13 Exponents and Powers

Learn and Remember

1. An exponential form
   $a \times a \times a \times \ldots\ldots$ m times $= a^m$
   where a is non-zero integer and m is whole number.
   And a is called the **base** and m is called the **exponent** or power or index.
2. For any non-zero rational numbers a and b and whole numbers m and n:
   (*i*) $a^m \times a^n = a^{m+n}$ (*ii*) $a^m \div a^n = a^{m-n}$ $(m > n)$
   (*iii*) $(a^m)^n = a^{mn}$ (*iv*) $a^m \times b^m = (a \times b)^m$
   (*v*) $a^m \div b^m = \left(\frac{a}{b}\right)^m$ (*vi*) $a^0 = 1$
   (*vii*) $(-1)^{\text{even number}} = 1$ (*viii*) $(-1)^{\text{odd number}} = -1$
3. The expanded form of large numbers can be expressed in terms of raising power of 10.
4. A number is said to be in standard form if it can be expressed as a decimal number between 1.0 and 10.0 including 1.0 multiplied by a power of 10.

TEXTBOOK QUESTIONS SOLVED

Exercise 13.1 *(Page No. 252-253)*

Q1. Find the value of:
(*i*) 2^6 (*ii*) 9^3 (*iii*) 11^2 (*iv*) 5^4

Sol. (*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*) $5^4 = 5 \times 5 \times 5 \times 5 = 625$.

Q2. Express the following in exponential form:
(*i*) $6 \times 6 \times 6 \times 6$ (*ii*) $t \times t$
(*iii*) $b \times b \times b \times b$ (*iv*) $5 \times 5 \times 7 \times 7 \times 7$
(*v*) $2 \times 2 \times a \times a$ (*vi*) $a \times a \times a \times c \times c \times c \times c \times d$

Sol. (*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*) $a \times a \times a \times c \times c \times c \times c \times d = a^3 \times c^4 \times d$.

Q3. Express each of the following numbers using exponential notation:

(*i*) 512 (*ii*) 343 (*iii*) 729 (*iv*) 3125.

Sol. (*i*) $512 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^9$.

2	512
2	256
2	128
2	64
2	32
2	16
2	8
2	4
2	2
	1

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

7	343
7	49
7	7
	1

(*iii*) $729 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 3^6$.

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

(*iv*) $3125 = 5 \times 5 \times 5 \times 5 \times 5 = 5^5$.

5	3125
5	625
5	125
5	25
5	5
	1

Q4. 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.

Sol. (*i*) 4^3 or 3^4

$4^3 = 4 \times 4 \times 4 = 64$

$3^4 = 3 \times 3 \times 3 \times 3 = 81$

Since, $64 < 81$

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

(*ii*) 5^3 or 3^5

$5^3 = 5 \times 5 \times 5 = 125$

$3^5 = 3 \times 3 \times 3 \times 3 \times 3 = 243$

Since, $125 < 243$

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

(*iii*) 2^8 or 8^2

$2^8 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 256$

$8^2 = 8 \times 8 = 64$

Since, $256 > 64$

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

(*iv*) 100^2 or 2^{100}

$100^2 = 100 \times 100 = 10{,}000$

$2^{100} = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$

$\ldots\ldots\ldots \times 2$

$= 16{,}384 \times \ldots\ldots \times 2$

Since, $10{,}000 < 16{,}384 \times \ldots\ldots \times 2$

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

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

$2^{10} = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 1{,}024$

$10^2 = 10 \times 10 = 100$

Since, $1,024 < 100$

Thus, 2^{10} is greater than 10^2.

Q5. Express each of the following as product of powers of their prime factors:

(i) 648 (ii) 405 (iii) 540 (iv) 3,600

Sol. (i) $648 = 2 \times 324$

$= 2 \times 2 \times 162$

$= 2 \times 2 \times 2 \times 81$

$= 2 \times 2 \times 2 \times 3 \times 27$

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

$= 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3$

Thus, $648 = 2^3 \times 3^4$.

OR

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

(ii) $405 = 5 \times 81$

$= 5 \times 3 \times 27$

$= 5 \times 3 \times 3 \times 9$

$= 5 \times 3 \times 3 \times 3 \times 3$

Thus, $405 = 5 \times 3^4$.

