INTRODUCTION TO GEOMETRY

In this unit, you will complete problems about geometry. It will be helpful to use drawing paper, a straight edge (ruler), a protractor, a compass, and/or a drawing program. You will find two parallel lines crossed by a transversal. There will be many vocabulary words to identify as well as relationships of angles to visualize. By drawing some of the diagrams and tracing the angles, you will better understand the ideas being shown. Geometry is a vital tool in real-life areas such as construction, surveying, and graphic design. Knowing the fundamentals is very important!
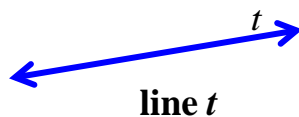
Basic Figures in Geometry

Here are some geometric figures that you should recognize as you study geometry.
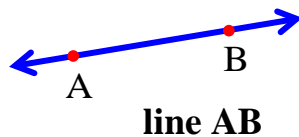
Line – a straight path goes in two directions without end.

A line can be named in two ways.

(a) One way is to label the line with one letter and name it. The letter is usually written in *lowercase* letters and italicized.

line *t*

(b) Another way is to name two points on the line. The letters that represent this points are usually written as UPPERCASE letters.

line AB
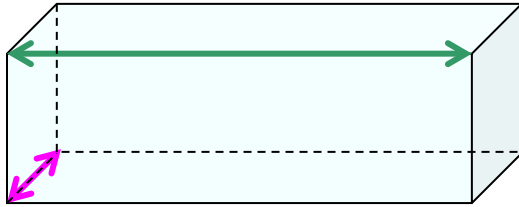
Segment – a part of a line with two endpoints.

A segment is named by labeling the endpoints of the segment with UPPERCASE letters.

Segment CD

Skew lines – lines in space that do not intersect and are not parallel. (You must think in terms of space (3-D), not flat (2-D) like a sheet of paper).

Ray – a part of a line that has one endpoint and continues in one direction without end.

A ray is named by labeling the starting point (endpoint) and a point on the ray with UPPERCASE letters. A ray is directional so the letter of the endpoint is written first. (Be careful to NOT reverse the letters when naming a ray.)

E

F

ray EF   (not ray FE)
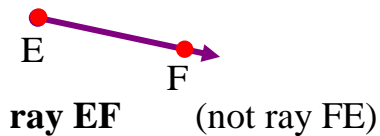
Angle – a figure formed by two rays that share a common endpoint called the vertex.
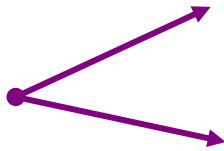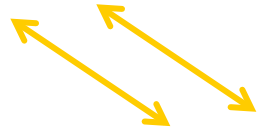
An angle is named by labeling the vertex and labeling a point on each ray. Sometimes an angle is named just by the vertex letter. (The vertex letter is always the middle letter of the name.)
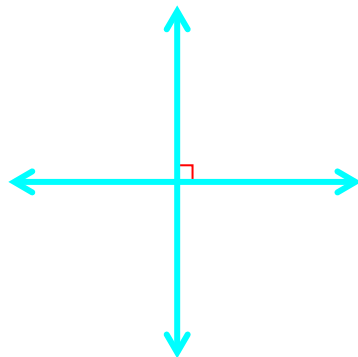
H

I

J
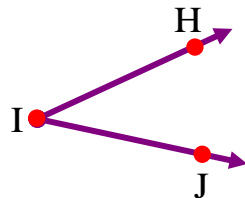
angle HIJ *or* **angle JIH** *or* **angle I**

Parallel lines – lines in the same plane that never intersect. (think of the lines lying in a two-dimensional area, like a flat sheet of paper).

Perpendicular lines – lines that intersect (cross each other) forming right angles at the point of intersection.
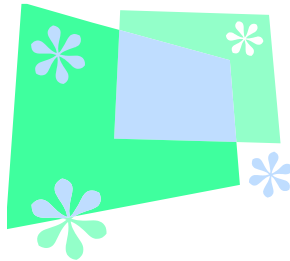
*Note: The small red right-angle in the figure (looks like an upside down L) denotes perpendicular lines.

Basic Shapes in Geometry

Here are some geometric shapes that you should recognize as you study geometry.

Quadrilaterals – any four sided shape.

