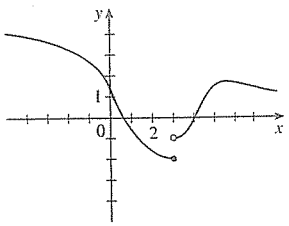
Exercises 2.5 □ page 131

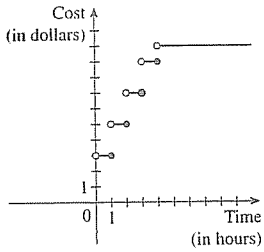
1. $\lim_{x\to 4} f(x) = f(4)$

3. (a) -5 (jump), -3 (infinite), -1 (undefined), 3 (removable), 5 (infinite), 8 (jump), 10 (undefined)
(b) -5, left; -3, left; -1, neither; 3, neither; 5, neither; 8, right; 10, neither

5.



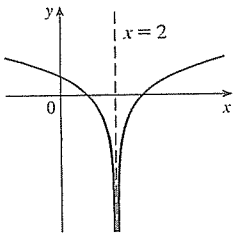
7. (a)



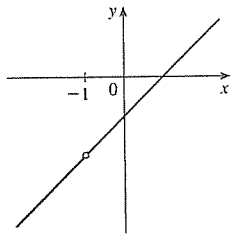
(b) Discontinuous at $t = 1, 2, 3, 4$

9. 6

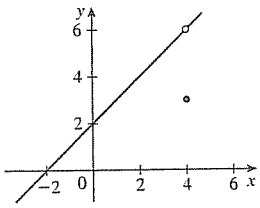
15. $f(2)$ is not defined



17. $f(-1)$ is not defined



19. $\lim_{x\to 4} f(x) \neq f(4)$



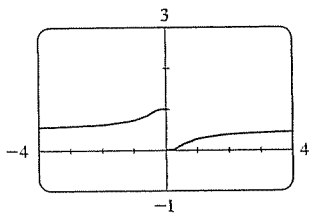
21. $\{x \mid x \neq -3, -2\}$

23. $\mathbb{R}$

25. $\mathbb{R}$

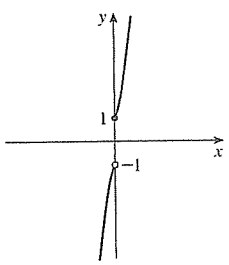
27. $(-\infty, -1) \cup (1, \infty)$

29. $x = 0$



31. $\frac{7}{3}$ 33. 1

37. 0, continuous from the right



39. $\frac{1}{3}$

41. (a) $g(x) = x - 4$
(c) $g(x) = x^2 - 4x + 16$
(d) $g(x) = 1/(3 + \sqrt{x})$

47. (b) (0.44, 0.45)

51. (b) 1.434

57. None

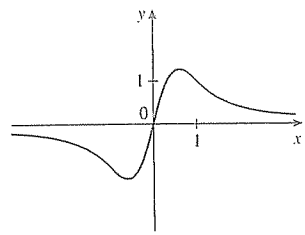
59. Yes

Exercises 2.6 □ page 144

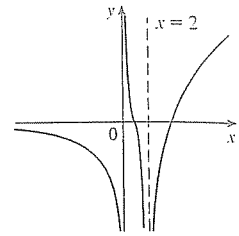
1. (a) As x becomes large, $f(x)$ approaches 5.
(b) As x becomes large negative, $f(x)$ approaches 3.

3. (a) ∞ (b) ∞ (c) $-\infty$ (d) 1 (e) 2
(f) $x = -1, x = 2, y = 1, y = 2$

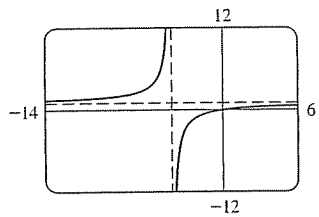
5.

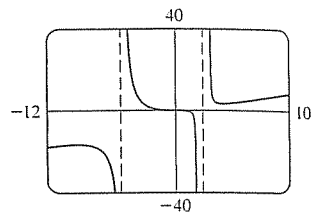


7.

