Name & Surname: _____ Class: _____ Date: _____

Power Rules

Use integer exponents to make equivalent expressions

About 45 minutes Level ★★★☆☆



Exponent Rules to Remember

A **power** like 3^4 means 3 × 3 × 3 × 3. The **base** is multiplied, the **exponent** counts copies.

- **Multiply** same base: add exponents: a^m × a^n = a^(m+n). Example: 2^3 × 2^2 = 2^5 = 32.
- **Divide** same base: subtract exponents: a^m ÷ a^n = a^(m-n). **Power** of a power: multiply: (a^m)^n = a^(m×n).
- **Zero** exponent: a^0 = 1 when a ≠ 0. **Negative** exponent: a^-n = 1 ÷ a^n. Example: 2^-3 = $\frac{1}{8}$.

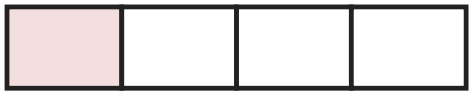
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Power Rules

Task A /6

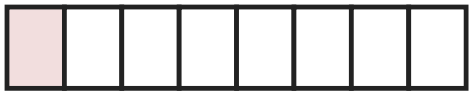
These bars show fractions equal to negative powers of 2. Read, shade or compare.

1



Fraction shaded: $\frac{\square}{\square}$

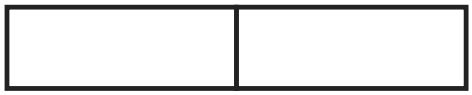
2



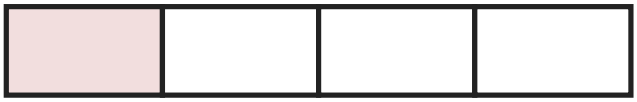
Fraction shaded: $\frac{\square}{\square}$

3

Shade $\frac{1}{2}$



4



$= \frac{1}{4}$



$= \frac{\square}{8}$

5



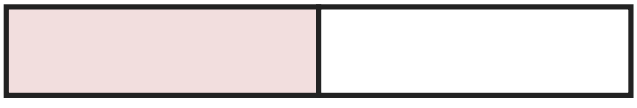
$\frac{1}{4}$



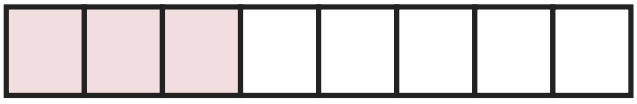
$\frac{1}{8}$

$\frac{1}{4}$ $\square$ $\frac{1}{8}$ Write <, > or =

6



$\frac{1}{2}$



$\frac{3}{8}$

$\frac{1}{2}$ $\square$ $\frac{3}{8}$ Write <, > or =

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Multiply and Divide

Practice adding, subtracting, and multiplying exponents.

Key words

base: number being multiplied

exponent: counts how many copies multiply

power: base with an exponent, like 2^3

product rule: add exponents when multiplying same base

quotient rule: subtract exponents when dividing same base

negative exponent: means 1 divided by the positive power

Task B /12

Simplify each power using the rules, then find its value.

WARM UP

1. Write 3^2 × 3^3 as a single **power**, then find its **value**.

Answer: _____

2. Write 5^4 ÷ 5^2 as a single **power**, then find its **value**.

Answer: _____

3. Write (2^2)^3 as a single **power**, then find its **value**.

Answer: _____

4. Write 10^5 ÷ 10^3 as a single **power**, then find its **value**.

Answer: _____

PRACTICE

5. Write 4^6 × 4^-2 as a single **power**, then find its **value**.

Answer: _____

6. Write 7^0 × 7^3 as a single **power**, then find its **value**.

Answer: _____

7. Write 3^4 ÷ 3^-1 as a single **power**, then find its **value**.

Answer: _____

8. A student says 2^3 × 2^2 = 4^5. Explain the **error** in this **thinking**.

Answer: _____

PROBLEM SOLVING

9. A square tile has side length 3^2 inches. Write its **area** as a **power** of 3, then find how many square inches it is.

