



**James Madison**  
HIGH SCHOOL

# Parallel and Perpendicular Lines



# James Madison HIGH SCHOOL Parallel Lines

- Two lines with the same slope are said to be parallel lines. If you graph them they will never intersect.
- We can decide algebraically if two lines are parallel by finding the slope of each line and seeing if the slopes are equal to each other.
- We can find the equation of a line parallel to a given line and going through a given point by: a.) first finding the slope  $m$  of the given line; b.) finding the equation of the line through the given point with slope  $m$ .



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# Testing if Lines are Parallel

Are the lines  $12x + 3y = -9$  and  $-8x - 2y = 14$  parallel?

Find the slope of  $12x + 3y = -9$     The slope  $m = -4$

$$3y = -12x - 9$$

$$y = -4x - 3$$

Find the slope of  $-8x - 2y = 14$     The slope  $m = -4$

$$-2y = 8x + 14$$

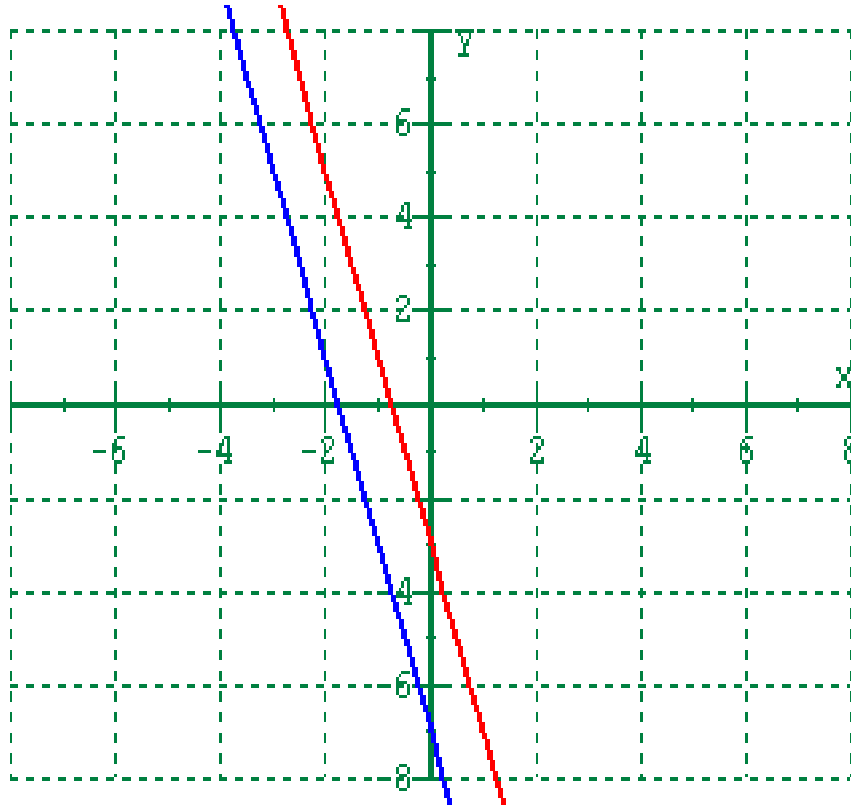
$$y = -4x - 7$$

Since the slopes are equal the lines are parallel.



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# Graphs of Parallel Lines



The red line is the graph of  
 $y = -4x - 3$   
and the blue line is the graph of  
 $y = -4x - 7$



# Practice Testing if Lines are Parallel

Are the lines  $6x - 3y = 5$  and  $2y = -4x + 4$  parallel? (click mouse for answer)

$$6x - 3y = 5$$

$$-3y = -6x + 5$$

$$y = 2x - \frac{5}{3}$$

$$m = 2$$

$$2y = -4x + 4$$

$$y = -2x + 2$$

$$m = -2$$

Since the slopes are different  
the lines are not parallel.

Are the lines  $x - 2y = 4$  and  $2x - 4y = 12$  parallel? (click mouse for answer)

$$x - 2y = 4$$

$$-2y = -x + 4$$

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

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

$$2x - 4y = 12$$

$$-4y = -2x + 12$$

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

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

Since the slopes are equal  
the lines are parallel.



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# Constructing Parallel Lines

Find the equation of a line going through the point (3, -5) and parallel to  $y = -\frac{2}{3}x + 8$

Using the point-slope equation where the slope  $m = -\frac{2}{3}$  and

the point is (3, -5) we get  $y - (-5) = -\frac{2}{3}(x - 3)$

$$y + 5 = -\frac{2}{3}x + 2$$

$$y = -\frac{2}{3}x - 3$$



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# Practice Constructing Parallel Lines

Find the equation of the line going through the point  $(4,1)$  and parallel to  $y = -3x + 7$  (click mouse for answer)

$$y - 1 = -3(x - 4)$$

$$y - 1 = -3x + 12$$

$$y = -3x + 13$$

Find the equation of the line going through the point  $(-2,7)$  and parallel to  $2x + y = 8$  (click mouse for answer)

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

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

$$y - 7 = -2x - 4$$

$$y = -2x + 3$$



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# Perpendicular Lines

- Perpendicular lines are lines that intersect in a right angle.
- We can decide algebraically if two lines are perpendicular by finding the slope of each line and seeing if the slopes are negative reciprocals of each other. This is equivalent to multiplying the two slopes together and seeing if their product is  $-1$ .
- We can find the equation of a line perpendicular to a given line and going through a given point by:
  - a.) first finding the slope  $m$  of the given line;
  - b.) finding the equation of the line through the given point with  $\text{slope} = -1 / m$ .