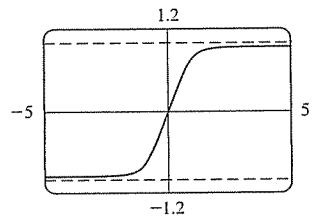


9. 0 11. 0 13. $\frac{1}{6}$ 15. 0 17. 2 19. -1
21. 0 23. $\frac{1}{6}$ 25. ∞ 27. ∞ 29. $-\infty$ 31. ∞
33. (a) and (b) $-\frac{1}{2}$
35. $y = 1, x = -4$ 37. $x = 2, x = -5$

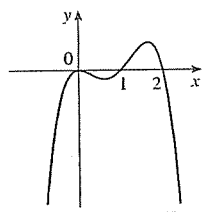




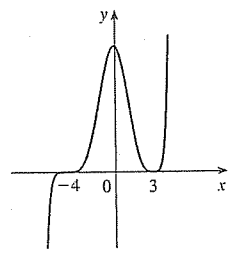
39. $y = \pm 1$



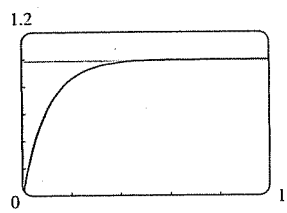
41. $(2 - x)/[x^2(x - 3)]$
43. $-\infty, -\infty$



45. $\infty, -\infty$



47. 0 49. (a) 0 (b) ∞ or $-\infty$ 51. 4
53. (a) v^*
(b) ≈ 0.47 s



55. $N \geq 13$ 57. $N \leq -6, N \leq -22$ 59. (a) $x > 100$

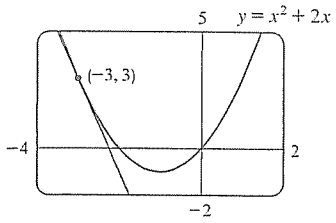
Exercises 2.7 □ page 154

1. (a) $\dfrac{f(x) - f(3)}{x - 3}$ (b) $\lim_{x\to 3} \dfrac{f(x) - f(3)}{x - 3}$

3. Slopes at D, E, C, A, B

5. (a) (i) -4 (ii) -4 (b) $y = -4x - 9$

(c)

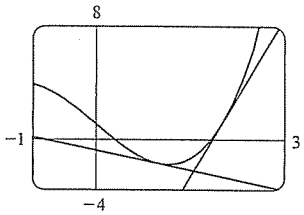


7. $y = 10x + 13$ 9. $y = \frac{1}{4}x + \frac{3}{4}$

11. (a) $-2/(a+3)^2$ (b) (i) $-\frac{1}{2}$ (ii) $-\frac{2}{9}$ (iii) $-\frac{1}{8}$

13. (a) $3a^2 - 4$ (b) $y = -x - 1, y = 8x - 15$

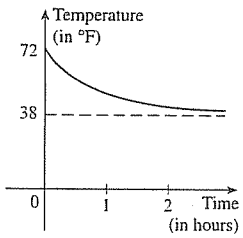
(c)



15. (a) 0 (b) C (c) Speeding up, slowing down, neither (d) The car stopped.

17. −24 ft/s 19. $12a^2 + 6$, 18 m/s, 54 m/s, 114 m/s

21.



Greater (in magnitude)

23. (a) (i) −1.2 °C/h (ii) −1.25 °C/h (iii) −1.3 °C/h (b) −1.9 °C/h

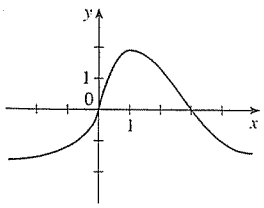
25. (a) (i) \$20.25/unit (ii) \$20.05/unit (b) \$20/unit

Exercises 2.8 □ page 161

1. The line from $(2, f(2))$ to $(2 + h, f(2 + h))$

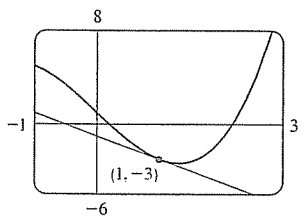
3. $g'(0), 0, g'(4), g'(2), g'(-2)$

5.



