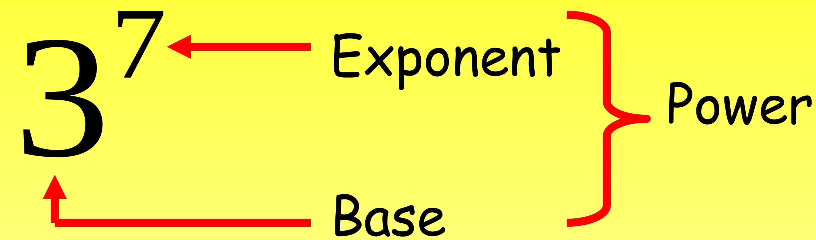
ST. JEAN DE BREBEUF MATHEMATICS

CHAPTER 6.1

EXPONENT LAWS

CHAPTER 6.1 EXPONENT LAWS

FUNDAMENTALS



EXPONENT LAWS

1. EXPONENT LAW FOR MULTIPLICATION (PRODUCT LAW)

Write $2^3 \times 2^4$ as a single power and evaluate

$$2^3 \times 2^4$$
$$= 2^{3+4}$$
$$= 2^7$$
$$\boxed{= 128}$$

GENERAL FORMULA FOR MULTIPLYING POWERS

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

Rule: When multiplying powers of the **same** base, you keep the base and **ADD** the exponents.

CHAPTER 6.1 EXPONENT LAWS

EXPONENT LAWS

1. *EXPONENT LAW FOR MULTIPLICATION (PRODUCT LAW)*

PRACTICE

1. $2^{-4} \times 2^{6}$

$= 2^{-4+6}$

$= 2^{2}$

$= 4$

2. $5^{-2} \times 5^{7}$

$= 5^{-2+7}$

$= 5^{5}$

$= 3125$

3. $2^{7} \times 2^{-3}$

$= 2^{7+(-3)}$

$= 2^{7-3}$

$= 2^{4}$

$= 16$

GENERAL FORMULA FOR MULTIPLYING POWERS

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

Rule: When multiplying powers of the **same** base, you keep the base and **ADD** the exponents.

EXPONENT LAWS

2. EXPONENT LAW FOR DIVISION (QUOTIENT LAW)

EXAMPLE:

Write $7^4 \div 7^2$ as a single power and evaluate

$$7^4 \div 7^2$$
$$= 7^{4-2}$$
$$= 7^2$$
$$= 49$$

GENERAL FORMULA FOR DIVIDING POWERS

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

Rule: When dividing powers of the **same** base, you keep the base and **SUBTRACT** the exponents.

EXPONENT LAWS

2. EXPONENT LAW FOR DIVISION (QUOTIENT LAW)

GENERAL FORMULA FOR DIVIDING POWERS

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

Rule: When dividing powers of the **same** base, you keep the base and **SUBTRACT** the exponents.

PRACTICE:

1. $5^5 \div 5^2$

$= 5^{5-2}$

$= 5^3$

$= 125$

2. $\dfrac{3^2}{3^{-7}}$

$= 3^{2-(-7)}$

$= 3^{2+7}$

$= 3^9$

$= 19683$

3. $\dfrac{7^{-3}}{7^{-5}}$

$= 7^{-3-(-5)}$

$= 7^{-3+5}$

$= 7^2$

$= 49$

EXPONENT LAWS

3. POWER OF A POWER LAW

EXAMPLE:

Express $(9^2)^3$ as a single power and evaluate

$$(9^2)^3$$
$$= 9^{2\times 3}$$
$$= 9^6$$
$$= 531441$$

GENERAL FORMULA FOR POWER LAW

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

Rule: When evaluating powers within brackets, you **MULTIPLY** the exponents.

EXPONENT LAWS

3. POWER OF A POWER LAW

PRACTICE:

1. $(2^3)^4$

$$= 2^{3\times4}$$
$$= 2^{12}$$
$$= 4096$$

2. $(4^5)^2$

$$= 4^{5\times2}$$
$$= 4^{10}$$
$$= 1048576$$

GENERAL FORMULA FOR POWER LAW

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

Rule: When evaluating powers within brackets, you **MULTIPLY** the exponents.

CHAPTER 6.1 EXPONENT LAWS

EXPONENT LAWS

4. POWER OF A PRODUCT LAW

Simplify $(4a^3)^2$

$$(4a^3)^2$$
$$=(4)^2(a^3)^2$$
$$=16a^{3\times 2}$$
$$=16a^6$$

*Apply the exponent to both the co-efficient and the variable

GENERAL FORMULA FOR POWER OF A PRODUCT LAW

$$(ab)^n = a^n b^n$$

Rule: When a co-efficient and a variable are inside the brackets, you must **distribute** the exponent

EXPONENT LAWS

4. POWER OF A PRODUCT LAW

Simplify the following:

(a) $(3x^2)^5$

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

$$= 243x^{2\times5}$$

$$= 243x^{10}$$

(b) $(-5y^3)^4$

$$= (-5)^4 (y^3)^4$$

$$= 625y^{3\times4}$$

$$= 625y^{12}$$

GENERAL FORMULA FOR POWER OF A PRODUCT LAW

$$(ab)^n = a^n b^n$$

Rule: When a co-efficient and a variable are inside the brackets, you must **distribute** the exponent

