Section 3.3 # 11–18, 21–43 odd, 46, 48

11. Yes, the function f is increasing on $(-8,-2)$
12. No. f is actually increasing on the interval $(-8,-4)$.
13. No. f is decreasing on $(2,5)$ and increasing on $(5,10)$.
14. Yes. f is decreasing on the interval $(2,5)$
15. f is increasing on $(-8,-2)$, $(0,2)$ and $(5,\infty)$
16. f is decreasing on $(-\infty,-8)$, $(-2,0)$ and $(2,5)$
17. f has a local maximum at 2. The value is 10.
18. f does not have a local maximum at 5.

21. (a) x-intercepts: 2, −2; y-intercept: 3
(b) Domain $[-4,4]$, Range $[0,3]$
(c) Increasing on $(-2,0)$, $(2,4)$; decreasing on $(-4,-2)$ and $(0,2)$
(d) Even, as it is symmetric w.r.t. the y-axis

23. (a) x-intercept: none; y-intercept: 1
(b) Domain: $(-\infty,\infty)$ or $\mathbb{R}$; Range $(0,\infty)$
(c) Increasing on $(-\infty,\infty)$; nowhere decreasing
(d) Neither odd nor even.

25. (a) x-intercepts: $-\pi$, π, 0; y-intercept: 0
(b) Domain: $[-\pi,\pi]$; Range $[-1,1]$
(c) Increasing on $(-\pi/2,\pi/2)$; Decreasing on $(-\pi,-\frac{\pi}{2})$, $(\frac{\pi}{2},\pi)$
(d) Odd as it is symmetric w.r.t. the origin

27. (a) x-intercepts: $\frac{1}{3}$, 2.5 (not labeled); y-intercept: $\frac{1}{2}$
(b) Domain: $[-3,3]$; Range $[-1,2]$
(c) Increasing on $(2,3)$; Decreasing on $(-1,1)$; constant on $(-3,-1)$ and $(1,2)$.
(d) Neither odd nor even.

29 (a) Local maximum value of 3 at $x=0$

(b) Local minimum value of 0 at $x=-2$ <u>and</u> $x=2$

31 (a) Local maximum value of 1 at $x=\frac{\pi}{2}$
(b) Local minimum value of −1 at $x=-\pi/2$

33. $f(-x) = 4(-x)^3 = -4x^3 = -f(x)$ so f is <u>odd</u>.

35. $g(-x) = -3(-x)^2 - 5 = -3x^2 - 5 = g(x)$ so g is <u>even</u>.

37. $F(-x) = \sqrt[3]{(-x)} = -\sqrt[3]{x} = -F(x)$ so F is odd

39. $f(-x) = (-x) + |-x| = -x + |x|$

$-f(x) = -(x + |x|) = -x - |x|$

$f(-x) \neq f(x)$ and $f(-x) \neq -f(x)$, so f is neither odd nor even,

41. $g(-x) = \dfrac{1}{(-x)^2} = \dfrac{1}{x^2} = g(x)$ so g is <u>even</u>.

43. $h(-x) = \dfrac{-(-x)^3}{3(-x)^2 - 9} = \dfrac{x^3}{3x^2 - 9}$

$-h(x) = -\left(\dfrac{-x^3}{3x^2 - 9}\right) = \dfrac{x^3}{3x^2 - 9}$

$h(-x) = -h(x)$, so h is <u>odd</u>.

46. For the function with the graph given, f has an absolute maximum of 4 (at $x=4$) and an absolute minimum of 0 (at $x=5$)

48. For the function with the graph given, f has no absolute maximum, but it has an absolute minimum of 1 (at $x=0$)

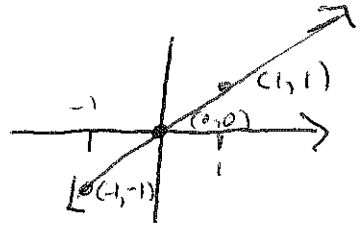
Section 3.4 # 9–16, 17–37 EOO (17, 21, 25, ...), 41–44

9. C   11. E   13. B   15. F

10. A   12. G   14. D   16. H

17.

