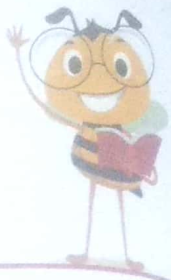
Chapter

5 Exponents (Powers)



You have already studied about integers, rational numbers, and their properties of various operations like addition, subtraction, multiplication, and division. You know that $7 + 7 = 14$. The expression $7 + 7$ can also be written as 2×7, read as two times seven. Similarly seven times seven can be written as $7 \times 7 = 49$.

There is another way to express $7 \times 7 = 49$— that is, $7^2 = 49$. Here 7^2 is read as 7 raised to the power of two, or 7 squared. Similarly $7 \times 7 \times 7 = 343$ can be written as $7^3 = 343$ in which 7^3 is read as 7 raised to the power of three, or 7 cubed.

What is 7^2 or 7^3? This is nothing but the exponential form of a number. Exponents are shortcuts for multiplication. The word exponent indicates how many times a number is being multiplied by itself. In 7^2, 7 is called the base and 2 is the exponent or power.

In 7^3, 7 is the base and 3 is the power, or exponent.

To illustrate this more clearly, let us look at the following table:

Repeated multiplication of a number	Exponential form of the product	Base of the product	Power of the product
$2 \times 2 \times 2 \times 2$	2^4	2	4
$5 \times 5 \times 5$	5^3	5	3
$6 \times 6 \times 6 \times 6 \times 6$	6^5	6	5
7×7	7^2	7	2
$a \times a \times \ldots m$ times	a^m	a	m

From the table, we conclude that if a is a rational number and m is a positive integer, then $a \times a \times a \times \ldots m$ times $= a^m$ (mth power of a).

Here a is called the base and m is called the exponent or power, or index.

In the exponential form, the number which is repeatedly multiplied is called the base and the number of times it is repeated is called the exponent, or power or index. This notation of writing the product of a rational number by itself several times is called the exponential notation.

If the base is a negative integer, then the product will be either negative or positive depending upon whether the exponent is an odd number or an even number.

Examples:

$(-5)^3 = -125$

(Power is odd, so the product is negative.)

$(-4)^4 = 256$

(Power is even, so the product is positive.)

$(-3)^5 = -243$

(Power is odd, so the product is negative.)

Example 1: Write the base and exponent of each of the following:

(a) 4^3 (b) 6^6

Solution:

(a) Base = 4

Exponent = 3

(b) Base = 6

Exponent = 6

Example 2: Express in power notations:

(a) $\frac{4}{5}\times\frac{4}{5}\times\frac{4}{5}\times\frac{4}{5}$ (b) $\frac{-343}{729}$

(c) $\frac{8000}{27}$

Solution:

(a) $\frac{4}{5}\times\frac{4}{5}\times\frac{4}{5}\times\frac{4}{5}=\left(\frac{4}{5}\right)^4$

(b) $\frac{-343}{729}=\frac{-7\times-7\times-7}{9\times9\times9}=\left(\frac{-7}{9}\right)^3$

(c) $\frac{8000}{27}=\frac{20\times20\times20}{3\times3\times3}=\left(\frac{20}{3}\right)^3$

Example 3: Find the values of the following:

(a) $\left(\frac{2}{5}\right)^4$ (b) $\left(\frac{-3}{4}\right)^3$

Solution:

(a) $\left(\frac{2}{5}\right)^4=\frac{2}{5}\times\frac{2}{5}\times\frac{2}{5}\times\frac{2}{5}=\frac{16}{625}$

(b) $\left(\frac{-3}{4}\right)^3=\frac{-3}{4}\times\frac{-3}{4}\times\frac{-3}{4}=\frac{-27}{64}$

LAWS OF EXPONENTS

The laws of exponents are very useful in performing the operations of multiplication and division.

