



**SUBJECT : MATHEMATICS**  
**CHAPTER NUMBER: 05**  
**CHAPTER NAME : EXPONENTS**

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**CHANGING YOUR TOMORROW**

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## Learning outcomes

Students will be able to evaluate problems based on laws of exponents.



# PREVIOUS CONNECT

- **Evaluate:**
- $(3^5 \times 4^7 \times 5^8)^0$

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## LAWS OF EXPONENTS

$$(1)^{\text{any natural number}} = 1$$

$$(-1)^{\text{an odd natural number}} = -1$$

$$(-1)^{\text{an even natural number}} = +1$$

$a^m \times a^n = a^{m+n}$ , where  $m$  and  $n$  are whole numbers and  $a (\neq 0)$  is an integer.

$$a^m \div a^n = a^{m-n} \text{ where } m \text{ and } n \text{ are whole numbers and } m > n.$$

$$(a^m)^n = a^{mn} \text{ (where } m \text{ and } n \text{ are whole numbers)}$$

$$a^m \times b^m = (ab)^m \text{ (where } m \text{ is any whole number)}$$

- For any non-zero integer a  
 $a^m \times b^m = (ab)^m$  (where m is any whole number)
  - (where m is a whole number; a and b are any non-zero integers)
  - $a^0 = 1$  (for any non-zero integer a)
- Any number (except 0) raised to the power (or exponent) 0 is 1.

$$a^m \div b^m = \frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$$

## EVALUATION QUESTIONS

3. Simplify, giving answers with positive index:

(i)  $2b^6 \cdot b^3 \cdot 5b^4$

(ii)  $x^2y^3 \cdot 6x^5y \cdot 9x^3y^4$

(iii)  $(-a)^5 (a^2)$

(iv)  $(-y)^2 (-y)^3$

(v)  $(-3)^2 (3)^3$

(vi)  $(-4x) (-5x^2)$

(vii)  $(5a^2b) (2ab^2) (a^3b)$

(viii)  $x^{2a+7} \cdot x^{2a-8}$

(ix)  $3^y \cdot 3^2 \cdot 3^{-4}$

(x)  $2^{4a} \cdot 2^{3a} \cdot 2^{-a}$

**xi)  $4x^2y^2 \div 9x^3y^3$**

**(xii)  $(10^2)^3 (x^8)^{12}$**

**(xiii)  $(a^{10})^{10} (1^6)^{10}$**

**(xiv)  $(n^2)^2 (-n^2)^3$**

**(xv)  $-(3ab)^2 (-5a^2bc^4)^2$**

**(xvi)  $(-2)^2 \times (0)^3 \times (3)^3$**

**(xvii)  $(2a^3)^4 (4a^2)^2$**

**(xviii)  $(4x^2y^3)^3 \div (3x^2y^3)^3$**

**Solution:**

$$\begin{aligned}
 \text{(i)} \quad & 2b^6 \cdot b^3 \cdot 5b^4 \\
 &= 2 \times 5 \times b^{6+3+4} \\
 &= 10 b^{13}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii)} \quad & x^2y^3 \cdot 6x^5y \cdot 9x^3y^4 \\
 &= 6 \times 9 \times x^{2+5+3} \times y^{3+1+4} \\
 &= 54 x^{10} y^8
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii)} \quad & (-a)^5 (a^2) \\
 &= (-1 \times a)^5 \times a^2 \\
 &= (-1)^5 \times a^{5+2} \\
 &= -1 \times a^7 \\
 &= -a^7
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv)} \quad & (-y)^2 (-y)^3 \\
 &= (-1 \times y)^2 \cdot (-1 \times y)^3 \\
 &= (-1)^2 \cdot y^2 \cdot (-1)^3 \times y^3 \\
 &= 1^{2+3} \cdot y^{2+3} \\
 &= 1^5 y^5 \\
 &= y^5
 \end{aligned}$$

