CHAPTER 5
EXPONENTS

1. Find the value of:

(i) 2^6

(ii) 9^3

(iii) 11^2

(iv) 5^4

Answer

(i) $2^6 = 2\times2\times2\times2\times2\times2 = 64$

(ii) $9^3 = 9\times9\times9 = 729$

(iii) $11^2 = 11 \times 11 = 121$

(iv) $5^4 = 5 \times 5 \times 5 \times 5 = 625$

2. Express the following in exponential form:

(i) $6 \times 6 \times 6 \times 6$

(ii) $t \times t$

(iii) $b \times b \times b \times b$

(iv) $5 \times 5 \times 7 \times 7 \times 7$

(v) $2 \times 2 \times a \times a$

(vi) $a \times a \times a \times c \times c \times c \times c \times d$

Answer

(i) $6 \times 6 \times 6 \times 6 = 6^4$

(ii) $t \times t = t^2$

(iii) $b \times b \times b \times b = b^4$

(iv) $5 \times 5 \times 7 \times 7 \times 7 = 5^2 \times 7^3$

(v) $2 \times 2 \times a \times a = 2^2 \times a^2$

(vi) $a \times a \times a \times c \times c \times c \times c \times d = a^3 \times c^4$ x d

3. Express each of the following numbers using exponential notation:

(i) 512

(ii) 343

(iii) 729

(iv) 3125

Answer

(i) 512

$512 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^9$

2	512
2	256
2	128
2	64
2	32
2	16
2	8
2	4
2	2
	1

(ii) 343

$343 = 7 \times 7 \times 7 = 7^3$

7	343
7	49
7	7
	1

(iii) 729

$729 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 3^6$

3	729

3	243
3	81
3	27
3	9
3	3
	1

(iv) 3125

$3125 = 5 \times 5 \times 5 \times 5 \times 5 = 5^5$

5	3125
5	625
5	125
5	25
5	5
	1

4. Identify the greater number, wherever possible, in each of the following:

(i) 4^3 and 34

(ii) 5^3 or 35

(iii) 2^8 or 82

(iv) 100^2 or 2100

(v) 2^{10} or 102

Answer

(i) $4^3 = 4 \times 4 \times 4 = 64$

$34 = 3 \times 3 \times 3 \times 3 = 81$

Since $64 < 81$

Thus, 34 is greater than 43.

(ii) $5^3 = 5 \times 5 \times 5 = 125$

$3^5 = 3 \times 3 \times 3 \times 3 \times 3 = 243$

Since, $125 < 243$

Thus, 34 is greater than 53.

(iii) $2^8 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 256$

$8^2 = 8 \times 8 = 64$

Since, $256 > 64$

Thus, 28 is greater than 82.

(iv) $100^2 = 100 \times 100 = 10,000$

$2^{100} = 2 \times 2 \times 2 \times 2 \times 2$ ....14 times ....$\times$ 2 = 16,384 ....$\times$ 2

Since, 10,000 < 16,384 ....$\times$2

Thus, 2100 is greater than 1002.

(v) $210 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 1,024$

$10^2 = 10 \times 10 = 100$

Since, $1,024 > 100$

Thus, $2^{10} > 10^2$

5. Express each of the following as product of powers of their prime factors:

(i) 648

(ii) 405

(iii) 540

(iv) 3,600

Answer

(i) $648 = 2^3 \times 3^4$

2	648
2	324
2	162
3	81
3	27

3	9
3	3
	1

(ii) $405 = 5 \times 3^4$

5	405
3	81
3	27
3	9
3	3
	1

(iii) $540 = 2^2 \times 3^3 \times 5$

2	540
2	270
3	135
3	45
3	15
5	5
	1

(iv) $3{,}600 = 2^4 \times 3^2 \times 5^2$

2	3600
2	1800
2	900
2	450
3	225
3	75
5	25
5	5
	1

6. Simplify:

(i) 2×10^3

(ii) $7^2 \times 2^2$

(iii) $2^3 \times 5$

(iv) 3×4^4

(v) 0×10^2

(vi) $5^2 \times 3^3$

(vii) $2^4 \times 3^2$

(viii) $3^2 \times 10^4$

Answer

(i) $2 \times 10^3 = 2 \times 10 \times 10 \times 10 = 2{,}000$

(ii) $7^2 \times 2^2 = 7 \times 7 \times 2 \times 2 = 196$

(iii) $2^3 \times 5 = 2 \times 2 \times 2 \times 5 = 40$

(iv) $3 \times 4^4 = 3 \times 4 \times 4 \times 4 \times 4 = 768$

(v) $0 \times 10^2 = 0 \times 10 \times 10 = 0$

(vi) $5^3 \times 3^3 = 5 \times 5 \times 3 \times 3 \times 3 = 675$

(vii) $2^4 \times 3^2 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 = 144$

