# 1.3–1.4 Linear Equations & Direct Variation

point-slope form: $y - y_1 = m(x - x_1)$

$y = mx + b$

Example 1: Write an equation in slope-intercept form for the line containing the points (6,9) and (5,–6).

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6-9}{5-6}$

$m = \frac{-15}{-1}$

$m = 15$

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

$y - 9 = 15(x - 6)$

$y - 9 = 15x - 90$

$+9 \qquad +9$

$y = 15x - 81$

Example 2: Write an equation in slope-intercept form for the line that has a slope of $\frac{3}{4}$ and contains the point (–12,2).

$m$ $x_1$ $y_1$

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

$y - 2 = \frac{3}{4}(x + 12)$

$y - 2 = \frac{3}{4}x + 9$

$+2 \qquad +2$

$y = \frac{3}{4}x + 11$

Example 3: Lisa left her house and drove at a constant speed. She picked up Ann along the way. Two hours after picking up Ann, they were 140 miles from Lisa's house, and five hours after picking up Ann they were 344 miles from Lisa's house. How far from her house was Lisa when she picked up Ann?

$(2, 140)$ $(5, 344)$ When $x=0$, find $y$.

$(x_1, y_1)$

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

$m = \frac{344 - 140}{5 - 2}$

$m = \frac{204}{3}$

$m = 68$

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

$y - 140 = 68(x - 2)$

$y - 140 = 68x - 136$

$+140 \quad +140$

$y = 68x + 4$

$y = 68(0) + 4$

$y = 4$ miles

Example 4: Tina leaves home and drives to college at a constant speed. On her way she stops at a restaurant for lunch. Two hours after leaving the restaurant she traveled 130 miles, and four hours after leaving she traveled 240 miles. How far from home was Tina when she had lunch?

$(2, 130)$ $(4, 240)$

$m = \frac{240 - 130}{4 - 2}$

$m = \frac{110}{2}$

$m = 55$

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

$y - 130 = 55(x - 2)$

$y - 130 = 55x - 110$

$+130 \quad +130$

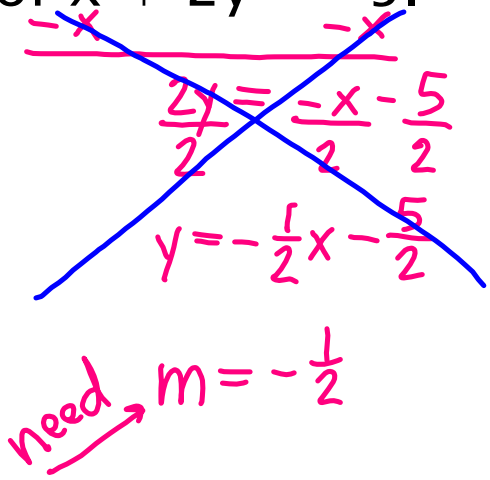
$y = 55x + 20$

$y = 55(0) + 20$

$y = 20$ miles

parallel lines – have the same slope

Example 5: Write an equation in slope-intercept form for the line that contains the point (3,7) and is parallel to the graph of $x + 2y = -5$.




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

$y - 7 = -\frac{1}{2}(x - 3)$

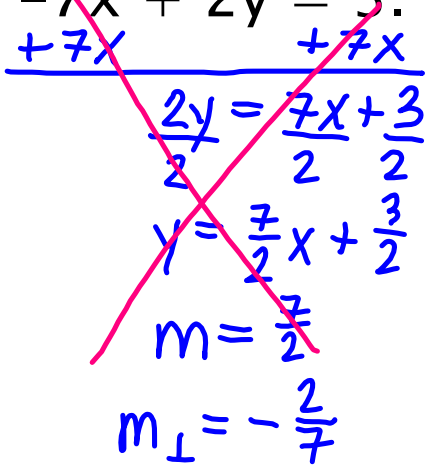
$y - 7 = -\frac{1}{2}x + \frac{3}{2}$

$+7 \quad +7 \quad \frac{14}{2}$

$y = -\frac{1}{2}x + \frac{17}{2}$

perpendicular lines – have slopes that are opposite reciprocals

Example 6: Write an equation in slope-intercept form for the line that contains the point (8,–1) and is perpendicular to the graph of $-7x + 2y = 3$.




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

$y + 1 = -\frac{2}{7}(x - 8)$

$y + 1 = -\frac{2}{7}x + \frac{16}{7}$

$-1 \quad -1 \quad -\frac{7}{7}$

$y = -\frac{2}{7}x + \frac{9}{7}$

direct variation: The variable y varies directly as x if there is a nonzero constant k such that $y = kx$.

k: constant of variation

Example 7: Find the constant of variation and the direct variation equation if y varies directly as x and y = −24 when x = 4.

direct var.

$y = kx$

$\frac{-24}{4} = \frac{k \cdot 4}{4}$

$-6 = k$

$y = -6x$

Example 8: When traveling at a constant rate, Armando drives his car 12 miles in about 15 minutes. At this rate, how long will it take him to drive 30 miles?

$y = kx$

$d = rt$

$\frac{12}{15} = \frac{r \cdot 15}{15}$

$\frac{4}{5} = r$

$d = \frac{4}{5}t$

$\frac{5}{2\cancel{4}} \cdot \frac{\cancel{30}^{15}}{1} = \frac{\cancel{4}}{\cancel{5}}t \cdot \frac{\cancel{5}}{\cancel{4}}$

$\frac{75}{2} = t$

min

What other method could we use to answer the last example?

proportion ☺

$$\frac{12 \text{ miles}}{15 \text{ min}} = \frac{30 \text{ miles}}{x \text{ min}}$$

$$\frac{12x}{12} = \frac{450 \div 6}{12 \div 6}$$

$$x = \frac{75}{2} \text{ min}$$

Example 9: Using a proportion, solve the following.

If a is 6.3 when b is 70, find b when a is 54.

$$\frac{a}{b}: \quad \frac{6.3}{70} = \frac{54}{b} \quad a$$

$$\frac{6.3b}{6.3} = \frac{3780}{6.3}$$

$$\boxed{b = 600}$$

## Example 10: Solve the proportion.

$$\frac{2a-1}{5} = \frac{3a}{7}$$

$15a = 7(2a-1)$

$15a = 14a - 7$

$-14a \quad -14a$

$a = -7$

## Example 11: Determine whether the values in each table represent a direct variation. If so, write an equation for the variation.

a)

| x | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| y | 1 | 0.5 | 0 | -0.5 | -1 |

(+1, +1, +1, +1 across x; −0.5, −0.5, −0.5, −0.5 across y)

$y = -0.5x$

direct var ✓

always go through (0,0)

$m = \frac{\Delta y}{\Delta x}$

$m = \frac{-0.5}{1} = -0.5$

b)

| x | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| y | -4 | -9 | -16 | -25 | -36 |

(+1 across x; −5, −7, −9, −11 across y)

not a direct. var.