$$\begin{aligned}
 \text{(v)} \quad & (-3)^2 (3)^3 \\
 &= (-1 \times 3)^2 \cdot (3)^3 \\
 &= (-1)^2 \times 3^2 \cdot 3^3 \\
 &= (-1)^2 \cdot 3^{2+3} \\
 &= 1 \cdot 3^5 \\
 &= 3^5
 \end{aligned}$$

$$\begin{aligned}
 \text{(vi)} \quad & (-4x) (-5x^2) \\
 &= (-1 \times 4 \times x) \cdot (-1 \times 5 \times x^2)^1 \\
 &= (-1 \times 4 \times x) \cdot (-1 \times 5 \times x^2) \\
 &= -1 \times -1 \times 4 \times 5 \times x^{1+2} \\
 &= -1^{1+1} \cdot 4^1 \cdot 5^1 x^3 \\
 &= 20 x^3
 \end{aligned}$$

$$\begin{aligned}
 \text{(vii)} \quad & (5a^2b) (2ab^2) (a^3b) \\
 &= 5 \times 2 \times a^{2+1+3} \times b^{1+2+1} \\
 &= 10 a^6b^4
 \end{aligned}$$

$$\begin{aligned}
 \text{(viii)} \quad & x^{2a+7} \cdot x^{2a-8} \\
 &= x^{2a+7+2a-8} \\
 &= x^{4a-1}
 \end{aligned}$$



$$\begin{aligned}
 \text{(ix)} \quad & 3^y \cdot 3^2 \cdot 3^{-4} \\
 & = 3^y \cdot 3^2/3^4 \\
 & 3 \times 3) \\
 & = 3^y \times 1/3^2 \\
 & = 3^{y-2}
 \end{aligned}$$

$$\begin{aligned}
 \text{(x)} \quad & 2^{4a} \cdot 2^{3a} \cdot 2^{-a} \\
 & = 2^{4a+3a-a} \\
 & = 2^{7a-a} \\
 & = 2^{6a}
 \end{aligned}$$

$$\begin{aligned}
 \text{(xi)} \quad & 4x^2y^2 \div 9x^3y^3 \\
 & = 4x^2y^2/9x^3y^3 \\
 & = 4x^{2-3}y^{2-3}/9 \\
 & = 4x^{-1}y^{-1}/9 \\
 & = 4/9xy
 \end{aligned}$$

$$\begin{aligned}
 \text{(xii)} \quad & (10^2)^3 (x^8)^{12} \\
 & = 10^{2 \times 3} \cdot x^{8 \times 12} \\
 & = 10^6 x^{96}
 \end{aligned}$$

$$\begin{aligned}
 \text{(xiii)} \quad & (a^{10})^{10} (1^6)^{10} \\
 & = a^{10 \times 10} \cdot 1^{6 \times 10} \\
 & = a^{100} \cdot 1^{60} \\
 & = a^{100}
 \end{aligned}$$

$$\begin{aligned}
 \text{(xiv)} \quad & (n^2)^2 (-n^2)^3 \\
 & = n^{2 \times 2} \cdot (-n)^{2 \times 3} \\
 & = n^4 \cdot (-n)^6 \\
 & = -n^4 - 1^6 n^6 \\
 & = -n^4 + 6 \\
 & = -n^{10}
 \end{aligned}$$

$$\begin{aligned}
 & \text{(xv)} - (3ab)^2 (-5a^2bc^4)^2 \\
 & = - (3^2a^2b^2) \times (-1)^2 \times 5^2a^{2 \times 2}b^2c^{4 \times 2} \\
 & = - (3^2a^2b^2) (5^2a^4b^2c^8) \\
 & = - 3^2 \cdot 5^2 \cdot a^{2+4} b^{2+2} c^8 \\
 & = - 225a^6b^4c^8
 \end{aligned}$$

$$\begin{aligned}
 & \text{(xvi)} (-2)^2 \times (0)^3 \times (3)^3 \\
 & = 4 \times 0 \times 27 \\
 & = 0
 \end{aligned}$$

$$\begin{aligned}
 & \text{(xvii)} (2a^3)^4 (4a^2)^2 \\
 & = (2a^3)^4 (2^2a^2)^2 \\
 & = 2^4 a^{3 \times 4} \cdot 2^{2 \times 2} \cdot a^{2 \times 2} \\
 & = 2^4 a^{12} \cdot 2^4 a^4 \\
 & = 2^{4+4} \cdot a^{12+4} \\
 & = 2^8 a^{16} \\
 & = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times a^{16} \\
 & = 256 a^{16}
 \end{aligned}$$