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# Testing if Lines Are Perpendicular

Are the lines  $2x + y = 5$  and  $y = \frac{1}{2}x + 4$  perpendicular?

Find the slope of  $2x + y = 5$                        $m = -2$

$$y = -2x + 5$$

Find the slope of  $y = \frac{1}{2}x + 4$                        $m = \frac{1}{2}$

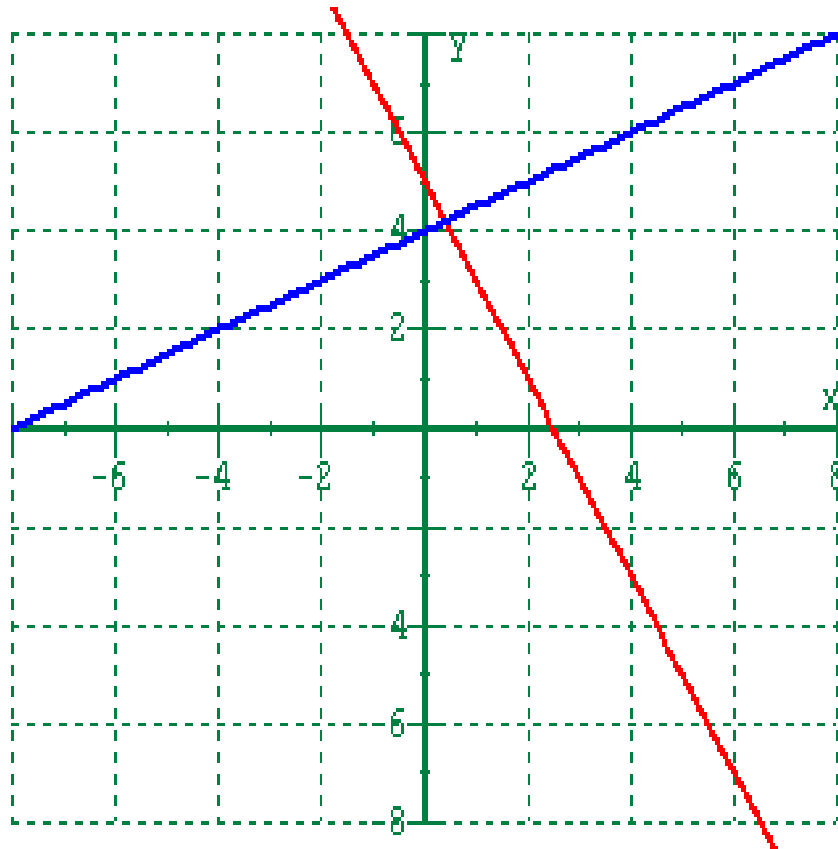
Since the slopes are negative reciprocals of each other the lines are perpendicular.

$$-2\left(\frac{1}{2}\right) = -1$$



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# Graphs of Perpendicular Lines



The red line is the graph of

$$y = -2x + 5$$

and the blue line is the  
graph of

$$y = -\frac{1}{2}x + 4$$



# Practice Testing if Lines Are Perpendicular

Are the lines  $6x - 3y = 5$  and  $2y = -4x + 4$  perpendicular?

$$6x - 3y = 5$$

$$-3y = -6x + 5$$

$$y = 2x - \frac{5}{3}$$

$$m = 2$$

$$2y = -4x + 4$$

$$y = -2x + 2$$

$$m = -2$$

Since the slopes are not negative reciprocals of each other (their product is not -1) the lines are not perpendicular

Are the lines  $x - 2y = 4$  and  $4x + 2y = 6$  perpendicular?

$$x - 2y = 4$$

$$-2y = -x + 4$$

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

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

$$4x + 2y = 6$$

$$2y = -4x + 6$$

$$y = -2x + 3$$

$$m = -2$$

Since the slopes are negative reciprocals of each other (their product is -1) the lines are perpendicular.



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# Constructing Perpendicular Lines

Find the equation of a line going through the point (3, -5) and perpendicular to  $y = -\frac{2}{3}x + 8$

The slope of the perpendicular line will be  $m = \frac{3}{2}$  Using the point-slope equation where the slope  $m = \frac{3}{2}$  and the point is (3, -5) we get

$$y - (-5) = \frac{3}{2}(x - 3)$$

$$y + 5 = \frac{3}{2}x - \frac{9}{2}$$

$$y = \frac{3}{2}x - \frac{19}{2}$$



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# Practice Constructing Perpendicular Lines

Find the equation of the line going through the point  $(4,1)$  and perpendicular to  $y = -3x + 7$  (click mouse for answer)

$$y - 1 = \frac{1}{3}(x - 4)$$

$$y - 1 = \frac{1}{3}x - \frac{4}{3}$$

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

Find the equation of the line going through the point  $(-2,7)$  and perpendicular to  $2x + y = 8$  (click mouse for answer)

$$y - 7 = \frac{1}{2}(x - (-2))$$

$$y - 7 = \frac{1}{2}(x + 2)$$

$$y - 7 = \frac{1}{2}x + 1$$

$$y = \frac{1}{2}x + 8$$