Prisms – a three dimensional shape with rectangular sides and any shape as its base (example: a cereal box).

Pyramid – a three dimensional shape with triangular sides and any shape as its base (example: the great pyramids in Egypt).
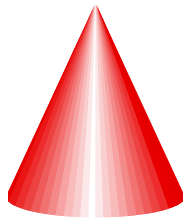
Cylinder – a three dimensional shape with circles as its base (example: soda pop can).

Sphere – a three dimensional shape that is completely round (example: ball).

Cone – a three dimensional shape with a circle as base that has a point opposite the center of the base (example: dunce cap).
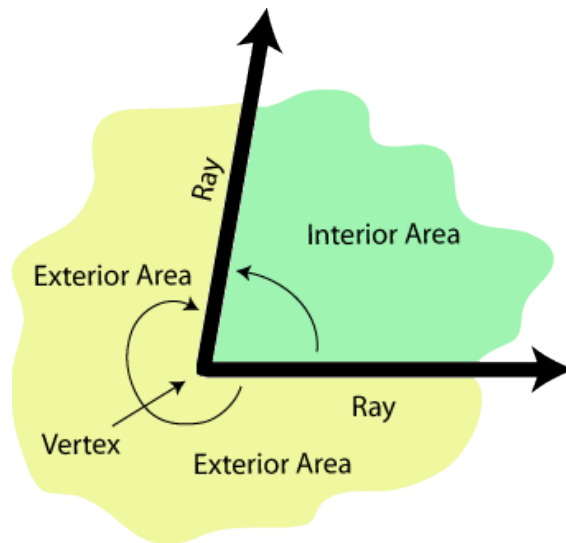
Angles

Properties of an Angle

An **angle** is formed when two **rays** meet at a common point called the **vertex**.

The measure of an angle is the amount of **circular rotation** about a point starting with a ray and ending with a second ray.

The area within the two rays is called the **interior** of the angle represented by the green shading in the figure below. The area outside the two rays is called the **exterior** of an angle represented by the yellow shading in the figure.

Ray

Interior Area

Exterior Area

Ray

Vertex

Exterior Area

Measuring Angles

Angle – a figure formed by two rays that share a common endpoint called the **vertex**.

Example 1: What kind of angle is shown below? What is the angle's measure?

First determine the measure of the angle.

