

EXERCISE 6.2

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1. Using laws of exponents, simplify and write the answer in exponential form

(i) $2^3 \times 2^4 \times 2^5$

(ii) $5^{12} \div 5^3$

(iii) $(7^2)^3$

(iv) $(3^2)^5 \div 3^4$

(v) $3^7 \times 2^7$

(vi) $(5^{21} \div 5^{13}) \times 5^7$

Solution:

(i) Given $2^3 \times 2^4 \times 2^5$

We know that first law of exponents states that $a^m \times a^n \times a^p = a^{(m+n+p)}$

Therefore above equation can be written as $2^3 \times 2^4 \times 2^5 = 2^{(3+4+5)}$
 $= 2^{12}$

(ii) Given $5^{12} \div 5^3$

According to the law of exponents we have $a^m \div a^n = a^{m-n}$

Therefore given question can be written as $5^{12} \div 5^3 = 5^{12-3} = 5^9$

(iii) Given $(7^2)^3$

According to the law of exponents we have $(a^m)^n = a^{mn}$

Therefore given question can be written as $(7^2)^3 = 7^6$

(iv) Given $(3^2)^5 \div 3^4$

According to the law of exponents we have $(a^m)^n = a^{mn}$

Therefore $(3^2)^5 \div 3^4 = 3^{10} \div 3^4$

According to the law of exponents we have $a^m \div a^n = a^{m-n}$

$3^{10} \div 3^4 = 3^{(10-4)} = 3^6$

(v) Given $3^7 \times 2^7$

We know that law of exponents states that $a^m \times b^m = (a \times b)^m$

$3^7 \times 2^7 = (3 \times 2)^7 = 6^7$

(vi) Given $(5^{21} \div 5^{13}) \times 5^7$

According to the law of exponents we have $a^m \div a^n = a^{m-n}$

$= 5^{(21-13)} \times 5^7$

$$= 5^8 \times 5^7$$

According to the law of exponents we have $a^m \times a^n = a^{(m+n)}$

$$= 5^{(8+7)} = 5^{15}$$

2. Simplify and express each of the following in exponential form:

(i) $\{(2^3)^4 \times 2^8\} \div 2^{12}$

(ii) $(8^2 \times 8^4) \div 8^3$

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

(iv) $(5^4 \times x^{10}y^5) / (5^4 \times x^7y^4)$

Solution:

(i) Given $\{(2^3)^4 \times 2^8\} \div 2^{12}$

$\{(2^3)^4 \times 2^8\} \div 2^{12} = \{2^{12} \times 2^8\} \div 2^{12}$ [According to the law of exponents we have $(a^m)^n = a^{mn}$]

$= 2^{(12+8)} \div 2^{12}$ [According to the law of exponents we have $a^m \times a^n = a^{(m+n)}$]

$= 2^{20} \div 2^{12}$ [According to the law of exponents we have $a^m \div a^n = a^{m-n}$]

$$= 2^{(20-12)}$$

$$= 2^8$$

(ii) Given $(8^2 \times 8^4) \div 8^3$

$(8^2 \times 8^4) \div 8^3$ [According to the law of exponents we have $a^m \times a^n = a^{(m+n)}$]

$$= 8^{(2+4)} \div 8^3$$

$= 8^6 \div 8^3$ [According to the law of exponents we have $a^m \div a^n = a^{m-n}$]

$$= 8^{(6-3)} = 8^3 = (2^3)^3 = 2^9$$

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

$= 5^{(7-2)} \times 5^3$ [According to the law of exponents we have $a^m \div a^n = a^{m-n}$]

$= 5^5 \times 5^3$ [According to the law of exponents we have $a^m \times a^n = a^{(m+n)}$]

$$= 5^{(5+3)} = 5^8$$

(iv) Given $(5^4 \times x^{10}y^5) / (5^4 \times x^7y^4)$

$= (5^{4-4} \times x^{10-7}y^{5-4})$ [According to the law of exponents we have $a^m \div a^n = a^{m-n}$]

$$= 5^0 x^3 y^1$$
 [since $5^0 = 1$]

$$= 1x^3y$$

3. Simplify and express each of the following in exponential form:

(i) $\{(3^2)^3 \times 2^6\} \times 5^6$

(ii) $(x/y)^{12} \times y^{24} \times (2^3)^4$

(iii) $(5/2)^6 \times (5/2)^2$
(iv) $(2/3)^5 \times (3/5)^5$

Solution:

