Module 12

INDICES (Exponents)

INTRODUCTION :

What is an exponent ?

If m is a positive integer then

$a^m = a \times a \times a \times a$ .... upto m terms/times.

Here

☆ 'a' is called base and

☆ 'm' is called Power (or exponent or index)

Plural of index is called indices

Eg : ⇨ $a^{10} = a \times a \times a \times a \times a \times a \times a \times a \times a \times a$

⇨ $5^3 = 5 \times 5 \times 5$

⇨ $m^4 = m \times m \times m \times m$

Upto 10 terms

Upto 3 terms

Upto 4 terms

SQUARE & SQUARE ROOTS:

$16 = 4 \times 4$

$16 = \boxed{4^2}$

What is the square root of 16?

$\therefore$ 16 is square of 4

4 is square root of 16

4

$\sqrt{16} = 4$

Which can also be written as

16 can also be written as

$16^{\frac{1}{2}} = 4$

$16^{\frac{1}{2}}$ is equal to $\sqrt{16}$

$16^{\frac{1}{2}}$

Here,

16 is base & $\frac{1}{2}$ is index

CUBE & CUBE ROOTS:

$8 = 2 \times 2 \times 2$

$8 = 2^3$

$\therefore$ 8 is cube of 2

4 is cube root of 8

$\sqrt[3]{8} = 2$

Which can also be written as

$8^{\frac{1}{2}} = 2$

$8^{\frac{1}{3}}$ is equal to $\sqrt[3]{8}$

$8^{\frac{1}{2}}$

Here,

8 is base & $\frac{1}{3}$ is index

What is the square root of 16?

4

16 can also be written as

RULES OF INDICES

1. $a^m \times a^n = a^{m+n}$
2. $a^m \div a^n = a^{m-n}$
3. $(a^m)^n = a^{m \times n}$
4. $(a \times b)^m = a^m \times b^m$
5. $(a \div b)^m = a^m \div b^m$
6. $a^{-m} = \dfrac{1}{a^m}$
7. $a^0 = 1$

CUBE & CUBE ROOTS:

(Same bases Laws)

❖ **Product Law** :

$a^m \times a^n = a^{m+n}$

Eg : * $3^7 \times 3^4 = 3^{7+4} = 3^{11}$

* $2^6 \times 2^2 = 2^{6+2}$

$= 2^8$

❖ **Quotient Law :**

$a^m \div a^n = a^{m-n}$

Eg : * $\frac{3^7}{3^4} = 3^{7-4} = 3^3$

* $\frac{a^3}{a^5} = a^{3-5} = a^{-2}$

1 Evaluate :

(i) 3^{-2}

Sol.

$$3^{-2} = \frac{1}{\boxed{3^2}}$$

$$= \frac{1}{\boxed{3 \times 3}}$$

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

$$\therefore \boxed{3^{-2} = \frac{1}{9}}$$

(ii) $(-4)^{-2}$

Sol.

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

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

$$= \frac{1}{\boxed{(-4) \times (-4)}}$$

$$\therefore \boxed{(-4)^{-2} = \frac{1}{16}}$$

1 **Evaluate :**

(iii) $\left(\frac{1}{2}\right)^{-5}$

Sol.

$$\left(\frac{1}{2}\right)^{-5} = \frac{1}{\boxed{\left(\frac{1}{2}\right)^{5}}}$$

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

$$= \frac{1}{\boxed{\left(\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}\right)}}$$

$$= \frac{1}{\left(\frac{1}{32}\right)}$$

$$= 1 \times \frac{32}{1}$$

$$\therefore \boxed{\left(\frac{1}{2}\right)^{-5} = 32}$$

2 **Simplify and express the result in power notation with positive exponent :**

(i) $(-4)^5 \div (-4)^8$

Sol.

$$(-4)^5 \div (-4)^8 = (-4)^{\boxed{5-8}}$$

$$= \boxed{(-4)^{-3}}$$

$$a^m \div a^n = a^{m-n}$$

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

$$\therefore \quad \boxed{(-4)^5 \div (-4)^8 = \frac{1}{(-4)^3}}$$

(ii) $\left(\frac{1}{2^3}\right)^2$

Sol.

