LIFEPAC®

MATH

STUDENT BOOK

7th Grade | Unit 8

Alpha Omega PUBLICATIONS

Math 708
Geometry

LIFEPAC Test is located in the center of the booklet. Please remove before starting the unit.

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Geometry

Introduction

In this unit, students will be introduced to geometry. They will learn basic terms and notation for points, lines, line segments, rays, angles, planes, polygons, and circles. Students will learn about the sum of angles for any polygon, as well as find angle measures in regular polygons. Students will also classify triangles by side and angle, learn about types of quadrilaterals, and solve for missing angle measures.

Students will then be introduced to transformations in the coordinate plane. They will explore symmetry in polygons, including line and rotational symmetry. They will also investigate reflections, noting the similarities to line symmetry, and work with translations in the coordinate plane. Students will learn how the coordinates are affected in these transformations and apply this knowledge to compound transformations.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC. When you have finished this LIFEPAC, you should be able to:

- Identify basic geometric components and shapes.
- Use angle and circle properties to determine missing angle measures and to find angle sums.
- Identify corresponding parts of similar and congruent figures.
- Use the properties of similar and congruent figures to solve problems.
- Determine if a figure has line symmetry or rotational symmetry.
- Determine the coordinates of an image following a reflection, translation, or compound transformation.

1. Basic Geometry

Introduction to Geometry

geometry \jē-'ä-mə-trē\

1: noun — a branch of mathematics concerned with the measurement, properties, and relationships of points, lines, angles, shapes, and figures

2: exclamation — what the acorn said when it grew up: "Gee, I'm a tree!"

In this unit, you will begin your exploration of the branch of mathematics known as geometry. You will begin by learning about the building blocks of geometry: *points*, *lines*, and *planes*.

Objectives

- Identify basic geometric components.
- Use correct geometric terminology and notation.
- Classify angles by their measures.

Vocabulary

acute angle—an angle measuring less than 90°
angle—two rays with a common endpoint
collinear—on the same line
dimensions—the measurements of an object (e.g., length, width, or height)
endpoint—a point that marks the end of a line segment or ray
line—an infinite set of points forming a straight path that continues in two directions
line segment—a part of a line bounded by two endpoints
obtuse angle—an angle measuring greater than 90°
plane—a flat surface that continues in all directions
point—a position in space
ray—a part of a line that has one endpoint and continues in one direction
right angle—an angle measuring 90°
straight angle—an angle measuring 180°
vertex—the point where two line segments, lines, or rays meet to form an angle

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Point

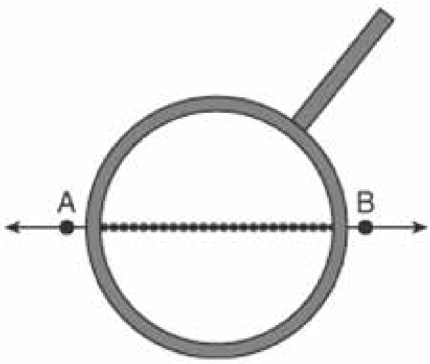
In geometry, a point defines a place in space. A point has no *dimensions* or measurements, but you can name its location with a capital letter and draw a representation of a point with a dot.

The point P can be represented as $\bullet P$.

Line

An infinite series of *collinear* points, or points lined up in a row, is called a line. A line can be named by any two points on the line because there can be only one line between any two points. The symbol $\leftrightarrow$ is used to indicate a line.

Key point! You can think of a line as an infinite series of points. However, even if you could magnify the line, you wouldn't see actual points because they have no dimensions.

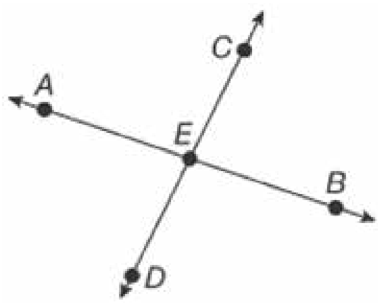


The line *AB* can be represented as $\overleftrightarrow{AB}$. The same line could also be named line *BA* or $\overleftrightarrow{BA}$.

The arrows indicate that the line keeps on going infinitely in both directions.

A line can also be named by a single lowercase letter, such as line *a*.

