

Quadratic Functions and Graphs: practice solutions, Grade 9 – download the PDF

Written solutions to the chapter problems. Check each step, then correct yourself.

1 Reading a , b , and c



- a. Already in standard form: $a = 3$, $b = -5$, $c = 2$.
- b. There is no x -term, so $b = 0$: $a = -1$, $b = 0$, $c = 4$.
- c. $a = 0.5$, $b = 1$ (because $x = 1x$), $c = -7$.
- d. Reorder: $y = -x^2 - 2x + 6$, so $a = -1$, $b = -2$, $c = 6$.

2 Up or down, and the y -intercept



The sign of a gives the direction, and the y -intercept is $(0, c)$.

- a. $a = 2 > 0$: opens up; $(0, -9)$.
- b. $a = -0.5 < 0$: opens down; $(0, 1)$.
- c. $a = -4 < 0$: opens down; $c = 0$, so $(0, 0)$.
- d. $a = 1 > 0$: opens up; $(0, 3)$.

3 A first vertex



$a = 1, b = -4$. Axis: $x = -\frac{-4}{2} = 2$.

$y = 2^2 - 4(2) + 1 = 4 - 8 + 1 = -3$, so the vertex is $(2, -3)$.

Since $a > 0$, the parabola opens up and the vertex is a **minimum**.

4 Completing a table



Substitute each value: $(-2)^2 + 4 - 3 = 5$, $1 + 2 - 3 = 0$, -3 , $1 - 2 - 3 = -4$,
 $4 - 4 - 3 = -3$, $9 - 6 - 3 = 0$, $16 - 8 - 3 = 5$.

x	-2	-1	0	1	2	3	4
y	5	0	-3	-4	-3	0	5

The lowest value is -4 at $x = 1$, and the values repeat symmetrically around it. The vertex is $(1, -4)$ and the axis is $x = 1$.

5 Reading vertex form



In $y = a(x - h)^2 + k$ the vertex is (h, k) .

a. $(4, 2)$; $a = 1 > 0$, up.

b. $x + 1 = x - (-1)$, so $(-1, -5)$; $a = -3$, down.

c. $k = 0$, so $(6, 0)$; $a = \frac{1}{2} > 0$, up.

d. $(-7, 9)$; $a = 1$, up.

6 Describing transformations



- a. Shifted down 5 units.
- b. Shifted left 3 units.
- c. Reflected across the x -axis (opens downward).
- d. Stretched vertically by a factor of 2, so it is narrower.
- e. Shifted right 1 unit and up 4 units; the vertex is $(1, 4)$.

7 Zeros from factored form



Set each factor equal to 0 (zero product property).

- a. $x - 2 = 0$ or $x + 6 = 0$: $x = 2$ or $x = -6$.
- b. $x = 0$ or $x - 9 = 0$: $x = 0$ or $x = 9$.
- c. $2x - 5 = 0$ gives $x = \frac{5}{2}$; $x + 1 = 0$ gives $x = -1$.

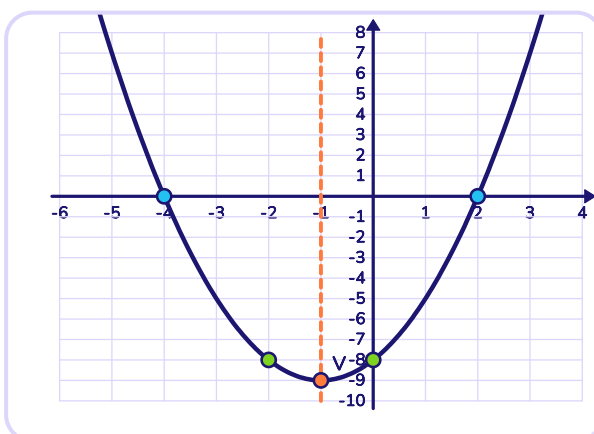
8 Graphing from the vertex



Axis: $x = -\frac{2}{2} = -1$. Vertex: $y = 1 - 2 - 8 = -9$, so $(-1, -9)$, a minimum because $a = 1$.

The y -intercept is $(0, -8)$; its mirror image across $x = -1$ is $(-2, -8)$.

Factor $x^2 + 2x - 8 = (x + 4)(x - 2)$: the x -intercepts are $(-4, 0)$ and $(2, 0)$.



9 Standard form from vertex form



Expand the square first: $(x - 3)^2 = x^2 - 6x + 9$.

Multiply by 2: $2x^2 - 12x + 18$. Subtract 5: $y = 2x^2 - 12x + 13$.

Check: at $x = 0$ both forms give $2(9) - 5 = 13$.

10 Equation from a vertex and a point



Use $y = a(x + 2)^2 + 5$. Substitute $(0, 1)$: $1 = a(2)^2 + 5$, so $4a = -4$ and $a = -1$.

The equation is $y = -(x + 2)^2 + 5$. Check: $-(4) + 5 = 1$.

