Checkpoint Results Interpretation Guide

Geometry

Tennessee Department of Education | August 2020

The Checkpoint

The Checkpoint can be used at the beginning of the school year to measure retention on **key standard-aligned skills that are most essential** for students to be able to **access, and engage in, on-grade-level content** for the current year. Because of this, the Checkpoints are smaller than a summative TCAP assessment and do not cover all the standards from the previous year. Instead, as recommended by experts[1], they focus on fewer, **prioritized vertically-aligned standards**, with the intent of providing educators more meaningful and actionable information about student needs so you can support your students' ability to access grade-level learning throughout the year.

The Geometry Math Checkpoint should be given to students who completed Geometry in 2019-20 to assist in determining readiness to access higher level math content this year.

To help students in their learning and teachers with their planning, Checkpoints come with fully **annotated questions** that help to understand trends and pinpoint misconceptions that may inhibit student progress. ***Using this Checkpoint Results Interpretation Guide (the Guide) and your student results data found in the Schoolnet platform, you and your students can plan for great academic success this year.***

It is best to use these results to identify any needed pre-requisite learning and incorporate it throughout the year to ensure students can access grade-level content or can build upon their current strengths. After you administer the Checkpoint and use this Guide to better meet student needs at the beginning of the year, **continue monitoring** your students' progress on **grade-appropriate assignments** for the rest of the year to ensure that these core foundations are continually strengthened.

The Checkpoint IS:

- an investigative tool to determine student readiness for the major work of the current grade
- aligned to the Tennessee State Academic Standards, using TN-educator reviewed questions from previous TCAP exams
- designed to identify student misconceptions and learning needs
- providing actionable next steps for informing instructional decisions

The Checkpoint IS NOT:

- a replacement for the performance level determinaions a student would have received on the TCAP assessment
- predictive of, or comparable to, summative TCAP results
- a replacement for RTI2 diagnostics or universal screeners
- used to evaluate teacher, school, or district performance
- a tool to change student placement decisions (e.g. retake a course, advance to honors)

[1] https://tntp.org/assets/covid-19-toolkit-resources/TNTP_Learning_Acceleration_Guide.pdf

Contents of this Guide

"When the COVID-19 pandemic forced prolonged school building closures and canceled spring assessments, it became even more important that districts and schools can reliably gather student data and understand student readiness for the next school year. These free and optional tools are one way the department can support the needs of our district partners in serving all students"

-Commissioner Penny Schwinn

Checkpoint Design

The Checkpoint assessments were designed using **real TCAP questions** from previous summative exams. This ensured each question was aligned to Tennessee state standards and had been reviewed by **Tennessee educators**. The Checkpoint was designed to be quick to access and administer, not requiring complicated adjustments to existing school schedules; with **flexibility for online or paper administration** based on school/district need.

The Math Checkpoint assessments:

1. **are quick easy to administer**: contain two subparts (separated by a section break and new instructions screen) in one short (less than 30 questions) assessment in Schoolnet
2. **include prioritized content:** standards, concepts, and skills from the designated grade-level/course that are considered essential pre-requisite content for accessing the next grade-level's work

Less than 60 minutes

Less than 30 questions

Two subparts: Calculator & Non-Calculator

Interpreting and Using Results

Automatic Reporting in Schoolnet

In order to support teachers in using these assessments, students who take the assessment online in the Schoolnet platform will have their Checkpoints scored automatically. Teachers have multiple scoring options for students who take the Checkpoints on paper, and you can find how-to documents and videos at https://tn.mypearsonsupport.com/schoolnet/. **Checkpoint assessment scoring in Schoolnet requires all answers to be submitted by the student for results to be produced.** The following automated reports can be found in Schoolnet:

- Individual student results
- Classroom level reports
- Standards analysis reports
- Item analysis
- Test comparison reports (e.g., student, class, school, district, and state)
- Shared reporting (e.g., district to school admin, school admin to educators in same content/grade-level)
- Aggregate and disaggregation of demographics

Overall Scores

The score groups on the checkpoint assessment are ***not* meant to represent performance levels or the blueprints of the TCAP summative assessments** (e.g., below, approaching, on track, and mastered). The score groups were designed to **share student preparedness for next grade level content** and provide guidance around the **level of support** students may need to access that content.

Score Group	% Correct	Results	Recommended Next Steps
Orange	**0 – 34%**	**Likely Needs More Targeted Support**	Use other sources of data for deeper insight; use identified misconceptions to offer targeted re-teaching, plan differentiation and intervention as needed as grade-level concepts are introduced.
Yellow	**35 – 52%**	**Likely Able to Engage in Grade Level Content with Some Support**	Investigate trends in student responses using the most important errors, to support differentiation on grade-level assignments and scaffolding when introducing new content; provide opportunities to check for understanding throughout the lesson to determine differentiation needs.
Green	**53 – 99%**	**Likely Ready for Grade Level Content**	Move directly into grade-level content.
Blue	**100%**	**Ready for Grade Level Content**	

Overall scoring is automatically available in the Schoolnet platform. This may help with you use the results of the student and class level reports to develop an overall summary and conclusion about your students' readiness for grade-level content. In responding to the Checkpoint assessments, we recommend addressing the learning needs of students **while engaging with on grade-level content**. For more information and tools for using assessment data to drive instructional decision making, review the Assessing Learning Toolkit, pages 18-21, and the Learning Loss PLC Guide.

While overall scoring is provided and can be helpful in planning for group instruction, the most actionable information in these Checkpoints can be found by analyzing at the question-level results.

Actionable Insights: Annotated Questions and Reporting Tools

Each question on the Checkpoint is fully annotated with information that describes the questions as they were used on previous TCAP tests, and automated scoring tools in Schoolnet that make getting that information easier. The most helpful and actionable information is in the **Item Annotations in this Guide** when combined with the **Item Analysis reports in Schoolnet**.

> ***When we need more time*** *in the school year, the best way to get it is to spend less time on things they've already mastered and more time on the specific gaps that students need.*

Answer Choice Rationales in each Question Annotation

It is possible that we have multiple students who may not have mastered some of the foundational content required to fully engage in this year's content. We are most effective at addressing these needs when we can pinpoint, as specifically as possible, the conceptual understanding that would most efficiently close this gap. That way we spend less time on previous content by focusing just on the piece that they need to be successful with this concept during the year. The Question Annotations are designed to help with that process.

To help teachers be more efficient in planning for the year, each question on the Checkpoint is accompanied by a set of answer choice rationales **which offers an explanation for each choice**. These annotations are not definitive: we know there may be many reasons for why students might select different answer choices. However, each rationale listed provides an explanation for why students may have selected a given answer choice, including what mis-steps may have caused them to select an incorrect answer (a "distractor"). These distractor rationales provide an instructional target to improve student understanding by breaking down and diagnosing the likely conceptual mistake, allowing you to **follow up with targeted instruction based on the most common mathematical errors you identify** for your specific group of students. These annotations assume that students tried their best and cannot provide information about whether students selected an option at random.

Item Annotations and Planning for Instruction

The department recommends in using this guide that educators look for trends in incorrect answers using the Item Analysis reporting on Schoolnet and then use the annotations using this process:

1. Find the highest-leverage error trend,
   A. This can mean comparing the frequency of each student error or understanding the group of students represented by that trend.
2. Unpack the conceptual misunderstanding that led to the most important error, and then use the annotations to support analyzing the incorrect answer by thinking through these questions in order:
   A. What DO these students understand?
   B. Based on what students do understand, why might a student think their error was a reasonable choice?
   C. What specific concept, if they had understood it clearly, would have made them recognize that the error was not a reasonable approach?
3. Put it all together to check your thinking by restating the answers to each of the three questions to articulate this sentence stem:

"Students understood [question A] but made the error of [student error], because they thought [question B] made sense. If they had understood [question C], they would have avoided the error."

This practice of pinpointing misconceptions and target understandings can help with long term planning to support students in accessing year-long content and making the most of the start of year Checkpoint.