Law 1: If x is a non-zero rational number and a and b are positive integers, then

$$x^a\times x^b=x^{a+b}$$

If bases are the same, then the powers are added in the multiplication of numbers.

Examples:

(a) $5^6\times5^4=(5)^{6+4}=5^{10}$

(b) $\left(\frac{3}{7}\right)^3\times\left(\frac{3}{7}\right)^3=\left(\frac{3}{7}\right)^{3+3}=\left(\frac{3}{7}\right)^6$

(c) $\left(\frac{-2}{5}\right)^2\times\left(\frac{-2}{5}\right)^5=\left(\frac{-2}{5}\right)^{2+5}=\left(\frac{-2}{5}\right)^7$

Law 2: If x is a non-zero rational number and a and b are positive integers, then

$$x^a\div x^b=x^{a-b}\text{, when } a>b$$

$$x^a\div x^b=\frac{1}{x^{b-a}}\text{, when } b>a$$

If bases are the same, then the powers are subtracted in the division of numbers.

Examples:

(a) $3^6\div3^4$

Here $6>4$.

So $3^6\div3^4=3^{6-4}=3^2$.

(b) $4^3\div4^7$

Here $3<7$.

So $4^3\div4^7=\frac{1}{4^{(7-3)}}=\frac{1}{4^4}=4^{-4}$.

(c) $\left(\frac{5}{9}\right)^9\div\left(\frac{5}{9}\right)^4$

Here $9>4$.

So $\left(\frac{5}{9}\right)^9\div\left(\frac{5}{9}\right)^4=\left(\frac{5}{9}\right)^{9-4}=\left(\frac{5}{9}\right)^5$.

Law 3: If x is a non-zero rational number and a is a negative integer, then $x^{-a}=\frac{1}{x^a}$.

Examples:

(a) $3^{-7}=\frac{1}{3^7}$

(b) $(-4)^{-2}=\frac{1}{(-4)^2}$

(c) $\left(\frac{5}{9}\right)^{-9}=\frac{1}{\left(\frac{5}{9}\right)^9}=\left(\frac{9}{5}\right)^9$

Law 4: If x is a non-zero rational number and a and b are positive integers, then $(x^a)^b=x^{ab}$.

Examples:

(a) $(3^2)^4=3^{2\times4}=3^8$

(b) $\left[\left(\frac{-2}{3}\right)^4\right]^5=\left(\frac{-2}{3}\right)^{4\times5}=\left(\frac{-2}{3}\right)^{20}$

Law 5: If x is a non-zero rational number, then $x^0 = 1$.

Examples:

(a) $6^4 \div 6^4 = \frac{6 \times 6 \times 6 \times 6}{6 \times 6 \times 6 \times 6} = 1$

or $6^{4-4} = 6^0 = 1$

(b) $13^3 \div 13^3 = \frac{13 \times 13 \times 13}{13 \times 13 \times 13} = 1$

or $13^{3-3} = 13^0 = 1$

Law 6: If x is a non-zero rational number, then $x^1 = x$

Example:

$6^3 \div 6^2 = \frac{6 \times 6 \times 6}{6 \times 6}$

or $6^{3-2} = 6$

Law 7: If x and y are non-zero rational numbers and a is a positive integer, then

$x^a \times y^a = (xy)^a$

and $x^a \div y^a = \left(\frac{x}{y}\right)^a$

Examples:

(a) $3^3 \times 4^3$

$$3^3 \times 4^3 = 3 \times 3 \times 3 \times 4 \times 4 \times 4$$
$$= (3 \times 4) \times (3 \times 4) \times (3 \times 4)$$
$$= 12 \times 12 \times 12$$
$$= (12)^3 = (3 \times 4)^3$$

(b) $2^{-2} \times 3^{-2}$

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

(c) $5^4 \div 4^4 = \frac{5^4}{4^4}$

$$= \frac{5 \times 5 \times 5 \times 5}{4 \times 4 \times 4 \times 4}$$
$$= \left(\frac{5}{4}\right) \times \left(\frac{5}{4}\right) \times \left(\frac{5}{4}\right) \times \left(\frac{5}{4}\right)$$
$$= \left(\frac{5}{4}\right)^4$$

Example 4: If $\frac{x}{y} = \left(\frac{3}{7}\right)^3 \div \left(\frac{3}{7}\right)^{-2}$, find $\left(\frac{x}{y}\right)^2$.

