CLASS-7 **SUB-MATHS**

Chapter 13
Exponents and Powers

Ex. 13.1

Question 1. Find the value of:

(i) 2^6 (ii) 9^3 (iii) 11^2 (iv) 5^4

Answer: (i) $2^6 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 64$

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

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

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

Question 2. Express the following in exponential form:

(i) 6 x 6 x 6 x 6 (ii) t x t (iii) b x b x b x b

(iv) 5 x 5 x 7 x 7 x 7 (v) 2 x 2 x a x a

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

Question 3. Express each of the following numbers using exponential notation: (i) 512 (ii) 343 (iii) 729 (iv) 3125

Answer: (i) $512 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^9$

(ii) $343 = 7 \times 7 \times 7 = 7^3$

(iii) 729 = 3 x 3 x 3 x 3 x 3 x 3 = 3^6

(iv) 3125 = 5 x 5 x 5 x 5 x 5 = 5^5

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

(i) 4^3 or 3^4

(ii) 5^3 or 3^5

(iii) 2^8 or 8^2

(iv) 100^2 or 2^{100} (v) 2^{10}

or 10^2

Answer: (i) 4^3= 4 x 4 x 4 = 64

3^4= 3 x 3 x 3 x 3 = 81

Since 64 < 81

Thus, 3^4 is greater than 4^3.

(ii) 5^3 = 5 x 5 x 5 = 125

3^5 = 3 x 3 x 3 x 3 x 3 = 243

Since, 125 < 243

Thus, 3^4 is greater than 5^3.

(iii) 2^8 = 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 = 256 8^2 = 8 x 8 = 64

Since, 256 > 64

Thus, 2^8 is greater than 8^2.

(iv) 100^2 = 100 x 100 = 10,000

2^{100} = 2 x 2 x 2 x 2 x 2 x …..14 times x ……. x 2 = 16,384 x ….. x 2

Since, 10,000 < 16,384 x ……. X 2

Thus, 2^{100} is greater than 100^2 .

(v) 2^{10} = 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 = 1,024

10^2 = 10 x 10 = 100

Since, 1,024 > 100

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

Question 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 = $2^3 \times 3^4$

(ii) 405 = 5×3^4

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

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

Question 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) $2^4 \times 63^2$

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

Answer: (i) 2×10^3 = 2 x 10 x 10 x 10 = 2,000

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

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

(iv) 3×4^4 = 3 x 4 x 4 x 4 x 4 = 768

(v) 0×10^2 = 0 x 10 x 10 = 0

(vi) $5^2 \times 3^3$ = 5 x 5 x 3 x 3 x 3 = 675

(vii) $2^4 \times 63^2$ = 2 x 2 x 2 x 2 x 3 x 3 = 144

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

Question 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) $(-2)^3 \times (-10)^3 = (-2) \times (-2) \times (-2) \times (-10) \times (-10) \times (-10) = 8000$

Question 8. Compare the followingnumbers:

(i) 2.7×10^{12} $1.5\,x \quad 10^8$

(ii) 4×10^{14} 3×10^{17}

Answer: (i) 2.7×10^{12} and $1.5\,x \quad 10^8$

On comparing the exponents of base 10,

2.7 X 10^{12} > 1.5 X 10^{8}

(ii) 4 X 10^{14} < 3 X 10^{17}

Ex. 13.2

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

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

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

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

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

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

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

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

(viii) $\left(3^4\right)^3$

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

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

Answer: (i) $3^2 \times 3^4 \times 3^8 = 3^{(2+4+8)} = 3^{14}$ $\left[\because a^m \times a^n = a^{m+n}\right]$

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

(iii) $a^3 \times a^2 = a^{3-2} = a^5$ $\left[\because a^m \times a^n = a^{m+n}\right]$

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

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

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

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

(viii) $(3^4)^3 = 3^{3X4} = 3^{12}$

(ix) $(2^{20} \div 2^{15}) \times 2^3 = (2^{20-15}) \times 2^3 = 2^5 \times 2^3 = 2^{5+2} = 2^7$