This angle starts on the **right** at 0°, 10°, 20°... passes by 90° … 130°, 135°, and goes up to 137°. (Read the bottom numbers since the bottom ray is pointing at zero, the starting point of the set of lower numbers.)
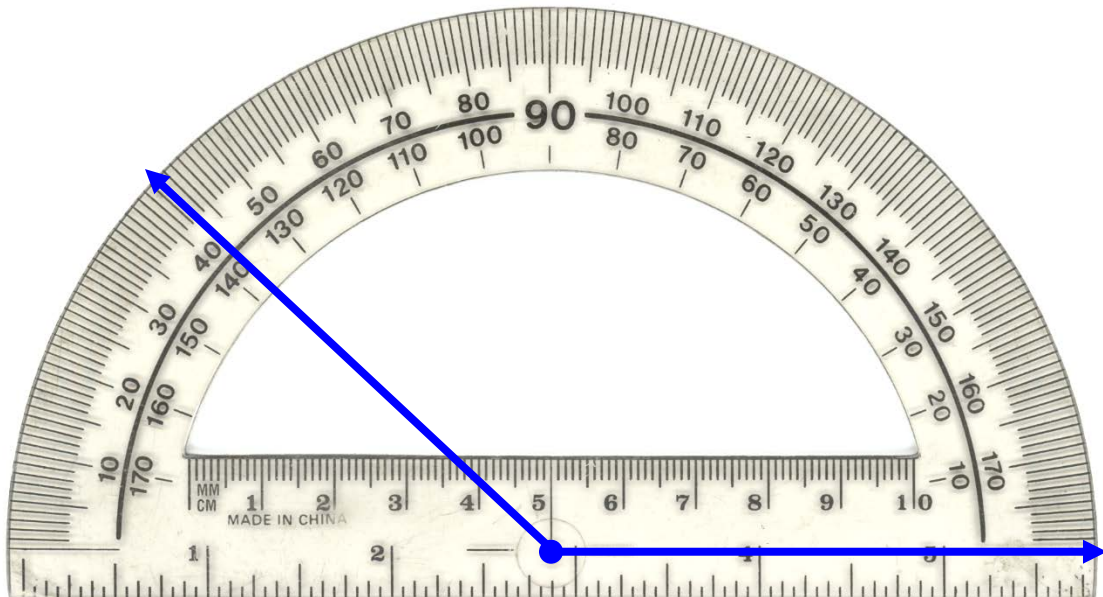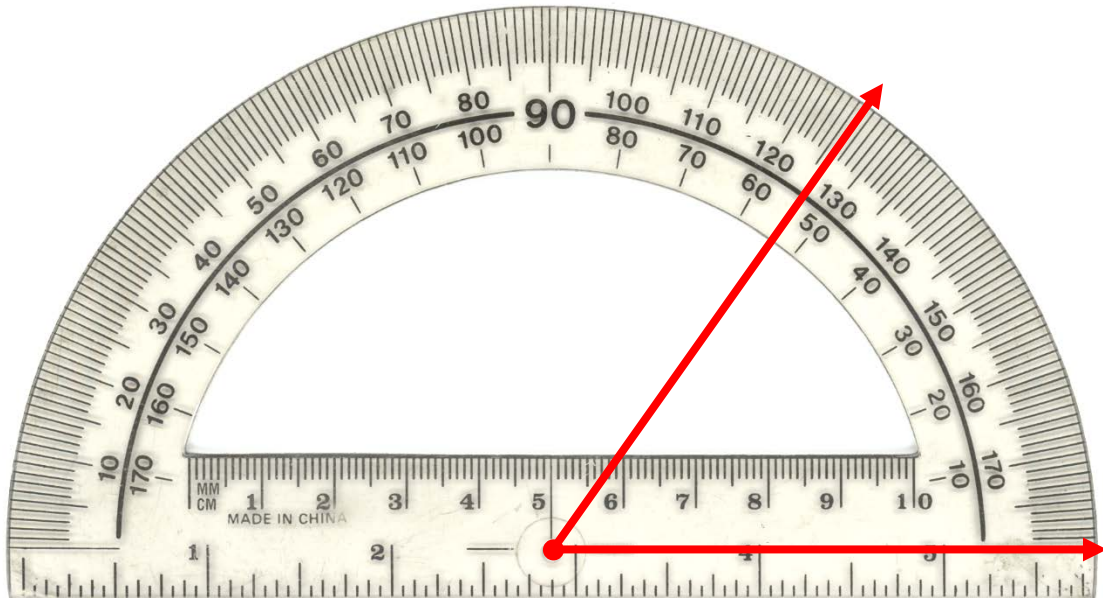

Now determine the kind of angle.

This angle can be labeled as an **obtuse angle**. Obtuse angles are angles that measure *more than 90 degrees and less than 180 degrees*.

The angle is an obtuse angle that measures 137 degrees.

Example 2: What kind of angle is shown below? What is the angle's measure?

First determine the measure of the angle.

This angle starts on the **right** at 0°, 10°, 20°... 50°, up to 54°. (Read the bottom numbers since the bottom ray is pointing at zero, the starting point of the set of lower numbers.)


Now determine the kind of angle.

This angle can be labeled as an **acute angle**. Acute angles are angles that measure *less than 90 degrees*.

The angle is an acute angle that measures 54 degrees.

Example 3: What kind of angle is shown below? What is the angle's measure?

Measure the angle and identify the type.

