CHAPTER - 13

EXPONENTS AND POWERS

INTRODUCTION:

Exponential Notations are used to write very large and very small numbers easily.

- For example: the number 80000000 can be written as 8×10^7 in an exponential form.

EXERCISE - 13.1

Formulas used:

- $(1)^x = 1$

1 raised to any power is 1.

- $(-1)^{\text{odd number}} = (-1)$
- $(-1)^{\text{even number}} = 1$

1. Fill in the blanks:

(i) In the expression 3^7, base = $\underline{3}$ and exponent = $\underline{7}$

(ii) In the expression $\left(\frac{2}{5}\right)^{11}$, base = $\underline{\frac{2}{5}}$ and exponent = $\underline{11}$

2. Find the value of the following

(i) 2^6

Sol. $2^6 = 2 \times 2 \times 2 \times 2 \times 2 \times 2$

$\boxed{2^6 = 64}$

(ii) 9^3

Sol. $9^3 = 9 \times 9 \times 9$

$\boxed{9^3 = 729}$

(iii) 5^5

Sol. $5^5 = 5 \times 5 \times 5 \times 5 \times 5$

$= 3125$

$\boxed{5^5 = 3125}$

(iv) $(-6)^4$

Sol. $(-6)^4 = (-6) \times (-6) \times (-6) \times (-6)$

$= 1296$

$\because$ when negative number is raised to the power of an even number, the answer will be positive (+)

$\therefore \boxed{(-6)^4 = 1296}$

(v) $\left[\frac{-2}{3}\right]^5$

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

$= -\frac{32}{243}$

$\because$ When negative number is raised to the power of an odd number, the answer will be negative (−)

$\therefore \boxed{\left[\frac{-2}{3}\right]^5 = \frac{-32}{243}}$

3. Express the following in the exponential form:

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

Sol $6 \times 6 \times 6 \times 6 = 6^4$

(ii) $b \times b \times b \times b$

Sol. $b \times b \times b \times b = b^4$

(iii) $5 \times 5 \times 7 \times 7 \times 7$

Sol. $5 \times 5 \times 7 \times 7 \times 7 = 5^2 \times 7^3$

4. Simplify the following:

(i) 2×10^3

Sol. $2 \times 10^3 = 2 \times 10 \times 10 \times 10$
$= 2000$

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

Sol. $5^2 \times 3^2 = 5 \times 5 \times 3 \times 3$
$= 225$

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

Sol. $3^2 \times 10^4 = 3 \times 3 \times 10 \times 10 \times 10 \times 10$
$= 90000$

5. Simplify

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

Sol. $= (-3) \times (-2) \times (-2) \times (-2)$
$= (-3) \times (-8)$
$\boxed{24}$

