Lines, Angles, and Figures
Program 2 Guide

The *Go Figure? Interactive Multimedia Kit* may be used in a classroom or intervention setting. Presented in a fun and creative way, each program on the *Go Figure?* DVD can be used as an introduction to or a review of basic mathematics concepts. The accompanying CD-ROM edu-game was designed for use by students on an individual basis. The object of the edu-game is to solve a mystery. In order to do this, the student must solve mathematics problems in the specific content areas presented by the DVD dramatic video series. Consequently, programs on the DVD are used to generate interest in and enthusiasm for learning mathematics concepts, while the CD-ROM edu-game allows students to practice the concepts in a challenging game format.

The three main characters in each DVD video program – the mysterious Pythagleo, plus two students named Carter and Chris who are trying to solve the mystery of Etna High School – discuss the targeted math concepts.

Chris, and to a lesser extent, Carter, verbalizes what each is thinking as they work through problems associated with the math concepts. The DVD programs assume that, like Chris and Carter, your students have already been introduced to the math concepts presented in the episode. The dialog may be too quick for some students. Every step that some of your students will need to solve similar problems on their own may not be mentioned in the programs. Therefore, pausing the DVD to review or present additional information will help adapt the learning situation to the needs of your students. See additional materials about teaching with videos and differentiated instruction in the Introduction of the Teacher Resources Guide.

Ohio Mathematics Content Standards and Benchmarks

Geometry and Spatial Sense Benchmark:

A. Identify and label angle parts and the regions defined within the plane where the angle resides.
D. Identify, describe and classify types of line pairs, angles, two-dimensional figures and three-dimensional objects and their properties.
G. Describe and use properties of triangles to solve problems involving angle measures and side lengths of right triangles.

Measurement Benchmark:

A. Select appropriate units to measure angles, circumference, surface area, mass and volume, using:
   - U. S. customary units: e.g., degrees, square feet, pounds, and other units as appropriate;
   - Metric units, e.g., square meters, kilograms and other units as appropriate.

Math Content

- Parallel and perpendicular: lines and planes
- Protractor use
- Acute, right, and obtuse angles
- Complementary, supplementary, and vertical angles
- Triangle: Sum of the angles = 180

Episode Notes

- Carter and Chris must work with math concepts and solve problems related to lines, angles, and rays in order to receive numbered pool balls. The numbers will be used to spell out a coded message that Pythagleo hints will explain what makes Etna High School "different".
- Note that Chris and Carter always point out that complementary angles and supplementary angles must share a common ray. This prevents students from overlapping their angles.

Teacher Notes

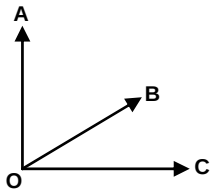
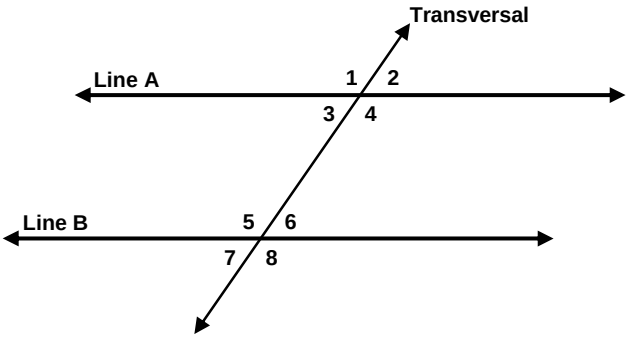
Use the episode to lead to discussions of Ohio Geometry and Spatial Sense content in this area. The glossary on the next page and the worksheets that accompany this guide provide information and practice.

- Grade Five: Indicators 2, 3, 5 and 7
- Grade Six: Indicators 1, 2, 3, and 4.
- Grade Seven: Indicator 2

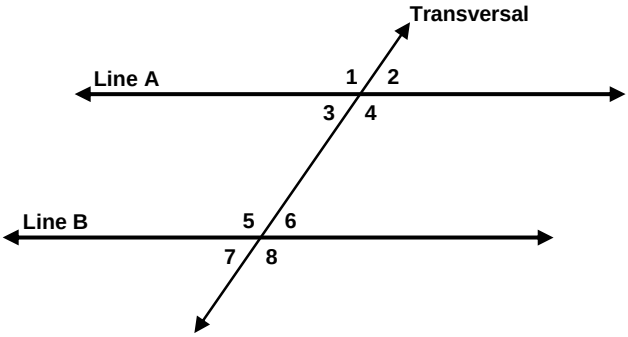
Reminders:

- The sum of the interior angles of a triangle is $180°$.
- The sum of the interior angles of a quadrilateral is $360°$.
- Pythagorean Theorem for right triangles: $a^2 + b^2 = c^2$. The square of the hypotenuse (line segment opposite the right angle) of a right triangle is equal to the sum of the squares of the other two sides (line segments adjacent to the right angle).

