

## SKILLS WARM UP 1.5

The following warm-up exercises involve skills that were covered in a previous course or in earlier sections. You will use these skills in the exercise set for this section. For additional help, review Appendix A.3 and Section 1.4.

In Exercises 1–4, simplify the expression by factoring.

1.  $\frac{2x^3 + x^2}{6x}$

2.  $\frac{x^5 + 9x^4}{x^2}$

3.  $\frac{x^2 - 3x - 28}{x - 7}$

4.  $\frac{x^2 + 11x + 30}{x + 5}$

In Exercises 5–8, evaluate the expression and simplify.

5.  $f(x) = x^2 - 3x + 3$

(a)  $f(-1)$  (b)  $f(c)$  (c)  $f(x + h)$

6.  $f(x) = \begin{cases} 2x - 2, & x < 1 \\ 3x + 1, & x \geq 1 \end{cases}$

(a)  $f(-\frac{1}{2})$  (b)  $f(1)$  (c)  $f(t^2 + 1)$

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

8.  $f(x) = 4x$   $\frac{f(2+h) - f(2)}{h}$

In Exercises 9–12, find the domain and range of the function and sketch its graph.

9.  $h(x) = -\frac{5}{x}$

10.  $g(x) = \sqrt{25 - x^2}$

11.  $f(x) = |x - 3|$

12.  $f(x) = \frac{2|x|}{x}$

In Exercises 13 and 14, determine whether  $y$  is a function of  $x$ .

13.  $9x^2 + 4y^2 = 49$

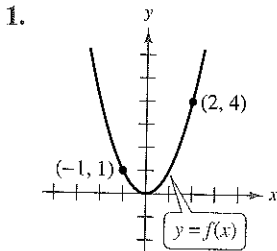
14.  $2x^2y + 8x = 7y$

## Exercises 1.5

See [CalcChat.com](http://CalcChat.com) for tutorial help and worked-out solutions to odd-numbered exercises.

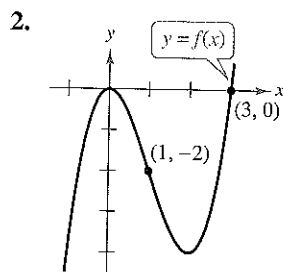


**Finding Limits Graphically** In Exercises 1–4, use the graph to find the limit. See Examples 1 and 2.



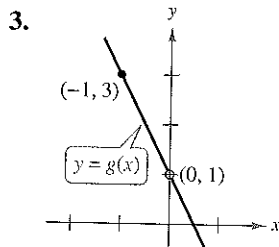
(a)  $\lim_{x \rightarrow 2} f(x)$

(b)  $\lim_{x \rightarrow -1} f(x)$



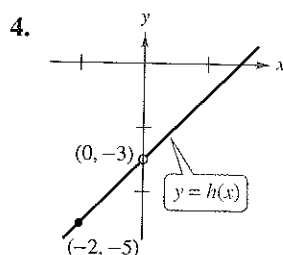
(a)  $\lim_{x \rightarrow 1} f(x)$

(b)  $\lim_{x \rightarrow 3} f(x)$



(a)  $\lim_{x \rightarrow 0} g(x)$

(b)  $\lim_{x \rightarrow -1} g(x)$



(a)  $\lim_{x \rightarrow -2} h(x)$

(b)  $\lim_{x \rightarrow 0} h(x)$



**Finding Limits Numerically** In Exercises 5–12, complete the table and use the result to estimate the limit. Use a graphing utility to graph the function to confirm your result. See Examples 1 and 2.

5.  $\lim_{x \rightarrow 6} \frac{2x + 3}{5}$

$x$	5.9	5.99	5.999	6	6.001	6.01	6.1
$f(x)$				?			

6.  $\lim_{x \rightarrow 1} (x^2 - 4x - 1)$

$x$	0.9	0.99	0.999	1	1.001	1.01	1.1
$f(x)$				?			

7.  $\lim_{x \rightarrow 4} \frac{x - 4}{x^2 - 5x + 4}$

$x$	3.9	3.99	3.999	4	4.001	4.01	4.1
$f(x)$				?			

8.  $\lim_{x \rightarrow 2} \frac{x-2}{x^2-4}$

$x$	1.9	1.99	1.999	2	2.001	2.01	2.1
$f(x)$				?			

9.  $\lim_{x \rightarrow 0} \frac{\sqrt{x+16}-4}{x}$

$x$	-0.1	-0.01	-0.001	0	0.001	0.01	0.1
$f(x)$				?			

10.  $\lim_{x \rightarrow 0} \frac{\sqrt{x+2}-\sqrt{2}}{x}$

$x$	-0.1	-0.01	-0.001	0	0.001	0.01	0.1
$f(x)$				?			

11.  $\lim_{x \rightarrow -4} \frac{1}{x+4} - \frac{1}{4}$

$x$	-4.1	-4.01	-4.001	-4	-3.999	-3.99	-3.9
$f(x)$				?			

12.  $\lim_{x \rightarrow -2} \frac{1}{2} - \frac{1}{x+2}$

$x$	-2.1	-2.01	-2.001	-2	-1.999	-1.99	-1.9
$f(x)$				?			

