

HS Statistics, Geometry and Number & Quantity - SBA Claim 1 Example Stems

This document takes publicly available information about the Smarter Balanced Assessment (SBA) in Mathematics, namely the Claim 1 Item Specifications, and combines and edits them down to hopefully be more useful for teachers and others. The SBA Consortium is not involved in producing this document, so editing choices do not reflect any guidance from the SBA Consortium.

The SBA uses evidence based design, viewing the assessment as eliciting evidence of student proficiency. That evidence is meant to support Claims, which in math are (to paraphrase):

1. A student understands **concepts** and can perform **procedures**.
2. A student can **solve problems**.
3. A student can **reason** (and critique the reasoning of others).
4. A student can analyze and **model real-world contexts** using mathematics.

These claims will be assessed in a roughly 40%-20%-20%-20% split. Given that previous assessments would heavily focus on procedures, while in this framework they constitute 20% as a focus (though of course are needed for items across all claims), this represents a significant shift in assessment.

This document only looks at Claim 1 about concepts and procedures. Items written for Claim can look much like the Example Stems below. At other Claims items can vary more widely, as one would expect for multistep problems and authentic reasoning or modeling contexts.

Claim 1 is divided into various Targets which correspond roughly to the Clusters within the Common Core State Standards in Mathematics. The items from different targets will be taken based on emphasis with [m] being major, [a] additional and [s] supporting.

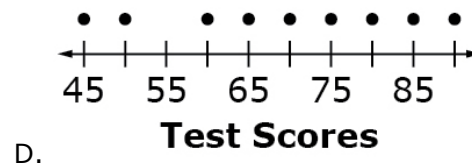
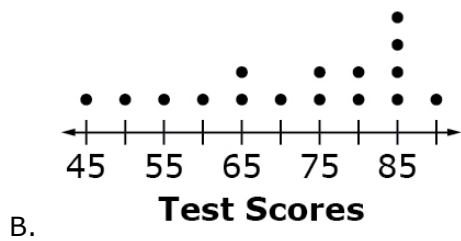
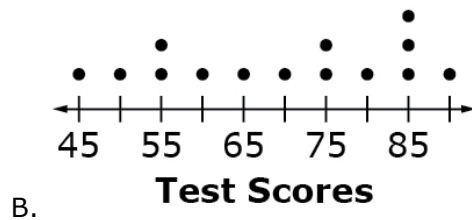
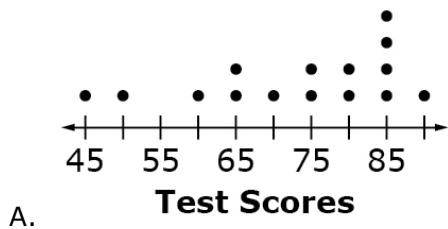
Finally, in an era of anxiety about end-of-year assessment (which constitutes only part of the Smarter Balanced system), it should be said that these are offered primarily to promote teacher professional understanding. Practices such as using the Example Stems exclusively as learning targets are discouraged. SBA is designed as much as possible to assess authentic learning of mathematics as outlined in the Standards, so that authentic learning should guide instruction.

Target P [m]: Summarize, represent, and interpret data on a single count or measurement variable. (DOK 1, 2)

Stimulus: The student is presented with a contextual data set.

Example Stem 1: Select the dot plot that represents the given test scores.

90, 45, 85, 70, 85, 50, 75, 85, 65, 75, 60, 85, 80, 65, 80

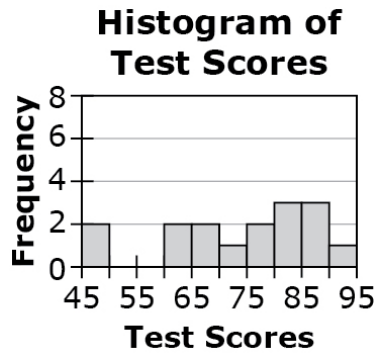


Rubric: (1 point) The student selects the correct option (e.g., A).

