Algebra 1 Readiness Intervention Lessons

Readiness Standard 4 - 8.EE.1

Learning Target: I will simplify numerical expressions with integer exponents

Readiness for 8.EE.2: Find equivalent numerical expressions using square roots and cube roots

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Learning Target: I will simplify numerical expressions with integer exponents.

IES Recommendations for Improving Algebra Knowledge:

Recommendation
1. Use solved problems to engage students in analyzing algebraic reasoning and strategies.
2. Teach students to utilize the structure of algebraic representations.
3. Teach students to intentionally choose from alternative algebraic strategies when solving problems.

(Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students, 2015, p. 3)

High School Planning Guide

Algebra 1 - Readiness Standard 4 - 8.EE.1

Recommended Actions ≈ 30 minutes	
Beginning *(5 min.)*	➢ **Review** the learning target with the whole group. ➢ For sessions 2, 3 and 4, ask each student to **set a personal goal** for the day based on their previous Quick Check Score and use a highlighter to plot their goal on their Growth Chart.
Middle *(15 min.)*	➢ **Guided Practice** o **Whole Group (Analyze solved problems)** ▪ The teacher covers up all solution steps except the first two. ▪ The teacher asks, "What math happened?" and elicits student responses to fill in the missing information. ▪ The teacher answers student questions to clarify the solution step. ▪ The teacher uncovers the next answer blank and repeats the analysis. o **Pairs (Gradual release to solve problems)** ▪ Students take turns leading to "think aloud" while completing each problem.
End *(10 min.)*	➢ **Reflect, Assess and Monitor Progress** o Ask students to **reflect** on their progress towards the learning target. ▪ What did I learn today about the learning target? ▪ How confident do I feel about doing the learning target on my own? o **Assess** each student's progress using a Quick Check. o Guide students to **self-correct** their Quick Check. o Guide students to **chart their progress** in their Growth Chart. ▪ If not using Delta Math lessons, record the activity in the table. o Collect each student's Quick Check and Growth Chart.
After	➢ **Exit** students who meet or exceed the learning goal for a third time.

Name _____ Date _____

Learning Target: I will simplify numerical expressions with positive integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 1: Guided Practice (Whole Group)

Directions: Below are solved problems to simplify expressions with exponents. For each solution step, discuss what happened and fill in the missing information.

Write	Describe
1. $3^6 \times 3^2 = 3 \bullet 3 \bullet 3 \bullet 3 \bullet 3 \bullet 3 \times 3 \bullet 3$ $= 3^8$	**Changed to Repeated Multiplication** 3 • 3 • 3 • 3 • 3 • 3 = _____ and 3 • 3 = _____ to see the total number of common bases. **Changed Back to Exponential Form** The exponent _____ represents 3 multiplied by itself _____ times.
2. $\frac{5^6}{5^2} = \frac{5 \bullet 5 \bullet \cancel{5} \bullet \cancel{5} \bullet 5 \bullet 5}{\cancel{5} \bullet \cancel{5}}$ $= 5 \bullet 5 \bullet 5 \bullet 5$ $= 5^4$	**Changed to Repeated Multiplication** 5 • 5 • 5 • 5 • 5 • 5 = _____ and 5 • 5 = _____ to see the total number of common bases. **Simplified Fractions** When multiplying, ignore each $\frac{5}{5}$ because its value is _____. **Changed Back to Exponential Form** The exponent _____ represents 5 multiplied by itself _____ times.
3. $(4^2)^5 = 4^2 \bullet 4^2 \bullet 4^2 \bullet 4^2 \bullet 4^2$ $= 4 \bullet 4 \bullet 4 \bullet 4 \bullet 4 \bullet 4 \bullet 4 \bullet 4 \bullet 4 \bullet 4$ $= 4^{10}$	**Changed to Repeated Multiplication** $4^2 \bullet 4^2 \bullet 4^2 \bullet 4^2 \bullet 4^2$ = _____ to see the total number of common bases. **Changed to Repeated Multiplication** Each 4 • 4 = _____ to see the total number of common bases. **Changed Back to Exponential Form** The exponent _____ represents 4 multiplied by itself _____ times.

Name _____ Date _____

Learning Target: I will simplify numerical expressions with positive integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 1: Guided Practice (Pairs)

Directions: Complete the missing steps to simplify each expression in exponential form.