Sample Set of Rationales

Rationales	
Incorrect – 1	Students choosing this answer likely skipped a step in multiplying (7×10). Students choosing this answer may need additional support in setting up the multiplication algorithm and tracking that they multiply each multiplicand by the multiplier.
Incorrect – 2	Students choosing this answer likely skipped multiplying 7 by the tens place, instead adding the regrouped 30 to the ten in the multiplicand. Students choosing this answer may need additional support in multiplying with regrouping.
Correct – 3	This problem requires students to understand the process involved to multiply a whole number of four digits by a one-digit whole number and using strategies based on place value and the properties of operations. To determine the correct product, students should have multiplied the multiplicand (2,815) by the multiplicator (7) while remembering to regroup correctly.
Incorrect – 4	Students choosing this answer likely added the regrouped tens (30) before multiplying by 7. Students choosing this answer may need additional support or practice in the order of operations while multiplying a whole number of four digits by a one-digit whole.

Geometry Checkpoint Item Annotations

Item Information

Item Code: TN0082689 Grade Level:

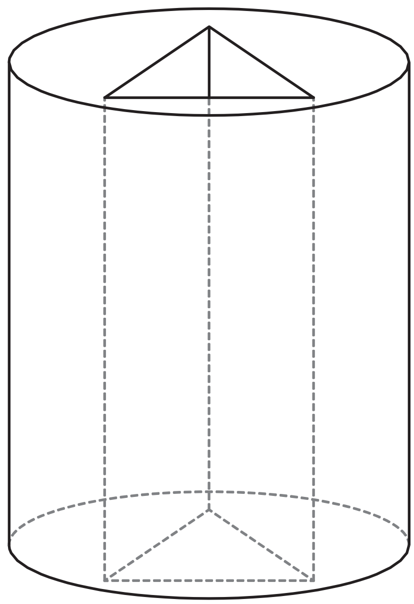
Geometry Standard Code: G.MG.A.1 Position No: 1

Standard Text: Use geometric shapes, their measures, and their properties to describe objects.

Calculator: N

Correct Answer: B,D

The figure shown represents a machine part. A hole passes through the machine part from top to bottom.



Marius wants to determine the volume of the machine part by subtracting the volume of one geometric shape from the volume of another geometric shape. Based on the figure, which two shapes should Marius use?

Select **two** shapes.

A. a cone

B. a cylinder

C. a pyramid

D. a triangular prism

E. a rectangular prism

Rationales	
Incorrect – 1	Students may have recognized that the figure consisted of two 3-dimensional shapes but confused the 3-dimensional shape of a cylinder or a triangular prism with that of a cone. Students who selected this option may need practice identifying the patterns found within geometric properties.
Correct – 2	Students were able to identify different geometric shapes in a figure. Students should have recognized that the volume of a triangular prism needed to be subtracted from the volume of a cylinder.
Incorrect – 3	Students may have recognized that the figure consisted of two 3-dimensional shapes but confused the 3-dimensional shape of a cylinder or a triangular prism with that of a pyramid. Students who selected this option may need practice identifying the patterns found within geometric properties.
Correct – 4	Students were able to identify different geometric shapes in a figure. Students should have recognized that the volume of a triangular prism needed to be subtracted from the volume of a cylinder.
Incorrect – 5	Students may have recognized that the figure consisted of two 3-dimensional shapes but confused the 3-dimensional shape of a triangular prism with that of a rectangular prism. Students who selected this option may need practice identifying the patterns found within geometric properties.

Item Information

Item Code: TN541761 Grade Level: Geometry

Standard Code: G.SRT.C.6 Position No: 2

Standard Text: 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.

Calculator: N

Correct Answer: B

For right triangle *PQR* with a right angle at *Q*, $\sin(P) = \frac{1}{2}$ and $\cos(P) = \frac{\sqrt{3}}{2}$.

What is $\tan R$?

A. $\frac{\sqrt{3}}{4}$

B. $\sqrt{3}$

C. $\frac{\sqrt{3}}{3}$

D. $\frac{4}{\sqrt{3}}$

Rationales	
Incorrect – 1	Students may have recognized that the values for sine and cosine of *P* represented trigonometric ratios but lacked an understanding of the relationships between the ratios and the side lengths of a right triangle. They may have multiplied the given sine and cosine ratios to find tan *R*. Students who selected this option may need support on how trigonometric ratios are related to the side lengths of a right triangle.
Correct – 2	Students were able to understand trigonometric ratios for acute angles in a right triangle. Students should have understood that angles *P* and *R* are acute angles in triangle *PQR* and sin *P* is equal to the ratio of the length of the opposite side, 1, to the length of the hypotenuse, 2. Students should have also understood that cos *P* is equal to the ratio of the length of the adjacent side, sqrt3, to the length of the hypotenuse, 2. Students should have understood that the tangent of an angle is the ratio of the side length opposite to the angle to the side length adjacent to the angle, thus tan R is equal to the ratio of the length of the opposite side, sqrt3, and the length of the adjacent side, 1.
Incorrect – 3	Students were able to understand trigonometric ratios for acute angles in a right triangle correctly but calculated tan *P* instead of tan R. Students who selected this option may need support on differentiating the acute angles of a right triangle.
Incorrect – 4	Students may have recognized that the values for sine and cosine of *P* represented trigonometric ratios but lacked an understanding of the relationships between the ratios and the side lengths of a right triangle. They may have found the reciprocals of the given sine and cosine ratios and multiplied the reciprocals to find tan *R*. Students who selected this option may need support on how trigonometric ratios are related to the side lengths of a right triangle.

Item Information

Item Code: TN441970 — Grade Level: Geometry

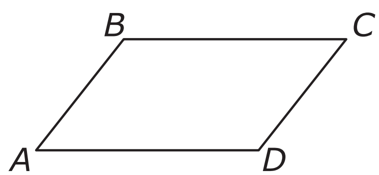
Standard Code: G.CO.C.11 — Position No: 3

Standard Text: Prove theorems about parallelograms.

Calculator: N

Correct Answer: A,D,E

A partial proof that the opposite angles of a parallelogram are congruent is shown.



Given: Quadrilateral *ABCD* is a parallelogram

Prove: $\angle A \cong \angle C$

Statements	**Reasons**
1. Quadrilateral *ABCD* is a parallelogram	1. Given
2. $\overline{BC} \parallel \overline{AD}$, $\overline{AB} \parallel \overline{DC}$	2.
3. $\angle A$ and $\angle B$ are supplementary; $\angle B$ and $\angle C$ are supplementary	3.
4. $\angle A$ and $\angle C$ are congruent	4.

Which reasons are missing from the proof?

Select **all** that apply.

A. Definition of parallelogram

B. Definition of parallel lines

C. When parallel lines are cut by a transversal, corresponding angles are congruent.

D. When parallel lines are cut by a transversal, consecutive interior angles are supplementary.

E. Angles supplementary to the same angle are congruent to each other.

F. Angles supplementary to the same angle are supplementary to each other.

Rationales	
Correct – 1	Students were able to understand the properties of parallelograms and complete the proof using some of these properties. Students should have understood that opposite sides of a parallelogram are parallel based on the definition of a parallelogram.
Incorrect – 2	Students may have selected this option based on a misunderstanding of the definition of parallel lines or because symbols for parallel line segments were used in Statement 2. These students may need support understanding how properties of geometric objects follow certain patterns and rules, by understanding these patterns and rules, we can find new information.
Incorrect – 3	Students may have selected this option based on a misunderstanding of corresponding angles and because the purpose of the proof is to prove that angles are congruent. These students may need support understanding how properties of geometric objects follow certain patterns and rules, by understanding these patterns and rules, we can find new information.
Correct – 4	Students were able to understand the properties of parallelograms and complete the proof using some of these properties. Students should have understood the results when parallel lines are cut by a transversal, specifically that consecutive interior angles are supplementary.
Correct – 5	Students were able to understand the properties of parallelograms and complete the proof using some of these properties. Students should have understood that angles supplementary to the same angle are congruent.
Incorrect – 6	Students may have selected this option based on a misunderstanding of supplementary angles and because Statement 3 includes supplementary angles. These students may need support understanding how properties of geometric objects follow certain patterns and rules, by understanding these patterns and rules, we can find new information.

Item Information

Item Code: TN941553 Grade Level: Geometry

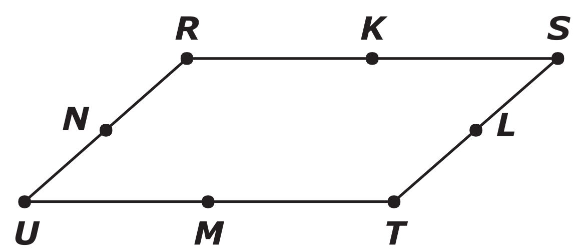
Standard Code: G.CO.B.6 Position No: 4

Standard Text: Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to determine informally if they are congruent.