Answer: _____

10. A drive holds 10^3 files, each with 10^4 bytes. Write the total **bytes** as a **power** of 10, then give its **value**.

Answer: _____

11. A lab culture starts with 5^3 cells and grows by a **factor** of 5^2. Write the final **count** as a **power** of 5, then give its **value**.

Answer: _____

12. Explain how you know that 4^0 = 1 using the **quotient** rule.

Answer: _____

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Zero and Negatives

Practice zero, negative, and product and quotient powers.

Task C /12

Rewrite each expression with the rules, then find the value.

WARM UP

1 Write 2^-3 as a **fraction** with a **positive** exponent, then give its **value**.

Answer: _____

2 Work out 9^0 × 2^3. Give the **value**.

Answer: _____

3 Write (2 × 3)^2 as a single **number**. Find its **value**.

Answer: _____

4 Write 10^-2 as a **fraction**, then give its **value**.

Answer: _____

PRACTICE

5 Write 2^3 × 2^-5 as a single **power**, then give its **value** as a **fraction**.

Answer: _____

6 Write (4^2)^-1 as a single **power**, then give its **value** as a **fraction**.

Answer: _____

7 Write (6^2) ÷ (2^2) as a single **power** of 3, then give its **value**.

Answer: _____

8 A student says 2^-3 = -8. Explain the **error** and give the correct **value**.

Answer: _____

PROBLEM SOLVING

9 A paper strip 2^4 inches long is cut into pieces 2^2 inches long. Write the **number** of pieces as a **power** of 2, then give its **value**.

Answer: _____

10 A website had 3^5 visits in June and 3^3 visits in July. Write how many **times** greater June was as a **power** of 3, then give its **value**.

Answer: _____

11 A medicine dose is $(\frac{1}{2})^3$ ounces. Write its **value** as a **fraction** of an ounce.

Answer: _____

12 Explain how you know that (-4)^2 and -4^2 have different **values**.

Answer: _____

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Spot the Match

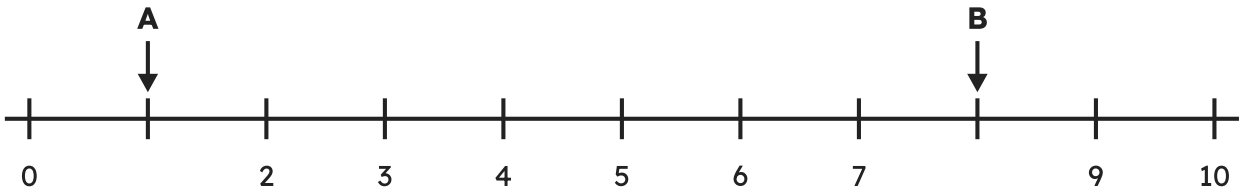
Read powers on number lines and sort equivalent expressions.

↑↓ Task D

/6

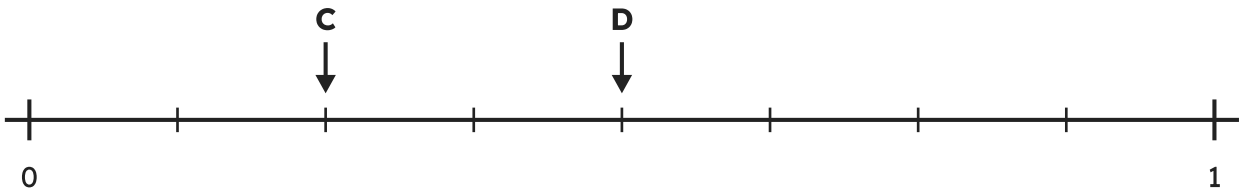
Read the powers of 2 marked on each line.

1



A = ☐ **B =** ☐ Draw an arrow to show: 4

2



C = ☐ **D =** ☐ Draw an arrow to show: $\frac{1}{8}$

Task E

Example done for you

/7

Sort each expression by whether it equals 3^4.

