

BATTLE SHEET · CHAPTER 9

Quadratic Functions

MathBound Standard Algebra 1 · Island 9: Thunderhead Rookery

Name _____ Class _____ Date _____

The foes of Thunderhead Rookery are out, and each one fights with its own kind of Algebra 1 problem. **Defeat each foe by solving its problems.** Show your work in the space on each card, then circle the letter of your answer.

The foes on this sheet



Arc Kite

A kite on a parabola-shaped frame: graphing parabolas, the vertex and the axis.

Problems 1–3 · Lessons 9.1–9.6 · Battle it online: **play.mathbound.org/alg1/?practice=r10.graph-quadratic-equations**



Fountain Fiona

Her fountain arcs in every form: vertex, intercept and standard form.

Problems 4–6 · Lessons 9.1–9.4 · Battle it online: **play.mathbound.org/alg1/?practice=quad.forms**



Pace Snail

Leaves an even mark at every step: rate of change.

Problems 7–8 · Lesson 9.5 · Battle it online: **play.mathbound.org/alg1/?practice=fn.rate-of-change**



Peak Peeper

Spots the peaks, valleys and zeros of a graph: reading graphs of functions.

Problems 9–11 · Lesson 9.6 · Battle it online: **play.mathbound.org/alg1/?practice=fn.graphs**



Growth Racer

Races a steady car, a curving one and a rocket: linear, quadratic and exponential models.

Problems 12–14 · Lesson 9.7 · Battle it online: **play.mathbound.org/alg1/?practice=fn.models**

> **For teachers.** 14 problems from MathBound's own question engine, on chapter 9 of MathBound Standard Algebra 1. The answer key, with worked steps, is at the end. Free to copy for your classes.
>
> Every foe here is also a battle in MathBound, the Algebra 1 adventure game: free for students, no sign-up, at **play.mathbound.org**. The link under each foe opens practice battles with it. Classes, progress by skill and assignments: **mathbound.org/teachers**.

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FOE 1 OF 5

Arc Kite

A kite on a parabola-shaped frame: graphing parabolas, the vertex and the axis. Lessons 9.1–9.6. Battle it:
play.mathbound.org/alg1/?practice=r10.graph-quadratic-equations

1 Lesson 9.1

Does the graph of $y = 4x^2 + 2x - 8$ open upward or downward?

A. Opens downward

B. It is a straight line

C. It opens to the right

D. Opens upward

WORK

2 Lesson 9.2

Which is $y = x^2 + 7x + 6$ written in vertex form?

A. $y = \left(x + \frac{7}{2}\right)^2 + 6$

B. $y = \left(x - \frac{7}{2}\right)^2 - \frac{25}{4}$

C. $y = (x + 7)^2 - 43$

D. $y = \left(x + \frac{7}{2}\right)^2 - \frac{25}{4}$

WORK

3 Lesson 9.5

A cinema charges 11 dollars a ticket and sells 90 tickets a night. For each $1-$dollar cut in price, it sells 10 more tickets. What is the greatest possible nightly revenue, in dollars?

A. 10 **B.** 960 **C.** 990 **D.** 1000

WORK

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FOE 2 OF 5

Fountain Fiona

Her fountain arcs in every form: vertex, intercept and standard form. Lessons 9.1–9.4. Battle it: **play.mathbound.org/alg1/?practice=quad.forms**

4 Lesson 9.1

$f(x) = x^2$ and $g(x) = f(x) - 4$. How does the graph of g compare to the graph of f?

A. a shift up 4 units

B. a shift right 4 units

C. a shift down 4 units

D. a shift left 4 units

WORK

5 Lesson 9.3

How does the graph of $y = (x - 4)^2$ compare to the graph of $y = x^2$?

A. a shift left 4 units

B. a shift up 4 units

C. a shift right 4 units

D. a shift down 4 units

WORK

6 Lesson 9.4

What is the vertex of $y = -(x + 9)(x - 1)$?