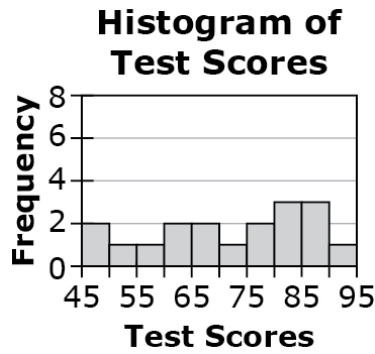
Example Stem 2: Select the histogram that represents the given test scores.

91, 48, 86, 73, 86, 49, 77, 86, 64, 78, 64, 82, 68, 82, 68, 82

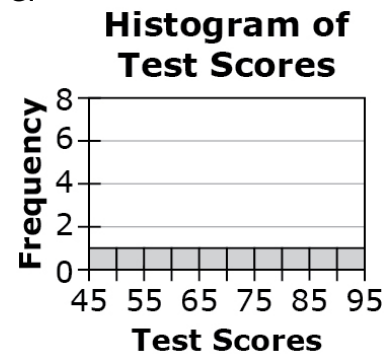
A.



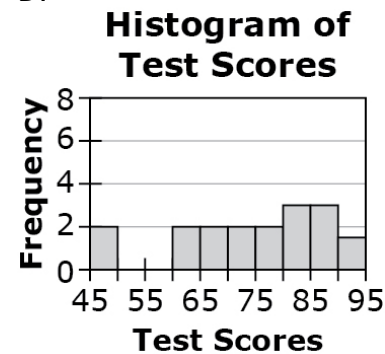
B.



C.



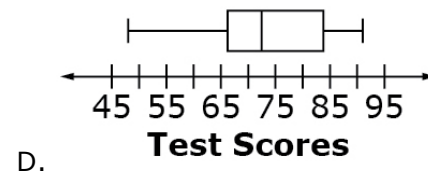
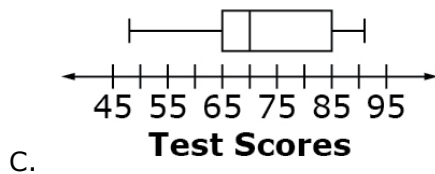
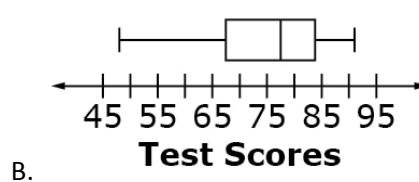
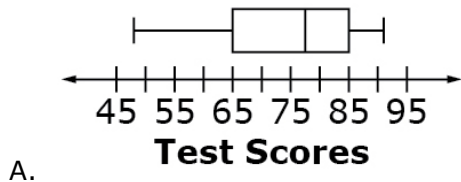
D.



Rubric: (1 point) The student selects the correct option (e.g., A).

Example Stem 3: Select the box plot that represents the given test scores.

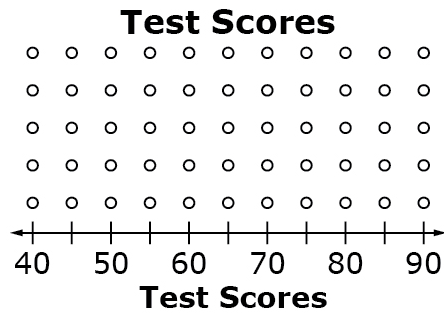
91, 48, 86, 73, 86, 50, 77, 86, 64, 78, 64, 82, 68, 82, 68, 82



Stimulus: The student is presented with a contextual data set and a blank plot to be completed in order to represent the data.

Example Stem 1: Click above the numbers to create a dot plot for the given test scores.

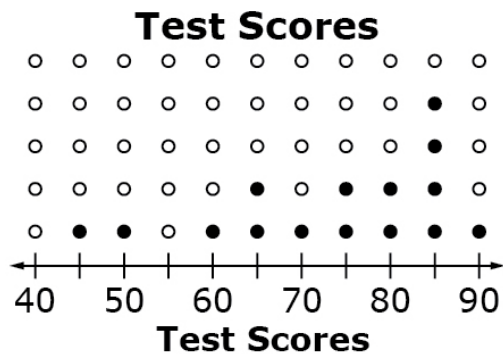
90, 45, 85, 70, 85, 50, 75, 85, 65, 75, 60, 85, 80, 65, 80



Interaction: Student selects the appropriate number of circles on the dot plot given the data.