Solution: $\frac{x}{y} = \frac{\left(\frac{3}{7}\right)^3}{\left(\frac{3}{7}\right)^{-2}}$

$$= \left(\frac{3}{7}\right)^3 \times \left(\frac{3}{7}\right)^2$$
$$= \left(\frac{3}{7}\right)^{3+2} = \left(\frac{3}{7}\right)^5$$

So $\left(\frac{x}{y}\right)^2 = \left[\left(\frac{3}{7}\right)^5\right]^2 = \left(\frac{3}{7}\right)^{5\times2}$

$$= \left(\frac{3}{7}\right)^{10}.$$

Example 5: Compare 5^2 and 2^5.

Solution: $5^2 = 5 \times 5 = 25$

$2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$

Hence $2^5 > 5^2$.

Example 6: Express $625 \times 10{,}000$ in power notation.

Solution: $625 \times 10{,}000 = 5 \times 5 \times 5 \times 5 \times 10 \times 10 \times 10 \times 10$

$$= 5^4 \times 10^4$$
$$= (5 \times 10)^4$$
$$= 50^4$$

Example 7: Find the value of a if $3^a \times 3^{2a+4} = 3^{13}$.

Solution: $3^a \times 3^{2a+4} = 3^{13}$

$3^{a+2a+4} = 3^{13}$ (Using $x^a \times x^b = x^{a+b}$)

Bases are the same, so powers will be the same on both sides.

$a + 2a + 4 = 13$

$3a + 4 = 13$

$3a = 9$

$a = 3$

EXERCISE 5.1

1. Write the bases and powers of each of the following:

   (a) $(-4)^6$ (b) $\left(\frac{8}{9}\right)^2$ (c) $(17)^4$ (d) $\left(\frac{-2}{3}\right)^4$ (e) $\left(\frac{7}{17}\right)^7$

2. Expand the following:

   (a) $a^3b^2c^5$ (b) x^2y^3z (c) p^2q^3 (d) $\left(\frac{3}{4}\right)^2$ (e) $(-9)^3$

3. Express each of the following in exponential forms:

   (a) $(-2)\times(-2)\times(-2)\times(-2)$ (b) $6\times6\times6\times6\times a\times a$

   (c) $(-4)\times(-4)\times(-4)\times y\times y$ (d) $p\times p\times p\times q\times q\times r$

   (e) $a\times a\times(-b)\times(-b)\times c$ (f) $\frac{-4}{3}\times\frac{-4}{3}\times\frac{-4}{3}$

4. Write the following in exponential forms:

   (a) $\frac{-27}{343}$ (b) $\frac{1}{125}$ (c) $\frac{81}{10000}$ (d) $\frac{64}{729}$ (e) $\frac{-1}{1000}$

5. Find the values of the following:

   (a) 6^3 (b) $(12)^2$ (c) $\left(\frac{-11}{12}\right)^2$ (d) $\left(\frac{-3}{5}\right)^3$ (e) $\left(\frac{5}{-7}\right)^2$

6. Compare the following:

   (a) $(-2)^4$ or $(-3)^3$ (b) 7^3 or 6^4 (c) 4^2 or 2^4 (d) 10^2 or 5^4 (e) 5^2 or 2^5

7. Simplify:

   (a) $(-7)^2\times3^2$ (b) $(-12)^2\times(-4)^3$ (c) $(-2)^3\times3^2\times5$ (d) $7^2\times2^2\times(-5)^2$

