

Let $f(x) = 2x + 9$ and $g(x) = 3x - 1$. Perform the indicated operation.

1. $f(x) + g(x)$

$$(2x+9) + (3x-1)$$

$$5x + 8 \text{ Ans.}$$

2. $f(x) - g(x)$

$$(2x+9) - (3x-1)$$

$$2x+9-3x+1$$

$$-x+10 \text{ Ans.}$$

3. $f(x) \cdot g(x)$

$$(2x+9)(3x-1)$$

$$6x^2 - 2x + 27x - 9$$

$$6x^2 + 25x - 9 \text{ Ans.}$$

4. $\frac{f(x)}{g(x)} = \frac{2x+9}{3x-1} \text{ Ans.}$

5. $f(g(x)) = 2(3x-1) + 9$

$$6x - 2 + 9$$

$$6x + 7 \text{ Ans.}$$

6. $g(f(x)) = 3(2x+9) - 1$

$$= 6x + 27 - 1$$

$$= 6x + 26 \text{ Ans.}$$

7. $f(f(x)) = 2(2x+9) + 9$

$$= 4x + 18 + 9$$

$$= 4x + 27 \text{ Ans.}$$

8. $g(g(x)) = 3(3x-1) - 1$

$$= 9x - 3 - 1$$

$$= 9x - 4 \text{ Ans.}$$

Let $f(x) = 3x + 2$, $g(x) = -x^2$, $h(x) = \frac{x-2}{5}$. Find the indicated value.

9. $f(g(-3)) = f(-9)$

$$g(-3) = -(-3)^2 = 3(-9) + 2$$

$$= -9 = -27 + 2$$

$$= -25 \text{ Ans.}$$

10. $h(f(9))$

$$f(9) = 3(9) + 2 = 29$$

$$h(29) = \frac{(29) - 2}{5}$$

$$= \frac{27}{5} \text{ Ans.}$$

11. $h(g(5))$

$$g(5) = -(5)^2 = -25$$

$$h(g(5)) = h(-25) = \frac{(-25) - 2}{5}$$

$$= -27/5 \text{ Ans.}$$

12. $h(h(-4))$

$$h(-4) = \frac{(-4) - 2}{5} = -6/5$$

$$h(h(-4)) = \frac{(-6/5) - 2}{5}$$

$$= -16/25 \text{ Ans.}$$

Let $f(x) = -x + 4$, $g(x) = x^2$, $h(x) = \frac{x}{4}$. Find the indicated value.

13. $f(g(x)) = -(x^2) + 4$

$$= -x^2 + 4 \text{ Ans.}$$

14. $h(g(x)) = \frac{(x^2)}{4}$

$$= \frac{x^2}{4} \text{ Ans.}$$

15. $g(h(x)) = \left(\frac{x}{4}\right)^2$

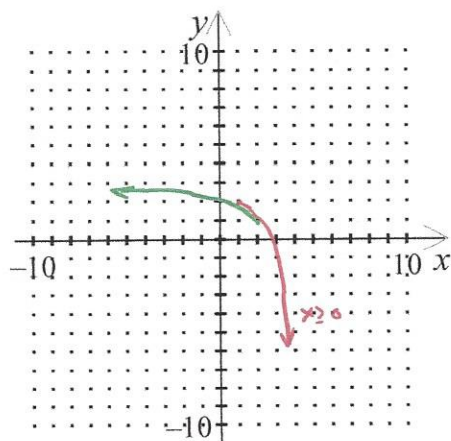
$$= \frac{x^2}{16}$$

16. $g(f(x)) = (-x + 4)^2$

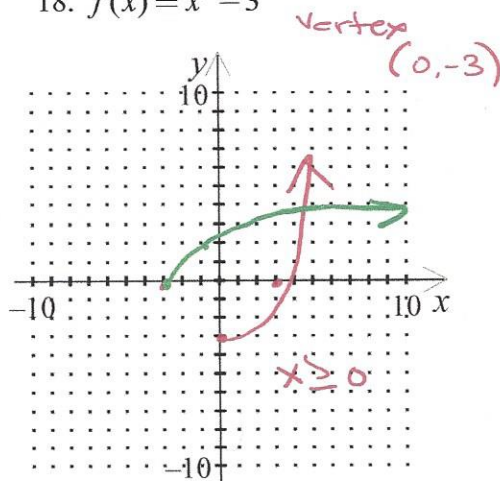
$$= x^2 - 16x + 16 \text{ Ans.}$$

Graph the equation and graph the inverse in a different color. Restrict the domain so that the inverse is a function. Find the domain and range of both the function and its inverse.