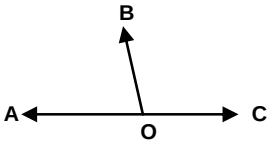
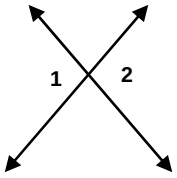
Go Figure? Geometry Glossary

Geometry Term	-	Definition
acute angle	-	An acute angle measures between 0° and 90°. In an acute triangle, all three angles are less than 90°.
altitude	-	Height. An altitude of a triangle is a line segment connecting a vertex to the line containing the opposite side. The altitude is perpendicular to the side opposite the vertex.
complementary angles	-	Two angles whose measures add up to 90°. Complimentary angles share a common ray. Angles AOB and BOC are complementary. 
diagonal	-	A segment in a polygon whose endpoints are 2 nonconsecutive vertices.
equilateral	-	A shape whose sides are equal.
exterior angle	-	• An exterior angle of a polygon is formed when you extend a side of a polygon. • Also, when a third line (a transversal) crosses two other lines, the angles formed outside the region of space between the two lines are called exterior angles. In the example below, Angles 1, 2, 7 and 8 are exterior angles. 
face	-	A face is one of the polygons that make up a polyhedron (solid figure). For example, a cube has six faces. Each face is a square.

Geometry Term	-	Definition
interior angle	-	• An interior angle of a polygon is formed by two adjacent sides. • Also, when a third line (a transversal) crosses two other lines, the angles formed in the region of space between the two original lines are called interior angles. In the example below, angles 3, 4, 5 and 6 are interior angles.



intersecting	-	Line: Lines that share a point. Plane: Planes that share a line.
isosceles	-	An isosceles triangle is a triangle with at least two sides having equal lengths. An isosceles trapezoid is a quadrilateral (4-sided figure) whose non-parallel sides are exactly the same length.
line	-	A line connects two points by the shortest path, and then continues on in both directions.
obtuse angle	-	An angle that measures between 90° and 180°.
parallel lines	-	Lines in the same plane that do not intersect.
perimeter	-	The distance around an object.
perpendicular	-	Lines or planes that intersect to form right angles.
plane	-	A flat surface that has only two dimensions.
polygon	-	A polygon is a two-dimensional geometric figure with these characteristics: • It is made of straight line segments. • Each segment touches exactly two other segments, one at each of its endpoints. • It is closed -- it divides the plane into two distinct regions, one inside and the other outside the polygon.
protractor	-	An instrument used to measure the degrees of an angle.
ray	-	A ray begins at a point and goes off forever in one direction.
right angle	-	An angle that measures 90° In a right triangle, one angle measures 90°.
skew	-	Lines that are neither parallel nor perpendicular.

Geometry Term	-	Definition
supplementary angles	-	Two angles whose measures add up to 180°. Supplementary angles share a common ray. Angles AOB and BOC are supplementary. 
vertex	-	Vertex of an angle: The common endpoint of the two rays that serve as the sides of an angle. Vertex of a polygon: The common endpoint of two line segments that serve as two sides of a polygon. Vertex of a 3-dimensional object: The point where three or more faces of a solid shape intersect.
vertical angles	-	Vertical angles are formed by two intersecting lines. They are not side by side, and they do not overlap. Angles 1 and 2 are vertical angles. 

Lines, Angles, and Figures
Worksheet 1

Choice *E*, in multiple-choice questions, is always: *I request help from the teacher*.

You may mark E in addition to one other choice if you think that you have the right answer to the question but you do not feel that you have a complete understanding of the problem.

