Indices - Lesson 1

Indices - Multiplying and Dividing Rules

LI

- Know what an index (pl. indices) is.
- Know and use the Rules of Indices for x and ÷.

SC

- + and − numbers.

Mar 15-08:05

An index is a power (aka exponent)

$2^3 = 2 \times 2 \times 2$

$3^4 = 3 \times 3 \times 3 \times 3$

Rules of Indices

$10^3 \times 10^2 = (10 \times 10 \times 10) \times (10 \times 10)$

$= 1\,000 \times 100$

$= 100\,000$

$\therefore \quad 10^3 \times 10^2 = 10^5$

We thus have the 1st Rule of Indices :

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

(m, n are any numbers)

Example 1

Simplify fully :

(a) $3^4 \times 3^7$

$= 3^{4+7}$

$= \boxed{3^{11}}$

(b) $w^{17} \times w^{-2}$

$= w^{17+(-2)}$

$= \boxed{w^{15}}$

Example 2

Simplify fully :

(a) $5m^3 \times 3m^6$

$= 15m^{3+6}$

$= \boxed{15m^9}$

(b) $6w^{-3} \times 8w^{-9}$

$= 48w^{-3+(-9)}$

$= \boxed{48w^{-12}}$

Sep 3-08:12

$10^6 \div 10^2 = (10 \times 10 \times 10 \times 10 \times 10 \times 10) \div (10 \times 10)$

$= 1\,000\,000 \div 100$

$= 10\,000$

$\therefore\ 10^6 \div 10^2 = 10^4$

We thus have the 2nd Rule of Indices :

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

(m, n are any numbers)

Example 3

Simplify fully :

(a) $5^9 \div 5^7$

$= 5^{9-7}$

$= \boxed{5^2}$

(b) $f^{11} \div f^{-3}$

$= f^{11-(-3)}$

$= \boxed{f^{14}}$

Example 4

Simplify fully :

(a) $20s^{30} \div 10s^{20}$

$= 2s^{30-20}$

$= \boxed{2s^{10}}$

(b) $98x^{14} \div 4x^7$

$= (98/4)x^{14-7}$

$= \boxed{(49/2)x^7}$

$10^3 \div 10^3 = (10 \times 10 \times 10) \div (10 \times 10 \times 10)$

$= 1\,000 \div 1\,000$

$= 1$

But $10^3 \div 10^3 = 10^{3-3} = 10^0$ (using Rule 2)

We thus have the 3rd Rule of Indices :

$$a^0 = 1$$

Some Notation

$$a^{-m} = \frac{1}{a^m}$$

This is shorthand for this

Example 5

Simplify fully, expressing the answers with positive indices :

(a) $3D^3y^{-2} \times 4D^{-7}y^5$

$= 12D^{-4}y^3$

$= 12 \times D^{-4} \times y^3$

$= 12 \times \frac{1}{D^4} \times y^3$

$= \frac{12y^3}{D^4}$

(b) $\frac{8m^{13}a^6 \times 3m^{-9}a^2}{48m^4a^{87}}$

$= \frac{24m^4a^8}{48m^4a^{87}}$

$= \frac{1}{2a^{79}}$

Jan 26-10:23

1 Simplify these expressions. Write your answer in index form with a positive exponent.

a $4^5 \times 4^3$ **b** $7^4 \times 7$ **c** $x^{10} \times x^2$ **d** $t^2 \times t^3 \times t^4$

e $3^2 \times 3^{-7}$ **f** $c^3 \times c^{-9}$ **g** $a^8 \times a^{-8}$ **h** $4y^3 \times 5y^6$

i $c \times 4c^2 \times 2c^3$ **j** $8c^2 \times 3c^{-7}$ **k** $10a^7 \times 3a^{-20}$ **l** $4t^3 \times 3t^{-8} \times 2t^2$

2 Simplify these expressions leaving your answer in index form.

a $3^7 \div 3^2$ **b** $6 \div 6^3$ **c** $x^8 \div x^5$ **d** $t^3 \div t$

e $p^3 \div p^{-2}$ **f** $y^{-3} \div y^{-3}$ **g** $12y^{10} \div 3y^3$ **h** $24y^3 \div 12y^8$

i $15x^2 \div 3x^{-4}$ **j** $42p^6 \div (-7p)^{-2}$ **k** $\dfrac{4t^5 \times -7t^3}{14t^{-4}}$ **l** $\dfrac{5y^2 \times 4y^{-6}}{2y^3}$

3 Simplify these expressions.

a $3x^2y \times 5x^3y^2$ **b** $3a^2b^3 \times 7ab^4$ **c** $30x^3y \div 6x^2y^4$

Sep 6-09:16

Answers

1
- **a** 4^8
- **b** 7^5
- **c** x^{12}
- **d** t^9
- **e** $\frac{1}{3^5}$
- **f** $\frac{1}{c^6}$
- **g** $a^0 = 1$
- **h** $20y^9$
- **i** $8c^6$
- **j** $\frac{24}{c^5}$
- **k** $\frac{30}{a^{13}}$
- **l** $\frac{24}{t^3}$

2
- **a** 3^5
- **b** 6^{-2}
- **c** x^3
- **d** t^2
- **e** p^5
- **f** $y^0 = 1$
- **g** $4y^7$
- **h** $2y^{-5}$
- **i** $5x^6$
- **j** $2058p^8$
- **k** $-2t^{12}$
- **l** $10y^{-7}$

3
- **a** $15x^5y^3$
- **b** $21a^3b^7$
- **c** $5xy^{-3}$