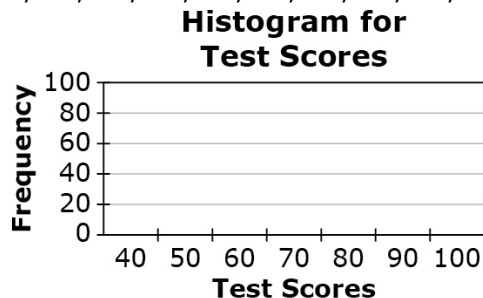
Rubric:

(1 point) Student gets 100% correct (see below).



Example Stem 2: Click above the line to create a histogram for the given test scores.

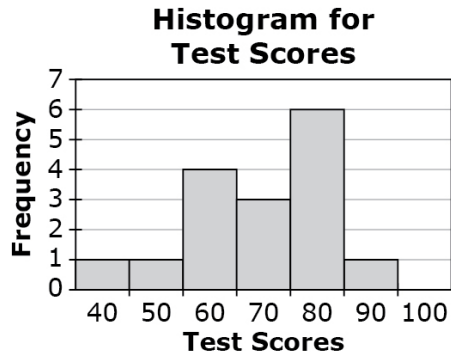
91, 48, 86, 73, 86, 50, 77, 86, 64, 78, 64, 82, 68, 82, 68, 82



Interaction: Student selects the appropriate frequency for each interval on the histogram.

Rubric:

(1 point) Student gets 100% correct (see below).



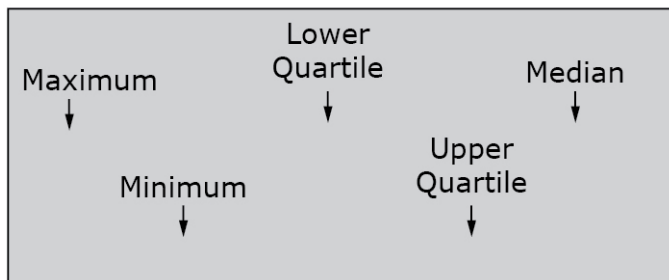
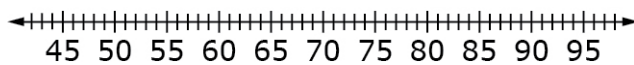
Response Type: Hot Spot

Stimulus: The student is presented with a contextual data set, key features of box plots, and a number line.

Example Stem: Consider these test scores.

91, 48, 86, 73, 86, 50, 77, 86, 64, 78, 64, 82, 68, 82, 68, 82

Drag each characteristic of data to the correct location on the number line.



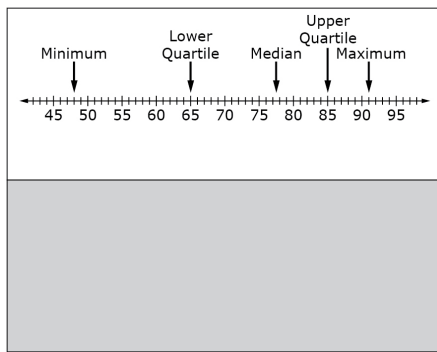
Interaction: Student drags each characteristic to the appropriate location on the number line.

Rubric:

(2 points) Student gets all five characteristics correct.

(1 point) Student gets three or four characteristics correct.

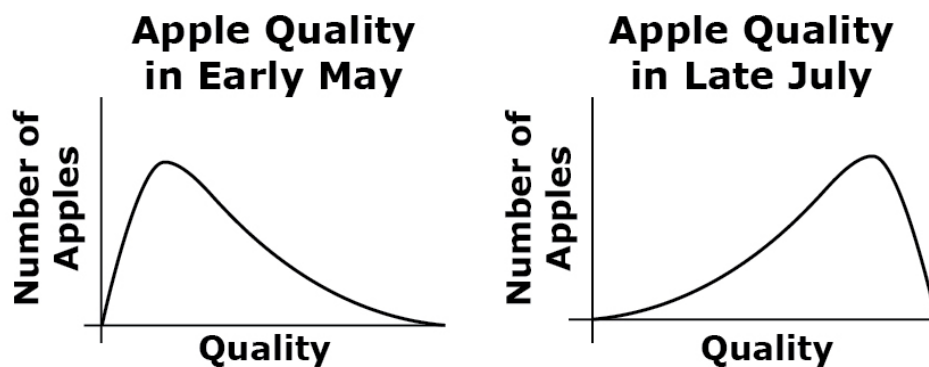
Reasoning: Knowing the minimum, maximum, and median of a data set is one level of understanding, knowing the quartile is another.