$$\left(\frac{1}{2^3}\right)^2 = \frac{1^2}{\boxed{(2^3)^2}}$$

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{a^n}$$

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

$$\therefore \quad \boxed{(-4)^{-2} = \frac{1}{(2)^6}}$$

$$(a^m)^n = a^{m \times n}$$

2 **Simplify and express the result in power notation with positive exponent :**

(iii) $(-3)^4 \times \left(\frac{5}{3}\right)^4$

Sol.

$$(-3)^4 \times \left(\frac{5}{3}\right)^4 = \left[(-\cancel{3}) \times \left(\frac{5}{\cancel{3}}\right)\right]^4$$

$a^m \times b^m = (ab)^m$

$$= \boxed{[(-1) \times 5]^4}$$

$$= [(-1)^4 \times (5)^4]$$

$(ab)^m = a^m b^m$

$$= 1 \times (5)^4$$

$$\therefore \quad \boxed{(-3)^4 \times \left(\frac{5}{3}\right)^4 = (5)^4}$$

2 **Simplify and express the result in power notation with positive exponent :**

(iv) $(3^{-7} \div 3^{-10}) \times 3^{-5}$

Sol.

$$(3^{-7} \div 3^{-10}) \times 3^{-5} = 3^{\boxed{-7-(-10)}} \times 3^{-5}$$

$$= 3^{\boxed{-7+10}} \times 3^{-5}$$

$$= \boxed{3^{3} \times 3^{-5}}$$

$$= 3^{\boxed{3+(-5)}}$$

$$= \boxed{3^{-2}}$$

$$\therefore \quad \boxed{(3^{-7} \div 3^{-10}) \times 3^{-5} = \frac{1}{3^2}}$$

$a^m \div a^n = a^{m-n}$

$a^{-m} = \dfrac{1}{a^m}$

$a^m \times a^n = a^{m+n}$

2

Simplify and express the result in power notation with positive exponent :

(v) $2^{-3} \times (-7)^{-3}$

$a^m \times b^m = (ab)^m$

Sol.

$$2^{-3} \times (-7)^{-3} = [2 \times (-7)]^{-3}$$

$$= (-14)^{-3}$$

$a^{-m} = \dfrac{1}{a^m}$

$$\therefore \quad \boxed{2^{-3} \times (-7)^{-3} = \frac{1}{(-14)^3}}$$

3 Find the value of :

(i) $(3^0 + 4^{-1}) \times 2^2$

Sol. $(3^0 + 4^{-1}) \times 2^2 = \left(\frac{1}{1} + \frac{1}{4}\right) \times 2^2$

$= \left(\frac{4 + 1}{4}\right) \times 2^2$

$= \frac{5}{\cancel{4}} \times \cancel{4}$

$\therefore \boxed{(3^0 + 4^{-1}) \times 2^2 = 5}$

$a^0 = 1$

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

3 **Find the value of :**

(ii) $(2^{-1} \times 4^{-1}) \div 2^{-2}$

Sol.

$$\begin{aligned}(2^{-1} \times 4^{-1}) \div 2^{-2} &= (2 \times 4)^{-1} \div 2^{-2}\\ &= (2^1 \times 2^2)^{-1} \div 2^{-2}\\ &= (2^{1+2})^{-1} \div 2^{-2}\\ &= (2^{-3}) \div 2^{-2}\\ &= (2)^{-3-(-2)}\\ &= (2)^{-3+2}\\ &= 2^{-1}\end{aligned}$$

$a^m \times b^m = (ab)^m$

$a^m \times a^n = a^{m+n}$

$a^m \div a^n = a^{m-n}$

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

$\therefore \quad (2^{-1} \times 4^{-1}) \div 2^{-2} = \frac{1}{2}$

3 Find the value of :

(iii) $\left(\frac{1}{2}\right)^{-2} + \left(\frac{1}{3}\right)^{-2} + \left(\frac{1}{4}\right)^{-2}$

Sol.

$$\left(\frac{1}{2}\right)^{-2} + \left(\frac{1}{3}\right)^{-2} + \left(\frac{1}{4}\right)^{-2} = (2^{-1})^{-2} + (3^{-1})^{-2} + (4^{-1})^{-2}$$

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

$$= 2^2 + 3^2 + 4^2$$

$$= 4 + 9 + 16$$

$$\therefore \boxed{\left(\frac{1}{2}\right)^{-2} + \left(\frac{1}{3}\right)^{-2} + \left(\frac{1}{4}\right)^{-2} = 29}$$

