

# MeTEOR Performance Task

## Geometry

Mathematics  
Angle Measure

## **Performance Task Item: Angle Measures**

*Grade Level: High School Geometry*

**Focus Area:** Triangle Angle-Sum Theorem

**Essential Question:** What strategies can be used in solving angle relationships to find various angle measures?

**Core Ideas:**

- Understands the sum of the angle measures of a triangle is always the same.
- Understands any exterior angle of a triangle has a special relationship with the two remote interior angles of a triangle.
- Understands angle relationships given parallel lines and transversals.

**Learning Targets:**

- Students will calculate interior and exterior angles of a triangle.
- Students will use angle relationships to find measures of angles.
- Students will explain their reasoning.

## **STANDARDS**

**Domain: Geometry-Congruence**

**Content Standards:**

- Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent.
- Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to  $180^\circ$ .

**Supporting Standard:**

- Know precise definitions of angles.

**Math Practice Standards:**

MP 1: Make sense of problems and persevere in solving them.

MP 3: Construct viable arguments and critique the reasoning of others.

MP 4: Model with mathematics.

MP 6: Attend to precision.

MP 7: Look for and make use of structure.

**Materials:**

- Performance Task
- Pencil
- Paper
- Calculator

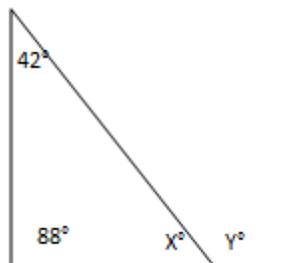
**Task/Question 1:**

**DOK Level 1:** Recall & Reproduction

**Math Practice Standard:**

- MP 6: Attend to precision.

**A.** Write the Triangle Angle-Sum Theorem:



Not drawn to scale

**B.** The triangle shown above resembles the Summer Triangle made up of stars and their constellations in the Northern Hemisphere called Vega, Altair and Denab. Find the measure of angle  $x$  showing where Denab would be located and the exterior angle  $y$ .

$m \angle x$  \_\_\_\_\_     $m \angle y$  \_\_\_\_\_

**C.** Complete the theorem (fill in the blank)

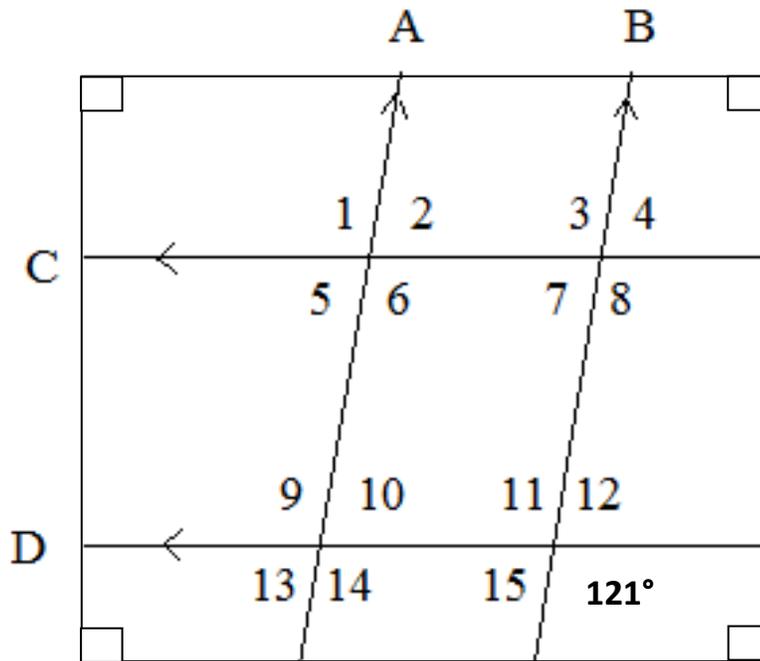
The measure of each exterior angle of a triangle equals the sum of the measures of its two \_\_\_\_\_ angles.

**Task/Question 2:**

**DOK Level 2:** Basic Application of Skills and Concepts

**Math Practice Standards:**

- MP 1: Make sense of problems and persevere in solving them.
- MP 6: Attend to precision.