If two lines intersect, the intersection will be a point.

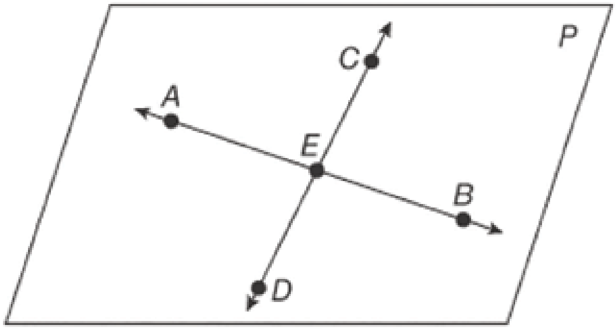


$\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ intersect at point *E*.

Plane

A plane is a flat surface continuing in all directions. Any two intersecting lines will be contained in a plane. A plane can be named by a single capital letter, such as plane *P*.

Vocabulary! You can think of a plane as a sheet of paper with no thickness (just like a line) that goes on forever in all directions.



Ray

A *ray* of sunshine starts at the sun and moves straight ahead.

Keep in mind! You can't change the order of the letters when naming a ray as you can with a line. The first point is the endpoint, and the ray goes toward the second point. So the letters also indicate which direction the ray is going.

A *ray* in geometry is similar. It is half of a line that has one *endpoint* and continues forever away from the point in one direction. A ray is named by its endpoint and any other point on the ray. The symbol $\rightarrow$ indicates a ray.

Ray *AB* can be represented as $\overrightarrow{AB}$.

Line Segment

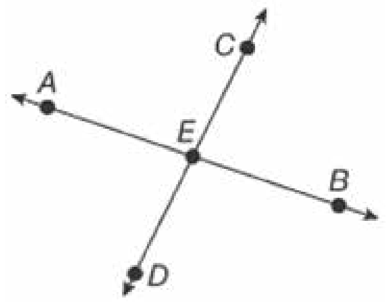
A *line segment* is a part of a line that has two endpoints and includes all the points between the endpoints. A line segment is named by the endpoints and shows a short line over the letters.

Line segment *AB* can be represented as $\overline{AB}$. The same line segment could also be named line segment *BA* or $\overline{BA}$.

Practice using some of these terms.

Example:

- In the following figure, name a point, a line, a ray, and a line segment.



Solution:

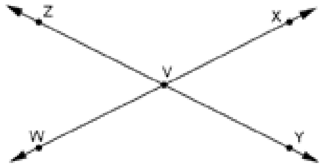
- Look at the figure and think about the definition of each term.
- Point: Although there are an infinite number of points on each line, there are five labeled points: point *A*, point *B*, point *C*, point *D*, and point *E*.

Keep in mind! Although any two points define a line, you can't name a line in a drawing unless it is shown. For example, point C and point A do not define a line in the drawing.

- Line: Any two points on a line can name the line: $\overleftrightarrow{AB}$, $\overleftrightarrow{AE}$, $\overleftrightarrow{EB}$, $\overleftrightarrow{BA}$, $\overleftrightarrow{EA}$, and $\overleftrightarrow{BE}$.
- Ray: Again, you can choose two points on one of the lines, but one must be the endpoint: $\overrightarrow{DE}$, $\overrightarrow{DC}$, $\overrightarrow{CE}$, $\overrightarrow{CD}$, $\overrightarrow{ED}$, and $\overrightarrow{EC}$.
- Line Segment: You can choose any two collinear points, but this time both must be endpoints: $\overline{AB}$, $\overline{DE}$, $\overline{CD}$, and $\overline{BE}$.

Example:

- In the following figure, name as many lines as possible.



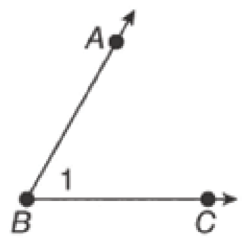
Solution:

$\overleftrightarrow{ZY}, \overleftrightarrow{YZ}, \overleftrightarrow{ZV}, \overleftrightarrow{VZ}, \overleftrightarrow{VY}, \overleftrightarrow{YV}, \overleftrightarrow{WX}, \overleftrightarrow{XW}, \overleftrightarrow{WV}, \overleftrightarrow{VW}, \overleftrightarrow{XV}, \overleftrightarrow{VX}$

Remember! Each line can be written forward and backward.