17. $f(x) = -\frac{1}{2}(x-1)^2 + 2$ vertex (1,2)



18. $f(x) = x^2 - 3$



Find the inverse algebraically.

19. $y = \frac{1}{3}x + 4$

$$y = 3(x - 4)$$

20. $y = 4x^2 + 9$

$$y = \pm \sqrt{\frac{x-9}{4}}$$

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

$$y = \sqrt[3]{x+4}$$

22. $y = -2x + 5$

$$y = \frac{x-5}{-2}$$

$$y = -\frac{x}{2} + \frac{5}{2}$$

23. $y = 5x - 12$

$$y = \frac{x+12}{5}$$

$$y = \frac{x}{5} + \frac{12}{5}$$

24. $f(x) = \frac{1}{2}x^4$

$$y = \sqrt[4]{2x}$$

Verify that f and g are inverse functions.

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

$$f(g(x)) = 2\left(\frac{1}{2}x - \frac{3}{2}\right) + 3$$

$$= x - 3 + 3$$

$$= x$$

yes! inverse

26. $f(x) = \frac{1}{5}x - 1, g(x) = 5x + 5$

$$f(g(x)) = \frac{1}{5}(5x + 5) - 1$$

$$= x + 1 - 1$$

$$= x$$

yes!

27. $f(x) = 5x^2 - 2, g(x) = \sqrt{\frac{x+2}{5}}$

$$f(g(x)) = 5\left(\sqrt{\frac{x+2}{5}}\right)^2 - 2$$

$$= 5\left(\frac{x+2}{5}\right) - 2$$

$$= x + 2 - 2$$

$$= x$$

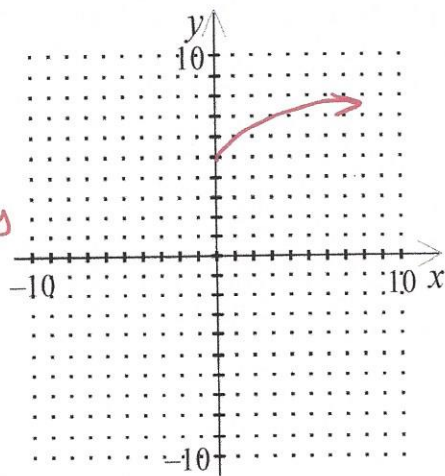
yes!

28. Graph: $f(x) = \frac{1}{2}\sqrt{x} + 5$
 $v(0, 5)$

Transformations:

$a = \frac{1}{2}$ vertical compression by $\frac{1}{2}$

$d = 5$ vertical shift up by 5



Domain: $x \geq 0$

Range: $y \geq 5$

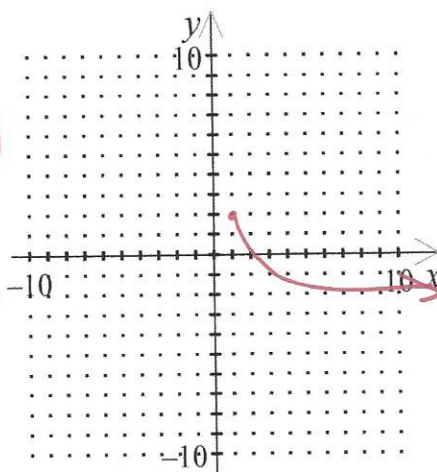
29. Graph: $f(x) = -\frac{1}{3}\sqrt{x-1} + 2$

$v(1, 2)$

Transformations:

$a = -\frac{1}{3}$ reflection over x-axis
 vertical compression by $\frac{1}{3}$

$c = 1$ right by 1
 $d = 2$ up by 2



Domain: $x \geq 1$

Range: $y \leq 2$

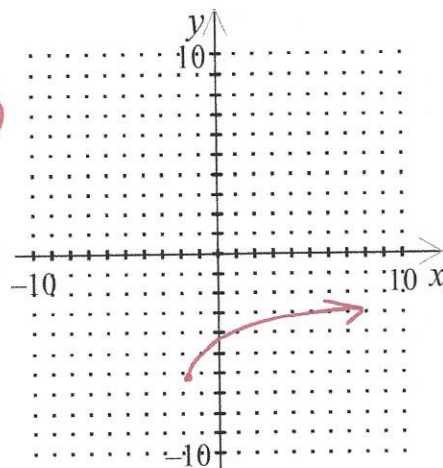
30. Graph: $f(x) = \sqrt{x+2} - 6$

$v(-2, -6)$

Transformations:

$c = -2$ left by 2

$d = -6$ down by 6

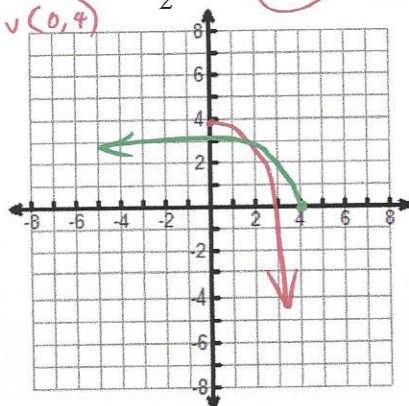


Domain: $x \geq -2$

Range: $y \geq -6$

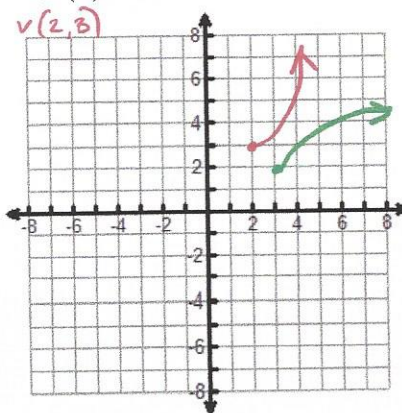
Graph $f(x)$ and $f^{-1}(x)$.

31. $f(x) = -\frac{1}{2}x^2 + 4; x \geq 0$ $\rightarrow$ right of zero
 $v(0, 4)$



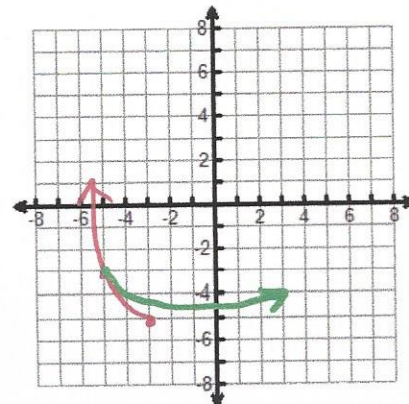
32. $f(x) = (x-2)^2 + 3; x \geq 2$

$v(2, 3)$



33. $f(x) = x^2 + 6x + 4; x \leq -3$

$x^2 + 6x + 9 + 4 - 9$
 $(x+3)^2 - 5$
 $v(-3, -5)$



Solve each equation. Be sure to check for extraneous solutions.

34. $x + \sqrt{x} - 2 = 0$

$$\begin{aligned} (\sqrt{x})^2 &= (2-x)^2 \\ x &= 4 - 4x + x^2 \\ -x & \quad -x \\ &= x^2 - 5x + 4 \\ &= (x-1)(x-4) \\ x=1 \quad | \quad x=4 \end{aligned}$$

36. $2(3x+4)^{\frac{1}{2}} + 1 = 15$

$$\begin{aligned} 2\sqrt{3x+4} + 1 &= 15 \\ 2\sqrt{3x+4} &= 14 \\ \sqrt{3x+4} &= 7 \\ (\sqrt{3x+4})^2 &= (7)^2 \\ 3x+4 &= 49 \\ -4 & \quad -4 \\ 3x &= 45 \\ x &= 15 \end{aligned}$$

