Homework answers

1. The quadratic functions are the ones in parts a, c, d., e, f, i.

2. .....
3. ..... 

(a) Zeros: none; \( y \)-intercept \((0, 3)\)
(b) Zeros: 0, 1/2; \( y \)-intercept \((0, 0)\)
(c) Zeros: \(-0.4, 2.4\); \( y \)-intercept \((0, -1)\)
(d) Zeros: \(-0.4, 2.4\); \( y \)-intercept \((0, -1)\)
(e) Zeros: 1/2, -3; \( y \)-intercept \((0, -3)\)

4. The functions with parabolic graphs are the one in a, c, d, e, f, i.
5. ..... 
(a) Concave up, $y$-intercept (0, 2.5) 
(b) Concave up, $y$-intercept (0, 3) 
(c) Concave up, $y$-intercept (0, $-8$) 
(d) Concave down, $y$-intercept (0, $-8$) 
(e) Concave down, $y$-intercept (0, 3) 
(f) Concave down, $y$-intercept (0, 6) 
(g) Concave down, $y$-intercept (0, 0) 
(h) Concave up, $y$-intercept (0, $-16$) 
(i) Concave up, $y$-intercept (0, $-156$) 
(j) Concave down, $y$-intercept (0, $315$) 
(k) Concave down, $y$-intercept (0, $-48$) 
(l) Concave up, $y$-intercept (0, $2 - 3/4$) 
(m) Concave up, $y$-intercept (0, $1/5$) 
(n) Concave up, $y$-intercept (0, $17/2$) 

6. ..... 
(a) 2 (c) 2 (e) 2 (g) 1 (i) 1 
(b) 2 (d) 0 (f) 0 (h) 0 (j) 0 

7. ..... 
(a) -3, -5 
(b) 2, 3 
(c) No zeros 
(d) 1, 4 
(e) 0, 3.4 
(f) $2 \pm \sqrt{3} = \pm3.7321$ 

8. ..... 
(a) 2 (c) 0 (e) 2 (g) 0 
(b) 2 (d) 2 (f) 2 

9. .....
(a) \( f(x) = (x + 1)(x + 2); \) the zeros are \(-1\) and \(-2\)

(b) \( f(x) = (x - 1)(x - 2); \) the zeros are \(1\) and \(2\)

(c) \( f(x) = (x + 4)(x - 3); \) the zeros are \(-4\) and \(3\)

(d) \( f(x) = (x + 5)(x - 3); \) the zeros are \(-5\) and \(3\)

(e) \( f(x) = (2x + 1)(x + 1); \) the zeros are \(-1\) and \(-1/2\)

(f) \( f(x) = (2x - 1)(x + 3); \) the zeros are \(-3\) and \(1/2\)

(g) \( f(x) = (x - 7)(x + 4); \) the zeros are \(-4\) and \(7\)

(h) \( f(x) = (2x + 1)(3x - 1); \) the zeros are \(-1/2\) and \(1/3\)

(i) \( f(x) = (2x - 1)(x - 3); \) the zeros are \(1/2\) and \(3\)

(j) \( f(x) = (x + 1)(x - 1); \) the zeros are \(-1\) and \(1\)

(k) \( f(x) = (x - 3)^2; \) the zero is \(3\)
10. ..... 

(a) 1, 3  
(b) 1, 3  
(c) No solution  
(d) −7, 1  
(e) $\sqrt{7} - 2, -\sqrt{7} - 2$  
(f) 1, 3  
(g) $2 - \sqrt{3}, \sqrt{3} + 2$  
(h) $-\frac{1}{2}\sqrt{61} - \frac{7}{2}, \frac{1}{2}\sqrt{61} - \frac{7}{2}$

11. a) and b):

c) The vertex of $a(x)$ is $(-2, -3)$, the vertex of $b(x)$ is $(1, 3)$ and the vertex of $c(x)$ is $(4, 1)$.