(x) $8^t \div 8^2 = 8^{t+2}$

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

(i) $\frac{2^3 \times 3^4 \times 4}{3 \times 32}$

(ii) $\left[(5^2)^3 \times 5^4\right] \div 5^7$

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

(iv) $\frac{3 \times 7^2 \times 11^8}{21 \times 11}$

(v) $\frac{3^7}{3^4 \times 3^3}$

(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) $\frac{2^8 \times a^5}{4^3 \times a^3}$

(x) $\left(\frac{a^5}{a^3}\right) \times a^8$

(xi) $\frac{4^5 \times a^8 b^3}{4^5 \times a^5 b^2}$

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

Answer: (i) $\frac{2^3 \times 3^4 \times 4}{3 \times 32} = \frac{2^3 \times 3^4 \times 2^2}{3 \times 2^5} = \frac{2^{3+2} \times 3^4}{3 \times 2^5} \quad [\because a^m \times a^n = a^{m+n}]$

$= \frac{2^5 \times 3^4}{3 \times 2^5} = 2^{5-5} \times 3^{4-3} \; [\because a^m \div a^n = a^{m-n}]$

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

(ii) $\left[(5^2)^3 \times 5^4\right] \div 5^7 = \left[5^6 \times 5^4\right] \div 5^7 \; [\because (a^m)^n = a^{m \times n}]$

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

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

(iii) $25^4 \div 5^3 = \left(5^2\right)^4 \div 5^3 = 5^8 \quad 5^3 \left[(a^m)^n = a^{m \times n}\right]$

$= 5^{8-3} = 5^3 \left[\because a^m \div a^n = a^{m-n}\right]$

(iv) $\frac{3 \times 7^2 \times 11^8}{21 \times 11^3} = \frac{3 \times 7^2 \times 11^8}{3 \times 7 \times 11^3} = 3^{1-1} \times 7^{2-1} \times 11^{8-3} \left[\because \quad a^m \div a^n = a^{m-n}\right]$

$= 3^0 \times 7^1 \times 11^5 \quad 7 \times 11^5$

(v) $\frac{3^7}{3^4 \times 3^3} = \frac{3^7}{3^{4+3}} = \frac{3^7}{3^7} \quad \left[\because a^m \times a^n = a^{m+n}\right]$

$= 3^{7-7} = 3^0 = 1 \quad \left[\because a^m \div a^n = a^{m-n}\right]$

(vi) $2^0 + 3^0 + 4^0 = 1 + 1 + 1 = 3 \left[\because a^0 = 1\right]$

(vii) $2^0 \times 3^0 \times 4^0 = 1 \times 1 \times 1 = 1 \quad \left[\because a^0 = 1\right]$

(viii) $\left(3^0 + 2^0\right) \times 5^0 = (1 + 1) \times 1 = 2 \times 1 = 2 \quad \left[\because a^0 = 1\right]$

(ix) $\frac{2^8 \times a^5}{4^3 \times a^3} = \frac{2^8 \times a^5}{\left(2^2\right)^3 \times a^3} = \frac{2^8 \times a^5}{2^6 \times a^3} \left[\because \left(a^m\right)^n = a^{m \times n}\right]$

$= 2^{8-6} \text{ x } a^{5-3} = 2^2 \text{ x } a^2$

(x) $\left(\frac{a^5}{a^3}\right) \times a^8 = \left(a^{5-3}\right) \times a^8 = a^2 \times a^8 \left[\because a^m \div a^n = a^{m-n}\right]$

$= a^{2+8} = a^{10} \left[\because a^m \times a^n = a^{m+n}\right]$

(xi) $\frac{4^5 \times a^8 b^3}{4^5 \times a^5 b^2} = 4^{5-5} \times a^{8-5} \times b^{3-2} = 4^0 \times a^3 \times b \quad \left[\because a^m \div a^n = a^{m-n}\right]$

