Lesson 3.1 – Using Exponents to Describe Numbers

Outcome:

- *Demonstrate an understanding of powers with integral bases (excluding zero) 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, and solving problems involving powers.*

Definitions

Power:

Base:

4^2

Exponent:

Exponential form:

Standard form:

How to Evaluate Powers

Examples

Write the following as a power, then evaluate the power.

a) $4 \times 4 \times 4$

b) $9 \times 9 \times 9 \times 9$

c) $6 \times 6 \times 6 \times 6 \times 6 \times 6$

d) $7 \times 7 \times 7$

Powers with Positive Bases

Example

Write each power as repeated multiplication, then evaluate.

a) $6^3 =$

b) $4^2 =$

c) $5^3 =$

d) $9^4 =$

e) $11^2 =$

f) $7^5 =$

Example

A single bacterium doubles in number every hour. How many bacteria are present after 10 hours?

Powers with Negative Bases

Write each power as repeated multiplication, then evaluate.

Example

a) $(-2)^4 =$

b) $-2^4 =$

c) $-(-3)^2 =$

d) $(-4)^3 =$

e) $-5^3 =$

f) $-4^3 =$

g) $-(-6)^2 =$

h) $(-7)^4 =$

ASSIGNMENT: pg. 97-98 #5-15, 17, 18, 21

Lesson 3.2 – Exponent Laws

Outcome:

- *Demonstrate an understanding of powers with integral bases (excluding zero) 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, and solving problems involving powers.*
- *Demonstrate an understanding of operations on powers with integral bases (excluding base 0) and whole number exponents:* $(a^m)(a^n) = a^{m+n}$, $a^m \div a^n = a^{m-n}$, $(a^m)^n$, $(ab)^m = a^m b^m$, *and* $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0$.

Multiplying Powers

When multiplying powers with the same base, add the exponents to write the product as a single power.

The "formula" for multiplying powers is $(a^m)(a^n) = a^{m+n}$.

Example

$2^3 \times 2^2$

Examples

Write each expression as one power, then evaluate.

a) $(-3)^2 \times (-3)^5$

b) $4^3 \times 4^5$

c) $6^4 \times 6^3$

d) $(-5)^2 \times (-5)^3$

Dividing Powers

When dividing powers with the same base, subtract the exponents to write the product as a single power.

The "formula" for dividing powers is $a^m \div a^n = a^{m-n}$.

Example

$2^6 \div 2^2$

Examples

Write each expression as one power, then evaluate.

a) $(-5)^9 \div (-5)^6$

b) $2^5 \div 2^4$

c) $(-8)^8 \div (-8)^6$

d) $4^7 \div 4^5$

Raising a Power to an Exponent

When raising a power to an exponent, multiply the exponents to write the expression with a single exponent.

The "formula" for raising a power to an exponent is $(a^m)^n = a^{mn}$.

Example

$(2^3)^2$

Examples

Write each expression with one exponent, then evaluate.

a) $[(-3)^4]^3$

b) $[(-4)^5]^2$

c) $(6^2)^4$

Raising a Product or a Quotient to an Exponent

When a product or quotient is raised to an exponent, you can rewrite each number in the product or quotient with the same exponent.

The "formula" for raising a product to an exponent is $(ab)^m = a^m b^m$.

The "formula" for raising a quotient to an exponent is $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0$.

Examples

$[2 \times (-3)]^4$ $\left(\frac{3}{4}\right)^3$

Examples

Write each expression as a product/quotient of two powers, then evaluate.

a) $(5 \times 4)^2$ b) $[(-2) \times (-6)]^2$

c) $\left(\frac{5}{6}\right)^3$ d) $\left(\frac{2}{5}\right)^4$

Raising a Quantity to an Exponent of Zero

When the exponent of a power is 0, the value of the power is 1.

The "formula" for raising a quantity to an exponent of zero is $a^0 = 1, a \neq 0$.

Example

3^0

Examples

Evaluate.

a) $(-5)^0$ b) -2^0 c) $-(4)^0$

ASSIGNMENT: pg. 106-107 #5-7 (a, c), 9-11 (a, c), 14-17, 21, 22

Lesson 3.3 – Order of Operations

Outcome:

- *Demonstrate an understanding of powers with integral bases (excluding zero) 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, and solving problems involving powers.*
- *Explain and apply the order of operations, including exponents, with and without technology.*

Definitions

B

E

D

M

A

S

Coefficient:

Easier Examples

Evaluate each of the following:

a) $3(2)^4$

b) $-3(-5)^2$

c) -4^4

d) 4×3^2

e) $6(-2)^3$

f) -7^2

Harder Examples

Evaluate each of the following:

a) $4^2 - 8 \div 2 + (-3^2)$

b) $-2(-15 - 4^2) + 4(2 + 3)^3$

c) $4^2 + (-4^2)$

d) $8(5 + 2)^2 - 12 \div 2^2$

ASSIGNMENT: pg. 111-112 #3-6, 8, 9, 11-15

Lesson 3.4 – Using Exponents to Solve Problems

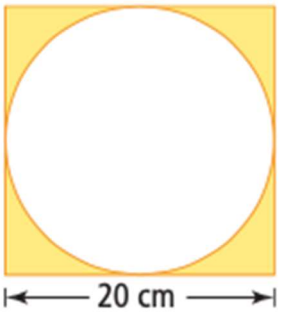
Outcome:

- *Demonstrate an understanding of powers with integral bases (excluding zero) 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, and solving problems involving powers.*
- *Explain and apply the order of operations, including exponents, with and without technology.*

Examples

1. What is the surface area of a cube with an edge length of 4 cm?

2. A circle is inscribed in a square with a side length of 20 cm. What is the area of the shaded region?



3. A dish holds 100 bacteria. It is known that the bacteria double in number every hour. How many bacteria will be present after each number of hours?
   a. 1

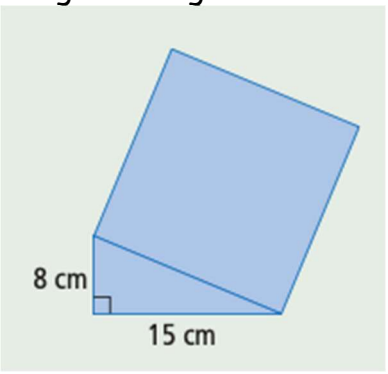
   b. 5

   c. n

4. The Hydra is a mythological character with one head. However, every time you cut off one head, two heads grow back in its place. If a hero tried to conquer the Hydra by cutting off all of its heads every day, how many heads would the Hydra have on the third day? How many heads at the end of 10 days?

5. Silas wants to send a cube-shaped package to his cousin in Vancouver. What is the minimum amount of brown paper that he will need to wrap the package if the side length of the package is 32 cm?

6. A right triangle has two shorter sides that measure 8 cm and 15 cm. What is the area of a square attached to the hypotenuse of the right triangle?



ASSIGNMENT: pg. 118-119, #1-5, 7-9, 11, 12