12. You may do the graphs all on one coordinate system if you wish.
(a)

\[ d(x) \quad e(x) \]
\[ f(x) \quad h(x) \]

(b) The vertex of \( d \) is \((-1, -10)\), the vertex of \( e \) is \((-2, 1)\), the vertex of \( f \) is \((2, -1)\), the vertex of \( g \) is \((-3, -2)\), the vertex of \( d \) is \((1, 3)\).

(c) The \( y \)-intercept of \( d \) is \(-11\), the \( y \)-intercept of \( e \) is \(5\), the \( y \)-intercept of \( d \) is \(-11\), the \( y \)-intercept of \( f \) is \(3\), the \( y \)-intercept of \( g \) is \(2\).

(d) The functions \( d \) and \( e \) have no zeros; the zeros of \( f \) are \(1\) and \(3\); the zeros of \( h \) are \(\sqrt{3} + 1 \approx 2.7, 1 - \sqrt{3} \approx -0.7\).

13. .....
a) Vertex: (1, 4)
b) Vertex: (2, 5)
c) Vertex: (2, 8)
d) Vertex: (−1, −6)
e) Vertex: (3, −7)
f) Vertex: (−10, −23)
g) Vertex: (1, −5)
h) Vertex: (4, 1)
i) Vertex: (−2, 1)
14. .....

(a) Domain: \((-\infty, \infty)\)       Range: \([4, \infty)\)
(b) Domain: \((-\infty, \infty)\)       Range: \([5, \infty)\)
(c) Domain: \((-\infty, \infty)\)       Range: \([8, \infty)\)
(d) Domain: \((-\infty, \infty)\)       Range: \([-6, \infty)\)
(e) Domain: \((-\infty, \infty)\)       Range: \([-7, \infty)\)
(f) Domain: \((-\infty, \infty)\)       Range: \([-23, \infty)\)
(g) Domain: \((-\infty, \infty)\)       Range: \([-5, \infty)\)
(h) Domain: \((-\infty, \infty)\)       Range: \((-\infty, 1]\)
(i) Domain: \((-\infty, \infty)\)       Range: \((-\infty, 1]\)
(j) Domain: \((-\infty, \infty)\)       Range: \([-5, \infty)\)
(k) Domain: \((-\infty, \infty)\)       Range: \((-\infty, -9]\)
(l) Domain: \((-\infty, \infty)\)       Range: \((-\infty, 7]\)

15. Strict adherence to the directions require writing subtraction as addition of a negative; for example, in (a), writing \(f(x) = x^2 + (-4)x + 1\) instead of \(f(x) = x^2 - 4x + 1\). You don’t have to do this, though you may if you wish. But be sure the values for \(a, b, c\) include the sign.

(a) \(f(x) = x^2 - 4x + 1\)  \(a = 1, b = -4, c = 1\)
(b) \(g(x) = 0.5x^2 + x + 12.25\)  \(a = 0.5, b = 0.5, c = 12.25\)
(c) \( h(x) = x^2 + 5x + 6.25 \) \( a = 1, b = 5, c = 6.25 \)
(d) \( u(x) = 30x - 5x^2 - 2 \) \( a = 30, b = -5, c = -2 \)
(e) \( w(x) = x^2 + x - 20 \) \( a = 1, b = 1, c = -20 \)
(f) \( z(x) = 24x - 3x^2 - 18 \) \( a = 24, b = -3, c = -18 \)
(g) \( j(x) = \frac{1}{4}x^2 + \frac{7}{4}x - \frac{3}{4} \) \( a = 1/4, b = 7/4, c = -3/4 \)
(h) \( k(x) = \frac{2}{5}x^2 - \frac{9}{5}x + \frac{1}{5} \) \( a = 2/5, b = -9/5, c = 1/5 \)
(i) \( m(x) = \frac{1}{2}x^2 - 3x + \frac{17}{2} \) \( a = 1/2, b = -3, c = 17/2 \)
(j) \( n(x) = \frac{1}{3}x^2 - \frac{37}{9}x + \frac{32}{3} \) \( a = 1/3, b = -37/9, c = 32/3 \)
(k) \( q(x) = 12x + 12x^2 + 3 \) \( a = 12, b = 12, c = 3 \)
(l) \( r(x) = \frac{3}{2}x + \frac{7}{4}x^2 - \frac{17}{4} \) \( a = 3/2, b = 7/4, c = -17/4 \)

