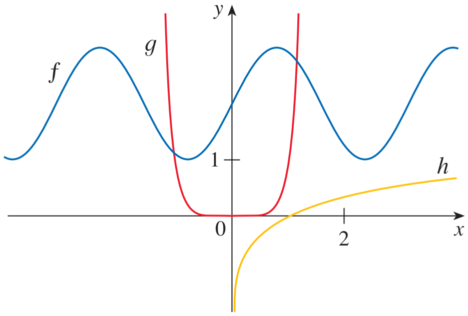
1.2 A CATALOG OF ESSENTIAL FUNCTIONS

A Click here for answers.

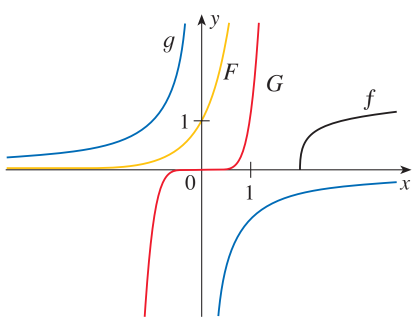
S Click here for solutions.

1–2 ▪ Match each equation with its graph. Explain your choices. (Don't use a computer or graphing calculator.)

1. (a) $y = x^8$ (b) $y = \log_8 x$ (c) $y = 2 + \sin 2x$



2. (a) $y = x^7$ (b) $y = 7^x$
(c) $y = -1/x$ (d) $y = \sqrt[4]{x - 2}$



3–18 ▪ Graph each function, not by plotting points, but by starting with the graph of one of the standard functions given in Section 1.2, and then applying the appropriate transformations.

3. $y = -1/x$

4. $y = 2 - \cos x$

5. $y = \tan 2x$

6. $y = \sqrt[3]{x + 2}$

7. $y = \cos(x/2)$

8. $y = x^2 + 2x + 3$

9. $y = \dfrac{1}{x - 3}$

10. $y = -2 \sin \pi x$

11. $y = \dfrac{1}{3} \sin\left(x - \dfrac{\pi}{6}\right)$

12. $y = 2 + \dfrac{1}{x + 1}$

13. $y = 1 + 2x - x^2$

14. $y = \frac{1}{2}\sqrt{x + 4} - 3$

15. $y = 2 - \sqrt{x + 1}$

16. $y = (x - 1)^3 + 2$

17. $y = \big||x| - 1\big|$

18. $y = |\cos x|$

19–25 ▪ Find the functions $f \circ g$, $g \circ f$, $f \circ f$, and $g \circ g$ and their domains.

19. $f(x) = \sqrt{x - 1}$, $g(x) = x^2$

20. $f(x) = 1/x$, $g(x) = x^3 + 2x$

21. $f(x) = \dfrac{1}{x - 1}$, $g(x) = \dfrac{x - 1}{x + 1}$

22. $f(x) = \sqrt{x^2 - 1}$, $g(x) = \sqrt{1 - x}$

23. $f(x) = \sqrt[3]{x}$, $g(x) = 1 - \sqrt{x}$

24. $f(x) = \dfrac{x + 2}{2x + 1}$, $g(x) = \dfrac{x}{x - 2}$

25. $f(x) = \dfrac{1}{\sqrt{x}}$ $g(x) = x^2 - 4x$

26–29 ▪ Find $f \circ g \circ h$.

26. $f(x) = x - 1$, $g(x) = \sqrt{x}$, $h(x) = x - 1$

27. $f(x) = \dfrac{1}{x}$, $g(x) = x^3$, $h(x) = x^2 + 2$

28. $f(x) = x^4 + 1$, $g(x) = x - 5$, $h(x) = \sqrt{x}$

29. $f(x) = \sqrt{x}$, $g(x) = \dfrac{x}{x - 1}$, $h(x) = \sqrt[3]{x}$

30–31 ▪ Express the function in the form $f \circ g$.

30. $F(x) = (x - 9)^5$

31. $u(t) = \tan \pi t$

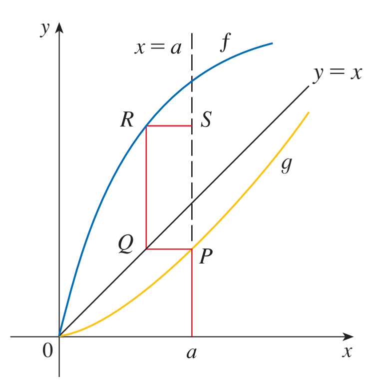
32. Suppose we are given the graphs of f and g, as in the figure, and we want to find the point on the graph of $h = f \circ g$ that corresponds to $x = a$. We start at the point $(a, 0)$ and draw a vertical line that intersects the graph of g at the point P. Then we draw a horizontal line from P to the point Q on the line $y = x$.

(a) What are the coordinates of P and of Q?

