MeTEOR Performance Task

Algebra II

Mathematics

Rational Exponents with Pool Dimensions

800-699-7516 | meteoreducation.com

MeTEOR
CONNECTING THE DOTS

Performance Task Item: Rational Exponents with Pool Dimensions

Grade Level: Algebra 2

Focus Area: Rational Exponents

Essential Question: To simplify the nth root of an expression, what must be true about the expression?

Core Ideas:

- Understands the laws of exponents.
- Understands rational numbers can be used as exponents.
- Understands a rational exponent represents both an integer exponent and an nth root.

Learning Targets:

- Students will simplify radical expressions.
- Students will use the properties of exponents to rewrite a radical expression as an expression with a rational exponent.
- Students will use the properties of exponents to rewrite an expression with a rational exponent to a radical expression.
- Students will apply the properties of operations of integer exponents to expressions with rational exponents.
- Students will apply the properties of operations of integer exponents to radical expressions.
- Students will explain their reasoning.

STANDARDS

Domain: Algebra: Number & Quantity: The Real Number System

Content Standards:

- Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{1/3\ (1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*
- Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Supporting Standard:

- Know precise definitions of radical function terminology.

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. What is the value under the radical symbol called?

B. Write the rational exponent rule also known as the exponent property of nth roots:

C. Fill in the blank below:

The _____ gives the degree of the root.

D. Simplify each of the following expressions:

$216^{1/3}$ = _____ $36^{1/2}$ = _____ $64^{4/3}$ = _____ $32^{4/5}$ = _____

$(-343)^{1/3}$ = _____ $(-243)^{1/5}$ = _____ $9^{1.5}$ = _____ $4^{5/2}$ = _____

E. Write each expression in radical form:

$X^{2/5}$ = _____ $27^{2/3}$ = _____ $81^{3/4}$ = _____ $4^{1.5}$ = _____

F. Scientists use the expression $0.036m^{3/4}$ when they are studying fluids. To the closest whole number, what is the value of the expression if m = 50,000?

Task/Question 2:

DOK Level 2: Basic Application of Skills and Concepts

Math Practice Standards:

- MP 2: Reason abstractly and quantitatively.
- MP 6: Attend to precision.

A. Multiply and simplify each :

$7^{1/2} \cdot 7^{1/2}$ = _____ $8^{1/3} \cdot 8^{2/3}$ = _____ $2\sqrt[4]{81^3}$ = _____

B. Solve for x:

$27^x = 9^{x+3}$ _____ $32^x = 8^{x+2}$ _____

C. Explain how you got your answers in Part B:

D. Anthony's Transport Company uses a kind of container that has the dimensions $64^{1/3}$ inches by $4^{3/2}$ inches by $27^{2/3}$ inches. What is the volume of the container?

E. Anthony needs a larger container and doubles the simplified dimensions in Part D. How does that change the volume? Explain.

Task/Question 3:

DOK Level 2: Basic Application of Skills and Concepts

Math Practice Standards:

- MP 1: Make sense of problems and persevere in solving them.
- MP 2: Reason abstractly and quantitatively.
- MP 6: Attend to precision.

Fatima, a zoo veterinarian, has been asked to study the brains of several animals at the zoo. By studying the brain mass, she can detect certain illnesses and diseases should they arise within the animal. She has been told that the brain mass for each animal can be found using the formula**,** $\mathbf{b = 0.01m^{2/3}}$, where **b** is the brain mass and **m** is the body mass of the animal.

A. Find the estimated brain masses for the following animals by their weight:

Moose: 512 Kg _____

Elephant: 5832 Kg _____

Lion: 343 Kg _____

Llama: 216 Kg _____

B. A blue whale, not at its heaviest, may have a brain mass of 33.64Kg. What would the body mass be of the whale?

C. Explain how you got your answer in Part B:

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 4: Model with mathematics.
- MP 6: Attend to precision.
- MP 7: Look for and make use of structure.

Gina decided to have a swimming pool built in her backyard. She had two rectangular shape pools she could choose from that would fit nicely in the area she selected. Pool A measured $1024^{2/5}$ feet by $625^{1/2}$ feet. Pool B measured $256^{1/2}$ feet by $961^{1/2}$ feet. Both pools are considered wading pools and have the same depth of $64^{1/3}$ feet.

A. What is the Perimeter of each pool?

(Pool A) P = _____

(Pool B) P = _____

B. What is the volume of each pool?

(Pool A) V = _____

(Pool B) V = _____

C. What is the difference in the volume of the two pools in Part B?

D. Gina decides she wants a square pool, not a rectangular one. What would be the dimensions of the smaller pool if the volume is the same as your answer in Part B?

E. Explain how you got your answer to Part D. Then, check to see if there are any other dimensions that will allow the volume to remain the same if you change the depth of the pool. Justify and defend how your process is the ***most efficient*** way of determining the side lengths.

Complete Performance Task Scoring Rubric
Rational Exponents with Pool Dimensions

22-24 Proficient 19-21 Good 17-18 Satisfactory 14-16 Poor 0-13 Unsatisfactory

	Depth of Knowledge Level	Points	Total Possible Points for Task	Total Points Earned by Student
Task 1:	**1**		**8**	
A. radicand		**1**		
B. $b^{m/n} = \sqrt[n]{b^m}$		**1**		
C. index		**1**		
D. 6, 6, 256, 16 -7, -3, 27, 32		**2**		
E. $\sqrt[5]{x^2}$, $\sqrt[3]{27^2}$, $\sqrt[4]{81^3}$, $\sqrt[2]{4^3}$		**2**		
F. 120		**1**		
Task 2:	**2**		**5**	
A. 7, 8, 54		**1**		
B. 6, 3		**1**		
C. "I simplified the bases to their prime factors. Then, set the exponents to an equation and solved them."		**1**		
D. 288 cubic inches		**1**		
E. "I knew that when you double the dimensions in a volume problem, the volume becomes 8 times the amount. I doubled the numbers and multiplied it out to verify."		**1**		

Task 3: A. Moose: 0.64 Kg Elephant: 3.24 Kg Lion: 0.49 Kg Llama: 0.36 Kg B. 195,112 Kg C. "First, I set up the equation and divided out the .01 getting 3,364. Since this represented two thirds of the weight, I worked backwards by inversing the exponent, using three halves as the exponent. Finally, I checked my work."	**2**	 **2** **1** **2**	**5**	
Task 4: A. 82 ft., 94 ft. B. 1600 cubic feet, 1984 cubic feet C. 384 cubic feet D. 20 by 20 by 4 E. Answers will vary. Possible Explanation: "First, I divided by 4 because that was the constant depth of each pool. Then, I square rooted the remaining number to see if it were a perfect square. Since it was, I had my answer. I checked my work and it was correct. I did find one other set of dimensions that would work if you made the pool 16 feet deep. The side lengths would be 10 feet".	**3**	 **1** **1** **1** **1** **2**	**6**	
			TOTAL POINTS:	

CONNECTING THE DOTS

meteoreducation.com . 800.699.7516