16. ..... 
(a) 1 \hspace{1cm} (e) -20 \hspace{1cm} (i) 17/2 
(b) 12.25 \hspace{1cm} (f) -18 \hspace{1cm} (j) 32/3 
(c) 6.25 \hspace{1cm} (g) -3/4 \hspace{1cm} (k) 3 
(d) -2 \hspace{1cm} (h) 1/5 \hspace{1cm} (l) -17/4 

17. ..... 
(a) (2, 3) \hspace{1cm} (f) (4, 6) \hspace{1cm} (k) (-\frac{1}{2}, 0) 
(b) (-1, 12) \hspace{1cm} (g) (-3\frac{1}{2}, -3\frac{13}{16}) \hspace{1cm} (l) (-\frac{3}{7}, -4\frac{4}{7}) 
(c) (\frac{1}{2}, 5\frac{3}{4}) \hspace{1cm} (h) (2\frac{1}{4}, -1\frac{21}{30}) 
(d) (3, 43) \hspace{1cm} (i) (3, 4) 
(e) (\frac{1}{2}, -20\frac{1}{4}) \hspace{1cm} (j) (6\frac{1}{6}, -2.009) 

18. ..... 
(a) \( 2 \pm \sqrt{3} \) \hspace{1cm} (f) \( 4 \pm \sqrt{10} \) \hspace{1cm} (j) \( -\frac{11 \pm \sqrt{21}}{2} \) 
(b) None \hspace{1cm} (g) \( -\frac{7 \pm \sqrt{61}}{2} \) \hspace{1cm} (k) -1/2 
(c) None \hspace{1cm} (h) \( -\frac{9 \pm \sqrt{73}}{4} \) \hspace{1cm} (l) \( -\frac{3 \pm 8\sqrt{2}}{7} \) 
(d) \( 3 \pm \frac{1}{5} \sqrt{215} \) \hspace{1cm} (i) None 
(e) 4, -5 

19. ..... 

(a) The points \((\pm a, a^2 - 2)\), for any \(a \neq 0\)

(b) Any two points of the graph with positive first coordinate work, or one with negative first coordinate \(a\) and the other with positive first coordinate \(b\), with \(|a| < |b|\) (so that the one on the left is closer to 0).

(c) Any two points of the graph with negative first coordinate, or one with negative first coordinate \(a\) and the other with positive first coordinate \(b\), with \(|a| > |b|\) (so that the one on the left is farther from 0).

(d) For this, any two points of the graph with first coordinates equally far from 2 and on opposite sides work; \(e.g., 1\) and 3, or 0 and 4.

(e) Same principle as in (d): choose \(x\)-values equally far from -2; \(e.g., -5\) and 1.

20. ..... 

(a) Approximately 201 feet

(b) 56.7 feet

21. ..... 

(a) \(f(x) = (x + 2)^2 - 1\) \(a = 1, h = -2, k = -1\)

(b) \(g(x) = (x - 4)^2 - 15\) \(a = 1, h = 4, k = -27\)

(c) \(h(x) = (x - 3)^2 - 27\) \(a = 1, h = 3, k = -27\)

(d) \(q(x) = (x + 1.5)^2 + 0.25\) \(a = 1, h = -1.5, k = 0.25\)

(e) \(s(x) = 3(x - 3)^2 - 24\) \(a = 3, h = 3, k = -24\)

(f) \(t(x) = 4(x + 2\frac{1}{2})^2 - 33\) \(a = 4, h = -2\frac{1}{2}, k = -33\)

(g) \(u(x) = -(x - 5)^2 + 17\) \(a = -1, h = 5, k = 17\)

(h) \(v(x) = (x - 1)^2 + 4\) \(a = -1, h = 1, k = 4\)
22.