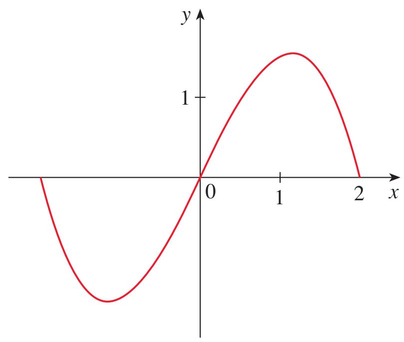
(b) If we now draw a vertical line from Q to the point R on the graph of f, what are the coordinates of R?

(c) If we now draw a horizontal line from R to the point S on the line $x = a$, show that S lies on the graph of h.

(d) By carrying out the construction of the path $PQRS$ for several values of a, sketch the graph of h.



33. If f is the function whose graph is shown, use the method of Problem 32 to sketch the graph of $f \circ f$. Start by using the construction for $a = 0, 0.5, 1, 1.5$, and 2. Sketch a rough graph for $0 \leqslant x \leqslant 2$. Then use the result of Exercise 66 in Section 1.2 to complete the graph.



1.2 ANSWERS

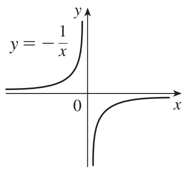
E Click here for exercises.

S Click here for solutions.

1. (a) g (b) h (c) f

2. (a) G (b) F (c) g (d) f

3.



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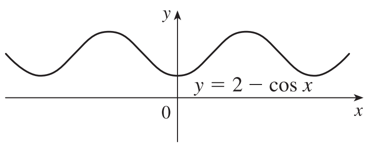

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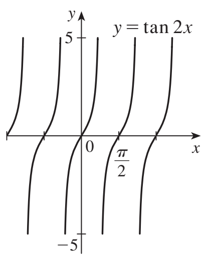

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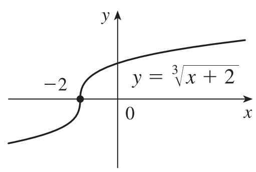

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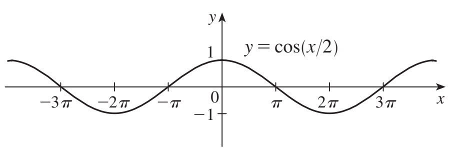

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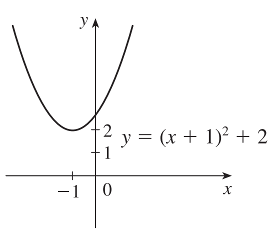

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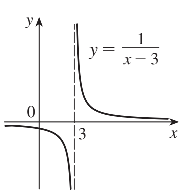

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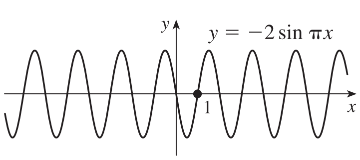

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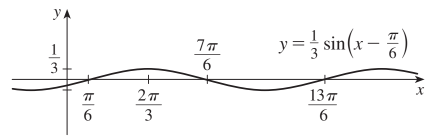

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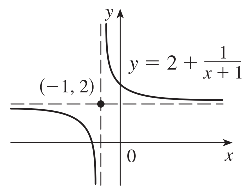

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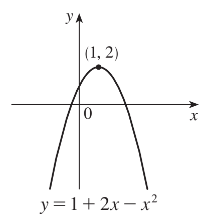

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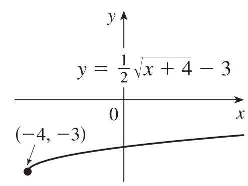

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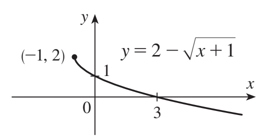

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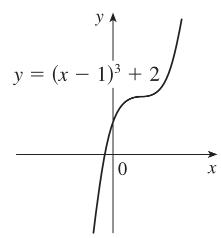

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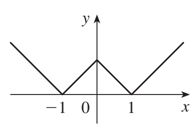

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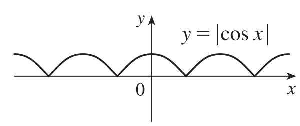


