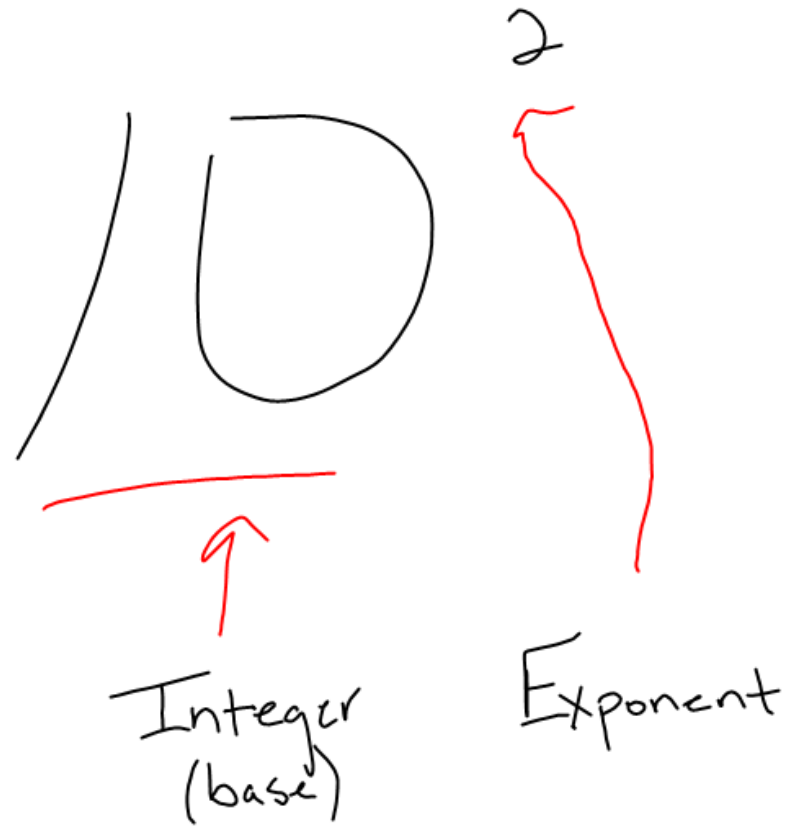


2.1 Integer Exponents

8.EE.1

Know and apply the properties of integer exponents to generate equivalent numerical expressions



EXPLORE ACTIVITY 1

COMMON CORE 8.EE.1

Using Patterns of Integer Exponents

The table below shows powers of 5, 4, and 3.

| | | | | | | |
|-------------|-------------|------------|-----------|-----------|------------------------|-------------------------|
| $5^4 = 625$ | $5^3 = 125$ | $5^2 = 25$ | $5^1 = 5$ | $5^0 = 1$ | $5^{-1} = \frac{1}{5}$ | $5^{-2} = \frac{1}{25}$ |
| $4^4 = 256$ | $4^3 = 64$ | $4^2 = 16$ | $4^1 = 4$ | $4^0 = 1$ | $4^{-1} = \frac{1}{4}$ | $4^{-2} = \frac{1}{16}$ |
| $3^4 = 81$ | $3^3 = 27$ | $3^2 = 9$ | $3^1 = 3$ | $3^0 = 1$ | $3^{-1} = \frac{1}{3}$ | $3^{-2} = \frac{1}{9}$ |

- A** What pattern do you see in the powers of 5?

Value is being divided by 5 as exponent decreases by 1

- B** What pattern do you see in the powers of 4?

Value is being divided by 4 as exponent decreases by 1

$$625 \div 5 = 125$$

$$125 \div 5 = 25$$

$$25 \div 5 = 5$$

$$5 \div 5 = 1$$

$$1 \div 5 = \frac{1}{5}$$

$$\frac{1}{5} \div 5 = \frac{1}{5} \div \frac{5}{1} = \frac{1}{5} \times \frac{1}{5} = \frac{1}{25}$$

5.5.5.5

- C** What pattern do you see in the powers of 3?

Value is divided by 3 as exponent is decreasing by 1

- D** Complete the table for the values of $5^0, 5^{-1}, 5^{-2}$.
E Complete the table for the values of $4^0, 4^{-1}, 4^{-2}$.
F Complete the table for the values of $3^0, 3^{-1}, 3^{-2}$.