7. 7; $y = 7x - 12$

9. (a) -2; $y = -2x - 1$ (b)



11. 3.296 13. $1 - 4a$ 15. $-1/(2a - 1)^2$

17. $1/(3 - a)^{3/2}$ 19. $f(x) = \sqrt{x}, a = 1$

21. $f(x) = x^9, a = 1$ 23. $f(x) = \sin x, a = \pi/2$

25. −2 m/s

27. (a) The rate at which the cost is changing per ounce of gold produced; dollars per ounce

(b) When the 800th ounce of gold is produced, the cost of production is \$17/oz.

(c) Decrease in the short term; increase in the long term

29. (a) The rate at which the fuel consumption is changing with respect to speed; (gal/h)/(mi/h)

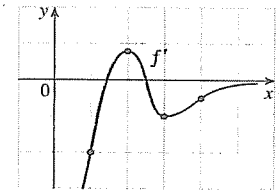
(b) The fuel consumption is decreasing by 0.05 (gal/h)/(mi/h) as the car's speed reaches 20 mi/h.

31. The rate at which the cash per capita in circulation is changing in dollars per year; \$39.90/yr

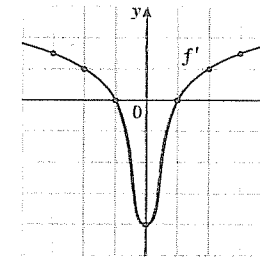
33. Does not exist

Exercises 2.9 □ page 171

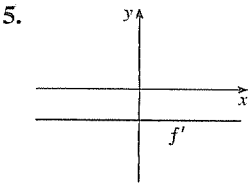
1. (a) −2 (b) 0.8 (c) −1 (d) −0.5



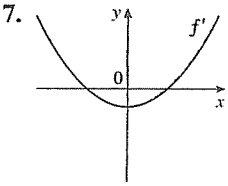
3. (a) 2 (b) 1 (c) 0 (d) −3 (e) 0 (f) 1 (g) 2



5.



7.



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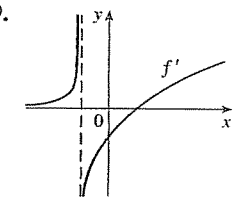
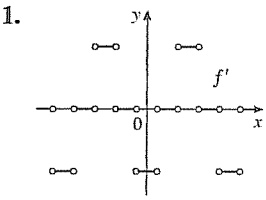
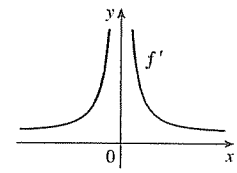


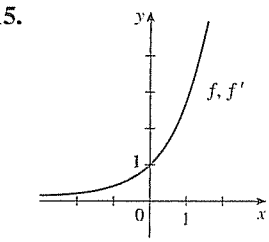
11.



13.



15.



$f'(x) = e^x$

17. (a) 0, 1, 2, 4 (b) −1, −2, −4 (c) $f'(x) = 2x$

19. $f'(x) = 5, \mathbb{R}, \mathbb{R}$ 21. $f'(x) = 3x^2 - 2x + 2, \mathbb{R}, \mathbb{R}$

23. $g'(x) = 1/\sqrt{1 + 2x}, \left[-\frac{1}{2}, \infty\right), \left(-\frac{1}{2}, \infty\right)$

25. $G'(x) = -10/(2 + x)^2, \{x \mid x \neq -2\}, \{x \mid x \neq -2\}$

27. $f'(x) = 4x^3, \mathbb{R}, \mathbb{R}$ 29. (a) $f'(x) = 1 + 2/x^2$

31. (a) The rate at which the unemployment rate is changing, in percent unemployed per year

(b)

t	$U'(t)$	t	$U'(t)$
1988	−0.20	1993	−0.70
1989	0.05	1994	−0.65
1990	0.75	1995	−0.35
1991	0.95	1996	−0.35
1992	0.05	1997	−0.50