4. $4^7 \times 4^3$ $4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \times 4 \cdot 4 \cdot 4$ $4^{\square}$	**5.** $7^6 \cdot 7^3$ $7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot$ _____ $7^{\square}$
6. $\frac{9^6}{9^4}$ $\frac{9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9}{}$ $9^{\square}$	**7.** $\frac{5^9}{5^3}$ $\frac{\quad}{5 \cdot 5 \cdot 5}$ $5^{\square}$
8. $(8^3)^4$ _____ $8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8$ _____	**9.** $(6^4)^2$ $6^4 \cdot 6^4$ _____ $6^{\square}$

Name _____ Date _____

Learning Target: I will simplify numerical expressions with positive integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 1: Guided Practice (Teacher Notes)

Directions: Below are solved problems to simplify expressions with exponents. For each solution step, discuss what happened and fill in the missing information.

Write	Describe
1. $3^6 \times 3^2 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \times 3 \cdot 3$ $= 3^8$	**Changed to Repeated Multiplication** $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 =$ **3^6** and $3 \cdot 3 =$ **3^2** to see the total number of common bases. **Changed Back to Exponential Form** The exponent **8** represents 3 multiplied by itself **8** times.
2. $\frac{5^6}{5^2} = \frac{5 \cdot 5 \cdot \cancel{5} \cdot \cancel{5} \cdot 5 \cdot 5}{\cancel{5} \cdot \cancel{5}}$ $= 5 \cdot 5 \cdot 5 \cdot 5$ $= 5^4$	**Changed to Repeated Multiplication** $5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 =$ **5^6** and $5 \cdot 5 =$ **5^2** to see the total number of common bases. **Simplified Fractions** When multiplying, ignore each $\frac{5}{5}$ because its value is **1**. **Changed Back to Exponential Form** The exponent **4** represents 5 multiplied by itself **4** times.
3. $(4^2)^5 = 4^2 \cdot 4^2 \cdot 4^2 \cdot 4^2 \cdot 4^2$ $= 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$ $= 4^{10}$	**Changed to Repeated Multiplication** $4^2 \cdot 4^2 \cdot 4^2 \cdot 4^2 \cdot 4^2 =$ **$(4^2)^5$** to see the total number of common bases. **Changed Again to Repeated Multiplication** Each $4 \cdot 4 =$ **4^2** to see the total number of common bases. **Changed Back to Exponential Form** The exponent **10** represents 4 multiplied by itself **10** times.

Session 1: Self-Reflection

Algebra 1 – Readiness Standard 4 – 8.EE.1

Learning Target: I will simplify numerical expressions with integer exponents

Briefly discuss student responses

- What did I learn today about simplifying numerical expressions with integer exponents?

- How confident do I feel about simplifying numerical expressions on my own? *(Thumbs up, down, or sideways)*

Algebra 1 Quick Check – Form A

Readiness Standard 4 - 8.EE.1

Name_____ Date_____

Learning Target: I will find equivalent numerical expressions using properties of integer exponents.

Directions: Circle the equivalent expression for each problem. (Work time: 3 minutes)

1.

$5^6 \times 5^4$

5^{10} 5^{24} 25^{10} 10^{24}

2.

$4^3 \times 4^7$

16^{10} 8^{21} 4^{10} 4^{21}

3.

$$\frac{2^8}{2^4}$$

2^{-4} 2^4 1^2 1^4

4.

$$\frac{8^3}{8^9}$$

1^6 1^{-3} 8^6 8^{-6}

5.

$(5^6)^2$

5^8 5^4 5^{12} 5^3

6.