OR

5	405
3	81
3	27
3	9
3	3
	1

(iii) $540 = 2 \times 270$

$= 2 \times 2 \times 135$

$= 2 \times 2 \times 3 \times 45$

$= 2 \times 2 \times 3 \times 3 \times 15$

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

Thus, $540 = 2^2 \times 3^3 \times 5$.

OR

2	540
2	270
3	135
3	45
3	15
5	5
	1

(iv) $3,600 = 2 \times 1800$

$= 2 \times 2 \times 900$

$= 2 \times 2 \times 2 \times 450$

$= 2 \times 2 \times 2 \times 2 \times 225$

$= 2 \times 2 \times 2 \times 2 \times 3 \times 75$

$= 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 25$

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

Thus, $3,600 = 2^4 \times 3^2 \times 5^2$.

OR

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

Q6. 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) $2^4 \times 3^2$ (viii) $3^2 \times 10^4$.

Sol. (i) $2 \times 10^3 = 2 \times 10 \times 10 \times 10 = 2,000$.

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

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

(iv) $3 \times 4^4 = 3 \times 4 \times 4 \times 4 \times 4 = 768$.

(v) $0 \times 10^2 = 0 \times 10 \times 10 = 0$.

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

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

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

Q7. Simplify:

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

(iii) $(-3)^2 \times (-5)^2$ (iv) $(-2)^3 \times (-10)^3$.

Sol. (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) $(-2)^3 \times (-10)^3 = (-2) \times (-2) \times (-2) \times (-10) \times (-10) \times (-10)$
$= 8,000$.

Q8. Compare the following numbers:

(i) 2.7×10^{12}; 1.5×10^8 (ii) 4×10^{14}; 3×10^{17}.

Sol. (i) 2.7×10^{12}; 1.5×10^8

Comparing the exponents of base 10,

$2.7 \times 10^{12} > 1.5 \times 10^8$.

(ii) $4 \times 10^{14}; 3 \times 10^{17}$

Comparing the exponents of base 10,

$4 \times 10^{14} < 3 \times 10^{17}$.

Exercise 13.2 *(Page No. 260-261)*

Q1. 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)** $(5^2)^3 \div 5^3$ **(vi)** $2^5 \times 5^5$

(vii) $a^4 \times b^4$ **(viii)** $(3^4)^3$ **(ix)** $(2^{20} \div 2^{15}) \times 2^3$

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

Sol. (i) $3^2 \times 3^4 \times 3^8 = 3^{(2+4+8)} = 3^{14}$.

(ii) $6^{15} \div 6^{10} = 6^{15-10} = 6^5$.

(iii) $a^3 \times a^2 = a^{3+2} = a^5$.

(iv) $7^x \times 7^2 = 7^{x+2}$.

(v) $(5^2)^3 \div 5^3 = 5^{2\times 3} \div 5^3 = 5^6 \div 5^3 = 5^{6-3} = 5^3$.

(vi) $2^5 \times 5^5 = (2 \times 5)^5 = 10^5$.

(vii) $a^4 \times b^4 = (a \times b)^4 = (ab)^4$.

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

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

$= 2^5 \times 2^3 = 2^{5+3} = 2^8$.

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

Q2. Simplify and express each of the following in exponential form:

(i) $\dfrac{2^3 \times 3^4 \times 4}{3 \times 32}$ **(ii)** $[(5^2)^3 \times 5^4] \div 5^7$ **(iii)** $25^4 \div 5^3$

(iv) $\dfrac{3 \times 7^2 \times 11^8}{21 \times 11^3}$ **(v)** $\dfrac{3^7}{3^4 \times 3^3}$ **(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)** $\dfrac{2^8 \times a^5}{4^3 \times a^3}$

(x) $\left(\dfrac{a^5}{a^3}\right) \times a^8$ **(xi)** $\dfrac{4^5 \times a^8 b^3}{4^5 \times a^5 b^2}$ **(xii)** $(2^3 \times 2)^2$.

Sol. (i) $\dfrac{2^3 \times 3^4 \times 4}{3 \times 32} = \dfrac{2^3 \times 3^4 \times 2 \times 2}{3 \times 2 \times 2 \times 2 \times 2 \times 2} = \dfrac{2^3 \times 3^4 \times 2^2}{3 \times 2^5}$

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

$= 2^{5-5} \times 3^{4-1}$

$= 2^0 \times 3^3$

$= 1 \times 3^3 = 3^3$.