(i) Given $\{(3^2)^3 \times 2^6\} \times 5^6$
 $= \{3^6 \times 2^6\} \times 5^6$ [According to the law of exponents we have $(a^m)^n = a^{mn}$]
 $= 6^6 \times 5^6$ [since law of exponents states that $a^m \times b^m = (a \times b)^m$]
 $= 30^6$

(ii) Given $(x/y)^{12} \times y^{24} \times (2^3)^4$
 $= (x^{12}/y^{12}) \times y^{24} \times 2^{12}$
 $= x^{12} \times y^{24-12} \times 2^{12}$ [According to the law of exponents we have $a^m \div a^n = a^{m-n}$]
 $= x^{12} \times y^{12} \times 2^{12}$
 $= (2xy)^{12}$

(iii) Given $(5/2)^6 \times (5/2)^2$
 $= (5/2)^{6+2}$ [According to the law of exponents we have $a^m \times a^n = a^{(m+n)}$]
 $= (5/2)^8$

(iv) Given $(2/3)^5 \times (3/5)^5$
 $= (2/5)^5$ [since law of exponents states that $a^m \times b^m = (a \times b)^m$]

4. Write $9 \times 9 \times 9 \times 9 \times 9$ in exponential form with base 3.

Solution:

Given $9 \times 9 \times 9 \times 9 \times 9 = (9)^5 = (3^2)^5$
 $= 3^{10}$

5. Simplify and write each of the following in exponential form:

(i) $(25)^3 \div 5^3$
(ii) $(81)^5 \div (3^2)^5$
(iii) $9^8 \times (x^2)^5 / (27)^4 \times (x^3)^2$
(iv) $3^2 \times 7^8 \times 13^6 / 21^2 \times 91^3$

Solution:

(i) Given $(25)^3 \div 5^3$
 $= (5^2)^3 \div 5^3$ [According to the law of exponents we have $(a^m)^n = a^{mn}$]

$$\begin{aligned}
 &= 5^6 \div 5^3 \text{ [According to the law of exponents we have } a^m \div a^n = a^{m-n}] \\
 &= 5^{6-3} \\
 &= 5^3
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) Given } &(81)^5 \div (3^2)^5 \text{ [According to the law of exponents we have } (a^m)^n = a^{mn}] \\
 &= (81)^5 \div 3^{10} [81 = 3^4] \\
 &= (3^4)^5 \div 3^{10} \text{ [According to the law of exponents we have } (a^m)^n = a^{mn}] \\
 &= 3^{20} \div 3^{10} \\
 &= 3^{20-10} \text{ [According to the law of exponents we have } a^m \div a^n = a^{m-n}] \\
 &= 3^{10}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii) Given } &9^8 \times (x^2)^5 / (27)^4 \times (x^3)^2 \\
 &= (3^2)^8 \times (x^2)^5 / (3^3)^4 \times (x^3)^2 \text{ [According to the law of exponents we have } (a^m)^n = a^{mn}] \\
 &= 3^{16} \times x^{10} / 3^{12} \times x^6 \\
 &= 3^{16-12} \times x^{10-6} \text{ [According to the law of exponents we have } a^m \div a^n = a^{m-n}] \\
 &= 3^4 \times x^4 \\
 &= (3x)^4
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv) Given } &(3^2 \times 7^8 \times 13^6) / (21^2 \times 91^3) \\
 &= (3^2 \times 7^2 \times 7^6 \times 13^6) / (21^2 \times 13^3 \times 7^3) \text{ [According to the law of exponents we have } (a^m)^n = a^{mn}] \\
 &= (21^2 \times 7^6 \times 13^6) / (21^2 \times 13^3 \times 7^3) \\
 &= (7^6 \times 13^6) / (13^3 \times 7^3) \\
 &= 91^6 / 91^3 \text{ [According to the law of exponents we have } a^m \div a^n = a^{m-n}] \\
 &= 91^{6-3} \\
 &= 91^3
 \end{aligned}$$