$(3^4)^8$

3^4 3^{32} 3^{12} 3^2

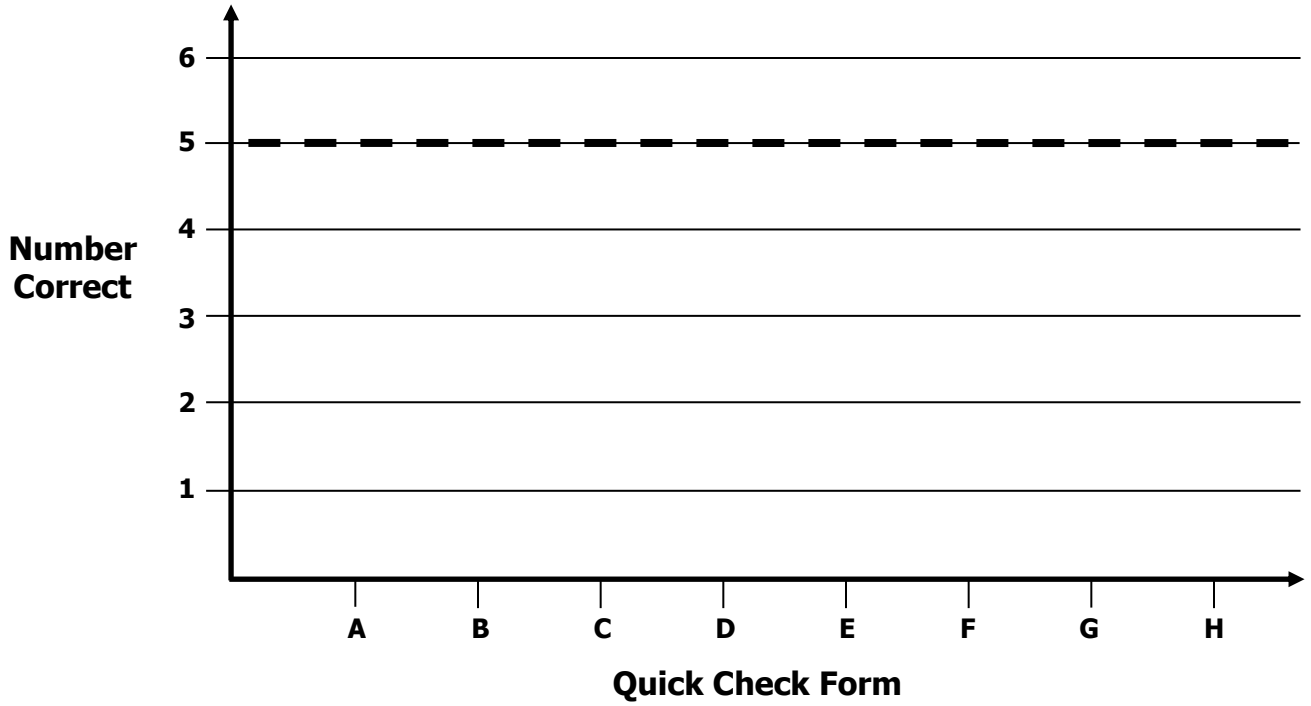
Algebra 1 Growth Chart

Readiness Standard 4 - 8.EE.1

Name_____

Learning Target: I will simplify numerical expressions with integer exponents.

Goal: 5 out of 6 correct



Intervention Notes	Date	Score

Name _____ Date _____

Learning Target: I will simplify numerical expressions with positive and negative integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 2: Guided Practice (Whole Group)

Directions: Below are solved problems to simplify expressions with exponents. For each solution step, discuss what happened and fill in the missing information.

Write	Describe
1. $3^6 \times 3^{-2} = \frac{3 \cdot 3 \cdot \cancel{3} \cdot \cancel{3} \cdot 3 \cdot 3}{\cancel{3} \cdot \cancel{3}}$	**Changed to Repeated Multiplication** 3 • 3 • 3 • 3 • 3 • 3 = _____ and $\frac{1}{3 \cdot 3}$ = _____ to see the total number of common bases.
$= 3 \cdot 3 \cdot 3 \cdot 3$	**Simplified Fractions** When multiplying, ignore each $\frac{3}{3}$ because its value is _____.
$= 3^4$	**Changed Back to Exponential Form** The exponent _____ represents 3 multiplied by itself _____ times.
2. $\frac{4^2}{4^5} = \frac{\cancel{4} \cdot \cancel{4}}{\cancel{4} \cdot \cancel{4} \cdot 4 \cdot 4 \cdot 4}$	**Changed to Repeated Multiplication** 4 • 4 = _____ and 4 • 4 • 4 • 4 • 4 = _____ to see the total number of common bases.
$= \frac{1}{4 \cdot 4 \cdot 4}$	**Simplified Fractions** When multiplying, ignore each $\frac{4}{4}$ because its value is _____.
$= 4^{-3}$	**Changed Back to Exponential Form** The exponent _____ represents $\frac{1}{4}$ multiplied by itself _____ times.
3. $(5^{-2})^3 = 5^{-2} \cdot 5^{-2} \cdot 5^{-2}$	**Changed to Repeated Multiplication** $5^{-2} \cdot 5^{-2} \cdot 5^{-2}$ = _____ to see the total number of common bases.
$= \frac{1}{5 \cdot 5} \cdot \frac{1}{5 \cdot 5} \cdot \frac{1}{5 \cdot 5}$	**Changed Negative Exponents to Division** Each $\frac{1}{5 \cdot 5}$ = _____.
$= 5^{-6}$	**Changed Back to Exponential Form** The exponent _____ represents $\frac{1}{5}$ multiplied by itself _____ times.