Calculator: N

Correct Answer: D

Parallelogram *RSTU* has midpoints *K*, *L*, *M*, *N* marked on the sides as shown.



Which rigid motion could be applied to $\triangle RSU$ to show that $\triangle RSU \cong \triangle TUS$?

A. reflection over $\overline{SU}$

B. reflection over $\overline{LN}$

C. rotation 90° clockwise about the intersection point of $\overline{KM}$ and $\overline{LN}$

D. rotation 180° clockwise about the intersection point of $\overline{SU}$ and $\overline{RT}$

Rationales	
Incorrect – 1	Students may have selected this option because they saw parallelogram *RSTU* as a rhombus and overlooked that reflecting $\triangle RSU$ over $\overline{SU}$ would not map $\triangle RSU$ to $\triangle TUS$. Students who selected this option need to understand that the properties of a rhombus do not apply to all parallelograms.
Incorrect – 2	Students may have selected this option because they saw parallelogram *RSTU* as a rectangle and overlooked that reflecting $\triangle RSU$ over $\overline{LN}$ would not map $\triangle RSU$ to $\triangle TUS$. Students who selected this option may need support on the rigid motions that map one figure onto another.
Incorrect – 3	Students may have selected this option because they saw parallelogram *RSTU* as a rhombus. In doing so students would have overlooked that while $\triangle RSU$ would have coincided with $\triangle STR$, incorrect triangles would have been determined congruent. Students who selected this option may need support on the rigid motions that map one figure onto another.
Correct – 4	Students were able to use the definition of congruence in terms of rigid motion to determine if two given figures are congruent. Students should have understood the properties of a parallelogram and that when $\triangle RSU$ is rotated 180° about the intersection of the two diagonals of parallelogram *RSTU*, the corresponding sides and angles of $\triangle RSU$ and $\triangle TUS$ coincide.

Item Information

Item Code: TN542946 Grade Level: Geometry

Standard Code: G.GMD.A.2 Position No: 5

Standard Text: Know and use volume and surface area formulas for cylinders, cones, prisms, pyramids, and spheres to solve problems.

Calculator: N

Correct Answer: A

A fish tank in the shape of a rectangular prism holds 30 cubic feet of water. The tank has a length of 5 feet and a width of 3 feet. What is the depth, in feet, of the tank?

A. 2

B. 6

C. 10

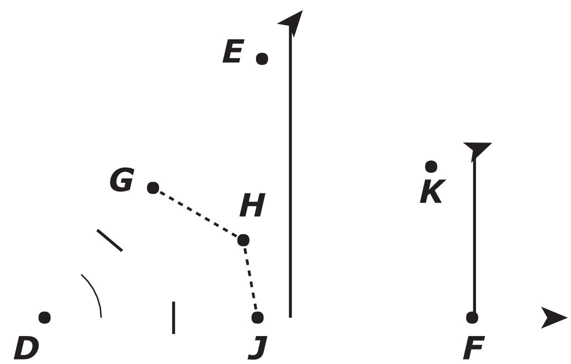
D. 15

Rationales	
Correct – 1	Students were able to use the given measures and the formula for the volume of a rectangular prism to find the height of the prism. Students should have understood that the volume of a rectangular prism is $V = LWH$, where H represents the depth of the tank. Students should have then solved for H by dividing 30 by 15 to find the height of 2.
Incorrect – 2	Students who selected this option may have not been familiar with the volume formula and divided the volume of 30 by the length of 5. Students who selected this option may need support on understanding the formula for the volume of a rectangular prism and being able to manipulate the formula to solve for an unknown value.
Incorrect – 3	Students who selected this option may have not been familiar with the volume formula and divided the volume of 30 by the width of 3. Students who selected this option may need support on understanding the formula for the volume of a rectangular prism and being able to manipulate the formula to solve for an unknown value.
Incorrect – 4	Students who selected this option may have not been familiar with the volume formula and multiplied the length of 5 by the width of 3. Students who selected this option may need support on understanding the formula for the volume of a rectangular prism and being able to manipulate the formula to solve for an unknown value.

Item Information

Item Code: TN941584 Grade Level: Geometry
Standard Code: G.CO.C.10 Position No: 6
Standard Text: Prove theorems about triangles.
Calculator: Y
Correct Answer: C

In the figure shown, Roland is to prove that $\overline{GH} \cong \overline{HJ}$.



Part of his proof is shown in the table.

Statement	Reason
1. $\overline{DG} \cong \overline{DJ}$	1. Given
2. $\overrightarrow{DK}$ bisects $\angle EDF$	2. Given
3. $\angle GDH \cong \angle JDH$	3. Definition of angle bisector
4. $\overline{DH} \cong \overline{DH}$	4. Reflexive property
5. $\triangle DGH \cong \triangle DJH$	5. ?
6. $\overline{GH} \cong \overline{HJ}$	6. Corresponding parts of congruent triangles are congruent

What is the reason for statement 5?

A. AAS

B. ASA

(This item continues on the next page.)

(***Item 6**, continued from the previous page)*

C. SAS

D. SSS

Rationales	
Incorrect – 1	Students may have selected this option because the two statements that preceded Statement 5 in the proof identified two angles and the common side $\overline{DH}$ and assumed this relates to AAS. These students may need support on understanding valid reasons why two triangles are congruent.
Incorrect – 2	Students may have selected this option because they either confused SAS for ASA or assumed $\triangle DGH$ and $\triangle DJH$ were right angles and thus congruent. These students may need support on understanding valid reasons why two triangles are congruent.
Correct – 3	Students were able to complete a proof involving the bisection of an angle. Students should have understood the justification for the triangles being congruent.
Incorrect – 4	Students may have selected this option because they confused $\overline{GH} \cong \overline{HJ}$ as a given statement rather than what is being proven. These students may need support on understanding valid reasons why two triangles are congruent.

Item Information

Item Code: TN543078 Grade Level: Geometry

Standard Code: G.SRT.A.2 Position No: 7

Standard Text: Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

Calculator: Y

Correct Answer: D

On a coordinate plane, $\triangle ABC$ has vertices at A (10, 5), B (10, 15), and C (5, 5). $\triangle A'B'C'$ has vertices at A' (30, 12), B' (30, 52), and C' (10, 12). Which transformation maps $\triangle ABC$ onto $\triangle A'B'C'$?

A. $(x, y) \rightarrow (3x, 3y + 3)$

B. $(x, y) \rightarrow (3x, 3y - 3)$

C. $(x, y) \rightarrow (4x + 10, 4y + 8)$

D. $(x, y) \rightarrow (4x - 10, 4y - 8)$

Rationales	
Incorrect – 1	Students who selected this option may have only focused on vertices A and A′ and made an operation error with the *y*-coordinates. Students who selected this option need to recognize the importance of applying the transformation correctly to each vertex.
Incorrect – 2	Students who selected this option may have only focused on vertices A and A′. Students who selected this option need to recognize the importance of applying the transformation to each vertex.
Incorrect – 3	Students who selected this option may have understood the transformation selected but confused the operations of adding and subtracting. Students who selected this option may need support on how a transformation is applied to each vertex of a figure.
Correct – 4	Students were able to determine the transformation that maps one triangle onto a second triangle given the vertices of both triangles. Students should have understood that the transformation $(x, y) \rightarrow (4x - 10, 4y - 8)$ satisfies all the vertices.

Item Information

Item Code: TN442951 Grade Level: Geometry

Standard Code: G.GMD.A.2 Position No: 8

Standard Text: Know and use volume and surface area formulas for cylinders, cones, prisms, pyramids, and spheres to solve problems.

Calculator: Y

Correct Answer: B

Propane is stored in a cylindrical tank with a diameter of 15 inches and a height of 48 inches. Which equation could be used to determine the radius of a spherical tank with the same volume?