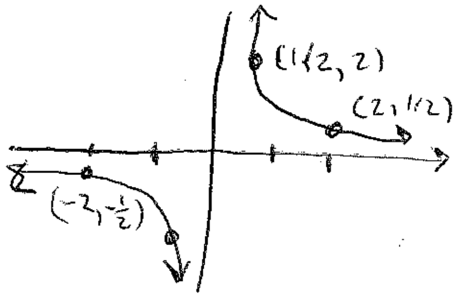
x	$f(x)$
1	1
0	0
−1	−1



$f(x) = x$

21.

x	$f(x)$
$\frac{1}{2}$	2
0	undef.
$-\frac{1}{2}$	−2



$f(x) = \frac{1}{x}$

25. (a) $f(-2) = (-2)^2 = 4$ (use the first rule since $-2 < 0$)

(b) $f(0) = 2$ (use the second rule)

(c) $f(2) = 2 \cdot 2 + 1 = 5$ (use the third rule since $2 > 0$)

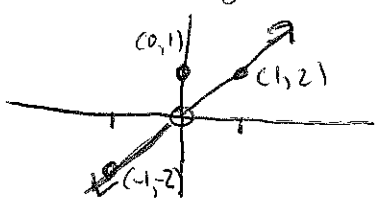
29 (a) The domain is all real numbers

(b) The y-intercept is $\underline{f(0) = 1}$

The x-intercepts occur when $f(x) = 0$.

But $1 \neq 0$, so we check if $2x = 0$, which occurs when ~~x = 0~~ $x = 0$. But at $x = 0$, $f(x) = 1$, so there are <u>no</u> x-intercepts.

(c)



(d) The range is all real numbers except 0.

(e) f is <u>not</u> continuous on its domain.

33. (a) The domain is $\{x \mid -2 \le x < \infty\}$

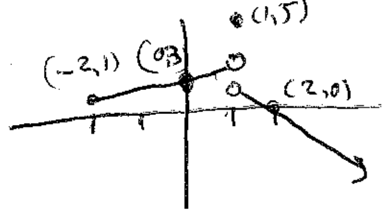
(b) Since $-2 \le 0 < 1$, $f(0) = 0+3 = 3$, and f has a $\boxed{\text{y-intercept of } 3}$

$x+3=0 \iff x=-3$, so this portion has no x-intercept

5 is never equal to 0, and lastly

$-x+2=0 \iff x=2$, and $2>1$, so the graph has an $\boxed{\text{x-intercept of } 2}$

(c)



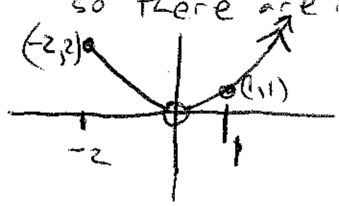
(d) The range is $\{y \mid y<4, y=5\}$ i.e. $(-\infty, 4) \cup \{5\}$

(e) The graph is discontinuous at 1.

37. (a) The domain is $\{x \mid -2 \le x\}$

(b) The function has no intercepts. 0 is not a valid input / member of the domain, so there is no y-intercept. Further, 0 is the only input which would make either piece evaluate to 0, so there are no x-intercepts either.

(c)



(d) The range is $\{y \mid y>0\}$

(e) The graph is discontinuous at $x=0$.