Name _____ Date _____

Learning Target: I will simplify numerical expressions with positive and negative integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 2: Guided Practice (Pairs)

Directions: Complete the missing steps to simplify each expression in exponential form.

4. $4^7 \times 4^{-3}$ $\frac{4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4}{\quad}$ $4^{\square}$	**5.** $7^{-6} \cdot 7^2$ $\frac{\quad}{7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7}$ $7^{\square}$
6. $\frac{9^4}{9^7}$ $\frac{9 \cdot 9 \cdot 9 \cdot 9}{\quad}$ $9^{\square}$	**7.** $\frac{8^5}{8^5}$ $\frac{\quad}{8 \cdot 8 \cdot 8 \cdot 8 \cdot 8}$ $8^{\square}$
8. $(8^3)^4$ $\frac{\quad}{\quad}$ $8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8$ $\frac{\quad}{\quad}$	**9.** $(6^{-4})^2$ $6^{-4} \cdot 6^{-4}$ $\frac{1}{\quad} \cdot \frac{1}{\quad}$ $6^{\square}$

Name _____ Date _____

Learning Target: I will simplify numerical expressions with positive and negative integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 2: Guided Practice (Teacher Notes)

Directions: Below are solved problems to simplify expressions with exponents. For each solution step, discuss what happened and fill in the missing information.

Write	Describe
1. $3^6 \times 3^{-2} = \frac{3 \cdot 3 \cdot \cancel{3} \cdot \cancel{3} \cdot 3 \cdot 3}{\cancel{3} \cdot \cancel{3}}$	**Changed to Repeated Multiplication** $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 =$ **3^6** and $\frac{1}{3 \cdot 3} =$ **3^{-2}** to see the total number of common bases.
$= 3 \cdot 3 \cdot 3 \cdot 3$	**Simplified Fractions** When multiplying, ignore each $\frac{3}{3}$ because its value is **1**.
$= 3^4$	**Changed Back to Exponential Form** The exponent **4** represents 3 multiplied by itself **4** times.
2. $\frac{4^2}{4^5} = \frac{\cancel{4} \cdot \cancel{4}}{\cancel{4} \cdot \cancel{4} \cdot 4 \cdot 4 \cdot 4}$	**Changed to Repeated Multiplication** $4 \cdot 4 =$ **4^2** and $4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 =$ **4^5** to see the total number of common bases.
$= \frac{1}{4 \cdot 4 \cdot 4}$	**Simplified Fractions** When multiplying, ignore each $\frac{4}{4}$ because its value is **1**.
$= 4^{-3}$	**Changed Back to Exponential Form** The exponent **-3** represents $\frac{1}{4}$ multiplied by itself **3** times.
3. $(5^{-2})^3 = 5^{-2} \cdot 5^{-2} \cdot 5^{-2}$	**Changed to Repeated Multiplication** $5^{-2} \cdot 5^{-2} \cdot 5^{-2} =$ **$(5^{-2})^3$** to see the total number of common bases.
$= \frac{1}{5 \cdot 5} \cdot \frac{1}{5 \cdot 5} \cdot \frac{1}{5 \cdot 5}$	**Changed Negative Exponents to Division** Each $\frac{1}{5 \cdot 5} =$ **5^{-2}**.
$= 5^{-6}$	**Changed Back to Exponential Form** The exponent **-6** represents $\frac{1}{5}$ multiplied by itself **6** times.