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

Sol. $= (-4) \times (-4) \times (-4) \times 5 \times 5$

$= \boxed{-1600}$

(iii) $(-1)^{99}$

Sol. $= \boxed{-1}$

$\because \quad (-1)^{\text{odd number}} = -1$

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

Sol. $= (-3) \times (-3) \times (-5) \times (-5)$

$= 9 \times 25$

$= \boxed{225}$

(v) $(-1)^{132}$

Sol. $= \boxed{1}$

$\because \quad (-1)^{\text{even number}} = 1$

6. Identify the greater number in each of the following:

(i) 4^3 or 3^4

Sol. $4^3 = 4 \times 4 \times 4$

$\boxed{4^3 = 64}$ — ①

$3^4 = 3 \times 3 \times 3 \times 3$

$\boxed{3^4 = 81}$ — ②

$\therefore$ From ① and ②

$81 > 64$

$\boxed{3^4 > 4^3}$

6(ii) 5^3 or 3^2

Sol. $5^3 = 5 \times 5 \times 5$

$\boxed{5^3 = 125}$ — ①

$3^2 = 3 \times 3$

$\boxed{3^2 = 9}$ — ②

$\therefore$ From ① and ②

$125 > 9$

$\boxed{5^3 > 3^2}$

(iii) 2^3 or 8^2

Sol. $2^3 = 2 \times 2 \times 2 = 8$

$\boxed{2^3 = 8}$ — ①

$8^2 = 8 \times 8$

$\boxed{8^2 = 64}$ — ②

$\therefore$ From ① and ②

$64 > 8$

$\boxed{8^2 > 2^3}$

(iv) 4^5 or 5^4

Sol. $4^5 = 4 \times 4 \times 4 \times 4 \times 4$

$\boxed{4^5 = 1024}$ — ①

$5^4 = 5 \times 5 \times 5 \times 5$

$\boxed{5^4 = 625}$ — ②

$\therefore$ From ① and ②

$1024 > 625$

$\boxed{4^5 > 5^4}$

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

Sol. $2^{10} = 2\times2\times2\times2\times2\times2\times2\times2\times2\times2$

$\boxed{2^{10} = 1024}$ — ①

$10^2 = 10\times10$

$\boxed{10^2 = 100}$ — ②

$\therefore$ From ① and ②

$1024 > 100$

$\boxed{2^{10} > 10^2}$

7. Write the following numbers as power of 2.

(i) 8

Sol. $8 = 2\times2\times2$

$\boxed{8 = 2^3}$

2	8
2	4
2	2
	1

(ii) 128

Sol. $128 = 2\times2\times2\times2\times2\times2\times2$

$\boxed{128 = 2^7}$

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

(iii) 1024

Sol. $1024 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$

$\boxed{1024 = 2^{10}}$

$$\begin{array}{r|l} 2 & 1024 \\ 2 & 512 \\ 2 & 256 \\ 2 & 128 \\ 2 & 64 \\ 2 & 32 \\ 2 & 16 \\ 2 & 8 \\ 2 & 4 \\ 2 & 2 \\ & 1 \end{array}$$

8. Write the following numbers as power of 3.

(i) 27

Sol. $27 = 3 \times 3 \times 3$

$\boxed{27 = 3^3}$

$$\begin{array}{r|l} 3 & 27 \\ 3 & 9 \\ 3 & 3 \\ & 1 \end{array}$$

(ii) 2187

Sol. $2187 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$

$\boxed{2187 = 3^7}$

$$\begin{array}{r|l} 3 & 2187 \\ 3 & 729 \\ 3 & 243 \\ 3 & 81 \\ 3 & 27 \\ 3 & 9 \\ 3 & 3 \\ & 1 \end{array}$$

9. Find the value of x in each of the following

(i) $7^x = 343$

Sol. $7^x = 7 \times 7 \times 7 = 343$

$7^x = 7^3$

$\therefore \boxed{x = 3}$

7	343
7	49
7	7
	1

(ii) $9^x = 729$

Sol. $729 = 9 \times 9 \times 9$

$9^x = 9^3$

$\therefore \boxed{x = 3}$

9	729
9	81
9	9
	1

(iii) $(-8)^x = -512$

Sol. $-512 = (-8) \times (-8) \times (-8)$

$(-8)^x = (-8)^3$

$\therefore \boxed{x = 3}$

8	512
8	64
8	8
	1

10 To what power (-2) should be raised to get 16?

Sol. $16 = (-2) \times (-2) \times (-2) \times (-2)$

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

2	16
2	8
2	4
2	2
	1

$\therefore$ (-2) should be raised to the power 4 to get 16.

11. Write Prime factorization of the following number in the exponential form.

(i) 72

Sol.

$72 = 2\times2\times2\times3\times3$

$\boxed{72 = 2^3\times3^2}$

2	72
2	36
2	18
3	9
3	3
	1

(ii) 360

Sol

$360 = 2\times2\times2\times3\times3\times5$

$\boxed{360 = 2^3\times3^2\times5^1}$

2	360
2	180
2	90
3	45
3	15
5	5
	1

(iii) 405

Sol.

$405 = 3\times3\times3\times3\times5$

$\boxed{405 = 3^4\times5^1}$

3	405
3	135
3	45
3	15
5	5
	1

(iv) 648

Sol.