A. $\pi(15)^2(48) = \frac{4}{3}\pi r^3$

B. $\pi\left(\frac{15}{2}\right)^2(48) = \frac{4}{3}\pi r^3$

C. $2\pi\left(\frac{15}{2}\right)^2 + \pi(15)(48) = 4\pi r^2$

D. $2\pi(15)^2 + \pi(15)(48) = 4\pi r^2$

Rationales	
Incorrect – 1	Students who selected this option may have understood that the volume of the cylinder needed to be equated to the volume of a sphere but used the value of 15 as the radius of the cylinder instead of $\frac{15}{2}$. Students who selected this option may need support on correctly using volume formulas.
Correct – 2	Students were able to be able to set up an equation with the volume of a cylinder given its height and base diameter and the volume of a sphere. Students should have understood that the volume of the cylinder is $\pi\left(\frac{15}{2}\right)^2(48)$ and then equated it to the formula of a sphere, $\frac{4}{3}\pi r^3$.
Incorrect – 3	Students who selected this option may have understood that an expression relating to a cylinder needed to be equated to an expression relating to a sphere but used the formulas of the surface area of a cylinder, $2\pi\left(\frac{15}{2}\right)^2 + \pi(15)(48)$, and the surface area of a sphere, $4\pi r^2$. Students who selected this option may need support in understanding how to distinguish between surface area and volume formulas and when to use each.
Incorrect – 4	Students who selected this option may have understood that an expression relating to a cylinder needed to be equated to an expression relating to a sphere but used the formulas of the surface area of a cylinder and the surface area of a sphere. The students also may have used the value of 15 as the radius of the cylinder in part of the expression instead of $\frac{15}{2}$. Students who selected this option may need support in understanding how to distinguish between surface area and volume formulas, when to use each, and use them correctly.

Item Information

Item Code: TN544274 Grade Level: Geometry

Standard Code: G.GPE.B.2 Position No: 9

Standard Text: Use coordinates to prove simple geometric theorems algebraically.

Calculator: Y

Correct Answer: A,D,E

On a coordinate plane, $\triangle ABC$ has vertices at $A(3, 6)$, $B(12, 6)$, and $C(12, 1)$. Which statements are true?

Select **all** that apply.

A. $\triangle ABC$ is a right triangle.

B. $\triangle ABC$ is an equilateral triangle.

C. $\triangle ABC$ is an isosceles triangle.

D. $\triangle ABC$ is a scalene triangle.

E. $\angle A$ and $\angle C$ are complementary.

F. $\angle A$ and $\angle C$ are supplementary.

Rationales	
Correct – 1	Students were able to apply the slope formula to the coordinates of a given triangle and evaluate the results. Students understood that the slope of $\overline{AB}$ is 0, thus $\overline{AB}$ is a horizontal line segment. Also, the slope of $\overline{BC}$ is undefined, thus $\overline{BC}$ is a vertical line segment. The two line segments create a right angle at the point of intersection.
Incorrect – 2	Students who selected this option did not apply the distance formula, recognized some commonality between the coordinates of the three vertices, and assumed that the triangle must be equilateral. Students who selected this option may need support on the use of the distance formula to determine if a triangle is equilateral.
Incorrect – 3	Students who selected this option did not apply the distance formula, recognized some commonality between the coordinates of the three vertices, and assumed that the triangle must be isosceles. Students who selected this option may need support on the use of the distance formula to determine if a triangle is isosceles.
Correct – 4	Students who selected this option understood the need to apply the distance formula to the coordinates of the given triangle, thus determining the triangle has sides with three different lengths. Students may have understood that since the triangle consists of three sides with different lengths, it is a scalene triangle.
Correct – 5	Students who selected this option may have recognized that the triangle was a right triangle based on the slopes of the line segments using the slope formula. Also, the students may have recognized that the right angle formed at the intersection of $\overline{AB}$ and $\overline{BC}$ measures 90°. Therefore, the sum of the measures of the other two angles, $\angle A$ and $\angle C$ must be 90°. The angles are complementary because the sum of the interior angles of any triangle must equal 180°.
Incorrect – 6	Students who selected this option may have understood that one angle in the triangle is a right angle but misidentified the other angles as supplementary. Students who selected this option may need support on understanding the difference between the terms complementary and supplementary.

Item Information

Item Code: TN641735 Grade Level: Geometry

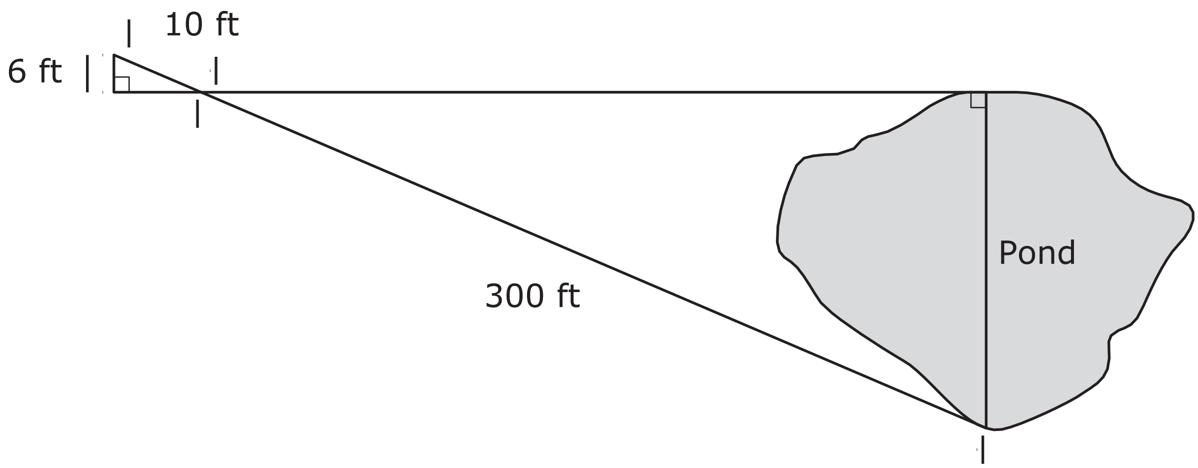
Standard Code: G.SRT.B.5 Position No: 10

Standard Text: Use congruence and similarity criteria for triangles to solve problems and to justify relationships in geometric figures.

Calculator: Y

Correct Answer: A

Lucy wants to approximate the area of a pond that is roughly circular. She knows the distances given.



Which is the closest approximation of the surface area of the pond?

A. 25,434 ft^2

B. 101,736 ft^2

C. 196,250 ft^2

D. 785,000 ft^2

Rationales	
Correct – 1	Students were able to recognize that the concept of similar triangles can be used to solve for an unknown quantity. Students understood that the two triangles given in the figure are similar based on the Angle - Angle Similarity Postulate and that proportionality of corresponding sides could be used to solve for the diameter of the circular pond. Students understood that the formula for the area of a circle could be used to answer the problem, and calculated: $\pi^2 \cong (3.14)90^2 = (3.14)8{,}100 = 25{,}434$.
Incorrect – 2	Students who selected this option may have understood that the triangles are similar and proportionality concepts could be used to find the diameter of the pond, but did not divide the diameter by 2 to find the radius of the pond and used the diameter in the area formula: $\pi^2 \cong \left(3.14\right)180^2 = (3.14)32{,}400 = 101{,}736$. Students who selected this option may need support on using the correct measures in a formula.
Incorrect – 3	Students who selected this option understood that the triangles are similar and proportionality concepts could be used to find the diameter of the pond but set up the incorrect proportion, $\frac{6}{300} = \frac{10}{x} \cong 6x = 3{,}000 \cong x = 500$. Using a radius of 250, the students may have calculated the area of the pond as $\pi r^2 \cong \left(3.14\right)250^2 = (3.14)62{,}500 = 196{,}250$. Students who selected this option may need support on recognizing corresponding sides of similar triangles.
Incorrect – 4	Students who selected this option understood that the triangles are similar and proportionality concepts could be used to find the diameter of the pond but set up the incorrect proportion, $\frac{6}{300} = \frac{10}{x} \cong 6x = 3{,}000 \cong x = 500$. Using the diameter of 500 instead of the radius of 250, the students may have calculated the area of the pond as $\pi r^2 \cong \left(3.14\right)500^2 = (3.14)250{,}000 = 785{,}000$. Students who selected this option may need support on recognizing corresponding sides of similar triangles and using the correct measures in a formula.

Item Information

Item Code: TN942987 Grade Level: Geometry
Standard Code: G.MG.A.2 Position No: 11
Standard Text: Apply geometric methods to solve real-world problems.
Calculator: Y
Correct Answer: D

A construction company is hired to resurface a straight section of road.

