9N1.1 Demonstrate an understanding of powers with integral bases (excluding base 0) and whole number exponents by:

- ***representing repeated multiplication, using powers***
- ***using patterns to show that a power with an exponent of zero is equal to one***
- ***solving problems involving powers.***

Understanding Powers

An **exponential expression**, or power, has a base and a exponent. For Example, given 2^3, 2 is the base and 3 is the exponent.

When numbers are multiplied together many times over, this is called **repeated multiplication**.

To simplify a power, convert the power to expanded form and use repeated multiplication to solve. For example, when 2^5 is converted to expanded form using repeated multiplication, it becomes $2 \times 2 \times 2 \times 2 \times 2 = 32$.

Brackets are used in powers to groups the base and exponent together inside the brackets: (-3^3). Brackets also separate the base and exponent by placing the exponent outside the brackets: $(-3)^3$. If no brackets are used, it is the same as the exponent inside the brackets: $(-3^3) = -3^3$.

Example

Evaluate $(-9)^2$.

Solution

Step 1

Write the expression in expanded form. The negative sign is inside the brackets, so it is included in the repeated multiplication.

$(-9)^2 = (-9) \text{ x } (-9)$

Step 2

Evaluate the expression.

$(-9) \text{ x } (-9) = 81$

Example

Evaluate -2^3.

Solution

Step 1

Write the power in expanded form. The exponent of 3 only applies to the base of 2. The negative sign becomes the coefficient of -1.

$-2^3 = (-1)(2 \times 2 \times 2)$

Step 2

Evaluate the expression using repeated multiplication

$(-1)(2 \times 2 \times 2) = (-1)(8) = -8$

The zero exponent law state that any number with an exponent of zero is equal to 1.

$a^0 = 1,\ a \neq 0$

Example

Use a pattern to prove that $4^0 = 1$.

Solution

The exponent law states that a^0 is equal to 1 for a given value of a, where $a \neq 0$.

Step 1

Create a pattern by showing the evaluation of the following powers:

$4^3 = 64$

$4^2 = 16$

$4^1 = 4$

$4^0 = 1$

Step 2

To prove that $4^0 = 1$, divide each of the results from Step 1 by 4.

$64 \div 4 = 16$

$16 \div 4 = 4$

$4 \div 4 = 1$

The pattern proves the zero exponent law.