$648 = 2\times2\times2\times3\times3\times3\times3$

$\boxed{648 = 2^3\times3^4}$

2	648
2	324
2	162
3	81
3	27
3	9
3	3
	1

(v) 3600

Sol.

$$3600 = 2\times2\times2\times2\times3\times3\times5\times5$$

$$\boxed{3600 = 2^4\times3^2\times5^2}$$

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

EXERCISE-13.2

Formulas used:

1. $a^m \times a^n = a^{m+n}$
2. $a^m \div a^n = \dfrac{a^m}{a^n} = a^{m-n}$
3. $a^0 = 1$

Anything raised to the power zero is always equals to one.

4. $(a^m)^n = a^{m\times n}$
5. $a^n \times b^n = (ab)^n$
6. $\dfrac{a^n}{b^n} = \left(\dfrac{a}{b}\right)^n$
7. $a^{-n} = \dfrac{1}{a^n}$
8. $a^{-1} = \dfrac{1}{a}$

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

(i) $2^7 \times 2^4$

Sol. $2^7 \times 2^4 = 2^{(7+4)}$

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

$\boxed{2^7 \times 2^4 = 2^{11}}$

(ii) $p^5 \times p^3$

Sol $p^5 \times p^3 = p^{(5+3)} = \boxed{p^8}$ $\because a^m \times a^n = a^{m+n}$

(iii) $(-7)^5 \times (-7)^{11}$

Sol $(-7)^5 \times (-7)^{11} = (-7)^{5+11} = \boxed{(-7)^{16}}$

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

(iv) $20^{15} \div 20^{13}$

Sol. $20^{15} \div 20^{13} = (20)^{15-13} = \boxed{(20)^2}$ $\because a^m \div a^n = a^{m-n}$

(v) $(-6)^7 \div (-6)^3$

Sol. $(-6)^7 \div (-6)^3 = (-6)^{7-3} = \boxed{(-6)^4}$ $\because a^m \div a^n = a^{m-n}$

(vi) $7^x \times 7^3$

Sol $7^x \times 7^3 = \boxed{7^{x+3}}$ $\because a^m \times a^n = a^{m+n}$

2. Simplify and write the following in exponential form.

(i) $5^3 \times 5^7 \times 5^{12}$

Sol $= 5^3 \times 5^{7+12} = 5^3 \times 5^{19}$ $\because a^m \times a^n = a^{m+n}$

$= 5^3 \times 5^{19} = 5^{3+19}$ $\because a^m \times a^n = a^{m+n}$

$= \boxed{5^{22}}$

(ii) $a^5 \times a^3 \times a^7$

Sol. $= a^5 \times a^{3+7}$ $\because a^m \times a^n = a^{m+n}$

$= a^5 \times a^{10}$

$= a^{5+10}$ $\because a^m \times a^n = a^{m+n}$

$= \boxed{a^{15}}$

3. Simplify and write the following in the exponential form.

(i) $(2^2)^{100}$

Sol. $(2^2)^{100} = (2)^{2\times 100}$

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

$(2^2)^{100} = (2)^{2\times 100} = \boxed{(2)^{200}}$

(ii) $(5^3)^7$

Sol. $(5^3)^7 = (5)^{3\times 7} = \boxed{5^{21}}$

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

4. Simplify and write in the exponential form.

(i) $(2^3)^4 \div 2^5$

Sol. $(2^3)^4 = (2)^{3\times 4} = 2^{12}$

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

$2^{12} \div 2^5 = 2^{12-5} = \boxed{2^7}$

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

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

Sol. $2^3 \times 2^2 \times 5^5$

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

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

$= 2^5 \times 5^5$

$= (2\times5)^5 = \boxed{10^5}$

$\because a^n \times b^n = (ab)^n$

(iii) $[(2^2)^3 \times 3^6] \times 5^6$

Sol. $[(2^2)^3 \times 3^6] \times 5^6$

$= [(2)^{2\times3} \times 3^6] \times 5^6$ $\quad \because (a^m)^n = a^{m\times n}$