   (e) $4^2\times(-5)^3\times3$ (f) $4\times5\times20^2$

8. Simplify and write in exponential forms.

   (a) $(-16)^5\times(-16)^3$ (b) $(18)^4\times(18)^7$ (c) $\left(\frac{5}{7}\right)^7\div\left(\frac{5}{7}\right)^7$ (d) $(-41)^6\div(-41)^3$

   (e) $\left(\frac{3}{5}\right)^3\div\left(\frac{3}{5}\right)^5$ (f) $\left(\frac{-2}{3}\right)^3\times\left(\frac{-2}{3}\right)^6$

9. Express each of the following with positive integers as exponents:

(a) 17^{-3} (b) $4^7 \div 4^{11}$ (c) $a^4 \times a^{-6}$ (d) $(4^{-6})^2$ (e) $\frac{1}{5^{-2}}$

10. Express each of the following with negative integers as exponents:

(a) $y^2 \times \frac{y^3}{y^4}$ (b) $\frac{3}{y}$ (c) $\frac{2}{3}$ (d) $\frac{5^3}{5^4}$ (e) $\frac{1}{2^4}$

11. Find the values of—

(a) $5^0 + 7^0$ (b) $\left[\left(\frac{-3}{5}\right)^3\right]^2$ (c) $(6^0 + 17) \div 2^5$ (d) $(4^{-1} + 5^{-1}) \div 3^2$

(e) $[(-1)^3]^6$ (f) $\left[\left(\frac{3}{4}\right)^2\right]^4 \div \left[\left(\frac{3}{4}\right)^4\right]^2$

12. Find the values of x if—

(a) $\left(\frac{-2}{5}\right)^8 \times \left(\frac{-2}{5}\right)^4 = \left(\frac{-2}{5}\right)^{x-1}$ (b) $\left(\frac{5}{9}\right)^{12} \div \left(\frac{5}{9}\right)^x = \frac{125}{729}$

(c) $\left(\frac{4}{11}\right)^x \times \left(\frac{4}{11}\right)^8 = \left(\frac{4}{11}\right)^{15}$ (d) $\left(\frac{-3}{4}\right)^x = \left(\frac{-3}{4}\right)^8 \div \left(\frac{-3}{4}\right)^2$

Points to Remember

- If a is a rational number and m is a positive integer, then $a \times a \times a \times \ldots m$ times $= a^m$ (read as a raised to the power of m), where a is called the base and m is called the exponent, or power or index.
- The laws of exponents state that if x is a rational number and a and b are positive integers, then

$x^a \times x^b = x^{a+b}$

$x^a \div x^b = x^{a-b}$, if $a > b$

$= \frac{1}{x^{b-a}}$, if $b > a$

$(x^a)^b = x^{ab}$

$x^a \times y^a = (x \times y)^a = (xy)^a$

$x^{-a} = \frac{1}{x^a}$

$x^0 = 1$, where x is not equal to zero.

Class - 7 Sub. - maths Chapter - 5

Exponents (Powers)

Page No. :- 48

If a is a rational number and m is a positive integer, then

$a \times a \times a \times a \times \cdots \times m \text{ times} = a^m$

Here a is called the base and m is called the exponent or power or index.

In the exponential form, the number which is repeatedly multiplied is called the base and the number of times it is repeated is called the exponent, or power or index. This notation of writing the product of a rational number by itself several times is called the exponential notation.

§ Laws of exponents :-

Law 1 :- If x is a non-zero rational number and a and b are positive integers, then

$$x^a \times x^b = x^{a+b}$$

If bases are the same then the powers are added in the multiplication of numbers.

Law 2 :- If x is a non-zero rational number and a and b are positive integers, then

$$x^a \div x^b = x^{a-b} \quad \text{when } a>b$$

$$x^a \div x^b = \frac{1}{x^{b-a}} \quad \text{when } b>a$$

If bases are the same, then the powers are subtracted in the division of numbers.