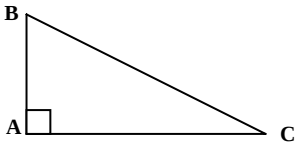
Your teacher will decide whether to use the two-point or four-point scoring rubric for problems that use numbers, pictures, or words to justify/explain your answer(s). You may request help for these questions, too. Write the word "teacher" by your answer(s).

1. In a triangle XYZ (not shown), angle X measures 42°, and angle Y measures 65°, what is the measure angle Z?

   A. 107° B. 253° C. 73° D. 100° E. Teacher

2. In the right triangle shown, if angle B measures 25°, what is the measure of angle C?

   A. 155° C. 105°
   B. 25° D. 65°
   E. Teacher



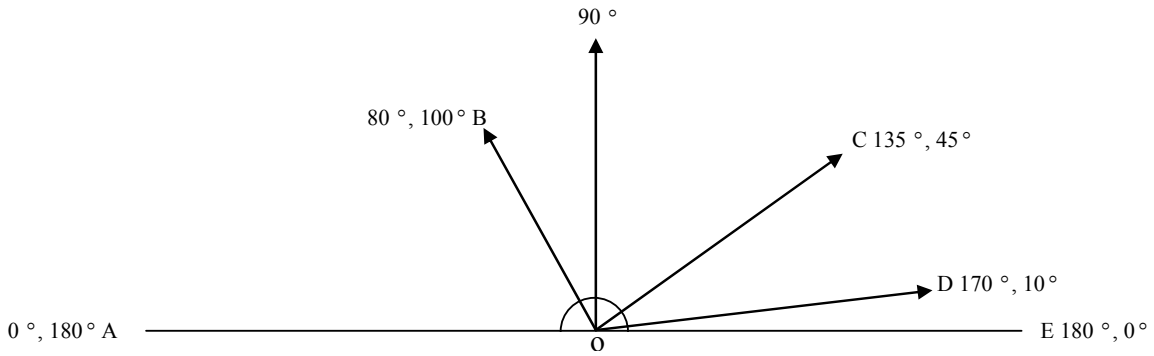
3. If the measure of an angle D is 75° (not shown) and the measure of angle E is 105°, then these angles are:

   A. complementary angles C. vertical angles
   B. supplementary angles D. obtuse angles
   E. Teacher

4. Which statement is incorrect?

   A. A 75° angle is acute. C. A 92° angle is acute.
   B. A 110° angle is obtuse. D. A 90° angle is right.
   E. Teacher

This protractor sketch represents degree markings for #5, #6, and #7.



5. The measure of angle AOC is

A. 45° B. 180° C. 135° D. 90° E. Teacher

6. The measure of angle EOB is

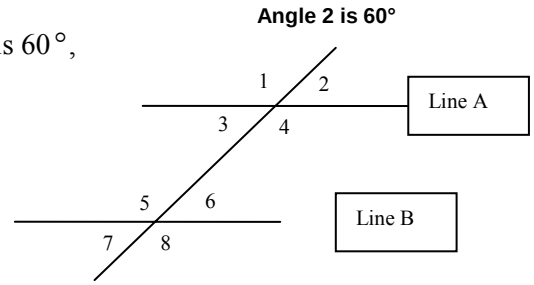
A. 100° B. 80° C. 60° D. 90° E. Teacher

7. The measure of angle DOB is

A. 100° B. 170° C. 80° D. 90° E. Teacher

8. If lines A and B are parallel, and the measure of angle 2 is 60°, then the measure of angle 3 is

A. 120° C. 90°
B. 60° D. 110°
E. Teacher



9. Of the angles 1 and 2 in the figure above, which is an exterior angle?

A. 1 B. 2 C. Both D. Neither E. Teacher

10. In the figure above, the measure of angle 5 is

A. 120° B. 60° C. 90° D. 110° E. Teacher

Lines, Angles, and Figures
Worksheet 2

Choice *E*, in multiple-choice questions, is always: *I request help from the teacher*.

You may mark E in addition to one other choice if you think that you have the right answer to the question but you do not feel that you have a complete understanding of the problem.

Your teacher will decide whether to use the two-point or four-point scoring rubric for problems that use numbers, pictures, or words to justify/explain your answer(s). You may request help for these questions, too. Write the word "teacher" by your answer(s).