● **Equals 3^4**: colour it blue or draw ● ▲ **Does not equal 3^4**: colour it orange or draw ▲

3^2 × 3^2 ●	3^6 ÷ 3^2	(3^2)^2	3^3 + 3^1
(3^3)^2	3^2 × 2^2	6^4 ÷ 2^4	3^-1 × 3^5

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Finish It Off

Follow worked methods, then finish fraction-decimal-percent values.

Task F /2

Study each method, then try the matching question.

WORKED EXAMPLE

Work out (5^2 × 5^3) ÷ 5^4

1. First **multiply** on top: 5^2 × 5^3 = 5^(2+3) = 5^5
2. Then **divide**: 5^5 ÷ 5^4 = 5^(5-4) = 5^1
3. 5^1 = 5

Answer: 5

YOUR TURN

Work out (4^3 × 4^2) ÷ 4^4

Answer: _____

WORKED EXAMPLE

Write 3^-2 with a positive exponent, then give its value

1. **Negative** means reciprocal: 3^-2 = 1 ÷ 3^2
2. 3^2 = 9, so the **value** is $\frac{1}{9}$

Answer: $\frac{1}{9}$

YOUR TURN

Write 2^-4 with a positive exponent, then give its value

Answer: _____

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Power Rules

Task G /12

Complete the missing fractions, decimals and percents for these powers.

Fraction	Decimal	Percentage
$\frac{1}{4}$		
	0.01	
		12.5%
$\frac{1}{2}$		
	0.001	
		100%

How did I do?

Circle a face for each line.

I can multiply and divide powers with the same base. ☹ 😐 ☺

I can use zero and negative exponents. ☹ 😐 ☺

I can write equivalent expressions with integer exponents. ☹ 😐 ☺

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Answer sheet: Power Rules

Task A

1. $\frac{1}{4}$
2. $\frac{1}{8}$
3. Shade 1 of the 2 equal parts ($\frac{1}{2}$).
4. $\frac{1}{4} = \frac{2}{8}$ (shade 2 parts)
5. $\frac{1}{4} > \frac{1}{8}$
6. $\frac{1}{2} > \frac{3}{8}$

Task B

1. 243
2. 25
3. 64
4. 100
5. 256
6. 343
7. 243
8. Keep the same base and add exponents: 2^3 × 2^2 = 2^5 = 32, not 4^5.
9. 81
10. 10000000
11. 3125
12. 4^3 ÷ 4^3 = 4^(3-3) = 4^0, but any nonzero number divided by itself is 1, so 4^0 = 1.

Task C

1. $\frac{1}{8}$
2. 8
3. 36
4. $\frac{1}{100}$
5. $\frac{1}{4}$
6. $\frac{1}{16}$
7. 9
8. A negative exponent means reciprocal: 2^-3 = 1 ÷ 2^3 = $\frac{1}{8}$, not -8.
9. 4
10. 9
11. $\frac{1}{8}$
12. (-4)^2 = (-4) × (-4) = 16, but -4^2 = -(4 × 4) = -16.

Task D

1. A = 1; B = 8; arrows at 4
2. C = $\frac{1}{4}$; D = $\frac{1}{2}$; arrows at $\frac{1}{8}$

Task E

Equals 3^4 (blue ●): 3^2 × 3^2, 3^6 ÷ 3^2, (3^2)^2, 6^4 ÷ 2^4, 3^-1 × 3^5

Does not equal 3^4 (orange ▲): 3^3 + 3^1, (3^3)^2, 3^2 × 2^2

Task F

1. 4
2. $\frac{1}{16}$

Task G

1. $\frac{1}{4}$ = 0.25 = 25%
2. $\frac{1}{100}$ = 0.01 = 1%
3. $\frac{1}{8}$ = 0.125 = 12.5%
4. $\frac{1}{2}$ = 0.5 = 50%
5. $\frac{1}{1000}$ = 0.001 = 0.1%
6. $\frac{1}{1}$ = 1 = 100%

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