$= [2^6 \times 3^6] \times 5^6$

$= (2\times3)^6 \times 5^6$ $\quad \because a^n \times b^n = (ab)^n$

$= 6^6 \times 5^6$

$= (6\times5)^6$ $\quad \because a^n \times b^n = (ab)^n$

$= \boxed{(30)^6}$

5. Simplify and write in the exponential form.

(i) $5^4 \times 8^4$

Sol. $5^4 \times 8^4 = (5\times8)^4 = \boxed{(40)^4}$

$\because a^n \times b^n = (ab)^n$

(ii) $(-3)^6 \times (-5)^6$

Sol. $[(-3)\times(-5)]^6 = 15^6$

$\because a^n \times b^n = (ab)^n$

6. Simplify and express each of the following in the exponential form.

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

Sol.
$= \dfrac{3^{2\times3} \times (-2)^5}{(-2)^3}$ $\quad \because (a^m)^n = a^{m\times n}$

$= 3^6 \times (-2)^{5-3}$ $\quad \because a^m \div a^n = a^{m-n}$

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

(ii) $\dfrac{3^7}{3^4 \times 3^3}$

Sol.
$= \dfrac{3^7}{3^{4+3}}$ $\quad \because a^m \times a^n = a^{m+n}$

$= \dfrac{3^7}{3^7} = 3^{7-7} = 3^0$ $\quad \because \dfrac{a^m}{a^n} = a^{m-n}$

$= 3^0 = \boxed{1}$

∵ Anything raised to the power zero is always equals to 1

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

Sol.
$= \dfrac{2^8 \times a^5}{(2\times2)^3 \times a^3} = \dfrac{2^8 \times a^5}{(2^2)^3 \times a^3}$

$= \dfrac{2^8 \times a^5}{2^{2\times3} \times a^3} = \dfrac{2^8 \times a^5}{2^6 \times a^3}$ $\quad \because (a^m)^n = a^{m\times n}$

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

$= 2^2 \times a^2 = (2\times a)^2 = \boxed{(2a)^2}$

$\because \frac{a^m}{a^n} = a^{m-n}$

$\because a^n \times b^n = (ab)^n$

(IV) $3^0 \times 4^0 \times 5^0$

Sol.

$3^0 \times 4^0 \times 5^0$

$= 1 \times 1 \times 1$

$= \boxed{1}$

$\because$ Anything raised to the power zero is always equals to 1

i.e. $a^0 = 1$

7 Express each of the following rational number in the exponential form:-

(i) $\frac{25}{64}$

Sol.

$= \frac{5\times5}{2\times2\times2\times2\times2\times2} = \frac{5^2}{2^6}$

2	64
2	32
2	16
2	8
2	4
2	2
	1

$= \frac{5^2}{2^{3\times2}} = \frac{5^2}{(2^3)^2}$

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

$\therefore \frac{5^2}{(2^3)^2} = \boxed{\left(\frac{5}{2^3}\right)^2}$

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

(ii) $\frac{-64}{125}$

<u>Sol.</u> $= -\frac{(2\times2\times2\times2\times2\times2)}{5\times5\times5}$

$= -\frac{2^6}{5^3} = -\frac{(2^2)^3}{5^3}$

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

$= \boxed{\left(\frac{-2^2}{5}\right)^3}$

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

$$\begin{array}{r|l} 2 & 64 \\ 2 & 32 \\ 2 & 16 \\ 2 & 8 \\ 2 & 4 \\ 2 & 2 \\ & 1 \end{array} \qquad \begin{array}{r|l} 5 & 125 \\ 5 & 25 \\ 5 & 5 \\ & 1 \end{array}$$

(iii) $\frac{-125}{216} = -\frac{(5\times5\times5)}{2\times2\times2\times3\times3\times3}$

<u>Sol.</u>

$= \frac{-5^3}{2^3\times3^3}$

$= \frac{-5^3}{(2\times3)^3} = \frac{-5^3}{6^3}$

$\because a^n\times b^n = (ab)^n$

$\frac{-5^3}{6^3} = \boxed{-\left(\frac{5}{6}\right)^3}$

$$\begin{array}{r|l} 2 & 216 \\ 2 & 108 \\ 2 & 54 \\ 3 & 27 \\ 3 & 9 \\ 3 & 3 \\ & 1 \end{array} \qquad \begin{array}{r|l} 7 & 343 \\ 7 & 49 \\ 7 & 7 \\ & 1 \end{array}$$

