

**Plane**

A two-dimensional flat surface

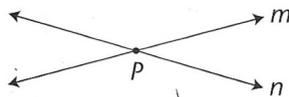
**Transversal**

A line that intersects two or more lines

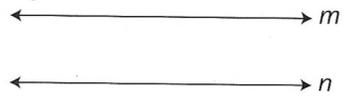
A **plane** can be thought of as a two-dimensional flat surface. Pairs of lines in a plane can exist in two different ways.

**Lines in a Plane**

Intersecting lines in a plane meet at exactly one point  $P$ .



Parallel lines in a plane never meet or intersect.

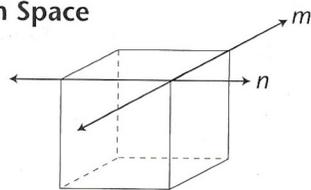


The symbol for parallel is  $\parallel$ ;  $m \parallel n$  is read “ $m$  is parallel to  $n$ .”

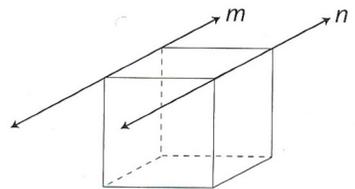
Space is three-dimensional. Pairs of lines in space can exist in three different ways.

**Lines in Space**

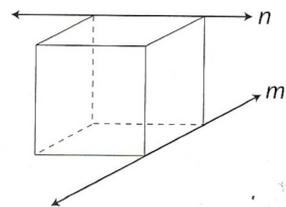
Intersecting lines form a plane and meet in that plane.



Parallel lines form a plane and do not meet.

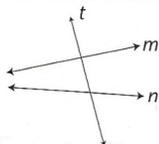


Skew lines are not parallel and do not intersect. Skew lines do not determine a plane.



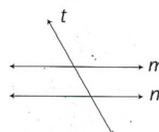
A **transversal** is a line that intersects two or more lines.

$m$  and  $n$  intersect.



$t$  is the transversal.

$m \parallel n$



$t$  is the transversal.

### Exterior angles

Angles that are formed outside two lines cut by a transversal

### Interior angles

Angles that are formed inside, or between, two lines cut by a transversal

### Corresponding angles

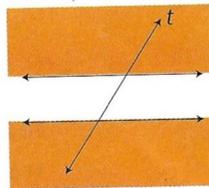
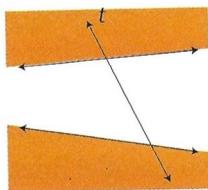
Interior and exterior angles on the same side of a transversal cutting through parallel lines

### Theorem

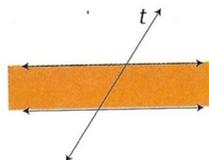
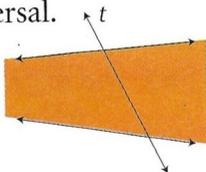
A statement that can be proven

Angles formed by transversals have special names.

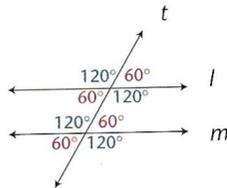
**Exterior angles** are those angles outside lines cut by a transversal.



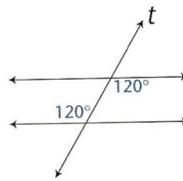
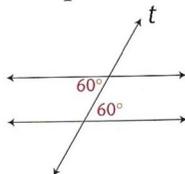
**Interior angles** are those angles inside, or between, lines cut by a transversal.



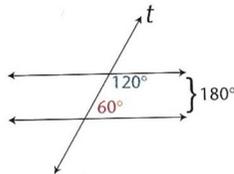
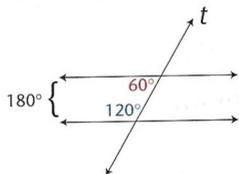
When parallel lines are cut by a transversal, certain angles will always be equal and others supplementary. Here is an example of  $l \parallel m$ ,  $t$  is the transversal.