- The section is 100 yards long and 18 feet wide.
- The company’s truck can haul 250 cubic feet of gravel per load.

What is the minimum number of truckloads required to completely cover the section of road to a depth of 6 inches?

A. 3

B. 4

C. 10

D. 11

Rationales	
Incorrect – 1	Students may have understood to model the problem with a rectangular prism but overlooked the need to convert the measure of 100 yards to 300 feet. These students may have calculated 100 * 18 * 0.5= 900cu.ft as the amount of gravel needed. The students then may have divided 900 by 250 to get 3.6 and rounded down instead of up to find the minimum number of truckloads of gravel needed. Students who selected this option may need support on using correct units of measurement and correct rounding strategies when solving problems. These students may need practice identifying and articulating what each given and needed value/variable represents in real-world problems, including identifying respective units, prior to selecting mathematical approaches.
Incorrect – 2	Students may have understood to model the problem with a rectangular prism but overlooked the need to convert the measure of 100 yards to 300 feet. The students may have calculated 100 * 18 * 0.5= 900 cu. ft as the amount of gravel needed. The students then may have divided 900 by 250 to get 3.6 and rounded up to find the minimum number of truckloads of gravel needed. These students may need practice identifying and articulating what each given and needed value/variable represents in real-world problems, including identifying respective units, prior to selecting mathematical approaches.
Incorrect – 3	Students who selected this option may have understood to use modeling to solve a geometric problem. The students should have recognized that a rectangular prism could be used in the model and that some measurements had to be converted to feet. Students should have calculated 300 * 18 * 0.5 = 2700 cu ft as the amount of gravel needed. Students should then have known to divide 2700 cu ft by 250 cu. ft, the amount of gravel carried by each truck, to find the minimum number of truckloads needed. Students should have calculated 2700/250 = 10.8 but then rounded down to 10. These students may need practice articulating what a computation represents in real-world problems in order to interpret its reasonableness.
Correct – 4	Students were able to use modeling to solve a geometric problem. The students should have recognized that a rectangular prism could be used in the model and that some measurements had to be converted to feet. Students should have calculated 300 * 18 * 0.5 = 2700 cu ft as the amount of gravel needed. Students should then have known to divide 2700 cu ft by 250 cu. ft, the amount of gravel carried by each truck, to find the minimum number of truckloads needed. Students should have calculated 2700/250 = 10.8, and then rounded up to 11 to determine the minimum number of truckloads needed.

Item Information

Item Code: TN544566 Grade Level: Geometry

Standard Code: G.SRT.C.8.a Position No: 12

Standard Text: Know and use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Calculator: Y

Correct Answer: C

Dante rides his bicycle due west at 10 miles per hour. Annie rides her bicycle due north at 12.5 miles per hour. If they both leave Annie's house at the same time, approximately how far apart, in miles, are they after 4 hours?

A. 16

B. 23

C. 64

D. 90

Rationales	
Incorrect – 1	Students who selected this option may have understood how to use the Pythagorean Theorem to solve a problem. They may have understood that the paths the two bicyclists travelled, one travelling due west and the other due north, created a right angle at the common departure point; however, they may have used the rates instead of the distances travelled over the 4 hours in their calculations and found $\sqrt{\mathbf{(10)^2} + \mathbf{(12.5)^2}} \approx \mathbf{16.01}$. These students may need practice identifying and articulating what each value and variable represents numerically and geometrically (e.g. by drawing) in real-world problems prior to selecting operations and formulas.
Incorrect – 2	Students who selected this option understood that the two rates needed to be used to solve the problem. The students however may have did not use the Pythagorean Theorem to solve the problem and added the two rates $10+12.5=22.5$, and then rounded to 23. These students may need practice identifying and articulating what each value and variable represents numerically and geometrically (e.g. by drawing) in real-world problems prior to selecting operations and formulas.
Correct – 3	Students were able to understand how to use the Pythagorean Theorem to solve a problem. Students should have understood that the paths the two bicyclists travelled, one travelling due west and the other due north, created a right angle at the common departure point. Students should have recognized that Dante's and Annie's paths represented the two legs in a right triangle and understood that the Pythagorean Theorem could be used to determine how far apart the two cyclists were at the end of 4 hours. Students should have calculated $\sqrt{\mathbf{(40)^2} + \mathbf{(50)^2}} \approx \mathbf{64.03}$ to arrive at 64 miles.
Incorrect – 4	Students may have understood that the paths the two bicyclists travelled, one travelling due west and the other due north, created a right angle at the common departure point. Students may have also understood that Annie travelled $12.5 \times 4 = 50$ miles and Dante travelled $10 \times 4 = 40$ miles over the 4 hours. Students may have did not recognize that this problem is solved with the Pythagorean Theorem and added the two distances, $40+50=90$. These students may need practice identifying and articulating what each value and variable represents numerically and geometrically (e.g. by drawing) in real-world problems prior to selecting operations and formulas.

Item Information

Item Code: TN839361 Grade Level: Geometry

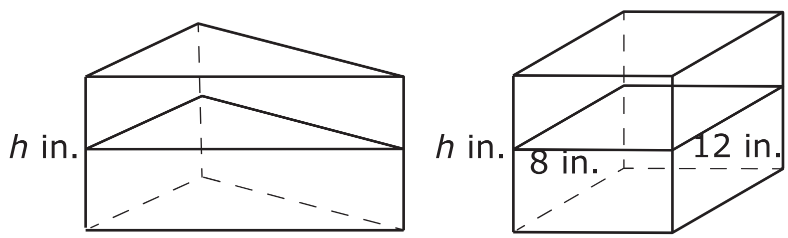
Standard Code: G.GMD.A.2 Position No: 13

Standard Text: Know and use volume and surface area formulas for cylinders, cones, prisms, pyramids, and spheres to solve problems.

Calculator: Y

Correct Answer: D

A right triangular prism and a rectangular prism are shown. Each prism has a height of *h* inches and a cross-section that is parallel to its base. The length and width of the rectangular cross-section are given.



If the volumes of the two solids are equal, which pair of measurements are possible lengths of the legs of the right-triangular cross-section?

A. 4 n. and 6 n.

B. 6 n. and 8 n.

C. 8 n. and 12 n.

D. 12 n. and 16 n.

Rationales	
Incorrect – 1	Students who selected this option may have understood that the area of a triangle is $\frac{1}{2}$ times the base times the height. The students may have taken one-half of each base measurement of the rectangular base and used these values as the dimensions of the triangular base. Students who selected this option may need support on understanding how to use relationships between volumes of prisms to solve problems.
Incorrect – 2	Students who selected this option may have understood to equate the volumes of two prisms with equal heights and solve for the base dimensions of one prism given the base dimensions of the other prism. Students may have calculated the dimensions of the triangular base as $96 = \frac{1}{2}xy \rightarrow 48 = xy$ after dividing 96 by 2 instead of multiplying 96 by 2. Students who selected this option may need support on understanding how to correctly solve equations.
Incorrect – 3	Students who selected this option may have understood that the base of the two prisms were equal but overlooked that the area of the triangle is $\frac{1}{2}$ times the base times the height while the area of a rectangle is the base times the height. Students may have used the given dimensions for the base of the rectangular prism as the dimensions of the triangular base. Students who selected this option may need support on understanding how to calculate areas of different bases.

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Correct – 4	Students were able to equate the volumes of two prisms with equal heights and solve for the base dimensions of one prism given the base dimensions of the other prism. Students should have understood that since the heights of the two prisms are equal, the areas of the two bases are equal. The dimensions of the triangular base should have been calculated to be $96 = \frac{1}{2}xy \rightarrow 192 = xy$. Students should have determined that 12 in. and 16 in. are the only values from the list of options that satisfy the equation.

