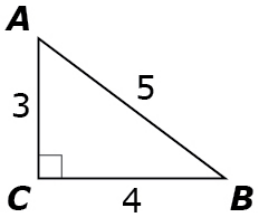
Claim 1: Concepts and Procedures Students can explain and apply mathematical concepts, and interpret and carry out mathematical procedures with precision and fluency.	
Content Domain: **Geometry**	
Target O [m]: Define trigonometric ratios and solve problems involving right triangles. (DOK 1, 2) Tasks for this target will be posed to elicit student understanding of the relationship between similar triangles and their side ratios. Other tasks will ask students to explain and use the relationship between the sine and cosine of complementary angles, some of which should appear in aspects of problems designed to elicit evidence for Claim 2. Tasks asking students to use trigonometric ratios and the Pythagorean Theorem in applied problems will contribute evidence to Claims 2 and 4.	
Standards: G-SRT.C, G-SRT.C.6, G-SRT.C.7, G-SRT.C.8	**G-SRT.C Define trigonometric ratios and solve problems involving right triangles.** **G-SRT.C.6** Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. **G-SRT.C.7** Explain and use the relationship between the sine and cosine of complementary angles. **G-SRT.C.8** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
Related Below-Grade Standards for Purposes of Planning for Vertical Scaling: 8.G.B, 8.G.B.6, 8.G.B.7, 8.G.B.8	**Related Grade 8 Standards** **8.G.B Understand and apply the Pythagorean Theorem.** **8.G.B.6.** Explain a proof of the Pythagorean Theorem and its converse. **8.G.B.7.** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. **8.G.B.8.** Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
DOK Levels:	1, 2
Achievement Level Descriptors:	
RANGE Achievement Level Descriptors (Range ALD) Target O: Define trigonometric ratios and solve problems involving	**Level 1** Students should be able to identify trigonometric ratios and use the Pythagorean Theorem to solve for the missing side in a right triangle in familiar real-world or mathematical contexts with scaffolding.
	Level 2 Students should be able to define trigonometric ratios and should know the relationship between the sine and cosine of complementary angles. They should be able to use the Pythagorean Theorem in unfamiliar problems and trigonometric ratios in familiar problems to solve for the missing side in a right triangle with some scaffolding.

right triangles.	**Level 3** Students should be able to use the Pythagorean Theorem, trigonometric ratios, and the sine and cosine of complementary angles to solve unfamiliar problems with minimal scaffolding involving right triangles, or finding the missing side or missing angle of a right triangle.
	Level 4 Students should be able to solve unfamiliar, complex, or multistep problems without scaffolding involving right triangles.
Evidence Required:	1. The student uses the definitions of trigonometric ratios for acute angles in a right triangle. 2. The student uses similar triangles to define and determine trigonometric ratios in right triangles. 3. The student explains and uses the relationship between the sine and cosine of complementary angles. 4. The student uses the Pythagorean Theorem and trigonometric ratios to solve problems involving right triangles in mathematical or real-world context.
Allowable Response Types:	Multiple Choice, single correct response; Multiple Choice, multiple correct response; Equation/Numeric; Matching Table
Allowable Stimulus Materials:	right triangles, coordinate plane
Construct-Relevant Vocabulary:	trigonometry, trigonometric ratio, right triangle, sine, cosine, tangent, side, Pythagorean Theorem
Allowable Tools:	calculator (varies by task model)
Target-Specific Attributes:	
Non-Targeted Constructs:	
Accessibility Guidance:	Item writers should consider the following Language and Visual Element/Design guidelines[1] when developing items. Language Key Considerations: • Use simple, clear, and easy-to-understand language needed to assess the construct or aid in the understanding of the context • Avoid sentences with multiple clauses • Use vocabulary that is at or below grade level • Avoid ambiguous or obscure words, idioms, jargon, unusual names and references Visual Elements/Design Key Considerations: • Include visual elements only if the graphic is needed to assess the construct or it aids in the understanding of the context • Use the simplest graphic possible with the greatest degree of contrast, and include clear, concise labels where necessary • Avoid crowding of details and graphics