(iv) $\frac{-343}{729}$

<u>Sol.</u> $\frac{-343}{729} = \frac{(-7)\times(-7)\times(-7)}{3\times3\times3\times3\times3\times3}$

$= \frac{(-7)^3}{(3)^6} = \frac{(-7)^3}{3^{2\times3}} = \frac{(-7)^3}{(3^2)^3}$

$$\begin{array}{r|l} 3 & 729 \\ 3 & 243 \\ 3 & 81 \\ 3 & 27 \\ 3 & 9 \\ 3 & 3 \\ & 1 \end{array}$$

$$= \frac{(-7)^3}{(9)^3} = \boxed{-\left(\frac{7}{9}\right)^3}$$

8. Simplify

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

Sol. $= \frac{2^{5\times2} \times 7^3}{(2\times2\times2)^3 \times 7}$, $\because (a^m)^n = a^{m\times n}$

$= \frac{2^{10} \times 7^{(3-1)}}{(2^3)^3}$, $\because \frac{a^m}{a^n} = a^{m-n}$

$= \frac{2^{10} \times 7^2}{2^{3\times3}} = \frac{2^{10} \times 7^2}{2^9}$ $\quad \because \frac{a^m}{a^n} = a^{m-n}$

$= 2^{(10-9)} \times 7^2$

$= 2^1 \times 7^2$

$= 2 \times 7 \times 7$

$= \boxed{98}$

(ii) $\frac{2 \times 3^4 \times 2^5}{9 \times 4^2}$

Sol. $= \frac{2 \times 3^4 \times 2^5}{3 \times 3 \times (2\times2)^2} = \frac{2 \times 3^4 \times 2^5}{3^2 \times (2^2)^2}$

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

$= \frac{2^{(1+5)} \times 3^4}{2^4 \times 3^2}$ $\quad \because a^m \times a^n = a^{m+n}$

$= 2^{(6-4)} \times 3^{(4-2)}$

$= 2^2 \times 3^2$

$= (2\times3)^2$

$= (6)^2$

$= 6\times6 = \boxed{36}$

$\because \frac{a^m}{a^n} = a^{m-n}$

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

9. Express each of the following as a product of prime factors in exponential form

(i) 384×147

Sol.

$384 = 2\times2\times2\times2\times2\times2\times2\times3$

$= 2^7 \times 3$

$147 = 3\times7\times7$

$= 3\times7^2$

$384\times147 = 2^7\times3\times3\times7^2$

$= \boxed{2^7\times3^2\times7^2}$ $\because a^m \times a^n = a^{m+n}$

2	384
2	192
2	96
2	48
2	24
2	12
2	6
3	3
	1

7	147
7	21
3	3
	1

(ii) 729×64

Sol.