(viii) $3^2 \times 10^4 = 3 \times 3 \times 10 \times 10 \times 10 \times 10 = 90{,}000$

7. Simplify:

(i) $(-4)^3$

(ii) $(-3)\times(-2)^3$

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

(iv) $(-2)^3 \times (-10)^3$

Answer

(i) $(-4)^3 = (-4)\times(-4)\times(-4) = -64$

(ii) $(-3)\times(-2)^3 =(-3)\times(-2)\times(-2)\times(-2) = 24$

(iii) $(-3)^2 \times (-5)^2 = (-3)\times(-3)\times(-5) \times (-5) = 225$

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

8. Compare the following numbers:

(i) 2.7×10^{12}; 1.5×10^8

(ii) 4×10^{14}; 3×10^{17}

Answer

(i) 2.7×10^{12} and 1.5×10^8

On comparing the exponents of base 10,

$2.7 \times 10^{12} > 1.5 \times 10^8$

(ii) 4×10^{14} and 3×10^{17}

On comparing the exponents of base 10,

$4 \times 10^{14} < 3 \times 10^{17}$

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

(i) $3^2 \times 3^4$ x 3^8

(ii) $6^{15} \div 6^{10}$

(iii) $a^3 \times a^2$

(iv) $7 \times$ x 7^2

(v) $(5^2)^2 \div 5^3$

(vi) $2^5 \times 5^5$

(vii) $a^4 \times b^4$

(viii) $(3^4)^3$

(ix) $[2^{20} \div 2^{15}) \times 2^3$

(x) $8^t \times 8^2$

Answer

(i) $3^2 \times 3^4 \times 3^8 = 3^{(2+4+8)} = 3^{14}$ [∵ $a^m \times a^n = a^{m+n}$]

(ii) $6^{15} \div 6^{10} = 6^{15-10} = 6^5$ [∵ $a^m \div a^n = a^{m-n}$]

(iii) $a^3 \times a^2 = a^{3+2} = a^5$ [∵ am × an = a m+n]

(iv) $7^x \times 7^2 = 7^{x+2}$ [∵ $a^m \times a^n = a^{m+n}$]

(v) $(5^2)^2 \div 5^3 = 5^{2\times3} \div 5^3 = 5^6 \div 5^3$ [∵ $(a^m)^n = a^{m\times n}$]

$= 5^{6-3} = 5^3$ [∵ $a^m \div a^n = a^{m-n}$]

(vi) $2^5 \times 2^5 = (2\times5)^5 = 10^5$ [∵ $a^m \times b^m = (a\times b)^m$]

(vii) $a^4 \times b^4 = (a\times b)^4$ [∵ $a^m \times b^m = (a\times b)^m$]

(viii) $(3^4)^3 = 3^{4\times3} = 3^{12}$ [∵ $(a^m)^n = a^{m\times n}$]

(ix) $(2^{20} \div 2^{15})\times 2^3 = (2^{20-15})\times 2^3$ [∵ $a^m \div a^n = a^{m-n}$]

$= 2^5 \times 2^3 = 2^{5+3} = 2^8$ [∵ $a^m \times a^n = a^{m+n}$]

(x) $8^t \div 8^2 = 8^{t-2}$ [∵ $a^m \div a^n = a^{m-n}$]

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

(i) $2^3 \times 3^4 \times 4/3\times32$

(ii) $[(5^2)^3 \times5^4] \div 5^7$

(iii) $25^4 \div 5^3$

(iv) $3 \times 7^2 \times 11^8 / 21 \times 11$

(v) $3^7 / 3^4 \times 3^3$

(vi) $2^0 + 3^0 + 4^0$

(vii) $2^0 \times 3^0 \times 4^0$

(viii) $(3^0 + 2^0) \times 5^0$

(ix) $2^8 \times a^5 / 4^3 \times a^3$

(x) $(a^5 / a^3) \times a^8$

(xi) $4^5 \times a^8b^3 / 4^5 \times a^5b^2$

(xii) $(2^3 \times 2)^3$

Answer

(i) $2^3 \times 3^4 \times 4 / 3\times 32 = 2^3 \times 3^4 \times 2^2 / 3 \times 2^5 = 2^{3+2} \times 3^4 / 3\times2^5$ [∵ $a^m \times a^n = a^{m+n}$]

$= 2^5 \times 3^4 / 3 \times 2^5 = 2^{5-5} \times 3^{4-3}$ [∵ $a^m \div a^n = a^{m-n}$]

$= 2^0 \times 3^3 = 1\times 3^3 = 3^3$

(ii) $[(5^2)^3 \times 5^4] \div 5^7$ [∵ $(a^m)^n = a^{m\times n}$]