Session 2: Self-Reflection

Algebra 1 – Readiness Standard 4 – 8.EE.1

Learning Target: I will simplify numerical expressions with integer exponents

Briefly discuss student responses

- What did I learn today about simplifying numerical expressions with integer exponents?

- How confident do I feel about simplifying numerical expressions on my own? *(Thumbs up, down, or sideways)*

Algebra 1 Quick Check – Form B

Readiness Standard 4 - 8.EE.1

Name_____ Date_____

Learning Target: I will find equivalent numerical expressions using properties of integer exponents.

Directions: Circle the equivalent expression for each problem. (Work time: 3 minutes)

1.

$3^4 \times 3^2$

3^8 3^6 6^8 9^6

2.

$7^3 \times 7^6$

14^{18} 49^9 7^{18} 7^9

3.

$$\frac{4^2}{4^6}$$

1^{-4} 4^4 1^{-3} 4^{-4}

4.

$$\frac{9^8}{9^4}$$

9^4 9^{-4} 1^2 1^{-4}

5.

$(6^4)^2$

6^6 6^8 6^2 6^{-2}

6.

$(2^3)^6$

2^3 2^2 2^9 2^{18}

Name _____ Date _____

Learning Target: I will simplify numerical expressions with integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 3: Guided Practice (Whole Group)

Directions: Below are solved problems to simplify expressions with exponents. For each solution step, discuss what happened and fill in the missing information.

1. $4^5 \times 4^2 = 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \times 4 \cdot 4$ $= 4^7$ **2.** $7^3 \cdot 7^5 = 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$ $= 7^8$	**Multiplying Powers Property** (4^5, 4^2, 7^3 and 7^5 are called powers) To multiply powers with the same bases, _____ the exponents. $4^5 \cdot 4^2 =$ _____ $= 4^7$ $7^3 \cdot 7^5 =$ _____ $= 7^8$
3. $\frac{5^6}{5^2} = \frac{\cancel{5} \cdot \cancel{5} \cdot 5 \cdot 5 \cdot 5 \cdot 5}{\cancel{5} \cdot \cancel{5}}$ $= 5^4$ **4.** $\frac{8^3}{8^5} = \frac{\cancel{8} \cdot \cancel{8} \cdot 8}{\cancel{8} \cdot \cancel{8} \cdot 8 \cdot 8 \cdot 8}$ $= 8^{-2}$	**Dividing Powers Property** (5^6, 5^2, 8^3 and 8^5 are each called powers) To divide powers with the same bases, _____ the exponents. $\frac{5^6}{5^2} =$ _____ $= 5^4$ $\frac{8^3}{8^5} =$ _____ $= 8^{-3}$
5. $(9^2)^3 = 9^2 \cdot 9^2 \cdot 9^2$ $= 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9$ $= 9^6$ **6.** $(3^4)^2 = 3^4 \cdot 3^4$ $= 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$ $= 3^8$	**Power of a Power Property** (9^2 and 3^4 are called a powers) To find the power of a power, _____ the exponents. $(9^2)^3 =$ _____ $= 9^6$ $(3^4)^2 =$ _____ $= 3^8$

Name _____ Date _____

Learning Target: I will simplify numerical expressions with integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 3: Guided Practice (Pairs)

Directions: Complete the missing steps to simplify each expression in exponential form.

7. $6^7 \times 6^{-3}$

$$\frac{6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6}{\qquad\qquad}$$

$$6^{\square}$$

Multiplying Powers Property:

$$6^{\square} = 6^{\square}$$

8. $3^{-6} \cdot 3^2$

$$\frac{}{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}$$

$$3^{\square}$$

Multiplying Powers Property:

$$3^{\square} = 3^{\square}$$

9. $\frac{5^4}{5^7}$

$$\frac{5 \cdot 5 \cdot 5 \cdot 5}{\qquad}$$

$$5^{\square}$$

Dividing Powers Property:

$$5^{\square} = 5^{\square}$$

10. $\frac{8^4}{8^4}$

$$\frac{}{8 \cdot 8 \cdot 8 \cdot 8}$$

$$8^{\square}$$

Dividing Powers Property:

$$8^{\square} = 8^{\square}$$

11. $(9^3)^4$

Power of a Power Property:

$$9^{\square} = 9^{\square}$$

12. $(3^{-4})^2$

Power of a Power Property:

$$3^{\square} = 3^{\square}$$

Name _____ Date _____

Learning Target: I will simplify numerical expressions with integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 3: Guided Practice (Teacher Notes)

Directions: Below are solved problems to simplify expressions with exponents. For each solution step, discuss what happened and fill in the missing information.