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

$(a^m)^n = a^{m \times n}$

(iv) $(3^{-1} + 4^{-1} + 5^{-1})^0$

Sol.

$$(3^{-1} + 4^{-1} + 5^{-1})^0 = 1$$

$a^0 = 1$

3 Find the value of :

(v) $\left\{\left(\frac{-2}{3}\right)^{-2}\right\}^{2}$

Sol.

$$\left\{\left(\frac{-2}{3}\right)^{-2}\right\}^{2} = \left(\frac{-2}{3}\right)^{\boxed{-2 \times 2}}$$

$(a^{m})^{n} = a^{m \times n}$

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

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

$$= \left(\frac{\boxed{-3}}{\boxed{2}}\right)^{4}$$

$$\therefore \quad \boxed{\left\{\left(\frac{-2}{3}\right)^{-2}\right\}^{2} = \frac{81}{16}}$$

4 **Evaluate :**

(i) $\dfrac{8^{-1} \times 5^3}{2^{-4}}$

Sol.

$$\frac{\boxed{8}^{-1} \times 5^3}{2^{-4}} = \frac{\boxed{(2^3)^{-1}} \times 5^3}{2^{-4}}$$

$(a^m)^n = a^{m \times n}$

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

$a^m \div a^n = a^{m-n}$

$$= 2^{\boxed{-3-(-4)}} \times 5^3$$

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

$$= 2 \times 125$$

$$\therefore \boxed{\frac{8^{-1} \times 5^3}{2^{-4}} = 250}$$

4 **Evaluate :**

(ii) $(5^{-1} \times 2^{-1}) \times 6^{-1}$

Sol.

$$(5^{-1} \times 2^{-1}) \times 6^{-1} = \left(\frac{1}{5} \times \frac{1}{2}\right) \times \frac{1}{6}$$

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

$$= \frac{1}{10} \times \frac{1}{6}$$

$$\therefore \quad \boxed{(5^{-1} \times 2^{-1}) \times 6^{-1} = \frac{1}{60}}$$

5 Find the value of m for which $5^m \div 5^{-3} = 5^5$

Sol.

$$\boxed{5^m \div 5^{-3}} = 5^5$$

$$\therefore \quad 5^{m-(-3)} = 5^5$$

$$\boxed{a^m \div a^n = a^{m-n}}$$

$$\therefore \quad 5^{m+3} = 5^5$$

Comparing exponents both sides, we get

$$\therefore \quad m + 3 = 5$$

$$\therefore \quad m = 5 - 3$$

$$\therefore \quad \boxed{m = 2}$$

6 Evaluate :

(i) $\left\{\left[\left(\frac{1}{3}\right)^{-1} - \left(\frac{1}{4}\right)^{-1}\right]\right\}^{-1}$

Sol.

$$\left\{\left[\left(\frac{1}{3}\right)^{-1} - \left(\frac{1}{4}\right)^{-1}\right]\right\}^{-1} = \left\{\left[\left(\frac{3}{1}\right)^{1} - \left(\frac{4}{1}\right)^{1}\right]\right\}^{-1}$$

$$= \{3 - 4\}^{-1}$$

$$= (-1)^{-1}$$

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

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

$$\therefore \quad \boxed{\left\{\left[\left(\frac{1}{3}\right)^{-1} - \left(\frac{1}{4}\right)^{-1}\right]\right\}^{-1} = -1}$$

6 **Evaluate :**

(ii) $\left(\frac{5}{8}\right)^{-7} \times \left(\frac{8}{5}\right)^{-4}$

Sol.

$$\left(\frac{5}{8}\right)^{-7} \times \left(\frac{8}{5}\right)^{-4} = \frac{5^{-7}}{8^{-7}} \times \frac{8^{-4}}{5^{-4}}$$

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{a^n}$$

$$= 5^{-7-(-4)} \times 8^{-4-(-7)}$$

$$a^m \div a^n = a^{m-n}$$

$$= 5^{-7+4} \times 8^{-4+7}$$

$$= 5^{-3} \times 8^3$$

$$= \frac{1}{5^3} \times 8^3$$

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

$$= \frac{8^3}{5^3}$$

$$\therefore \quad \left(\frac{5}{8}\right)^{-7} \times \left(\frac{8}{5}\right)^{-4} = \frac{512}{125}$$

7 Simplify

(i) $\dfrac{25 \times t^{-4}}{5^{-3} \times 10 \times t^{-8}}$ $(t \neq 0)$

Sol.

