

# 3.1

## Identify Pairs of Lines and Angles

- Goal** • Identify angle pairs formed by three intersecting lines.

### Your Notes

#### VOCABULARY

**Parallel lines** Two lines are parallel lines if they do not intersect and are coplanar.

**Skew lines** Two lines are skew lines if they do not intersect and are not coplanar.

**Parallel planes** Two planes that do not intersect are parallel planes.

**Transversal** A transversal is a line that intersects two or more coplanar lines at different points.

**Corresponding angles** Two angles are corresponding angles if they have corresponding positions.

**Alternate interior angles** Two angles are alternate interior angles if they lie between the two lines and on opposite sides of the transversal.

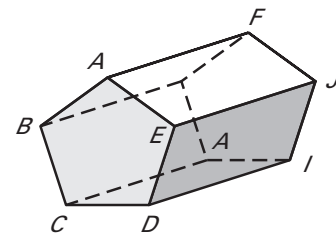
**Alternate exterior angles** Two angles are alternate exterior angles if they lie outside the two lines and on opposite sides of the transversal.

**Consecutive interior angles** Two angles are consecutive interior angles if they lie between the two lines and on the same side of the transversal.

**Your Notes**

**Example 1** Identify relationships in space

Think of each segment in the figure as part of a line. Which line(s) or plane(s) in the figure appear to fit the description?



- Line(s) parallel to  $\overleftrightarrow{AF}$  and containing point  $E$
- Line(s) skew to  $\overleftrightarrow{AF}$  and containing point  $E$
- Line(s) perpendicular to  $\overleftrightarrow{AF}$  and containing point  $E$
- Plane(s) parallel to plane  $FGH$  and containing point  $E$

**Solution**

- $\overleftrightarrow{EJ}$ ,  $\overleftrightarrow{BG}$ ,  $\overleftrightarrow{CH}$ , and  $\overleftrightarrow{DI}$  all appear parallel to  $\overleftrightarrow{AF}$ , but only  $\overleftrightarrow{EJ}$  contains point  $E$ .
- $\overleftrightarrow{BC}$ ,  $\overleftrightarrow{CD}$ ,  $\overleftrightarrow{DE}$ ,  $\overleftrightarrow{GH}$ ,  $\overleftrightarrow{HI}$ , and  $\overleftrightarrow{IJ}$  all appear skew to  $\overleftrightarrow{AF}$ , but only  $\overleftrightarrow{DE}$  contains point  $E$ .
- $\overleftrightarrow{AB}$ ,  $\overleftrightarrow{AE}$ ,  $\overleftrightarrow{FG}$ , and  $\overleftrightarrow{FJ}$  all appear perpendicular to  $\overleftrightarrow{AF}$ , but only  $\overleftrightarrow{AE}$  contains point  $E$ .
- Plane  $ABC$  appears parallel to plane  $FGH$  and contains point  $E$ .

✓ **Checkpoint** Think of each segment in the figure as part of a line. Which line(s) or plane(s) in the figure appear to fit the description?

- parallel to  $\overleftrightarrow{MN}$  and contains  $J$

$\overleftrightarrow{JL}$

- skew to  $\overleftrightarrow{MN}$  and contains  $J$

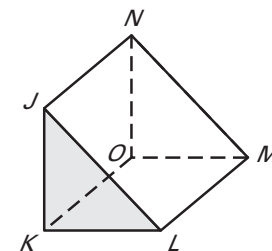
$\overleftrightarrow{KJ}$

- perpendicular to  $\overleftrightarrow{MN}$  and contains  $J$

$\overleftrightarrow{JN}$

- Name the plane that contains  $J$  and appears to be parallel to plane  $MNO$ .

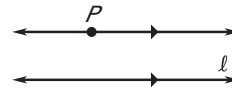
plane  $JKL$



## Your Notes

### POSTULATE 13 PARALLEL POSTULATE

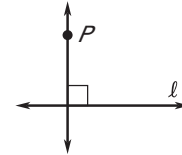
If there is a line and a point not on the line, then there is exactly one line through the point parallel to the given line.