Item Information

Item Code: TN262363 Grade Level: Geometry

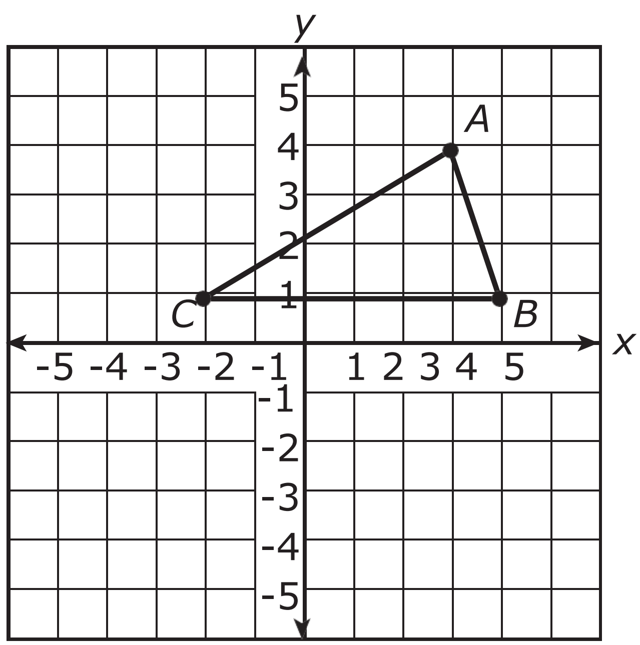
Standard Code: G.GPE.B.5 Position No: 14

Standard Text: Know and use coordinates to compute perimeters of polygons and areas of triangles and rectangles.

Calculator: Y

Correct Answer: B,D,E

Triangle *ABC* is shown on a coordinate plane.



Which statement is true?

Select **all** that apply.

A. If $\overline{AD}$ is the altitude from *A* to $\overline{BC}$, the coordinates of *D* are (1, 3).

B. The perimeter of $\triangle ABC$ is about 15 units.

C. The length of the longest side of the triangle is about 5.83 units.

D. The area of the triangle is 9 square units.

E. The length of the shortest side of the triangle is about 3.16 units.

Rationales	
Incorrect – 1	Students who selected this option may have understood that there is an altitude between vertex *A* and segment *BC* but reversed the *x* and *y* coordinates of point *D*. Students who selected this option may need support on correctly identifying coordinates of points.
Correct – 2	Students were able to understand and apply coordinate geometry formulas to find the side lengths, altitude, area, and perimeter of a triangle. Students should have used the distance formula to find the three side lengths of the triangle and to sum these lengths to find the perimeter. Students should have calculated $AB = \sqrt{(4-3)^2 + (1-4)^2} = \sqrt{10}$; $AC = \sqrt{(-2-3)^2 + (1-4)^2} = \sqrt{34}$; and $BC = \sqrt{(-2-4)^2 + (1-1)^2} = 6$, to arrive at a perimeter of about 15 units.
Incorrect – 3	Students who selected this option may have understood how to use the distance formula but overlooked the fact that the length of segment *BC* was 6 units, which is more than the length of segment *AC*. Students who selected this option may need support on correctly comparing values.
Correct – 4	Students were able to understand and apply coordinate geometry formulas to find the side lengths, altitude, area, and perimeter of a triangle. Students should have understood that the altitude (height) of the triangle was 3 units, that the base length was 6 units, and that the formula $A = \frac{1}{2}bh$ should be used to arrive at an area of 9 square units.
Correct – 5	Students were able to understand and apply coordinate geometry formulas to find the side lengths, altitude, area, and perimeter of a triangle. Students should have used the distance formula to find the three side lengths of the triangle and to compare the lengths. Students should have calculated $AB = \sqrt{(4-3)^2 + (1-4)^2} = \sqrt{10}$; $AC = \sqrt{(-2-3)^2 + (1-4)^2} = \sqrt{34}$; and $BC = \sqrt{(-2-4)^2 + (1-1)^2} = 6$, to arrive at a length of $\sqrt{10} \approx 3.16$ units as the shortest side length.

Item Information

Item Code: TN444396 | Grade Level: Geometry

Standard Code: G.SRT.B.4 | Position No: 15

Standard Text: Prove theorems about similar triangles.

Calculator: Y

Correct Answer: D

The following statements describe triangles ABC and PQR.

For $\triangle ABC: AC = 2, AB = 4,$ and $BC = 5.$
For $\triangle PQR: QR = 7.5, PR = 3,$ and $PQ = 6.$

Which statement explains why $\triangle ABC$ and $\triangle PQR$ are either similar or not similar?

A. $\triangle ABC$ and $\triangle PQR$ are not similar because $\frac{AC}{QR} = \frac{AB}{PR}$.

B. $\triangle ABC$ and $\triangle PQR$ are similar because $\frac{AC}{PR} = \frac{PQ}{AB} = \frac{BC}{QR}$.

C. $\triangle ABC$ and $\triangle PQR$ are similar because $\frac{AB}{PQ} = \frac{BC}{QR}$.

D. $\triangle ABC$ and $\triangle PQR$ are similar because $\frac{AC}{PR} = \frac{BC}{QR} = \frac{AB}{PQ}$.

Rationales	
Incorrect – 1	Students who selected this option may have understood proportionality but used non-corresponding sides to support for why the two triangles were not similar. Students may have assumed that the first and second lengths listed for $\triangle ABC$ correspond to the first and second lengths listed for $\triangle PQR$. Students who selected this option may need support on understanding how to correctly identify corresponding sides of triangles and justify similarity.
Incorrect – 2	Students who selected this option may have understood proportionality but reversed the proportional relationship between AB and PQ. The students did not notice that the proportion should have included $\frac{AB}{PQ}$ instead of $\frac{PQ}{AB}$. Students who selected this option may need support on identifying the correct corresponding relationships.
Incorrect – 3	Students who selected this option may have understood how to use proportionality to prove that two triangles are similar but overlooked the necessity to include all three sets of corresponding sides. Students who selected this option may need support on understanding how to justify that two triangles are similar.
Correct – 4	Students were able to understand what is necessary to prove that two triangles are similar using proportionality of corresponding sides. Students should have arrived at the conclusion that since $\frac{2}{3} = \frac{5}{7.5} = \frac{4}{6}, \frac{AC}{PR} = \frac{BC}{QR} = \frac{AB}{PQ}$ and $\triangle ABC \sim \triangle PQR$.

Item Information

Item Code: TN342763 | Grade Level: Geometry

Standard Code: G.GPE.B.3 | Position No: 16

Standard Text: Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems.

Calculator: Y

Correct Answer: A

What is the equation of the line parallel to the line with equation $y = -\frac{3}{4}x - 5$ and passing through the point $(8, -3)$?

A. $y = -\frac{3}{4}x + 3$

B. $y = \frac{4}{3}x - 5$

C. $y = -\frac{3}{4}x - 3$

D. $y = \frac{4}{3}x - \frac{41}{3}$

Rationales	
Correct – 1	Students were able to determine the equation of a line that passes through a given point and is parallel to a given line. Students should have understood that the slope of the given line, $-\frac{3}{4}$, should be used as the slope of the desired line. Students should have substituted this slope and the coordinates $(8, -3)$, into the slope-intercept form of a line, $y=mx+b$, to solve for b, the y-intercept: $-3 = -\frac{3}{4}(8) + b \rightarrow 3 = b$. To find the equation of the new line, students should have substituted the given slope of $-\frac{3}{4}$ and value of b, the y-intercept, into the slope-intercept form of the line to arrive at $y = -\frac{3}{4}x + 3$.
Incorrect – 2	Students who selected this option may have used the negative reciprocal of the given slope, $\frac{4}{3}$, and the given y-intercept of -5 to form the equation $y = \frac{4}{3}x - 5$. Students who selected this option may need support on identifying slopes of parallel lines and finding the y-intercept of a line.
Incorrect – 3	Students who selected this option may have understood that the slope of the given line, $-\frac{3}{4}$, should be used as the slope of the desired line, but then used the y-coordinate of the given point, -3, as the y-intercept to arrive at $y = -\frac{3}{4}x - 3$. Students who selected this option may need support on finding the y-intercept of a line.
Incorrect – 4	Students who selected this option may have used the negative reciprocal of the given slope, $\frac{4}{3}$, instead of the slope $-\frac{3}{4}$, in the slope-intercept form of the line to solve for b, the y-intercept: $-3 = \frac{4}{3}(8) + b \rightarrow -\frac{41}{3} = b$. Students who selected this option may need support on identifying slopes of parallel lines.

