Name Ms. Kresovic

Adv Geo - *4.5: Introduction to parallel lines*

Objectives

After studying this section, you will be able to

- Recognize planes
- Recognize transversals
- Identify the pairs of angles formed by a transversal
- Recognize parallel lines

Part One: Introduction

Planes

In order to explain parallel lines adequately, we must first acquaint you with the meaning of ***plane***.

Definition A ***plane*** is a surface such that if any two points on the surface are connected by a line, all points of the line are also on the surface.

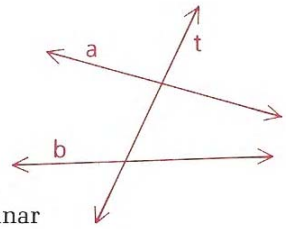
A plane has only two dimensions—length and width. Both the length and the width are infinite. A plane has no thickness.

Definition If points, lines, segments, and so forth, lie in the same plane, we call them ***coplanar***. Points, lines, segments, and so forth, that do not lie in the same plane are called ***noncoplanar***.

Planes are discussed more fully in Chapter 6.

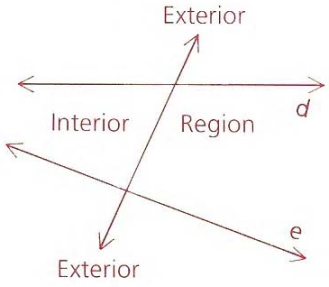
Transversals

In the figure, line t is a ***transversal*** of lines a and b.

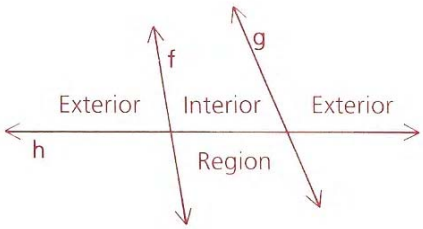


Definition A ***transversal*** is a line that intersects two coplanar lines in two distinct points.

The region between lines d and e is the ***interior*** of the figure. The rest of the plane is the ***exterior***.

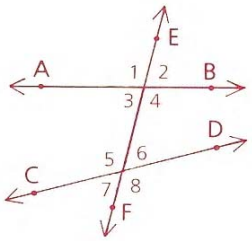


The diagram of lines f and g cut by transversal h provides another illustration of the regions formed by two lines and a transversal.



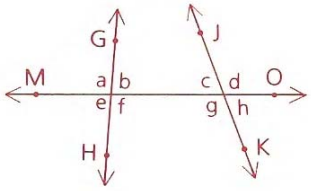
Angle Pairs Formed by Transversals

$\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ are cut by transversal $\overleftrightarrow{EF}$.



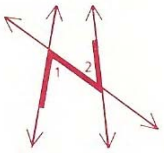
The two pairs of ***alternate interior angles*** are 3 and 6, 4 and 5.
The two pairs of ***alternate exterior angles*** are 1 and 8, 2 and 7.
The four pairs of ***corresponding angles*** are 1 and 5, 2 and 6, 3 and 7, 4 and 8.

$\overleftrightarrow{GH}$ and $\overleftrightarrow{JK}$ are cut by transversal $\overleftrightarrow{MO}$.



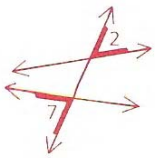
The alternate interior angles are b and g, f and c.
The alternate exterior angles are a and h, e and d.
The corresponding angles are a and c, b and d, e and g, f and h.

Definition ***Alternate interior angles*** are a pair of angles formed by two lines and a transversal. The angles must both lie in the interior of the figure, must lie on alternate sides of the transversal, and must have different vertices.

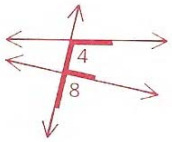


Look for an N or Z shape.

Definition ***Alternate exterior angles*** are a pair of angles formed by two lines and a transversal. The angles must both lie in the interior of the figure, must lie on alternate sides of the transversal, and must have different vertices.

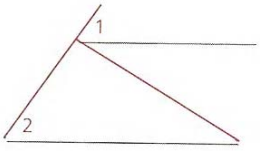


Definition ***Corresponding angles*** are a pair of angles formed by two lines and a transversal. One angle must lie in the interior of the figure, and the other must lie in the exterior. The angles must lie on the same side of the transversal but have different vertices.

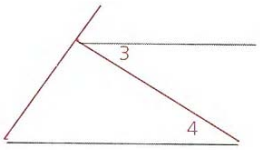


Look for an F shape.

