

Course 2 Answer Key

1.1 Rational & Irrational Numbers

Defining Real Numbers

Student Logbook

- integers; 0
- terminates; repeats
- two; number
- ratio; integers
- terminating; repeating
- rational; irrational
- real
- root
- radical

Your Turn

1. The following answers are samples

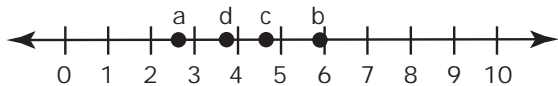
a. $-\frac{12}{2}, \frac{18}{3}, -\frac{30}{5}$ b. $\frac{2}{10}, -\frac{3}{15}, \frac{4}{20}$
 c. $-\frac{16}{6}, \frac{24}{9}, -\frac{32}{12}$ d. $\frac{9}{4}, -\frac{9}{4}, \frac{18}{8}$

2. a. 0.375 b. 0.2
 c. 3.5 d. 0.714285

3. 1.222343

4. Sample answer: $\sqrt{7}$, 5.1682032412

5. a. 2.646 b. 5.916
 c. 4.690 d. 3.742



Working with Radicals

Student Logbook

- 3.14
- d
- radicand
- 1, 4, 9, 16, 25
- $\sqrt{a^2} = a$
- non-negative square root

7. $\sqrt{a \times b}$

8. $5\sqrt{10}$

9. $\frac{\sqrt{a}}{\sqrt{b}}$

10. rationalize; denominator; rational

Your Turn

1. a. 9; 9 b. 625; 25 c. 144; 12
 2. 121, 144, 169, 196, 225
 3. a. $4\sqrt{10}$ b. $30\sqrt{3}$ c. $-\frac{1}{2}\sqrt{10}$
 4. $-96\sqrt{7}$
 5. $\frac{\pi}{6}$
 6. a. $\frac{\sqrt{6}}{6}$ b. $\frac{\sqrt{33}}{11}$ c. $\frac{\sqrt{14}}{7}$
 7. a. $\frac{16}{5}$ b. $5\sqrt{5}$ c. $\frac{2\sqrt{3}}{3}$
 8. $16\sqrt{2}$
 9. $2\sqrt{3}$ seconds

The Square Root Function

Student Logbook

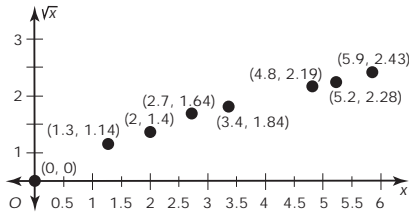
- \sqrt{x}
- Sample answer: The slope formula can be used to show that slopes between plotted consecutive points are not equal.
- Because for each first coordinate there is one and only one second coordinate
- interpolate; domain
- extrapolate; observed
- non-negative real numbers
- non-negative real numbers
- parameter
- steepness; quadrant

Your Turn

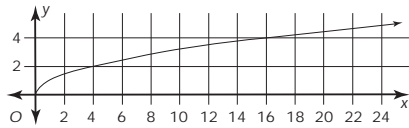
1.

x	0	1.3	2.0	2.7	3.4	4.8	5.2	5.9
\sqrt{x}	0	1.14	1.41	1.64	1.84	2.19	2.28	2.43

2.



3.



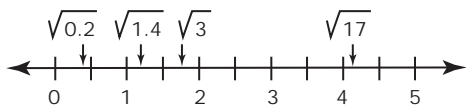
4. a. 3 b. 4 c. 2 d. 1 e. 5

Unit Assessment

1. a. rational, terminating decimal
 b. rational, can be written as $\frac{25}{14}$
 c. irrational, nonterminating and nonrepeating decimal
 d. rational, repeating decimal
 e. rational, can be written as -3
 f. irrational, nonterminating and nonrepeating decimal
 g. rational, repeating decimal
 h. irrational, nonterminating and nonrepeating decimal
2. sometimes
3. always
4. Irrational; by the Pythagorean theorem, the length of the hypotenuse is given by the square root of $4^2 + 5^2$, or the square root of 41. No rational number can be squared to equal 41, so the length of the hypotenuse is given by an irrational number.

5. b and d

6.



7. c and d

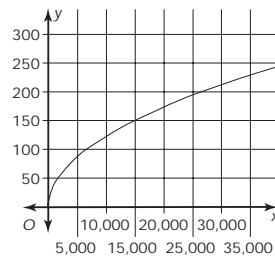
8. a. $5\sqrt{3}$ b. 0.06 c. $5\sqrt{17}$ d. $14\sqrt{7}$
 e. $4\sqrt{3}$ f. $2\sqrt{3}$ g. $3\sqrt{5}$
 h. $4\sqrt{3}$ i. $\frac{3\sqrt{5}}{5}$ j. $\sqrt{5}$

9. c

10. a. 4 b. 3 c. 2 d. 5 e. 1

Unit Investigation

1.