$729 = 3\times3\times3\times3\times3\times3 = 3^6$

$64 = 2\times2\times2\times2\times2\times2 = 2^6$

$729\times64 = 3^6\times2^6$

$= (3\times2)^6 = \boxed{6^6}$

$\because a^n \times b^n = (ab)^n$

3	729
3	243
3	81
3	27
3	9
3	3
	1

2	92
2	46
23	23
	1

2	64
2	32
2	16
2	8
2	4
2	2
	1

(iii) 108×92

Sol

$108 = 2\times2\times3\times3\times3 = 2^2\times3^3$

$92 = 2\times2\times23 = 2^2\times23$

$108\times92 = 2^2\times3^3\times2^2\times23$

$= 2^{2+2}\times3^3\times23$

$= \boxed{2^4\times3^3\times23}$

2	108
2	54
3	27
3	9
3	3
	1

10. Simplify and write the following in exponential form.

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

Sol Take 2^2 common

$2^2(3^3 + 5^0)$

$2^2(3\times3\times3 + 1)$ $\because a^0 = 1$

$2\times2\,(27+1)$

$4 \times 28 = 112$

$112 = 2\times2\times2\times2\times7$

$= \boxed{2^4 \times 7}$

2	112
2	56
2	28
2	14
7	7
	1

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

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

$= 3^5 \times 3^5$

$= 3^{5+5} = \boxed{3^{10}}$

$\because \frac{a^m}{a^n} = a^{m-n}$

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

(iii) $8^2 \div 2^3$

Sol. $= (2\times2\times2)^2 \div 2^3$

$= (2^3)^2 \div 2^3$

$= 2^6 \div 2^3$ $\because (a^m)^n = a^{m\times n}$

$= (2)^{6-3} = \boxed{2^3}$

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

11. Multiple choice questions

11. $\left[-\frac{5}{8}\right]^0$ is equal to

(i) 0 (ii) 1 ✓

(iii) $\frac{-5}{8}$ (iv) $-\frac{8}{5}$

Sol. $\because \quad a^0 = 1$

12 $(5^2)^3$ is equal to

~~(i)~~ 5^6 (ii) 5^5

(iii) 5^9 (iv) 10^3

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

$\therefore (5^2)^3 = 5^{2\times 3} = \boxed{5^6}$

13. $a \times a \times a \times b \times b \times b$ is equal to

(i) $a^3 b^2$ (ii) $a^2 b^3$

~~(iii)~~ $(ab)^3$ (iv) $a^6 b^6$

Sol. $a \times a \times a \times b \times b \times b$

$a^{(1+1+1)} \times b^{(1+1+1)}$

$a^3 \times b^3$

$(a \times b)^3 = \boxed{(ab)^3}$

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

14. $(-5)^2 \times (-1)^1$ is equal to

(i) 25 ~~(ii)~~ -25

(iii) 10 (iv) -10

Sol. $(-1)^1 = -1$

$\because (-1)^{\text{odd number}} = -1$

$(-5)^2 = (-5) \times (-5)$ $\quad \because (-) \times (-) = (+)$

$= 25$

$(-5)^2 \times (-1)^1 = 25 \times (-1)$

$= \boxed{-25}$

EXERCISE - 13·3

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

(i) 104278

Sol. $104278 = 100000 + 0 + 4000 + 200 + 70 + 8$

$= 1 \times 100000 + 4 \times 1000 + 2 \times 100 + 7 \times 10 + 8$

$= 1 \times 10^5 + 4 \times 10^3 + 2 \times 10^2 + 7 \times 10^1 + 8 \times 10^0$

(iii) 120719

Sol. $120719 = 100000 + 20000 + 0 + 700 + 10 + 9$

$= 1 \times 100000 + 2 \times 10000 + 7 \times 100 + 1 \times 10 + 9$

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

(ii) 20068

Sol. $20068 = 20000 + 0 + 0 + 60 + 8$

$= 2 \times 10000 + 6 \times 10 + 8$

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

(iv) 3006194

Sol. $3006194 = 3000000 + 0 + 0 + 6000 + 100 + 90 + 4$

$= 3 \times 1000000 + 6 \times 1000 + 1 \times 100 + 9 \times 10 + 4$

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

(v) 28061906

Sol: $28061906 = 20000000 + 8000000 + 0 + 60000 + 1000 + 900 + 0 + 6$

$= 2\times10000000 + 8\times1000000 + 6\times10000 + 1\times1000 + 9\times100 + 6$

$= 2\times10^7 + 8\times10^6 + 6\times10^4 + 1\times10^3 + 9\times10^2 + 6\times10^0$

2. Find the number from each of the following expanded form:

(i) $4\times10^4 + 7\times10^3 + 5\times10^2 + 6\times10^1 + 1\times10^0$

Sol. $= 40000 + 7000 + 500 + 60 + 1$

$= 47561$

$$\begin{array}{r} 40000 \\ +7000 \\ +500 \\ +60 \\ +1 \\ \hline 47561 \end{array}$$

(ii) $3\times10^4 + 7\times10^2 + 5\times10^0$

Sol. $= 30000 + 700 + 5$

$= 30705$

$$\begin{array}{r} 30000 \\ +700 \\ +5 \\ \hline 30705 \end{array}$$

(iii) $4\times10^5 + 5\times10^3 + 3\times10^2 + 2\times10^0$

Sol. $= 400000 + 5000 + 300 + 2$

$= 405302$

$$\begin{array}{r} 400000 \\ +5000 \\ +300 \\ +2 \\ \hline 405302 \end{array}$$

(iv) $8\times10^7 + 3\times10^4 + 7\times10^3 + 5\times10^2 + 8\times10^1$

Sol. $= 80000000 + 30000 + 7000 + 500 + 80$

$= 80037580$

$$\begin{array}{r} 80000000 \\ +30000 \\ +7000 \\ +500 \\ +80 \\ \hline 80037580 \end{array}$$