Reflect

- Make a Conjecture** Write a general rule for the value of a^0 .
- Make a Conjecture** Write a general rule for the value of a^{-n} .

$$\begin{array}{l} a^0 = 1 \\ a^{-n} = \end{array}$$

$$3^{-2} = \frac{1}{3^2} = \frac{1}{9}$$

$$\frac{1}{a^n}$$

EXPLORE ACTIVITY 2COMMON
CORE 8.EE.1**Exploring Properties of Integer Exponents****A** Complete the following equations.

$$3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 3^{\boxed{5}} \quad \begin{array}{l} |+|+|+|+| \\ |+|+|+|+| \end{array}$$

$$(3 \cdot 3 \cdot 3 \cdot 3) \cdot 3 = 3^{\boxed{4}} \cdot 3^{\boxed{1}} = 3^{\boxed{5}}$$

$$(3 \cdot 3 \cdot 3) \cdot (3 \cdot 3) = 3^{\boxed{3}} \cdot 3^{\boxed{2}} = 3^{\boxed{5}}$$

What pattern do you see when multiplying two powers with the same base?

When multiplying integer exponents with the same base, add the exponents

Use your pattern to complete this equation: $5^2 \cdot 5^5 = 5^{\boxed{7}}$. $(\overline{5 \cdot 5}) (\overline{5 \cdot 5 \cdot 5 \cdot 5 \cdot 5})$

B Complete the following equation:

$$\frac{4^5}{4^3} = \frac{4 \cdot 4 \cdot 4 \cdot 4 \cdot 4}{4 \cdot 4 \cdot 4} = \frac{\cancel{4} \cdot \cancel{4} \cdot \cancel{4} \cdot 4 \cdot 4}{\cancel{4} \cdot \cancel{4} \cdot \cancel{4}} = 4 \cdot 4 = 4^{\boxed{2}}$$

What pattern do you see when dividing two powers with the same base?

Dividing integer exponents with the same base, subtract the exponents

$$\frac{4^5}{4^3} = 4^2$$

Use your pattern to complete this equation: $\frac{6^8}{6^3} = 6^{\boxed{5}}$.

C Complete the following equations:

$$(5^3)^2 = (5 \cdot 5 \cdot 5)^{\boxed{2}} = (5 \cdot 5 \cdot 5) \cdot (5 \cdot 5 \cdot 5) = 5^{\boxed{6}}$$

$$(5^3)^2 = 5^6$$

What pattern do you see when raising a power to a power?

If you have a power raised to a power,
you multiply the exponents

Use your pattern to complete this equation: $(7^2)^4 = 7^{\boxed{8}}$.

Reflect

Let m and n be integers.

3. **Make a Conjecture** Write a general rule for the value of $a^m \cdot a^n$.
4. **Make a Conjecture** Write a general rule for the value of $\frac{a^m}{a^n}$, $a \neq 0$.
5. **Make a Conjecture** Write a general rule for the value of $(a^m)^n$.

$$a^m \cdot a^n = a^{m+n}$$

$$\frac{a^m}{a^n} = a^{m-n}$$

$$(a^m)^n = a^{m \cdot n}$$

Use what you learned from yesterday to complete these problems

$$5^2 \cdot 5^3 = \boxed{5^5}$$

$$\frac{7^6}{7^2} = \boxed{7^4}$$

$$(3^3)^5 = \boxed{3^{15}}$$

Integer Exponent Rules

$$1. a^0 = 1$$

$$422^0 = 1 \quad -5^0 = 1$$

$$2. a^1 = a$$

$$31^1 = 31$$

$$3. a^{-n} = \frac{1}{a^n}$$

$$6^{-3} = \frac{1}{6^3} = \frac{1}{216}$$

$$4. a^m \cdot a^n = a^{m+n}$$

$$6^4 \cdot 6^3 = 6^{4+3} = 6^7$$

$$5. \frac{a^m}{a^n} = a^{m-n}$$

$$\frac{6^{10}}{6^3} = 6^{10-3} = 6^7$$

$$6. (a^m)^n = a^{m \cdot n}$$

$$(6^3)^2 = 6^{3 \cdot 2} = 6^6$$

EXAMPLE 1COMMON
CORE 8.EE.1

Simplify each expression.