1. If a triangle has sides of lengths 3 inches, 4 inches, and 6 inches, it is which type of triangle?

   A. right B. scalene C. isosceles D. equilateral E. Teacher

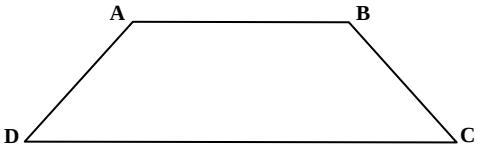
2. If a triangle has two angles that measure 70° and 70°, what type of triangle is this?

   A. obtuse B. acute C. right D. isosceles E. Teacher

3. A STOP sign has eight sides and is called

   A. a quadrilateral B. a hexagon C. an octagon D. a pentagon E. Teacher

4. Quadrilateral ABCD has sides BC = AD and AB || DC. What is the name of this figure?



   A. pentagon C. isosceles triangle
   B. trapezoid D. hexagon
   E. Teacher

5. If a line "a" intersects a line "b" at right angles, the lines are called

   A. perpendicular B. parallel C. vertical D. skew E. Teacher

6. Think about a parallelogram. Think about a trapezoid.

   a) How are they the same? Use words, pictures or diagrams to explain your answers.
   b) How are they different? Use words, pictures or diagrams to explain your answers.

7. Draw an equilateral triangle. Draw a line segment within the triangle to show its altitude. Label your drawing.

8. Draw a polygon and then add a diagonal to the polygon. Label your drawing.

9. Draw a model of two intersecting planes that are neither parallel nor perpendicular. Label your drawing.

10. Explain why a square is a rectangle but a rhombus may or may not be a rectangle. Support your answer with words and pictures.

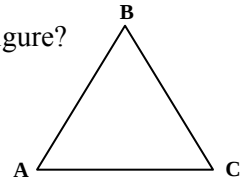
Lines, Angles, and Figures
Worksheet 3

Choice *E*, in multiple-choice questions, is always: *I request help from the teacher*.

You may mark E in addition to one other choice if you think that you have the right answer to the question but you do not feel that you have a complete understanding of the problem.

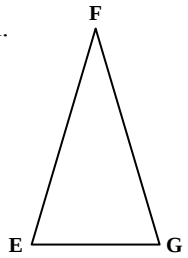
Your teacher will decide whether to use the two-point or four-point scoring rubric for problems that use numbers, pictures, or words to justify/explain your answer(s). You may request help for these questions, too. Write the word "teacher" by your answer(s).

1. Triangle ABC is shown. What is the sum of the interior angles of this figure?



A. 90º
B. 180º
C. 270º
D. 360º
E. Teacher

2. In triangle EFG, the length of EF is equal to the length of FG. GE is a different length. Triangle EFG is which type of triangle?

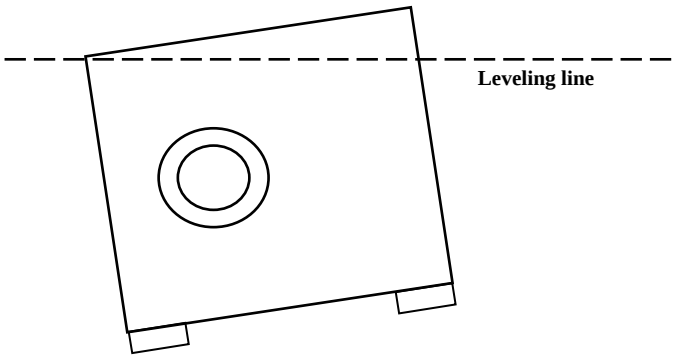


A. right equilateral triangle
B. acute equilateral triangle
C. right isosceles triangle
D. acute isosceles triangle
E. Teacher

3. A classroom is a rectangular prism. Which term best describes the relationship between the plane represented by the floor of a classroom and the plane represented by its front wall?

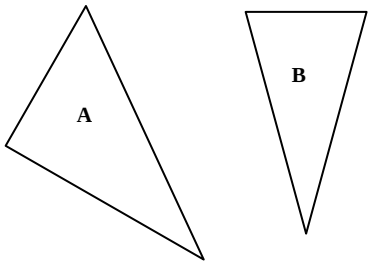
A. parallel
B. perpendicular
C. skewed
D. vertical
E. Teacher

4. Carter wants to project his PowerPoint presentation but the image is crooked. The diagram shows that the projector is not level. Using a protractor, how many degrees must Carter lower the higher side of the project to make the top of the projector level with the leveling line?