Law 3 :- If x is a non-zero rational number and a is a negative integers then $x^{-a} = \frac{1}{x^a}$.

Law 4 :- $(x^a)^b = x^{ab}$

Law 5 :- $x^0 = 1$

example :- $6^0 = 1$

Law 6 :- $x^1 = x$

Law 7 :- If x and y are non-zero rational numbers and a is a positive integer, then

$$x^a \times y^a = (xy)^a$$

and

$$x^a \div y^a = \left(\frac{x}{y}\right)^a$$

Q.1 Write the bases and Powers of each of the following:

(a) $(-4)^6$ (b) $\left(\frac{8}{9}\right)^2$ (c) $(17)^4$ (d) $\left(\frac{-2}{3}\right)^4$

(e) $\left(\frac{7}{17}\right)^7$

Solution:- (a) $(-4)^6$

Here, Base = (-4) and Power = 6

(b) $\left(\frac{8}{9}\right)^2$

Here, Base = $\left(\frac{8}{9}\right)$ and Power = 2

(c) (d) and (e) solve by yourself as solved above.

Q.2 Expand the following:

(a) $a^3b^2c^5$ (b) x^2y^3z (c) p^2q^3

(d) $\left(\frac{3}{4}\right)^2$ (e) $(-9)^3$

Solution:- (a) $a^3b^2c^5 = a \times a \times a \times b \times b \times c \times c \times c \times c \times c$

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

(e) $(-9)^3 = (-9) \times (-9) \times (-9)$

(b) (c) solve by yourself.

Q.3 Express each of the following in exponential forms:

(a) $(-2)\times(-2)\times(-2)\times(-2)$

Solution:- $(-2)^4$

(c) $(-4)\times(-4)\times(-4)\times y\times y$

Solution:- $(-4)^3\times y^2$

(f) $\left(\frac{-4}{3}\right)\times\left(\frac{-4}{3}\right)\times\left(\frac{-4}{3}\right)$

Solution: $\left(\frac{-4}{3}\right)^3$

(b) (d) and (e) Solve by yourself.

Q.4 Write the following in exponential forms:

(a) $\frac{-27}{343}$

Solution:- $\frac{-27}{343}$

$$\begin{array}{r|l} 3 & 27 \\ 3 & 9 \\ 3 & 3 \\ & 1 \end{array} \qquad \begin{array}{r|l} 7 & 343 \\ 7 & 49 \\ 7 & 7 \\ & 1 \end{array}$$

$$\frac{-27}{343} = \frac{-3\times-3\times-3}{7\times7\times7} = \left(\frac{-3}{7}\right)^3$$

(c) $\frac{81}{10000}$

solution:- $\frac{81}{10000}$

$$\begin{array}{r|l} 3 & 81 \\ \hline 3 & 27 \\ \hline 3 & 9 \\ \hline 3 & 3 \\ \hline & 1 \end{array} \qquad \begin{array}{r|l} 10 & 10000 \\ \hline 10 & 1000 \\ \hline 10 & 100 \\ \hline 10 & 10 \\ \hline & 1 \end{array}$$

$$\frac{81}{10000} = \frac{3\times3\times3\times3}{10\times10\times10\times10} = \left(\frac{3}{10}\right)^4$$

(d) $\frac{64}{729}$

solution:- $\frac{64}{729}$

$$\begin{array}{r|l} 4 & 64 \\ \hline 4 & 16 \\ \hline 4 & 4 \\ \hline & 1 \end{array} \qquad \begin{array}{r|l} 9 & 729 \\ \hline 9 & 81 \\ \hline 9 & 9 \\ \hline & 1 \end{array}$$

$$\frac{64}{729} = \frac{4\times4\times4}{9\times9\times9} = \left(\frac{4}{9}\right)^3$$

(b) and (e) solve by yourself.

Q.5 Find the values of the following

(a) 6^3

solution:- $6^3 = 6\times6\times6$

$= 36\times6$

$= 216$

$6^3 = 216$ ans.