Response Type: Drag and Drop

Stimulus: The student is presented with two data distributions in which both are skewed or both are distributed normally.

Example Stem: Data distributions are shown for the quality of a farm's red apples at different points in time during the harvest season.



Which summary statistics should be used to compare the two data sets and why?

- A. The median and the interquartile range because the data sets are normally distributed.
- B. The median and the interquartile range because both data sets are skewed.
- C. The mean and standard deviation because the data sets are normally distributed.
- D. The mean and standard deviation because both data sets are skewed.

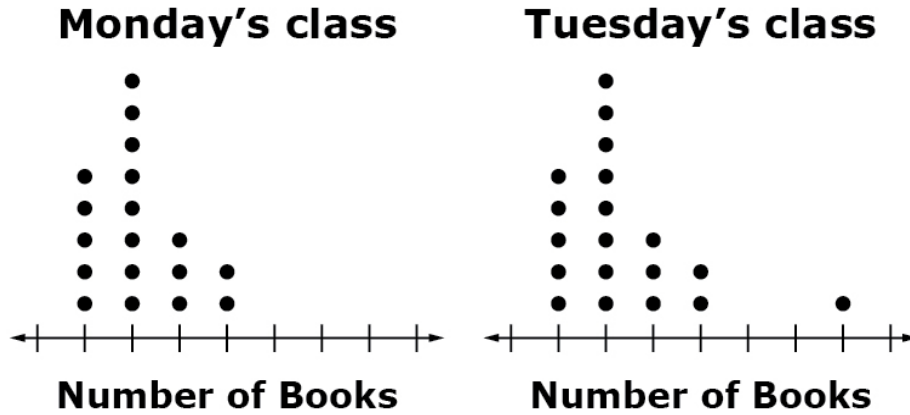
Rubric: (1 point) The student selects the correct option (e.g., B).

Response Type: Multiple Choice, single correct response

Stimulus: The student is presented with data sets or plots of data sets.

- Graphs and data sets should include at least 1 outlier.
- Graphs and data sets should each have no more than 20 data values.

Example Stem 1: On Monday, Mr. Dickens asked his class how many books they read last month and set up a dot plot showing the information. On Tuesday, Walter joined the class and his information was added to the dot plot.



Select whether the value of each statistic, for the number of books read, is greater for Monday's class, equal for both days, or greater for Tuesday's class based on the dot plots.

	Greater for Monday's Class	Equal for Both Days	Greater for Tuesday's Class
Mean			
Median			
Standard Deviation			

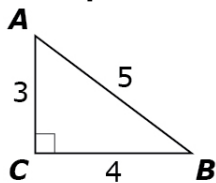
Interaction: Student selects the correct box for each statistic.

Target O [m]: Define trigonometric ratios and solve problems involving right triangles. (DOK 1, 2)

Note: Geometric proofs are assessed in Claim 3, about reasoning. Claim 1 questions about concepts and procedures focus on right triangles.

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

Example Stem: Consider this right triangle.



Select the ratio equivalent to $\sin(B)$.

A) $\frac{4}{5}$

B) $\frac{5}{3}$

C) $\frac{3}{5}$

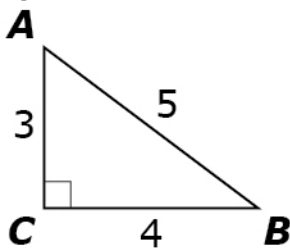
D) $\frac{3}{4}$

Rubric: (1 Point) The student selects the correct ratio (e.g., C).

Response Type: Multiple Choice, single correct response

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

Example Stem: Consider this right triangle.



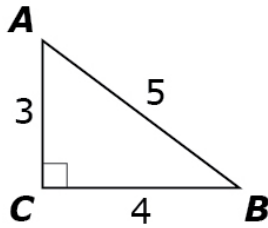
Determine whether each equation is correct. Select Yes or No for each equation.

