NAME _____ DATE _____

# Fourth of July: Fireworks!

"Elijah, stop swinging that backpack before you knock something over! There are water bottles on the kitchen counter for everyone, so grab yours and keep track of it," Mom called.

Dancing into the kitchen with a sidestep, Elijah grabbed a bottle and shoved it into the pocket of his backpack, adding to the weight of his jacket, handheld video game, granola bar, and apple, which he already had stowed inside.

Mom shooed him out of the kitchen with a swat in the air. "Entertain your sister while I assemble our picnic."

"How many people will be there? Will we be able to see all the fireworks?" Tiana tugged on Elijah's backpack straps as she peppered him with questions.

Elijah sat on a straight-backed chair and tried to look important. He answered her questions quickly and asked, "Do you want to hear more about fireworks?"

She jumped up and down in response.

"In some communities, thousands of people gather to watch a fireworks display. While the audience enjoys the show, pyrotechnicians work hard behind the scenes to ensure the safety of those watching."

"Pyro what?" Tiana frowned at him.

"The people who set off the fireworks. I read about how it all works."

Turning away, she called over her shoulder, "I get the window seat!"

As they maneuvered through heavy holiday traffic, Elijah entertained himself with thoughts of what he'd learned. The pyrotechnicians set the shell inside a mortar tube and then light the fuse. A chemical reaction forces the shell into the air along a trajectory. With proper timing, the shell explodes at exactly the right point in its arc and the debris falls to the ground. The angle at which the explosive is shot makes a difference. If the shell is shot straight up, it goes higher before exploding, but a shell shot at an angle goes farther out before it bursts. The trick is to launch the firework at the correct angle so that it travels high enough in the air to be seen and far enough that the debris does not fall on the crowd.

### THINK ABOUT THE MATH

- The solution to an equation is the value of the variable that will make the equation true.
- We can substitute a value for the variable to prove that it makes the equation true.
- Use inverse operations (addition / subtraction, multiplication / division) to find the value of a variable.
- $\leq$ means "less than or equal to."
- $\geq$ means "greater than or equal to."

NAME _____ DATE _____

## Problem Solving

**Directions:** Use page 61 to answer these questions. First, skim the paragraphs to find information that might help you solve the problem. Remember to show your thinking as you do the math!

1. In 2010, organizers hoped to have 60,000 attendees at a local fireworks display. What is the difference between the anticipated attendance and the actual attendance of 35,000? Write and solve an equation.

2. Tickets for general admission to the historic site for the 4th of July celebration are $5 per person. The organizing committee needs to raise $250,000 to break even. Write and solve an equation to find how many tickets need to be sold.

Explain the strategies used to find your answer. _____

Prove the answer is correct by using substitution.

3. Extremely large shells require at least a 1,000-foot launch, while other shells can be launched to a height of half that height or less. Write and solve an inequality to show the possible launch heights of other shells.

4. A pyrotechnician might set up a fireworks station—with multiple fireworks—to go off every *n* minutes. If there are 4 such stations and one 5-minute station, how long will the show last? Write an expression.

NAME _____ DATE _____

**Engage**

**Directions:** Think about the science behind fireworks and fireworks displays.

1. Draw a diagram to show how a single firework is launched.

   Which two factors are important?

   _____

   _____

   _____

   _____

   _____

2. What do pyrotechnicians do to ensure a display remains safe for the audience?

   _____

   _____

   _____

3. Why do so many people attend fireworks displays? _____

   _____

   _____

   _____

4. What causes a firework to explode? _____

   _____

5. What is your opinion of fireworks and firework displays? Consider smaller local shows and/or larger regional shows. Include reasons and examples to support your arguments.

   _____

   _____

   _____

   _____

# Answer Key *(cont.)*

## Hitting the Trail (pages 31–33)

**Problem Solving: 1.** 29 feet; lose; $-253 > -282$ **2.** $\frac{1}{3}$ of 2,180 $= \frac{1}{3} \times 2{,}180 \approx 726.67$ miles; $726.67 \div 30 \approx 24.22$ miles/day **3.** $\frac{1}{2}$ of 2,180 = 1,090 miles; $1{,}090 \div 20$ miles/day $= 54\frac{1}{2}$ days **4.** $2{,}650 \div 120 \approx 22$ miles/day; $2{,}650 - 726.67 = 1{,}923.33$ miles farther **5.** $13{,}153 - 180 = 12{,}973$ ft. difference; 180 ft. is not described as a negative number, or below sea level, so it must be above sea level.

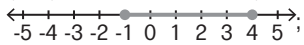
**Engage:** Answers will vary.

## Paleontology: Digging for Dinosaurs (pages 34–36)

**Problem Solving: 1.** 42: 1, 2, 3, 6, 7, 14, 21, 42; 36: 1, 2, 3, 4, 6, 9, 12, 18, 36; They can use a grid box 6 feet wide. **2.** 36: 1, 2, 3, 4, 6, 9, 12, 18, 36; 50: 1, 2, 5, 10, 25, 50; They can use a grid box 2 meters long. **3.** $\frac{5}{8} \times w = \frac{1}{4}$; $w = \frac{2}{5}$ mi. **4.** 2: 2, 4, 6, 8, 10; 5: 5, 10, 15, 20; On the 10th day he will visit both dig sites. **5.** 2,841 ft. difference in elevation

**Engage:** Answers will vary.

## Ocean Depths (pages 37–39)

**Problem Solving: 1.** 70% **2.** −1 **3.** Plotted point on number line should be at −2.65. **4.** 2.65 × 5,280 feet/mile = 13,992 feet; 13,992 feet ÷ 3.28 ≈ 4,265.9 meters **5.** 

; range = 5 **6.** Answers will vary.

