Proofs with Perpendicular Lines

Lesson 3.4

Bell Work: Write the three theorems on page 150 into your notes (if they aren't there already).

Include Images!

- **Linear Pair Perpendicular Theorem** – if two lines intersect to form a linear pair of congruent angles, then the lines are perpendicular.
- **Perpendicular Transversal Theorem** – In a plane, if a transversal is perpendicular to one of two parallel lines, then it is perpendicular to the other line.
- **Lines Perpendicular to a Transversal Theorem** – In a plane, if two lines are perpendicular to the same line, then they are parallel to each other.

Distance from a Point to a Line

The distance from a point to a line is the length of the perpendicular segment from the point to the line.

Find the distance from point A to $\overleftrightarrow{CB}$.

$A(-1, 8)$ $\quad x_1 \; y_1$

$D(-4, 2)$ $\quad x_2 \; y_2$

$$d = \sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

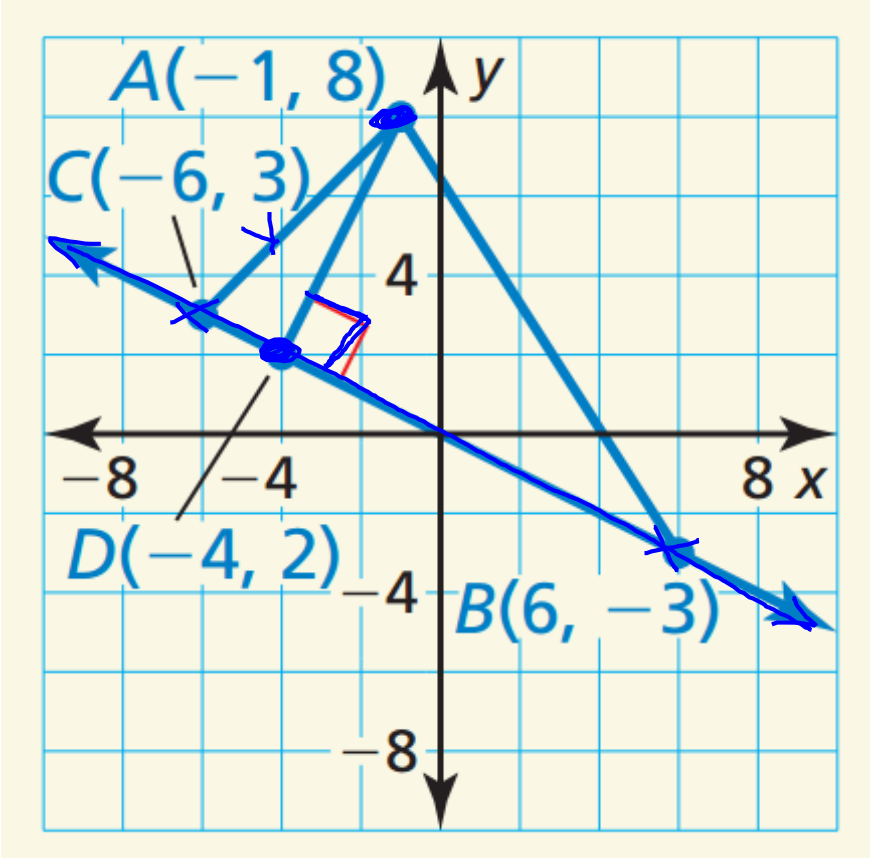
$$\sqrt{(-4 + 1)^2 + (2 - 8)^2}$$

$$\sqrt{(-3)^2 + (-6)^2}$$

$$\sqrt{9 + 36}$$

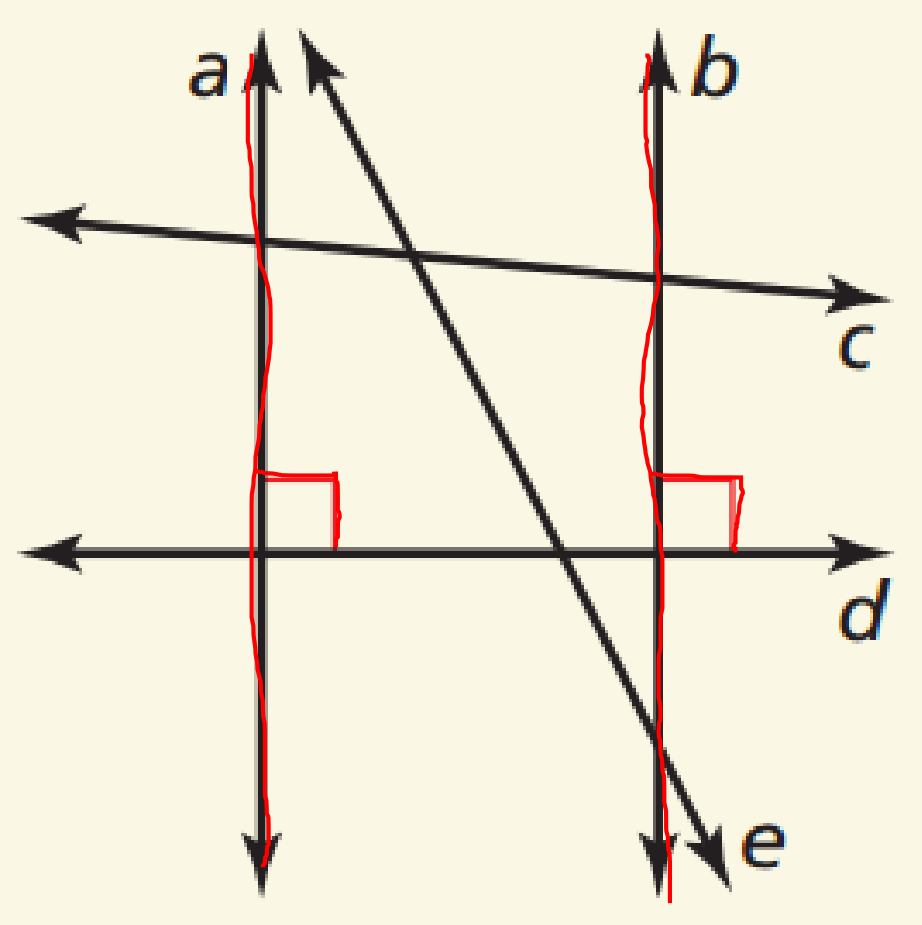
$$\sqrt{45} = \sqrt{5} \cdot \sqrt{9}$$

$$3\sqrt{5}$$



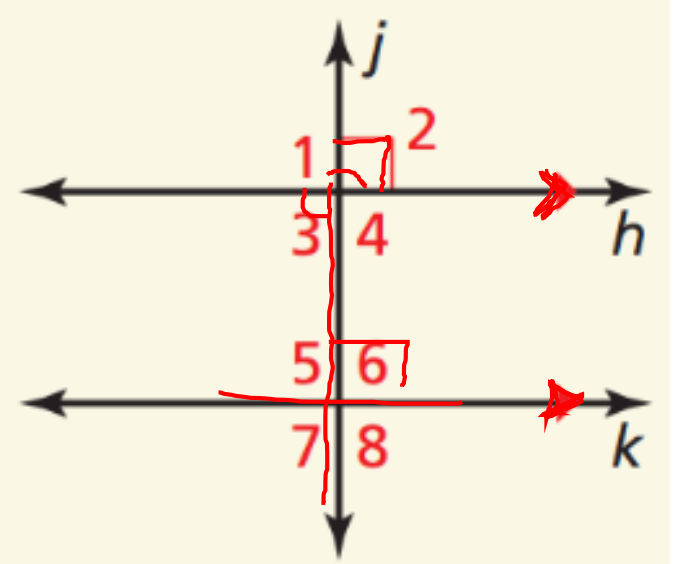
Determine which lines, if any, must be parallel in the diagram. Explain your reasoning.

a ∥ b because Lines ⊥ to transversal thm



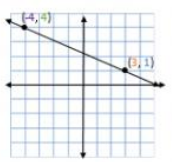
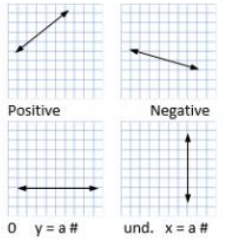
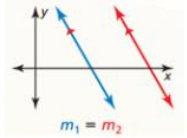
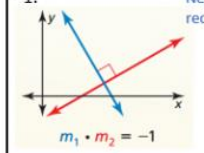
Prove the Perpendicular Transversal Theorem using the diagram and the Alternate Interior Angles Theorem.

Statements	Reasons
1. $h \parallel k$; $j \perp h$	1. given
2. $m\angle 2 = 90°$	2. def of $\perp$
3. $\angle 2 \cong \angle 3$	3. vertical $\angle$ thm
4. $m\angle 3 = 90°$	4. Subst.
5. $m\angle 6 = 90°$	5. AIA $\cong$
6. $j \perp k$	6. def $\perp$ lines
7.	7.
8.	8.