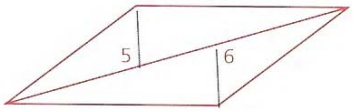
It is important to be able to recognize these pairs of angles when they appear in figures made up of a number of segments. In each of the following examples, the segment corresponding to the transversal is shown in red, and the segments corresponding to the lines it cuts are shown in blue.



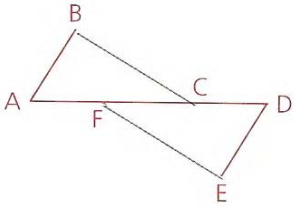
$\angle 1$ and $\angle 2$ are corresponding $\angle$s.



$\angle 3$ and $\angle 4$ are alternate interior $\angle$s.

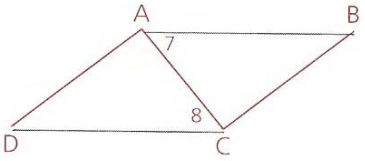


$\angle 5$ and $\angle 6$ are alternate exterior $\angle$s.



$\angle BCA$ and $\angle DFE$ are alternate interior $\angle$s.

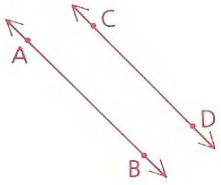
$\angle BCD$ and $\angle EFA$ are alternate exterior $\angle$s.

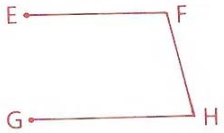


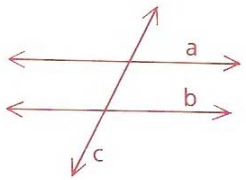
$\angle 7$ and $\angle 8$ are alternate interior $\angle$s.

Can you find a pair of alternate interior $\angle$s formed by $\overleftrightarrow{AD}$ and $\overleftrightarrow{BC}$ with transversal $\overleftrightarrow{AC}$?

Parallel Lines







Above are three illustrations of ***parallel*** ($\parallel$) lines. We write $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$, $\overleftrightarrow{EF} \parallel \overleftrightarrow{GH}$, and $a \parallel b$.

Definition ***Parallel lines*** are two coplanar lines that do not intersect.

We shall also call segments or rays parallel if they are parts of parallel lines. For example, we can say that in the preceding diagrams $\overline{AB} \parallel \overline{CD}$ and $\overline{EF} \parallel \overline{GH}$.

There are many lines that do not intersect yet are not parallel. *To be parallel, lines must be coplanar.* In Chapter 6, lines that are noncoplanar and nonintersecting are defined as *skew* lines.

Part Two: Sample Problem

Problem

a *Which of the lines in the figure at the right is the transversal?*

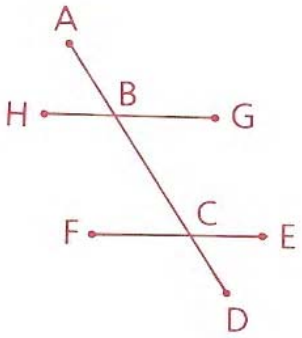
b *Name all pairs of alternate interior angles.*

c *Name all pairs of alternate exterior angles.*

d *Name all pairs of corresponding angles.*

e *Name all pairs of interior angles on the same side of the transversal.*

f *Name all pairs of exterior angles on the same side of the transversal.*



Answers

a

b

c

d

e

f

AMDG

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Homework

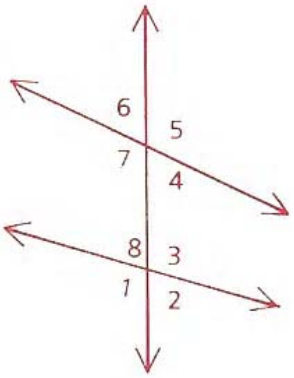
1 a Name all pairs of alternate interior angles.

b Name all pairs of alternate exterior angles.

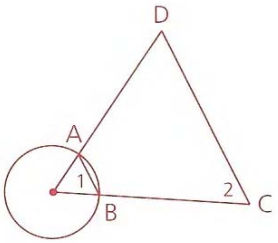
c Name all pairs of corresponding angles.

d Name all pairs of interior angles on the same side of the transversal.

e Name all pairs of exterior angles on the same side of the transversal.

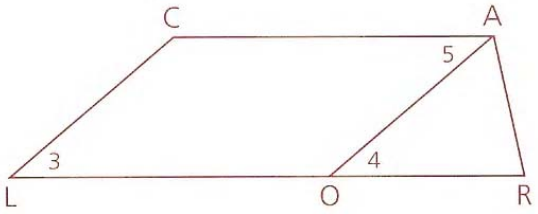


2 a What name is given to $\angle 1$ and $\angle 2$ for $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$? What is the transversal?