[1] For more information, refer to the General Accessibility Guidelines at: http://www.smarterbalanced.org/wordpress/wp-content/uploads/2012/05/TaskItemSpecifications/Guidelines/AccessibilityandAccommodations/GeneralAccessibilityGuidelines.pdf

	Items are selected for a student's test according to the blueprint, which selects items based on Claims and targets, not task models. As such, careful consideration is given to making sure fully accessible items are available to cover the content of every Claim and target, even if some item formats are not fully accessible using current technology.[2]
Development Notes:	None

[2] For more information about student accessibility resources and policies, refer to http://www.smarterbalanced.org/wordpress/wp-content/uploads/2014/08/SmarterBalanced_Guidelines.pdf

Task Model 1 **Response Type: Multiple Choice, single correct response** **DOK Level 1** **G-SRT.C.6** Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. **Evidence Required:** 1. Student uses the definitions of trigonometric ratios for acute angles in a right triangle. **Tools:** None	**Prompt Features:** The student is prompted to identify the value of sine, cosine, or tangent for a given angle. **Stimulus Guidelines:** • Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles. • Right triangles have measures for sides or angles. • Right triangles may have unknown sides or angles that can be determined using trigonometric ratios. • Side lengths should be limited to less than 40. • Side lengths may be whole numbers or simple expressions. • Difficulty level can be altered by requiring basic definitions of the trigonometric ratios or by applying the trigonometric ratios to find lengths of sides of a right triangle, etc. **TM1a** **Stimulus:** The student is presented with a right triangle that has given side lengths. **Example Stem:** Consider this right triangle.  What is the value of sin(B)? A) $\frac{4}{5}$ B) $\frac{5}{3}$ C) $\frac{3}{5}$ D) $\frac{3}{4}$ **Rubric:** (1 Point) The student selects the correct number (C). **Response Type:** Multiple Choice, single correct response

Task Model 1

Response Type: Matching Table

DOK Level 1

G-SRT.C.6
Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

Evidence Required:
1. Student uses the definitions of trigonometric ratios for acute angles in a right triangle.

Tools: None

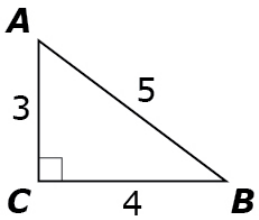
Prompt Features: The student is prompted to identify the value of sine, cosine, or tangent for a given angle.

Stimulus Guidelines:

- Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles.
- Right triangles have measures for sides or angles.
- Right triangles may have unknown sides or angles that can be determined using trigonometric ratios.
- Side lengths should be limited to less than 40.
- Side lengths may be whole numbers or simple expressions.
- Difficulty level can be altered by requiring basic definitions of the trigonometric rations, or by applying the trigonometric ratios to find lengths of sides of a right triangle, etc.

TM1b
Stimulus: The student is presented with a right triangle that has given side lengths.

Example Stem: Consider this right triangle.

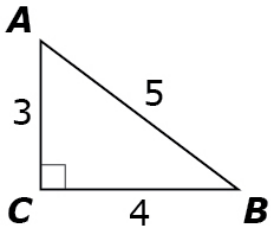


Determine whether each equation is correct. Select Yes or No for each equation.

	Yes	No
$\sin(A) = \frac{4}{5}$		
$\cos(A) = \frac{5}{3}$		
$\sin(B) = \frac{3}{5}$		
$\cos(B) = \frac{3}{4}$		

Rubric: (1 Point) The student chooses the correct option for each equation (e.g., YNYN).