**Engage:** Answers will vary.

## The Cartesian Plane (pages 40–42)

**Problem Solving:** Answers will vary.

**Engage:** Answers will vary.

## Polar Vortex (pages 43–45)

**Problem Solving: 1.** $-2 < 3 < 29$ **2.** January 6; January 5; 31°F difference **3.** above zero; by 3 degrees **4.** $-22 < -14$ **5.** January 6

**Engage:** Answers will vary.

## Mapping Public Transit (pages 46–48)

**Problem Solving: 1.** Verify points on grid for accuracy. **2.** 8° × 69 mi./degree = 552 mi. **3.–4.** Answers will vary based on coordinate plane drawn.

**Engage: 1.–2.** Answers will vary. **3.** *Possible answer:* Public transit maps help people plan which routes are the best to take to reach a particular destination. **4.** Answers will vary.

## Exponential Earthquakes (pages 49–51)

**Problem Solving: 1.** $10^9$ **2.** $10^4 = 10 \times 10 \times 10 \times 10 = 10{,}000$ microns **3.** $10^6 - 10^4 = (10 \times 10 \times 10 \times 10 \times 10 \times 10) - (10 \times 10 \times 10 \times 10) = 1{,}000{,}000 - 10{,}000 = 990{,}000$ microns **4.** $t = 18{,}045 - 9{,}833$; $t = 8{,}212$

**Engage: 1.** *Possible answer:* Safe places include under sturdy furniture that would protect you from falling debris, or against an interior wall. **2.** *Possible answer:* (1.) Drop to the ground. (2.) Cover your head and neck and/or crawl to a nearby safe place for cover. (3.) Hold on to a sturdy structure. **3.** Answers will vary. **4.** *Possible answers:* water, medications, non-perishable food items, battery-operated radio **5.** Answers will vary.

## Thousands of Books! (pages 52–54)

**Problem Solving: 1.** $g = 818{,}524 - 67{,}054$; $g = 751{,}470$ books **2.** 3; The library in the state's capital has a collection that is *three times* the size of the collection at Sofia's local library. **3.** $2r - 6$; 130 computers; 198 computers **4.** $t = 2c + 5$; $2c$; $t$, $2c$, and 5; $t = 41$ branches

**Engage:** Computed answers will vary, but expressions should be written as the following: **1.** $n + 50$ **2.** $3n + 62$ **3.** $c \div b$ **4.** $n - c$ **5.** $n - 75$

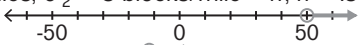
## Small Town U.S.A.: Tallulah Falls, Georgia (pages 55–57)

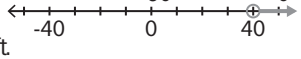
**Problem Solving: 1.** 6 mi.$^2$ **2.** 2 **3.** $2(w + 3) = 2w + 6$ **4.** $262 + a + b = 600$ ft. **5.** $\frac{1}{4}n = \frac{1}{2}$; $n = 2$ mi.

**Engage: 1.** It was founded on the basis of tourism—people wanted to come and see the falls; then the railroad came through the area, making it more accessible. **2.** The power company harnessed the falls to produce electricity, which changed the scenic nature of the area, and therefore detracted from the tourist attraction. The railroad increased tourist visits. **3.** The power company agreed to increase overall flow of water by a bit, and they also provide scheduled "water release" days for recreation and aesthetic purposes. **4.** Answers will vary. **5.** Answers will vary.

## Chicago's Pedway (pages 58–60)

**Problem Solving: 1.** let $c$ = current year: $c - 1951$ **2.** 8 blocks **3.** 9 blocks = 1.125 mi.; $A = 1.125 \times 0.75 \approx 0.84$ mi.$^2$ **4.** $n$ = number of miles; $6\frac{1}{2} \div 8$ blocks/mile = $n$; $n \approx .81$ mile

**Engage: 1.** $b > 50$; 

**2.** $b > 40$; 

**3.** $t = 138(10) + 70$; $t = 1{,}450$ ft.

## Fourth of July: Fireworks! (pages 61–63)

**Problem Solving: 1.** $d$ = the difference in attendance; $60{,}000 - 35{,}000 = d$; $d = 25{,}000$ people **2.** $x$ = number of tickets sold; $5x = 250{,}000$; $x = 50{,}000$ tickets; divided both sides of the equation by 5—inverse operation for multiplication; $5(50{,}000) = 250{,}000$ **3.** $h$ = height of other shells; $h \leq \frac{1}{2}(1{,}000)$; $h \leq 500$; any value 500 or less **4.** $4n + 5$

**Engage: 1.** height and angle of the firework **2.** They calculate the height and angle carefully so debris from the explosion does not fall on the crowd. **3.** Answers will vary but may include how it is illegal or too expensive for individuals to purchase fireworks; people enjoy the novelty and dramatic, mysterious nature of explosions. **4.** a chemical reaction, lighting a fuse **5.** Answers will vary.

## Fuel Cell Vehicles (pages 64–66)

**Problem Solving: 1.** $75{,}000 + m = 150{,}000$; $m = 75{,}000$ miles **2.** $231 \div 5.67 = g$; $g \approx 41$ gallons **3.** $4.4 \div 11 = t$; $t = 0.4$ hours = 24 minutes **4.** $p = 286 - 79$; $p = 207$ mph

**Engage: 1.** Answers will vary but might include cost and limited distribution of hydrogen. **2.** Hydrogen is a gas. When its atoms are combined with oxygen, it forms water. Its negatively charged electrons can be used to produce electricity. **3.** Answers will vary; accept all reasonable answers. **4.** no greenhouse gas emissions; reduced dependence on other types of fuel **5.** Answers will vary.