41. $f(x) = \begin{cases} -x & \text{if } -1 \le x \le 0 \\ 2x & \text{if } 0 < x \le 1 \end{cases}$

43. $f(x) = \begin{cases} -x & \text{if } x \le 0 \\ 2-x & \text{if } 0 < x \le 2 \end{cases}$

42. $f(x) = \begin{cases} x & \text{if } -1 \le x \le 0 \\ 2 & \text{if } 0 < x \le 1 \end{cases}$

44. $f(x) = \begin{cases} 2x+2 & \text{if } -1 \le x \le 0 \\ x & \text{if } 0 < x < \infty \end{cases}$

Section 3.5 # 7–18, 19–55 E OO (19, 23, 27, ...), 82, 83

7. B: $y=-x^2+2$; the graph of x^2, flipped over the y axis, shifted up 2

8. E: $y=(x-2)^2$; The graph of x^2, shifted 2 units right

9. H: $y=-|x+2|$; the graph of $|x|$, shifted 2 units left, then flipped over the ~~y~~ x axis.

10. D: $y=-|x|+2$; the graph of $|x|$, flipped over the ~~x~~ y axis, then shifted up 2 units.

11. I: $y=2x^2$; The graph of x^2, stretched vertically by a factor of 2.

12. A: $y=x^2+2$; The graph of x^2, shifted up 2 units

13. L: $y=-2|x|$; The graph of $y=|x|$ stretched vertically, then flipped over the ~~y~~ x axis

14. C: $y=|x|+2$; The graph of $|x|$ shifted up 2 units

15. F: $y=-(x+2)^2$ The graph of x^2, shifted left 2 units, then flipped over the x-axis

16. J: $y=-2x^2$; The graph of $2x^2$ (part I), flipped over the y axis

17. G: $y=|x-2|$; The graph of $y=|x|$, shifted 2 units right.

18. K: $2|x|$; the graph of $|x|$ stretched vertically by a factor of 2

19. $y=x^3$ shifted right 4 units becomes
$y=(x-4)^3$

23. $y=x^3$ reflected about the y-axis becomes
$y=(-x)^3$

27. $y=\sqrt{x} \xrightarrow{\text{up } 2} y=\sqrt{x}+2 \xrightarrow[\text{over } x]{\text{reflect}} y=-(\sqrt{x}+2)$
$=-\sqrt{x}-2$
$\downarrow$ reflect over y
$y=-\sqrt{(-x)}-2$

31. (3, 6) is on the graph of $y = f(x)$ if and only if $f(3) = 6$

So $-f(3) = -6$, i.e. $(3, -6)$ is on the graph of $y = -f(x)$. We answer $\boxed{(c)\ (3, -6)}$

35. $y = f(x)$ has x intercepts of -5 and 3.

i.e. $f(-5) = 0$ and $f(3) = 0$

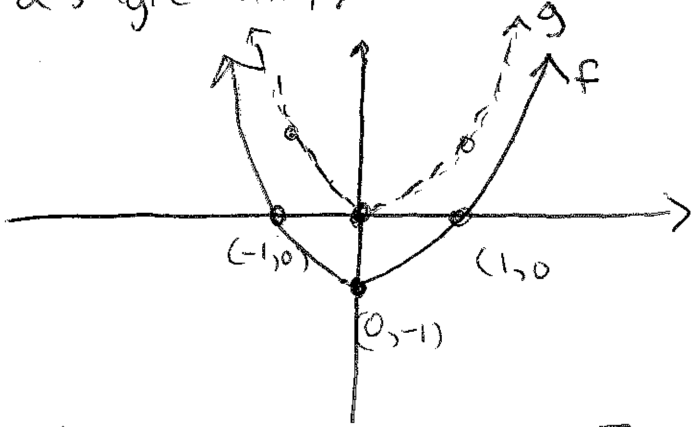
(a) For $y = f(x+2)$, the x intercepts are $\boxed{1 \text{ and } -7}$, because $f(1+2) = f(3) = 0$ and $f(-7+2) = f(-5) = 0$

(b) For $y = f(x-2)$, the x-intercepts are $\boxed{5 \text{ and } -3}$ because $f(5-2) = f(3) = 0$ and $f(-3-2) = f(-5) = 0$