Angles

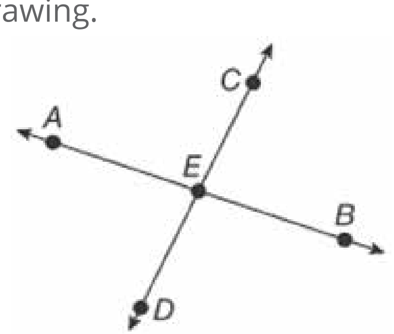
Two rays with a common endpoint form an *angle*. The endpoint is called the *vertex*. There will be angles anywhere lines intersect. The symbol ∠ is used to indicate an angle. Angles can be named three different ways.



- The angle can be named with three letters. The letters, in order, are a point on one ray, the vertex, and a point on the other ray:
- ∠*ABC* or ∠*CBA*
- The angle can be named with one letter, using just the vertex, as long as it is the only angle in the drawing with that vertex:
- ∠*B*
- The angle can be named with a number. The number is written inside the two rays:
- ∠1

Example:

- Name the angles shown in the drawing.



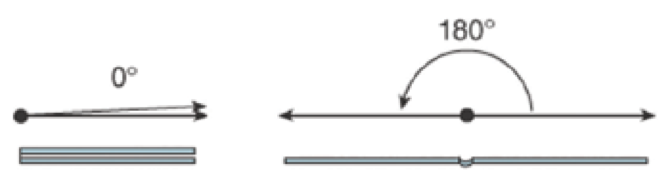
Solution:

- You can't use a numerical name for the angles because none of the angles are labeled numerically. You also can't name the angle by the vertex because point *E* is the vertex for all of the angles.
- So you'll need to use the three-letter designation to name the angles. Use the points on the rays and the vertex *E* to name the angles: ∠*AED*, ∠*AEC*, ∠*CEB*, and ∠*BED*.

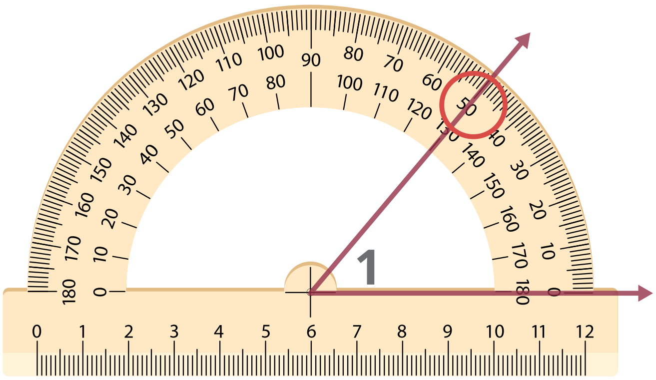
Angle Measurement

Angles are measured in degrees according to how far apart the two rays are. Picture a closed folder on your desk. The edges of the front and back of the folder represent the two rays. When the folder is closed, the angle measure is 0°. As the folder opens, the angle measure increases until the folder is opened flat on the desk and the angle measures 180°. An angle with a measure of 180° is called a *straight angle*.

Key point! The symbol ° above and to the right of the angle measure indicates degrees, just as it does for degrees of temperature.



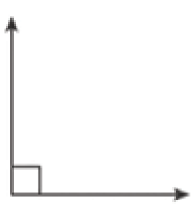
Angles are measured using a tool called a protractor.



There are three types of angles. They are named for how they relate to 90°:

- angle < 90°: *acute angle*
- angle = 90°: *right angle*
- angle > 90°: *obtuse angle*

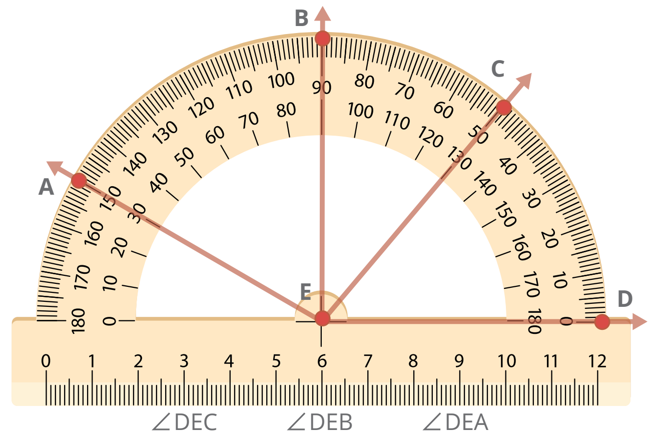
Did you know! A 90° angle is often shown with a small square at the vertex to indicate that it is a right angle.



