

Date:

Section: 9.2

Objective: Describe & use relationships between pairs of angles

Review of angles:

Name of angle	Definition	Picture	Relationship of the angles
Complementary Angles	measures add to $90^\circ$		add to $90^\circ$
Supplementary Angles	measures add to $180^\circ$		add to $180^\circ$
Linear Pair	adjacent angles whose non-common sides form a straight line		Supplementary (add to $180^\circ$ )
Adjacent Angles	next-door neighbors (common side & vertex)		not necessarily any
Vertical Angles	angles across from each other when two lines intersect		congruent (same measure)

Use the diagram at the right to answer the following questions.

a) Name two pairs of vertical angles.

$\angle ABC \cong \angle EBG$   $\angle CBD \cong \angle FBE$   $\angle ABE \cong \angle CBG$   $\angle BGH \cong \angle JGI$   
 $\angle ABD \cong \angle FBG$   $\angle ABF \cong \angle DBG$   $\angle FBC \cong \angle EBD$   $\angle BGJ \cong \angle HGI$

b) Name two sets of angles that form linear pairs.

$\angle ABC \cong \angle CBG$   $\angle FBA \cong \angle ABD$   $\angle FBE \cong \angle EBD$   $\angle EBG \cong \angle GBC$   
 $\angle ABD \cong \angle DBG$   $\angle FBC \cong \angle CBD$   $\angle FBG \cong \angle GBD$   $\angle EBD \cong \angle DBC$

c) Name two pairs of complementary angles.

$\angle CBD \cong \angle DBG$   $\angle ABF \cong \angle FBE$

d) Name two pairs of supplementary angles.

See part b)  $\rightarrow$  linear pairs are supplementary!

e) Name two pairs of congruent angles.

See part a)  $\rightarrow$  vertical angles are congruent!

f) Name a pair of adjacent angles that are neither complementary nor supplementary.

$\angle CBA \cong \angle ABF$   $\angle ABC \cong \angle CBD$   $\angle DBG \cong \angle GBE$   $\angle GBE \cong \angle EBF$

Examples: Find the missing angle measures.

g)  $m\angle 1 = 126^\circ$   
 $m\angle 2 = 54^\circ$   
 $m\angle 3 = 126^\circ$

h)  $m\angle 1 = 30^\circ$   
 $m\angle 2 = 150^\circ$   
 $m\angle 3 = 30^\circ$

i)  $57^\circ + 50^\circ = 107^\circ$   
 $180^\circ - 107^\circ = 73^\circ$   
 $180^\circ - 57^\circ = 123^\circ$

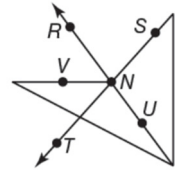
Use the diagram to the right to answer the following questions.

a) Name an angle congruent to  $\angle RNT$ . How do you know the angles are congruent?

$\angle SNU$ . They are vertical angles

b) Name an angle congruent to  $\angle RNS$ . How do you know the angles are congruent?

$\angle TNU$ . They are vertical angles



**Angle Algebra Problem Tips:**

- Ask yourself: "Are the angle measures equal to each other, or do they add up to something?"
  - If the angles are congruent, set one measure equal to the other.
  - If the angles are supplementary, add the measures together and set the sum equal to  $180^\circ$ .
  - If the angles are complementary, add the measures together and set the sum equal to  $90^\circ$ .

**Examples:** Find the value of the variable and the size of each angle.

a)

$$10z - 11 = 99$$

$$\begin{array}{r} 10z - 11 = 99 \\ + 11 \quad + 11 \\ \hline 10z = 110 \\ \frac{10z}{10} = \frac{110}{10} \\ \boxed{z = 11} \end{array}$$

b)

$$3x - 5 + 20 = 180$$

$$3x + 15 = 180$$

$$\begin{array}{r} 3x + 15 = 180 \\ - 15 \quad - 15 \\ \hline 3x = 165 \\ \frac{3x}{3} = \frac{165}{3} \\ \boxed{x = 55} \end{array}$$

c)

$$4x + 12 + 2x = 180$$

combine like terms:  $6x + 12 = 180$

$$\begin{array}{r} 6x + 12 = 180 \\ - 12 \quad - 12 \\ \hline 6x = 168 \\ \frac{6x}{6} = \frac{168}{6} \\ \boxed{x = 28} \end{array}$$

plug in 28 for x:

$$4(28) + 12 = \boxed{124^\circ}$$

$$2(28) = \boxed{56^\circ}$$

d) How big is the complement of a  $57^\circ$  angle?

add to  $90^\circ$

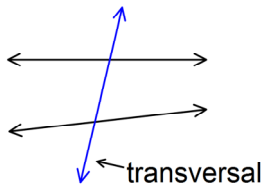
$$90^\circ - 57^\circ = \boxed{33^\circ}$$

e) Two angles are supplementary. The measure of one angle is  $152^\circ$ . What is the measure of the other?

