In Exercises 1–4, an object dropped from rest from the top of a tall building falls $y = 16t^2$ feet in the first t seconds.

1. Find the average speed during the first 3 seconds of fall. 48 ft/sec
2. Find the average speed during the first 4 seconds of fall. 64 ft/sec
3. Find the speed of the object at $t = 3$ seconds and confirm your answer algebraically. 96 ft/sec
4. Find the speed of the object at $t = 4$ seconds and confirm your answer algebraically. 128 ft/sec

In Exercises 5 and 6, use $\lim_{x\to c} k = k$, $\lim_{x\to c} x = c$, and the properties of limits to find the limit.

5. $\lim_{x\to c} (2x^3 - 3x^2 + x - 1)$ $2c^3 - 3c^2 + c - 1$

6. $\lim_{x\to c} \dfrac{x^4 - x^3 + 1}{x^2 + 9}$ $\dfrac{c^4 - c^3 + 1}{c^2 + 9}$

In Exercises 7–14, determine the limit by substitution. Support graphically.

7. $\lim_{x\to -1/2} 3x^2(2x - 1)$ $-\frac{3}{2}$

8. $\lim_{x\to -4} (x + 3)^{1998}$ 1

9. $\lim_{x\to 1} (x^3 + 3x^2 - 2x - 17)$ -15

10. $\lim_{y\to 2} \dfrac{y^2 + 5y + 6}{y + 2}$ 5

11. $\lim_{y\to -3} \dfrac{y^2 + 4y + 3}{y^2 - 3}$ 0

12. $\lim_{x\to 1/2} \operatorname{int} x$ 0

13. $\lim_{x\to -2} (x - 6)^{2/3}$ 4

14. $\lim_{x\to 2} \sqrt{x + 3}$ $\sqrt{5}$

In Exercises 15–20, complete the following tables and state what you believe $\lim_{x\to 0} f(x)$ to be.

(a)

x	-0.1	-0.01	-0.001	-0.0001	...
$f(x)$	?	?	?	?	

(b)

x	0.1	0.01	0.001	0.0001	...
$f(x)$	?	?	?	?	

15. $f(x) = \dfrac{x^2 + 6x + 2}{x + 1}$

16. $f(x) = \dfrac{x^2 - x}{x}$

17. $f(x) = x \sin \dfrac{1}{x}$

18. $f(x) = \sin \dfrac{1}{x}$

19. $f(x) = \dfrac{10^x - 1}{x}$

20. $f(x) = x \sin(\ln |x|)$

In Exercises 21–24, explain why you cannot use substitution to determine the limit. Find the limit if it exists.

21. $\lim_{x\to -2} \sqrt{x - 2}$ Expression not defined at $x = -2$. There is no limit.

22. $\lim_{x\to 0} \dfrac{1}{x^2}$ Expression not defined at $x = 0$. There is no limit.

23. $\lim_{x\to 0} \dfrac{|x|}{x}$ Expression not defined at $x = 0$. There is no limit.

24. $\lim_{x\to 0} \dfrac{(4 + x)^2 - 16}{x}$ Expression not defined at $x = 0$. Limit = 8

In Exercises 25–34, determine the limit graphically. Confirm algebraically.

25. $\lim_{x\to 1} \dfrac{x - 1}{x^2 - 1}$ $\frac{1}{2}$

26. $\lim_{t\to 2} \dfrac{t^2 - 3t + 2}{t^2 - 4}$ $\frac{1}{4}$

27. $\lim_{x\to 0} \dfrac{5x^3 + 8x^2}{3x^4 - 16x^2}$ $-\frac{1}{2}$

28. $\lim_{x\to 0} \dfrac{\frac{1}{2 + x} - \frac{1}{2}}{x}$ $-\frac{1}{4}$

29. $\lim_{x\to 0} \dfrac{(2 + x)^3 - 8}{x}$ 12

30. $\lim_{x\to 0} \dfrac{\sin 2x}{x}$ 2

31. $\lim_{x\to 0} \dfrac{\sin x}{2x^2 - x}$ -1

32. $\lim_{x\to 0} \dfrac{x + \sin x}{x}$ 2

33. $\lim_{x\to 0} \dfrac{\sin^2 x}{x}$ 0

34. $\lim_{x\to 5} \dfrac{x^3 - 125}{x - 5}$ 75

In Exercises 35 and 36, use a graph to show that the limit does not exist.

35. $\lim_{x\to 1} \dfrac{x^2 - 4}{x - 1}$

36. $\lim_{x\to 2} \dfrac{x + 1}{x^2 - 4}$

In Exercises 37–42, determine the limit.

37. $\lim_{x\to 0^+} \operatorname{int} x$ 0

38. $\lim_{x\to 0^-} \operatorname{int} x$ -1

35. Answers will vary. One possible graph is given by the window $[-4.7, 4.7]$ by $[-15, 15]$ with Xscl = 1 and Yscl = 5.
36. Answers will vary. One possible graph is given by the window $[-4.7, 4.7]$ by $[-15, 15]$ with Xscl = 1 and Yscl = 5.