**A.** Find the value of each numbered angle in the figure shown.

$m\angle 1$ \_\_\_\_\_     $m\angle 2$ \_\_\_\_\_     $m\angle 3$ \_\_\_\_\_     $m\angle 4$ \_\_\_\_\_

$m\angle 5$ \_\_\_\_\_     $m\angle 6$ \_\_\_\_\_     $m\angle 7$ \_\_\_\_\_     $m\angle 8$ \_\_\_\_\_

$m\angle 9$ \_\_\_\_\_     $m\angle 10$ \_\_\_\_\_     $m\angle 11$ \_\_\_\_\_     $m\angle 12$ \_\_\_\_\_

$m\angle 13$ \_\_\_\_\_     $m\angle 14$ \_\_\_\_\_     $m\angle 15$ \_\_\_\_\_

**B.** Explain how you determined the value of the angles in Part A:

**Task/Question 3:**

**DOK Level 2:** Basic Application of Skills and Concepts

**Math Practice Standards:**

- MP 1: Make sense of problems and persevere in solving them.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 7: Look for and make use of structure.

The diagram shown in task/question 2 is an ariel view of downtown Mathville. The construction board needs to know all the angle measures in order to build sidewalk frames for the concrete to be poured down each street. However, the measure of angle 16 was off by a degree. It should have been  $120^\circ$  instead of  $121^\circ$ .

- A.** How does the change in this measurement change the measures of the other angles?
- B.** Explain how you can check your angle measurements for accuracy before submitting them to the construction board.

## Task/Question 4:

**DOK Level 3:** Strategic Thinking and Complex Reasoning

### Math Practice Standards:

- MP 1: Make sense of problems and persevere in solving them.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.
- MP 7: Look for and make use of structure.

The city council of Mathville decided to make a change to the diagram in task/question 2. They decided it would be fun to include a park in the center of town which would include a sidewalk from angle 6 to angle 11 and also from angle 10 to angle 7. In making this change, no cars would be allowed to come through this area. (It will only be for pedestrians to have different paths to get from one side of the park to the other side.)

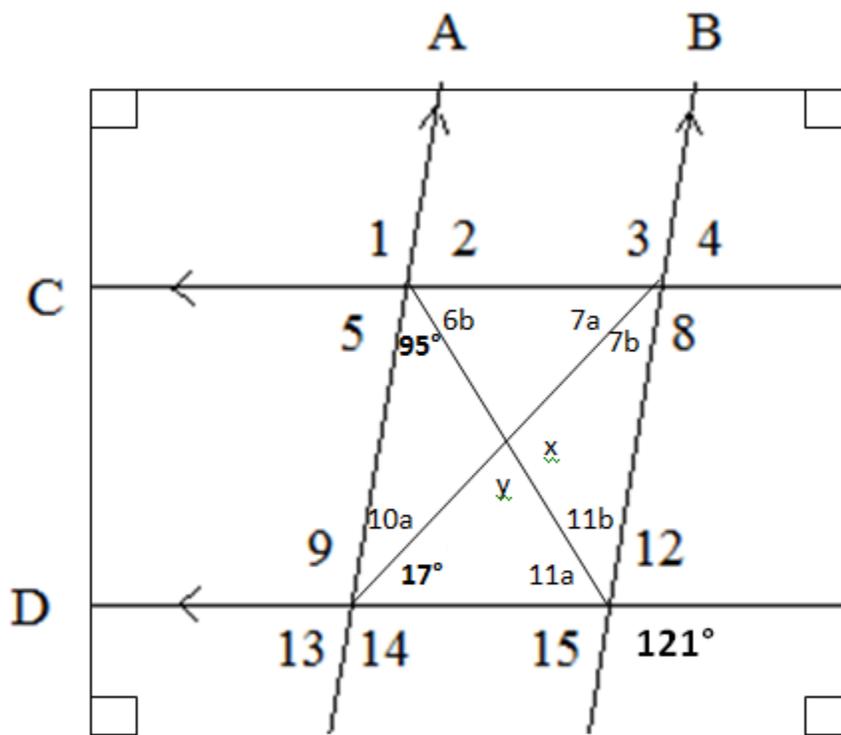


Figure not drawn to scale

A. Calculate the new angles in the park to submit to the construction board:

- |                     |                     |                    |                     |
|---------------------|---------------------|--------------------|---------------------|
| $m\angle 6b$ _____  | $m\angle 7a$ _____  | $m\angle 7b$ _____ | $m\angle 10a$ _____ |
| $m\angle 11a$ _____ | $m\angle 11b$ _____ | $m\angle x$ _____  | $m\angle y$ _____   |

- B.** After you calculate the new angles in part A, justify and defend how your process is the **most efficient** way of determining the angle measurements:

**Task/Question 5:**

**DOK Level 4:** Extended Thinking

**Math Practice Standards:**

- MP 1: Make sense of problems and persevere in solving them.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.