A. $(4, 25)$ **B.** $(-4, 25)$ **C.** $(-9, 1)$ **D.** $(-4, -25)$

WORK



FOE 3 OF 5

Pace Snail

Leaves an even mark at every step: rate of change. Lesson 9.5. Battle it: **play.mathbound.org/alg1/?practice=fn.rate-of-change**

7 Lesson 9.5

The table shows a quadratic function f. What is the average rate of change of f from $x = 1$ to $x = 3$?

x	1	2	3	4	5
y	2	6	12	20	30

A. 10 **B.** 5 **C.** 4 **D.** -5

WORK

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FOE 3 OF 5

Pace Snail (continued)

Leaves an even mark at every step: rate of change. Lesson 9.5. Battle it: **play.mathbound.org/alg1/?practice=fn.rate-of-change**

8 Lesson 9.5

Over which interval is the average rate of change of $f(x) = x^2 - 4x + 6$ equal to 0?

A. from $x = -5$ to $x = 1$

B. from $x = -1$ to $x = 6$

C. from $x = 2$ to $x = 8$

D. from $x = -1$ to $x = 5$

WORK



FOE 4 OF 5

Peak Peeper

Spots the peaks, valleys and zeros of a graph: reading graphs of functions. Lesson 9.6. Battle it: **play.mathbound.org/alg1/?practice=fn.graphs**

9 Lesson 9.6

What is the minimum value of the function graphed?

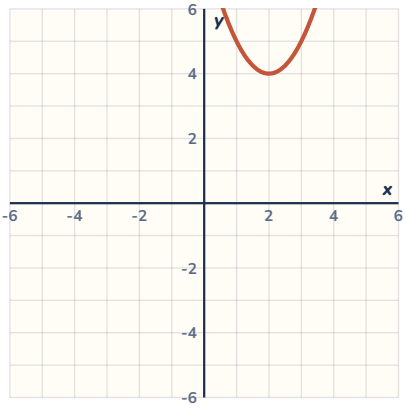
A. 4

B. -4

C. 5

D. 2

WORK



10 Lesson 9.6

What is the range of the function graphed?

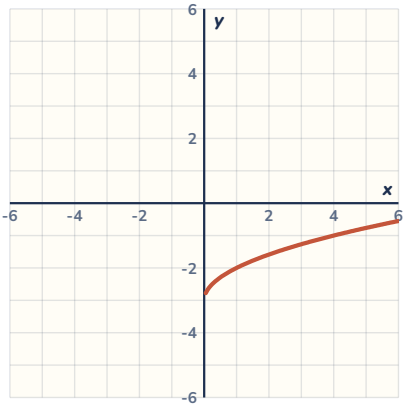
A. $y \geq 0$

B. $y \leq -3$

C. $x \geq 0$

D. $y \geq -3$

WORK



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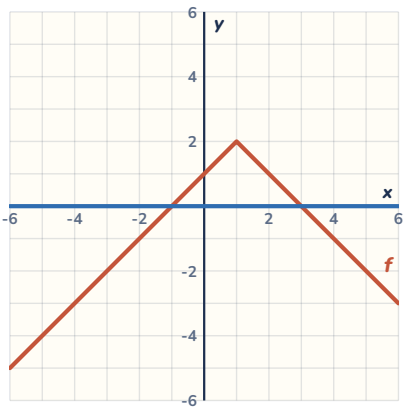
FOE 4 OF 5

Peak Peeper (continued)

Spots the peaks, valleys and zeros of a graph: reading graphs of functions. Lesson 9.6. Battle it:
play.mathbound.org/alg1/?practice=fn.graphs

11 Lesson 9.6

The graphs of f and $y = 0$ are shown. What are the solutions of $f(x) = 0$?



A. $x = 1$

B. $x = -2$ and $x = 4$

C. $x = -3$ and $x = 1$

D. $x = -1$ and $x = 3$

WORK



FOE 5 OF 5

Growth Racer

Races a steady car, a curving one and a rocket: linear, quadratic and exponential models. Lesson 9.7. Battle it:
play.mathbound.org/alg1/?practice=fn.models

12 Lesson 9.7

A sensor takes a reading every minute. The readings are $4, 12, 36, 108, 324$. What kind of function fits the readings?