2. Answers will vary.

3. The distance to the horizon when the plane is on the ground

4. about 211 miles

5. about 6,719 feet

6. about 26,874 feet

7. The distance to the horizon decreases

2.1 Polynomial Arithmetic

Working with Powers

Student Logbook

1. exponent; base
2. 1
3. $\frac{1}{a^n}$
4. reciprocal; opposite
5. base
6. $a^r + s$; integers
7. $a^r - s$; integers
8. $a^r \times s$; integers
9. $a^n \times b^n$; integer
10. $\frac{a^n}{b^n}$; integer

Your Turn

1. a. 3^2 b. 3^{-2} c. 3^4 d. 3^2
 2. 1
 3. a. b^5 b. $-3c^2$ c. 25^6
 d. $\frac{1}{3}$, or 3^{-1} e. $32x^{15}y^{20}$ f. $\frac{625x^4}{16y^4}$

4. Mercury: 5.8×10^7
Earth: 1.5×10^8
Mars: 2.3×10^8
Saturn: 1.4×10^9
Pluto: 5.9×10^9
5. 1.4×10^{12}

Transforming Equations Using Multiple Operations

Student Logbook

1. x^2
2. ax^n ; real number; variable; nonnegative
3. polynomial
4. trinomial; three monomials
5. left; right; descending order
6. left; right; ascending order
7. nonzero value; simplify; identify
8. Their exponents are different.
9. Students' answers will vary.

Your Turn

1. No. In the definition of a monomial, a term of the form ax^n , n is a nonnegative integer. Since n in the expression $2x^{-3}$ is negative, this expression is not a monomial.
2. a. $2x^2 + x$; binomial
b. $4s^{23} - 7s^{17} - s$; trinomial
3. a. $2x^3 + 10x^2 - 2x + 12$
b. $-2b^4 - b + 4$
c. $7c^3 + 6c^2 - 2$
4. a. $-3a + 11a^3$
b. $3 - x - 6x^2 + 8x^3$
c. $7c^3 + 6c^2 - 2$
5. a. $2n^2 + 4n$
b. $3n^2 + 7n + 3$
c. $4n^2 + 9n + 3$

Multiplying Polynomials

Student Logbook

1. $n + 1$
2. distributive; $(n + 10)n + (n + 10)1$
3. sum; products
4. FOIL stands for First, Outer, Inner, Last: multiply the first terms of each binomial; multiply the outer terms; multiply the inner terms; multiply the last terms.
5. substitute; identity
6. $a^2 + 2ab + b^2$
7. $a^2 - ab - ab + b^2$; or $a^2 - 2ab + b^2$
8. $a^2 - b^2$

Your Turn

1. a. $(n + 2)(n + 8)$; $n^2 + 10n + 16$
b. $n(n + 8)$; $n^2 + 8n + 0$
c. $(n - 1)(n + 8)$; $n^2 + 7n - 8$
d. $(3n + 1)(n + 8)$; $3n^2 + 25n + 8$
2. $(n + 3)(4n - 2)$; $4n^2 - 2n + 12n - 6$; $4n^2 + 10n - 6$
3. a. $9b^2 + 12b + 4$
b. $25y^2 - 30y + 9$
4. $x^2 - 16$
5. $2n^2 + 16n$; Sample answer: multiply using the distributive property, then multiply by 2, which will double the area.

Unit Assessment

1. b and c
2. a. $-32a^3$
c. 4^{-4} , or $\frac{1}{4^4}$, or $\frac{1}{256}$
e. $8s^{3n+6}$
- b. $5r^6$
- d. $16y^{12}$
f. $\frac{64r^3}{343s^3}$
3. 3.8×10^{-2}
4. a. $7n^2 + 10n - 5$
b. $-2n^2 + 3n + 15$
c. $n^2 - 15n - 14$
d. $9n^2 + 24n + 7$
5. $(2n + 3)(3n - 4)$; $6n^2 - 8n + 9n - 12$; $6n^2 + n^2 + 2$

6. d
7. See students' work. After substituting and simplifying $-16 = -16$
8. a. $n^2 - n$
 b. $3n^2 + 13n + 4$
 c. $2n^2 + 14n + 4$

Unit Investigation

- Students' diagrams will vary. Dimensions should be reasonable.
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- Students' diagrams will vary. Area and dimensions should be reasonable.
- Students' answers will vary.

