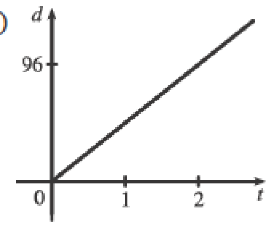
14. (a) Let d = distance traveled (in miles) and t = time elapsed (in hours). At $t = 0$, $d = 0$ and at $t = 50$ minutes $= 50 \cdot \frac{1}{60} = \frac{5}{6}$ h, $d = 40$. Thus we have two points: $(0, 0)$ and $\left(\frac{5}{6}, 40\right)$, so $m = \dfrac{40 - 0}{\frac{5}{6} - 0} = 48$ and so $d = 48t$.

(b) 

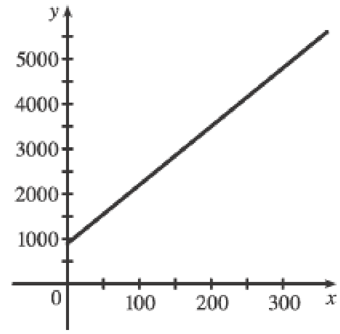
(c) The slope is 48 and represents the car's speed in mi/h.

15. (a) Using N in place of x and T in place of y, we find the slope to be $\dfrac{T_2 - T_1}{N_2 - N_1} = \dfrac{80 - 70}{173 - 113} = \dfrac{10}{60} = \dfrac{1}{6}$. So a linear equation is $T - 80 = \frac{1}{6}(N - 173) \quad \Leftrightarrow \quad T - 80 = \frac{1}{6}N - \frac{173}{6} \quad \Leftrightarrow \quad T = \frac{1}{6}N + \frac{307}{6} \quad \left[\frac{307}{6} = 51.1\overline{6}\right]$.

(b) The slope of $\frac{1}{6}$ means that the temperature in Fahrenheit degrees increases one-sixth as rapidly as the number of cricket chirps per minute. Said differently, each increase of 6 cricket chirps per minute corresponds to an increase of 1°F.

(c) When $N = 150$, the temperature is given approximately by $T = \frac{1}{6}(150) + \frac{307}{6} = 76.1\overline{6}\,°\text{F} \approx 76\,°\text{F}$.

16. (a) Let x denote the number of chairs produced in one day and y the associated cost. Using the points $(100, 2200)$ and $(300, 4800)$, we get the slope $\frac{4800-2200}{300-100} = \frac{2600}{200} = 13$. So $y - 2200 = 13(x - 100) \quad \Leftrightarrow$ $y = 13x + 900$.



(b) The slope of the line in part (a) is 13 and it represents the cost (in dollars) of producing each additional chair.

(c) The y-intercept is 900 and it represents the fixed daily costs of operating the factory.

1. (a) It is defined as the inverse of the exponential function with base a, that is, $\log_a x = y \quad \Leftrightarrow \quad a^y = x$.

(b) $(0, \infty)$ (c) $\mathbb{R}$ (d) See Figure 1.

3. (a) $\log_5 125 = 3$ since $5^3 = 125$.

(b) $\log_3 \dfrac{1}{27} = -3$ since $3^{-3} = \dfrac{1}{3^3} = \dfrac{1}{27}$.

5. (a) $\log_5 \frac{1}{25} = \log_5 5^{-2} = -2$ by (2).

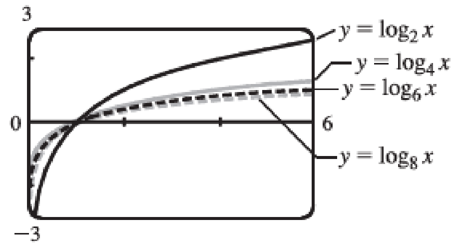
(b) $e^{\ln 15} = 15$ by (8).

7. (a)
$$\begin{aligned} \log_2 6 - \log_2 15 + \log_2 20 &= \log_2\left(\tfrac{6}{15}\right) + \log_2 20 && \text{[by Law 2]} \\ &= \log_2\left(\tfrac{6}{15} \cdot 20\right) && \text{[by Law 1]} \\ &= \log_2 8, \text{ and } \log_2 8 = 3 \text{ since } 2^3 = 8. \end{aligned}$$

(b)
$$\begin{aligned} \log_3 100 - \log_3 18 - \log_3 50 &= \log_3\left(\tfrac{100}{18}\right) - \log_3 50 = \log_3\left(\tfrac{100}{18 \cdot 50}\right) \\ &= \log_3\left(\tfrac{1}{9}\right), \text{ and } \log_3\left(\tfrac{1}{9}\right) = -2 \text{ since } 3^{-2} = \tfrac{1}{9}. \end{aligned}$$

14. $\ln(x+y) + \ln(x-y) - 2\ln z = \ln((x+y)(x-y)) - \ln z^2 = \ln(x^2 - y^2) - \ln z^2 = \ln \dfrac{x^2 - y^2}{z^2}$

20. To graph the functions, we use $\log_2 x = \dfrac{\ln x}{\ln 2}$, $\log_4 x = \dfrac{\ln x}{\ln 4}$, etc. These graphs all approach $-\infty$ as $x \to 0^+$, and they all pass through the point $(1, 0)$. Also, they are all increasing, and all approach ∞ as $x \to \infty$. The smaller the base, the larger the rate of increase of the function (for $x > 1$) and the closer the approach to the y-axis (as $x \to 0^+$).



26. (a) $e^{2x+3} - 7 = 0 \quad \Rightarrow \quad e^{2x+3} = 7 \quad \Rightarrow \quad 2x + 3 = \ln 7 \quad \Rightarrow \quad 2x = \ln 7 - 3 \quad \Rightarrow \quad x = \frac{1}{2}(\ln 7 - 3)$

(b) $\ln(5 - 2x) = -3 \quad \Rightarrow \quad 5 - 2x = e^{-3} \quad \Rightarrow \quad 2x = 5 - e^{-3} \quad \Rightarrow \quad x = \frac{1}{2}(5 - e^{-3})$