(ii) $[(5^2)^3 \times 5^4] \div 5^7 = [5^6 \times 5^4] \div 5^7$

$= 5^{6+4} \div 5^7 = 5^{10} \div 5^7 = 5^{10-7} = 5^3$.

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

$= (5^2)^4 \div 5^3 = 5^8 \div 5^3 = 5^{8-3} = 5^5$.

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

$= (3 \div 3) \times (7^2 \div 7) \times (11^8 \div 11^3)$

$= 3^{1-1} \times 7^{2-1} \times 11^{8-3} = 3^0 \times 7^1 \times 11^5$

$= 1 \times 7 \times 11^5 = 7 \times 11^5$.

(v) $\dfrac{3^7}{3^4 \times 3^3} = \dfrac{3^7}{3^{4+3}} = \dfrac{3^7}{3^7} = 3^7 \div 3^7$

$= 3^{7-7} = 3^0 = 1$.

(vi) $2^0 + 3^0 + 4^0 = 1 + 1 + 1 = 3$.

(vii) $2^0 \times 3^0 \times 4^0 = 1 \times 1 \times 1 = 1$.

(viii) $(3^0 + 2^0) \times 5^0 = (1 + 1) \times 1 = 2 \times 1 = 2$.

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

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

$= (2^8 \div 2^6) \times (a^5 \div a^3)$

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

(x) $\left(\dfrac{a^5}{a^3}\right) \times a^8 = (a^5 \div a^3) \times a^8$

$= a^{5-3} \times a^8 = a^2 \times a^8 = a^{2+8} = a^{10}$.

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

$= (4^5 \div 4^5) \times (a^8 \div a^5) \times (b^3 \div b^2)$

$= 4^{5-5} \times a^{8-5} \times b^{3-2} = 4^0 \times a^3 \times b^1$

$= 1 \times a^3 \times b = a^3 b.$

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

$= (2^4)^2 = 2^{4 \times 2} = 2^8.$

Q3. 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) $3^0 = (1000)^0$**

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

Take L.H.S. $= 10 \times 10^{11} = 10^{1+11} = 10^{12}$

R.H.S. $= 100^{11} = (10^2)^{11} = 10^{22}$

$\Rightarrow$ L.H.S. $\neq$ R.H.S.

So, this is false.

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

Take L.H.S. $= 2^3 = 8$

R.H.S. $= 5^2 = 25$

$\Rightarrow$ L.H.S. $\not>$ R.H.S.

So, this is false.

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

Take L.H.S. $= 2^3 \times 3^2 = 8 \times 9 = 72$

R.H.S. $= 6^5 = 7{,}776$

$\Rightarrow$ L.H.S. $\neq$ R.H.S.

So, this is false.

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

Take L.H.S. $= 3^0 = 1$

R.H.S. $= (1000)^0 = 1$

$\Rightarrow$ L.H.S. $=$ R.H.S.

So, this is true.

Q4. Express each of the following as a product of prime factors only in exponential form:

(i) 108×192 **(ii) 270** **(iii) 729×64** **(iv) 768**

Sol. (i) $108 \times 192 = (2 \times 2 \times 3 \times 3 \times 3) \times (2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3)$

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

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

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

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

2	108
2	54
3	27
3	9
3	3
	1

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

(ii) $270 = 2 \times 3 \times 3 \times 3 \times 5$

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

2	270
3	135
3	45
3	15
5	5
	1

(iii) $729 \times 64 = (3 \times 3 \times 3 \times 3 \times 3 \times 3) \times (2 \times 2 \times 2 \times 2 \times 2 \times 2)$

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

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

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

(iv) $768 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3$
$= 2^8 \times 3.$

2	768
2	384
2	192
2	96
2	48
2	24
2	12
2	6
3	3
	1

Q5. Simplify:

(i) $\frac{(2^5)^2 \times 7^3}{8^3 \times 7}$ **(ii)** $\frac{25 \times 5^2 \times t^8}{10^3 \times t^4}$ **(iii)** $\frac{3^5 \times 10^5 \times 25}{5^7 \times 6^5}$

