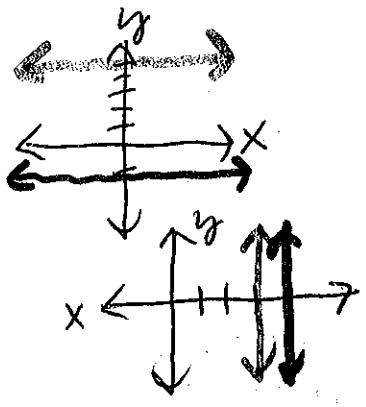
Nonvertical lines are parallel if they have the same slope and different y-intercepts.
Any 2 vertical lines are parallel. ($\parallel$)

(ex) $y = \frac{2}{3}x + 1$, $y = \frac{2}{3}x - 3$ are parallel

diagonal $m = \frac{2}{3}$ $b = 1$ $m = \frac{2}{3}$ $b = -3$



(ex) horizontal $y = 5 \parallel y = -1$
both have a zero slope.

(ex) vertical $x = 3 \parallel x = 4$
both have an undefined slope.

(ex) Write an equation for a line that contains $(2, -6)$ and is parallel to $y = 3x + 9$

$m = 3$ $(\underset{x_1}{2}, \underset{y_1}{-6})$ $y + 6 = 3(x - 2)$
$y + 6 = 3x - 6$
$-6 \quad -6$
$y = 3x - 12$

(ex) WTEOTL that contains $(5, 1)$ and is $\parallel$ to $y = \frac{3}{5}x - 4$

$m = \frac{3}{5}$ $(\underset{x_1}{5}, \underset{y_1}{1})$ $y - y_1 = m(x - x_1)$
$y - 1 = \frac{3}{5}(x - 5)$
$y - 1 = \frac{3}{5}x - 3$
$+1 \quad +1$
$y = \frac{3}{5}x - 2$

2 Lines are Perpendicular ($\perp$) if the product of their slopes is -1. (this means their slopes are opposite reciprocals $\frac{1}{2}, \frac{-2}{1}$)

Horizontal Lines are $\perp$ to Vertical Lines.

(ex) $y = 5 \perp x = 3$

(ex) $y = -\frac{1}{4}x - 1 \perp y = \frac{4}{1}x + 3$ (y-intercepts can be the same or different)

(ex) WTEOTL that contains $(1, 8)$ and is $\perp$ to $y = \frac{3}{4}x + 1$

$m = -\frac{4}{3}$ $y - 8 = -\frac{4}{3}(x - 1)$
$y - 8 = -\frac{4}{3}x + \frac{4}{3}$
$+8 \quad +8$
$y = -\frac{4}{3}x + \frac{28}{3}$

WTEOTL

(ex) thm $(4, 2)$ $\perp$ to $y = -\frac{1}{3}x + 2$

$m = \frac{3}{1} = 3$ $y - 2 = 3(x - 4)$
$(4, 2)$
$y - 2 = 3x - 12$
$+2 \quad +2$
$y = 3x - 10$

(ex) Find the slope of a line ∥ to the eq.

① $y = 4x + 2$ $m = 4$ (same slope), $\perp$ $m = -\frac{1}{4}$

② $-3x - 5y = 6$
$+3x \quad +3x$

$m_{\parallel} = -\frac{3}{5}$ $m_{\perp} = \frac{5}{3}$

$\frac{-5y}{-5} = \frac{3x}{-5} + \frac{6}{-5}$

$y = -\frac{3}{5}x - \frac{6}{5}$

Tell whether the lines are ∥, $\perp$ or neither.

(ex) $y = 3x - 8$
$-3x \quad -3x$

$-3x - y = -1$

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

$y = 3x + 1$

parallel, both slopes are 3.

(ex) $9x + 3y = 6$
$3x + 9y = 6$

* Put each in $y = mx + b$ form. 1st.