Example:

- What are the measures of the angles shown on the following protractor, and what types of angles are they?

Make note! Notice that the protractor is numbered from 0° to 180°, and the measurements go from left to right and from right to left. This is so you can measure angles that open in either direction.



Solution:

- Compare the angles to 90° to decide which measure to use and how to classify them.
- *∠DEC* is less than 90°. It measures 50° and is an acute angle.
- *∠DEB* is 90°, so it is a right angle.
- *∠DEA* is greater than 90°. It measures 150° and is an obtuse angle.

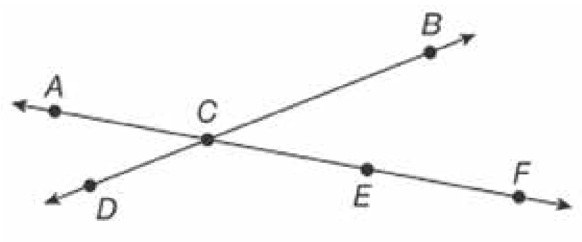
Let's Review

Before going on to the practice problems, make sure you understand the main points of this lesson:

- Geometry is a branch of mathematics that deals with the properties of points, lines, angles, and planes.
- Angles are measured in degrees from 0° for a closed angle to 180° for a straight angle.
- Angles are named as they relate to 90°.
  - Angles greater than 90° are obtuse angles.
  - Angles equal to 90° are right angles.
  - Angles less than 90° are acute angles.

Complete the following activities.

1.1 Select all that apply. Which of the following name a line in the drawing?



☐ $\overleftrightarrow{EC}$ ☐ $\overleftrightarrow{EB}$ ☐ $\overleftrightarrow{DB}$ ☐ $\overleftrightarrow{FC}$

1.2 Select all that apply. Which of the following name a ray in the drawing above?

☐ $\overrightarrow{FC}$ ☐ $\overrightarrow{CD}$ ☐ $\overrightarrow{AF}$ ☐ $\overrightarrow{FD}$

1.3 Select all that apply. Which of the following name a line segment in the drawing above?

☐ $\overline{AF}$ ☐ $\overline{CE}$ ☐ $\overline{AB}$ ☐ $\overline{EF}$

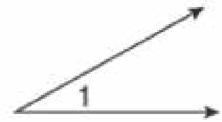
1.4 Select all that apply. Which of the following name an angle in the drawing above?

☐ ∠ACB ☐ ∠CDE ☐ ∠ECB ☐ ∠BDA

1.5 What is the intersection of $\overleftrightarrow{AF}$ and $\overleftrightarrow{BD}$ in the drawing above?

☐ point *A* ☐ point *D* ☐ point *C* ☐ point *E*

1.6 What type of angle is ∠1?



☐ obtuse ☐ straight
☐ acute ☐ right

1.7 Which measurement is the measure of an obtuse angle?

☐ 75° ☐ 87° ☐ 137° ☐ 90°

1.8 Use a protractor to find the measure of the angle below.

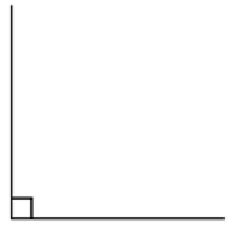
☐ 170° ☐ 10°
☐ 15° ☐ 165°

1.9 What does the notation $\overrightarrow{PQ}$ mean?

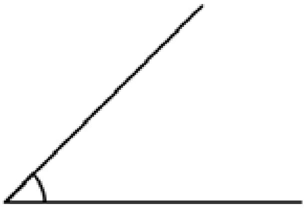
1.10 What does the notation $\bullet R$ mean?

Identify each angle below as acute, right, or obtuse.