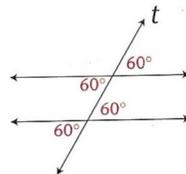
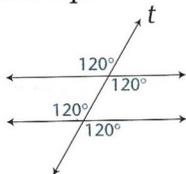
Alternate interior angles are equal:



Interior angles on the same side of the transversal are supplementary:

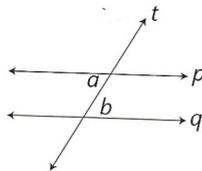


Corresponding angles are equal:



Each fact illustrated here is a **theorem** from geometry. This means these angles are always equal or supplementary as long as they are in the positions as shown in the diagrams.

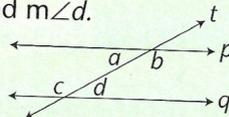
In this figure,  $p \parallel q$  and  $t$  is a transversal.



If you would measure  $\angle a$  and  $\angle b$ , you would find that  $m\angle a = m\angle b$ .  $\angle a$  and  $\angle b$  are alternate interior angles. Whenever a transversal cuts two parallel lines, the alternate interior angles that are formed are equal.

**EXAMPLE 1**

In the following figure,  $p \parallel q$  and  $m\angle a = 30^\circ$ . Find  $m\angle b$ ,  $m\angle c$ , and  $m\angle d$ .



**Step 1** If  $p \parallel q$  and  $t$  is a transversal, then  $m\angle a = m\angle d$  and  $m\angle b = m\angle c$ . This statement is true because it is a theorem from geometry.

**Step 2** Since  $m\angle a = 30^\circ$ ,  $m\angle d = 30^\circ$  because alternate interior angles have the same measure.

**Step 3** Recognize that  $\angle a$  and  $\angle b$  are supplementary angles because they form a straight line. Find  $m\angle b$ .

$$m\angle a + m\angle b = 180^\circ$$

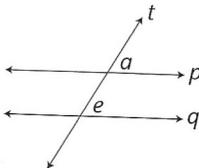
$$30^\circ + m\angle b = 180^\circ$$

$$m\angle b = 180^\circ - 30^\circ$$

$$m\angle b = 150^\circ$$

**Step 4** Since  $m\angle b = 150^\circ$ ,  $m\angle c = 150^\circ$  because alternate interior angles have the same measure.

In this figure,  $p \parallel q$  and  $t$  is a transversal.

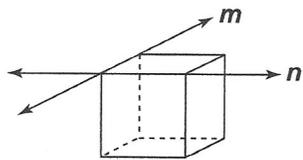


If you would measure  $\angle a$  and  $\angle e$ , you would find that  $m\angle a = m\angle e$ .  $\angle a$  and  $\angle e$  are corresponding angles. Whenever a transversal cuts two parallel lines, the corresponding angles that are formed on the same side of the transversal are equal.

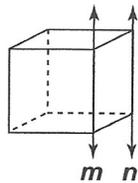
# Pairs of Lines in a Plane and in Space

**EXAMPLE**

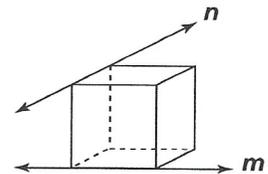
Intersecting lines,  $m$  and  $n$



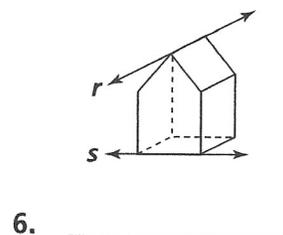
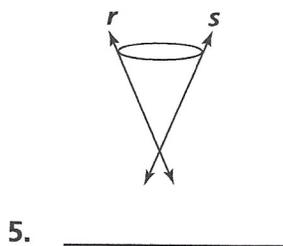
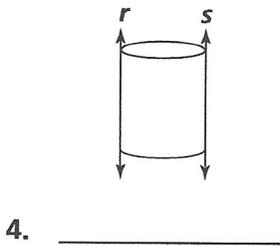
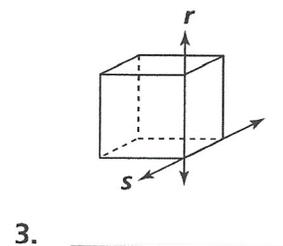
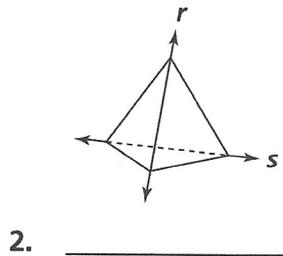
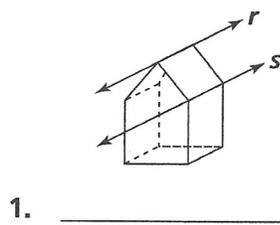
Parallel lines,  $m$  and  $n$