(a)  

(b)  

(c)  

(d)  

(e)  

(f)  

(g)  

(h)  

23. .....  

(a)
CHAPTER 0 HOMEWORK ANSWERS

\[
\begin{array}{lll}
(\text{a}) & [3, \infty) & (\text{d}) [2.5, \infty) & (\text{g}) (-\infty, -8] \\
(\text{b}) & [1, \infty) & (\text{e}) [3, \infty) & (\text{h}) (-\infty, 3] \\
(\text{c}) & [-18, \infty) & (\text{f}) [-8, \infty) & \\
\end{array}
\]

24. For (a)-(f), an input of 200 easily gives an output greater than 10,000, and there are smaller numbers that also work. For (g) and (h) no input gives an output that large, since each function opens downward and has its maximum value at its vertex.

25. .....
26. 

(a) $(3, -7)$  
(b) $(-5, -54)$  
(c) $(-2, -13)$  
(d) $(4, -29)$  
(e) $(7, -46)$  
(f) $(8, -40)$  
(g) $(-6, -29)$  
(h) $(5, -14)$  
(i) $(-7, -53)$  
(j) $(-\frac{1}{2}, -1 \frac{1}{4})$  
(k) $(-4 \frac{1}{2}, 23 \frac{1}{4})$  
(l) $(5, -43)$

27. 

(a) Domain: $(-\infty, \infty)$  
(b) Domain: $(-\infty, \infty)$  
(c) Domain: $(-\infty, \infty)$  
(d) Domain: $(-\infty, \infty)$  
(e) Domain: $(-\infty, \infty)$  
(f) Domain: $(-\infty, \infty)$  
(g) Domain: $(-\infty, \infty)$  
(h) Domain: $(-\infty, \infty)$  
(i) Domain: $(-\infty, \infty)$  
(j) Domain: $(-\infty, \infty)$  
(k) Domain: $(-\infty, \infty)$  
(l) Domain: $(-\infty, \infty)$  

Range: $[-7, \infty)$  
Range: $[-54, \infty)$  
Range: $[-13, \infty)$  
Range: $[-29, \infty)$  
Range: $[-46, \infty)$  
Range: $[-40, \infty)$  
Range: $[-29, \infty)$  
Range: $[-14, \infty)$  
Range: $[-253, \infty)$  
Range: $[-1 \frac{1}{4}, \infty)$  
Range: $(-\infty, 23 \frac{1}{4}]$  
Range: $[-43, \infty)$

28. For all but (k), 100 works easily (as do many other numbers), and for (k) there is no such $x$, since the maximum value the function takes is $23 \frac{1}{4}$.

29. 

(a) 6  
(b) $(-1, 8)$  
(c) $-3, 1$

(d) Since $g(x)$ is of a quadratic function, it must have a $y$-intercept, though it doesn’t appear in the picture. Estimate it by extending the graph; you should get 18 or close to it.
(e) (4, 2)
(f) The function has no zeros.
(g) (−∞, 8]
(h) [2, ∞)

30. ..... 
(a) \((x - 1)(x - 5)\)  
(b) \(2(x - 1)(x - 5)\)  
(c) \(-(x - 2)(x + 2)\)  
(d) \(2(x - 2)^2\)  
(e) \(2(x + 3)^2\)  
(f) \((x - 2)(x + 3)\)  
(g) \(2(x + 1)(x - 5)\)  
(h) \(-\frac{1}{2}(x - 5)^2 + 8\)

31. ..... 

![Graphs](image-url)
32. ..... 