$$\frac{\boxed{25} \times t^{-4}}{5^{-3} \times \boxed{10} \times t^{-8}} = \frac{\boxed{5^2} \times \boxed{t^{-4}}}{\boxed{5^{-3}} \times \boxed{5} \times 2 \times \boxed{t^{-8}}}$$

$$= \frac{5^{\boxed{2-(-3)-1}} \times t^{\boxed{-4-(-8)}}}{2}$$

$a^m \div a^n = a^{m-n}$

$$= \frac{5^{\boxed{2+3-1}} \times t^{\boxed{-4+8}}}{2}$$

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

$$\therefore \boxed{\frac{25 \times t^{-4}}{5^{-3} \times 10 \times t^{-8}} = \frac{625}{2} t^4}$$

7 Simplify

(i) $\dfrac{3^{-5} \times 10^{-5} \times 125}{5^{-7} \times 6^{-5}}$

Sol.

$$\frac{3^{-5} \times \boxed{10^{-5}} \times \boxed{125}}{5^{-7} \times \boxed{6^{-5}}} = \frac{3^{-5} \times \boxed{(2 \times 5)^{-5}} \times 5^3}{5^{-7} \times \boxed{(2 \times 3)^{-5}}}$$

$a^m \times a^n = a^{m+n}$

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

$(ab)^m = a^m b^m$

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

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

$a^m \div a^n = a^{m-n}$

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

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

$$= \boxed{3^0} \times \boxed{2^0} \times \boxed{5^5}$$

$a^0 = 1$

$$= 1 \times 1 \times 3125$$

$$\therefore \boxed{\frac{3^{-5} \times 10^{-5} \times 125}{5^{-7} \times 6^{-5}} = 3125}$$

EXERCISE 12.2

1 **Express the following numbers in standard form :**

(i) 0.0000000000085

Sol.

$$0.0000000000085 = \frac{85}{10000000000000}$$

$$= \frac{85}{10^{13}}$$

$$= \frac{8.5 \times 10^{1}}{10^{13}}$$

$$= 8.5 \times 10 \times 10^{-13}$$

$$\therefore \boxed{0.0000000000085 = 8.5 \times 10^{-12}}$$

How many numbers are there after decimal point?

13 number

If we write this in index form we get

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

$a^m \times a^n = a^{m+n}$

85 can also be written as 8.5×10^1

1 **Express the following numbers in standard form :**

(ii) 0.00000000000942

Sol.

$$0.00000000000942 = \frac{942}{100000000000000}$$

$$= \frac{942}{10^{14}}$$

$$= \frac{9.42 \times 10^2}{10^{14}}$$

$$= 9.42 \times 10^2 \times 10^{-14}$$

$$\therefore \boxed{0.0000000000085 = 9.42 \times 10^{-12}}$$

How many numbers are there after decimal point?

13 number

If we write this in index form we get

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

$a^m \times a^n = a^{m+n}$

942 can also be written as 9.42×10^2

1 Express the following numbers in standard form :

(iii) 602000000000000

Sol.

$$602000000000000 = 602 \times \boxed{10000000000000}$$

How many zeros are there?

13 number

$$= \boxed{602} \times 10^{13}$$

This can also be written as

602 can also be written as 6.02×10^2

$$= 6.02 \times \boxed{10^2 \times 10^{13}}$$

If we write this in index form we get

$a^m \times a^n = a^{m+n}$

$$= 6.02 \times \boxed{10^{2+13}}$$

$$\therefore \boxed{602000000000000 = 6.02 \times 10^{15}}$$

1 **Express the following numbers in standard form :**

(iv) 0.00000000837

Sol.

$$0.\boxed{00000000837} = \frac{837}{\boxed{100000000000}}$$

$$= \frac{\boxed{837}}{10^{11}}$$

$$= \frac{8.37 \times 10^{2}}{\boxed{10^{11}}}$$

$$= 8.37 \times \boxed{10^{2} \times 10^{-11}}$$

$$\therefore \boxed{0.00000000837 = 8.37 \times 10^{-9}}$$

How many numbers are there after decimal point?

11 number

If we write this in index form we get

$a^{-m} = \dfrac{1}{a^{m}}$

$a^{m} \times a^{n} = a^{m+n}$

837 can also be written as 8.37×10^{2}

1 **Express the following numbers in standard form :**

(v) 31860000000

Sol.

