14. (a) This reflection consists of first reflecting the graph about the \( x \)-axis (giving the graph with equation \( y = -e^x \)) and then shifting this graph \( 2 \cdot 4 = 8 \) units upward. So the equation is \( y = -e^x + 8 \).

(b) This reflection consists of first reflecting the graph about the \( y \)-axis (giving the graph with equation \( y = e^{-x} \)) and then shifting this graph \( 2 \cdot 2 = 4 \) units to the right. So the equation is \( y = e^{-(x-4)} \).

25. (a) Fifteen hours represents 5 doubling periods (one doubling period is three hours). \( 100 \cdot 2^5 = 3200 \)

(b) In \( t \) hours, there will be \( t/3 \) doubling periods. The initial population is 100,
so the population \( y \) at time \( t \) is \( y = 100 \cdot 2^{t/3} \).

(c) \( t = 20 \) \( \Rightarrow \) \( y = 100 \cdot 2^{20/3} \approx 10,159 \)

(d) We graph \( y_1 = 100 \cdot 2^{x/3} \) and \( y_2 = 50,000 \). The two curves intersect at \( x \approx 26.9 \), so the population reaches 50,000 in about 26.9 hours.

24. \( y = f(x) = 2x^2 + 3 \Rightarrow y - 3 = 2x^2 \Rightarrow \frac{y - 3}{2} = x^2 \Rightarrow x = \sqrt{\frac{y - 3}{2}} \) Interchange \( x \) and \( y \): \( y = \sqrt{\frac{x - 3}{2}} \).

So \( f^{-1}(x) = \sqrt{\frac{x - 3}{2}} \).

38. \( \ln(a + b) + \ln(a - b) - 2 \ln c = \ln[(a + b)(a - b)] - \ln c^2 \) [by Laws 1, 3]

\[ = \ln\frac{(a + b)(a - b)}{c^2} \] [by Law 2]

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

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

2. (a) Slope = \( \frac{2998 - 2320}{42 - 36} = \frac{418}{6} \approx 69.67 \)

(b) Slope = \( \frac{2998 - 2561}{42 - 38} = \frac{237}{4} = 71.75 \)

(c) Slope = \( \frac{2998 - 3506}{42 - 40} = \frac{148}{2} = 71 \)

(d) Slope = \( \frac{2998 - 2948}{44 - 42} = \frac{123}{2} = 66 \)

From the data, we see that the patient’s heart rate is decreasing from 71 to 66 heartbeats/minute after 42 minutes. After being stable for a while, the patient’s heart rate is dropping.
7. (a) (i) On the interval $[1, 3]$, $v_{\text{ave}} = \frac{s(3) - s(1)}{3 - 1} = \frac{10.7 - 1.4}{2} = \frac{9.3}{2} = 4.65 \text{ m/s}$.
(ii) On the interval $[2, 3]$, $v_{\text{ave}} = \frac{s(3) - s(2)}{3 - 2} = \frac{10.7 - 5.1}{1} = 5.6 \text{ m/s}$.
(iii) On the interval $[3, 5]$, $v_{\text{ave}} = \frac{s(5) - s(3)}{5 - 3} = \frac{25.8 - 10.7}{2} = \frac{15.1}{2} = 7.55 \text{ m/s}$.
(iv) On the interval $[3, 4]$, $v_{\text{ave}} = \frac{s(4) - s(3)}{4 - 3} = \frac{17.7 - 10.7}{1} = 7 \text{ m/s}$.

(b) Using the points $(2, 4)$ and $(5, 23)$ from the approximate tangent line, the instantaneous velocity at $t = 3$ is about $\frac{23 - 4}{5 - 2} \approx 6.3 \text{ m/s}$.

5. (a) $f(x)$ approaches 2 as $x$ approaches 1 from the left, so $\lim_{x \to 1^-} f(x) = 2$.
(b) $f(x)$ approaches 3 as $x$ approaches 1 from the right, so $\lim_{x \to 1^+} f(x) = 3$.
(c) $\lim_{x \to 1} f(x)$ does not exist because the limits in part (a) and part (b) are not equal.
(d) $f(x)$ approaches 4 as $x$ approaches 5 from the left and from the right, so $\lim_{x \to 5} f(x) = 4$.
(e) $f(5)$ is not defined, so it doesn’t exist.

12. $\lim_{x \to a} f(x)$ exists for all $a$ except $a = \pm 1$.

28. $\lim_{x \to 5^-} \frac{e^x}{(x - 5)^3} = -\infty$ since the numerator is positive and the denominator approaches 0 from the negative side as $x \to 5^-$. 