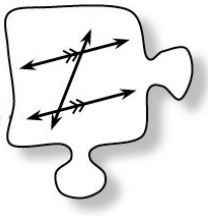
Name:_____ Date:_____ Per:_____ A#_____

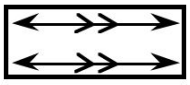
9.1.1 How are the angles related?



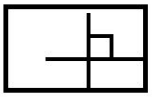
Parallel Line Angle Pair Relationships

In a previous course you probably learned the vocabulary and considered the relationships created by two intersecting lines. Now you will look at the vocabulary and relationships created by a line that intersects two parallel lines.

9-1. The box below has some reminders about notation. Read the information, and then use it to complete the following problems.



Arrowheads at the end of lines indicate that they extend indefinitely. Marks on pairs of lines or segments like **>** and **>>** indicate that the lines (or segments) are **parallel**.



The small box at the point of intersection of two lines or segments indicates that the lines (or segments) are **perpendicular** (that is, form right angles).

In Figure 1 to the right, line *s* is parallel to line *t*, and line *r* intersects (cuts) line *s* and line *t*. In Figure 2, lines *x* and *y* are *not* parallel, and line *w* intersects lines *x* and *y*. Lines *r* and *w* are called **transversals** because they cut across (intersect) 2 lines. Transversals can also intersect several lines, each at different points.

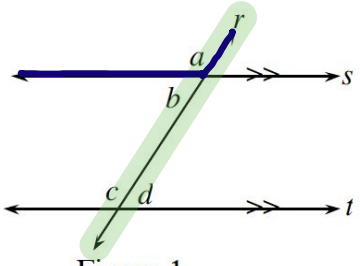


Figure 1

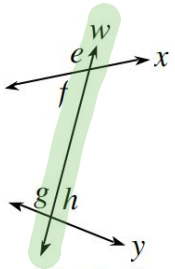


Figure 2

a. Take a sheet of plain paper (tracing paper is best, but binder paper will work) and **place it over ∠*a*.** Using a ruler as a guide, **make a precise copy of the angle**. Slide the **copy of ∠*a* to ∠*c* and compare the sizes of the two angles**. What do you observe?

They're the same

b. Trace a **copy of ∠*b* and place it over ∠*d*.** What do you observe? They're the same

c. Trace a **copy of ∠*e* and place it over ∠*g*.** What do you observe? They're different

d. Trace a **copy of ∠*f* and place it over ∠*h*.** What do you observe? They're different

e. Both figures show two lines that are intersected by a transversal. Summarize your findings by **describing the relationship between pairs of angles and parallel lines cut by a transversal.** That is, when the angles are congruent, what must be true? And vice versa: If the lines are parallel, then what must be true?

Parallel lines are needed to create congruent angles with a transversal.

9-2. Each figure below shows a pair of parallel lines, p and q, which are intersected (cut) by a third line, m. Line m, often called a transversal, forms several angles at each point of intersection with p and q. If you need help with some of the vocabulary from a previous course, see the Math Notes box in this lesson.

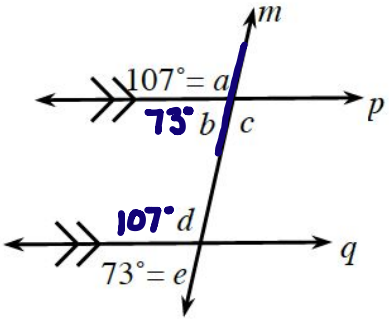


Figure 1

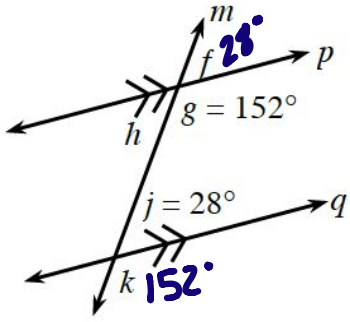


Figure 2

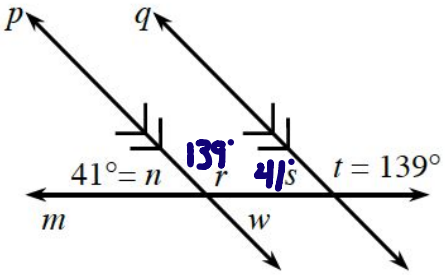


Figure 3

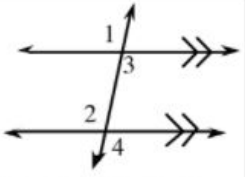
a. Use what you know about straight angles to calculate the measures of these angles: b, d, f, k, r, and s. When everyone in your team has completed the calculations and agrees with the results, check with your team to be sure that everyone agrees that the results are correct.

b= 73° d= 107° f= 28° k= 152° r= 139° s= 41°

b. Keep in mind that lines p and q must be parallel as you complete the directions below.

- In Figure 1, compare the measures of angles a and d, and then **compare the measures of angles b and e.**
- In Figure 2, compare the measures of angles f and j, and then **compare the measures of angles g and k.**
- In Figure 3, make **similar comparisons** for **angles n and s**, and then for **angles r and t**.

