EXPONENTS AND POWERS

EXPONENTS

INRRODUCTION

We have learnt earlier that $5 \times 5 \times 5$ can be written as 5^3 . We read 5^3 as 'five raised to the power of three'. In 5^3 , the number 5 is called the base and 3 is called the exponent or the index or the power. Similarly, exponential notation or exponential form can also be used for writing the product of a rational number multiplied by itself several times.



For example,

$$\frac{2}{5} \times \frac{2}{5} \text{ is written as } \left(\frac{2}{5}\right)^2$$
$$\frac{7}{4} \times \frac{7}{4} \times \frac{7}{4} \text{ as } \left(\frac{7}{4}\right)^3$$
$$\frac{-3}{2} \times \frac{-3}{2} \times \frac{-3}{2} \times \frac{-3}{2} \text{ as } \left(\frac{-3}{2}\right)^4, \text{ etc.}$$

Hence, if a is any rational number, then

$$a \times a \times a \times \dots m$$
 times = a^m .

Here, *a* is called the base and *m* is called the exponent.

Ex.1 Evaluate :

(a)
$$\left(\frac{3}{4}\right)^2$$
 (b) $\left(\frac{-4}{3}\right)^3$ (c) $\left(\frac{-1}{2}\right)^4$

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Sol. (a) We have
$$\left(\frac{3}{4}\right)^2 = \frac{3}{4} \times \frac{3}{4} = \frac{9}{16}$$

(b) We have $\left(\frac{-4}{3}\right)^3 = \frac{-4}{3} \times \frac{-4}{3} \times \frac{-4}{3} = \frac{-64}{27}$
(c) We have $\left(\frac{-1}{2}\right)^4 = \frac{-1}{2} \times \frac{-1}{2} \times \frac{-1}{2} \times \frac{-1}{2} = \frac{1}{16}$
Ex.2 Express the following in exponential form.
(a) $\frac{2}{5} \times \frac{2}{5} \times \frac{2}{5}$ (b) $\frac{-7}{3} \times \frac{-7}{3} \times \frac{-7}{3} \times \frac{-7}{3}$

Sol. (a) $\frac{2}{5} \times \frac{2}{5} \times \frac{2}{5} = \left(\frac{2}{5}\right)^3$

(b)
$$\frac{-7}{3} \times \frac{-7}{3} \times \frac{-7}{3} \times \frac{-7}{3} = \left(\frac{-7}{3}\right)^4$$

Ex.3 Express in power notation.

(a)
$$\frac{49}{81}$$
 (b) $\frac{-8}{27}$

Sol. (a) $\frac{49}{81} = \frac{7 \times 7}{9 \times 9} = \frac{7}{9} \times \frac{7}{9} = \left(\frac{7}{9}\right)^2$

(b)
$$\frac{-8}{27} = \frac{(-2) \times (-2) \times (-2)}{3 \times 3 \times 3}$$
$$= \left(\frac{-2}{3}\right) \times \left(\frac{-2}{3}\right) \times \left(\frac{-2}{3}\right) = \left(\frac{-2}{3}\right)^3$$

Ex.4 Simplify :

(a)
$$\left(\frac{3}{4}\right)^2 \times \left(\frac{-2}{3}\right)^3 \times \left(\frac{-10}{12}\right)^2$$

(b) $\left(\frac{-3}{5}\right)^2 \times \left(\frac{4}{9}\right)^4 \times \left(\frac{-15}{18}\right)^2$

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(a)
$$\left(\frac{3}{4}\right)^2 \times \left(\frac{-2}{3}\right)^3 \times \left(\frac{-10}{12}\right)^2$$

$$= \left(\frac{3}{4} \times \frac{3}{4}\right) \times \left(\frac{-2}{3} \times \frac{-2}{3} \times \frac{-2}{3}\right) \times \left(\frac{-10}{12} \times \frac{-10}{12}\right)$$

$$= \frac{9}{16} \times \frac{-8}{27} \times \frac{100}{144} = \frac{-25}{216}$$
(b) $\left(\frac{-3}{5}\right)^2 \times \left(\frac{4}{9}\right)^4 \times \left(\frac{-15}{18}\right)^2$

$$= \left(\frac{-3}{5} \times \frac{-3}{5}\right) \times \left(\frac{4}{9} \times \frac{4}{9} \times \frac{4}{9} \times \frac{4}{9}\right) \times \left(\frac{-15}{18} \times \frac{-15}{18}\right)$$

$$= \frac{9}{25} \times \frac{256}{6561} \times \frac{225}{324} = \frac{64}{6561}$$

Ex.5 F

Find the reciprocal of the following :

(a)
$$3^2$$
 (b) $(-4)^3$ (c) $\left(\frac{3}{4}\right)^3$

Sol. (a) Reciprocal of $3^2 = \frac{1}{3^2} = \frac{1}{9}$

(b) Reciprocal of $(-4)^3$

$$= \left(\frac{1}{-4}\right)^{3} = \frac{1}{-4} \times \frac{1}{-4} \times \frac{1}{-4} = \frac{1}{-64}$$

(c) Reciprocal of $\left(\frac{3}{4}\right)^{3}$
$$= \left(\frac{4}{3}\right)^{3} = \frac{4}{3} \times \frac{4}{3} \times \frac{4}{3} = \frac{64}{27}$$