Weekly Focus: quadratic equations
Weekly Skill: solving

LESSON 27: Quadratic Equations part 2

Lesson Summary: For the warm-up, students will solve a problem about a party venue. In Activity 1, they learn to factor quadratic equations with the quadratic formula. In Activities 2 and 3, students will solve various problems with quadratic equations. Activity 4 is a short application problem. Estimated time for the lesson is 2 hours.

Materials Needed for Lesson 27:

- Video (length 8:01) on the quadratic formula. The video is required for teachers and recommended for students.
- 1 Notes (27.1) handout (attached)
- 1 Worksheet (27.2) with answers (attached)
- *Mathematical Reasoning Test Preparation for the 2014 GED Test* Student Book (pages 64 – 65)
- *Mathematical Reasoning Test Preparation for the 2014 GED Test* Workbook (pages 86 – 89)
- Note: Some websites for more practice problems are kutasoftware and math-aids.

Objectives: Students will be able to:

- Solve the review word problem
- Solve quadratic equations with factoring and with the quadratic formula
- Factor various quadratic equation problems

ACES Skills Addressed: N, CT, LS
CCRS Mathematical Practices Addressed: Building Solution Pathways, Mathematical Fluency, Model with Math
Levels of Knowing Math Addressed: Intuitive, Abstract, and Application

Notes:
You can add more examples if you feel students need them before they work. Any ideas that concretely relate to their lives make good examples.

For more practice as a class, feel free to choose some of the easier problems from the worksheets to do together. The "easier" problems are not necessarily at the beginning of each worksheet. Also, you may decide to have students complete only part of the worksheets in class and assign the rest as homework or extra practice.

The GED Math test is 115 minutes long and includes approximately 46 questions. The questions have a focus on quantitative problem solving (45%) and algebraic problem solving (55%).

Students must be able to understand math concepts and apply them to new situations, use logical reasoning to explain their answers, evaluate and further the reasoning of others, represent real world problems algebraically and visually, and manipulate and solve algebraic expressions.

This computer-based test includes questions that may be multiple-choice, fill-in-the-blank, choose from a drop-down menu, or drag-and-drop the response from one place to another.

The purpose of the GED test is to provide students with the skills necessary to either further their education or be ready for the demands of today's careers.

Lesson 27 Warm-up: Solve the party venue problem	**Time: 5-10 Minutes**

Write on the board:

Ibrahim is planning a party. He is considering using one of two venues. The banquet hall of hotel A will cost $862 for a reservation, plus $76 per dinner. The banquet hall of hotel B will cost $75 per dinner, in addition to $864 for the reservation.

Basic Questions:

- Which venue is a better deal for 15 guests?
  - A= $862 + $76(15) = $2,002, B=$864 + $75(15) = $1,989 so B is cheaper for 15 guests
- Venue A is in a city that charges 7% tax and Venue B is in a different city with 8% tax. Which is less expensive now?
  - A is less expensive with tax. A= $2,002 x 1.07 = $2142.14, B= $1989 x 1.08 =$2148.12

Extension Questions:

- How many guests would it take to have the venues cost the same? Write an equation with *g* for guests.
- Hint: Set up the equation with the two venues equal to each other to solve for g.
- $862 + $76g = $864 + $75g
  g = 2. With 2 guests the two venues would cost the same at $1,014.

Lesson 27 Activity 1: Quadratic Formula	**Time: 30 Minutes**

1. In the previous lesson, we learned how to solve quadratic equations with factoring. Let's do one problem for review. Factor $x^2 + 4x - 21 = 0$. *Answer: (x+7)(x – 3)= 0 so x = -7, x = 3*
2. Sometimes equations such as $x^2 - 5x - 14 = 0$ are not easy to factor.
3. That is when we use the quadratic formula. $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$.
4. Note: The formula is given on the GED test so you don't need to memorize it.

5. Example:

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

setting y to zero and using the quadratic formula we have:

$$x = \frac{-5 \pm \sqrt{5^2 - 4 \cdot 4}}{2}$$

$$x = \frac{-5 \pm 3}{2}$$

$$x = \frac{-8}{2} \quad \text{and} \quad x = \frac{-2}{2}$$

$$x = -4 \quad \text{and} \quad x = -1$$

6. Handout **Notes 27.1.** Do this example on the board also.
7. **Do Worksheet 27.2**. Circulate to help. Have volunteers solve a few problems on the board.