1.11



1.12



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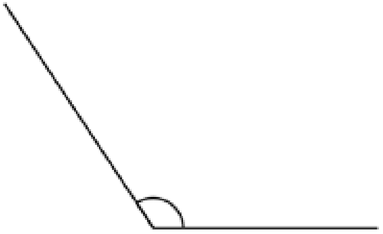
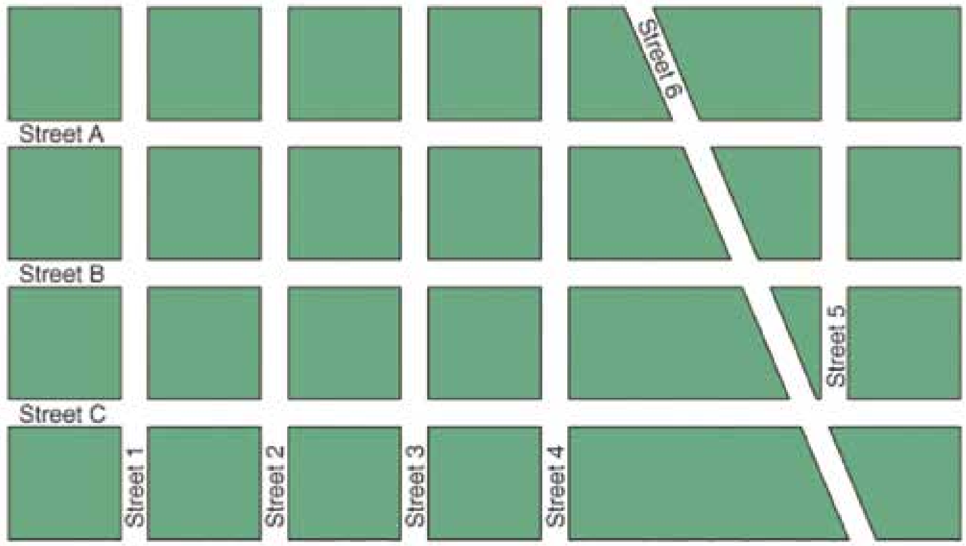


Special Pairs of Angles



If you've ever looked at a city map, you've probably noticed that some streets intersect, but others never do. Some streets intersect at right angles, but others intersect diagonally.

In this lesson, you will look at lines that have some of the same properties as streets. You will also look at the special angles that result when lines cross.

Objectives

- Identify special pairs of angles.
- Use angle properties to determine missing angle measures.

Vocabulary

adjacent angles—two angles that have a common vertex and side but are not overlapping

complementary angles—two angles whose sum is 90°

congruent angles—angles that have the same measure

corresponding angles—two angles in the same position on different lines

parallel lines—lines that never cross one another and are the same distance apart at all times

perpendicular lines—lines that intersect and create right angles

supplementary angles—two angles whose sum is 180°

transversals—lines that intersect two or more lines to create angles

vertical angles—congruent angles that are opposite from one another at the intersection of two lines

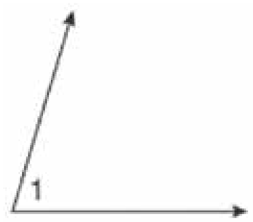
Self Test 1: Basic Geometry

Complete the following activities (5 points, each numbered activity).

1.01 Which number shows the measure of an acute angle?

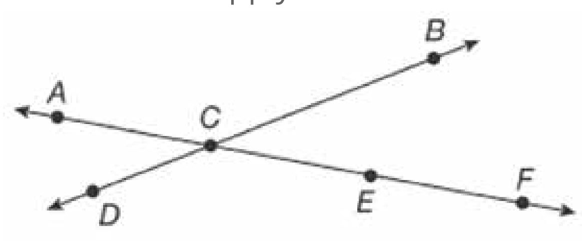
☐ 45° ☐ 90° ☐ 135° ☐ 180°

1.02 *Estimate* the measure of $\angle 1$.