$9x + 3y = 6$
$-9x \quad -9x$

$\frac{3y}{3} = \frac{-9x}{3} + \frac{6}{3}$

$y = -3x + 2$

$3x + 9y = 6$
$-3x \quad -3x$

$\frac{9y}{9} = \frac{-3x}{9} + \frac{6}{9}$

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

* neither

$\perp$ $m = -3$, $m = \frac{1}{3}$

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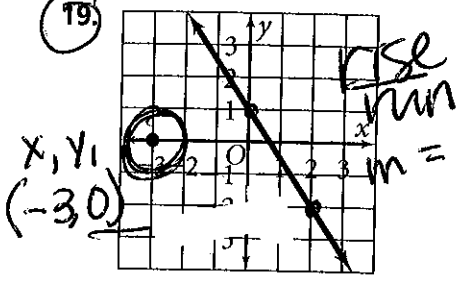
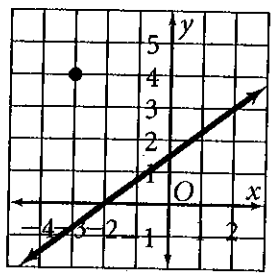
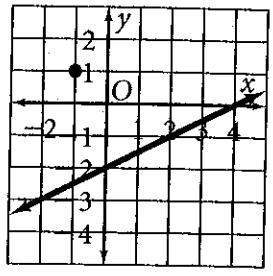
Parallel and Perpendicular Lines

Find the slope of a line parallel to the graph of each equation. same slope

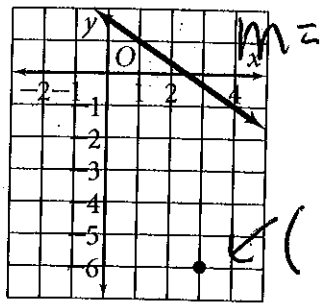
1. $y = 4x + 2$
2. $y = \frac{2}{7}x + 1$
3. $y = -9x - 13$
4. $y = -\frac{1}{2}x + 1$
5. $6x + 2y = 4$
6. $y - 3 = 0$
7. $-5x + 5y = 4$
8. $9x - 5y = 4$
9. $-x + 3y = 6$
10. $6x - 7y = 10$
11. $x = -4$
12. $-3x - 5y = 6$

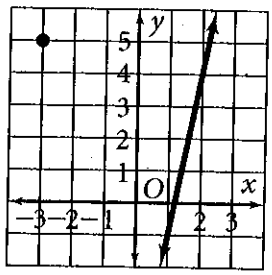
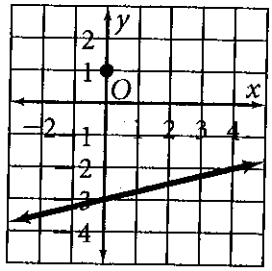
Write an equation for the line that is perpendicular to the given line and that passes through the given point.

13. $(6, 4); y = 3x - 2$
14. $(-5, 5); y = -5x + 9$ $m = \frac{1}{5}$
15. $(-1, -4); y = \frac{1}{6}x + 1$
16. $(1, 1); y = -\frac{1}{4}x + 7$
17. $(12, -6); y = 4x + 1$
18. $(0, -3); y = -\frac{4}{3}x - 7$
19. 

20. 
21. 

Write an equation for the line that is parallel to the given line and that passes through the given point.

22. $(3, 4); y = 2x - 7$
23. $(1, 3); y = -4x + 5$
24. $(4, -1); y = x - 3$
25. $(4, 0); y = \frac{3}{2}x + 9$
26. $(-8, -4); y = -\frac{3}{4}x + 5$
27. $(9, -7); -7x - 3y = 3$
28. 

29. 
30. 

Tell whether the lines for each pair of equations are *parallel*, *perpendicular*, or *neither*.

31. $y = 3x - 8$
    $3x - y = -1$
32. $3x + 2y = -5$
    $y = \frac{2}{3}x + 6$
33. $y = -\frac{5}{2}x + 11$
    $-5x + 2y = 20$
34. $9x + 3y = 6$
    $3x + 9y = 6$
35. $y = -4$
    $y = 4$
36. $x = 10$
    $y = -2$