(c) For $y = 4f(x)$, the x intercepts are $\boxed{-5 \text{ and } 3}$ because $4f(-5) = 4 \cdot 0 = 0$ and $4f(3) = 4 \cdot 0 = 0$

(d) The x-intercepts of $y = f(-x)$ are 5 and -3 because $f(-(5)) = f(-5) = 0$ and $f(-(-3)) = f(3) = 0$

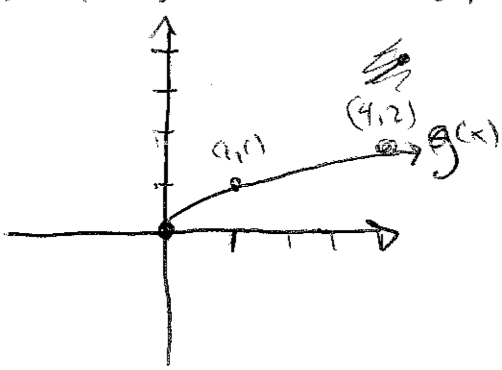
39. $f(x) = x^2 - 1$ has the graph of $g(x) = x^2$, shifted down by a single unit.



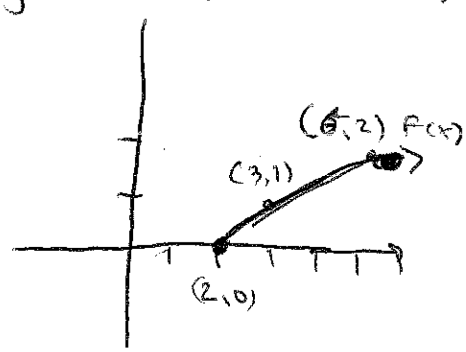
Domain: $\mathbb{R}$

Range: $\{y \mid y \geq -1\}$

43. $f(x) = \sqrt{x-2}$ has the graph of $g(x) = \sqrt{x}$, shifted right 2 units.



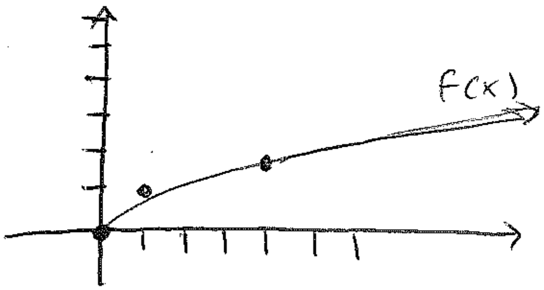
becomes



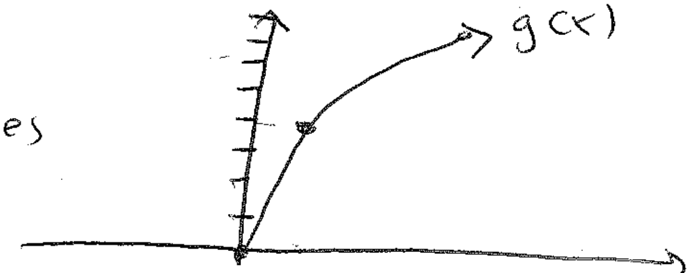
Domain $\{x \mid x \geq 2\}$

Range $\{y \mid y \geq 0\}$

47. $g(x) = 4\sqrt{x}$ is the graph of $f(x) = \sqrt{x}$, stretched vertically by a factor of 4.



becomes



~~Dom~~

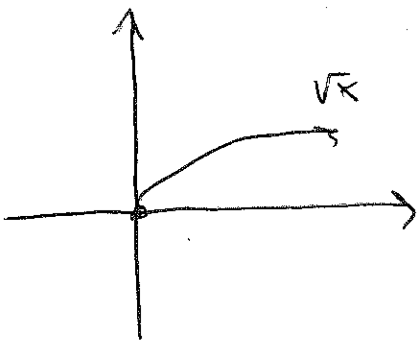
Domain: $\{x : x \geq 0\}$
Range: $\{y : y \geq 0\}$