$= [5^{6+4}] \div 5^7 = 5^{10} \div 5^7$ [∵ $a^m \times a^n = a^{m+n}$]

$= 5^{10-7} = 5^3$ [∵ $a^m \div a^n = a^{m-n}$]

(iii) $25^4 \div 5^3 = (5^2)^4 \div 5^3 = 5^8 \div 5^3$ [$\because (a^m)^n = a^{m\times n}$]
$= 5^{8-3} = 5^5$ [$\because a^m \div a^n = a^{m-n}$]
(iv) $3 \times 7^2 \times 11^8 / 21 \times 11^2 = 3 \times 72 \times 11^8 / 3 \times 7 \times 11^3 = 3^{1-1} \times 7^{2-1} \times 11^{8-3}$ [$\because$ $a^m \div a^n = a^{m-n}$]
$= 3^0 \times 7^1 \times 11^5 = 7 \times 11^5$
(v) $3^7 / 3^4 \times 3^3 = 3^7 / \times 3^{4+3} = 3^7 / 3^7$ [$\because a^m\times a^n = a^{m+n}$]
$= 37\text{-}7 = 30 = 1$ [$\because a^m\times a^n = a^{m+n}$]
(vi) $2^0 + 3^0 + 4^0 + 1+1+1 = 3$ [$\because a^0 = 1$]
(vii) $2^0 \times 3^0 \times 4^0 = 1\times1\times1 = 1$ [$\because a^0 = 1$]
(viii) $(3^0 + 2^0) \times 5^0 = (1+1)\times1 = 2\times1 = 2$ [$\because a^0 = 1$]
(ix) $2^8 \times a^5 / 4^3 \times a^3 = 2^8 \times a^5 / (2^2)^3 \times a^3 = 2^8\times a^5 / 2^6 \times a^3$ [$\because (a^m)^n = a^{m\times n}$]
$= 2^{8-6} \times a^{5-2} = 2^2 \times a^2$ [$\because a^m \div a^n = a^{m-n}$]
$= (2a)^2$ [$\because a^m\times b^m = (a\times b)^m$]
(x) $(a^5 / a^3) \times a^8 = (a^{5-3}) \times a^8 = a^2 \times a^8$ [$\because a^m \div a^n = a^{m-n}$]
$= a^{2+8} = a^{10}$ [$\because a^m\times a^n = a^{m+n}$]
(xi) $4^5 \times a^8b^3 / 4^5 \times a^5b^2 = 4^{5-5} \times a^{8-5} \times b^{3-2} = 4^0 \times a^3 \times b$ [$\because a^m \div a^n = a^{m-n}$]
$= 1 \times a^3 \times b = a^3b$ [$\because a^0 = 1$]
(xii) $(2^3 \times 2)^2 = (2^{3+1})^2 = (2^4)^2$ [$\because a^m\times a^n = a^{m+n}$]
$= 2^{4\times2} = 2^8$

11. Say true or false and justify your answer:
(i) $10 \text{ x } 10^{11} = 10011$
(ii) $2^3 > 5^2$
(iii) $2^3\times 3^2 = 6s$
(iv) $3^0 = (1000)^0$

Answer

(i) $10\times10^{11} = 100^{11}$
L.H.S. $10^{1+11} = 10^{12}$ and R.H.S. $(10^2)^{11}=10^{22}$
Since, L.H.S. ≠ R.H.S.
Therefore, it is false.
(ii) $2^3 > 5^2$
L.H.S $2^3 = 8$ and R.H.S. $5^2 = 25$

Since, L.H,S. is not greater than R.H.S.

Therefore, it is false,

(iii) $2^3 \times 3^2 = 6^5$

L.H.S. $2^3 \times 3^2 = 8 \text{ x } 9 = 72$ and R.H.S. $6^5 = 7.776$

Since, L.H.S. ≠ R.H.S.

Therefore, it is false.

(iv) $3^0 = (1000)^0$

L.H.S. $3^0 = 1$ and R.H.S. $(1000)^0 = 1$

Since, L.H.S. = R.H.S.

Therefore, it is true.

12. Express each of the following as a product of prime factors only in exponential form:

(i) 108 × 192

(ii) 270

(iii) 729 × 64

(iv) 768

Answer

(i) 108 × 192

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

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

$= 2^{6+2} \times 3^{3+1}$ $(a^m \times a^n = a^{m+n})$

$= 2^8 \times 3^4$

(ii) $270 = 2 \times 3 \times 3 \times 3 \times 5 = 2 \times 3^3 \times 5$

(iii) $729 \times 64 = (3 \times 3 \times 3 \times 3 \times 3 \times 3) \times (2 \times 2 \times 2 \times 2 \times 2)$

$= 3^6 \times 2^5$

(iv) $768 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 = 2^8 \times 3$