Lesson 3 - 4

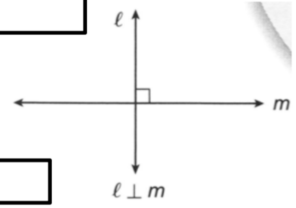
Perpendicular Lines

Going Deeper

Essential question: *How can you construct perpendicular lines and prove theorems about perpendicular bisectors?*

Perpendicular lines are lines that intersect at ________. In the figure, line ℓ is perpendicular to line m and you write ________. The right angle mark in the figure indicates that the lines are perpendicular.

The ________ of a line segment is a line perpendicular to the segment at the segment's ________

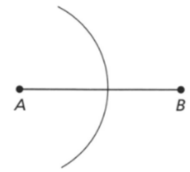


CC.9-12.G.CO.12

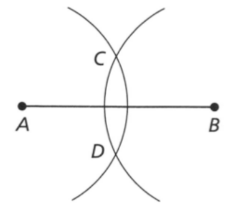
1 EXAMPLE Constructing a Perpendicular Bisector

Construct the perpendicular bisector of $\overline{AB}$. Work directly on the figure below.

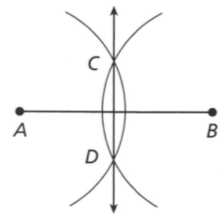
A Place the point of your compass at A. Using a compass setting that is greater than half the length of $\overline{AB}$, draw an arc.



B Without adjusting the compass, place the point of the compass at B and draw an arc intersecting the first arc at C and D.



C Use a straightedge to draw $\overleftrightarrow{CD}$. $\overleftrightarrow{CD}$ is the perpendicular bisector of $\overline{AB}$.

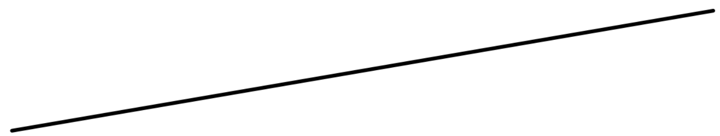


Construct the perpendicular bisector of the segment

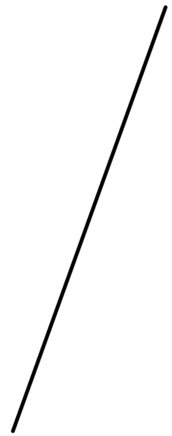
REFLECT

1a. How can you use a ruler and protractor to check the construction?

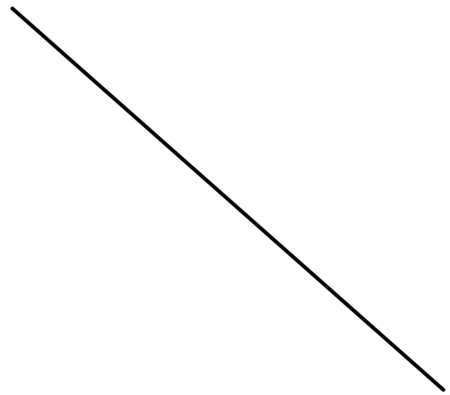
Construct the perpendicular bisector of the segment



Construct the perpendicular bisector of the segment



Construct the perpendicular bisector of the segment



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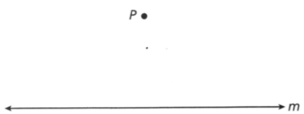
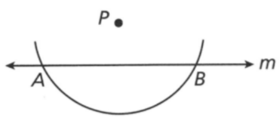
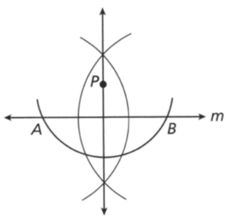
4 EXAMPLE **Constructing a Perpendicular to a Line**

Construct a line perpendicular to line m that passes through point P. Work directly on the figure at right.

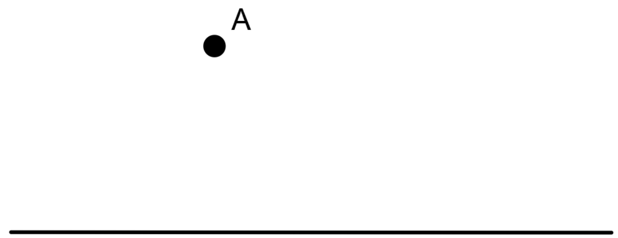




B Construct the perpendicular bisector of $\overline{AB}$. This line will pass through P and be perpendicular to line m.