2.2 Factoring Polynomials

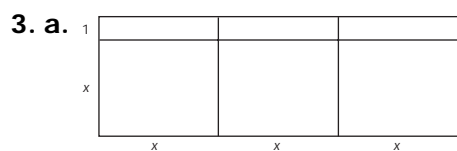
Finding Common Factors

Student Logbook

- positive integers; 1; itself
- It has exactly one factor (itself), not two.
- composite number
- prime factors; product
- Factor the variables. The greatest common factor of the variable terms is equal to the variable term with the lower exponent.
- degree
- $12n^2$
- the product of two or more polynomials
- highest; monomial

Your Turn

- a. $(2)(2)(3)(5)$
 b. $(5)(31)(x)(y)$
 c. $(2)(2)(2)(2)(3)(3)(n)(n)$
- a. $8y^3$ b. $4a^3$



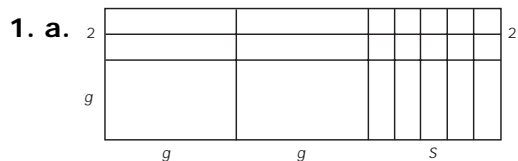
- b. $3x(2x + 1)$
- c. If $x = 4$, $3(4)[(2)(4) + 1] = (6)(16) + (12)$;
 $(12)(9) = (96) + 12$; $108 = 108$
4. a. $4n(3n^2 + 5)$ b. $8y^3(9y - 5)$
 c. $(x + 2)(x + 5)$ d. $3(m + 7)(m + 2)$

Factoring Quadratic Trinomials

Student Logbook

- 24; 10
- $(x + 4)(x + 6)$
- quadratic term
- linear term
- constant term
- Yes. It is of form $ax^2 + bx + c$; a, b, c are 1, 10, 24 which are real numbers and $a \neq 0$.
- opposite
- $(y - 3)(y - 4)$
- $(2r + 3)(r + 2)$
- $(2n + 5)(3n - 2)$

Your Turn



- b. $(g + 2)(2g + 5)$
- c. Sample answer: if $g = 2$,
 $(2 + 2)[(2)(2) + 5] = (4)(9)$; $36 = 36$
2. a. $s^2 + 5s - 1$ b. s^2
 c. $5s$ d. -1
3. a. $(x + 2)(x + 3)$ b. $(d - 8)(d + 4)$
 c. $(2p + 1)(p + 3)$ d. $(3y - 4)(y + 1)$
 e. $3(f + 2)(f - 3)$

Special Cases

Student Logbook

- $(a + b)^2$
- difference; two squares
- $(2x + 3)(2x - 3)$

4. $(a + b)(a - b)$
 5. $(5k + 12)(5k - 12)$
 6. yes; $\sqrt{x^4} = x^2$ and $\sqrt{64} = 8$
 7. $(x^2 - 8)(x^2 + 8)$
 8. prime
 9. a. common factors; distributive
 b. perfect square trinomial; difference of two squares
 10. prime

Your Turn

1.

Factored form	Trinomial expression	Special Case
$(x + 9)^2$	$x^2 + 18x + 81$	perfect square trinomial
$(2x + 10)^2$	$4x^2 + 40x + 100$	perfect square trinomial
$(x - 3)^2$	$x^2 - 6x + 9$	perfect square trinomial
$(x + 5)(x - 5)$	$x^2 - 25$	difference of squares
$(x + 7)(x - 7)$	$x^2 - 49$	difference of squares
prime, not factorable	$x^2 + 81$	sum of squares
$(2x + 20)^2$ or $4(x + 10)^2$	$4x^2 - 80x + 400$	perfect square trinomial

2. a. $(a - b)^2$ is the square of the differences and is in factored form and equal to $a^2 - 2ab + b^2$. $(a^2 - b^2)$ is the difference of squares and is in standard form and factors to $(a + b)(a - b)$.
 b. Solutions will vary. Example: let $a = 1$ and $b = 2$; 1 is not equal to -3 when they are substituted.

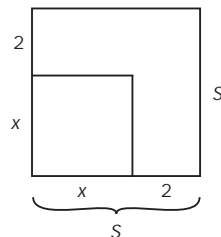
Unit Assessment

1. The next step would be to eliminate all multiples of 3 from the table, then multiples of 4, etc. The numbers remaining would not be multiples of any numbers other than themselves and 1 and are therefore prime.
 2. $24 = 2 \times 2 \times 2 \times 3$
 3. a. Solutions will vary. Example: 8 and 12, GCF is 4
 b. Solutions will vary. Example: 15 and 18, GCF is 3
 4. t^4
 5.
- | Terms | Greatest common factor |
|-----------------|------------------------|
| 16, 24 | 8 |
| $64m, 32m, 96m$ | $32m$ |
| $42x^2, 18x^3$ | $6x^2$ |
6. a. $(x + 3)(x + 1) = x^2 + 4x + 3$
 b. Solutions will vary. Example: Let $x = 5$,

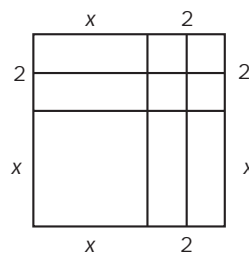
7. a. $(g - 10)(g + 2)$ b. $(k + 6)^2$
 c. $(p - 8)(p + 2)$ d. $(2x + 3)(2x + 5)$
 e. prime f. $(4a - 5)(4a + 5)$
 8. a. $4(p + 4)$ b. $2(h + 20)$
 c. $2(3d + 8)$ d. $4(x^2 - 2)$

Unit Investigation

1.

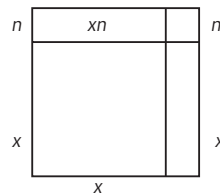


2.



