# 4.7 Prove Theorems about Perpendicular Lines

pp. 246 - 248

## VOCABULARY

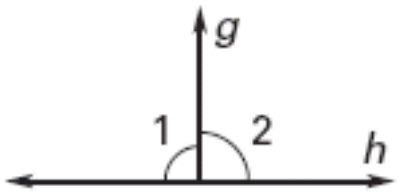
Distance from a point to a line **The length of the perpendicular segment from the point to the line.**

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

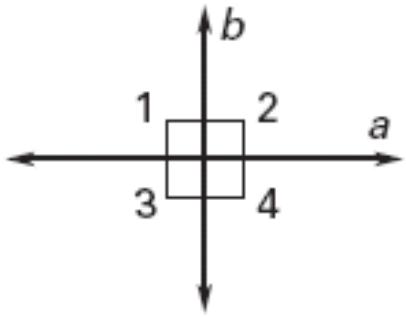
## THEOREM 4.7

If two lines intersect to form a linear pair of congruent angles, then the lines are _____.

If $\angle 1 \cong \angle 2$, then $g$ ____ $h$.



## THEOREM 4.8




If two lines are perpendicular, then they intersect to form four _____.

If $a \perp b$, then $\angle 1$, $\angle 2$, $\angle 3$, and $\angle 4$ are _____.

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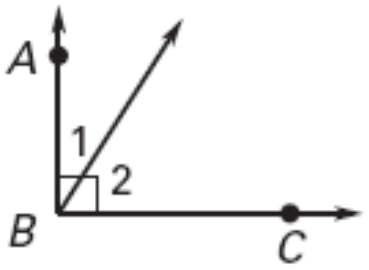
## THEOREM 4.9

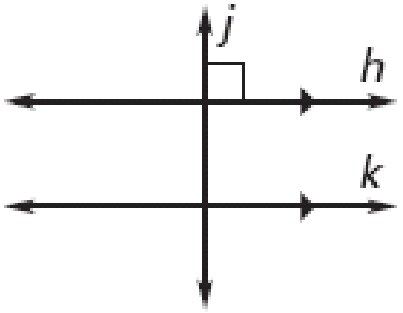



If two sides of two adjacent acute angles are perpendicular, then the angles are _____.

If $\overrightarrow{BA} \perp \overrightarrow{BC}$, then $\angle 1$ and $\angle 2$ are _____.

## THEOREM 4.10 PERPENDICULAR TRANSVERSAL THEOREM

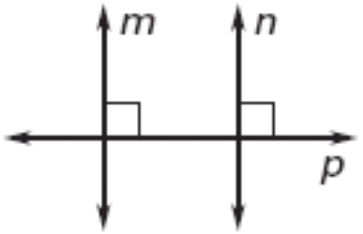
If a transversal is perpendicular to one of two parallel lines, then it is _____ to the other.




If $h \parallel k$ and $j \perp h$, then $j$ ⊥ $k$.

## THEOREM 4.11 LINES PERPENDICULAR TO A TRANSVERSAL THEOREM

In a plane, if two lines are perpendicular to the same line, then they are _____ to each other.

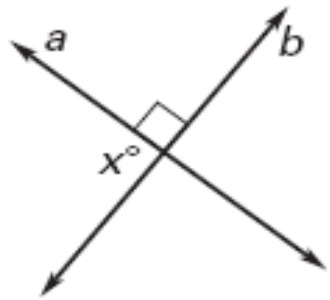



If $m \perp p$ and $n \perp p$, then $m$ ___ $n$.

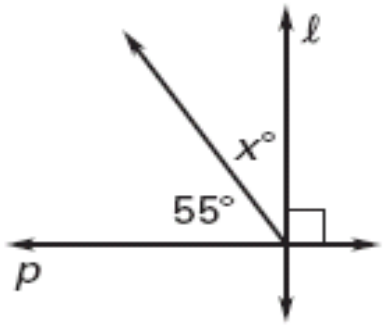
## Example 1 *Applications of the theorems*