 **Evaluating Basic Limits** In Exercises 13–20, find the limit. See Example 3.

13.  $\lim_{x \rightarrow 3} 6$

14.  $\lim_{x \rightarrow 5} 4$

15.  $\lim_{x \rightarrow -2} x$


16.  $\lim_{x \rightarrow 10} x$

17.  $\lim_{x \rightarrow 7} x^2$

18.  $\lim_{x \rightarrow 3} x^3$

19.  $\lim_{x \rightarrow 36} \sqrt{x}$

20.  $\lim_{x \rightarrow -1} \sqrt[3]{x}$

 **Operations with Limits** In Exercises 21 and 22, find the limit of (a)  $f(x) + g(x)$ , (b)  $f(x)g(x)$ , and (c)  $f(x)/g(x)$ , as  $x$  approaches  $c$ .

21.  $\lim_{x \rightarrow c} f(x) = 3$

22.  $\lim_{x \rightarrow c} f(x) = \frac{3}{2}$

$\lim_{x \rightarrow c} g(x) = 9$

$\lim_{x \rightarrow c} g(x) = \frac{1}{2}$



**Operations with Limits** In Exercises 23 and 24, find the limit of (a)  $\sqrt{f(x)}$ , (b)  $3f(x)$ , and (c)  $[f(x)]^2$ , as  $x$  approaches  $c$ .

23.  $\lim_{x \rightarrow c} f(x) = 16$

24.  $\lim_{x \rightarrow c} f(x) = 9$



**Using Properties of Limits** In Exercises 25–36, find the limit using direct substitution. See Examples 3 and 4.

25.  $\lim_{x \rightarrow -3} (2x + 5)$

26.  $\lim_{x \rightarrow -4} (4x + 3)$

27.  $\lim_{x \rightarrow 1} (1 - x^2)$

28.  $\lim_{x \rightarrow 2} (-x^2 + x - 2)$

29.  $\lim_{x \rightarrow 3} \sqrt{x+6}$

30.  $\lim_{x \rightarrow 5} \sqrt[3]{x-5}$

31.  $\lim_{x \rightarrow -3} \frac{2}{x+2}$

32.  $\lim_{x \rightarrow -2} \frac{3x+1}{2-x}$

33.  $\lim_{x \rightarrow -2} \frac{x^2-1}{2x}$

34.  $\lim_{x \rightarrow -8} \frac{3x}{x+2}$

35.  $\lim_{x \rightarrow 5} \frac{\sqrt{x+11}+6}{x}$

36.  $\lim_{x \rightarrow 12} \frac{\sqrt{x-3}-2}{x}$



**Finding Limits** In Exercises 37–58, find the limit (if it exists). See Examples 5, 6, 7, 9, and 11.

37.  $\lim_{x \rightarrow -3} \frac{x^2-9}{x+3}$

38.  $\lim_{x \rightarrow -1} \frac{2x^2-x-3}{x+1}$

39.  $\lim_{x \rightarrow 2} \frac{x^2+3x-10}{x^2-4}$

40.  $\lim_{t \rightarrow 1} \frac{t^2+t-2}{t^2-1}$

41.  $\lim_{x \rightarrow -2} \frac{x^3+8}{x+2}$

42.  $\lim_{x \rightarrow -3} \frac{x^3+27}{x+3}$

43.  $\lim_{\Delta x \rightarrow 0} \frac{2(x+\Delta x)-2x}{\Delta x}$

44.  $\lim_{\Delta x \rightarrow 0} \frac{-3(x+\Delta x)+3x}{\Delta x}$

45.  $\lim_{\Delta t \rightarrow 0} \frac{(t+\Delta t)^2-5(t+\Delta t)-(t^2-5t)}{\Delta t}$

46.  $\lim_{\Delta t \rightarrow 0} \frac{(t+\Delta t)^2-4(t+\Delta t)+2-(t^2-4t+2)}{\Delta t}$

47.  $\lim_{x \rightarrow 4} \frac{\sqrt{x+5}-3}{x-4}$

48.  $\lim_{x \rightarrow 3} \frac{\sqrt{x+1}-2}{x-3}$

49.  $\lim_{x \rightarrow 0} \frac{\sqrt{x+5}-\sqrt{5}}{x}$

50.  $\lim_{x \rightarrow 0} \frac{\sqrt{x+2}-\sqrt{2}}{x}$

51.  $\lim_{x \rightarrow 2} f(x)$ , where  $f(x) = \begin{cases} 4-x, & x \neq 2 \\ 0, & x = 2 \end{cases}$

52.  $\lim_{x \rightarrow 1} f(x)$ , where  $f(x) = \begin{cases} x^2+2, & x \neq 1 \\ 1, & x = 1 \end{cases}$

53.  $\lim_{x \rightarrow 3} f(x)$ , where  $f(x) = \begin{cases} \frac{1}{3}x-5, & x \leq 3 \\ -3x+7, & x > 3 \end{cases}$

54.  $\lim_{s \rightarrow 4} f(s)$ , where  $f(s) = \begin{cases} 3s-4, & s \leq 4 \\ 5-\frac{1}{2}s, & s > 4 \end{cases}$