A. exponential

B. linear

C. quadratic

D. absolute value

WORK

13 Lesson 9.7

The table is quadratic. What is y when $x = 5$?

x	0	1	2	3	4
y	2	0	-4	-10	-18

A. -20

B. -30

C. -28

D. -26

WORK

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GROWTH RACER (continued)

Races a steady car, a curving one and a rocket: linear, quadratic and exponential models. Lesson 9.7. Battle it:
play.mathbound.org/alg1/?practice=fn.models

14 Lesson 9.7

Ana puts $2,100 in an account that earns 6% interest a year, compounded. Ben puts $3,600 in a box and adds $125 each year. After how many whole years does Ana first have more than Ben?

A. 19 **B.** 18 **C.** 17 **D.** 16

WORK

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Answer key · Chapter 9: Quadratic Functions

Each answer is followed by its worked steps, as the game shows them after a battle.

Arc Kite

1. **D**: Opens upward

1. The direction depends only on the sign of the x^2 coefficient.
2. Here $a = 4$, which is positive, so it opens upward.

2. **D**: $y = \left(x + \frac{7}{2}\right)^2 - \frac{25}{4}$

1. Half of 7 is $\frac{7}{2}$; its square is $\frac{49}{4}$.
2. Add and subtract it: $y = \left(x + \frac{7}{2}\right)^2 - \frac{25}{4}$.

3. **D**: 1000

1. With x cuts of 1 dollar, $R = (11 - x)(90 + 10x) = -10x^2 + 20x + 990$.
2. The vertex is at $x = \frac{-20}{-20} = 1$, a price of 10 dollars.
3. $R = 10 \cdot 100 = 1000$ dollars.

Fountain Fiona

4. **C**: a shift down 4 units

1. Adding to $f(x)$ changes every output, so the graph moves vertically.
2. So it is a shift down 4 units.

5. **C**: a shift right 4 units

1. A number inside the square moves the graph horizontally, the opposite way to its sign.
2. So it is a shift right 4 units.

6. **B**: $(-4, 25)$

1. The vertex is on the axis $x = -4$, halfway between -9 and 1.
2. $y = - \cdot 5 \cdot (-5) = 25$, so the vertex is $(-4, 25)$.

Pace Snail

7. **B**: 5

1. $f(3) = 12$ and $f(1) = 2$.
2. Average rate $= \frac{12 - 2}{3 - 1} = 5$.

8. **D**: from $x = -1$ to $x = 5$

1. The average rate is 0 when f has the same value at both ends.
2. The vertex is at $x = 2$, and $f(-1) = f(5) = 11$, so the interval is from $x = -1$ to $x = 5$.

Peak Peeper

9. **A**: 4

1. The minimum is the y-value of the vertex, the lowest point.
2. The vertex is $(2, 4)$, so the minimum value is 4.

10. **D**: $y \geq -3$

1. The graph starts at $(0, -3)$ and rises without end.
2. So the range is $y \geq -3$.

11. **D**: $x = -1$ and $x = 3$

1. The solutions are the x-values where the graph of f meets the line $y = 0$.
2. They meet at $(-1, 0)$ and $(3, 0)$, so $x = -1$ and $x = 3$.

Growth Racer

12. **A**: exponential

1. The differences $(8, 24, 72, 216)$ change, but each y is 3 times the one before.
2. A constant ratio means the table is exponential.

13. **C**: -28

1. First differences: $-2, -4, -6, -8$. The second difference is -2.
2. The next first difference is $-8 - 2 = -10$.
3. So $y = -18 - 10 = -28$.

14. **B**: 18

1. After y years Ana has $2{,}100(1.06)^y$ dollars and Ben has $3{,}600 + 125y$.
2. After 17 years: Ana \$5654.82, Ben \$5,725. After 18: Ana \$5994.11, Ben \$5,850.

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