3. expanded form: $c^2 + 4c + 4$; factored form: $(c + 2)^2$

4. a.



- b. expanded form: $c^2 + 2nc + n^2$; factored form: $(c + n)^2$

5. a perfect square trinomial
 6. Floor plans will vary.
 7. Answers will vary. Example: If there is 6 feet of tile on one wall and 1 foot of tile on the other, then $(x + 6)(x + 1) = x^2 + 7x + 6$.
 8. The polynomial in expanded form clearly shows the regions and the areas of the regions that will have carpet and those that will have tile. The quadratic term is the carpet and the linear and constant terms are the tiled areas. The factored form of the area gives the lengths of the sides of the room.

3.1 Graphing Quadratic Functions & Equations

Graphing Parabolas

Student Logbook

1. a second degree polynomial function
2. x value; y value
3. up
4. down
5. the least value of y on the graph of a parabolic function
6. the greatest value of y on the graph of a parabolic function
7. axis of symmetry
8. $x = 0$
9. vertex

Your Turn

1. **a.** a ; c
2. **a.** concave down
b. concave up
c. concave up
3. **a.** b and c
b. a
4. c
5. Students' graphs should depict a parabola in quadrants I and II whose vertex is the origin. The curve is concave up and should pass through points $(1, 2)$, $(-1, 2)$, $(2, 8)$, $(-2, 8)$, $(3, 18)$, $(-3, 18)$, and so on.
a. domain: $x =$ all real numbers;
range: $y \geq 0$
b. $x = 0$
c. the origin, $(0, 0)$
d. concave up
e. $y = 0$ (minimum)

Analyzing Properties of Parabolas

Student Logbook

1. the y -intercept
2. down; vertex; 1,000
3. 0; real numbers
4. incomplete; 0
5. midpoint; h
6. 240.1
7. 7
8. parabola; y -axis; vertex
9. x -intercepts; 0

Your Turn

1. **a.** -5
b. 0
c. 67
2. b , c
3. Students' parabolas should open upward, the lowest value of y (the minimum) should be -3 , and the parabola should be centered around the axis of symmetry, $x = -2$. The parabolas may have any width, provided these conditions are met.
4. $(8, 15)$
5. **a.** maximum = 400
b. the height of the cliff, or the distance between the cliff and the ground

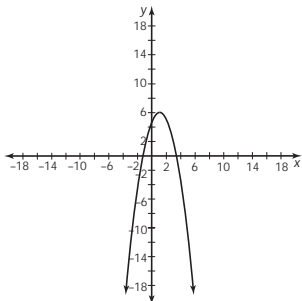
Solving Quadratic Equations by Graphing

Student Logbook

1. trajectory
2. quadratic; linear; 0; -6
3. vertex
4. root; solution
5. horizontal intercepts
6. real roots
7. 5.6
8. real root
9. x -intercept

Your Turn

1. a. 5
- b. 12 feet (at $d = 10$)
- c.

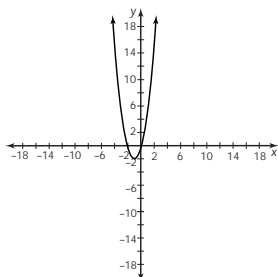


Since d cannot be negative in this problem, only the segment in Quadrant 1 corresponds to the ball's trajectory.

Equation	Roots	Concavity	Max / min
$h = 0.5d^2 + 1$	0	Concave up	(0,1)
$y = 3x^2 + 6x + 1$	2	Concave down	(1,4)
$d = -1.9t^2$	1	Concave down	(0,0)
$y = 4x^2 + 4x - 35$	2	Concave up	(-0.5, -36)

Unit Assessment

1. a. $3x^2$
- b. $5x$
- c. -7
- d. equation is of the form $y = ax^2 + bx + c$
- e. the coefficient of the quadratic term, 3
- f. If the quadratic term is positive, the parabola is concave up; if the coefficient is negative, the parabola is concave down.
- g. the constant term, -7
2. a. maximum b. minimum c. minimum
3. a. $y = x^2 - 1$ b. $y = -x^2 + 1$
4. a. 2 real roots b. 2 real roots
- c. 0 real roots d. 1 real root
- 5.



6. $t = 0$ to 5 inclusive

7. 0 to 70 inclusive.

Unit Investigation

1. h_1 and h_2 are the same for all values of t ; this shows that the objects were always at the same height and that they both hit the ground at the same time.
2. Each object was in the air for 3.2 seconds; this is seen by the fact that h (height) becomes 0 when t (time) reaches 3.2.
3. One covered 50 meters; the other covered 25 meters.
4. The coordinates of the points are: (0, 50), (1, 45.1), (2, 30.4), (3, 5.9), (3.2, 0); a curve or a parabola; students' graphs should show a parabolic curve that passes through all the points.
5. $h = 4.9t^2$
6. The horizontal intercept increases.
7. The object would remain in the air for a longer period of time (because the horizontal intercept, which represents the time the object hits the ground, is greater).
8. The coordinates for the first trial are: (0, 50), (15.65, 45.1), (31.30, 30.4), (46.96, 5.9), (50, 0). The coordinates for the second trial are: (0, 50), (7.83, 45.1), (15.65, 30.4), (23.48, 5.9), (25, 0).
9. curves or parabolas
10. h_1 is identical to Trial 1, and h_2 is identical to Trial 2.
11. 50 and 25; the horizontal distance covered by each object
12. Trial 1; The object in trial 1 must have had a greater initial velocity because it covered a greater horizontal distance in the same time period.