$= 1 \text{x } a^3 \text{ x } b = a^3 \text{ x } b \quad \left[\because a^0 = 1\right]$

(xi $\left(2^3 \times 2\right)^2 = \left(2^{3+1}\right)^2 = \left(2^4\right)^2 \left[\because a^m \times a^n = a^{m+n}\right]$

$2^{4 \times 2} \quad 2^8 \left[\because \left(a^m\right)^n \quad a^{m \times n}\right]$

Question 3. Say true or false and justify your answer:

(i) $10 \times 10^{11} = 100^{11}$

(ii) $2^3 > 5^2$

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

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

Answer: (i) $10 \times 10^{11} = 100^{11}$

L.H.S $10^{1+11} = 10^{12}$ and R.H.S $(10^2)^{11} = 10^{22}$

Since, L.H.S. $\neq$ 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. $2^3 \times 3^2 = 8 \times 9 = 72$ and R.H.S $6^5 = 7{,}776$

Since, L.H.S. $\neq$ 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.

Question 4. Express each of the following as a product of prime factors only in exponential form:

(i) 108 x 192

(ii) 270

(iii) 729 x 64

(iv) 768

Answer: (i) 108 x 192

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

$= 2^{2+6} \times 3^{3+1}$

$= 2^8 \times \ 3^4$

(ii) 270

$= 2 \times \ 3^3 \times 5$

(iii) 729 x 64

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

(iv) 768

$= 2^8 \times 3$

Question 5. Simplify:

(i) $\frac{\left(2^5\right)^2 \times 7^3}{8^3 \times 7}$

(ii) $\frac{25 \times 5^2 \times t^8}{10^3 \times t^4}$

(iii) $\frac{3^5 \times 10^5 \times 25}{5^7 \times 6^5}$

Answer: (i) $\frac{\left(2^5\right)^2 \times 7^3}{8^3 \times 7} = \frac{2^{5 \times 2} \times 7^3}{\left(2^3\right)^3 \times 7}$

$= \frac{2^{10} \times 7^3}{2^9 \times 7}$

$= 2^{10-9} \times 7^{3-1} = 2 \times 7^2$

= 2 x 49

= 98

(ii) $\frac{25\times5^2\times t^8}{10^3\times t^4} = \frac{5^2\times5^2\times t^8}{(5\times2)^3\times t^4}$

$= \frac{5^{2+2}\times t^{8-4}}{2^3\times5^3}$

$= \frac{5^4\times t^4}{2^3\times5^3}$

$= \frac{5^{4-3}\times t^4}{2^3}$

$= \frac{5t^4}{8}$

(iii) $\frac{3^5\times10^5\times25}{5^7\times6^5} = \frac{3^5\times(2\times5)^5\times5^2}{5^7\times(2\times3)^5}$

$= \frac{3^5\times2^5\times5^5\times5^2}{5^7\times2^5\times3^5}$

$= \frac{3^5\times2^5\times5^{5+2}}{5^7\times2^5\times3^5}$

$= \frac{3^5\times2^5\times5^7}{5^7\times2^5\times3^5}$

$= 2^{5-5}\times\ 3^{5-5}\times\ 5^{7-7}$

$= 2^0\times\ 3^0\times\ 5^0$

= 1 x 1 x 1

= 1

Ex. 13.3

Question 1. Write the following numbers in the expanded form:

279404, 3006194, 2806196, 120719, 20068

Answer: (i) 2,79,404 = 2,00,000 + 70,000 + 9,000 + 400 + 00 + 4

= 2 x 100000 + 7 x 10000 + 9 x 1000 + 4 x 100 + 0 x 10 + 4 x 1

= $2 \times 10^5 + 7 \times 10^4 + 9 \times 10^3 + 4 \times 10^2 + 0 \times 10^1 + 4 \times 10^0$