Skew lines,  $m$  and  $n$

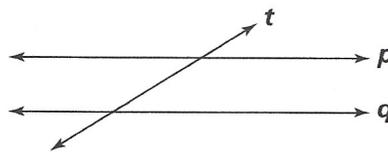


**Directions** Identify lines  $r$  and  $s$  in each figure. Write *intersecting*, *parallel*, or *skew*.

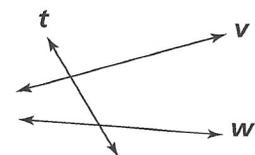
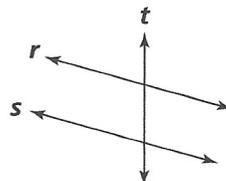
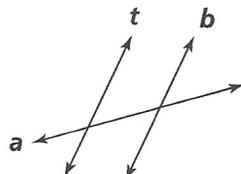
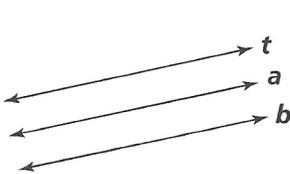


**EXAMPLE**

A transversal,  $t$ , intersects two or more lines.

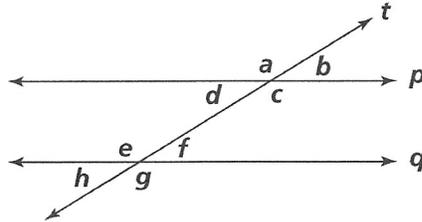


**Directions** If  $t$  is a transversal, write *yes*. Otherwise, write *no*.



## Pairs of Lines in a Plane and in Space

Use this figure for problems 1–7. Note that  $p \parallel q$  and  $t$  is a transversal.



**Directions** Identify the following pairs of angles. Write *supplementary*, *alternate interior*, or *corresponding*.

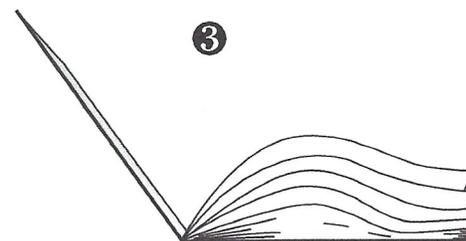
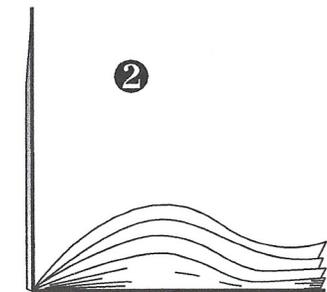
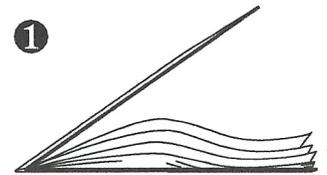
- |                              |       |                              |       |
|------------------------------|-------|------------------------------|-------|
| 1. $\angle d$ and $\angle f$ | _____ | 3. $\angle e$ and $\angle c$ | _____ |
| 2. $\angle e$ and $\angle g$ | _____ | 4. $\angle a$ and $\angle b$ | _____ |

**Directions** If  $m\angle f = 48^\circ$ , find  $m$  of the following angles.

- |               |       |               |       |               |       |
|---------------|-------|---------------|-------|---------------|-------|
| 5. $\angle d$ | _____ | 6. $\angle e$ | _____ | 7. $\angle h$ | _____ |
|---------------|-------|---------------|-------|---------------|-------|

**Directions** Circle the letter of the correct answer to each question.

Dana has her book open differently at three different moments. Diagrams 1, 2, and 3 represent these moments.



8. At 1, what kind of angle is formed by the open covers of Dana's book?
- a. acute                      b. obtuse                      c. right
9. At 2, what kind of angle is formed by the book covers? (Assume that one cover is straight up and down.)
- a. acute                      b. obtuse                      c. right
10. At 3, what kind of angle is formed by the book covers?
- a. acute                      b. obtuse                      c. right