51. $f(x) = 2(x+1)^2 - 3$ has the graph of $g(x) = x^2$, put through the following

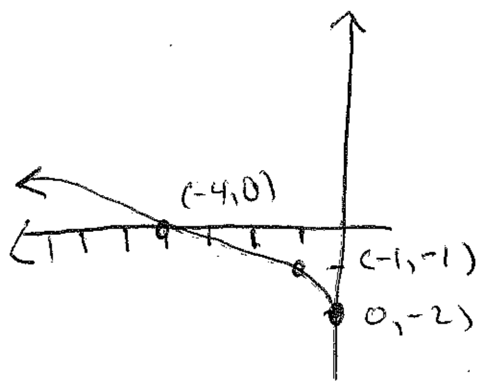
$$x^2 \xrightarrow[\text{vertically}]{\text{stretch}} 2x^2 \xrightarrow[\text{left}]{\text{shift}} 2(x+1)^2 \xrightarrow[\text{down}]{\text{shift}} f(x) = 2(x+1)^2 - 3$$

The domain will be $\mathbb{R}$, while the range will be $\{y \mid y \geq -3\}$

55. $h(x) = \sqrt{-x} - 2$ has the graph of $g(x) = \sqrt{x}$, reflected over the y axis and then shifted down 2 units.

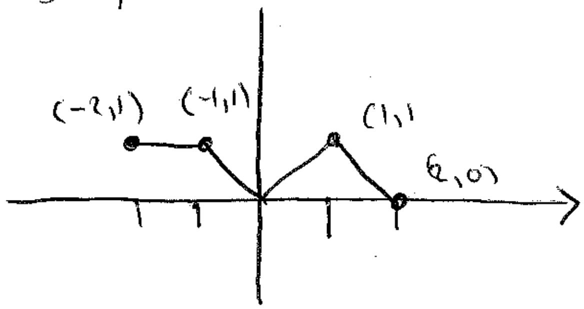


becomes

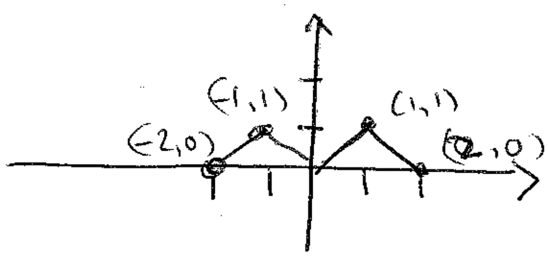


Domain: $\{x \mid x \leq 0\}$
Range $\{y \mid y \geq -2\}$

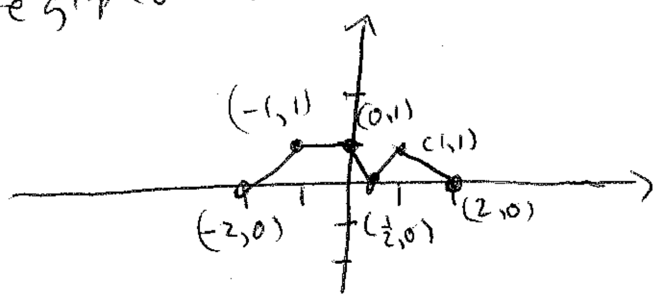
82 (a) The graph of $y = |f(x)|$ is the graph of $f(x)$ on $0 \le x \le 2$ and the graph of $-f(x)$ on $-2 \le x < 0$.



(b) The graph of $y = f(|x|)$ is the graph of $f(x)$ on $0 \le x \le 2$ and the graph of $f(-x)$ on $-2 \le x < 0$.



83 (a) The graph of $y = |f(x)|$ is the graph of $f(x)$ on $[\frac{1}{2}, 2]$ and the graph of $-f(x)$ on $[-2, \frac{1}{2})$



(b)