☐ 90°
☐ 80°
☐ 110°
☐ 45°

1.03 Select all that apply. Which of the following names a ray in the drawing?

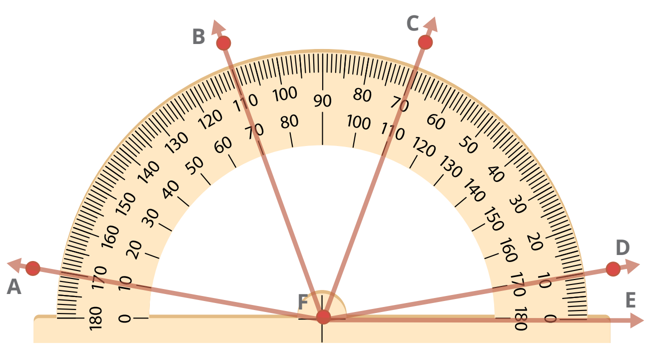


☐ $\overrightarrow{CB}$ ☐ $\overrightarrow{AF}$
☐ $\overrightarrow{BF}$ ☐ $\overrightarrow{AB}$

1.04 Select all that apply. Which of the following names an angle in the drawing used in the previous question?

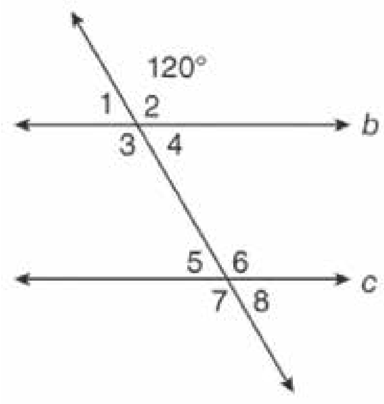
☐ $\angle ACD$ ☐ $\angle CBE$ ☐ $\angle FBC$ ☐ $\angle DCE$

1.05 Which angle measures 70°?



☐ $\angle EFA$
☐ $\angle EFB$
☐ $\angle EFC$
☐ $\angle EFD$

1.06 Select all that apply. Which pairs of angles are supplementary?



- ☐ ∠1 and ∠8
- ☐ ∠2 and ∠4
- ☐ ∠3 and ∠5
- ☐ ∠6 and ∠7

1.07 Select all that apply. Which angles are congruent to ∠4 in the drawing used in the previous question?

☐ ∠1 ☐ ∠7 ☐ ∠8 ☐ ∠2

1.08 ∠*A* and ∠*B* are complementary and congruent. What is the measure of each of these angles?

☐ 90° ☐ 45° ☐ 50° ☐ 180°

1.09 Two lines intersect and two of the vertical angles measure 37°. What is the measure of the other two vertical angles?

☐ 37° ☐ 74° ☐ 90° ☐ 143°

1.010 What is a polygon with 10 sides called?

☐ dodecagon ☐ octagon ☐ tarragon ☐ decagon

1.011 What is the measure of an angle in a regular hexagon?

☐ 144° ☐ 135° ☐ 120° ☐ 108°

1.012 What is the sum of the angle measures in a heptagon?

☐ 900° ☐ 540° ☐ 360° ☐ 720°

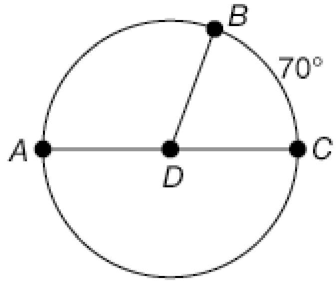
1.013 Which polygon will have the largest angle sum?

☐ octagon ☐ heptagon ☐ pentagon ☐ dodecagon

1.014 A section of a circle has both endpoints on the circle. What is the section of the circle called?

☐ arc ☐ radius ☐ chord ☐ diameter

1.015 $\overline{AC}$ is a diameter of $\odot D$, and m$\angle BC$ = 70°. What is the measure of $\angle ADB$?



- ☐ 70°
- ☐ 30°
- ☐ 110°
- ☐ 90°

1.016 What is the sum of the interior angles of a 30-gon?

1.017 What is the measure of each interior angle of a regular 30-gon?

1.018 An angle measures 42°. What is the measure of its complementary angle?

1.019 An angle measures 77°. What is the measure of its supplementary angle?

1.020 A circular swimming pool has a diameter of 18 feet. What is the radius of the pool?

80/100 **SCORE** ____________ **TEACHER** ____________ ____________
initials date

MAT0708 – May '14 Printing

ISBN 978-0-7403-3173-2

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