$31860000000 = 3186 \times \boxed{10000000}$

How many zeros are there?

7 number

This can also be written as

$= \boxed{3186} \times 10^7$

3186 can also be written as 3.186×10^3

$3.186 \times \boxed{10^3 \times 10^7}$

If we write this in index form we get

$a^m \times a^n = a^{m+n}$

$= 3.186 \times \boxed{10^{3+7}}$

$\therefore \boxed{31860000000 = 3.186 \times 10^{10}}$

2 Express the following numbers in usual form :

(i) 3.02×10^{-6}

Sol. $3.02 \times \boxed{10^{-6}} = \boxed{\dfrac{3.02}{10^{6}}}$

$a^{-m} = \dfrac{1}{a^{m}}$

$\therefore \boxed{3.02 \times 10^{-6} = 0.00000302}$

(ii) 4.5×10^{4}

Sol. $\boxed{4.5} \times \boxed{10^{4}} = \dfrac{45}{1\cancel{0}} \times 1000\cancel{0}$

$= \boxed{45 \times 1000}$

$\dfrac{4.5 \times 10}{10} = \dfrac{45}{10}$

$\therefore \boxed{4.5 \times 10^{4} = 45000}$

2 Express the following numbers in usual form :

(iii) 3×10^{-8}

Sol. $3 \times \boxed{10^{-6}} = \boxed{\dfrac{3}{10^{8}}}$

$a^{-m} = \dfrac{1}{a^m}$

$\therefore$ $\boxed{3 \times 10^{-6} = 0.00000003}$

(iv) 1.0001×10^9

Sol. $\boxed{1.0001} \times \boxed{10^9} = \dfrac{10001}{1\cancel{0000}} \times 10000\cancel{0000}0$

$= \boxed{10001 \times 100000}$

$\dfrac{10001 \times 10000}{10000} = \dfrac{10001}{10000}$

$\therefore$ $\boxed{1.0001 \times 10^9 = 1000100000}$

2 Express the following numbers in usual form :

(v) 5.8×10^{12}

Sol.

$$\boxed{5.8} \times \boxed{10^{12}} = \frac{58}{1\cancel{0}} \times 100000000000\cancel{0}$$

$$= \boxed{58 \times 100000000000}$$

$$\frac{5.8 \times 10}{10} = \frac{58}{10}$$

$$\therefore \boxed{5.8 \times 10^{12} = 5800000000000}$$

(vi) 3.61492×10^{6}

Sol.

$$\boxed{3.61492} \times \boxed{10^{6}} = \frac{361492}{1\cancel{00000}} \times 1\cancel{00000}0$$

$$= \boxed{361492 \times 10}$$

$$\frac{3.61492 \times 100000}{100000} = \frac{361492}{100000}$$

$$\therefore \boxed{3.61492 \times 10^{6} = 3614920}$$

3 **Express the number appearing in the following statements in standard form :**

(i) 1 micron is equal to $\frac{1}{1000000}$ m

Sol.

$$1 \text{ micron} = \frac{1}{\boxed{1000000}}$$

$$= \frac{1}{\boxed{10^6}}$$

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

$$\therefore \boxed{1 \text{ micron} = 1 \times 10^{-6} \text{ m}}$$

3 **Express the number appearing in the following statements in standard form :**

(ii) Charge of an electron is 0.000,000,000,000,000,000,16 coulomb.

Sol. Charge of an electron $= 0.00000000000000000016$

$= \dfrac{16}{100000000000000000000}$

$= \dfrac{16}{10^{20}}$

$= \dfrac{1.6 \times 10^{1}}{10^{20}}$

$= 1.6 \times 10 \times 10^{-20}$

$\therefore$ Charge of an electron $= 1.6 \times 10^{-19}$ coulomb

How many numbers are there after decimal point?

20 number

If we write this in index form we get

$a^{-m} = \dfrac{1}{a^{m}}$

$a^{m} \times a^{n} = a^{m+n}$

16 can also be written as 1.6×10^{1}

3 **Express the number appearing in the following statements in standard form :**

(iii) Size of a bacteria is 0.0000005 m.

Sol. Size of bacteria = 0.0000005

$$= \frac{5}{10000000}$$

$$= \frac{5}{10^7}$$

$\therefore$ $\boxed{\text{Size of bacteria} = 5 \times 10^{-7}\ \text{m.}}$

How many numbers are there after decimal point?