In class: finish the worksheet.
Homework: fill out the All About Slope Foldable

Types of Slope			Slope
∥ lines	Back		Slope y- int.
⊥ lines			Point Slope

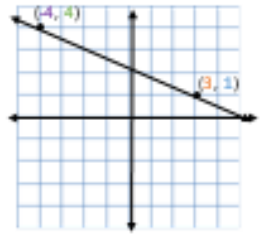
$\frac{rise}{run} \rightarrow \frac{\Delta y}{\Delta x}$ $m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$ (1, 2) (3, 4) $m = \frac{(4-2)}{(3-1)} = \frac{2}{2} = 1$	 $m = \frac{(1-4)}{(3--4)} = \frac{-3}{7}$	 Positive Negative 0 y = a # und. x = a #	**Mr. Slope** 
y = mx + b Equation of a line with slope m and point (0, b). Most commonly used. If standard form (ax + by = c) is given solve for y.	Find an equation of a line with slope -3 passing through (-1, 5). y = mx + b 5 = -3(-1) + b 5 = 3 + b 2 = b y = -3x + 2	Find an equation of the line parallel to $y = -\frac{1}{2}x + 2$ passing through (8, -3). ∥ lines = slopes y = mx + b $-3 = -\frac{1}{2}(8) + b$ -3 = -4 + b $y = -\frac{1}{2}x + 1$	In a coordinate plane, two non-vertical lines are parallel if and only if they have the same slope.  $m_1 = m_2$
$y = m(x - x_1) + y_1$ Equation of a line with slope m and point (x_1, y_1).	Find an equation of a line through (-2, 7) with slope of -5. $y = m(x - x_1) + y_1$ y = -5(x – -2) + 7 y = -5(x + 2) + 7 y = -5x – 10 + 7 y = -5x - 3	Find an equation of a line perpendicular to 3x – 2y = 6, passing through (1, 2). Solve for y -2y = -3x + 6 $y = \frac{3}{2}x - 3$; $-\frac{2}{3}$ is ⊥ slope $y = -\frac{2}{3}(x - 1) + 2$ $y = -\frac{2}{3}x + \frac{2}{3} + 2$; $y = -\frac{2}{3}x + 2\frac{2}{3}$	In a coordinate plane, two non-vertical lines are perpendicular if and only if the product of their slopes is -1. Negative reciprocals  $m_1 \cdot m_2 = -1$

$$\frac{rise}{run} \rightarrow \frac{\Delta y}{\Delta x}$$

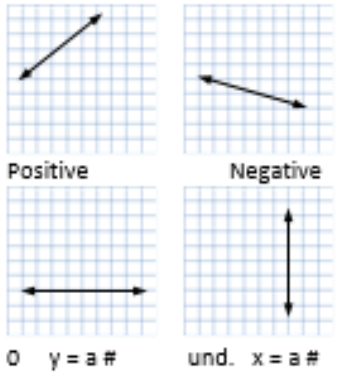
$$m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

(1, 2) (3, 4)

$$m = \frac{(4-2)}{(3-1)} = \frac{2}{2} = 1$$



$$m = \frac{(1-4)}{(3--4)} = \frac{-3}{7}$$



Mr. Slope

$y = mx + b$

Equation of a line with slope m and point (0, b). Most commonly used. If standard form (ax + by = c) is given solve for y.

Find an equation of a line with slope -3 passing through (-1, 5).

$y = mx + b$

$5 = -3(-1) + b$

$5 = 3 + b$

$2 = b$

$y = -3x + 2$

Find an equation of the line parallel to $y = -\frac{1}{2}x + 2$ passing through (8, -3).

∥ lines = slopes

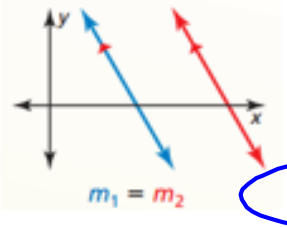
$y = mx + b$

$-3 = -\frac{1}{2}(8) + b$

$-3 = -4 + b$

$y = -\frac{1}{2}x + 1$

In a coordinate plane, two non-vertical lines are parallel if and only if they have the same slope.



$y = m(x - x_1) + y_1$

Equation of a line with slope m and point (x_1, y_1).

Find an equation of a line through (-2, 7) with slope of -5.

$y = m(x - x_1) + y_1$

$y = -5(x - -2) + 7$

$y = -5(x + 2) + 7$

$y = -5x - 10 + 7$

$y = -5x - 3$

Find an equation of a line perpendicular to $3x - 2y = 6$, passing through (1, 2).

Solve for y

$-2y = -3x + 6$

$y = \frac{3}{2}x - 3$; $-\frac{2}{3}$ is ⊥ slope

$y = -\frac{2}{3}(x - 1) + 2$

$y = -\frac{2}{3}x + \frac{2}{3} + 2$; $\boxed{y = -\frac{2}{3}x + 2\frac{2}{3}}$

In a coordinate plane, two non-vertical lines are perpendicular if and only if the product of their slopes is -1.