The angles of the triangle used to create guy wires (*the wires that go from the ground up to an object that helps to hold it in place*), to an antenna are in the ratio of 1:2:3.

Find the measure of each angle. Then, create a real life situation where the measure of these angles is used in a real world setting within your history class. Describe your scenario in the space below.

Finally, describe how you could modify an equilateral triangle to use in this same setting.

## Complete Performance Task Scoring Rubric *Angle Measures*

21-23 Proficient 18-20 Good 16-17 Satisfactory 14-15 Poor 0-13 Unsatisfactory

	Depth of Knowledge Level	Points	Total Possible Points for Task	Total Points Earned by Student
<p><b>Task 1:</b></p> <p>A. The sum of the measures of the angles of a triangle is <math>180^\circ</math></p> <p>B. <math>X = 50^\circ</math>    <math>Y = 130^\circ</math></p> <p>C. Remote</p>	<b>1</b>	<p><b>1</b></p> <p><b>1</b></p> <p><b>1</b></p>	<b>3</b>	
<p><b>Task 2:</b></p> <p>A. The measures of angles 1, 3, 6, 8, 9, 11 and 14 each equal <math>121^\circ</math>.</p> <p style="padding-left: 20px;">The measures of angles 2, 4, 5, 7, 10, 12, 13 and 15 each equal <math>59^\circ</math>.</p> <p>B. Answers will vary. However, the student should include some of the following to show an understanding of angle relationships using terminology such as vertical angles, linear pairs, and supplementary, corresponding and alternate interior angles.</p> <p style="padding-left: 20px;">“Angle 16 and 15 make a linear pair adding to the sum of <math>180^\circ</math>. When I subtracted <math>121^\circ</math> from <math>180^\circ</math> I got <math>59^\circ</math>; Since angle 11 is vertical to angle 16 and all corresponding angles related to angle 16 are equal, I knew these angles had a measure of <math>121^\circ</math>. Likewise, since angle 12 is vertical to angle 15, it had the same measure as</p>	<b>2</b>	<p><b>1</b></p> <p><b>1</b></p> <p><b>2</b></p>	<b>4</b>	



<p>corresponding angles are congruent.”</p>				
<p><b>Task 4:</b></p> <p>A. angle 6b = 26°  angle 7a = 17°  angle 7b = 42°  angle 10a = 42°  angle 11a = 26°  angle 11b = 95°  angle X = 43°  angle Y = 137°</p> <p>B. Answers will vary. However, the student should include some of the following to show an understanding of angle relationships using terminology such as vertical angles, linear pairs, and supplementary, corresponding and alternate interior angles. In addition, students should mention using the Triangle Angle-Sum Theorem.</p> <p>“When a transversal intersects two parallel lines the following are true: alternate interior angles are congruent, alternate exterior angles are congruent, same-side interior angles are supplementary, and corresponding angles are congruent, and the Triangle Angle-Sum Theorem can be used.</p> <p>Vertical angles are congruent making the total angle of 11a and 11b congruent to angle 16;  Angle 11b is 95° due to alternate interior angles having the same measure. Since angle 16 is vertical to angle 11, they are congruent. This makes the total angle 121°. Subtract to get 26° for 11a;  You then have two out of the three angles for a triangle. Follow the</p>	<p><b>3</b></p>	<p><b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>2</b></p>	<p><b>10</b></p>	

<p>Triangle Angle-Sum Theorem for angle Y to equal <math>137^\circ</math>;          Since angle X and Y make a linear pair, you can subtract to get the measure angle of X equal to <math>43^\circ</math>;          Then, follow the Triangle Angle-Sum Theorem to get <math>7b</math> equal to <math>42^\circ</math>.          Alternate interior angles make angle 10a equal to <math>42^\circ</math>. Alternate interior angles make angle 6b equal to <math>26^\circ</math>.”</p>				
<p><b>Task 5:</b>          This is a 30-60-90 degree triangle.</p> <p>Answers will vary. However, in the history class students study lots of architecture from periods of time. The angle measures would be used in many forms of construction as long as the side lengths were also in a ratio of <math>x: x\sqrt{3}: 2x</math>.</p> <p>The equilateral triangle becomes a 30-60-90 triangle if an altitude is dropped from the top angle to the base.</p>	<p><b>4</b></p>	<p><b>3</b></p>	<p><b>3</b></p>	
<p><b>TOTAL POINTS:</b></p>				



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