This angle starts on the **left** at 0°, 10°, 20°... passes by 90° … 120°, 125°, and goes up to 126°. (Read the top numbers since the bottom ray is pointing at zero, the starting point of the set of upper numbers.)
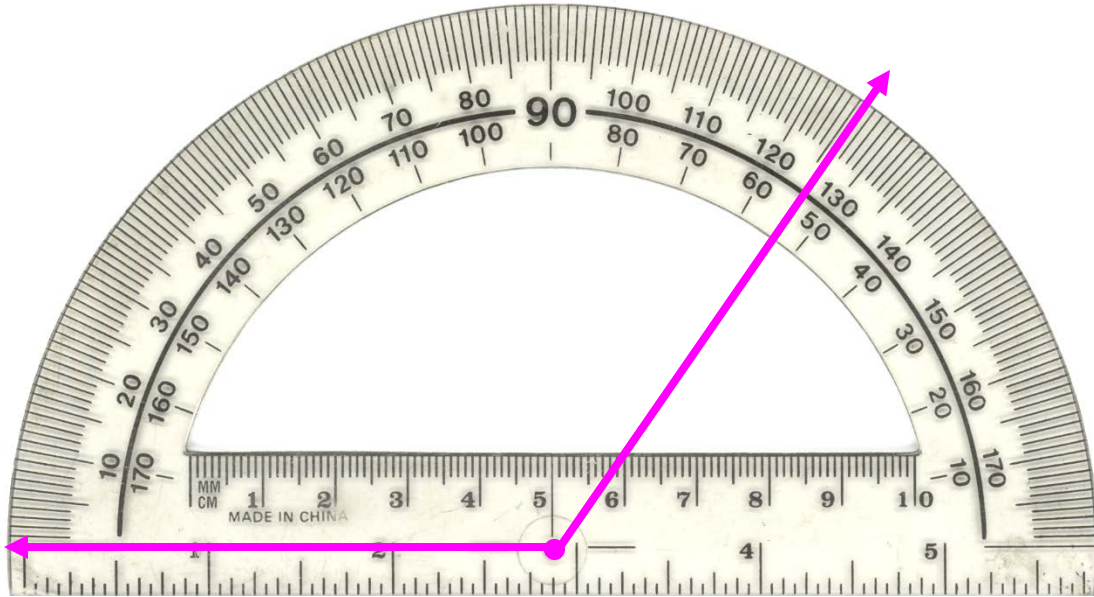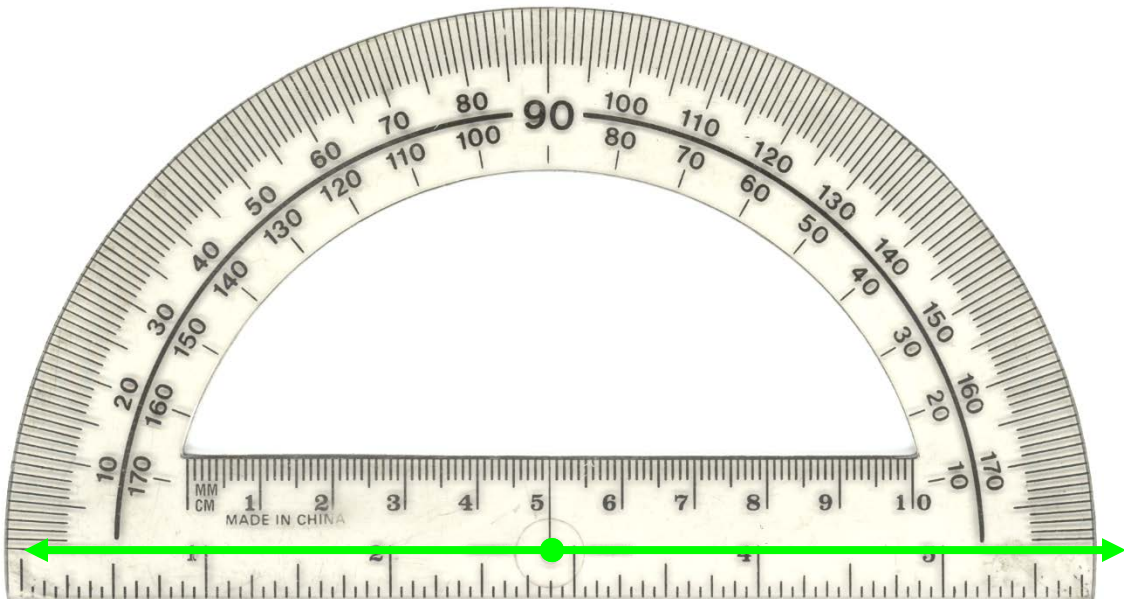

The angle is an obtuse angle that measures 126 degrees.

Example 4: What kind of angle is shown below? What is the angle's measure?

The angle below appears to be a straight line?   Start at $0°, 10°, 20°$... on either end and go past $90°$ up to $180°$.