Response Type: Matching Table

Task Model 1 **Response Type: Equation / Numeric** **DOK Level 1** **G-SRT.C.6** Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. **Evidence Required:** 1. Student uses the definitions of trigonometric ratios for acute angles in a right triangle. **Tools:** None	**Prompt Features:** The student is prompted to identify the value of sine, cosine, or tangent for a given angle. **Stimulus Guidelines:** • Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles. • Right triangles have measures for sides or angles. • Right triangles may have unknown sides or angles that can be determined using trigonometric ratios. • Side lengths should be limited to less than 40. • Side lengths may be whole numbers or simple expressions. • Difficulty level can be altered by requiring basic definitions of the trigonometric ratios, or by applying the trigonometric ratios to find lengths of sides of a right triangle, etc. **TM1c** **Stimulus:** The student is presented with a right triangle that has given side lengths. **Example Stem:** Consider this right triangle.  Enter the value of sin(*B*). **Rubric:** (1 Point) The student enters the correct value (e.g., $\frac{3}{5}$). **Response Type:** Equation/Numeric

Task Model 2

Response Type: Multiple Choice, multiple correct response

DOK Level 1

G-SRT.C.6
Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

Evidence Required:
2. Student uses similar triangles to define and determine trigonometric ratios in right triangles.

Tools: Calculator

Prompt Features: The student is prompted to identify which angle or angles in each triangle have a given trigonometric ratio.

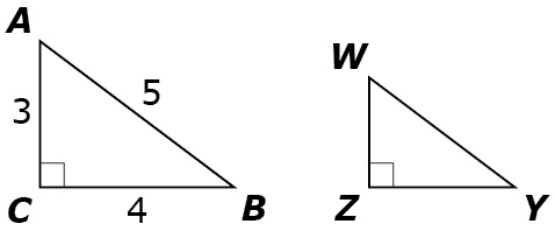
Stimulus Guidelines:

- Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles.
- Right triangles have measures for sides or angles.
- Right triangles may have unknown side lengths that can be determined using trigonometric ratios.
- Side lengths should be limited to less than 40.
- Side lengths may be whole numbers or simple expressions.
- Difficulty level can be altered by asking students to compare trigonometric ratios of similar right triangles, comparing right triangles with different orientation, etc.

TM2

Stimulus: The student is presented with two right triangles that are similar and asked to identify the angle or angles that satisfy a trigonometric ratio.

Example Stem: Triangle ABC is similar to triangle WYZ.



Select all angles whose tangent equals $\frac{3}{4}$.

A) $\angle A$
B) $\angle B$
C) $\angle C$
D) $\angle W$
E) $\angle Y$
F) $\angle Z$

Rubric: (1 point) The student correctly identifies all angles (e.g., B, E).

Response Type: Multiple Choice, multiple correct response

Task Model 3 **Response Type: Equation / Numeric** **DOK Level 1** **G-SRT.C.7** Explain and use the relationship between the sine and cosine of complementary angles. **Evidence Required:** 3. Student explains and uses the relationship between the sine and cosine of complementary angles. **Tools:** Calculator	**Prompt Features:** The student is prompted to write the angle measure that will satisfy an equation. **Stimulus Guidelines:** • Stimuli may include sine or cosine of a specified angle less than 90 degrees and its value, or • sine or cosine of a missing angle with the same value as the given angle. • Difficulty level can be altered by asking students to write the angle measure of complementary angles when comparing the sine and cosine value, compare the sine and cosine values of various angle measures, etc. **TM3** **Stimulus:** The student is given the value (as a fraction or a decimal) of the sine or cosine for a specified angle and asked to fill in the blank for an equation involving the sine or cosine of the complement with the same value. **Example Stem 1:** Let $\sin(47°) = 0.7314$. Enter an angle measure (β), in degrees, where $\cos(\beta) = 0.7314$. **Example Stem 2:** Let $\sin(30°) = \frac{1}{2}$. Enter the angle measure (β), in degrees, for $\cos(\beta) = \frac{1}{2}$. **Rubric**: (1 point) The student enters the correct angle that can be used to satisfy the equation. Example Stem 1: any value so that 360*n*+/-43 where *n* is an integer. Example Stem 2: any value so that 60(6*n*+/-1) where *n* is an integer. **Response Type:** Equation/Numeric

Task Model 4

Response Type: Matching Table

DOK Level 2

G-SRT.C.8
Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Evidence Required:
4. Student uses the Pythagorean Theorem and trigonometric ratios to solve problems involving right triangles in mathematical or real-world context.