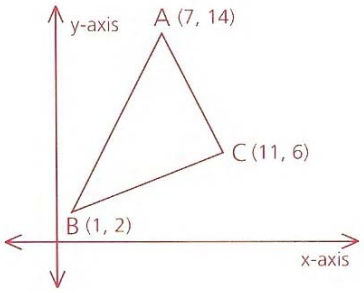
b What type of angles are 3 and 4? Which lines and transversal form them?

c What type of angles are 4 and 5? Which lines and transversal form them?



3a. Find the coordinates of M, the midpoint of $\overline{AB}$. Draw & label this point on the diagram.

3b. Find (draw, and label) the corrdinates of N, the midpoint of $\overline{AC}$.



c Draw $\overleftrightarrow{MN}$. What *appears* to be true about $\overleftrightarrow{MN}$ and $\overleftrightarrow{BC}$?

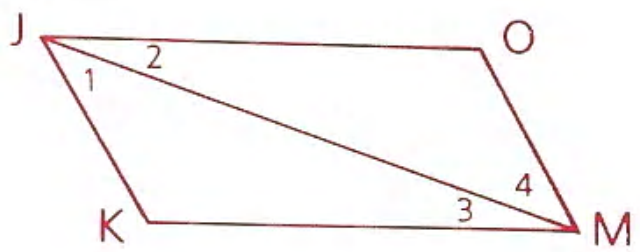
d What *appears* to be true about $\angle AMN$ and $\angle ABC$?

e Name a pair of corresponding angles formed by $\overleftrightarrow{MN}$ and $\overleftrightarrow{BC}$ with transversal $\overleftrightarrow{AC}$.

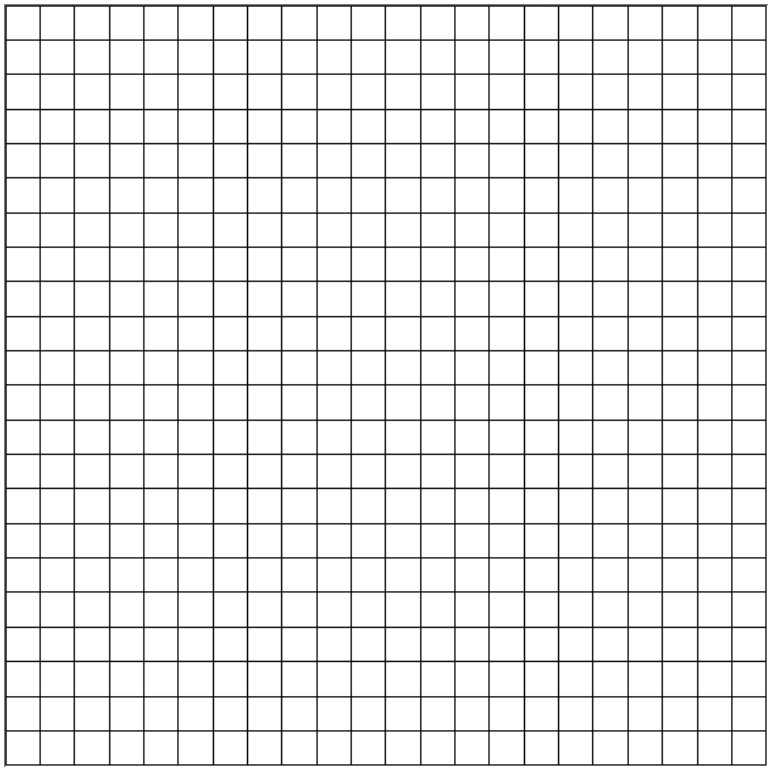
4 **a** For which pair of lines are angles 1 and 4 a pair of alternate interior angles?

b For which pair of lines are angles 2 and 3 a pair of alternate interior angles?

c How many transversals of $\overleftrightarrow{JO}$ and $\overleftrightarrow{KM}$ are shown?



5 Locate the following points on a graph: $(x_1, y_1) = (0, 0)$, $(x_2, y_2) = (4, 5)$, $(x_3, y_3) = (0, 3)$ and $(x_4, y_4) = (4, 8)$.



a Find $\frac{y_2 - y_1}{x_2 - x_1}$.

b Find $\frac{y_4 - y_3}{x_4 - x_3}$.

c. Draw a line through the first two points and a line through the second two points. What *appears* to be true about these lines?