1. $4^5 \times 4^2 = 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \times 4 \cdot 4$ $= 4^7$ **2.** $7^3 \cdot 7^5 = 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$ $= 7^8$	**Multiplying Powers Property** (4^5, 4^2, 7^3 and 7^5 are called powers) To multiply powers with the same bases, **add** the exponents. $4^5 \cdot 4^2 = \mathbf{4^{5+2}} = 4^7$ $7^3 \cdot 7^5 = \mathbf{7^{3+5}} = 7^8$
3. $\frac{5^6}{5^2} = \frac{\cancel{5} \cdot \cancel{5} \cdot 5 \cdot 5 \cdot 5 \cdot 5}{\cancel{5} \cdot \cancel{5}}$ $= 5^4$ **4.** $\frac{8^3}{8^5} = \frac{\cancel{8} \cdot \cancel{8} \cdot 8}{\cancel{8} \cdot \cancel{8} \cdot 8 \cdot 8 \cdot 8}$ $= 8^{-2}$	**Dividing Powers Property** (5^6, 5^2, 8^3 and 8^5 are each called powers) To divide powers with the same bases, **subtract** the exponents. $\frac{5^6}{5^2} = \mathbf{5^{6-2}} = 5^4$ $\frac{8^3}{8^5} = \mathbf{8^{3-5}} = 8^{-3}$
5. $(9^2)^3 = 9^2 \cdot 9^2 \cdot 9^2$ $= 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9$ $= 9^6$ **6.** $(3^4)^2 = 3^4 \cdot 3^4$ $= 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$ $= 3^8$	**Power of a Power Property** (9^2 and 3^4 are called a powers) To find the power of a power, **multiply** the exponents. $(9^2)^3 = \mathbf{9^{2 \cdot 3}} = 9^6$ $(3^4)^2 = \mathbf{3^{4 \cdot 2}} = 3^8$

Session 3: Self-Reflection

Algebra 1 – Readiness Standard 4 – 8.EE.1

Learning Target: I will simplify numerical expressions with integer exponents

Briefly discuss student responses

- What did I learn today about simplifying numerical expressions with integer exponents?

- How confident do I feel about simplifying numerical expressions on my own? *(Thumbs up, down, or sideways)*

Algebra 1 Quick Check – Form C

Readiness Standard 4 - 8.EE.1

Name_____ Date_____

Learning Target: I will find equivalent numerical expressions using properties of integer exponents.

Directions: Circle the equivalent expression for each problem. (Work time: 3 minutes)

1.

$6^2 \times 6^5$

6^7 12^{10} 36^7 6^{10}

2.

$2^7 \times 2^3$

2^{21} 4^{10} 4^{21} 2^{10}

3.

$$\frac{5^{12}}{5^4}$$

5^{-8} 5^8 1^3 5^{-3}

4.

$$\frac{4^5}{4^{15}}$$

4^{10} 1^{-3} 4^{-3} 4^{-10}

5.

$(8^2)^{10}$

8^{-8} 8^{12} 8^{20} 8^5

6.

$(6^9)^3$

6^6 6^3 6^{12} 6^{27}

Name _____ Date _____

Learning Target: I will simplify numerical expressions with integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 4: Guided Practice (Whole Group)

Directions: Below are solved problems to simplify expressions with exponents. For each solution step, discuss what happened and fill in the missing information.