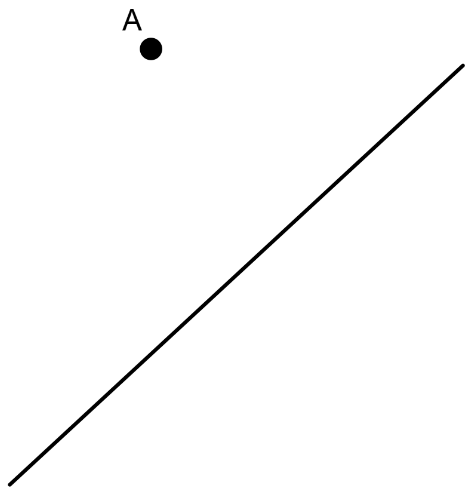
Construct a line through point A and perpendicular to the segment



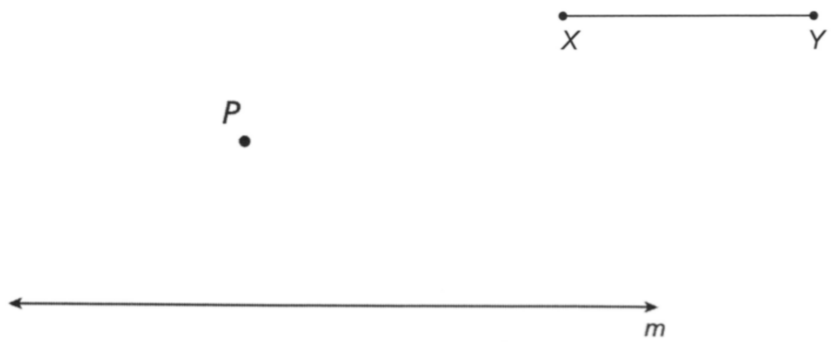
REFLECT

4a. Does the construction still work if point P is on line m? Why or why not?

Construct a line through point A and perpendicular to the segment

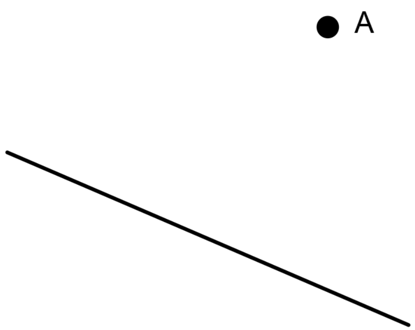


3. Construct a line perpendicular to m through P. Then, using your two perpendicular lines, construct a right triangle that has P as a vertex and a hypotenuse with length XY.

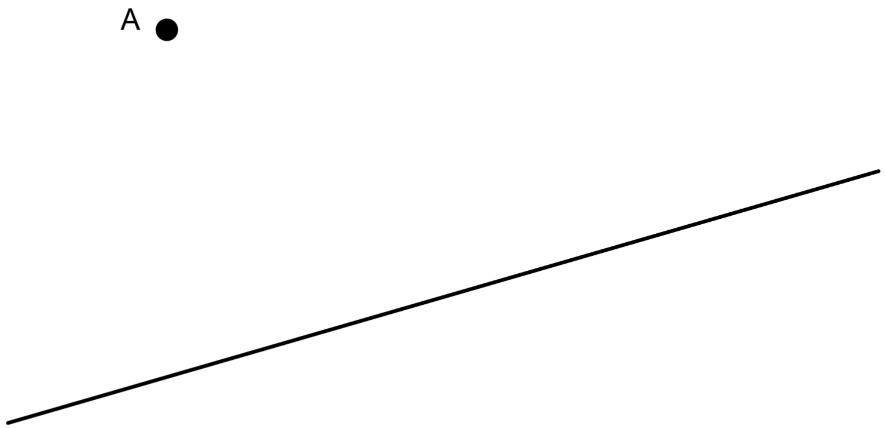


The shortest segment from a point to a line is
[ ] to the line.

Find the point, on the segment, closest to point A

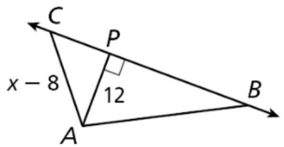


Find the point, on the segment, closest to point A



A. Name the shortest segment from point A to $\overleftrightarrow{BC}$.

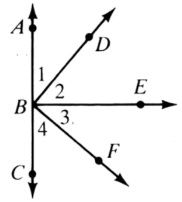
The shortest distance from a point to a line is the length of the ________ segment, so ____ is the shortest segment from A to $\overleftrightarrow{BC}$.