Tools: Calculator

Prompt Features: The student is prompted to identify true or false statements about two similar triangles. The lengths of two sides of one triangle and one side of the second triangle are labeled.

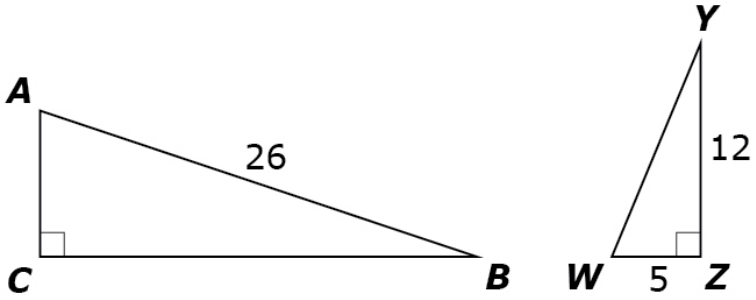
Stimulus Guidelines:

- Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles.
- Right triangles have measures for sides or angles.
- Right triangles may have unknown sides or angles that can be determined using trigonometric ratios.
- Side lengths should be limited to less than 40.
- Side lengths may be whole numbers or simple expressions.
- Difficulty level can be altered by asking students to find the side or angle that can be found using a trigonometric expression, use knowledge of trigonometric ratios and Pythagorean Theorem to find a missing side length or angle measure in a right triangle, to solve for an angle measure or distance, given a verbal description of a situation where trigonometric ratios can be used, etc.

TM4a

Stimulus: The student is presented with two similar triangles. The lengths of two sides of one triangle and one side of the second triangle are labeled.

Example Stem: Triangle ABC is similar to triangle WYZ.



Determine whether each statement is true. Select True or False for each statement.

	True	False
$\sin(A) < \sin(Y)$		
$\cos(B) = \sin(W)$		
$\tan(W) > \tan(A)$		

Rubric: (1 point) The student evaluates each statement correctly (e.g., FTF).

Response Type: Matching Table

Task Model 4

Response Type: Matching Table

DOK Level 1

G-SRT.C.8
Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Evidence Required:
4. Student uses the Pythagorean Theorem and trigonometric ratios to solve problems involving right triangles in mathematical or real-world context.

Tools: Calculator

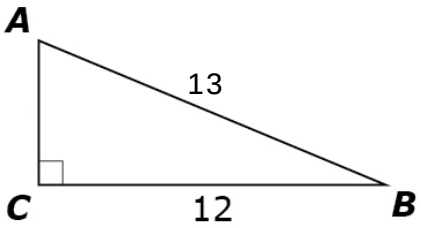
Prompt Features: The student is prompted to determine trigonometric functions that can be used to find a side length of a right triangle.

Stimulus Guidelines:

- Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles.
- Right triangles have measures for sides or angles.
- Right triangles may have unknown sides or angles that can be determined using trigonometric ratios.
- Side lengths should be limited to less than 40.
- Side lengths may be whole numbers or simple expressions.
- Difficulty level can be altered by asking students to find the side or angle that can be found using a trigonometric expression, use knowledge of trigonometric ratios and Pythagorean Theorem to find a missing side length or angle measure in a right triangle, to solve for an angle measure or distance, given a verbal description of a situation where trigonometric ratios can be used, etc.

TM4b
Stimulus: The student is presented with a right triangle and two side lengths or a side and an angle measure and asked to write the trigonometric equation used to solve for a side or angle.

Example Stem: Consider this right triangle.