1. $3^6 \times 3^2 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \times 3 \cdot 3$ $= 3^8$ **2.** $9^3 \cdot 9^4 = 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9$ $= 9^7$	**Multiplying Powers Property** (3^6, 3^2, 9^4 and 9^3 are called powers) To multiply powers with the same bases, _____ the exponents. $3^6 \cdot 3^2 =$ _____ $= 3^8$ $9^3 \cdot 9^4 =$ _____ $= 9^7$
3. $\frac{4^5}{4^2} = \frac{\cancel{4} \cdot \cancel{4} \cdot 4 \cdot 4 \cdot 4}{\cancel{4} \cdot \cancel{4}}$ $= 4^3$ **4.** $\frac{7^2}{7^5} = \frac{\cancel{7} \cdot \cancel{7}}{\cancel{7} \cdot \cancel{7} \cdot 7 \cdot 7 \cdot 7}$ $= 7^{-3}$	**Dividing Powers Property** (4^5, 4^2, 7^2 and 7^5 are each called powers) To divide powers with the same bases, _____ the exponents. $\frac{4^5}{4^2} =$ _____ $= 4^3$ $\frac{7^2}{7^5} =$ _____ $= 7^{-3}$
5. $(5^2)^4 = 5^2 \cdot 5^2 \cdot 5^2 \cdot 5^2$ $= 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$ $= 5^8$ **6.** $(8^3)^2 = 8^3 \cdot 8^3$ $= 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8$ $= 8^6$	**Power of a Power Property** (5^2 and 8^3 are called a powers) To find the power of a power, _____ the exponents. $(5^2)^4 =$ _____ $= 5^8$ $(8^3)^2 =$ _____ $= 8^6$

Name _____ Date _____

Learning Target: I will simplify numerical expressions with integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 4: Guided Practice (Pairs)

Directions: Simplify each expression using repeated multiplication and using the power properties.

7. $4^7 \cdot 4^{-3}$	**8.** $7^{-6} \times 7^2$
9. $\frac{9^4}{9^7}$	**10.** $\frac{8^9}{8^5}$
11. $(8^3)^4$	**12.** $(6^{-4})^2$

Name _____ Date _____

Learning Target: I will simplify numerical expressions with integer exponents

Algebra 1 – Readiness Standard 4 – 8.EE.1

Readiness for finding equivalent numerical expressions using square roots and cube roots

Session 4: Guided Practice (Teacher Notes)

Directions: Below are solved problems to simplify expressions with exponents. For each solution step, discuss what happened and fill in the missing information.

1. $3^6 \times 3^2 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \times 3 \cdot 3$ $= 3^8$ **2.** $9^3 \cdot 9^4 = 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9$ $= 9^7$	**Multiplying Powers Property** (3^6, 3^2, 9^4 and 9^3 are called powers) To multiply powers with the same bases, **add** the exponents. $3^6 \cdot 3^2 = \mathbf{3^{6+2}} = 3^8$ $9^3 \cdot 9^4 = \mathbf{9^{3+4}} = 9^7$
3. $\frac{4^5}{4^2} = \frac{\cancel{4} \cdot \cancel{4} \cdot 4 \cdot 4 \cdot 4}{\cancel{4} \cdot \cancel{4}}$ $= 4^3$ **4.** $\frac{7^2}{7^5} = \frac{\cancel{7} \cdot \cancel{7}}{\cancel{7} \cdot \cancel{7} \cdot 7 \cdot 7 \cdot 7}$ $= 7^{-3}$	**Dividing Powers Property** (4^5, 4^2, 7^2 and 7^5 are each called powers) To dividing powers with the same bases, **subtract** the exponents. $\frac{4^5}{4^2} = \mathbf{4^{5-2}} = 4^3$ $\frac{7^2}{7^5} = \mathbf{7^{2-5}} = 7^{-3}$
5. $(5^2)^4 = 5^2 \cdot 5^2 \cdot 5^2 \cdot 5^2$ $= 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$ $= 5^8$ **6.** $(8^3)^2 = 8^3 \cdot 8^3$ $= 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8$ $= 8^6$	**Power of a Power Property** (5^2 and 8^3 are called a powers) To find the power of a power, **multiply** the exponents. $(5^2)^4 = \mathbf{5^{2 \cdot 4}} = 5^8$ $(8^3)^2 = \mathbf{8^{3 \cdot 2}} = 8^6$

Session 4: Self-Reflection

Algebra 1 – Readiness Standard 4 – 8.EE.1

Learning Target: I will simplify numerical expressions with integer exponents

Briefly discuss student responses

- What did I learn today about simplifying numerical expressions with integer exponents?