Angles on the same side of two lines and on the same side of a third line (the transversal) that intersects the two lines are called **corresponding angles**. In the figure at right, angles 1 and 2 are corresponding angles, as are angles 3 and 4. Other examples of corresponding angles are on your resource page: angles a and d in Figure 1, angles g and k in Figure 2, and angles r and t in Figure 3.



c. A conjecture is an **inference or judgment based on incomplete evidence**. Use the definition above and your observations in part (b) to complete the following conjecture.

Conjecture: If two parallel lines are cut by a transversal, then pairs of **corresponding angles** are congruent

9-3. Now focus on a different set of angles.

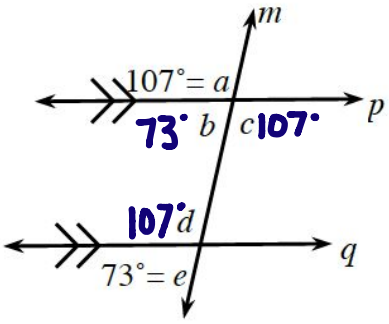


Figure 1

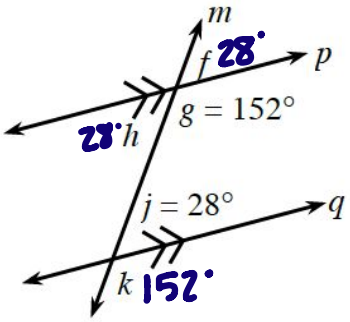


Figure 2

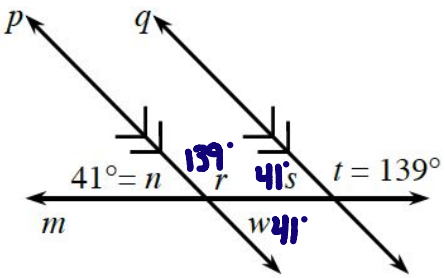


Figure 3

a. Use what you know about straight angles and/or vertical angles and your results from the previous problem to find the measures of angles c (Figure 1), h (Figure 2), and w (Figure 3).

c= 107° **h=** 28° **w=** 41°

b. Compare the measures of the following three pairs of angles.

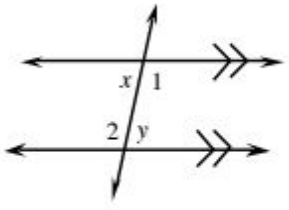
- Figure 1: $m\angle c$ and $m\angle d$
- Figure 2: $m\angle h$ and $m\angle j$
- Figure 3: $m\angle w$ and $m\angle s$

How is each pair of angles related?

They're the same

c. Read the following definition, and then use it along with your observation in part (a) to complete the conjecture that follows.

Angles between a pair of lines and on opposite sides of a transversal are called **alternate interior angles**. In the figure at right, angles 1 and 2 and angles x and y are examples of *pairs* of alternate interior angles. Other examples of alternate interior angles are on your resource page: angles c and d in Figure 1, angles h and j in Figure 2, and angles w and s in Figure 3.



Conjecture: If parallel lines are cut by a transversal, then **alternate interior angles are**

congruent.

9-4. Use Figures 1 through 3.

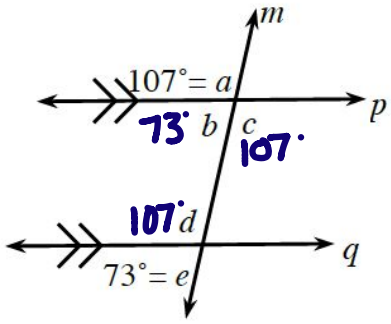


Figure 1

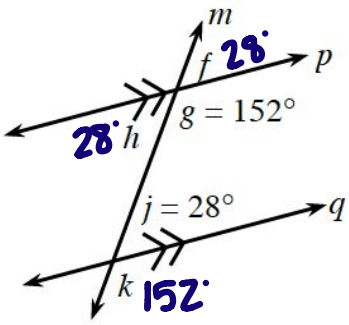


Figure 2

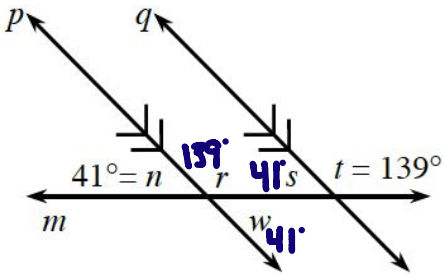


Figure 3

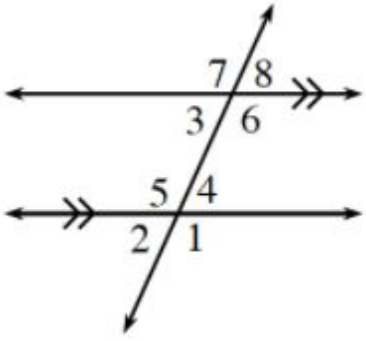
a. Examine the pairs of angles **b and d, g and j,** and **r and s**. If you add the measures of each pair, what do you observe?