19. $(f \circ g)(x) = f(x^2) = \sqrt{x^2 - 1}$, $(-\infty, -1] \cup [1, \infty)$

$(g \circ f)(x) = x - 1$, $[1, \infty)$

$(f \circ f)(x) = \sqrt{\sqrt{x - 1} - 1}$, $[2, \infty)$

$(g \circ g)(x) = x^4$, $(-\infty, \infty)$

20. $(f \circ g)(x) = 1/(x^3 + 2x)$, $\{x \mid x \neq 0\}$

$(g \circ f)(x) = 1/x^3 + 2/x$, $\{x \mid x \neq 0\}$

$(f \circ f)(x) = x$, $\{x \mid x \neq 0\}$

$(g \circ g)(x) = x^9 + 6x^7 + 12x^5 + 10x^3 + 4x$, $(-\infty, \infty)$

21. $(f \circ g)(x) = \dfrac{-x-1}{2}$, $\{x \mid x \neq -1\}$

$(g \circ f)(x) = \dfrac{2-x}{x}$, $\{x \mid x \neq 0, 1\}$

$(f \circ f)(x) = \dfrac{x-1}{2-x}$, $\{x \mid x \neq 1, 2\}$

$(g \circ g)(x) = -\dfrac{1}{x}$, $\{x \mid x \neq 0, -1\}$

22. $(f \circ g)(x) = \sqrt{-x}$, $(-\infty, 0]$

$(g \circ f)(x) = \sqrt{1 - \sqrt{x^2 - 1}}$, $[-\sqrt{2}, -1] \cup [1, \sqrt{2}]$

$(f \circ f)(x) = \sqrt{x^2 - 2}$, $(-\infty, -\sqrt{2}] \cup [\sqrt{2}, \infty)$

$(g \circ g)(x) = \sqrt{1 - \sqrt{1 - x}}$, $[0, 1]$

23. $(f \circ g)(x) = \sqrt[3]{1 - \sqrt{x}}$, $[0, \infty)$

$(g \circ f)(x) = 1 - \sqrt[6]{x}$, $[0, \infty)$

$(f \circ f)(x) = \sqrt[9]{x}$, $(-\infty, \infty)$

$(g \circ g)(x) = 1 - \sqrt{1 - \sqrt{x}}$, $[0, 1]$

24. $(f \circ g)(x) = \dfrac{3x-4}{3x-2}$, $\{x \mid x \neq 2, \frac{2}{3}\}$

$(g \circ f)(x) = \dfrac{-x-2}{3x}$, $\{x \mid x \neq 0, -\frac{1}{2}\}$

$(f \circ f)(x) = \dfrac{5x+4}{4x+5}$, $\{x \mid x \neq -\frac{1}{2}, -\frac{5}{4}\}$

$(g \circ g)(x) = \dfrac{x}{4-x}$, $\{x \mid x \neq 2, 4\}$

25. $(f \circ g)(x) = 1/\sqrt{x^2 - 4x}$, $(-\infty, 0) \cup (4, \infty)$

$(g \circ f)(x) = \dfrac{1}{x} - \dfrac{4}{\sqrt{x}}$, $(0, \infty)$

$(f \circ f)(x) = x^{1/4}$, $(0, \infty)$

$(g \circ g)(x) = x^4 - 8x^3 + 12x^2 + 16x$, $(-\infty, \infty)$

26. $(f \circ g \circ h)(x) = \sqrt{x-1} - 1$

27. $(f \circ g \circ h)(x) = 1/(x^2 + 2)^3$

28. $(f \circ g \circ h)(x) = (\sqrt{x} - 5)^4 + 1$

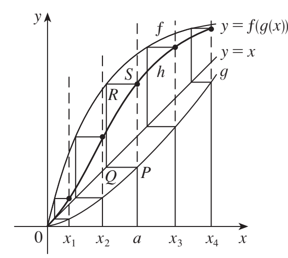
29. $(f \circ g \circ h)(x) = \sqrt{\dfrac{\sqrt[3]{x}}{\sqrt[3]{x} - 1}}$

30. $g(x) = x - 9$, $f(x) = x^5$

31. $g(t) = \pi t$, $f(t) = \tan t$

32. (a) $P(a, g(a))$, $Q(g(a), g(a))$ (b) $(g(a), f(g(a)))$

(d)



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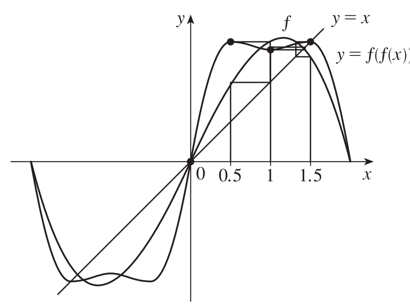


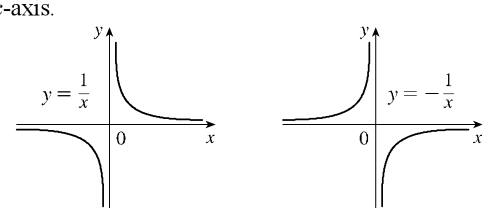
1.2 SOLUTIONS

E Click here for exercises.