A $(5 - 2)^5 \cdot 3^{-8} + (5 + 2)^0$

$$\underline{3^5} \cdot \underline{3^{-8}} + 7^0$$

$$3^{5+(-8)} + 7^0$$

$$3^{-3} + 7^0$$

$$\frac{1}{3^3} + 1$$

$$\frac{1}{27} + 1 = \boxed{\frac{1}{27}}$$

B $\frac{[(3 + 1)^2]^3}{(7 - 3)^2}$

$$\frac{(4^2)^3}{4^2} = \frac{4^{2 \times 3}}{4^2} = \frac{4^6}{4^2}$$

$$= 4^{6-2} = 4^4 = \boxed{256}$$

ADDITIONAL EXAMPLE 1**Simplify each expression.**

A $5 - (6 - 4)^{-3} + (-2)^0$

$$5 - 2^{-3} + (-2)^0$$

$$5 - 2^{-3} + 1$$

$$5 - \frac{1}{2^3} + 1$$

$$5 - \frac{1}{8} + 1$$

$$\boxed{5\frac{7}{8}}$$

B $\frac{[(6 - 2)]^4}{(8 - 4)^1}$

$$\frac{4^4}{4^1} = 4^{4-1} = 4^3 = \boxed{64}$$

YOUR TURN

Simplify each expression.

6. $\frac{[(6-1)^2]^2}{(3+2)^3}$

5

7. $(2^2)^3 - (10-6)^3 \cdot 4^{-5}$

$63\frac{15}{16}$

$$\begin{aligned} \#6 \quad \frac{(5^2)^2}{5^3} &= \frac{5^4}{5^3} = 5^{4-3} \\ &= 5^1 \end{aligned}$$

$$\begin{aligned} (2^2)^3 - (4)^3 \cdot 4^{-5} \\ 2^6 - \underline{4^3} \cdot \underline{4^{-5}} &\rightarrow 2^6 - \frac{1}{16} \\ 2^6 - 4^{-2} &= 64 - \frac{1}{16} \\ 2^6 - \frac{1}{4^2} &= 63\frac{15}{16} \end{aligned}$$

Guided Practice

Find the value of each power. (*Explore Activity 1*)

1. $8^{-1} =$ _____

2. $6^{-2} =$ _____

3. $256^0 =$ _____

4. $10^2 =$ _____

5. $5^4 =$ _____

6. $2^{-5} =$ _____

7. $4^{-5} =$ _____

8. $89^0 =$ _____

9. $11^{-3} =$ _____

Use properties of exponents to write an equivalent expression. (Explore Activity 2)

$$10. 4 \cdot 4 \cdot 4 = 4^{\square}$$

$$11. (2 \cdot 2) \cdot (2 \cdot 2 \cdot 2) = 2^{\square} \cdot 2^{\square} = 2^{\square}$$

$$12. \frac{6^7}{6^5} = \frac{6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6}{6 \cdot 6 \cdot 6 \cdot 6 \cdot 6} = \square^{\square}$$

$$13. \frac{8^{12}}{8^9} = 8^{\square} - \square = \square^{\square}$$

$$14. 5^{10} \cdot 5 \cdot 5 = 5^{\square}$$

$$15. 7^8 \cdot 7^5 = \square^{\square}$$

$$16. (6^2)^4 = (6 \cdot 6)^{\square}$$

$$= (6 \cdot 6) \cdot (6 \cdot 6) \cdot (\square \cdot \square) \cdot \text{---}$$

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

$$17. (3^3)^3 = (3 \cdot 3 \cdot 3)^3$$

$$= (3 \cdot 3 \cdot 3) \cdot (\square \cdot \square \cdot \square) \cdot \text{---}$$

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

Simplify each expression. (Example 1)

18. $(10 - 6)^3 \cdot 4^2 + (10 + 2)^2$ _____

19. $\frac{(12 - 5)^7}{[(3 + 4)^2]^2}$ _____

HW

GP 1-20

IP 21-27

* Bonus #30