## Question 4.

Simplify and express the Solution in the positive exponent form

$$(i) \frac{(-3)^3 \times 2^6}{6 \times 2^3} \quad (ii) \frac{(2^3)^5 \times 5^4}{4^3 \times 5^2}$$

$$(iii) \frac{36 \times (-6)^2 \times 3^6}{12^3 \times 3^5} \quad (iv) -\frac{128}{2187}$$

$$(v) \frac{a^{-7} \times b^{-7} \times c^5 \times d^4}{a^3 \times b^{-5} \times c^{-3} \times d^8}$$

$$(vi) (a^3 b^{-5})^{-2}$$

$$(i) \frac{(-3)^3 \times 2^6}{6 \times 2^3} = \frac{(-3)^3 \times 2^6}{2 \times 3 \times 2^3} = \frac{(-3)^3 \times 2^6}{3 \times 2^{3+1}}$$

$$= -(3)^{3-1} 2^{6-4} = -(3)^2 2^2 = -3^2 2^2$$

$$(ii) \frac{(2^3)^5 \times 5^4}{4^3 \times 5^2} = \frac{2^{3 \times 5} \times 5^4}{2^3 \times 2^2 \times 5^2}$$

$$= \frac{2^{15} \times 5^4}{2^6 \times 5^2} = 2^{15-6} \times 5^{4-2}$$

$$= 2^9 \times 5^2$$

$$(iii) \frac{36 \times (-6)^2 \times 3^6}{12^3 \times 3^5} = \frac{6 \times 6 \times (-6)^2 \times 3^6}{3^3 \times 4^3 \times 3^5}$$

$$= \frac{(6)^2 (-6)^2 \times 3^{6-3-5}}{4^3} = \frac{(6)^2 (-6)^2 3^{-2}}{4^3}$$

$$= \frac{6^2 (-6)^2}{3^2 \times 4^3} = \frac{6 \times 6 \times -6 \times -6}{3 \times 3 \times 4 \times 4 \times 4}$$

$$= \frac{9}{4} = \left(\frac{3}{2}\right)^2$$

$$(iv) -\frac{128}{2187}$$

|   |     |   |      |
|---|-----|---|------|
| 2 | 128 | 3 | 2187 |
| 2 | 64  | 3 | 729  |
| 2 | 32  | 3 | 243  |
| 2 | 16  | 3 | 81   |
| 2 | 8   | 3 | 27   |
| 2 | 4   | 3 | 9    |
| 2 | 2   | 3 | 3    |
| 1 |     | 1 |      |

$$= -\frac{2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2}{3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3} = -\frac{2^7}{3^7}$$

$$(v) \frac{a^{-7} \times b^{-7} \times c^5 \times d^4}{a^3 \times b^{-5} \times c^{-3} \times d^8}$$

$$= a^{-7-3} \times b^{-7+5} \times c^{5-(-3)} \times d^{4-8}$$

$$= a^{-10} \times b^{-2} \times c^8 \times d^{-4}$$

$$= \frac{c^8}{a^{10} \times b^2 \times d^4}$$

$$(vi) (a^3 b^{-5})^{-2} = a^{3 \times -2} b^{-5 \times -2}$$

$$= a^{-6} b^{10} = \frac{b^{10}}{a^6}$$

# HW EX5B QQ.3, 4.

AHA

1. Find the value of

$$(2/3)^3 \times (5/7)^3$$

2. Which of the following is not equal to  $(-5/4)^4$ ?

(a)  $(-5)^4/4^4$  (b)  $5^4/(-4)^4$

(c)  $-(5^4/4^4)$  (d)  $(-5/4) \times (-5/4) \times (-5/4) \times (-5/4)$

**THANKING YOU**  
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