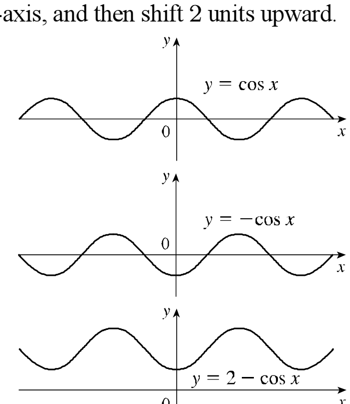
1. (a) The graph of $y = x^8$ must be the graph labelled g, because g is the graph of a power function of even degree, as shown in Figure 7.
   (b) The graph of $y = \log_8 x$ must be the graph labelled h, because h is a graph similar to the graphs of logarithmic functions shown in Figure 14.
   (c) The graph of $y = 2 + \sin 2x$ must be the graph labelled f, because f is the graph of a periodic function.

2. (a) The graph of $y = x^7$ must be the graph labelled G, because G passes through the origin.
   (b) The graph of $y = 7^x$ must be the graph labelled F, because F appears to be an exponential function with y-intercept 1, increasing, and horizontal asymptote $y = 0$.
   (c) The graph of $y = -1/x$ must be the graph labelled g, because g has a vertical asymptote at $x = 0$.
   (d) The graph of $y = \sqrt[4]{x-2}$ must be the graph labelled f, because f has domain $[2, \infty)$.

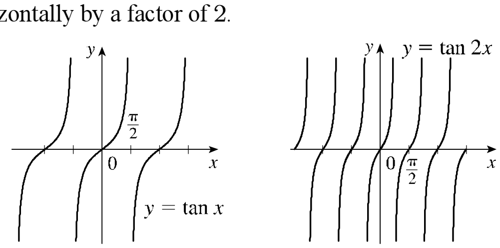
3. $y = -1/x$: Start with the graph of $y = 1/x$ and reflect about the x-axis.



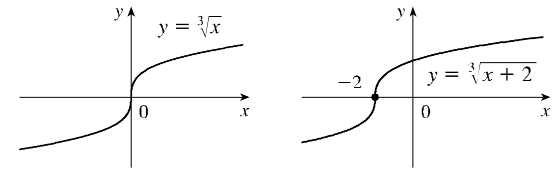
4. $y = 2 - \cos x$: Start with the graph of $y = \cos x$, reflect about the x-axis, and then shift 2 units upward.



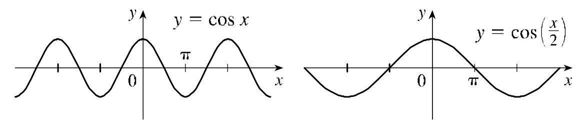
5. $y = \tan 2x$: Start with the graph of $y = \tan x$ and compress horizontally by a factor of 2.



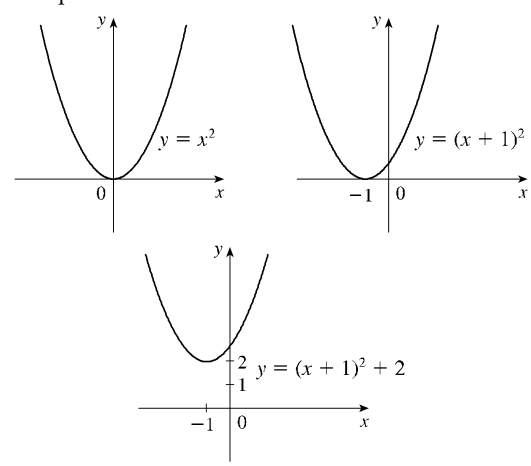
6. $y = \sqrt[3]{x+2}$: Start with the graph of $y = \sqrt[3]{x}$ and shift 2 units to the left.



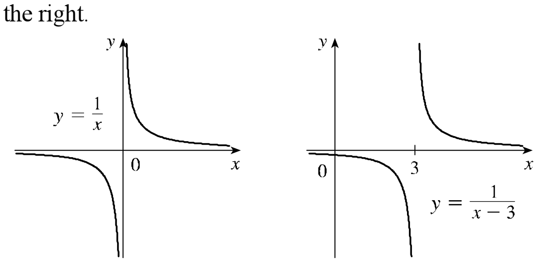
7. $y = \cos(x/2)$: Start with the graph of $y = \cos x$ and stretch horizontally by a factor of 2.



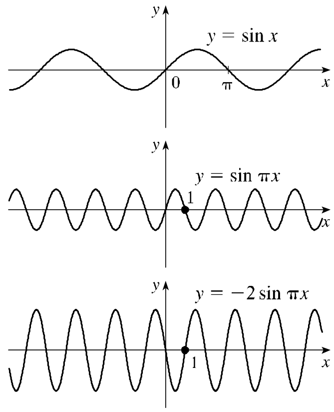
8. $y = x^2 + 2x + 3 = (x^2 + 2x + 1) + 2 = (x+1)^2 + 2$: Start with the graph of $y = x^2$, shift 1 unit left, and then shift 2 units upward.