(c) $\left(\frac{-11}{12}\right)^2$

solution:- $\left(\frac{-11}{12}\right)^2 = \frac{-11 \times -11}{12 \times 12}$

$\{(-) \times (-) = (+)\}$

$= \frac{121}{144}$

(e) $\left(\frac{5}{-7}\right)^2$

solution: $\left(\frac{5}{-7}\right)^2 = \frac{5 \times 5}{-7 \times -7}$

$\{(-) \times (-) = +$

$= \frac{25}{49}$

Q.6 Compare the following:

(a) $(-2)^4$ or $(-3)^3$

solution:- $(-2)^4 = (-2) \times (-2) \times (-2) \times (-2)$

$\{(-) \times (-) = (+)\}$

$= 16$

$(-3)^3 = (-3) \times (-3) \times (-3)$

$\{(-) \times (-) = (+)\}$

$= 9 \times (-3)$

$\{(-) \times (+) = (-$

$= -27$

Hence $(-2)^4 > (-3)^3$

$16 > (-27)$

(c) 4^2 or 2^4

solution:- $4^2 = 4 \times 4 = 16$

$2^4 = 2 \times 2 \times 2 \times 2 = 16$

Hence $4^2 = 2^4$

$16 = 16$

(6) (d) and (e) solve by yourself.

Q.7 Simplify:

(a) $(-7)^2 \times 3^2$

solution:- $(-7)^2 = -7 \times -7 = 49$ $\{(-)\times(-) = +$

$3^2 = 3 \times 3 = 9$

$(-7)^2 \times 3^2 = 49 \times 9$

441

$(-7)^2 \times 3^2 = 441$

(e) $4^2 \times (-5)^3 \times 3$

solution:- $4^2 = 4 \times 4 = 16$

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

Hence $4^2 \times (-5)^3 \times 3 = 16 \times (-125) \times 3$

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$$\frac{16 \times (-125)}{} \times 3$$

$$\frac{-2000 \times 3}{-6000}$$

$$4^2 \times (-5)^3 \times 3 = -6000$$

(b) (c) (d) and (f) solve by yourself

Q.8 Simplify and write in exponential forms.

(a) $(-16)^5 \times (-16)^3$

Solution:- $(-16)^5 \times (-16)^3$

According to Law 1,

$$x^a \times x^b = x^{a+b}$$

$$\Rightarrow (-16)^5 \times (-16)^3 = (-16)^{5+3} = (-16)^8 \text{ ans.}$$

(c) $\left(\frac{5}{7}\right)^7 \div \left(\frac{5}{7}\right)^7$

Solution:- $\left(\frac{5}{7}\right)^7 \div \left(\frac{5}{7}\right)^7$

According to Law 5,

$$x^a \div x^a = x^{a-a} = x^0 = 1$$

$\Rightarrow \left(\frac{5}{7}\right)^7 \div \left(\frac{5}{7}\right)^7 = \left(\frac{5}{7}\right)^{7-7} = \left(\frac{5}{7}\right)^0 = 1$ ans.

(f) $\left(\frac{-2}{3}\right)^3 \times \left(\frac{-2}{3}\right)^6$

Solution:- $\left(\frac{-2}{3}\right)^3 \times \left(\frac{-2}{3}\right)^6$

According to Law 1,

$$x^a \times x^b = x^{a+b}$$

$\Rightarrow \left(\frac{-2}{3}\right)^3 \times \left(\frac{-2}{3}\right)^6 = \left(\frac{-2}{3}\right)^{3+6} = \left(\frac{-2}{3}\right)^9$

(b) (d) and (e) solve by yourself.