3.2 Solving Quadratic Equations Using Algebra

Factoring & The Zero Product

Student Logbook

1. Zero product theorem
2. two
3. horizontal intercepts or x-intercepts
4. axis of symmetry, vertex
5. 0, 0
6. 1
7. -22, 2
8. double root
9. x-intercepts; parabolic function

Your Turn

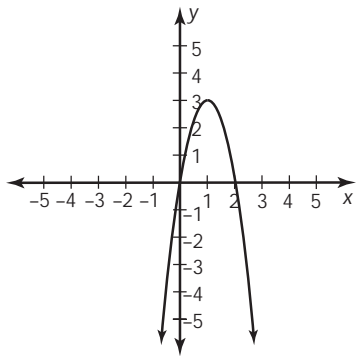
1. a. two
b. $0 = 0.25x^2 - 4$
 $0 = (0.5x + 2)(0.5x - 2)$
 $0 = 0.5x + 2$ or $0 = 0.5x - 2$
 $-2 = 0.5x$ or $2 = 0.5x$
 $-4 = x$ or $4 = x$

2. $(x), (x + 4)$

3. a. 0, 2

b. (1, 3)

c.



4. a. $(6x + 2)(6x + 2)$, or $4(3x + 1)^2$

b. $x = -\frac{1}{3}$

c. 1

The Square Root Method & Completing the Square

Student Logbook

1. square root property
2. $a + (-a) = 0, -(a) + a = 0$
3. sum
4. perfect square trinomial
5. 3; -13
6. 4
7. $x - 2 = \sqrt{3}$ or $x - 2 = -\sqrt{3}$
8. square root property
9. completing; square
10. irrational

Your Turn

1. two

2. a. $x = \pm 3$ b. $x = \pm 1$ c. $x = \pm 2$

3. b^2

4. a. 36 b. 100 c. $\frac{9}{4}$

5. $x^2 + 4x - 5 = 0$

$$x^2 + 4x = 5$$

$$x^2 + 4x + 4 = 5 + 4$$

$$(x + 2)^2 = 9$$

$$x + 2 = \pm 3$$

$$x + 2 = 3$$

$$x + 2 = -3$$

$$x = 1$$

$$x = -5$$

6. $x = 5 + \sqrt{7}, x = 5 - \sqrt{7}$

The Quadratic Formula

Student Logbook

1. $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

2. 2; 8; -13

3. $2\sqrt{42}$

4. real

5. $b^2 - 4ac$

6. radicand

7. no real

8. one real

9. two real

Your Turn

- square root property
 - completing the square
 - zero product theorem
- $g = \frac{-h \pm \sqrt{h^2 - 4fj}}{2f}$
- $x^2 + 12x - 18 = 0$; 1; 12; -18
 - $3y^2 - 2y + 51 = 0$; 3; -2; 51
 - $8y^2 - 2y + 27 = 0$; 8; -2; 27
 - $x^2 + 5x - 2 = 0$; 1; 5; -2
- $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\frac{-(-5) \pm \sqrt{(-5)^2 - 4(5)(1)}}{2(5)}$$

$$x = \frac{5 \pm \sqrt{25 - 20}}{10}$$

$$\frac{5 \pm \sqrt{5}}{10}$$

$$x = \frac{0.5 + \sqrt{5}}{10} \quad \text{or} \quad x = \frac{0.5 - \sqrt{5}}{10}$$

Unit Assessment

- The equation has two solutions. This makes sense because the rabbit touches the ground ($x = 0$) at two points, the point that it jumps from and the point where it lands.
 - $x = 0$ or $x = 2$
 - distance = $2 - 0 = 2$ ft
- $m = 9$ or $m = -9$
- $s = 0$ or $s = 99$
- $(\frac{b}{2})^2$
- $x^2 + 18x - 19 = 0$
 $x^2 + 18x = 19$
 $x^2 + 18x + 81 = 19 + 81$
 $(x + 9)^2 = 100$
 $x + 9 = \pm \sqrt{100} = \pm 10$
 $x + 9 = 10 \quad x + 9 = -10$
 $x = 1 \quad x = -19$
 $x = 1$ or $x = -19$
- $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
 $\frac{-7 \pm \sqrt{7^2 - 4(1)(5)}}{2(1)}$
 $x = \frac{-7 \pm \sqrt{49 - 20}}{2}$
 $\frac{-7 \pm \sqrt{29}}{2} = \frac{-3.5 \pm \sqrt{29}}{2}$

$$x = -3.5 + \frac{\sqrt{29}}{2}, \quad x = -3.5 - \frac{\sqrt{29}}{2}$$

- The discriminant can tell you how many real number solutions the equation has, as well as how often the parabola described by the equation crosses the x-axis.