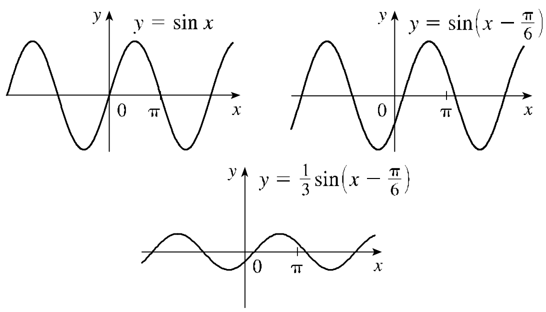
9. $y = \dfrac{1}{x-3}$: Start with the graph of $y = 1/x$ and shift 3 units to the right.



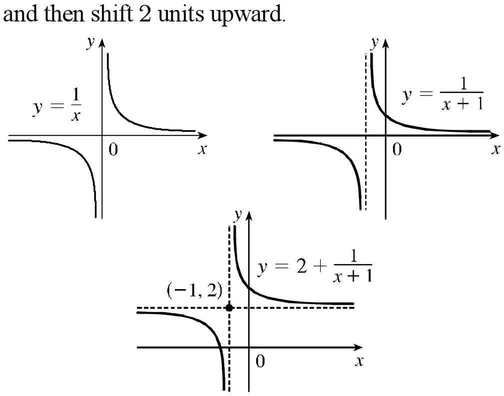
10. $y = -2\sin \pi x$: Start with the graph of $y = \sin x$, compress horizontally by a factor of π, stretch vertically by a factor of 2, and then reflect about the x-axis.



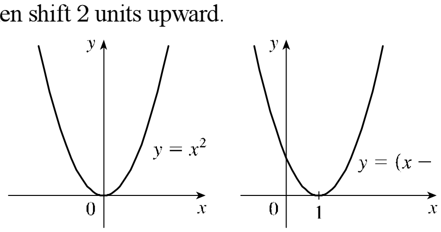
11. $y = \frac{1}{3}\sin\left(x - \frac{\pi}{6}\right)$: Start with the graph of $y = \sin x$, shift $\frac{\pi}{6}$ units to the right, and then compress vertically by a factor of 3.

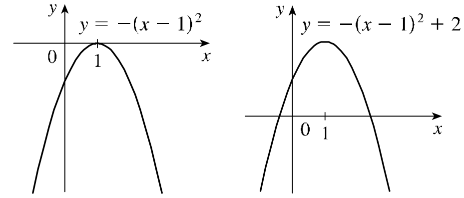


12. $y = 2 + \dfrac{1}{x+1}$: Start with the graph of $y = 1/x$, shift 1 unit left, and then shift 2 units upward.

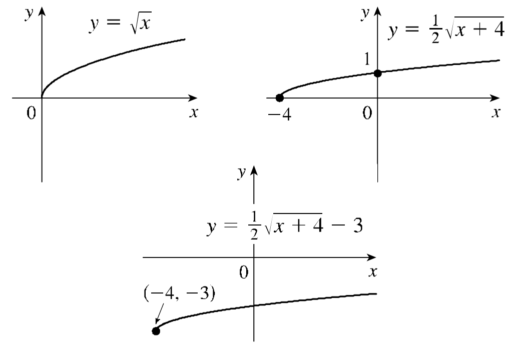


13. $y = 1 + 2x - x^2 = -x^2 + 2x + 1 = -\left(x^2 - 2x + 1\right) + 1 + 1 = -(x-1)^2 + 2$: Start with the graph of $y = x^2$, shift 1 unit right, reflect about the x-axis, and then shift 2 units upward.

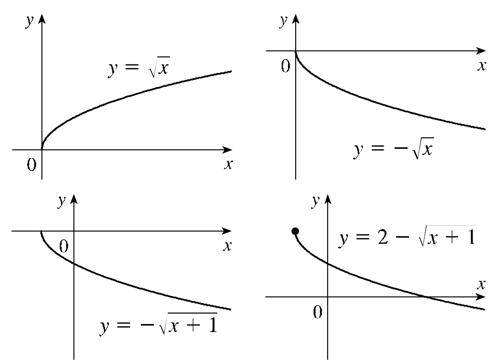




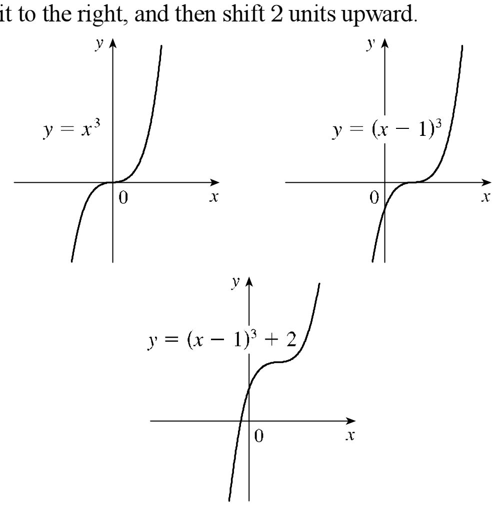
14. $y = \frac{1}{2}\sqrt{x+4} - 3$: Start with the graph of $y = \sqrt{x}$, shift 4 units to the left and compress vertically by a factor of 2, and then shift 3 units downward.