Q.9 Express each of the following with positive integers as exponents:

(a) $(17)^{-3}$

Solution:- $(17)^{-3}$

According to Law 3,

$$x^{-a} = \frac{1}{x^a}$$

$(17)^{-3} = \frac{1}{17^3}$

(b) $4^7 \div 4^{11}$

Solution:- $4^7 \div 4^{11}$

According to Law 2,

$$x^a \div x^b = \frac{1}{x^{b-a}} \quad \text{when } b > a$$

$$\Rightarrow 4^7 \div 4^{11} = \frac{1}{4^{11-7}} = \frac{1}{4^4}$$

(d) $(4^{-6})^2$

Solution:- $(4^{-6})^2$

According to Law 4,

$$(x^a)^b = x^{ab}$$

$$\Rightarrow (4^{-6})^2 = 4^{-6\times 2} = 4^{-12}$$

again According to Law 3,

$$x^{-a} = \frac{1}{x^a}$$

$$4^{-12} = \frac{1}{4^{12}}$$ ans.

(e) $\frac{1}{5^{-2}}$

Solution:- $\frac{1}{5^{-2}}$

According to Law 3,

$$x^{-a} = \frac{1}{x^a} \quad \text{or} \quad \frac{1}{x^{-a}} = x^a$$

$$\Rightarrow \frac{1}{5^{-2}} = 5^2 \quad \underline{\text{ans}}.$$

(c) Solve by yourself.

Q.10 Express each of the following with negative integers as exponents.

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

Solution:- $y^2 \times \frac{y^3}{y^4}$

$\frac{y^3}{y^4}$

According to Law 2,

$$\frac{x^a}{x^b} = \frac{1}{x^{b-a}}$$

$$\Rightarrow \frac{y^3}{y^4} = \frac{1}{y^{4-3}} = \frac{1}{y}$$

Now $y^2 \times \frac{1}{y} = \frac{y^2}{y}$

$$\Rightarrow \frac{1}{y^{1-2}} = \frac{1}{y^{-1}}$$

(b) $\frac{3}{y}$

<u>Solution:-</u> According to Law 3,

$$\frac{1}{x^a} = x^{-a}$$

$$\Rightarrow \frac{3}{y^1} = 3y^{-1}$$

(c) (d) (e) solve by yourself.

<u>Q.11</u> Find the values of :—

(a) $5^0 + 7^0$

<u>Solution:-</u> $5^0 + 7^0$

According to Law 5,

$$x^0 = 1$$

$$\Rightarrow 5^0 + 7^0 = 1 + 1 = 2$$

Hence $5^0 + 7^0 = 2$ <u>ans.</u>

(c) $(6^0 + 17) \div 2^5$

<u>Solution:-</u> $(6^0 + 17) \div 2^5$

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$\Rightarrow (6^0+17) = 1+17$ $\left\{ \because 6^0 = 1 \atop x^0 = 1 \right.$

$= 18$

$\Rightarrow 18 \div 2^5$

$2^5 = 2\times2\times2\times2\times2$

$= 32$

$\Rightarrow 18 \div 32$

$\Rightarrow \frac{\cancel{18}\ 9}{\cancel{32}\ 16} = \frac{9}{16}$ ans.

(d) $(4^{-1} + 5^{-1}) \div 3^2$

solution:- $(4^{-1}+5^{-1}) \div 3^2$

$4^{-1}+5^{-1} = \frac{1}{4} + \frac{1}{5}$

taking L.C.M. of 4 and 5.

L.C.M. of 4 and 5 is 20.

$\frac{5+4}{20} = \frac{9}{20}$

$\Rightarrow \frac{9}{20} \div 3^2 = \frac{9}{20} \div \frac{9}{1}$

$\Rightarrow \frac{\cancel{9}^1}{20} \times \frac{1}{\cancel{9}_1} = \frac{1}{20}$ ans.