7 number

If we write this in index form we get

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

3 **Express the number appearing in the following statements in standard form :**

(iv) Size of a plant cell is 0.00001275 m.

Sol. Size of a plant cell $= 0.00001275$

$$= \frac{1275}{100000000}$$

$$= \frac{1275}{10^8}$$

$$= \frac{1.275 \times 10^3}{10^8}$$

$$= 1.275 \times 10^3 \times 10^{-8}$$

$\therefore$ $\boxed{\text{Size of a plant cell} = 1.275 \times 10^{-5}\ \text{m}}$

How many numbers are there after decimal point?

8 number

If we write this in index form we get

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

$a^m \times a^n = a^{m+n}$

1275 can also be written as 1.275×10^3

3 **Express the number appearing in the following statements in standard form :**

(v) Thickness if a thick paper is 0.07 mm.

Sol. Thickness of a thick paper = $0.\boxed{07}$ mm

$$= \frac{7}{\boxed{100}}$$

$$= \frac{\boxed{7}}{\boxed{10^2}}$$

$\therefore$ $\boxed{\text{Thickness of a thick paper} = 7 \times 10^{-2}\text{ mm}}$

How many numbers are there after decimal point?

2 number

If we write this in index form we get

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

4 In a stack there are 5 books each of thickness 20 mm and 5 paper sheets each of thickness 0.016 mm. what is the total thickness of the stack ?

Sol.

	Thickness of one book	=	20 mm
$\therefore$	Thickness of 5 books	=	5×20 mm
		=	$\boxed{100 \text{ mm}}$
	Thickness of 1 paper sheet	=	0.016 mm
$\therefore$	Thickness of 5 sheets	=	5×0.016 mm
		=	$\boxed{0.080 \text{ mm}}$
	Total thickness	=	100 mm + 0.080 mm
		=	100.08 mm
		=	100.08×10^2 mm

$\therefore$ **Total thickness of the stack is 100.08×10^2 mm**

ADDITIONAL SUMS

1 **Express each of the following as power of a rational number with positive exponent :**

(i) $\left(\frac{1}{4}\right)^{-3}$

Sol.

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

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

$$= \frac{1}{\frac{1^3}{4^3}}$$

$$= \frac{4^3}{1^3}$$

$$\therefore \boxed{\left(\frac{1}{4}\right)^{-3} = 4^3}$$

1 **Express each of the following as power of a rational number with positive exponent :**

(ii) $\left(\frac{-1}{4}\right)^{-5} \times \left(\frac{-1}{4}\right)^{-7}$

Sol.

$$\left(\frac{-1}{4}\right)^{-5} \times \left(\frac{-1}{4}\right)^{-7} = \frac{1}{\left(\frac{-1}{4}\right)^{5}} \times \frac{1}{\left(\frac{-1}{4}\right)^{7}}$$

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

$$= \frac{1}{\frac{(-1)^5}{4^5}} \times \frac{1}{\frac{(-1)^7}{4^7}}$$

$$= \frac{4^5}{-1} \times \frac{4^7}{-1}$$

$$a^m \times a^n = a^{m+n}$$

$$= \frac{4^5 \times 4^7}{(-1) \times (-1)}$$

$$= \frac{4^{5+7}}{1}$$

$$\therefore \left(\frac{-1}{4}\right)^{-5} \times \left(\frac{-1}{4}\right)^{-7} = 4^{12}$$

1 Evaluate :

(i) $(4^{-1} + 8^{-1}) \div \left(\frac{2}{3}\right)^{-1}$

Sol.

$$(4^{-1} + 8^{-1}) \div \left(\frac{2}{3}\right)^{-1} = \left(\frac{1 \times 2}{4 \times 2} + \frac{1}{8}\right) \div \frac{1}{\frac{2}{3}}$$

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

$$= \left(\frac{2 + 1}{8}\right) \div \left(\frac{3}{2}\right)$$

$$= \frac{3}{8} \div \frac{3}{2}$$

$$= \frac{\cancel{3}}{\cancel{8}_4} \times \frac{\cancel{2}^1}{\cancel{3}}$$

$$\therefore \quad \boxed{(4^{-1} + 8^{-1}) \div \left(\frac{2}{3}\right)^{-1} = \frac{1}{4}}$$

1 **Evaluate :**

(ii) $(6^{-1} - 8^{-1})^{-1} + (2^{-1} - 3^{-1})^{-1}$

Sol.

$$(6^{-1} - 8^{-1})^{-1} + (2^{-1} - 3^{-1})^{-1} = \left(\frac{1}{6} - \frac{1}{8}\right)^{-1} + \left(\frac{1}{2} - \frac{1}{3}\right)^{-1}$$

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

$$= \left(\frac{1}{24}\right)^{-1} + \left(\frac{1}{6}\right)^{-1}$$

...ply second
...tion by 2

Multiply first fraction by 4

Re...