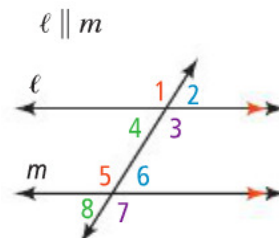
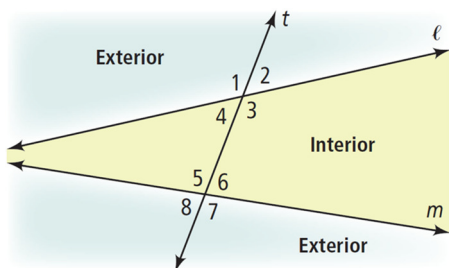
add to  $180^\circ$

$$180^\circ - 152^\circ = \boxed{28^\circ}$$

**Transversal:** A line that intersects two or more coplanar lines at different points.



Lines crossed by a transversal create several different types of angle pairs. The lines don't have to be parallel for the angle pairs to exist, but if they are, the angle pairs have special properties.

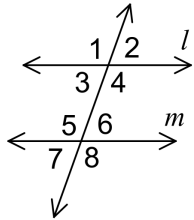


## Angle Pairs Formed by Transversals Crossing Coplanar Lines

Name of Angle Pair	Definition	Picture	Relationship if the lines are parallel
Corresponding Angles	Angles in the same place in the intersections (top left, top right, bottom left, bottom right)		Congruent
Alternate Exterior Angles	Angles outside the two lines on opposite sides of the transversal		Congruent
Alternate Interior Angles	Angles between the two lines on opposite sides of the transversal		Congruent
Same-Side Interior Angles	Angles between the two lines on the same side of the transversal		Supplementary (add to 180°)

**Examples:** Identify the following angle pairs. Name all possible pairs in the diagram.

Corresponding Angles  $\angle 1 \cong \angle 5$ ,  $\angle 2 \cong \angle 6$ ,  $\angle 3 \cong \angle 7$ ,  $\angle 4 \cong \angle 8$

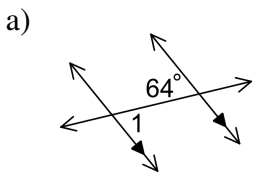


Alternate Exterior Angles  $\angle 1 \cong \angle 8$ ,  $\angle 2 \cong \angle 7$

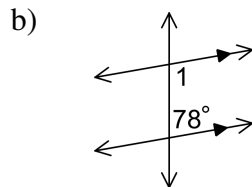
Alternate Interior Angles  $\angle 3 \cong \angle 6$ ,  $\angle 4 \cong \angle 5$

Same-Side Interior Angles  $\angle 3 \cong \angle 5$ ,  $\angle 4 \cong \angle 6$

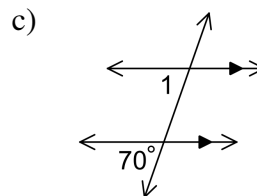
**Examples:** Find  $m\angle 1$  in each diagram. Give a reason for each answer.



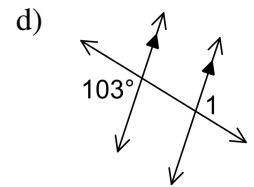
alternate interior  
 $64^\circ$



same-side interior  
Supplementary  
 $180^\circ - 78^\circ = \boxed{102^\circ}$

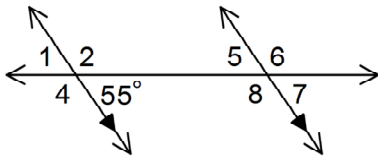


Corresponding  
 $70^\circ$



alternate exterior  
 $103^\circ$

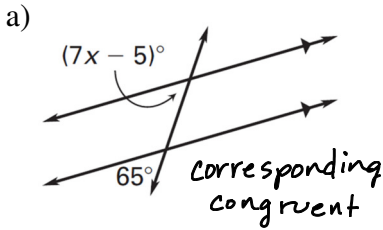
**Example:** Find the measure of each numbered angle.