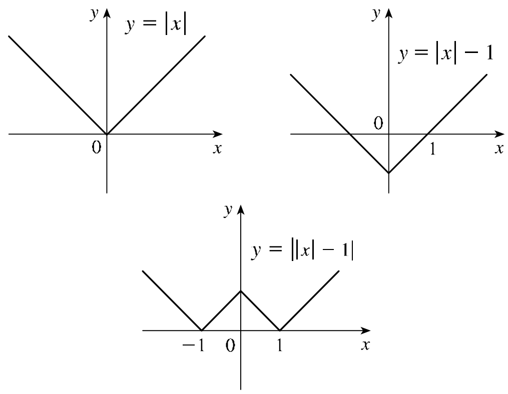
15. $y = 2 - \sqrt{x+1}$: Start with the graph of $y = \sqrt{x}$, reflect about the x-axis, shift 1 unit to the left, and then shift 2 units upward.



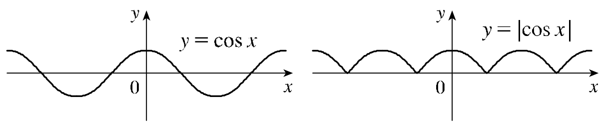
16. $y = (x-1)^3 + 2$: Start with the graph of $y = x^3$, shift 1 unit to the right, and then shift 2 units upward.



17. $y = ||x| - 1|$: Start with the graph of $y = |x|$, shift 1 unit downward, and then reflect the part of the graph from $x = -1$ to $x = 1$ about the x-axis.



18. $y = |\cos x|$: Start with the graph of $y = \cos x$ and reflect the parts of the graph that lie below the x-axis about the x-axis.



19. $f(x) = \sqrt{x-1}$, $D = [1, \infty)$; $g(x) = x^2$, $D = \mathbb{R}$.

$(f \circ g)(x) = f(g(x)) = f(x^2) = \sqrt{x^2 - 1}$,

$D = \{x \in \mathbb{R} \mid g(x) \in [1, \infty)\} = (-\infty, -1] \cup [1, \infty)$.

$$(g \circ f)(x) = g(f(x)) = g\left(\sqrt{x-1}\right) = \left(\sqrt{x-1}\right)^2 = x - 1,\ D = [1, \infty).$$

$(f \circ f)(x) = f(f(x)) = f\left(\sqrt{x-1}\right) = \sqrt{\sqrt{x-1} - 1}$,

$D = \left\{x \in [1, \infty) \mid \sqrt{x-1} \geq 1\right\} = [2, \infty)$.

$(g \circ g)(x) = g(g(x)) = g(x^2) = (x^2)^2 = x^4$, $D = \mathbb{R}$.

20. $f(x) = 1/x$, $D = \{x \mid x \neq 0\}$; $g(x) = x^3 + 2x$, $D = \mathbb{R}$.

$(f \circ g)(x) = f(g(x)) = f(x^3 + 2x) = 1/(x^3 + 2x)$,

$D = \left\{x \mid x^3 + 2x \neq 0\right\} = \{x \mid x \neq 0\}$.

$(g \circ f)(x) = g(f(x)) = g(1/x) = 1/x^3 + 2/x$,

$D = \{x \mid x \neq 0\}$.

$$(f \circ f)(x) = f(f(x)) = f(1/x) = \frac{1}{1/x} = x,$$

$D = \{x \mid x \neq 0\}$.

$$\begin{aligned}(g \circ g)(x) &= g(g(x)) = g(x^3 + 2x) \\ &= (x^3 + 2x)^3 + 2(x^3 + 2x) \\ &= x^9 + 6x^7 + 12x^5 + 10x^3 + 4x,\ D = \mathbb{R}.\end{aligned}$$

21. $f(x) = \dfrac{1}{x-1}$, $D = \{x \mid x \neq 1\}$; $g(x) = \dfrac{x-1}{x+1}$,

$D = \{x \mid x \neq -1\}$.

$$\begin{aligned}(f \circ g)(x) &= f\left(\frac{x-1}{x+1}\right) = \left(\frac{x-1}{x+1} - 1\right)^{-1} \\ &= \left(\frac{-2}{x+1}\right)^{-1} = \frac{-x-1}{2},\end{aligned}$$

$D = \{x \mid x \neq -1\}$.

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

$D = \{x \mid x \neq 0, 1\}$.

$$(f \circ f)(x) = f\left(\frac{1}{x-1}\right) = \frac{1}{1/(x-1) - 1} = \frac{x-1}{2-x},$$

$D = \{x \mid x \neq 1, 2\}$.

$$(g \circ g)(x) = g\left(\frac{x-1}{x+1}\right) = \frac{(x-1)/(x+1) - 1}{(x-1)/(x+1) + 1} = -\frac{1}{x},$$

$D = \{x \mid x \neq 0, -1\}$.