38. $\sqrt{3a+5} - \sqrt{a-4} = 2$

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

$$\begin{aligned} \sqrt{x+3} - x &= 3 \\ (\sqrt{x+3})^2 &= (x+3)^2 \\ x+3 &= x^2 + 6x + 9 \\ -x-3 & \quad -x-3 \\ 0 &= x^2 + 5x + 6 \\ &= (x+2)(x+3) \\ x=-2 \quad | \quad x=-3 \end{aligned}$$

37. $(\sqrt{x^2+7x})^2 = (\sqrt{7x-9})^2$

$$\begin{aligned} x^2 + 7x &= 7x - 9 \\ x^2 &= -9 \\ x &= \sqrt{-9} \\ x &= \pm 3i \end{aligned}$$

39. $\sqrt{4x-7} = \sqrt{2x} + 1$

40. $\sqrt{x^2+1} - 2 = \sqrt{x^2-7}$

41. $\sqrt{k+9} - \sqrt{k} = \sqrt{3}$

$$\begin{aligned}
 38. \quad & \sqrt{3a+5} - \sqrt{a-4} = 2 \\
 & (\sqrt{3a+5})^2 = (\sqrt{a-4} + 2)^2 \\
 & \overset{2a}{3a+5} = \cancel{(a-4)} + 4\sqrt{a-4} + 4 \\
 & (2a+5)^2 = (4\sqrt{a-4})^2 \\
 & 4a^2 + 20a + 25 = 16(a-4) \\
 & 4a^2 + 20a + 25 = 16a - 64 \\
 & 4a^2 + 4a + 89 = 0 \\
 & a = \frac{-4 \pm \sqrt{4^2 - 4(4)(89)}}{2(4)} \\
 & a = \frac{-4 \pm \sqrt{1408}}{8} \quad \text{Ans?}
 \end{aligned}$$

$$\begin{aligned}
 40. \quad & (\sqrt{x^2+1} - 2)^2 = (\sqrt{x^2-7})^2 \\
 & \cancel{(x^2+1)} - 4\sqrt{x^2+1} + 4 = \cancel{x^2-7} \\
 & \frac{-4\sqrt{x^2+1}}{-4} = \frac{-12}{-4} \\
 & (\sqrt{x^2+1})^2 = (3)^2 \\
 & x^2 + 1 = 9 \\
 & \frac{-1}{-1} \quad \frac{-1}{-1} \\
 & x^2 = \pm\sqrt{8} \text{ or } \pm 2\sqrt{2} \\
 & \text{Ans?}
 \end{aligned}$$

$$\begin{aligned}
 39. \quad & (\sqrt{4x-7})^2 = (\sqrt{2x} + 1)^2 \\
 & \frac{4x-7}{-2x-1} = \frac{2x + 2\sqrt{2x} + 1}{-2x-1} \\
 & (2x-8)^2 = (2\sqrt{2x})^2 \\
 & \cancel{(x-4)}^2 = (\sqrt{2x})^2 \\
 & x^2 - 8x + 16 = 2x \\
 & x^2 - 10x + 16 = 0 \\
 & (x-8)(x-2) = 0 \\
 & \boxed{x=8} \mid x=2
 \end{aligned}$$

$$\begin{aligned}
 41. \quad & \sqrt{k+9} - \sqrt{k} = \sqrt{3} \\
 & (\sqrt{k+9})^2 = (\sqrt{3} + \sqrt{k})^2 \\
 & \cancel{k+9} = \cancel{3} + 2\sqrt{3k} + \cancel{k} \\
 & \frac{6}{2} = \frac{2\sqrt{3k}}{2} \\
 & (3)^2 = (\sqrt{3k})^2 \\
 & 9 = 3k \\
 & \boxed{3 = k} \\
 & 2\sqrt{3} - \sqrt{3} = \sqrt{3}
 \end{aligned}$$