8.

Quadratic equation	Discriminant	Nature of roots
a. $5x^2 + 6x + 5 = 0$	- 64	no real roots
b. $6x^2 + 6x + 7 = 0$	- 132	no real roots
c. $2x^2 + 8x + 2 = 0$	48	two real roots
d. $8x^2 + 3x - 4 = 0$	137	two real roots

9. a, b

Unit Investigation

- 2.5 seconds
- 3.5 seconds
- a. (3.5, 0) b. (0, 60)
- When $x = 0$, $y = 2$. Since y is defined as the height in feet above the player's shoulders, the initial height of the ball is 2 feet above the player's shoulders.
- See Question 4 above.
- 12.5 feet
- 11.8 feet
- Player C's; For Player B, the height is 8.25 feet; for Player C, the height is 8.96 feet.
- Player B. Students may refer to answers for Questions 6 and 7.

4.1 Radical Equations & Functions

Solving Radical Equations

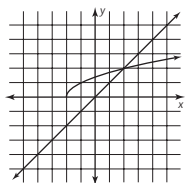
Student Logbook

- radical equation
- $a^2 = b^2$
- square root
- radical; square
- If the system of equations that represents the left and right sides of the radical equation has a point of intersection, then the x-coordinate is the solution to the original radical equation.

6. extraneous root
7. $x^{0.5}$
8. true
9. extraneous root

Your Turn

1. $x = 25$
2. No. $\sqrt{}$ indicates the principal, or positive, root, so it cannot have a negative value. Therefore, it cannot equal -4 .
3. $\sqrt{r-5} - 8 = 0$
 $\sqrt{r-5} - 8 + 8 = 0 + 8$
 $\sqrt{r-5} = 8$
 $[(r-5)]^{\frac{1}{2} \cdot 2} = 8^2$
 $r - 5 = 64$
 $r = 69$
4. a. one solution



- b. $\sqrt{x+2} = x$
 $x + 2 = x^2$
 $0 = x^2 - x - 2 = (x + 1)(x - 2)$
 $x = -1x = 2$
- c. $x = -1$ is an extraneous solution.
- d. $x = 2$

The Inverse of the Square Root Function

Student Logbook

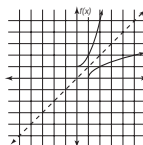
1. one-to-one
2. inverse
3. interchange; function; inverse
4. $f^{-1}(x)$
5. range
6. domain

7. $y = x$
8. domain

Your Turn

1. Yes. For every point on the graph, each second coordinate is paired with one and only one first coordinate and each first coordinate is paired with one and only one second coordinate.

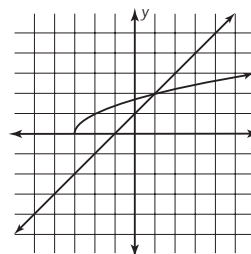
2. a.



- b. The domain is $x \geq 1$.
- c. The range is $f(x) \geq 0$.
- d. $f^{-1}(x) = x^2 + 1$
- e. $x \geq 0$
- f. See part (a).
- g. See part (a) for graph; $y = x$.

Unit Assessment

1. $\sqrt{a} = 12$, $(\sqrt{a})^2 = 12^2$, $a = 144$
2. $\sqrt{k} + 2 = 0$, $\sqrt{k} = -2$, no solution
3. $\sqrt{d-15} - 5 = 0$, $\sqrt{d-15} = 5$
 $(\sqrt{d-15})^2 = 5^2$, $d - 15 = 25$, $d = 40$
4. $z = \sqrt{z+7} + 5$
 $z - 5 = \sqrt{z+7}$
 $(z - 5)^2 = (\sqrt{z+7})^2$
 $z^2 - 10z + 25 = z + 7$
 $z^2 - 11z + 18 = 0$
 $(z - 2)(z - 9) = 0$
 $z - 2 = 0$, $z - 9 = 0$, $z = 2$, $z = 9$
 9 is a solution, and 2 is an extraneous root.
5. one solution



$$\begin{aligned}
 6. \sqrt{f-1} - 1 &= \frac{f}{5} \\
 \sqrt{f-1} &= \frac{f}{5} + 1 \\
 (\sqrt{f-1})^2 &= \frac{f}{5} + 1^2 \\
 f-1 &= \frac{f^2}{25} + 2\frac{f}{5}(1) + 1^2 = \frac{f^2}{25} + \frac{2f}{5} + 1 \\
 f-1 &= \frac{f^2}{25} + \frac{2f}{5} + 1 \\
 25f - 25 &= f^2 + 10f + 25 \\
 0 &= f^2 - 15f + 50 \\
 0 &+ (f-5)(f-10) \\
 f &= 5 \text{ or } f = 10, \text{ both are solutions}
 \end{aligned}$$

7. No; It is not a one-to-one function because there are two x -values for every positive y -value.

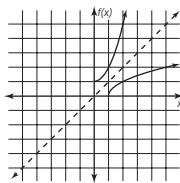
8. a. The domain is $x \geq -2$.

b. The range is $y \geq 0$.

c. $f^{-1}(x) = x^2 - 2$

d. $x \geq 0$

e.



