

## 3.5B - Parallel and Perpendicular Lines

**Bellwork:** Name the property of equality the statement illustrates.

1. If  $x = y$ , then  $2x = 2y$ .
2. If  $BN = NC$ , then  $BN - 6 = NC - 6$ .
3.  $z = z$
4.  $m\angle A = m\angle A$
5. If  $m\angle D = 38^\circ$  and  $m\angle E = 38^\circ$ , then  $m\angle E = m\angle D$ .
6. If  $FG = JK$ , then  $JK = FG$ .

Essential Question

**Slope** - describes the steepness of the line. Can use any two points on the line to find slope.

$$\text{Slope} = \frac{\text{rise}}{\text{run}}$$

**Slope Formula:** Label two points

$(x_1, y_1)$  and  $(x_2, y_2)$

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

Slope-Intercept Form

Provides the exact location of a line on a graph

$$y = mx + b$$

m = slope

b = y intercept

Write the equation of the line that goes through each point:

(5, 2) and (-5, 6)

slope:  $\frac{6-2}{-5-5} = \frac{4}{-10} = -\frac{2}{5}$

$$y = mx + b$$

$$2 = -\frac{2}{5}(5) + b$$

$$2 = -2 + b$$

$$4 = b$$

$$y = -\frac{2}{5}x + 4$$

(-3, 4) and (5, -7)

Slope:  $\frac{-7-4}{5+3} = -\frac{11}{8}$

$$y = mx + b$$

$$4 = -\frac{11}{8}(-3) + b$$

$$4 = \frac{33}{8} + b$$

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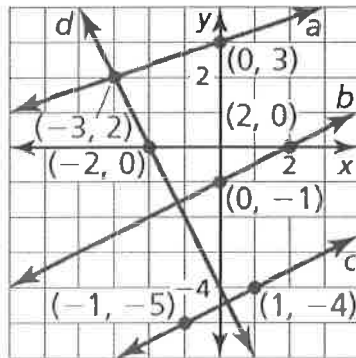
$$32 = 33 + 8b$$

$$-1 = 8b$$

$$-\frac{1}{8} = b$$

$$y = -\frac{11}{8}x - \frac{1}{8}$$

Write the equation for each line in slope-intercept form.



a:  $y = \frac{1}{3}x + 3$

c:  $y = \frac{1}{2}x - 4.5$

b:  $y = \frac{1}{2}x - 1$

d:  $y = -2x - 4$

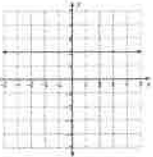
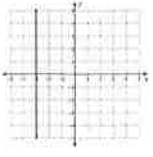
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Horizontal and Vertical Lines

HOY - VUX

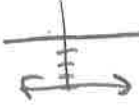
Write the equation for each line.


$y = 2$

$x = -3$

Graph each line.

$y = -4$   


$x = 2$   


Write the equation of the line through each point.

Vertical through  $(-2, 4)$       $x = -2$

Horizontal through  $(3, -6)$       $y = -6$

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Parallel Lines - Have the same slope

Perpendicular Lines - Slopes are opposite reciprocals

Also: Any two vertical lines are parallel

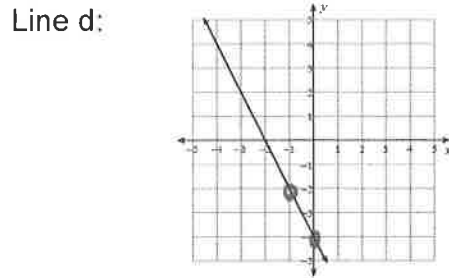
Horizontal lines and vertical lines are perpendicular

Determine which of the lines are parallel and which of the lines are perpendicular.

Line a:  $-x + 3y = 9$        $\frac{3y}{3} = \frac{x+9}{3}$       slope =  $\frac{1}{3}$   
 $y = \frac{1}{3}x + 3$

Line b:  $y = (1/2)x - 1$       slope =  $\frac{1}{2}$

Line c: Through Points  $(-1, -5)$  and  $(1, -4)$       slope =  $\frac{-4+5}{1+1} = \frac{1}{2}$



slope =  $-\frac{2}{1}$

$b \parallel c, b \perp d$   
 $c \perp d$

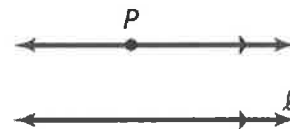
Example 2

## REMEMBER!

### Postulate 3.1 Parallel Postulate

If there is a line and a point not on the line, then there is exactly one line through the point parallel to the given line.

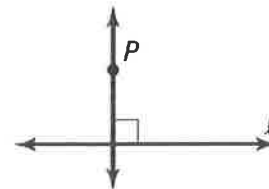
There is exactly one line through  $P$  parallel to  $\ell$ .



### Postulate 3.2 Perpendicular Postulate

If there is a line and a point not on the line, then there is exactly one line through the point perpendicular to the given line.

There is exactly one line through  $P$  perpendicular to  $\ell$ .



Write an equation of the line passing through the point  $(-1, 1)$  that is parallel to the line  $y = 2x - 3$ .

$$m = 2$$

$$y = mx + b$$

$$1 = 2(-1) + b$$

$$1 = -2 + b$$

$$3 = b$$

$$y = 2x + 3$$

Write an equation of the line passing through the point  $(2, 3)$  that is perpendicular to the line  $2x + y = 2$ .

$$y = -2x + 2$$

$$\perp m = \frac{1}{2}$$

$$y = mx + b$$

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

$$3 = 1 + b$$

$$2 = b$$

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

Example 3

Write an equation of the line that passes through the point  $(4, -5)$  and is (a) parallel to the line  $y = 3x - 5$  and (b) perpendicular to the line  $y = 3x - 5$ .

a)  $m = 3$   $(4, -5)$

$$y = mx + b$$

$$-5 = (3)(4) + b$$

$$-5 = 12 + b$$

$$-17 = b$$

$$y = 3x - 17$$

b)  $m = -\frac{1}{3}$   $(4, -5)$

$$\left[-5 = -\frac{1}{3}(4) + b\right] \cdot 3$$

$$-15 = -4 + 3b$$

$$-11 = 3b \quad b = -\frac{11}{3}$$

$$y = -\frac{1}{3}x - \frac{11}{3}$$

How do you know that the lines  $x = 4$  and  $y = 2$  are perpendicular?

Because they are vertical and horizontal.

Homework:

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