There is exactly one line through  $P$  parallel to  $l$ .

### POSTULATE 14 PERPENDICULAR POSTULATE

If there is a line and a point not on the line, then there is exactly one line through the point perpendicular to the given line.

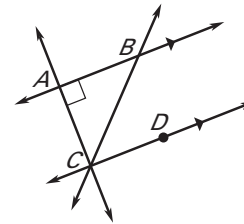


There is exactly one line through  $P$  perpendicular to  $l$ .

### Example 2 Identify parallel and perpendicular lines

Use the diagram at the right to answer each question.

- Name a pair of parallel lines.
- Name a pair of perpendicular lines.
- Is  $\overleftrightarrow{AB} \perp \overleftrightarrow{BC}$ ? Explain.



#### Solution

- $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$
- $\overleftrightarrow{AB} \perp \overleftrightarrow{AC}$
- $\overleftrightarrow{AB}$  is not perpendicular to  $\overleftrightarrow{BC}$ , because  $\overleftrightarrow{AB}$  is perpendicular to  $\overleftrightarrow{AC}$  and by the Perpendicular Postulate there is exactly one line perpendicular to  $\overleftrightarrow{AB}$  through  $C$ .

✔ **Checkpoint** Complete the following exercise.

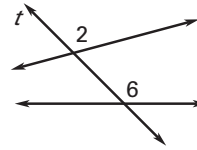
5. In Example 2, can you use the Perpendicular Postulate to show that  $\overleftrightarrow{AC} \perp \overleftrightarrow{CD}$ ? Explain.

No, there is no right angle symbol at  $C$  so you do not know if  $\overleftrightarrow{AC} \perp \overleftrightarrow{CD}$ .

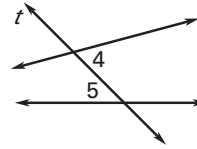
## Your Notes

### ANGLES FORMED BY TRANSVERSALS

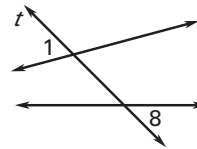
Two angles are corresponding angles if they have corresponding positions. For example,  $\angle 2$  and  $\angle 6$  are above the lines and to the right of the transversal  $t$ .



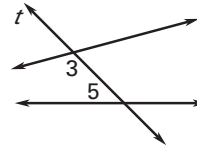
Two angles are alternate interior angles if they lie between the two lines and on opposite sides of the transversal.



Two angles are alternate exterior angles if they lie outside the two lines and on opposite sides of the transversal.



Two angles are consecutive interior angles if they lie between the two lines and on the same side of the transversal.

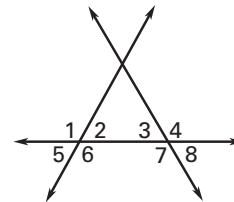


Another name for consecutive interior angles is

same-side interior angles.

### Example 3 Identify angle relationships

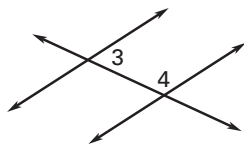
Identify all pairs of (a) corresponding angles, (b) alternate interior angles, (c) alternate exterior angles, and (d) consecutive interior angles.

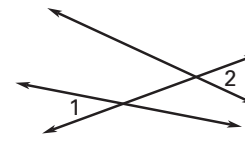


- $\angle 1$  and  $\angle 3$ ,  $\angle 2$  and  $\angle 4$ ,  $\angle 5$  and  $\angle 7$ ,  $\angle 6$  and  $\angle 8$
- $\angle 2$  and  $\angle 7$ ,  $\angle 6$  and  $\angle 3$
- $\angle 5$  and  $\angle 4$ ,  $\angle 1$  and  $\angle 8$
- $\angle 2$  and  $\angle 3$ ,  $\angle 6$  and  $\angle 7$

## Homework

✔ **Checkpoint** Classify the pair of numbered angles.

6.   
Consecutive interior angles

7.   
Alternate exterior angles