

MeTEOR Performance Task

Algebra II

Mathematics
Population Growth

Performance Task Item: Population Growth

Grade Level: Algebra 2

Focus Area: Solving Radical Equations

Essential Question: How can you solve radical equations?

Core Ideas:

- Understands how to solve equations.
- Understands why isolating a variable is important.
- Understands how to eliminate a rational exponent.
- Understands extraneous solutions.
- Understands how to eliminate a radical sign.

Learning Targets:

- Students will solve a rational equation in one variable.
- Students will solve a radical equation in one variable
- Students will justify algebraically why a solution is extraneous.
- Students will explain their reasoning.

STANDARDS

Domain: Algebra: Reasoning with Equations & Inequalities

Content Standards:

- Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Supporting Standards:

- Know precise definitions of quadratic terminology.
- Solve equations in inequalities in one variable.

Math Practice Standards:

MP 1: Make sense of problems and persevere in solving them.

MP 2: Reason abstractly and quantitatively.

MP 3: Construct viable arguments and critique the reasoning of others.

MP 4: Model with mathematics.

MP 6: Attend to precision.

MP 7: Look for and make use of structure.

Materials:

- Performance Task
- Pencil
- Paper
- Calculator

Task/Question 1:

DOK Level 1: Recall & Reproduction

Math Practice Standard:

- MP 6: Attend to precision.

A. Fill in the blanks below:

A radical equation is an equation that has a variable in a _____ or a variable with a _____ exponent.

B. How do you get rid of the rational exponent?

C. Write the solution to each equation:

$$3(x + 1)^{2/3} = 12$$

$$2(x + 3)^{2/3} = 8$$

$$(7x - 3)^{1/2} = 5$$

$$\sqrt{2x - 1} = 3$$

$$4 + \sqrt{2x + 5} = 7$$

$$\sqrt{2x + 3} - 7 = 0$$

- D.** Johnny, the pool technician at **Jones Caribe**, tested the swimming pool water after he cleaned the pool for his routine bacteria count. The equation he used to see what the bacteria count was $y = 5500\sqrt{(0.025x + .1)}$ where x represents the number of minutes passed. After how many minutes are there 3000 bacteria left in the swimming pool? Round to the nearest minute.

Task/Question 2:

DOK Level 2: Basic Application of Skills and Concepts

Math Practice Standards:

- MP 1: Make sense of problems and persevere in solving them.
- MP 6: Attend to precision.

A. What do extraneous solutions mean?

B. Solve and check:

$$\sqrt{x} + 32 = 7$$

$$\sqrt{x + 2} + 12 = 7$$

$$\sqrt{x + 1} = x + 1$$

C. Benjamin solved $\sqrt{x} = x - 2$ and got two answers as his solution. One of his classmates, Makayla, solved the same equation and got only one answer as a solution. Solve the equation and explain who is correct and why they are correct.

D. The citrus industry conducted a survey to see the average amount of oranges consumed per year. They found the average amount of oranges consumed (in pounds per person) between years 2000 and 2016. One of the statisticians came up with the equation, $y = \sqrt{22x + 290}$, where x is the number of years since 2000. In what year were about 20 pounds of apples consumed per person? Explain how you got your answer.

Task/Question 3:**DOK Level 3:** Strategic Thinking and Complex Reasoning**Math Practice Standards:**

- MP 1: Make sense of problems and persevere in solving them.
- MP 2: Reason abstractly and quantitatively.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.
- MP 7: Look for and make use of structure.

Ruthie and Lyndie opened a new company called **Educator's Brain Shop**. Knowing they would need financial backing, they went before the **Shark Team** to seek financial aid. This arrangement would not be free; it would come with a cost of the company's shares and profits. After working with the **Shark Team** for a little more than a year, their company grew to having an average profit, in the millions, per year from 2000 - 2016. The equation the Sharks used to project their earnings can be modeled by the equation $y = 4.5\sqrt{1.2x + 1.05}$ where x is the number of years since 2000.

- A.** How many years will it take the profit to average 13.5 million a year?
- B.** The Shark Team receives 50% of the profits. How much money will each Shark team member get if they split it equally between the five of them?
- C.** Ruthie and Lyndie want each of their profits to be at least 4.5 million before they can retire. How many years will they need to work in order to reach that amount?
- D.** Explain how you got your answer to Part C. Justify and defend how your approach to solving this is the **most efficient**.

Task/Question 4:

DOK Level 3: Strategic Thinking and Complex Reasoning

Math Practice Standards:

- MP 1: Make sense of problems and persevere in solving them.
- MP 2: Reason abstractly and quantitatively.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.
- MP 7: Look for and make use of structure.

The 2015 Census showed the population of Savage Island rapidly increasing. The population increase can be calculated by $P(t) = 5\sqrt{3 + 0.23t}$. **P** is the population (measured by millions) and **t** the time (measured by years).

- A.** About how many years will it take the Island to reach 15 million people?
- B.** About how many years will it take the Island to reach 20 million people?
- C.** The Island has a population growth limit of 25 million. Using 2015 as your baseline, when will the Island hit its limit? If you work on the growth board, how will you handle stopping the growth at that time?
- D.** Explain how you determined your answer to Part C. Justify and defend how your approach to solving this is the **most efficient**.

Complete Performance Task Scoring Rubric *Population Growth*

21-23 Proficient 19-20 Good 16-18 Satisfactory 14-15 Poor 0-13 Unsatisfactory

	Depth of Knowledge Level	Points	Total Possible Points for Task	Total Points Earned by Student
<p>Task 1:</p> <p>A. Radicand, rational</p> <p>B. Raise each side of the equation to the reciprocal power</p> <p>C. $7, -9$ $5, -11$ 4 5 2 23</p> <p>D. About 8 minutes</p>	1	<p>1</p> <p>1</p> <p>3</p> <p>1</p>	6	
<p>Task 2:</p> <p>A. When a number satisfies the transformed equation, but not the original equation when checked.</p> <p>B. $x = 625$, extraneous $x = 23$, extraneous $x = 0, -1$</p> <p>C. Benjamin did not check his work, but Makayla did. She found that 1 was extraneous because it did not work as a solution to the original equation.</p> <p>D. “First, I substituted the 20 in for y, and then solved the radical by squaring both sides, subtracting and performing division. I got 5. I added 5 to the year and got 2005.”</p>	2	<p>1</p> <p>3</p> <p>1</p> <p>2</p>	7	

<p>Task 3:</p> <p>A. 6.6 years</p> <p>B. 1.35 million</p> <p>C. 12.5 years</p> <p>D. Answers may vary. Possible Explanation: “First, I knew I had to double the amount that Ruthie and Lyndie would get because their half was divided by two. Then, I had to double that amount because the Shark Team gets half of the total. That took me up to 18 million. I substituted this amount into the equation and solved for x. I got 12.5 years.”</p>	<p>2</p>	<p>1</p> <p>1</p> <p>1</p> <p>2</p>	<p>5</p>	
<p>Task 4:</p> <p>A. 26 years</p> <p>B. 56.5 years</p> <p>C. 2110 “I will not be on the board at that time.”</p> <p>D. Answers may vary. Possible Explanation: “I solved the equation with the given information and came up with 95.7 years. That means it would take 95.7 years to hit the population limit. I would have to add that number to my current age. Assuming I will not be living at that time, I won’t be here to handle the situation.”</p>	<p>3</p>	<p>1</p> <p>1</p> <p>1</p> <p>2</p>	<p>5</p>	
TOTAL POINTS:				



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