Investigating Gravity

Student Investigation

1. The rock is 192 feet above the ground.

$$t = \sqrt{16 - \frac{1}{16}s}, \quad 2 = \sqrt{16 - \frac{1}{16}s}$$

$$(2)^2 = \sqrt{16 - \frac{1}{16}s^2}$$

$$4 = 16 - \frac{1}{16}s$$

$$-12 = -\frac{1}{16}s$$

$$192 = s$$

2. No. After 3 seconds, the rock is 112 feet above the ground. Since the bird is flying at a level of 120 feet, it will be higher than the rock. Graphs should support this answer.

3. $0 \leq s \leq 256$

4. about 2.8 seconds

$$\begin{aligned}
 s &= \frac{256}{2} = 128 \\
 t &= \sqrt{16 - \frac{1}{16}(128)} \\
 &= \sqrt{16 - \frac{128}{16}} \\
 &= \sqrt{16 - 8} \\
 &= \sqrt{8}
 \end{aligned}$$

$$= 2\sqrt{2}$$

$$= 2.828427$$

5. The rock hits the ground when $s = 0$:

$$t = \sqrt{16 - \frac{1}{16}s}, \quad t = \sqrt{16 - \frac{1}{16}0} = \sqrt{16},$$

$$t = 4$$

So, the rock hits the ground after 4 seconds.

6. Answers will vary. Sample answer: Since the domain of the function is $0 \leq s \leq 256$, the range of the function is $0 \leq t \leq 4$. When s is 0, t is 0, and when s is 256, t is 4.

7. Yes. Answers will vary, but students should indicate that the function is a one-to-one function because for every value of s , there is one and only one value for t .

4.2 Rational Expressions, Equations, & Functions

Rational Operations

Student Logbook

1. rational expression; one

$$2. \frac{a}{c} \times \frac{b}{d}$$

$$3. \frac{a}{0}$$

4. excluded value

5. Yes; the quotient of two rational expressions can be expressed as the product of two rational expressions.

$$6. \frac{a+c}{b}$$

$$7. \frac{ad+cb}{bd}$$

8. denominator; x

$$9. \frac{d}{b}$$

Your Turn

1. a. -2 b. 0 c. -1 d. ± 2

$$2. \text{ a. } b \neq -2, 0, 2; \frac{5}{b(b-2)}$$

$$\text{ b. } c \neq 0; \frac{4c+12}{c}$$

$$\text{ c. } d \neq 0; \frac{2-5d}{4d^2}$$

$$\text{ d. } h \neq 0, 6; \frac{h+6}{h(h-6)}$$

$$\text{ e. } k \neq 0, 2; \frac{5k-14k+2}{k(k-2)}$$

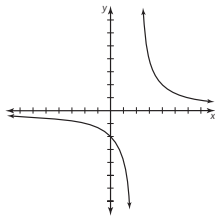
Rational Functions

Student Logbook

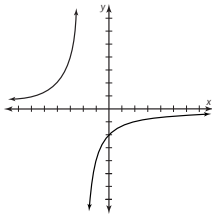
- rational equation
- hyperbola
- vertical axis, horizontal axis
- $\rightarrow +\infty$ $\rightarrow -\infty$
 $\rightarrow 0$ $\rightarrow 0$
- asymptote
- discontinuous
- excluded value, vertical asymptote
- horizontally
- asymptotes

Your Turn

- a. $>$ b. $<$ c. $>$ d. $<$
- $x = 1$
- a.



b.



Rational Equations

Student Logbook

- common denominator
- $x = 3$
- 3
- rate, time, work
- $7x$
- $t = \frac{d}{r}$
- extraneous root
- excluded values
- rational equation

Your Turn

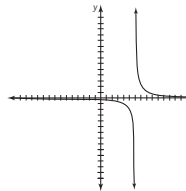
- a. $2k^2 + 8k$
b. $12w^2 - 36w$
c. $p^2 - 5p + 6$
- $p = 2.8$
- $b = 3$
- $3\frac{1}{3}$ hours
- a. $\frac{rt}{t-30}$
b. 8:10 A.M.
- $3\frac{1}{3}$ minutes

Unit Assessment

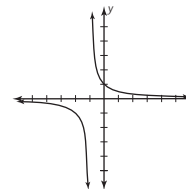
- a. $h \neq 0$ b. $g \neq -3$
c. $d \neq 2$
- a. $\frac{2w^2 + 6}{w - 2}$ b. $\frac{2z^2 + 5z - 3}{z^2 - 1}$
c. $\frac{4 - u}{36}$ d. $\frac{-y^2 - 5y + 42}{6y + 12}$
-

x	f(x)
-4	-2
-3	undefined
-2	2
-1	1
0	$\frac{2}{3}$
1	$\frac{2}{4}$ or $\frac{1}{2}$
2	$\frac{2}{5}$
3	$\frac{2}{6}$ or $\frac{1}{3}$
4	$\frac{2}{7}$

4. a.



b.