22. $f(x) = \sqrt{x^2 - 1}$, $D = (-\infty, -1] \cup [1, \infty)$;

$g(x) = \sqrt{1-x}$, $D = (-\infty, 1]$.

$$\begin{aligned}(f \circ g)(x) &= f(g(x)) = f\left(\sqrt{1-x}\right) \\ &= \sqrt{\left(\sqrt{1-x}\right)^2 - 1} = \sqrt{-x}.\end{aligned}$$

To find the domain of $(f \circ g)(x)$, we must find the values of x that are in the domain of g such that $g(x)$ is in the domain of f. In symbols, we have $D = \left\{x \in (-\infty, 1] \mid \sqrt{1-x} \in (-\infty, -1] \cup [1, \infty)\right\}$. First, we concentrate on the requirement that $\sqrt{1-x} \in (-\infty, -1] \cup [1, \infty)$. Because $\sqrt{1-x} \geq 0$, $\sqrt{1-x}$ is not in $(-\infty, -1]$. If $\sqrt{1-x}$ is in $[1, \infty)$, then we must have $\sqrt{1-x} \geq 1 \Rightarrow 1 - x \geq 1 \Rightarrow x \leq 0$. Combining the restrictions $x \leq 0$ and $x \in (-\infty, 1]$, we obtain $D = (-\infty, 0]$.

$(g \circ f)(x) = g(f(x)) = g\left(\sqrt{x^2 - 1}\right) = \sqrt{1 - \sqrt{x^2 - 1}}$,

$D = \left\{x \in (-\infty, -1] \cup [1, \infty) \mid \sqrt{x^2 - 1} \in (-\infty, 1]\right\}$.

Now $\sqrt{x^2 - 1} \leq 1 \Rightarrow x^2 - 1 \leq 1 \Rightarrow x^2 \leq 2 \Rightarrow |x| \leq \sqrt{2} \Rightarrow -\sqrt{2} \leq x \leq \sqrt{2}$. Combining this restriction with $x \in (-\infty, -1] \cup [1, \infty)$, we obtain $D = \left[-\sqrt{2}, -1\right] \cup \left[1, \sqrt{2}\right]$.

$$\begin{aligned}(f \circ f)(x) &= f(f(x)) = f\left(\sqrt{x^2 - 1}\right) \\ &= \sqrt{\left(\sqrt{x^2 - 1}\right)^2 - 1} = \sqrt{x^2 - 2},\end{aligned}$$

$D = \{x \in (-\infty, -1] \cup [1, \infty) \mid \sqrt{x^2 - 1} \in (-\infty, -1] \cup [1, \infty)\}$.

Now $\sqrt{x^2 - 1} \geq 1 \Rightarrow x^2 - 1 \geq 1 \Rightarrow x^2 \geq 2 \Rightarrow |x| \geq \sqrt{2} \Rightarrow x \geq \sqrt{2}$ or $x \leq -\sqrt{2}$. Combining this restriction with $x \in (-\infty, -1] \cup [1, \infty)$, we obtain $D = \left(-\infty, -\sqrt{2}\right] \cup \left[\sqrt{2}, \infty\right)$.

$(g \circ g)(x) = g(g(x)) = g\left(\sqrt{1-x}\right) = \sqrt{1 - \sqrt{1-x}}$,

$D = \left\{x \in (-\infty, 1] \mid \sqrt{1-x} \in (-\infty, 1]\right\}$. Now $\sqrt{1-x} \leq 1 \Rightarrow 1 - x \leq 1 \Rightarrow x \geq 0$. Combining this restriction with $x \in (-\infty, 1]$, we obtain $D = [0, 1]$.

23. $f(x) = \sqrt[3]{x}$, $D = \mathbb{R}$; $g(x) = 1 - \sqrt{x}$, $D = [0, \infty)$.
$(f \circ g)(x) = f(g(x)) = f(1 - \sqrt{x}) = \sqrt[3]{1 - \sqrt{x}}$,
$D = [0, \infty)$. $(g \circ f)(x) = g(f(x)) = g(\sqrt[3]{x}) = 1 - x^{1/6}$,
$D = [0, \infty)$.
$(f \circ f)(x) = f(f(x)) = f(\sqrt[3]{x}) = x^{1/9}$, $D = \mathbb{R}$.
$(g \circ g)(x) = g(g(x)) = g(1 - \sqrt{x}) = 1 - \sqrt{1 - \sqrt{x}}$,
$D = \{x \geq 0 \mid 1 - \sqrt{x} \geq 0\} = [0, 1]$.