(ii) 30,06,194 = 30,00,000 + 0 + 0 + 6,000 + 100 + 90 + 4

= 3 x 1000000 + 0 x 100000 + 0 x 10000 + 6 x 1000 + 1 x 100 + 9 x 10 + 4 x 1

= $3 \times 10^6 + 0 \times 10^5 + 0 \times 10^4 + 6 \times 10^3 + 1 \times 10^2 + 9 \times 10^1 + 4 \times 10^0$

(iii) 28,06,196 = 20,00,000 + 8,00,000 + 0 + 6,000 + 100 + 90 + 6

= 2 x 1000000 + 8 x 100000 + 0 x 10000 + 6 x 1000 + 1 x 100 + 9 x 10 + 6 x 1

= $2 \times 10^6 + 8 \times 10^5 + 0 \times 10^4 + 6 \times 10^3 + 1 \times 10^2 + 9 \times 10^1 + 6 \times 10^0$

(iv) 1,20,719 = 1,00,000 + 20,000 + 0 + 700 + 10 + 9

= 1 x 100000 + 2 x 10000 + 0 x 1000 + 7 x 100 + 1 x 10 + 9 x 1

= $1 \times 10^5 + 2 \times 10^4 + 0 \times 10^3 + 7 \times 10^2 + 1 \times 10^1 + 9 \times 10^0$

(v) 20,068 = 20,000 + 00 + 00 + 60 + 8

= 2 x 10000 + 0 x 1000 + 0 x 100 + 6 x 10 + 8 x 1

= $2 \times 10^4 + 0 \times 10^3 + 0 \times 10^2 + 6 \times 10^1 + 8 \times 10^0$

Question 2. Find the number from each of the following expanded forms: (a) 8

$\times 10^4 + 6 \times 10^3 + 0 \times 10^2 + 4 \times 10^1 + 5 \times 10^0$

(b) $4 \times 10^5 + 5 \times 10^3 + 3 \times 10^2 + 2 \times 10^0$

(c) $3 \times 10^4 + 7 \times 10^2 + 5 \times 10^0$

(d) $9 \times 10^5 + 2 \times 10^2 + 3 \times 10^1$

Answer: (a) $8 \times 10^4 + 6 \times 10^3 + 0 \times 10^2 + 4 \times 10^1 + 5 \times 10^0$

$= 8 \times 10000 + 6 \times 1000 + 0 \times 100 + 4 \times 10 + 5 \times 1$

$= 80000 + 6000 + 0 + 40 + 5 = 86,045$

(b) $4 \times 10^5 + 5 \times 10^3 + 3 \times 10^2 + 2 \times 10^0$

$= 4 \times 100000 + 5 \times 1000 + 3 \times 100 + 2 \times 1$

$= 400000 + 5000 + 300 + 2 = 4,05,302$

(c) $3 \times 10^4 + 7 \times 10^2 + 5 \times 10^0$

$= 3 \times 10000 + 7 \times 100 + 5 \times 1$

$= 30000 + 700 + 5 = 30,705$

(d) $9 \times 10^5 + 2 \times 10^2 + 3 \times 10^1$

$= 9 \times 100000 + 2 \times 100 + 3 \times 10$

$= 900000 + 200 + 30 = 9,00,230$

Question 3. Express the following numbers in standard form:

(i) 5,00,00,000 (ii) 70,00,000 (iii) 3,18,65,00,000

(iv) 3,90,878 (v) 39087.8 (vi) 3908.78

Answer: (i) $5,00,00,000 = 5 \times 1,00,00,000 = 5 \times 10^7$

(ii) $70,00,000 = 7 \times 10,00,000 = 7 \times 10^6$

(iii) $3,18,65,00,000 = 31865 \times 100000 = 3.1865 \times 10000 \times 100000 = 3.1865 \times 10^9$

(iv) $3,90,878 = 3.90878 \times 100000 = 3.90878 \times 10^5$

(v) $39087.8 = 3.90878 \times 10000 = 3.90878 \times 10^4$

(vi) $3908.78 = 3.90878 \times 1000 = 3.90878 \times 10^3$

Question 4. Express the number appearing in the following statements in standard form:

\