Item Information

Item Code: TN144443 | Grade Level: Geometry

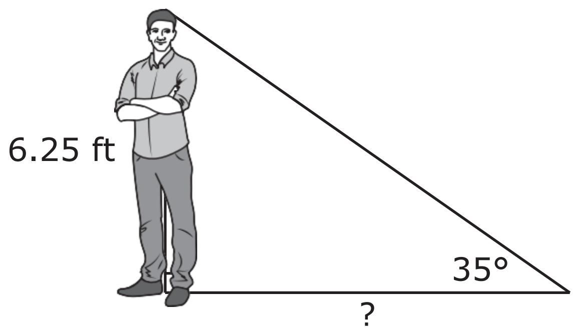
Standard Code: G.SRT.C.8.a | Position No: 17

Standard Text: Know and use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Calculator: Y

Correct Answer: C

Lorenzo is 6 feet, 3 inches in height. He looks at his shadow when the angle of elevation of the sun is 35°.



What is the approximate length of his shadow?

A. 4 feet, 5 inches

B. 7 feet, 7 inches

C. 8 feet, 11 inches

D. 10 feet, 11 inches

Rationales	
Incorrect – 1	Students who selected this option may have understood that the ratio for the tangent of an angle needs to be used but set up the equation as $6.25\tan 35^\circ = x \rightarrow x \approx 4.38$ which converts to 4 ft 5 in. Students who selected this option may need support on understanding how to solve problems with trigonometric ratios.
Incorrect – 2	Students who selected this option may have understood that a trigonometric ratio was needed but used cos 35° instead of tan 35° and solved $x = \dfrac{6.25}{\cos 35^\circ} \approx 7.63$; students may then have rounded 7.63 to 7 ft 7 in. instead of converting the 0.63 to 8 in. Students who selected this option may need support on understanding how to solve problems with trigonometric ratios.
Correct – 3	Students were able to understand how to use trigonometric ratios to solve a problem with a right triangle. Students also understood how to convert a measurement from inches to feet. Students should have understood that the tangent function should be used to determine x, the length of the man's shadow in feet, given the man's height of 6.25 ft and the sun's angle of elevation of 35°. The students should have set up and solved $\tan 35^\circ = \dfrac{6.25}{x} \rightarrow x\tan 35^\circ = 6.25 \rightarrow x = \dfrac{6.25}{\tan 35^\circ} \approx 8.93$ which converts to 8 ft 11 in.
Incorrect – 4	Students who selected this option may have understood that a trigonometric ratio was needed but used sin 35° instead of tan 35° and solved $x = \dfrac{6.25}{\sin 35^\circ} \approx 10.9$ which converts to 10 ft 11 in. Students who selected this option may need support on understanding how to solve problems with trigonometric ratios.

Item Information

Item Code: TN0063723 Grade Level: Geometry

Standard Code: G.GPE.B.4 Position No: 18

Standard Text: Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

Calculator: Y

Correct Answer: B

The coordinates of the endpoints of $\overline{AB}$ are given.

$A(7, 6)$ and $B(-5, -6)$

Point K is located on $\overline{AB}$ so that $\frac{AK}{KB} = \frac{2}{1}$. What is the x-coordinate of point K?

A. -2

B. -1

C. 1

D. 3

Rationales	
Incorrect – 1	Students who selected this option may have understood partitioning line segments in a given ratio but may have confused the *y*-coordinate of point *K* with the *x*-coordinate. Students may have understood that the distance between endpoints $A(7,6)$ and $B(-5,-6)$ is segmented by positioning a point *K* such that the ratio of $\frac{AK}{KB}=\frac{2}{1}$, or that $\frac{2}{3}$ of $\overline{AB}$ is $\overline{AK}$ and $\frac{1}{3}$ is $\overline{KB}$. The students may have found the change in the *y* values between points *A* and *B* as $6-(-6)=12$ units. Students should have understood that $\frac{2}{3}$ of these 12 units, or 8 units, represent the change in *y*-values between points *A* and *K*. The students may have calculated the *y*-coordinate as $6-8=-2$ Students who selected this option may need support on making sense of problems to determine what they are asked to find.
Correct – 2	Students were able to understand how to determine the coordinates of a point that lies on a line segment and partitions the segment in a given ratio. Students should have understood that the distance between endpoints $A(7,6)$ and $B(-5,-6)$ is segmented by positioning a point *K* such that the ratio of $\frac{AK}{KB}=\frac{2}{1}$, or that $\frac{2}{3}$ of $\overline{AB}$ is $\overline{AK}$ and $\frac{1}{3}$ is $\overline{KB}$. To find the *x*-coordinate of point *K*, students should have understood that the change in the *x* values between points *A* and *B* as $7-(-5)=12$ units. Students should have understood that $\frac{2}{3}$ of these 12 units, or 8 units, represent the change in *x*-values between points *A* and *K*. The students should have concluded that the *x* value for *K* is equal to $7-8$ and arrived at −1.
Incorrect – 3	Students who selected this option may have understood partitioning line segments in a given ratio but may have used a ratio of 1:1. Students may have calculated $\frac{7-(-5)}{2}=6$, and then subtracted 6 from 7 to get an *x* value of 1 for point *K*. Students who selected this option may need support on understanding how to partition a segment in a given ratio.

Incorrect – 4	Students who selected this option may have understood partitioning line segments in a given ratio but may have confused a 2:1 ratio with a 1:2 ratio. To find the *x*-coordinate of point *K*, students may have found the change in the *x* values between points *A* and *B* as $7-(-5)=12$ units. Students may have calculated $\frac{1}{3}$ of these 12 units, or 4 units, as the change in *x*-values between points *A* and *K*. Students may have found the *x* value for *K* as $7-4=3$. Students who selected this option may need support on understanding how to partition a segment in a given ratio.

Item Information

Item Code: TN162390 Grade Level: Geometry

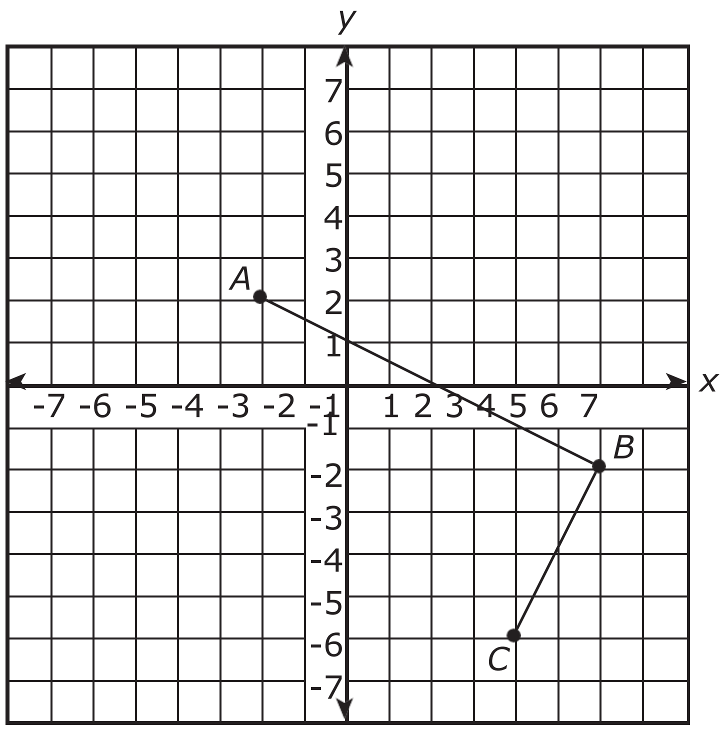
Standard Code: G.GPE.B.5 Position No: 19

Standard Text: Know and use coordinates to compute perimeters of polygons and areas of triangles and rectangles.

Calculator: Y

Correct Answer: A,C,D,E

Three points of rectangle *ABCD* are shown on a coordinate plane.



Which statement is true? Select **all** that apply.

