

1.6 Inverse Functions and Logarithms

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1–2 ■ Determine whether f is one-to-one.

1. $f(x) = 7x - 3$

2. $f(x) = x^2 - 2x + 5$

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3–6 ■ Find a formula for the inverse of the function.

3. $f(x) = \frac{1 + 3x}{5 - 2x}$

4. $f(x) = 5 - 4x^3$

5. $f(x) = \sqrt{2 + 5x}$

6. $y = 2^{10^x}$

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7. Use Formula 10 to evaluate each logarithm correct to six decimal places.

(a) $\log_2 5$

(b) $\log_5 26.05$

8. Find the domain and range of the function $g(x) = \ln(4 - x^2)$.

9–10 ■ Solve each equation for x .

9. (a) $e^x = 16$

(b) $\ln x = -1$

10. (a) $\ln(2x - 1) = 3$

(b) $e^{3x-4} = 2$

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||| Answers

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1. Yes 2. No

3. $f^{-1}(x) = \frac{5x - 1}{2x + 3}$

4. $f^{-1}(x) = \left(\frac{5 - x}{4}\right)^{1/3}$

5. $f^{-1}(x) = \frac{x^2 - 2}{5}, x \geq 0$

6. $f^{-1}(x) = \log_{10} \log_2 x$

7. (a) 2.321928 (b) 2.025563

8. $(-2, 2), (-\infty, \ln 4]$

9. (a) $4 \ln 2$ (b) $1/e$

10. (a) $\frac{1}{2}(e^3 + 1)$ (b) $\frac{1}{3}(\ln 2 + 4)$


Solutions

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- $x_1 \neq x_2 \Rightarrow 7x_1 \neq 7x_2 \Rightarrow 7x_1 - 3 \neq 7x_2 - 3 \Rightarrow f(x_1) \neq f(x_2)$, so f is 1-1.
- $f(x) = x^2 - 2x + 5 \Rightarrow f(0) = 5 = f(2)$, so f is not one-to-one.
- $y = f(x) = \frac{1+3x}{5-2x} \Rightarrow 5y - 2xy = 1 + 3x \Rightarrow 5y - 1 = 3x + 2xy \Rightarrow x(3+2y) = 5y - 1 \Rightarrow x = \frac{5y-1}{2y+3}$. Interchange x and y : $y = \frac{5x-1}{2x+3}$. So $f^{-1}(x) = \frac{5x-1}{2x+3}$.
- $y = f(x) = 5 - 4x^3 \Rightarrow 4x^3 = 5 - y \Rightarrow x^3 = (5-y)/4 \Rightarrow x = \left(\frac{5-y}{4}\right)^{1/3}$. Interchange x and y : $y = \left(\frac{5-x}{4}\right)^{1/3}$. So $f^{-1}(x) = \left(\frac{5-x}{4}\right)^{1/3}$.
- $y = f(x) = \sqrt{2+5x} \Rightarrow y^2 = 2 + 5x$ and $y \geq 0 \Rightarrow 5x = y^2 - 2 \Rightarrow x = \frac{y^2-2}{5}, y \geq 0$. Interchange x and y : $y = \frac{x^2-2}{5}, x \geq 0$. So $f^{-1}(x) = \frac{x^2-2}{5}, x \geq 0$.
- $y = 2^{(10^x)} \Rightarrow \log_2 y = 10^x \Rightarrow \log_{10} \log_2 y = x$. Interchange x and y : $y = \log_{10} \log_2 x$. So $f^{-1}(x) = \log_{10} \log_2 x$.
- (a) $\log_2 5 = \frac{\ln 5}{\ln 2} \approx 2.321928$
 (b) $\log_5 26.05 = \frac{\ln 26.05}{\ln 5} \approx 2.025563$
- The domain of \ln is $(0, \infty)$. Thus, $4 - x^2 > 0 \Leftrightarrow x^2 < 4 \Leftrightarrow |x| < 2$. So the domain is $(-2, 2)$. As x gets close to 2 from the left (or -2 from the right), $4 - x^2$ gets close to 0, and $\ln(4 - x^2)$ decreases without bound. The maximum value occurs when $x = 0$. Hence, the range is $(-\infty, \ln 4]$.
- (a) $e^x = 16 \Leftrightarrow \ln e^x = \ln 16 \Leftrightarrow x = \ln 16 = \ln 2^4 = 4 \ln 2$
 (b) $\ln x = -1 \Leftrightarrow e^{\ln x} = e^{-1} \Leftrightarrow x = 1/e$
- (a) $\ln(2x-1) = 3 \Leftrightarrow e^{\ln(2x-1)} = e^3 \Leftrightarrow 2x-1 = e^3 \Leftrightarrow x = \frac{1}{2}(e^3+1)$
 (b) $e^{3x-4} = 2 \Leftrightarrow \ln(e^{3x-4}) = \ln 2 \Leftrightarrow 3x-4 = \ln 2 \Leftrightarrow x = \frac{1}{3}(\ln 2 + 4)$