This angle can be labeled as a **straight angle**. Straight angles are angles that measure *exactly 180 degrees*.
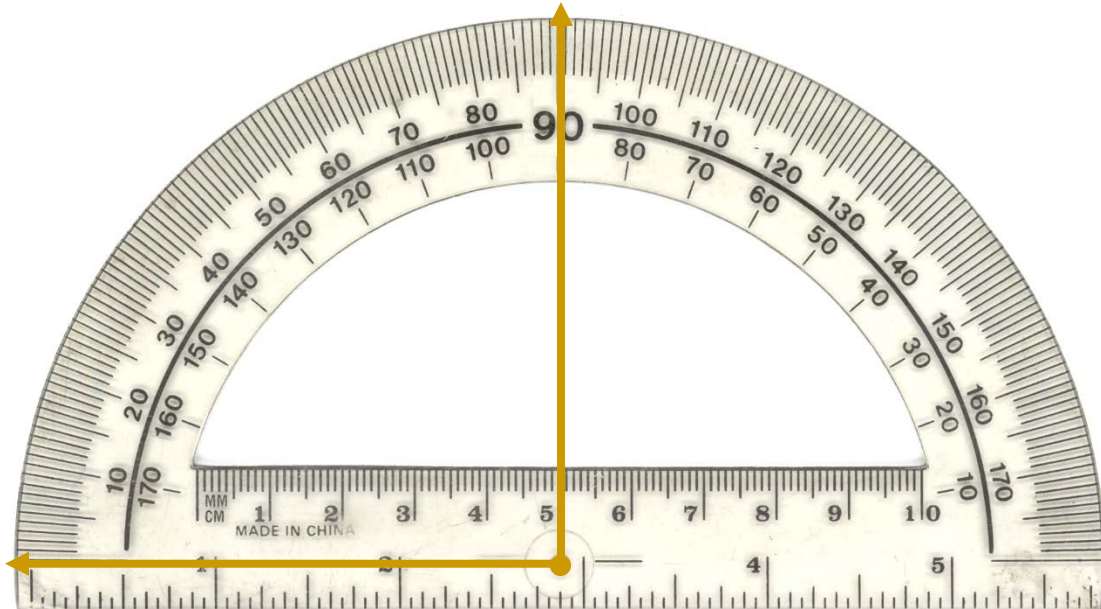

The angle is a straight angle that measures 180 degrees.

Example 5: What kind of angle is shown below? What is the angle's measure?

Measure the angle and identify the type.

This angle starts on the **left** at $0°$, $10°$, $20°$... and goes up to $90°$. (Read the top numbers since the bottom ray is pointing at zero, the starting point of the set of upper numbers.)
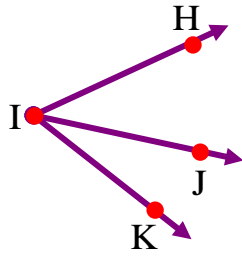

This angle can be labeled as a **right angle**. Right angles are angles that measure *exactly 90 degrees*.

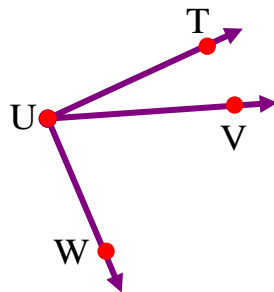The angle is a right angle that measures 90 degrees.

Pairs of Angles

Adjacent Angles – angles that share a common vertex and a common ray.

Angle HIJ is adjacent to angle JIK. The adjacent angles share vertex I and ray IJ.

Complementary Angles – adjacent angles that form a right angle (90°).

Angle TUV and angle VUW are complementary angles. Together these angles form right angle TUW.

Supplementary Angles – adjacent angles that form a straight angle (180°).
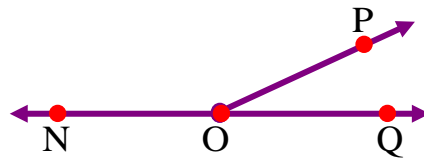
Angle NOP and angle OPQ are supplementary angles. Together these angles form straight angle NOQ.