A. 170 degrees
B. 10 degrees
C. 15 degrees
D. 165 degrees
E. Teacher

5. Compare the sides and angles of the two triangles. Describe two ways in which these triangles are different. Use words to explain your answers.



6. Carter's rectangular backyard is 20 meters wide and 50 meters long. He takes a diagonal shortcut through the yard each day on his way to Etna High.

   a. How long is Carter's diagonal shortcut?
   b. Round the answer to the nearest whole number.
   c. Use numbers, words, or pictures to explain your answer.

7. Parallelogram EFGH (not shown) has the dimensions 4 meters wide by 6 meters high. Parallelogram WXYZ is similar and its width is 12 meters. What is the height of parallelogram WXYZ? Use numbers, words, or pictures to explain your answer.

8. Two of the interior angles of triangle KLM measure 42° and 57°. What is the measure of the third angle of triangle KLM? Use numbers, words, or pictures to explain your answer.

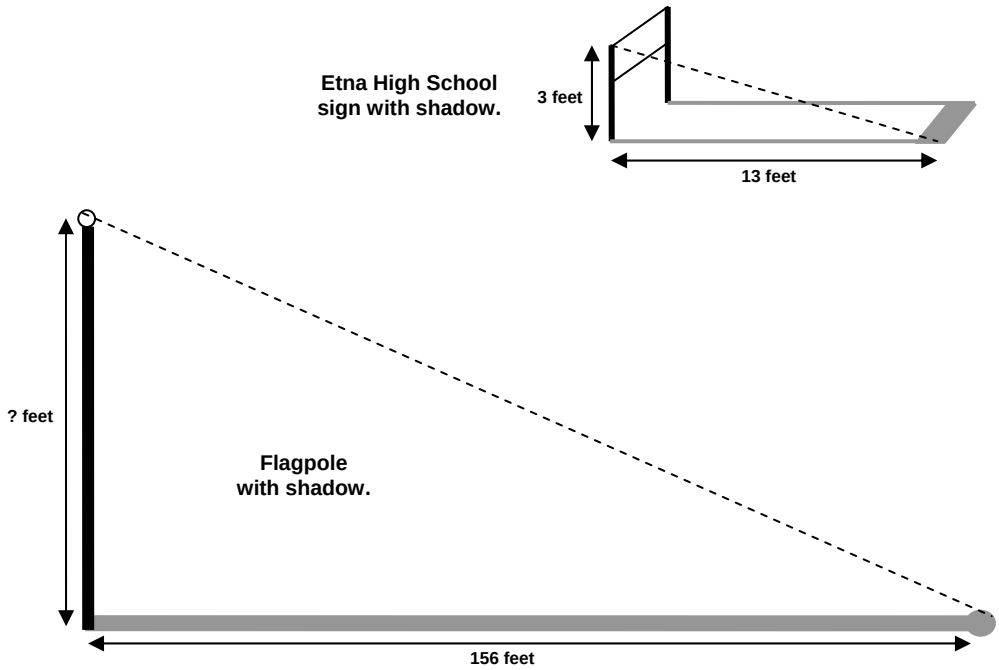
9. Which statement is a characteristic of all parallelograms?

   A. Adjacent sides are congruent.
   B. Adjacent sides are perpendicular.
   C. Opposite angles are congruent.
   D. Opposite angles are supplementary.
   E. Teacher

10. Chris and Carter bought a new flag for Etna High School but they could not raise the flag because there was no rope on the pole. They needed to buy a rope but they did not know how much to buy because they did not know how tall the pole is. They did know that the Etna High sign in front of the school is 3 feet high. They measured the shadow cast by the sign. The sign's shadow was 13 feet long. Then they measured the length of flagpole's shadow.

The flagpole cast a shadow 156 feet long. How tall is the flagpole?

A. 36 feet B. 16 feet C. 56 feet D. 34 feet E. Teacher



Lines, Angles, and Forms

Answer Keys, Program 2: Worksheets 1-3

Each question on every worksheet offers the students the option of marking "Teacher" instead of or in conjunction with answering the question. The "Teacher" option is included to support student understanding and achievement. Students may have as much help and guidance as they need to understand concepts and master skills.