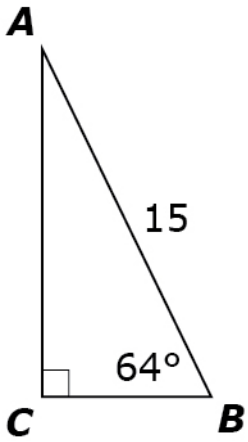


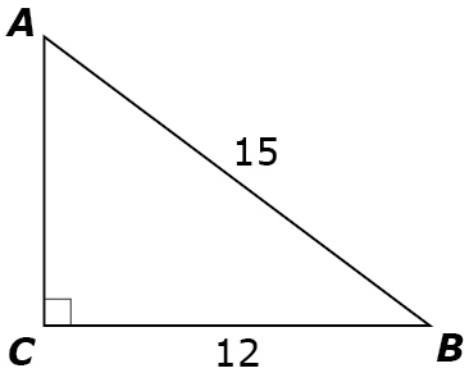
Determine whether each expression can be used to find the length of $\overline{AC}$. Select Yes or No for each expression.

	Yes	No
13sin(*B*)		
13cos(*A*)		
12tan(*A*)		
12tan(*B*)		

Rubric:
(1 point) The student selects the correct response for each expression (e.g., YYNY).

Response Type: Matching Table

Task Model 4 **Response Type: Equation / Numeric** **DOK Level 2** **G-SRT.C.8** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. **Evidence Required:** 4. Student uses the Pythagorean Theorem and trigonometric ratios to solve problems involving right triangles in mathematical or real-world context. **Tools:** Calculator	**Prompt Features:** The student is prompted to solve for a missing side in a right triangle using trigonometric ratios. **Stimulus Guidelines:** • Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles. • Right triangles have measures for sides or angles. • Right triangles may have unknown sides or angles that can be determined using trigonometric ratios. • Side lengths should be limited to less than 40. • Side lengths may be whole numbers or simple expressions. • Difficulty level can be altered by asking students to find the side or angle that can be found using a trigonometric expression, use knowledge of trigonometric ratios and Pythagorean Theorem to find a missing side length or angle measure in a right triangle, to solve for an angle measure or distance, given a verbal description of a situation where trigonometric ratios can be used, etc. **TM4c** **Stimulus:** The student is presented with a right triangle and asked to find a missing side using information given in the problem. **Example Stem:** Consider this right triangle.  Enter the length of $\overline{AC}$, to the nearest tenth. **Rubric:** (1 point) The student enters the correct side length (e.g., 13.5). **Response Type:** Equation/Numeric

Task Model 4 **Response Type: Equation / Numeric** **DOK Level 2** **G-SRT.C.8** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. **Evidence Required:** 4. Student uses the Pythagorean Theorem and trigonometric ratios to solve problems involving right triangles in mathematical or real-world context. **Tools:** Calculator	**Prompt Features:** The student is prompted to solve for a missing angle in a right triangle using trigonometric ratios. **Stimulus Guidelines:** • Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles. • Right triangles have measures for sides or angles. • Right triangles may have unknown sides or angles that can be determined using trigonometric ratios. • Side lengths should be limited to less than 40. • Side lengths may be whole numbers or simple expressions. • Difficulty level can be altered by asking students to find the side or angle that can be found using a trigonometric expression, use knowledge of trigonometric ratios and Pythagorean Theorem to find a missing side length or angle measure in a right triangle, to solve for an angle measure or distance, given a verbal description of a situation where trigonometric ratios can be used, etc. **TM4d** **Stimulus:** The student is presented with a right triangle and asked to find a missing angle using information given in the problem. **Example Stem:** Consider this right triangle.  Enter the measure of $\angle A$, to the nearest degree. **Rubric:** (1 point) The student enters the correct angle measure (e.g., 53). **Response Type:** Equation/Numeric

Task Model 4

Response Type: Multiple Choice, multiple correct response

DOK Level 1

G-SRT.C.8
Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Evidence Required:
4. Student uses the Pythagorean Theorem and trigonometric ratios to solve problems involving right triangles in mathematical or real-world context.