3. Express the following numbers in the standard form.

(i) 3,43,000

Sol. (a) Count the number of digits after 3 (1st digit)

there are 5 numbers after first digit

∴ Multiply and divide the whole number with 100000

$$= \frac{343\cancel{000} \times 100000}{100\cancel{000}}$$

$$= \frac{343}{100} \times 10^5$$

$$= \boxed{3{\cdot}43 \times 10^5}$$

(ii) 70,00,000

Sol

$$= \frac{\cancel{70,00,000} \times 1000000}{\cancel{1000000}}$$

$$= \boxed{7 \times 10^6} \text{ OR } \boxed{7{\cdot}0 \times 10^6}$$

(iii) 3,18,65,00,000

Sol

$$= \frac{31865\cancel{00000} \times 1000000000}{10000\cancel{00000}}$$

$$= \boxed{3{\cdot}1865 \times 10^9}$$

(iv) 530·7

Sol

$$= 530{\cdot}7$$

$$= \frac{530{\cdot}7}{100} \times 100 = \frac{5307}{1000} \times 100$$

$$= \boxed{5{\cdot}307 \times 10^2}$$

(v) 3908.78

Sol

$$= \frac{3908.78}{1000} \times 1000$$

$$= \frac{390878}{1000 \times 100} \times 1000$$

$$= \frac{390878}{100000} \times 10^3$$

$$= \boxed{3.90878 \times 10^3}$$

(vi) 5985.3

Sol

$$= \frac{5985.3}{1000} \times 1000$$

$$= \frac{59853}{1000 \times 10} \times 1000$$

$$= \frac{59853}{10000} \times 10^3$$

$$= \boxed{5.9853 \times 10^3}$$

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

(i) The distance between the earth and the moon is 384,000000 m

Sol

$$= \frac{384000000}{100000000} \times 100000000$$

$$= \boxed{3.84 \times 10^8 m}$$

(ii) The diameter of the earth is 1,27,56.000m

Sol.

$$= \frac{12756\cancel{000}}{10000\cancel{000}} \times 10000000$$

$$= \boxed{1 \cdot 2756 \times 10^{7} m}$$

(iii) The diameter of the sun is 1,400,000,000 m

Sol.

$$= \frac{14\cancel{00000000}}{1\cancel{000000000}} \times 1000000000$$

$$= \boxed{1 \cdot 4 \times 10^{9} m}$$

(iv) The universe is estimated to be about 12000000000 years old.

Sol.

$$= \frac{12\cancel{000000000}}{10\cancel{000000000}} \times 10000000000$$

$$= \boxed{1 \cdot 2 \times 10^{10} \text{ years}}$$

(v) Mass of uranis is -
86,800,000,000,000,000,000,000,000 kg.

Sol.

$$= \frac{868\cancel{00000000000000000000000}}{1\cancel{00000000000000000000000000}} \times 10^{25}$$

$$= \boxed{8 \cdot 68 \times 10^{25} kg}$$

5. Compare the following numbers:

(i) 4.3×10^{14} ; 3.01×10^{17}

Sol • First of all check the exponential powers of both the numbers.

• The number with greater exponential power is larger

• Here 3.01×10^{17} have larger exponential power (17) than 4.3×10^{14} with smaller exponential power (14).

$\therefore$ $3.01 \times 10^{17} > 4.3 \times 10^{14}$

(ii) 1.439×10^{12} ; 1.4335×10^{12}

Sol • First of all check which number has larger exponential power.

• Here both the numbers have same exponential powers.

• So in this ~~ch~~ case check the base. The number having greater base value will be larger.

Here to avoid confusion lets take 1.439 as 1.4390

Now 1.4390 is greater than 1.4335.

$\therefore$ $1.439 \times 10^{12} > 1.4335 \times 10^{12}$