Instructors may decide whether to use the two or four point scoring rubric for constructed response problems (problems that use numbers, pictures, or words to justify/explain student answers). See the appendix for the complete rubrics.

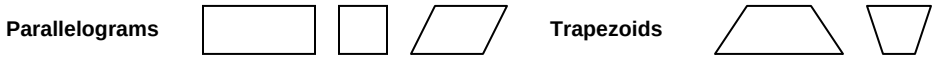
Two-Point Scoring Rubric	Four-Point Scoring Rubric
2 – Complete	4 – Complete
1 – Partial	3 – Clear
0 – Inadequate	2 – Partial
	1 – Minimal
	0 - Inadequate

Worksheet 1

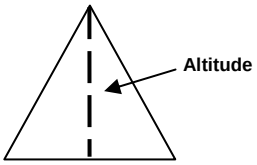
1. C. 73°
2. D. 65°
3. B. supplementary angles
4. C. A 92° angle is acute.
5. C. 135°
6. A. 100°
7. D. 90°
8. B. 60°
9. C.1 and 2 (Angles1, 2, 7, and 8 are all exterior angles.)
10. A. 120°

Worksheet 2

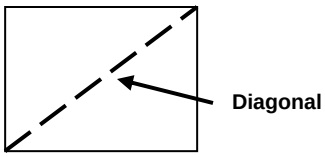
1. B. scalene
2. D. isosceles
3. C. an octagon
4. B. trapezoid
5. A. perpendicular

6. 

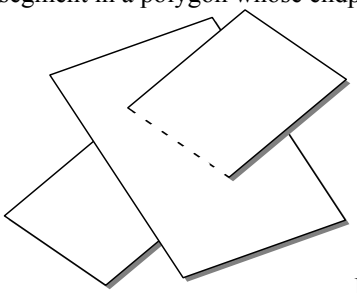
Answers should reflect the following facts: 1) A parallelogram is a quadrilateral (four-sided polygon) that has two pairs of opposite sides that are parallel. 2) A trapezoid is a quadrilateral that has one pair of opposite sides that are parallel. Students will need to identify the differences and similarities between the two figures.

7. 

Drawings or diagrams should reflect the following facts: 1) An equilateral triangle is a triangle with three congruent sides and three equal angles. 2) Altitude is the height of the triangle.

8. 

Drawings or diagrams should reflect the following facts: 1) A polygon is a two-dimensional geometric figure with these characteristics a) It is made of straight line segments. b) Each segment touches exactly two other segments, one at each of its endpoints. c) It is closed -- it divides the plane into two distinct regions, one inside and the other outside the polygon. 2) A diagonal is a segment in a polygon whose endpoints are 2 nonconsecutive vertices.

9. 
Drawings or diagrams should reflect the follwing facts: 1) A plane is a flat, two-dimensional object. 2) The planes must not be parallel to one another. 3) The planes must not be perpendicular to one another. 4) The planes must intersect.
10. Answers should reflect the following facts. 1) A rectangle is a quarilateral with four 90° angles. 2) A square is a quadrilateral with four congruent sides and four 90° angles. 3) A rhombus is a quadrilateral with four congruent sides – but the angles in a rhombus do not need to be right angles.

Worksheet 3

1. B. 180º
2. D. acute isosceles triangle
3. B. perpendicular
4. B. 10 degrees
5. Answers should reflect the following facts. 1) Triangle A is a right, scalene triangle with every side a different length and every angle a different measure. 2) Triangle B is an isosceles triangle with two congruent sides and two congruent angles.
6. 54 meters. Students may use the Pythagorean Theorum to solve the problem. The square of the hypotenuse equals the sum of the square of the two sides. $20^2 + 50^2 = 400 + 2500$ or 2900. $\sqrt{2900} = 53.8516\ldots$ or 54 when rounded to the nearest whole number.
7. 18 meters. Answers should reflect the following facts. 1) Two polygons are similar polygons if corresponding angles have the same measure and corresponding sides are in proportion. 2) The proportion between the widths {4 feet, 12 feet} is 1 to 3 (12 is 3×4 and $3 \times 6 = 18$).
8. 81°. Answers should reflect the following facts: 1) The sum of the interior angles of a triangle is 180°. 2) 180° – (42° + 57°) = 81°.
9. C. Opposite angles are congruent.
10. A. 36 feet