	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).

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

Example Stem: Consider this right triangle.

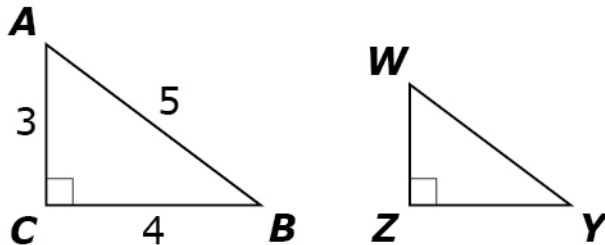


Enter the ratio equivalent to $\sin(B)$.

Rubric: (1 Point) The student enters the correct value (e.g., $\frac{3}{5}$).

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) A B) B C) C
D) W E) Y F) Z

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

Response Type: Multiple Choice, multiple correct response

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, $\sin(47^\circ) = 0.7314$. Enter the angle measure (β), in degrees, for $\cos(\beta) = 0.7314$.

Example Stem 2: Let, $\sin(30^\circ) = \frac{1}{2}$. 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.

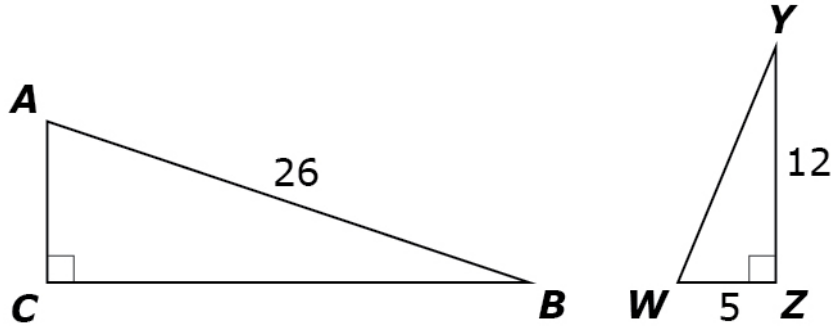
Example Stem 1: any value so that $360n+43$ where n is an integers.

Example Stem 2: any value so that $60(6n+1)$ where n is an integer.

Response Type: Equation/Numeric

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.

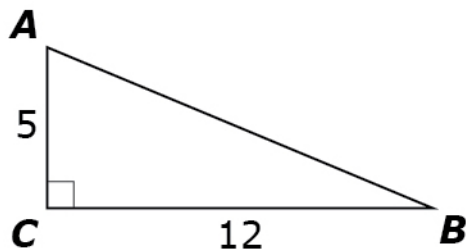
	True	False
$\sin(A) < \sin(Y)$		
$\cos(B) = \sin(W)$		
$\tan(W) > \tan(A)$		

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

Response Type: Matching Tables

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.

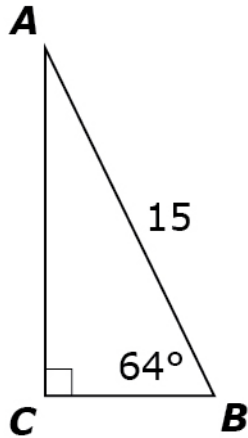
	Yes	No
$13\sin(B)$		
$13\cos(A)$		
$12\tan(A)$		
$12\tan(B)$		

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

Response Type: Matching Tables

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.

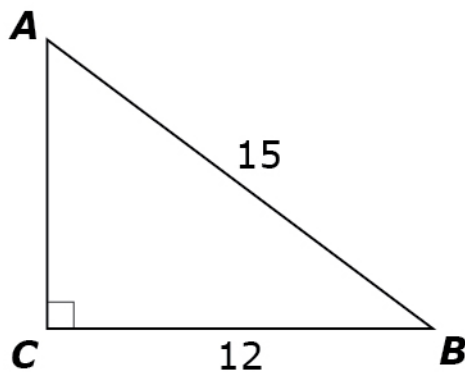
Rubric:

(1 point) The student enters the correct side length (e.g., 13.5).

Response Type: Equation/Numeric

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.