EXPONENT LAWS

5 The Zero Exponent Law

Use a calculator to evaluate the following:

a) 7^0 = 1

b) $(-3)^0$ = 1

c) k^0 = 1

THE EXPONENT ZERO

Any base raised to the exponent zero *always* equals
ONE (1)

CHAPTER 6.1 EXPONENT LAWS

6. Negative Exponents

EXAMPLE:

Express $\mathbf{4^{-3}}$ as a single power and evaluate

$$4^{-3}$$

$$= \left(\frac{1}{4}\right)^3$$

$$= \frac{(1)^3}{(4)^3}$$

$$= \frac{1}{64}$$

STEPS:

1. Write the base as a **reciprocal** (ie. "flip" the base)
2. Make the exponent **positive**
3. Raise the numerator and denominator by the exponent

6. Negative Exponents

PRACTICE:

Express each as a single power and evaluate

1. 3^{-5}

$$= \left(\frac{1}{3}\right)^5$$

$$= \frac{(1)^5}{(3)^5}$$

$$= \frac{1}{243}$$

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

*Subtract exponents first!

$$= 4^{3-5}$$

$$= 4^{-2}$$

$$= \left(\frac{1}{4}\right)^2$$

$$= \frac{(1)^2}{(4)^2}$$

$$= \frac{1}{16}$$

STEPS:

1. Write the base as a **reciprocal** (ie. “flip” the base)
2. Make the exponent **positive**
3. Raise the numerator and denominator by the exponent

CHAPTER 6.1 EXPONENT LAWS

6. Negative Exponents

PRACTICE:

Express each as a single power and evaluate

3. $(2^{-2})^3$ ***Multiply** exponents first!*

$$= 2^{-2\times 3}$$

$$= 2^{-6}$$

$$= \left(\frac{1}{2}\right)^6$$

$$= \frac{(1)^6}{(2)^6}$$

$$= \frac{1}{64}$$

STEPS:

1. Write the base as a **reciprocal** (ie. "flip" the base)
2. Make the exponent **positive**
3. Raise the numerator and denominator by the exponent

OPERATION 2 Simplifying Expressions

a) $(29^5)^0$ ***Multiply** the exponents first!*

$$= 29^{5\times 0}$$

$$= 29^0$$

$$= 1$$

b) $\dfrac{6^8 \times 6^{-2}}{(6^2)^2}$

*Add exponents

***Multiply** exponents*

$$= \frac{6^{8+(-2)}}{6^{2\times 2}}$$

$$= \frac{6^{8-2}}{6^4}$$

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

***Subtract** exponents*

$$= 6^{6-4}$$

$$= 6^2$$

$$= 36$$

c) $k^{-5} \times k^{3}$ *Add exponents!

$$= k^{-5+3}$$

$$= k^{-2}$$

$$= \left(\frac{1}{k}\right)^2$$

*Flip the base

*Make exponent **positive**

$$= \frac{(1)^2}{(k)^2}$$

Raise numerator and denominator by the exponent

$$= \frac{1}{k^2}$$

d) $\frac{n^3 \times n^3}{(n^4)^2}$

*Add exponents!

***Multiply** exponents!

$$= \frac{n^{3+3}}{n^{4\times 2}}$$

$$= \frac{n^6}{n^8}$$

***Subtract** exponents!

$$= n^{6-8}$$

$$= n^{-2}$$

$$= \left(\frac{1}{n}\right)^2$$

*Flip the base

*Make exponent **positive**

$$= \frac{(1)^2}{(n)^2}$$

Raise numerator and denominator by the exponent

$$= \frac{1}{n^2}$$

e) $\frac{(7m^{-2})(6m^{5})}{2m}$ ← ***Multiply** the co-efficients

***Add** the exponents

$$= \frac{42m^{-2+5}}{2m}$$

$$= \frac{42m^{3}}{2m}$$

***Divide** the co-efficients

***Subtract** the exponents

$$= 21m^{3-1}$$

$$= 21m^{2}$$

OPERATION 3

Using exponent laws, simplify the expression $\dfrac{a^2b^5c^5}{ab^{-3}c^4}$ and evaluate for **a = 8**, **b = 2** and **c = -30**

SOLUTION

First, **subtract** the exponents for each variable separately!

$$= a^{2-1}b^{5-(-3)}c^{5-4}$$

$$= a^1b^{5+3}c^1$$

$$= ab^8c$$

*Next, substitute the values into the variables (do not forget the brackets!)

$$= (8)(2)^8(-30)$$

$$= (8)(256)(-30)$$

$$= -61440$$

EXAMPLE 4

The sound produced in the first row of a rock concert is 110 dB and the sound produced from a CD player is 60 dB.

a) If 80 dB can be expressed as 10^8, re-write the decibel readings as powers with base 10.

$$110\,dB \qquad\qquad 60\,dB$$

$$=10^{11} \qquad\qquad =10^{6}$$

b) Calculate how many times louder the rock concert is compared to the CD player.

$$\frac{10^{11}}{10^{6}}$$

$$=10^{11-6}$$

$$=10^{5}$$

$$=100\,000$$

Therefore, the rock concert is 100 000 times louder than the CD player.

HOMEWORK

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(Day 1) #1ac, 3, 4bd, 5ad

(Day 2) 7abc, 9acd, 10ab, 12adef