Add up to 180°

b. Write a conjecture about two angles on the same side of a transversal and are between two parallel lines. Note: These are called same side interior angles.

Conjecture: The sum of the measures of **two interior angles on the same side of a transversal is** supplementary.

Use your conjecture and the figure below right to answer parts (c) and (d).

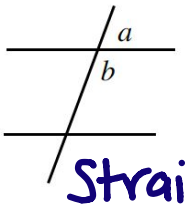


c. If m∠2 = 67°, what is m∠5? EXPLAIN.

d. If m∠4 = 2x and m∠6 = 4, find m∠4. EXPLAIN.

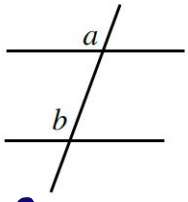
9-5. Classify each of the following pairs of angles as corresponding, alternate interior, same side interior, straight, or "none of these."

a.



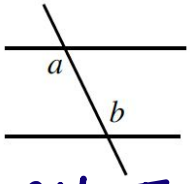
Straight

b.



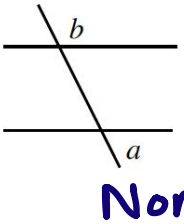
Corresponding

c.



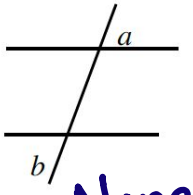
Alt. Int.

d.



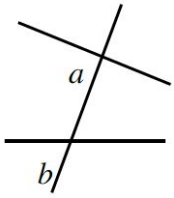
None

e.



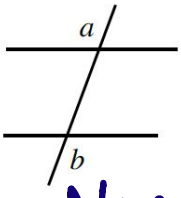
None

f.



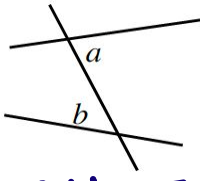
Corresponding

g.



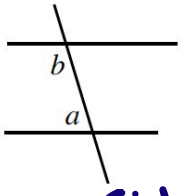
None

h.



Alt. Int.

i.



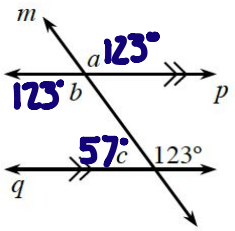
Same-Side Int.

j. What condition is necessary to be able to say that the pairs of corresponding angles or alternate interior angles above are equal?

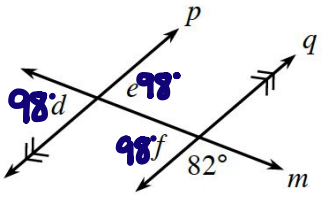
We need a set of parallel lines.

9-6. Use your conjectures about parallel lines and the angles formed by a transversal to find the measures of the labeled angles. Show step-by-step how you found the measures and *and* name each angle conjecture you use (e.g., corresponding, alternate interior, vertical, same side interior or straight) to justify your calculation.

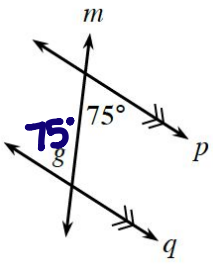
a.



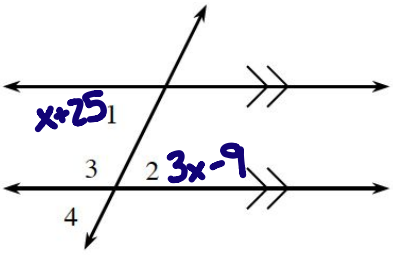
b.



c.



9-8. Use the conjectures and definitions in this lesson to solve parts (a) and (b). Each part is a separate problem.



a. If $m\angle 1 = 63°$, find $m\angle 2$ and $m\angle 3$ by calculation.

b. If $m\angle 1 = 75°$ and $m\angle 4 = 3x - 18°$, write an equation and find x.

a. $m\angle 2 = 63°$ $m\angle 3 = 117°$

b. $3x - 18 = 75$

$+18 \quad +18$

$3x = 93$

$\frac{3x}{3} = \frac{93}{3}$

$x = 31$

c. If $m\angle 2 = 3x - 9°$ and $m\angle 1 = x + 25°$, write an equation to find x. Then find $m\angle 2$.

$3x - 9 = x + 25$

$-x \quad -x$

$2x - 9 = 25$

$+9 \quad +9$

$2x = 34$

$x = 17$

$3x - 9$

$3(17) - 9$

$51 - 9$

$42°$

9-9. If $m\angle 5 = 53°$ and $m\angle 7 = 125°$, find the measures of each numbered angle. Then explain how you found each angle, citing definitions and conjectures that support your steps.

$m\angle 1 = 53°$ $m\angle 4 = 127°$

$m\angle 2 = 72°$

$m\angle 3 = 55°$ $m\angle 6 = 55°$