Vertical Angles – opposite angles formed when two lines intersect. Vertical angles are equal in measure (congruent).
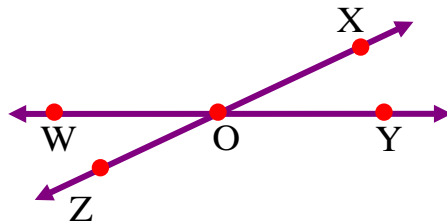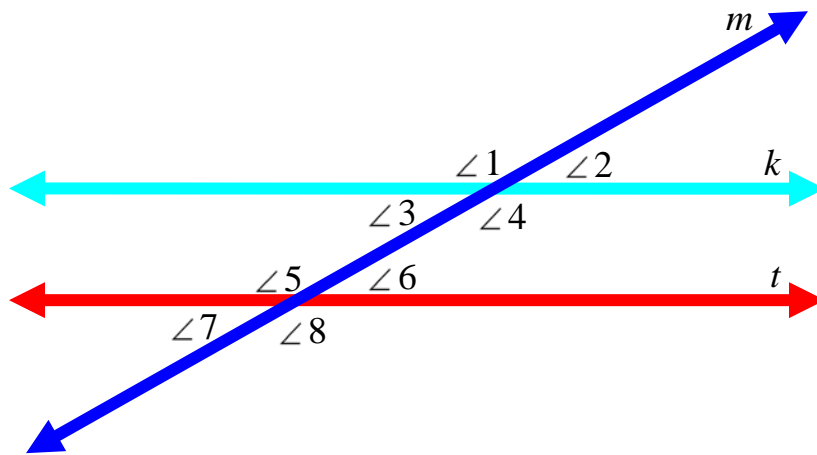
Angle WOZ and angle XOY are vertical angles. These angles are congruent acute angles

Angle WOX and angle ZOY are vertical angles. These angles are congruent obtuse angles.

Parallel Lines Cut by a Transversal

The figure below shows two parallel lines (*k* and *t*) cut by a transversal (*m*).

The picture above is a classic example of two parallel lines (*k* and *t*) cut by a transversal (*m*).

Notice the position of the eight angles formed. There are many types of angle relationships formed in this figure and given special names.

Vertical Angles

Angles 1 and 4 are vertical angles. Vertical angles are congruent (equal in measure) and are the opposite angles formed when two lines intersect.

∠1 and ∠4 are vertical angles.

Other vertical angles formed are:

∠2 and ∠3

∠5 and ∠8

∠6 and ∠7

Corresponding Angles

Now take a look at angle 1 and compare its position and size to angle 5.

These angles are in the same position along the transversal line. Their positions are corresponding (left of the transversal and above the parallel lines), so we call them corresponding angles. Notice too, if they are corresponding, then they can also be shown to be congruent.

The **corresponding angles** are:

Location

∠1 and ∠5   *Left* of the transversal, *above* the parallel lines.

∠2 and ∠6   *Right* of the transversal, *above* the parallel lines..

∠3 and ∠7   *Left* of the transversal, *below* the parallel lines.

∠4 and ∠8   *Right* of the transversal, *below* the parallel lines..

Alternate Interior Angles

Now consider angles 3 and 6. These angles are called alternate interior angles and you guessed it! They can also be shown to be congruent. They are named by their position; they are located on opposite sides of the transversal and within the interior of the parallel lines.

The alternate interior angles are:

∠3 and ∠6

∠4 and ∠5

Supplementary Angles

Recall that supplementary angles are angles that together form a straight line (or total 180°).

There are lots of supplementary angles formed when parallel lines are cut by a transversal.

Some supplementary angles formed are:

$$m\angle 1 \;+\; m\angle 2 \;=180°$$

$$m\angle 1 \;+\; m\angle 3 \;=180°$$

$$m\angle 3 \;+\; m\angle 5 \;=180°$$

$$m\angle 6 \;+\; m\angle 8 \;=180°$$

*Note: $m\angle 1$ is read "the measurement of angle 1".

You can check the sum of angles 3 and 5 by using thin paper and tracing the angles. After tracing the angles, slide them together to see that they form a straight line with their outer rays.

This ends the discussion of parallel lines cut by a transversal. You may be able to spot this classic geometric setting in the real world around you. Look around to see!