B. Write and solve an inequality for x.

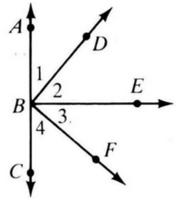
Given: $\overrightarrow{BE} \perp \overleftrightarrow{AC}$; $\overrightarrow{BD} \perp \overrightarrow{BF}$. Find the value of x.

8) $m(\angle 2) = 2x + 10$; $m(\angle 3) =$ ________



Given: $\overrightarrow{BE} \perp \overleftrightarrow{AC}$; $\overrightarrow{BD} \perp \overrightarrow{BF}$. Find the value of x.

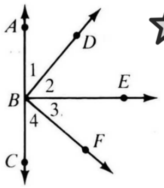
9) $m(\angle 3) = 2x + 5$; $m(\angle 4) =$ ________



Given: $\overrightarrow{BE} \perp \overleftrightarrow{AC}$; $\overrightarrow{BD} \perp \overrightarrow{BF}$. Find the value of x.

10) $m(\angle 1) = 2x$; $m(\angle 2) =$ ________

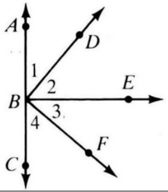
$m(\angle 3) = 3x - 20$; $m(\angle 4) =$ ________



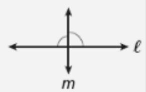
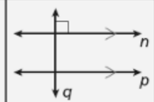
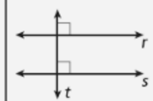
Given: $\overrightarrow{BE} \perp \overleftrightarrow{AC}$; $\overrightarrow{BD} \perp \overrightarrow{BF}$. Find the value of x.

11) $m(\angle 1) = 7x$; $m(\angle 2) =$ ________

$m(\angle 3) = 5x + 12$; $m(\angle 4) =$ ________

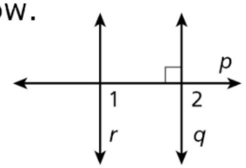


Theorems

THEOREM		HYPOTHESIS	CONCLUSION
3-4-1	If two intersecting lines form a linear pair of ________ angles, then the lines are perpendicular. (2 intersecting lines form lin. pair of ≅ ∠s → lines ⊥.)		$\ell \perp m$
3-4-2	**Perpendicular Transversal Theorem** In a plane, if a transversal is ________ to one of two ________ lines, then it is ________ to the other line.		$q \perp p$
3-4-3	If two coplanar lines are ________ to the ________ line, then the two lines are ________ to each other. (2 lines ⊥ to same line → 2 lines ∥.)		$r \parallel s$

3. Complete the two-column proof below.

Given: $\angle 1 \cong \angle 2$, $p \perp q$
Prove: $p \perp r$

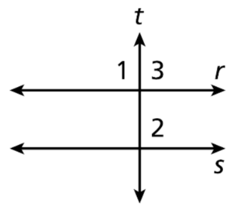


Proof	
Statements	**Reasons**
1.	1.
2.	2.
3.	3.
4.	4.

Write a two-column proof.

Given: $r \parallel s$, $\angle 1 \cong \angle 2$

Prove: $r \perp t$

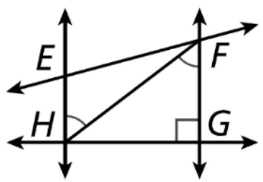


Statements	Reasons
1. $r \parallel s$, $\angle 1 \cong \angle 2$	**1.**
2.	**2.**
3.	3.
4. $r \perp t$	**4.**

Write a two-column proof.

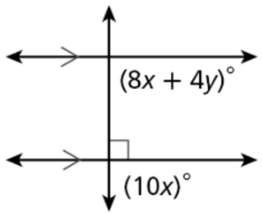
Given: $\angle EHF \cong \angle HFG$, $\overleftrightarrow{FG} \perp \overleftrightarrow{GH}$

Prove: $\overleftrightarrow{EH} \perp \overleftrightarrow{GH}$



Statements	Reasons
1. $\angle EHF \cong \angle HFG$	**1.**
2.	**2.**
3. $\overleftrightarrow{FG} \perp \overleftrightarrow{GH}$	3.
4.	**4.**

2. Solve to find x and y in the diagram.



$x =$ ☐ $y =$ ☐