6. Simplify:

- (i) $(3^5)^{11} \times (3^{15})^4 - (3^5)^{18} \times (3^5)^5$
 (ii) $(16 \times 2^{n+1} - 4 \times 2^n) / (16 \times 2^{n+2} - 2 \times 2^{n+2})$
 (iii) $(10 \times 5^{n+1} + 25 \times 5^n) / (3 \times 5^{n+2} + 10 \times 5^{n+1})$
 (iv) $(16)^7 \times (25)^5 \times (81)^3 / (15)^7 \times (24)^5 \times (80)^3$

Solution:

$$\begin{aligned}
 \text{(i) Given } &(3^5)^{11} \times (3^{15})^4 - (3^5)^{18} \times (3^5)^5 \\
 &= (3)^{55} \times (3)^{60} - (3)^{90} \times (3)^{25} \text{ [According to the law of exponents we have } (a^m)^n = a^{mn}] \\
 &= 3^{55+60} - 3^{90+25} \\
 &= 3^{115} - 3^{115}
 \end{aligned}$$

$$= 0$$

$$(ii) \text{ Given } (16 \times 2^{n+1} - 4 \times 2^n) / (16 \times 2^{n+2} - 2 \times 2^{n+2})$$

$$= (2^4 \times 2^{(n+1)} - 2^2 \times 2^n) / (2^4 \times 2^{(n+2)} - 2^{2+1} \times 2^2) \text{ [According to the law of exponents we have}$$

$$(a^m)^n = a^{mn}]$$

$$= 2^2 \times 2^{(n+3-2n)} / 2^2 \times 2^{(n+4-2n+1)}$$

$$= 2^n \times 2^3 - 2^n / 2^n \times 2^4 - 2^n \times 2$$

$$= 2^n(2^3 - 1) / 2^n(2^4 - 1) \text{ [According to the law of exponents we have } a^m \div a^n = a^{m-n}]$$

$$= 8 - 1 / 16 - 2$$

$$= 7/14$$

$$= (1/2)$$

$$(iii) \text{ Given } (10 \times 5^{n+1} + 25 \times 5^n) / (3 \times 5^{n+2} + 10 \times 5^{n+1})$$

$$= (10 \times 5^{n+1} + 5^2 \times 5^n) / (3 \times 5^{n+2} + (2 \times 5) \times 5^{n+1})$$

$$= (10 \times 5^{n+1} + 5 \times 5^{n+1}) / (3 \times 5^{n+2} + (2 \times 5) \times 5^{n+1}) \text{ [According to the law of exponents we have } (a^m)^n = a^{mn}]$$

$$= 5^{n+1} (10+5) / 5^{n+1} (10+15) \text{ [According to the law of exponents we have } a^m \div a^n = a^{m-n}]$$

$$= 15/25$$

$$= (3/5)$$

$$(iv) \text{ Given } (16)^7 \times (25)^5 \times (81)^3 / (15)^7 \times (24)^5 \times (80)^3$$

$$= (16)^7 \times (5^2)^5 \times (3^4)^3 / (3 \times 5)^7 \times (3 \times 8)^5 \times (16 \times 5)^3$$

$$= (16)^7 \times (5^2)^5 \times (3^4)^3 / 3^7 \times 5^7 \times 3^5 \times 8^5 \times 16^3 \times 5^3$$

$$= (16)^7 / 8^5 \times 16^3$$

$$= (16)^4 / 8^5$$

$$= (2 \times 8)^4 / 8^5$$

$$= 2^4 / 8$$

$$= (16/8)$$

$$= 2$$

7. Find the values of n in each of the following:

$$(i) 5^{2n} \times 5^3 = 5^{11}$$

$$(ii) 9 \times 3^n = 3^7$$

$$(iii) 8 \times 2^{n+2} = 32$$

$$(iv) 7^{2n+1} \div 49 = 7^3$$

$$(v) (3/2)^4 \times (3/2)^5 = (3/2)^{2n+1}$$

$$(vi) (2/3)^{10} \times \{(3/2)^2\}^5 = (2/3)^{2n-2}$$

Solution:

(i) Given $5^{2n} \times 5^3 = 5^{11}$
 $= 5^{2n+3} = 5^{11}$

On equating the coefficients, we get

$$2n + 3 = 11$$

$$\Rightarrow 2n = 11 - 3$$

$$\Rightarrow 2n = 8$$

$$\Rightarrow n = (8/2)$$

$$\Rightarrow n = 4$$

(ii) Given $9 \times 3^n = 3^7$

$$= (3)^2 \times 3^n = 3^7$$

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

On equating the coefficients, we get

$$2 + n = 7$$

$$\Rightarrow n = 7 - 2 = 5$$

(iii) Given $8 \times 2^{n+2} = 32$

$$= (2)^3 \times 2^{n+2} = (2)^5 \quad [\text{since } 2^3 = 8 \text{ and } 2^5 = 32]$$

$$= (2)^{3+n+2} = (2)^5$$

On equating the coefficients, we get

$$3 + n + 2 = 5$$

$$\Rightarrow n + 5 = 5$$

$$\Rightarrow n = 5 - 5$$

$$\Rightarrow n = 0$$

(iv) Given $7^{2n+1} \div 49 = 7^3$

$$= 7^{2n+1} \div 7^2 = 7^3 \quad [\text{since } 49 = 7^2]$$

$$= 7^{2n+1-2} = 7^3$$

$$= 7^{2n-1} = 7^3$$

On equating the coefficients, we get

$$2n - 1 = 3$$

$$\Rightarrow 2n = 3 + 1$$

$$\Rightarrow 2n = 4$$

$$\Rightarrow n = 4/2 = 2$$

(v) Given $(3/2)^4 \times (3/2)^5 = (3/2)^{2n+1}$

$$= (3/2)^{4+5} = (3/2)^{2n+1}$$

$$= (3/2)^9 = (3/2)^{2n+1}$$

On equating the coefficients, we get

$$2n + 1 = 9$$

$$\Rightarrow 2n = 9 - 1$$

$$\Rightarrow 2n = 8$$

$$\Rightarrow n = 8/2 = 4$$

(vi) Given $(2/3)^{10} \times \{(3/2)^2\}^5 = (2/3)^{2n-2}$

$$= (2/3)^{10} \times (3/2)^{10} = (2/3)^{2n-2}$$

$$= 2^{10} \times 3^{10}/3^{10} \times 2^{10} = (2/3)^{2n-2}$$

$$= 1 = (2/3)^{2n-2}$$

$$= (2/3)^0 = (2/3)^{2n-2}$$

On equating the coefficients, we get

$$0 = 2n - 2$$

$$2n - 2 = 0$$

$$2n = 2$$

$$n = 1$$

8. If $(9^n \times 3^2 \times 3^n - (27)^n) / (3^3)^5 \times 2^3 = (1/27)$, find the value of n.

Solution:

Given $(9^n \times 3^2 \times 3^n - (27)^n) / (3^3)^5 \times 2^3 = (1/27)$

$$= (3^2)^n \times 3^2 \times 3^n - (3^3)^n / (3^{15} \times 2^3) = (1/27)$$

$$= 3^{(2n+2+n)} - (3^3)^n / (3^{15} \times 2^3) = (1/27)$$

$$= 3^{(3n+2)} - (3^3)^n / (3^{15} \times 2^3) = (1/27)$$

$$= 3^{3n} \times 3^2 - 3^{3n} / (3^{15} \times 2^3) = (1/27)$$

$$= 3^{3n} \times (3^2 - 1) / (3^{15} \times 2^3) = (1/27)$$

$$= 3^{3n} \times (9 - 1) / (3^{15} \times 2^3) = (1/27)$$

$$= 3^{3n} \times (8) / (3^{15} \times 2^3) = (1/27)$$

$$= 3^{3n} \times 2^3 / (3^{15} \times 2^3) = (1/27)$$

$$= 3^{3n} / 3^{15} = (1/27)$$

$$= 3^{3n-15} = (1/27)$$

$$= 3^{3n-15} = (1/3^3)$$

$$= 3^{3n-15} = 3^{-3}$$

On equating the coefficients, we get

$$3n - 15 = -3$$

$$\Rightarrow 3n = -3 + 15$$

$$\Rightarrow 3n = 12$$

$$\Rightarrow n = 12/3 = 4$$



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