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(f) $\left[\left(\frac{3}{4}\right)^2\right]^4 \div \left[\left(\frac{3}{4}\right)^4\right]^2$

Solution:- $\left[\left(\frac{3}{4}\right)^2\right]^4 \div \left[\left(\frac{3}{4}\right)^4\right]^2$

According to Law 4,

$$(x^a)^b = x^{ab}$$

$$\Rightarrow \left(\frac{3}{4}\right)^{2\times4} \div \left(\frac{3}{4}\right)^{4\times2}$$

$$\Rightarrow \left(\frac{3}{4}\right)^8 \div \left(\frac{3}{4}\right)^8$$

$$\Rightarrow \left(\frac{3}{4}\right)^{8-8} = \left(\frac{3}{4}\right)^0 = 1$$

(b) and (e) Solve by yourself.

Q.12 Find the value of x if -

(a) $\left(\frac{-2}{5}\right)^8 \times \left(\frac{-2}{5}\right)^4 = \left(\frac{-2}{8}\right)^{x-1}$

Solution:- $\left(\frac{-2}{5}\right)^8 \times \left(\frac{-2}{5}\right)^4 = \left(\frac{-2}{5}\right)^{x-1}$

According to Law 1,

$$x^a \times x^b = x^{a+b}$$

$$\left(\frac{-2}{8}\right)^8 \times \left(\frac{-2}{5}\right)^4 = \left(\frac{-2}{5}\right)^{8+4} = \left(\frac{-2}{5}\right)^{12}$$

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$$\Rightarrow \left(\frac{-2}{5}\right)^{12} = \left(\frac{-2}{5}\right)^{x-1}$$

Bases are the same, so powers will be the same on both sides.

$$\Rightarrow 12 = x - 1$$

$$\Rightarrow 12 + 1 = x$$

$$\Rightarrow x = 13$$

(b) $\left(\frac{5}{9}\right)^{12} \div \left(\frac{5}{9}\right)^{x} = \frac{125}{729}$

Solution:- $\frac{125}{729} =$

$$\begin{array}{r|l} 5 & 125 \\ 5 & 25 \\ 5 & 5 \\ & 1 \end{array} \qquad \begin{array}{r|l} 9 & 729 \\ 9 & 81 \\ 9 & 9 \\ & 1 \end{array}$$

$$\frac{125}{729} = \frac{5 \times 5 \times 5}{9 \times 9 \times 9} = \left(\frac{5}{9}\right)^3$$

$$\Rightarrow \left(\frac{5}{9}\right)^{12} \div \left(\frac{5}{9}\right)^{x} = \left(\frac{5}{9}\right)^{3}$$

According to Law 2,

$$x^a \div x^b = x^{a-b}$$

$$\Rightarrow \left(\frac{5}{9}\right)^{12} \div \left(\frac{5}{9}\right)^{x} = \left(\frac{5}{9}\right)^{12-x}$$

$$\Rightarrow \left(\frac{5}{9}\right)^{12-x} = \left(\frac{5}{9}\right)^{3}$$

Bases are the same, so powers

will be the same on both sides.

$\Rightarrow 12-x = 3$

$\Rightarrow 12-3 = x$

$\Rightarrow 9 = x$ ans.

(c) $\left(\frac{4}{11}\right)^x \times \left(\frac{4}{11}\right)^8 = \left(\frac{4}{11}\right)^{15}$

solution:- $\left(\frac{4}{11}\right)^x \times \left(\frac{4}{11}\right)^8 = \left(\frac{4}{11}\right)^{15}$

According to Law 1,

$x^a \times x^b = x^{a+b}$

$\Rightarrow \left(\frac{4}{11}\right)^x \times \left(\frac{4}{11}\right)^8 = \left(\frac{4}{11}\right)^{x+8}$

$\Rightarrow \left(\frac{4}{11}\right)^{x+8} = \left(\frac{4}{11}\right)^{15}$

$\Rightarrow$ Bases are the same, so powers will be same on both sides.

$\Rightarrow x+8 = 15$

$\Rightarrow x = 15-8$

$\Rightarrow x = 7$ ans.

(d) Solve by yourself.