**Find the value of *x*.**

**a.**




**b.**

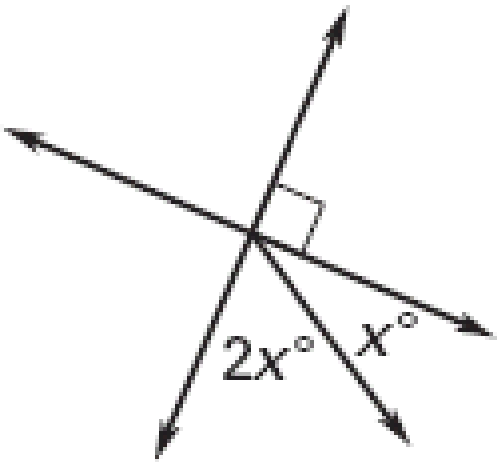



**Solution**

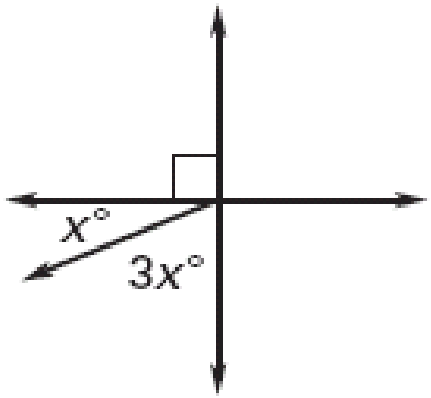
**a.** Because *a* and *b* are _____, all four angles formed are right angles by _____. By definition of a right angle, $x =$ _____.

**b.** Because $\ell$ and *p* are perpendicular, all four angles formed are right angles by _____. By _____, the 55° angle and the *x*° angle are _____. Thus $x + 55 = 90$, so $x =$ _____.

**1.**

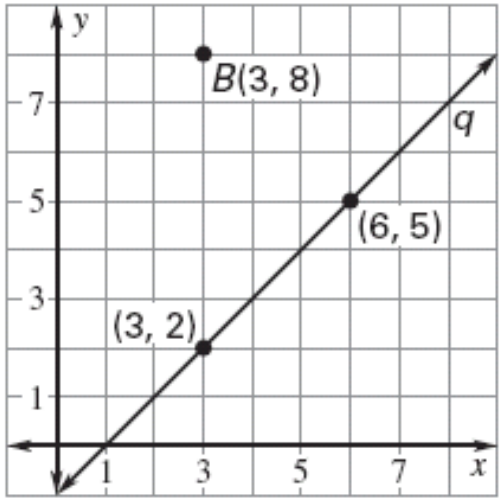



**2.**



## Example 2 *Find the distance between a point and a line*

**What is the distance from point *B* to line *q*?**




### Solution

You need to find the slope of line *q*. Using the points (3, 2) and (6, 5), the slope of line *q* is

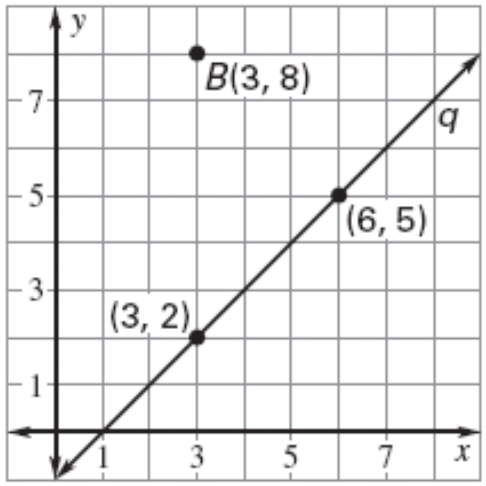
$$m = \frac{\square - 2}{6 - \square} = \underline{\quad}.$$

The distance from point $B$ to line $q$ is the length of the perpendicular segment from point $B$ to line $q$. The slope of a perpendicular segment from point $B$ to line $q$ is the negative reciprocal of ____, or $\frac{\quad}{\quad} = \frac{\quad}{\quad}$. The segment from (6, 5) to (3, 8) has a slope of ____. So, the segment is perpendicular to line $q$.

Find the distance between (6, 5) and (3, 8).

$$d = \sqrt{(\quad - \quad)^2 + (\quad - \quad)^2} \approx \quad$$

The distance from point $B$ to line $q$ is about ____ units.




**HW pp. 231 - 232**
**2 – 22 even**