$$\begin{array}{r} 180^\circ \\ - 55^\circ \\ \hline 125^\circ \end{array}$$

$$\begin{array}{lll} m\angle 1 = \underline{55^\circ} & m\angle 2 = \underline{125^\circ} & m\angle 4 = \underline{125^\circ} \\ m\angle 5 = \underline{55^\circ} & m\angle 6 = \underline{125^\circ} & m\angle 7 = \underline{55^\circ} \\ m\angle 8 = \underline{125^\circ} & & \end{array}$$

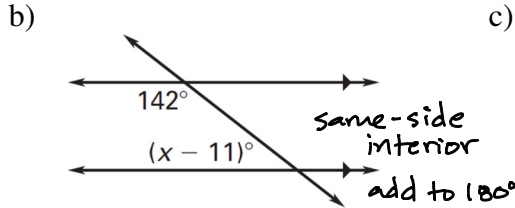
**Examples:** Find the value of  $x$ .



$$\begin{array}{r} 7x - 5 = 65 \\ +5 \quad +5 \end{array}$$

$$\frac{7x}{7} = \frac{70}{7}$$

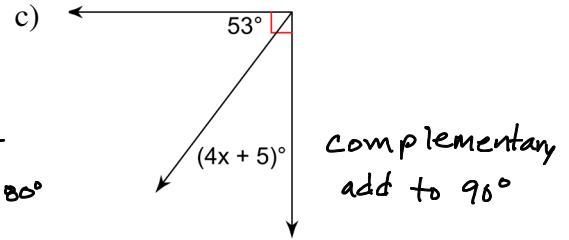
$$\boxed{x = 10}$$



$$x - 11 + 142 = 180$$

$$\begin{array}{r} x + 131 = 180 \\ -131 \quad -131 \end{array}$$

$$\boxed{x = 49}$$



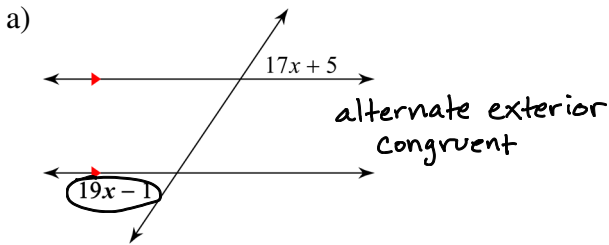
$$4x + 5 + 53 = 90$$

$$\begin{array}{r} 4x + 58 = 90 \\ -58 \quad -58 \end{array}$$

$$\frac{4x}{4} = \frac{32}{4}$$

$$\boxed{x = 8}$$

**Examples:** Find the measure of the angle indicated in bold.



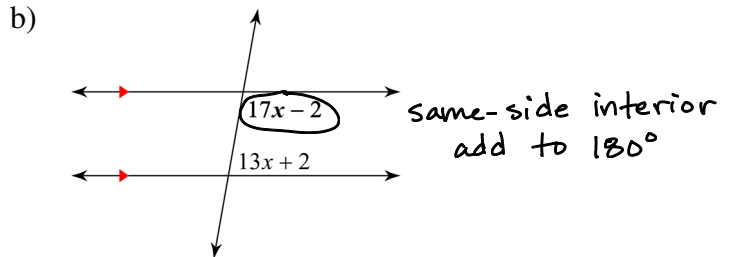
$$\begin{array}{r} 17x + 5 = 19x - 1 \\ -17x \quad -17x \end{array}$$

$$\begin{array}{r} 5 = 2x - 1 \\ +1 \quad +1 \end{array}$$

$$\frac{6}{2} = \frac{2x}{2}$$

$$3 = x$$

Plug in  $x$ :  $19(3) - 1 = \boxed{56^\circ}$



$$\underline{17x - 2} + \underline{13x + 2} = 180$$

$$\frac{30x}{30} = \frac{180}{30}$$

$$x = 6$$

Plug in  $x = 6$ :  $17(6) - 2 = \boxed{100^\circ}$