Lesson 27 Activity 2: Practice Problems	**Time: 15-20 Minutes**

1. Do the problems in the **student book pages 64-65.**
2. Page 64 has more examples of multiplying and factoring you can do if necessary.

Lesson 27 Activity 3: Independent Practice	Time: 40-45 Minutes

1. Have students work independently in the **workbook pages 86-89.**
2. Circulate to help.
3. Choose a few problems to have volunteer students do on the board and explain if they want.

Lesson 27: Application Problem	Time: 5-10 Minutes

A rectangular box has a volume of 280 cm^3. The dimensions of the box are 4 cm by x cm by (x+3) cm. Solve for x.

Answer:

$V = (x)(4)(x + 3) = 280$
$V = 4x (x + 3) = 280$ (Step 2)
$4x^2 + 12x = 280$
$4x^2 + 12x – 280 = 0$
$4(x^2 + 3x – 70) = 0$
Divide both sides by 4 to get rid of it. You could also have done that earlier in step 2.
$(x^2 + 3x – 70) = 0$
$(x – 7)(x+10) = 0$
$x = 7$ or $x = -10$
Since we can't have a negative measurement, the answer is $x = 7$
Check: $V = (7)(4)(7+3) = (28)(10) = 280$. Correct.

Notes Handout 27.1

Using the Quadratic Formula - Step-by-Step Lesson

Solve using the quadratic formula.

$6y^2 - 9y + 3 = 0$

Explanation:

We will use the quadratic formula is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Where $a \neq 0$.
We can use it to solve a quadratic equation $(ax^2 + bx + c = 0)$.

Now we will use the quadratic formula to solve $6y^2 - 9y + 3 = 0$.

In this case a = 6 b = -9 c= 3. We plug those values in:

$$y = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$y = \frac{-(-9) \pm \sqrt{(-9)^2 - 4(6)(3)}}{2(6)}$$

$$y = \frac{9 \pm \sqrt{81 - 72}}{12}$$

$$y = \frac{9 \pm \sqrt{9}}{12}$$

$$y = \frac{9 - \sqrt{9}}{12} \quad or \quad y = \frac{9 + \sqrt{9}}{12}$$

$$y = \frac{9 - 3}{12} \quad or \quad y = \frac{9 + 3}{12}$$

$$y = \frac{1}{2} \quad or \quad y = 1$$

Worksheet 27.2 Solving with the Quadratic Formula

Solve each equation with the quadratic formula.

1) $6g^2 + 2g - 60 = 0$

2) $m^2 + m - 20 = 0$

3) $d^2 - 6d - 40 = 0$

4) $y^2 - 10y - 11 = 0$

5) $w^2 - 2w - 80 = 0$

6) $6r^2 + 4r - 42 = 0$

7) $q^2 + 6q - 27 = 0$

8) $20n^2 - 46n - 10 = 0$

9) $8s^2 + 32s - 18 = 0$

10) $30z^2 + 116z + 110 = 0$

Worksheet 27.2 Answers

1) $6g^2 + 2g - 60 = 0$

$g = \{ 3 , \frac{-10}{3} \}$

2) $m^2 + m - 20 = 0$

$m = \{ -5 , 4 \}$

3) $d^2 - 6d - 40 = 0$

$d = \{ 10 , -4 \}$

4) $y^2 - 10y - 11 = 0$

$y = \{ 11 , -1 \}$

5) $w^2 - 2w - 80 = 0$

$w = \{ 10 , -8 \}$

6) $6r^2 + 4r - 42 = 0$

$r = \{ -3 , \frac{7}{3} \}$

7) $q^2 + 6q - 27 = 0$

$q = \{ 3 , -9 \}$

8) $20n^2 - 46n - 10 = 0$

$n = \{ \frac{-1}{5} , \frac{5}{2} \}$

9) $8s^2 + 32s - 18 = 0$

$s = \{ \frac{1}{2} , \frac{-9}{2} \}$

10) $30z^2 + 116z + 110 = 0$

$z = \{ \frac{-11}{5} , \frac{-5}{3} \}$