



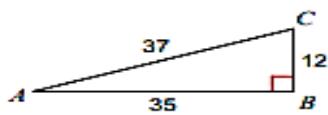
3) $\cos C$



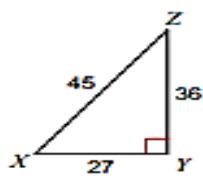
4) $\cos C$

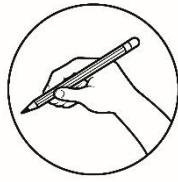


5) $\tan A$



6) $\tan X$





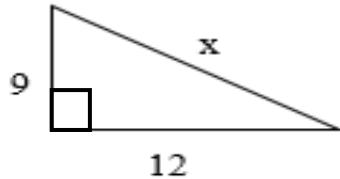
Assessment

I. Direction: Encircle the letter of the correct answer.

For numbers 1 – 4, Use the figure at the right, find the missing part of a right triangle.

1. What formula should be used to find the length of the third side?

- a. Distance Formula
- b. Midpoint Formula
- c. Pythagorean Formula
- d. Quadratic Formula



2. What is the value of x?

- a. 13
- b. 14
- c. 15
- d. 16

3. What is the value of $\sin \theta$?

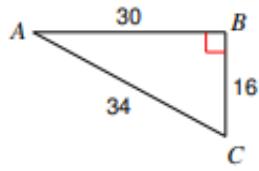
- a. $\frac{12}{15}$
- b. $\frac{9}{12}$
- c. $\frac{15}{12}$
- d. $\frac{9}{15}$

4. What is the value of $\cos \theta$?

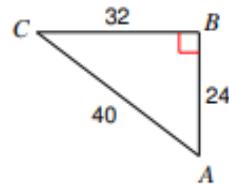
- a. $\frac{12}{15}$
- b. $\frac{9}{12}$
- c. $\frac{15}{12}$
- d. $\frac{9}{15}$

For items 5 – 10, use the given figure in each item then find the trigonometric function value of the indicated angle. Write your answers below each equation.

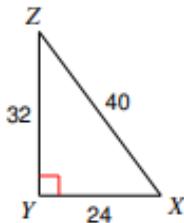
5) $\cos A$



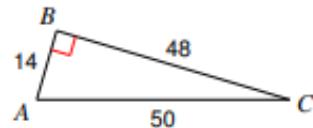
6) $\sin A$



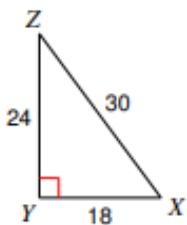
7) $\sin Z$



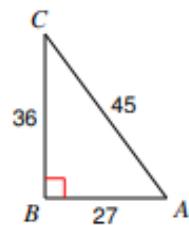
8) $\sin C$



9) $\cos Z$



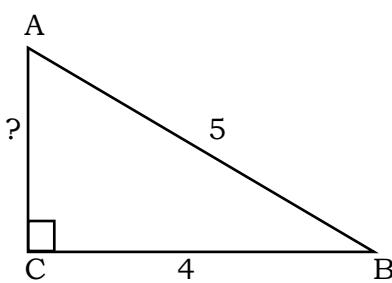
10) $\tan C$



Additional Activities

Challenge Problems:

1. Solve the problem below:
In $\triangle ABC$, where $C = 90^\circ$ and $\sin A = \frac{4}{5}$, find a) $\cos A$, b) $\tan A$, c) $\sin B$, d) $\cos B$, and e) $\tan B$.



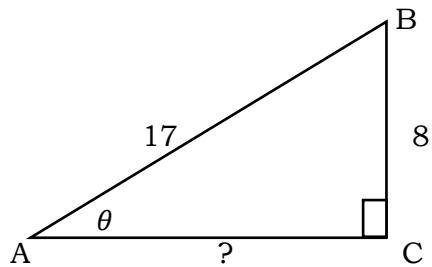
2. Find the missing length of a side of the right triangle BCA below and give the value of $\cot \theta$ if $\sin \theta = \frac{8}{17}$, where θ is an acute angle in the triangle.

Formula:

Solution:

Final Answer:

third side = _____; $\cot \theta =$ _____

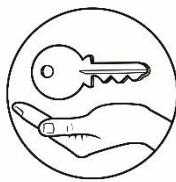


PROBLEM – BASED LEARNING WORKSHEET

Problem:

To be safe, a 20 ft-ladder should not be inclined in an angle more than 70° with the ground. Suppose the ladder leans against the wall of a house ad makes a 70-degree angle with the ground, find the a) distance b from the base of the house to the foot of the ladder, b) height a reached by the ladder.