LCM

$$= \frac{1}{\frac{1}{24}} + \frac{1}{\frac{1}{6}}$$

$$= \frac{24}{1} + \frac{6}{1}$$

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

$\therefore$ $\boxed{(6^{-1} - 8^{-1})^{-1} + (2^{-1} - 3^{-1})^{-1} = 30}$

3 **Simplify :** $\left[\left(\frac{1}{3}\right)^{-3} - \left(\frac{1}{2}\right)^{-3}\right] \div \left(\frac{1}{4}\right)^{-3}$

Sol.

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

$$= [(3)^3 - (2)^3] \div (4)^3$$

$$= [27 - 8] \div 64$$

$$= 19 \div 64$$

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

$$\therefore \quad \left[\left(\frac{1}{3}\right)^{-3} - \left(\frac{1}{2}\right)^{-3}\right] \div \left(\frac{1}{4}\right)^{-3} = \frac{19}{64}$$

4 Write in standard form $4 \div 100000$

Sol. $4 \div 100000 = \frac{4}{\boxed{100000}}$

$= \frac{4}{\boxed{10^5}}$

$\therefore$ $\boxed{4 \div 100000 = 4 \times 10^{-5}}$

If we write this in index form we get

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

5 Express the following numbers in usual form :

(i) 3.52×10^5

Sol. $\boxed{3.52} \times \boxed{10^5} = \dfrac{352}{1\cancel{00}} \times 1000\cancel{00}$

$= \boxed{352 \times 1000}$

$\dfrac{3.52 \times 100}{100} = \dfrac{352}{100}$

$\therefore \boxed{4.5 \times 10^4 = 352000}$

(ii) 7.54×10^{-4}

Sol. $7.54 \times \boxed{10^{-4}} = \dfrac{7.54}{\boxed{10^4}}$

$= \boxed{\dfrac{7.54}{10000}}$

$a^{-m} = \dfrac{1}{a^m}$

$\therefore \boxed{7.54 \times 10^{-4} = 0.000754}$

5 **Express the following numbers in usual form :**

(iii) 3×10^{-5}

Sol.

$$3 \times \boxed{10^{-5}} = \frac{3}{\boxed{10^5}}$$

$$= \boxed{\frac{3}{100000}}$$

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

$\therefore$ $\boxed{3 \times 10^{-5} = 0.00003}$

6 **Write the following numbers in standard form :**

(i) 216000000

Sol.

$$216000000 = 216 \times \boxed{1000000}$$

$$= \boxed{216} \times 10^6$$

$$= 2.16 \times \boxed{10^2 \times 10^6}$$

$$= 2.16 \times \boxed{10^{2+6}}$$

$$\therefore \boxed{216000000 = 2.16 \times 10^8}$$

This can also be written as

How many zeros are there?

6 number

If we write this in index form we get

$a^m \times a^n = a^{m+n}$

216 can also be written as 2.16×10^2

6 **Write the following numbers in standard form :**

(ii) 0.0000529×10^4

Sol.

$$0.\boxed{0000529} \times 10^4 = \frac{529}{\boxed{10000000}} \times 10^4$$

$$= \frac{\boxed{529}}{10^7} \times 10^4$$

$$= \frac{5.29 \times 10^2}{\boxed{10^7}} \times 10^4$$

$$= 5.29 \times \boxed{10^2 \times 10^{-7}} \times 10^4$$

$$= 5.29 \times \boxed{10^{-5} \times 10^4}$$

$$\therefore \boxed{0.0000529 \times 10^4 = 5.29 \times 10^{-1}}$$

How many numbers are there after decimal point?

7 number

If we write this in index form we get

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

$a^m \times a^n = a^{m+n}$

529 can also be written as 5.29×10^2