- How confident do I feel about simplifying numerical expressions on my own? *(Thumbs up, down, or sideways)*

Algebra 1 Quick Check – Form D

Readiness Standard 4 - 8.EE.1

Name_____ Date_____

Learning Target: I will find equivalent numerical expressions using properties of integer exponents.

Directions: Circle the equivalent expression for each problem. (Work time: 3 minutes)

1.

$4^5 \times 4^3$

4^{15} 4^8 8^{15} 16^8

2.

$9^4 \times 9^6$

81^{10} 9^{24} 18^{24} 9^{10}

3.

$$\frac{7^2}{7^{10}}$$

7^{12} 7^{-8} 7^{-5} 1^{-8}

4.

$$\frac{2^9}{2^3}$$

2^{12} 2^3 1^3 2^6

5.

$(5^4)^8$

5^{12} 5^{32} 5^2 5^{-4}

6.

$(9^2)^6$

9^{12} 9^{-3} 9^8 9^{-4}

Algebra 1 Quick Check – Form E

Readiness Standard 4 - 8.EE.1

Name_____ Date_____

Learning Target: I will find equivalent numerical expressions using properties of integer exponents.

Directions: Circle the equivalent expression for each problem. (Work time: 3 minutes)

1.

$5^6 \times 5^4$

5^{10} 5^{24} 25^{10} 10^{24}

2.

$4^3 \times 4^7$

16^{10} 8^{21} 4^{10} 4^{21}

3.

$$\frac{2^8}{2^4}$$

2^{-4} 2^4 1^2 1^4

4.

$$\frac{8^3}{8^9}$$

1^6 1^{-3} 8^6 8^{-6}

5.

$(5^6)^2$

5^8 5^4 5^{12} 5^3

6.

$(3^4)^8$

3^4 3^{32} 3^{12} 3^2

Algebra 1 Quick Check – Form F

Readiness Standard 4 - 8.EE.1

Name_____ Date_____

Learning Target: I will find equivalent numerical expressions using properties of integer exponents.

Directions: Circle the equivalent expression for each problem. (Work time: 3 minutes)

1.

$3^4 \times 3^2$

3^8 3^6 6^8 9^6

2.

$7^3 \times 7^6$

14^{18} 49^9 7^{18} 7^9

3.

$$\frac{4^2}{4^6}$$

1^{-4} 4^4 1^{-3} 4^{-4}

4.

$$\frac{9^8}{9^4}$$

9^4 9^{-4} 1^2 1^{-4}

5.

$(6^4)^2$

6^6 6^8 6^2 6^{-2}

6.

$(2^3)^6$

2^3 2^2 2^9 2^{18}

Algebra 1 Quick Check – Form G

Readiness Standard 4 - 8.EE.1

Name_____ Date_____

Learning Target: I will find equivalent numerical expressions using properties of integer exponents.

Directions: Circle the equivalent expression for each problem. (Work time: 3 minutes)

1.

$6^3 \times 6^5$

6^8 12^{10} 36^7 6^{10}

2.

$2^7 \times 2^4$

2^{21} 4^{10} 4^{21} 2^{11}

3.

$$\frac{5^{12}}{5^4}$$

5^{-8} 5^8 1^3 5^{-3}

4.

$$\frac{4^5}{4^{12}}$$

4^{10} 1^{-3} 4^{-7} 4^{-10}

5.

$(8^2)^{10}$

8^{-8} 8^{12} 8^{20} 8^5

6.

$(6^5)^3$

6^6 6^3 6^{15} 6^{27}

Algebra 1 Quick Check – Form H

Readiness Standard 4 - 8.EE.1

Name_____ Date_____

Learning Target: I will find equivalent numerical expressions using properties of integer exponents.

Directions: Circle the equivalent expression for each problem. (Work time: 3 minutes)

1.

$4^5 \times 4^3$

4^{15} 4^8 8^{15} 16^8

2.

$9^4 \times 9^6$

81^{10} 9^{24} 18^{24} 9^{10}

3.

$$\frac{7^2}{7^{10}}$$

7^{12} 7^{-8} 7^{-5} 1^{-8}

4.

$$\frac{2^9}{2^3}$$

2^{12} 2^3 1^3 2^6

5.

$(5^4)^8$

5^{12} 5^{32} 5^2 5^{-4}

6.

$(9^2)^6$

9^{12} 9^{-3} 9^8 9^{-4}