Answer Key

The height reached by the ladder is 18.79 ft.
to the foot of the ladder is 6.84 ft.
The distance from the base of the house

$$\begin{aligned} \cot \theta &= \frac{8}{15} \\ \text{Third side} &= 15 \\ 15 &= b \\ 0.939693(20) &= a \\ \sin 70^\circ(20) &= a \\ 225 &= b^2 \\ b \sin 70^\circ &= \frac{a}{20} \\ 289 - 64 &= b^2 \\ 684 &= b \\ 0.342020(20) &= b \\ 17^2 - 8^2 &= b^2 \\ \text{Solutions: } 17^2 &= 8^2 + b^2 \\ 2. \text{ Formula: } c^2 &= a^2 + b^2 \\ \cos 70^\circ(20) &= b \\ a) \cos 70^\circ &= \frac{b}{20} \\ \text{Solution:} & \\ \cos \theta &= \frac{\text{adjacent}}{\text{hypotenuse}} \\ 9. 24/30 & \\ 8. 14/50 & \\ 7. 24/40 & \\ 6. 32/40 & \\ \text{Formula: } \sin \theta &= \frac{\text{opposite}}{\text{hypotenuse}} \\ 1. C & \\ 2. C & \\ 3. A & \\ 4. D & \\ 5. 30/34 & \\ 10. 27/36 & \end{aligned}$$

ADDITIONAL ACTIVITIES

PROBLEM - BASED ASSESSMENT

$$\begin{aligned} 1. \sin A &= \frac{7}{25}, \cos A = \frac{24}{25}, \tan A = \frac{7}{24} & 5. 12/35 \\ 2. \sin B &= \frac{3}{5}, \cos B = \frac{4}{5}, \tan B = \frac{3}{4} & 6. 4/3 \\ 3. \sin A &= \frac{8}{10}, \sin B = \frac{6}{10}, \cos A = \frac{6}{10} & 7. 12/13 \\ 4. \cos B &= \frac{8}{10}, \tan A = \frac{6}{8}, \tan B = \frac{6}{8} & 8. 8/17 \\ 5. 30/34 & \\ 6. 24/30 & \\ 7. 24/40 & \\ 8. 14/50 & \\ 9. 24/30 & \\ 10. 27/36 & \end{aligned}$$

WHAT I CAN DO

- The opposite side of $\angle A$ is line segment a.
- \overline{AB} is the hypotenuse.
- \overline{BC} is the shorter leg.
- \overline{AC} is the longer leg.
- The adjacent side of $\angle B$ is line segment b.
- The opposite side of $\angle B$ is line segment a.
- The adjacent side of $\angle A$ is line segment a.

WHAT'S MORE

- \overline{AB} is the hypotenuse.
- \overline{BC} is the shorter leg.
- \overline{AC} is the longer leg.
- The adjacent side of $\angle A$ is line segment a.
- The opposite side of $\angle B$ is line segment b.
- The adjacent side of $\angle B$ is line segment a.
- The opposite side of $\angle A$ is line segment a.

WHAT'S IN

- A
- B
- C
- D
- E
- F
- G
- H
- I
- J
- K
- L
- M
- N
- O
- P
- Q
- R
- S
- T
- U
- V
- W
- X
- Y
- Z

References

To further explore the concepts learned today, you may visit the following links:

<https://www.shmoop.com/trig-functions/trig-ratios.html>
https://media1.shmoop.com/images/algebra-ii/alg2_trig_graphik_3.png
<https://www.math-aids.com/Geometry/Trigonometry/>
<https://cdn.kutasoftware.com/Worksheets/Geo/9-Trigonometric%20Ratios.pdf>
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https://www.google.com/search?q=ladder&tbo=isch&ved=2ahUKEwifvdWn55TrAhUNUJQKHaAoDo4Q2-cCegQIABAA&oq=ladder&gs_lcp=CgNpbWcQAzIECCMQJzIECAAQQzIECAAQQzIECAAQQzIECAAQQzIFCAAQsQMyAggAMgIIADICCAAyAggAOgcIABCxAxBDOgcIIxDqAhAnOgQIABADUJOMFVi-oBVgjqcVaAFwAHgEgAGNAogBohKSAQUwLjcuNZgBAKABAaoBC2d3cy13aXotaW1nsAEKwAEB&sclient=img&ei=Mm0zX5_cFI2g0QSg0bjwCA&bih=568&biw=1242

Orlando A. Oronce, Marilyn O. Mendoza (2010) Work text in Mathematics e-math Advanced Algebra and Trigonometry Rex Book Store 856 Nicanor Reyes, Sr. Street 1977 C.M. Recto Avenue, Manila, Philippines

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