11 Solving by factoring



Find two numbers with product -28 and sum -3 : they are -7 and 4 .

$(x - 7)(x + 4) = 0$, so $x = 7$ or $x = -4$.

Check: $49 - 21 - 28 = 0$ and $16 + 12 - 28 = 0$.

12 True or false?



a. True. $3x^2 = 12$ gives $x^2 = 4$, so $x = \pm 2$.

b. False. $x^2 + 4 = 0$ would need $x^2 = -4$, which has no real solution. The vertex $(0, 4)$ is above the x -axis and the parabola opens up.

c. True. $x = -\frac{-10}{2} = 5$.

13 Maximum and minimum values



a. $x = -\frac{-8}{2} = 4$ and $y = 16 - 32 + 19 = 3$. Since $a > 0$, the **minimum value is 3** at $x = 4$.

b. $x = -\frac{12}{2(-2)} = 3$ and $y = -18 + 36 - 5 = 13$. Since $a < 0$, the **maximum value is 13** at $x = 3$.

14 The dog run



a. The perimeter gives $2w + 2\ell = 60$, so $\ell = 30 - w$. The area is

$$A(w) = w(30 - w) = -w^2 + 30w.$$

b. $a = -1 < 0$, so the vertex is a maximum: $w = -\frac{30}{2(-1)} = 15$ feet, and

$$A(15) = 15 \cdot 15 = 225 \text{ square feet. The best run is a 15 ft by 15 ft square.}$$

The zeros $w = 0$ and $w = 30$ make sense: a width of 0 or 30 feet leaves no area.

15 Using the quadratic formula



$a = 2$, $b = -5$, $c = -3$. Discriminant: $b^2 - 4ac = 25 + 24 = 49$, which is positive, so there are two real solutions.

$$x = \frac{5 \pm 7}{4}, \text{ so } x = 3 \text{ or } x = -\frac{1}{2}.$$

Check: $2(9) - 15 - 3 = 0$ and $2(0.25) + 2.5 - 3 = 0$.

16 A thrown ball



a. $h(0) = 6$, so the roof is 6 feet high.

b. $t = -\frac{32}{2(-16)} = 1$ second and $h(1) = -16 + 32 + 6 = 22$ feet. That is $22 \times 0.3048 \approx 6.7$ meters.

c. Solve $-16t^2 + 32t + 6 = 0$, that is $8t^2 - 16t - 3 = 0$. Discriminant:

$$256 + 96 = 352. t = \frac{16 + \sqrt{352}}{16} \approx 2.17 \text{ seconds (the negative root is rejected).}$$

17 Smoothie revenue



a. Revenue is price times quantity: $R(p) = p(90 - 5p) = -5p^2 + 90p$.

b. $p = -\frac{90}{2(-5)} = 9$ dollars. $R(9) = 9 \times 45 = 405$ dollars per day. At a \$9 price the stand sells 45 smoothies.

c. At $p = 18$ the quantity is $90 - 90 = 0$: the price is so high that nobody buys, so the revenue is 0.

18 Equation from the zeros



a. Substitute $(2, -18)$: $-18 = a(3)(-3) = -9a$, so $a = 2$ and $y = 2(x + 1)(x - 5)$.

b. $2(x^2 - 4x - 5) = 2x^2 - 8x - 10$.

c. The axis lies halfway between the zeros: $x = \frac{-1 + 5}{2} = 2$. The given point is on that axis, so the vertex is $(2, -18)$. Check with the formula: $x = \frac{8}{4} = 2$.

19 A full description



Vertex: $(-4, 6)$. Axis: $x = -4$.

Transformations: shift left 4, shift up 6, shrink vertically by a factor of $\frac{1}{2}$ (wider), and reflect across the x -axis (opens down).

y -intercept: $-\frac{1}{2}(16) + 6 = -2$, so $(0, -2)$. The mirror point across $x = -4$ is $(-8, -2)$.

Since the maximum value is 6, the range is $y \leq 6$.

20 A parabolic arch



a. $x = -\frac{3}{2(-0.25)} = 6$ and $y = -9 + 18 = 9$. The arch is 9 meters tall.

b. Centered on the road, the truck spans $x = 4.5$ to $x = 7.5$. The arch is lowest at those edges, and by symmetry both have the same height:

$y = -0.25(4.5)^2 + 3(4.5) = -5.0625 + 13.5 \approx 8.44$ meters. Because $8.44 > 8$, the truck **fits**, with about 0.44 meter to spare at the corners.

21 Counting solutions with k



The discriminant is $b^2 - 4ac = 36 - 4k$.

a. One solution means the discriminant is 0: $36 - 4k = 0$, so $k = 9$. Then $(x - 3)^2 = 0$ and $x = 3$.

b. $k = 5$: $36 - 20 = 16 > 0$, so **two** solutions ($x = 1$ and $x = 5$). $k = 12$:
 $36 - 48 = -12 < 0$, so **no** real solution.



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