(a) $a(x - 200)(x - 800)$, any $a$
(b) $-\frac{1}{3}(x - 3)^2 + 4$
(c) $a(x - 2)(x + 4), a > 0$
(d) $a(x - h)^2, a > 0$
(e) Not possible: the vertex is above the $x$-axis and the parabola opens downward, so it crosses the $x$-axis.
(f) Any formula $ax^2 + bx + c$ such that $b^2 - 4ac < 0$ gives this result (no zeros).
(g) $ax(x - 8), a > 0$
(h) This is not possible; the vertex is the only zero.
(i) $a(x - h)^2 + k, a, h, k < 0$
(j) $-\frac{2}{3}(x - 3)^2 + 4$
(k) $-2(x - 4)(x - 9)$
(l) $a(x - \frac{1}{2})(x - 5)$ (or $a(2x - 1)(x - 5)$), any $a$.
(m) $a(x - \frac{1}{2})(x - \frac{2}{3})$ (or $a(2x - 1)(5x - 2)$), any $a$.
(n) $\frac{1}{3}(x - 4)(x - 6)$
(o) Not possible; a quadratic has at most 2 zeros.
(p) Not possible—the vertex is above the $x$-axis and the graph opens upward, so it does not cross the $x$-axis.
(q) $a(x - 100)(x - 200), a$}

33. ..... 

(a) $3(x - 2)(x - 6)$
(b) $(x + 2)(x + 6)$
(c) $-\frac{1}{2}(x - 8)(x + 8)$
(d) $-2(x - 2)^2$ (if 2 is the only intercept—there are other possibilities if there is another intercept)
(e) Not possible—the domain of any quadratic consists of all real numbers, including zero, so there is a $y$-intercept.
(f) $\frac{1}{551}(x - 30)(x - 20)$
(g) $a(x - h)^2 - 3, a > 0, a$
(h) \(a(x - h)^2, a < 0, \) any \(h\)

(i) Not possible, because the range is closed.

(j) Not possible, because the range is closed.

(k) \(\frac{1}{45}(x + 3)(x - 15)\)

(l) \(4(x - 1)^2 + 3\)

(m) \(a(x + 3)(x - 5), \) any \(a\)

34. .....
35. ..... 

(a) \(-\frac{1}{3}(x - 3)^2 + 8\)
(b) \((x - 3)(x - 7)\)
(c) Not possible, because the \(x\)-coordinate of the vertex is not halfway between the zeros.
(d) \(-x(x - 6)\)

(e) Not possible: the vertex must occur at \(x = 0\).

(f) Not possible: since the vertex is above the \(x\)-axis and the parabola opens up, there are no zeros.

(g) Not possible: since the vertex is below the \(x\)-axis and the parabola opens down, there are no zeros.

(h) Not possible: since the vertex is not on the \(x\)-axis, the quadratic has no zeros (if it opens up) or two (if it opens down).

(i) Not possible: since the vertex is on the \(x\)-axis, it has one zero, at the vertex.

36. ..... 

37. ..... 

(a) \(\frac{1}{25}(x - 5)^2 + 4\)

(b) \(-1.1875(x + 2)(x - 4)\)

(c) Not possible, because the \(x\)-coordinate of the vertex is not halfway between the zeros.

(d) Not possible, because the \(x\)-coordinate of the vertex is not halfway between the zeros.

(e) \((x + 1)^2 + 2\)

38. ..... 

(a)
(a) All real numbers

(b) The range of $f$ is $[-3, \infty)$ and the range of $g$ is $-\infty, -2]$

(c) The zeros of $f$ are approximately 0.8 and 3.2, and $g$ has no zeros.

(d) The $y$-intercept of $f$ is 5, and the $y$-intercept of $g$ is -3.

(e) Many possibilities
40. ......

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<td>(d) -3</td>
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<td>(c)</td>
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41. ......

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<td>(f) 8</td>
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<td>(c)</td>
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<td>(g) 20</td>
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<tr>
<td>(d)</td>
<td>-4</td>
<td>(h) 32</td>
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42. The graph goes down from left to right, more and more gradually, then starts to rise, more and more steeply. (It changes at the vertex, where $x = -1/3$.)