WALCH EDUCATION

Daily Warm-Ups ALGEBRA

Common Core State Standards

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Part 1: Number and Quantity

Overview

The Real Number System

- Extend the properties of exponents to rational exponents.

Vector and Matrix Quantities

- Perform operations on matrices and use matrices in applications.

Exponential Expressions

The following exponential expressions can be rewritten in other forms. Use your understanding of how exponents behave to change each expression to an equivalent one.

1. x^{-n}

2. $\frac{y^r}{y^s}$

3. $(x^a)^b$

4. $(ab)^n$

5. $\left(\frac{d}{t}\right)^n$

6. $\frac{1}{x^n}$

7. $n^p \bullet n^q$

8. $y^{\frac{1}{n}}$

Intercepting Intercepts

Do all quadratic functions have real-number x-intercepts? Do they all have real-number y-intercepts? Justify your answers to these questions by generating sample functions symbolically and/or graphically. Then explain if and why the functions have real-number intercepts and what the graphs will look like.

Thinking About Using Matrices

Think about a real-world context for creating matrices. What are some advantages and disadvantages of organizing and representing the information in a matrix format? Explain how data might be represented in matrices in more than one way. Write a few sentences to explain your thinking.

Bicycle Sales Matrices

The first matrix below represents the combined quarterly sales of three brands of mountain bikes and hybrid bikes at Bikes Unlimited in three large American cities. The second matrix shows the quarterly sales of hybrid bikes.

Combined Sales

	Trek	K2	Schwinn
Los Angeles	150	95	105
Boston	75	75	90
Chicago	85	110	175

Hybrid Sales

	Trek	K2	Schwinn
Los Angeles	50	40	70
Boston	30	35	50
Chicago	55	50	150

Find the matrix that represents the quarterly sales of mountain bikes. Find the matrix that represents the quarterly sales of mountain bikes and hybrid bikes in Boston for the three brands. Then construct one matrix that shows the total sales for all three brands in all three cities combined. Label the rows of your matrix with the brand names. Label the columns with the terms *hybrid* or *mountain*. What matrix operations did you use to construct each of these matrices?

Manipulating Matrices

Perform the indicated operations on the given matrices and scalars without using a calculator.

$s_1 = 4,\ s_2 = -3$ $\quad [A] = \begin{bmatrix} 3 & 6 \\ 4 & 2 \end{bmatrix}$ $\quad [B] = \begin{bmatrix} -2 & 4 \\ 5 & -1 \end{bmatrix}$ $\quad [C] = [-2 \quad 4 \quad 3]$

$[D] = [3 \quad -2]$ $\quad [E] = \begin{bmatrix} -1 & -5 \\ 3 & -4 \\ 2 & 3 \end{bmatrix}$ $\quad [F] = \begin{bmatrix} 3 & -2 & 4 \\ -1 & 5 & -3 \end{bmatrix}$

1. $[A] + [B]$
2. $s_1 \bullet [B]$
3. $[B] - [A]$
4. $s_2 \bullet [C]$
5. $[F] - [E]$

More Manipulating Matrices

Perform the indicated operations on the given matrices and scalars without using a calculator.

$s_1 = 4,\ s_2 = -3$ $\quad [A] = \begin{bmatrix} 3 & 6 \\ 4 & 2 \end{bmatrix}$ $\quad [B] = \begin{bmatrix} -2 & 4 \\ 5 & -1 \end{bmatrix}$ $\quad [C] = [-2 \quad 4 \quad 3]$

$[D] = [3 \quad -2]$ $\quad [E] = \begin{bmatrix} -1 & -5 \\ 3 & -4 \\ 2 & 3 \end{bmatrix}$ $\quad [F] = \begin{bmatrix} 3 & -2 & 4 \\ -1 & 5 & -3 \end{bmatrix}$

1. $s_1 \bullet [A] - s_2[B]$
2. $[A] - [B]$
3. $[B] + [D]$
4. $[E] \bullet [F]$

Thinking About Multiplying Matrices

Think about the process of multiplying matrices. Describe in detail how to multiply two matrices and any limitations there might be. Does the order that you multiply matrices matter? Write a few sentences to explain your thinking.

Problem Number	Common Core State Standard(s)
	Category: Number and Quantity
1	**N-RN.2.** Rewrite expressions involving radicals and rational exponents using the properties of exponents.
2	**N-CN.9.** (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
3	**N-VM.6.** (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
4	**N-VM.6.** (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. **N-VM.8**. (+) Add, subtract, and multiply matrices of appropriate dimensions.
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7	**N-VM.8.** (+) Add, subtract, and multiply matrices of appropriate dimensions. **N-VM.9.** (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
8	**N-VM.8.** (+) Add, subtract, and multiply matrices of appropriate dimensions. **N-VM.9.** (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.

Answer Key

Part 1: Number and Quantity

1. 1. $\frac{1}{x^n}$
   2. y^{r-s}
   3. x^{ab}
   4. $a \quad b$
   5. $\frac{d^n}{t^n}$
   6. x^{-n}
   7. n^{p+q}
   8. $\sqrt[n]{y}$
2. Answers will vary. Sample answer: Not all quadratic functions have *x*-intercepts, but they do all have a *y*-intercept. Quadratic functions can have 2, 1, or 0 *x*-intercepts depending on the location of the vertex and the direction of the opening. One example: If the quadratic function has a vertex below the *x*-axis and opens down, then it has no *x*-intercepts.
3. Answers will vary. Sample answer: An advantage is that matrices are easily stored and calculated with technology. Disadvantages are that matrices only represent two variables in the rows and columns and are not as visual as graphs. A matrix could be represented in different matrices by transposing the rows and columns and by listing the data in a different order.
4. **Mountain bike sales**

	Trek	K2	Schwinn
Los Angeles	100	55	35
Boston	45	40	40
Chicago	30	60	25

Boston sales

	hybrid	mountain
Trek	30	45
K2	35	40
Schwinn	50	40

Combined sales all cities

	hybrid	mountain
Trek	135	175
K2	125	155
Schwinn	270	100

Students used addition and subtraction of matrices to construct the matrices.