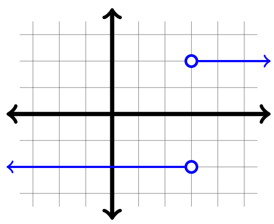
Solutions:

1. $f(x) = \begin{cases} -2 & x < 3 \\ 2 & x > 3 \end{cases}$



   (a) -2 (b) 2 (c) DNE

2. (a) 2 (b) $\frac{1}{2}$ (c) $+\infty$ (d) -1

   $x = -1$: removable, $x = 0$: removable, $x = 1$: infinite

   vertical asymptote: $x = 1$, horizontal asymptote: $y = -1$

3. 1) 0 2) $-\frac{2}{3}$ 3) $x = \ln \frac{1}{3}$; $y = 0$ and $y = -\frac{2}{3}$

4. B or D

5. (a) $(-\infty, -2) \cup 0) \cup (0, 3) \cup (3, 4) \cup (4, \infty)$

   (b) 0

   (c) 4

   (d) 2, 3

6. $f'(x) = \lim_{h \to 0} \dfrac{\sqrt{2x + 2h - 1} - \sqrt{2x - 1}}{h} = \dfrac{1}{\sqrt{2x - 1}}$

7. (a) $f'(x) = \lim_{h \to 0} \dfrac{\dfrac{x+h}{2x + 2h - 1} - \dfrac{x}{2x - 1}}{h} = -\dfrac{1}{(2x-1)^2}$ (b) $\left(-\infty, \frac{1}{2}\right), \left(\frac{1}{2}, \infty\right)$

   (c) $y = -\frac{1}{9}x + \frac{2}{9}$

8. (a) False (consider $f(x) = |x|$ at $x = 0$ for example)

   (b) True

   (c) True

9. (a) use one-sided limits to show $\lim_{x \to 0} f(x) = f(0) = 2$

(b) $f'(0) = \lim_{x \to 0} \frac{f(x) - f(0)}{x - 0}$. Use one-sided limits to show that the limit does not exist, so f is not differentiable at $x = 0$.

10. (a) 32 feet per second (b) $IV = \lim_{t \to 1} \frac{h(t) - h(1)}{t - 1} = 32$ feet per second

11. $x = -2$ or $x = 3$

12. $a = 15$

13. $f'(x) = 7x^{5/2} + 3x^2 - 6\sqrt{x} - 2$

14. $x = -\frac{2}{5}$, $x = \frac{2}{9}$, $x = 1$

15. $f'(x) = \frac{\sqrt{x} - 1}{x^2}$; $y = \frac{1}{16}x$

16. $y = 5x - 14$

17. $f'(x) = \frac{-4x - 1}{x^2(6x + 1)^{2/3}}$

    (a) horizontal tangent line at $x = -\frac{1}{4}$; equation $y = \frac{4}{\sqrt[3]{2}} = 2^{5/3}$

    (b) vertical tangent line at $x = -\frac{1}{6}$; equation $x = 0$

18. (a) 4 (b) $-\frac{5}{4}$

19. Graph should cross x-axis at $x = -1, 1$, have vertical asymptote at $x = 2$, be negative (below the x-axis) on intervals $(-\infty, -1), (1, 2)$, and be positive (above x-axis) on intervals $(-1, 1), (2, \infty)$

20. (a) $f'(x) = 2 \cdot 3^{2x-1}(\ln 3)$ (b) $f'(x) = \frac{2x - 1}{(x^2 - x)(\ln 4)}$

21. $m = -\frac{1}{e}$

22. $m = -1$

23. $f'(x) = \frac{2x}{x^2 + 1}$; $f''(x) = \frac{2 - 2x^2}{(x^2 + 1)^2}$; $f'''(x) = \frac{4x(x^2 - 3)}{(x^2 + 1)^3}$

24. $f'(x) = \dfrac{1}{x-3} - \dfrac{x}{x^2+3} = 0$ when $x = -1$ but -1 is not in the domain of $f(x)$ so the graph has no horizontal tangent lines.

25. $1 + \dfrac{1}{6+3x} - \dfrac{6}{3x+1}$

26. $8 + 4\ln 4$

27. horizontal tangent lines at $x = -1$, $x = 0$ and $x = 2$

relative maximum at $x = 0$; relative minima at $x = -1$ and $x = 2$

absolute maximum on $[-2, 1]$: $\dfrac{8}{3} = f(-2)$ and

absolute minimum on $[-2, 1]$: $-\dfrac{13}{12} = f(1)$

28. critical number: $x = 4$ only

relative maximum value is $f(4) = -\dfrac{3}{16}$, no relative minima

29. (a) $f'(x) = \dfrac{2-2x}{x^2(3x-2)^{2/3}}$

(b) HTL: $y = 1$, VTL: $x = \dfrac{2}{3}$

(c) $x = 1$ and $x = \dfrac{2}{3}$ ($f(x)$ has a vertical asymptote at $x = 0$ so not a critical number)

(d) local maximum: $f(1) = 1$, no local minima

30. (a) $\dfrac{dC}{dt} = 600$ so cost is increasing by \$600 per day

(b) Average cost $\overline{C}(x) = \dfrac{C(x)}{x}$ is decreasing on interval (0, 80) and increasing for $x > 80$ so average cost is minimized when 80 items are produced.

31. $P(x) = -0.02x^2 + 300x - 300,000$

(a) When $x = 2000$, $MP = 220$ so the profit from the 2001st item is approximately \$220.

(b) $\Delta P = P(2001) - P(2000) = 219.98$

(c) increasing: $(0, 7500)$ and decreasing: $(7500, 20,000)$
Profit is maximized when 7500 items are sold at a unit price of \$250.

32. $f'(x) = \dfrac{10x - 10}{3x^{1/3}}$
relative maximum is $f(0) = 0$; relative minimum is $f(1) = -3$
on $[-8, 0]$: absolute maximum is $f(0) = 0$ and absolute minimum is $f(-8) = -84$

33. maximum: $1 = f(0)$, minimum: $\dfrac{1}{e^{16}} = f(2)$

34. maximum: $1 = f(1)$, minimum: $4 - 8\ln 2 = f(2)$