Tools: Calculator

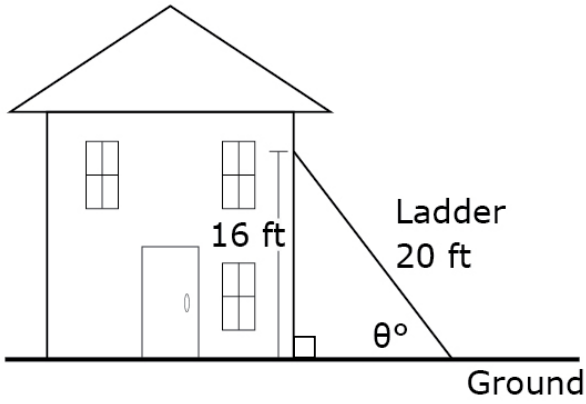
Prompt Features: The student is prompted to identify the equation for a missing angle in a right triangle given real-world context by using the Pythagorean Theorem and trigonometric ratios.

Stimulus Guidelines:

- Two of the side lengths are known.
- The student may be given information about the triangle in the preamble and/or a picture.
- It must be a right triangle.
- Difficulty level can be altered by giving students a verbal description and a picture, or by giving them a verbal description only, etc.

TM4e
Stimulus: The student is presented with a right triangle in a real-world context.

Example Stem: Bob uses a 20 foot ladder to paint a section of his house that is 16 feet high.



Select **all** equations that can be used to solve for Θ.

A. $\sin\theta = \frac{12}{20}$

B. $\cos\theta = \frac{12}{20}$

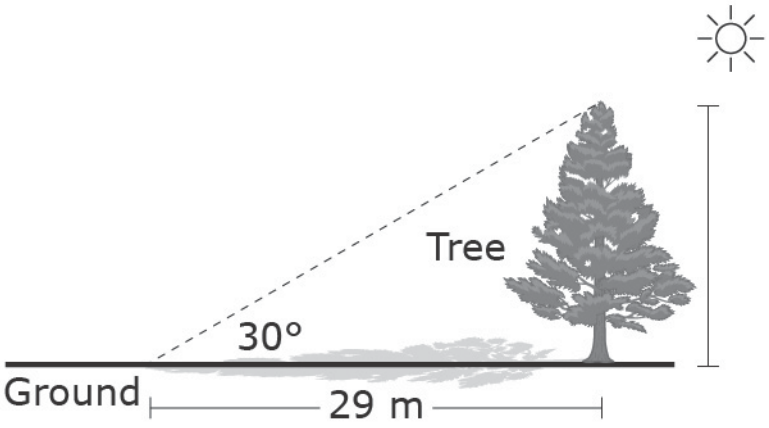
C. $\tan\theta = \frac{12}{20}$

D. $\sin\theta = \frac{16}{20}$

E. $\cos\theta = \frac{16}{20}$

F. $\tan\theta = \frac{16}{20}$

Rubric: (1 point) The student is able to identify all correct equations (e.g., B, D).
Response Type: Multiple Choice, multiple correct response

Task Model 4 **Response Type: Equation / Numeric** **DOK Level 2** **G-SRT.C.8** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. **Evidence Required:** 4. Student uses the Pythagorean Theorem and trigonometric ratios to solve problems involving right triangles in mathematical or real-world context. **Tools:** Calculator	**Prompt Features:** The student is asked to find a missing side length or angle measure of a right triangle that can be used to model a real-world situation. Examples of right triangles in context include but are not limited to: survey problems, height of an object, navigation, ramps, shadows, etc. **Stimulus Guidelines:** • Two of the side lengths are known. • The student may be given information about the triangle in the preamble and/or a picture. • It must be a right triangle. • Difficulty level can be altered by giving students a verbal description and a picture, or by giving them a verbal description only, etc. **TM4f** **Stimulus:** The student is provided with information in context to be able to create a situation in which a right triangle can be created to help solve a problem in context. A picture may/may not be provided. **Example Stem:** Donna wants to calculate the height of a tree. She makes the following measurements. • The length of the tree's shadow is 29 meters. • The angle of elevation from the ground to the top of the tree is 30°. • The tree stands perpendicular to the ground.  Enter the height of the tree, in meters. Round your answer to the nearest whole meter. **Rubric:** (1 point) The student finds the missing side of the right triangle (e.g., 17). **Response Type:** Equation/Numeric