Sample Problems

On a separate sheet of paper, write the answers to the practice problems shown below. Then, check your answers by clicking on the link to "Answers to Sample Problems".
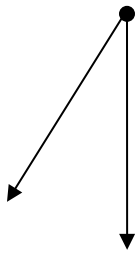
*Note: You can print out this exercise by clicking on the PDF link at the top of the content section and printing pages 15 and 16 of the PDF file
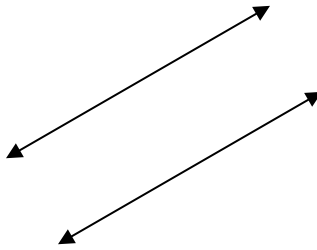
Geometry Vocabulary

Identify each of the given geometric figures by choosing from the list below.

A. Line
B. Perpendicular Lines
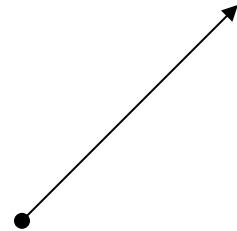C. Skew Lines
D. Line Segment
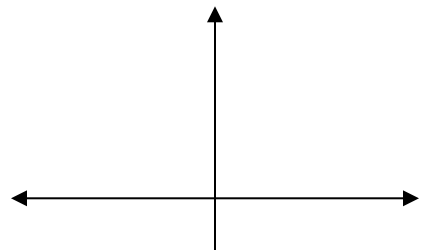E. Ray
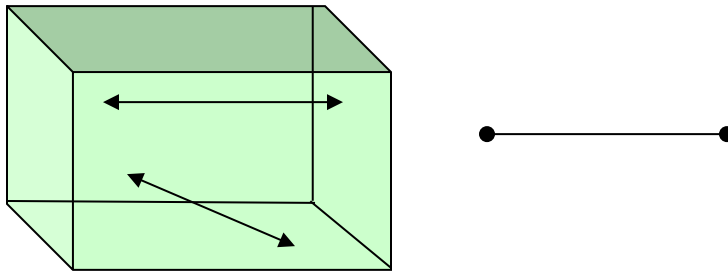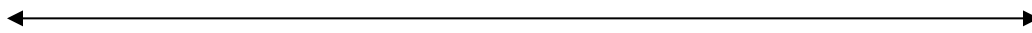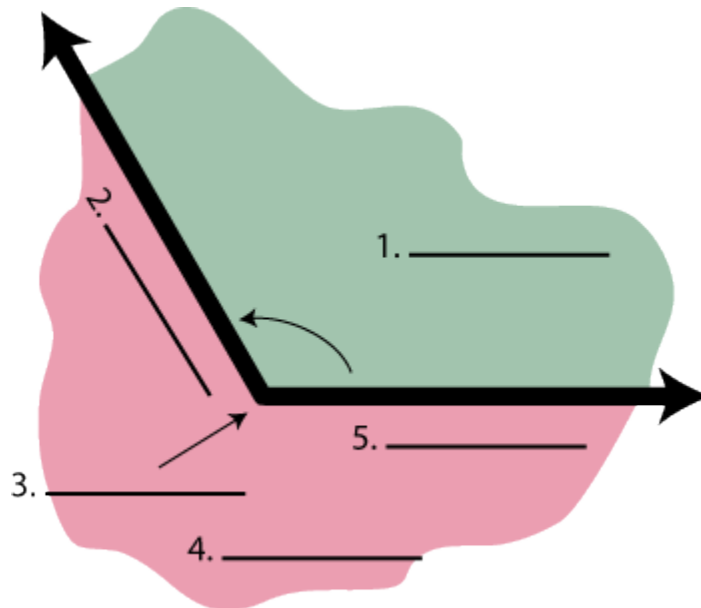F. Angle
G. Parallel Lines

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

Parts and Properties of an Angle

Label the parts of the angle by choosing from the list provided below. You will use one term twice.

A. exterior
B. interior
C. vertex
D. ray

2.
1. _____
3. _____
4. _____
5. _____

Solutions to Sample Problems

Geometry Vocabulary

1. F
2. G
3. E
4. C
5. D
6. B
7. A

Parts and properties of angles

1. B (interior)
2. D (ray)
3. C (vertex)
4. A (exterior)
5. D (ray)