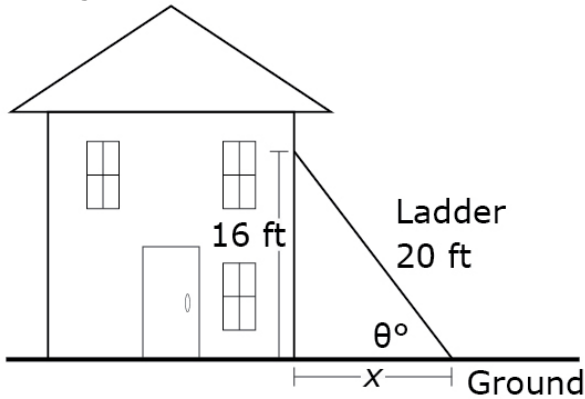
Rubric:

(1 point) The student enters the correct angle measure (e.g., 53).

Response Type: Equation/Numeric

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

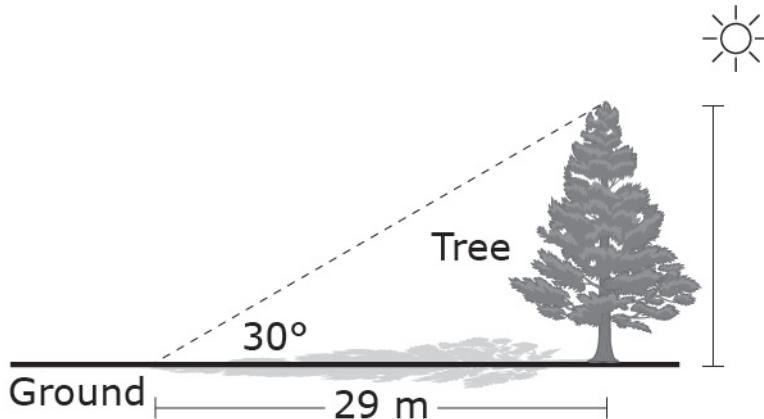
Rubric: (1 point) The student is able to identify all correct equations (e.g., B,D).

Response Type: Multiple Choice, multiple correct response

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° .



Enter the height of the tree, in meters. Round your answer to the nearest whole meter.

Target C [m]: Reason quantitatively and use units to solve problems. (DOK 1, 2)

Stimulus: The student is presented with a formula that uses measurements given in different units.

Example Stem: Given the formula, $K = \frac{1}{2}mv^2$ where

- K represents kinetic energy,
- m represents mass and has units of kilograms (kg), and
- v represents velocity and has units of meters per second (m/s).

Select an appropriate measurement unit for kinetic energy.

- A. $\frac{kg\ m^2}{s}$
- B. $\frac{kg^2\ m^2}{s^2}$
- C. $\frac{kg\ m}{s^2}$
- D. $\frac{kg\ m^2}{s^2}$

Rubric: (1 point) Student selects the correct response (e.g., D).

Stimulus: The student is presented with a context in which a number needs converting of units.

Example Stem: The density of water at a certain temperature is $62.4 \frac{lb}{ft^3}$.

Drag a rate or quantity from the box to each blank to calculate the density of water in units of kilograms per cubic meter, $\frac{kg}{m^3}$.

	•		•	
$62.4\ lb$		$3.28\ ft$		$2.205\ kg$
$\frac{1\ kg}{2.205\ lb}$		$\frac{3.28\ ft}{1\ m}$		$\frac{62.4\ lb}{1\ ft^3}$
$\frac{62.4\ lb^3}{1\ ft^3}$		$\frac{3.28\ ft^3}{1\ m}$		$\frac{2.205\ lb}{1\ kg}$
$\left(\frac{3.28\ ft}{1\ m}\right)^3$		$\left(\frac{1\ kg}{2.205\ lb}\right)^3$		$\left(\frac{62.4\ lb}{1\ ft}\right)^3$

Interaction: The student drags and drops the correct rate or quantify from the box in order to calculate the density of water in $\frac{kg}{m^3}$.

Rubric: (1 point) The student chooses the following correct three rates or quantities (order does not matter): $\frac{62.4 lb}{1 ft^3}$, $(\frac{3.28 ft}{1 m})^3$, $\frac{1 kg}{2.205 lb}$

One such ordering would be: $\frac{62.4 lb}{1 ft^3} \cdot (\frac{3.28 ft}{1 m})^3 \cdot \frac{1 kg}{2.205 lb}$.