A. The coordinates of *D* are (–4, –2).

B. The perimeter of rectangle *ABCD* is about 13.41 units.

C. The length of $\overline{CD}$ is about 8.94 units.

D. The area of the rectangle is about 40 square units.

E. The length of $\overline{AD}$ is about 4.47 units.

Rationales	
Correct – 1	Students were able to understand how to use coordinate geometry to determine the coordinates of a vertex of a rectangle given the coordinates of the remaining vertices. Students should have used the slope and length of $\overline{BC}$ to find the coordinates of vertex *D*. Students should have determined that point *C* was 4 units down and 2 units left of point *B* and used this same change from point *A* to arrive at $(-2-2, 2-4) = (-4, -2)$.
Incorrect – 2	Students who selected this option may have understood how to use the distance formula or the Pythagorean Theorem to determine the side lengths of *ABCD* but only used the lengths *AB* and BC in their perimeter calculations. These students may need support on understanding how to find the perimeter of a rectangle.
Correct – 3	Students were able to understand how to use the distance formula or the Pythagorean Theorem to determine the lengths of the sides of rectangle *ABCD*. Students should have understood that finding *AB* is the same as finding *CD* because of the definition of a rectangle and used the distance formula to find AB: $AB = CD = \sqrt{(6-(-2))^2 + (-2-2)^2} = \sqrt{8^2 + (-4)^2} = \sqrt{80} \approx 8.94$.
Correct – 4	Students were able to understand how to use the distance formula or the Pythagorean Theorem to determine the lengths of the sides of rectangle *ABCD* in order to find its area. Using the distance formula, students should have calculated $AB = CD = \sqrt{(6-(-2))^2 + (-2-2)^2} = \sqrt{8^2 + (-4)^2} = \sqrt{80}$. $BC = \sqrt{(4-6)^2 + (-6-(-2))^2} = \sqrt{(-2)^2 + (-4)^2} = \sqrt{20}$. Students should have then used the length and width, *AB* and *BC*, to calculate the area of *ABCD*, calculating $\sqrt{80} \times \sqrt{20} = 40$.
Correct – 5	Students were able to understand how to use the distance formula or the Pythagorean Theorem to determine the lengths of the sides of rectangle *ABCD*. Students should have understood that finding *BC* is the same as finding *AD* because of the definition of a rectangle and used the distance formula to find BC: $AD = BC = \sqrt{(4-6)^2 + (-6-(-2))^2} = \sqrt{(-2)^2 + (-4)^2} = \sqrt{20} \approx 4.47$.

Item Information

Item Code: TN844507 | Grade Level: Geometry

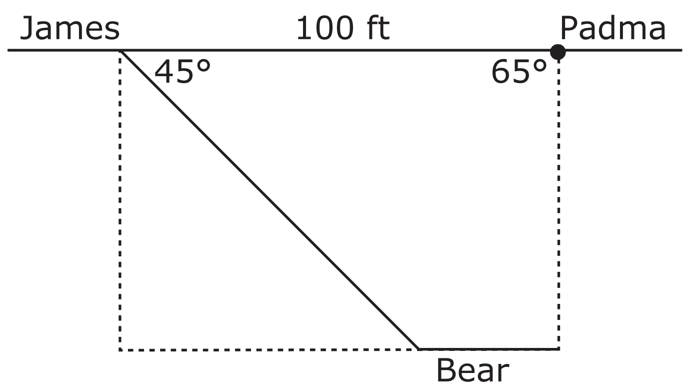
Standard Code: G.SRT.C.8.b | Position No: 20

Standard Text: Know and use the Law of Sines and Law of Cosines to solve problems in real life situations. Recognize when it is appropriate to use each.

Calculator: Y

Correct Answer: B

James and Padma are on opposite sides of a 100-ft-wide canyon. James sees a bear at an angle of depression of 45°. Padma sees the same bear at an angle of depression of 65°.



What is the approximate distance, in feet, between Padma and the bear?

A. 21.2 ft

B. 75.2 ft

C. 96.4 ft

D. 171.6 ft

Rationales	
Incorrect – 1	Students who selected this option may have understood the Law of Sines and calculated the distances between James and the bear and between Padma and the bear but then found the difference between 96.4 and 75.2 to arrive at 21.2 ft. These students may need support on making sense of problems to determine what they are asked to find.
Correct – 2	Students were able to understand the Law of Sines. Students should have first found the measure of the third angle in the triangle: 180-45-65=70. Next, students should have set up and solved the equation $\frac{\sin 70^\circ}{100} = \frac{\sin 45^\circ}{x} \rightarrow x\sin 70^\circ = 100\sin 45^\circ$ to arrive at $x = \frac{100\sin 45^\circ}{\sin 70^\circ} \approx 75.2^\circ$, the number of feet between Padma and the bear.
Incorrect – 3	Students who selected this option may have understood that the Law of Sines could be used to solve this problem but calculated the distance between James and the bear, $\frac{\sin 70^\circ}{100} = \frac{\sin 65^\circ}{x} \rightarrow x\sin 70^\circ = 100\sin 65^\circ \rightarrow x = \frac{100\sin 65^\circ}{\sin 70^\circ} \approx 96.4$. These students may need support on making sense of problems to determine what they are asked to find.
Incorrect – 4	Students who selected this option may have understood the Law of Sines and calculated the distances between James and the bear and between Padma and the bear but then found the sum of 75.2 and 96.4 to arrive at 171.6 ft. These students may need support on making sense of problems to determine what they are asked to find.

Item Information

Item Code: TN710390 | Grade Level: Geometry

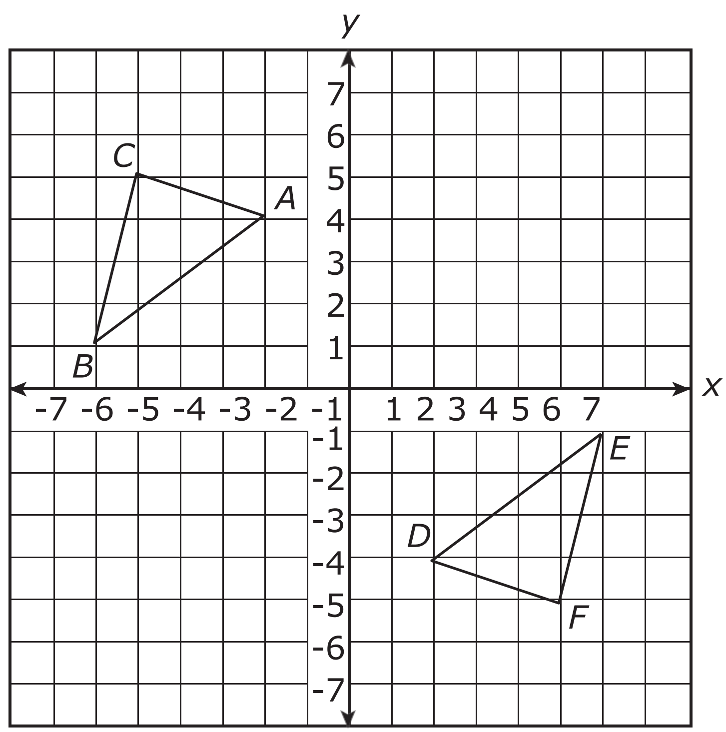
Standard Code: G.CO.B.7 | Position No: 21

Standard Text: Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

Calculator: Y

Correct Answer: D

Which transformation proves $\triangle ABC \cong \triangle DEF$?



A. reflection of $\triangle ABC$ over the line $y = x$

B. translation of $\triangle ABC$ 7 units right and 9 units down

C. rotation of $\triangle ABC$ 90° clockwise, centered at the origin

D. reflection of $\triangle ABC$ over the y-axis and then over the x-axis

Rationales	
Incorrect – 1	Students who selected this option may have assumed that mapping one vertex of one figure to the corresponding vertex of the other figure was enough to prove the two figures congruent. Students may have used the mapping $(x, y) \to (y, x)$ for the reflection of a figure over the line $y = x$, and only verified that vertex *C* maps onto vertex *F.* Students who chose this option may need support understanding how to correctly apply transformations to each component of the geometric object, paying attention to the numeric representations of the coordinates.
Incorrect – 2	Students who selected this option may have assumed that mapping one vertex of one figure to any vertex of the other figure was enough to prove the two figures congruent. Students may have only mapped vertex *A* onto vertex *F* using the mapping $(x, y) \to (x+7, y-9)$ Students who chose this option may need support understanding how to correctly apply transformations to each component of the geometric object, paying attention to the numeric representations of the coordinates.
Incorrect – 3	Students who selected this option may have confused the transformation mapping rule of a 90-degree clockwise rotation with a 180-degree clockwise rotation that is mapped by $(x, y) \to (-x, -y)$. These students may need support on understanding rigid motions that could be used to prove triangle congruence.
Correct – 4	Students were able to use the definition of congruence in terms of rigid motions to show that two triangles are congruent.

Additional Resources

- Information on Tennessee's Assessment Program
- Tennessee Academic Standards for Mathematics
- The eight Standards for Mathematical Practice
- Best for All Central
- Assessing Student Learning Reopening Toolkit
- Assessment Development LiveBinder Resource Site

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