5. $\frac{t}{6} + \frac{t}{h} = 1$, so if $t = 4$, $h = 12$ hours
 6. a. 5 miles b. 18 mph c. 1.5 hours

Unit Investigation

- It decreases.
- It decreases.
- $\frac{1}{2}$ swing per second
- $\frac{1}{4}$ seconds
- Students' graphs should resemble the graph for $f = \frac{1}{T}$ but should be shifted away from the asymptotes.
- Students' graphs should resemble the graph for Question 5 but should be shifted even farther away from the asymptotes.
- Increasing the wavelength of a wave causes the period of a wave to increase for a given speed.

5.1 Graphical Displays

Stem & Leaf Plots & Box Plots

Student Logbook

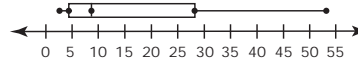
- collection; display; analysis
- histogram; intervals
- stem; leaf
- difference
- skewed
- median
- four
- second quartile
- box plot or box-and-whisker plot
- first; third
- outlier

Your Turn

1. stem	leaf
3	3
4	2 9
6	5 7
10	5 7
28	7
29	7
53	4

2. a. 3.3 b. 53.4
 c. 15.86 d. 8.6
 3. 4.9; 8.6; 28.7
 4. 23.8

5.



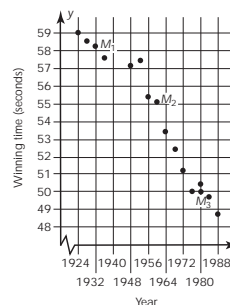
Scatter Plots & Linear Best-Fit Graphs

Student Logbook

- two
- best-fit
- median-median
- No; the line M_1M_3 does not represent the data in the center group because most of the data points in the center group lie below the line M_1M_3 .
- parallel; $\frac{1}{3}$; $\frac{2}{3}$
- trend
- predictions

Your Turn

1.



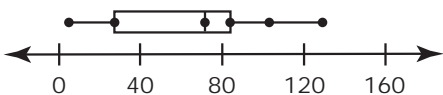
- $M_1 = (1932, 58.2)$;
 $M_2 = (1960, 55.2)$;
 $M_3 = (1980, 50.4)$
- $y = -0.1625x + 372.15$
 - $y = -0.1625x + 373.7$
 - $y = -0.1625x + 372.667$
- $y = 48.967$ seconds

Unit Assessment

1. stem	leaf	2 5 = 25mph
2	5	
3	0 2 2	
4	0 2 3 5	
5	0	
7	0	

- 40.9 mph
- 25 mph and 70 mph
- 45
- Yes; 40.9 represents the central tendency in the data set because it divides the data set into two equal halves, both consisting of five data points.

2. a. 32 mph; 41 mph; 45 mph



- 13 mph
 - The interquartile range shows that approximately 50% of the animals listed in the table have speeds between 32 mph and 45 mph.
- one-dimensional
 - one-dimensional
 - two-dimensional
 - $M_1 = (1937.5, 64.55)$
 $M_2 = (1960, 73.1), M_3 = (1982.5, 77.8)$
 - $m = 0.294$
 - $y = 0.294x - 504.43$
 - 82.1 years

Unit Investigation

- A box plot is the best way to display the desired information. The range of years that the middle 50% of the parks have been established is the interquartile range. To find this range, each quartile must be found:

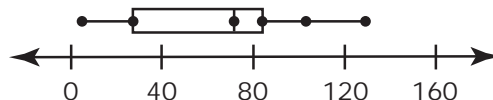
$$Q_1 = \frac{28 + 35}{2} = 31.5 \text{ years}$$

$$Q_2 = \frac{70 + 75}{2} = 72.5 \text{ years}$$

$$Q_3 = \frac{80 + 84}{2} = 82.0 \text{ years}$$

The interquartile range is $Q_3 - Q_1$, or $82.0 - 31.5 = 50.5$ years.

Outliers include Saguaro (5 years) and Yellowstone (127 years).



- A stem-and-leaf plot is the best way to display the desired information. The maximum is 27 years, and the minimum is 5 years. The mean of the data is 61.8. There are 5 values below the mean and 7 values above the mean. Thus, the data are only slightly skewed, and the mean does represent a central tendency.

stem	leaf	2/8 = 28 years
0	5	
2	8 8	
3	5 7	
7	0 5	
8	0 0 4	
9	3	
12	7	

- A scatter plot is the best way to display a general trend in the data. Accept all reasonable predictions for 2000. Sample: The prediction may not be reasonable because over the last ten years the number of visitors has not increased at regular intervals.