Response Type: Drag and Drop

Stimulus: The student is presented with a contextual situation.

Example Stem 2: Carla borrowed \$18,000 to start a business. Her business earnings averaged \$350 per week for the first 10 weeks. Her earnings averaged \$500 for the next 10 weeks. Carla's balance, y , in any week, x , is equal to her total earnings minus the amount she borrowed.

Select as few quadrants as possible that would allow you to create a graph of Carla's balance over the first 20 weeks.

- A. Quadrant 1
- B. Quadrant 2
- C. Quadrant 3
- D. Quadrant 4

Rubric: (1 point) The student selects the correct responses (e.g., A; D).

Response Type: Multiple Choice

Target A [m]: Extend the properties of exponents to rational exponents.

Stimulus: The student will be presented with an expression of the form $\sqrt[q]{p^r}$.

Example Stem: Select an expression that is equivalent to $\sqrt[9]{3^6}$.

- A. $3^{\frac{2}{3}}$
- B. $3^{\frac{3}{2}}$
- C. 3^3
- D. 3^{15}

Rubric: (1 point) The student correctly selects the equivalent rational form (e.g., A).

Stimulus: The student will be presented with an expression of the form $p^{\frac{r}{q}}$.

Example Stem: Select an expression that is equivalent to $3^{\frac{6}{9}}$.

- A. $\sqrt[9]{3^6}$
- B. $\sqrt[6]{3^9}$
- C. $\sqrt{3^3}$
- D. $\sqrt[3]{3}$

Rubric: (1 point) The student correctly selects the equivalent radical form (e.g. A).

Response Type: Multiple Choice, single correct response

Stimulus: The student will be presented with an expression of the form $p^{\frac{r}{q}}$.

Example Stem 1: Determine whether each expression is equivalent to $x^{\frac{5}{3}}$. Select Yes or No for each expression.

	Yes	No
\sqrt{x}		
$\sqrt[3]{x^5}$		
$\sqrt[5]{x^3}$		
$\sqrt{x^{\frac{5}{3}}}$		

Stimulus: The student will be presented with an expression in the form $p^{\frac{r}{q}} \cdot p^{\frac{s}{t}}$.

Example Stem 1: Select an expression that is equivalent to $16^{\frac{1}{4}} \cdot 16^{\frac{2}{3}}$.

- A. $\sqrt[12]{16^{11}}$
- B. $\sqrt[7]{16^3}$
- C. $\sqrt[12]{16^2}$
- D. $\sqrt[6]{16^4}$

Stimulus: The student will be presented with an expression of the form $p^{\frac{r}{q}}(\sqrt[t]{p^s} + p^m)$.

Example Stem: Select an expression that is equivalent to $8^{\frac{1}{3}}(\sqrt[3]{8^2} + 8^2)$.

- A. $\sqrt{8^9} + 8^{\frac{3}{7}}$
- B. $\sqrt[3]{8^3} + 8^{\frac{7}{3}}$
- C. $\sqrt[7]{8^3} + 8^{\frac{3}{2}}$
- D. $\sqrt[9]{8^2} + 8^{\frac{7}{3}}$

Rubric: (1 point) The student correctly selects the equivalent radical form (e.g., C).

Response Type: Multiple Choice, single correct response

Stimulus: The student will be presented with an equation of the form $\frac{p^{\frac{r}{q}}}{p^{\frac{s}{t}}} = \sqrt[n]{p^m}$.

- $m, n, q, r, s,$ or t may be replaced with a variable.

Example Stem: Enter the value of x such that $\frac{16^{\frac{5}{4}}}{16^x} = \sqrt[3]{16^3}$ is true.

Rubric: (1 point) The student enters the correct value of the variable. (e.g., 4).

Response Type: Equation/Numeric

Stimulus: The student will be presented with an expression of the form $p^{\frac{r}{q}} \cdot \sqrt[t]{p^s}$.

Example Stem 1: Select an expression that is equivalent to $5^{\frac{3}{8}} \cdot \sqrt[4]{5^2}$.

- A. $5^{\frac{6}{32}}$
- B. $5^{\frac{5}{12}}$
- C. $5^{\frac{12}{16}}$
- D. $5^{\frac{7}{8}}$