24. $f(x) = \dfrac{x + 2}{2x + 1}$, $D = \{x \mid x \neq -\frac{1}{2}\}$; $g(x) = \dfrac{x}{x - 2}$,
$D = \{x \mid x \neq 2\}$.

$$(f \circ g)(x) = f(g(x)) = f\left(\frac{x}{x-2}\right) = \frac{x/(x-2) + 2}{2x/(x-2) + 1} = \frac{3x - 4}{3x - 2},\ D = \{x \mid x \neq 2, \tfrac{2}{3}\}.$$

$$(g \circ f)(x) = g(f(x)) = g\left(\frac{x+2}{2x+1}\right) = \frac{(x+2)/(2x+1)}{(x+2)/(2x+1) - 2} = \frac{-x - 2}{3x},\ D = \{x \mid x \neq 0, -\tfrac{1}{2}\}.$$

$$(f \circ f)(x) = f(f(x)) = f\left(\frac{x+2}{2x+1}\right) = \frac{(x+2)/(2x+1) + 2}{2(x+2)/(2x+1) + 1} = \frac{5x + 4}{4x + 5},\ D = \{x \mid x \neq -\tfrac{1}{2}, -\tfrac{5}{4}\}.$$

$$(g \circ g)(x) = g(g(x)) = g\left(\frac{x}{x-2}\right) = \frac{x/(x-2)}{x/(x-2) - 2} = \frac{x}{4 - x},\ D = \{x \mid x \neq 2, 4\}.$$

25. $f(x) = 1/\sqrt{x}$, $D = (0, \infty)$; $g(x) = x^2 - 4x$, $D = \mathbb{R}$.
$(f \circ g)(x) = f(g(x)) = f(x^2 - 4x) = 1/\sqrt{x^2 - 4x}$,
$D = \{x \mid x^2 - 4x > 0\} = (-\infty, 0) \cup (4, \infty)$.

$$(g \circ f)(x) = g(f(x)) = g\left(\frac{1}{\sqrt{x}}\right) = \frac{1}{x} - \frac{4}{\sqrt{x}},$$

$D = (0, \infty)$.

$$(f \circ f)(x) = f(f(x)) = f\left(\frac{1}{\sqrt{x}}\right) = \frac{1}{\sqrt{1/\sqrt{x}}} = x^{1/4},$$

$D = (0, \infty)$.

$$(g \circ g)(x) = g(g(x)) = g(x^2 - 4x) = (x^2 - 4x)^2 - 4(x^2 - 4x) = x^4 - 8x^3 + 12x^2 + 16x,\ D = \mathbb{R}.$$

26. $(f \circ g \circ h)(x) = f(g(h(x))) = f(g(x - 1)) = f(\sqrt{x - 1}) = \sqrt{x - 1} - 1$

27. $(f \circ g \circ h)(x) = f(g(h(x))) = f(g(x^2 + 2)) = f\left((x^2 + 2)^3\right) = 1 \big/ (x^2 + 2)^3$

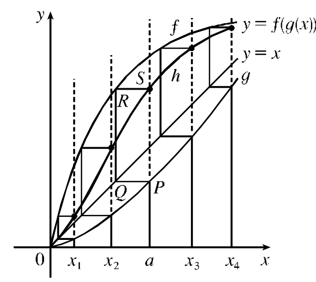
28. $(f \circ g \circ h)(x) = f(g(h(x))) = f(g(\sqrt{x})) = f(\sqrt{x} - 5) = (\sqrt{x} - 5)^4 + 1$

29. $(f \circ g \circ h)(x) = f(g(h(x))) = f(g(\sqrt[3]{x})) = f\left(\dfrac{\sqrt[3]{x}}{\sqrt[3]{x} - 1}\right) = \sqrt{\dfrac{\sqrt[3]{x}}{\sqrt[3]{x} - 1}}$

30. Let $g(x) = x - 9$ and $f(x) = x^5$. Then $(f \circ g)(x) = (x - 9)^5 = F(x)$.

31. Let $g(t) = \pi t$ and $f(t) = \tan t$. Then $(f \circ g)(t) = \tan \pi t = u(t)$.

32. (a) $P = (a, g(a))$ and $Q = (g(a), g(a))$ because Q has the same y-value as P and it is on the line $y = x$.
(b) The x-value of Q is $g(a)$; this is also the x-value of R. The y-value of R is therefore f (x-value), that is, $f(g(a))$. Hence, $R = (g(a), f(g(a)))$.
(c) The coordinates of S are $(a, f(g(a)))$ or, equivalently, $(a, h(a))$.
(d)



33. We need to plot points only for the first quadrant since we can see that f is an odd function, and we then know that $f \circ f$ is an odd function, and hence, symmetric with respect to the origin.

x	0	0.5	1	1.5	2
$f(x)$	0	1	1.5	1.4	0
$f(f(x))$	0	1.5	1.4	1.5	0