Sol. (i) $\frac{(2^5)^2 \times 7^3}{8^3 \times 7} = \frac{2^{5\times2} \times 7^3}{(2^3)^3 \times 7} = \frac{2^{5\times2} \times 7^3}{2^{3\times3} \times 7} = \frac{2^{10}}{2^9} \times \frac{7^3}{7}$

$= (2^{10} \div 2^9) \times (7^3 \div 7)$

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

$= 2^1 \times 7^2 = 2 \times 49 = 98.$

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

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

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

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

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

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

(iii) $\frac{3^5 \times 10^5 \times 25}{5^7 \times 6^5} = \frac{3^5 \times (2\times5)^5 \times (5\times5)}{5^7 \times (2\times3)^5} = \frac{3^5 \times 2^5 \times 5^5 \times 5^2}{5^7 \times 2^5 \times 3^5}$

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

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

$= 3^0 \times 2^0 \times 5^0 = 1 \times 1 \times 1 = 1.$

Exercise 13.3 *(Page No. 263)*

Q1. Write the following numbers in the expanded forms:
279404, 3006194, 2806196, 120719, 20068.

Sol. (i) $2,79,404 = 2,00,000 + 70,000 + 9,000 + 400 + 00 + 4$

$= 2 \times 100000 + 7 \times 10000 + 9 \times 1000 + 4 \times 100 + 00 + 4 \times 1$

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

(ii) $30,06,194 = 30,00,000 + 0 + 0 + 6000 + 100 + 90 + 4$

$= 3 \times 1000000 + 0 \times 100000 + 0 \times 10000 + 6 \times 1000$
$+ 1 \times 100 + 9 \times 10 + 4 \times 1$

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

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

$= 2 \times 1000000 + 8 \times 100000 + 0 \times 10000 + 6 \times 1000$
$+ 1 \times 100 + 9 \times 10 + 6 \times 1$

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

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

$= 1 \times 100000 + 2 \times 10000 + 0 \times 1000 + 7 \times 100 + 1 \times 10 + 9 \times 1$

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

(v) $2,00,68 = 20,000 + 0 + 0 + 60 + 8$

$= 2 \times 10000 + 0 \times 1000 + 0 \times 100 + 6 \times 10 + 8 \times 1$

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

Q2. 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) $9 \times 10^5 + 2 \times 10^2 + 3 \times 10^1$.

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

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

$= 900000 + 200 + 30$

$= 9,00,230.$

Q3. 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.

Sol. (i) $5,00,00,000 = 5 \times 10000000 = 5 \times 10^7$.

(ii) $70,00,000 = 7 \times 1000000 = 7 \times 10^6$.

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

Q4. Express the number appearing in the following statements in standard form:

(a) The distance between Earth and Moon is 384,000,000 m.

(b) Speed of light in vacuum is 300,000,000 m/s.

(c) Diameter of the Earth is 1,27,56,000 m.

(d) Diameter of the Sun is 1,400,000,000 m.

(e) In a galaxy there are on an average 100,000,000,000 stars.

(f) The universe is estimated to be about 12,000,000,000 years old.

(g) The distance of the Sun from the centre of the Milky Way Galaxy is estimated to be 300,000,000,000,000,000,000 m.

(h) 60,230,000,000,000,000,000,000 molecules are contained in a drop of water weighing 1.8 gm.

(i) The earth has 1,353,000,000 cubic km of sea water.

(j) The population of India was about 1,027,000,000 in March, 2001.

Sol. (a) The distance between Earth and Moon

$= 384,000,000$ m

$= 384 \times 1000000$ m

$= 3.84 \times 100 \times 1000000$ m

$= 3.84 \times 10^2 \times 10^6$ m

$= 3.84 \times 10^{2+6}$ m

$= 3.84 \times 10^8$ m.

(b) Speed of light in vacuum $= 300,000,000$ m/s

$= 3 \times 100000000$ m/s

$= 3 \times 10^8$ m/s.

(c) Diameter of the earth $= 1,27,56,000$ m

$= 12756 \times 1000$ m

$= 1.2756 \times 10000 \times 1000$ m

$= 1.2756 \times 10^4 \times 10^3$ m

$= 1.2756 \times 10^{4+3}$ m

$= 1.2756 \times 10^7$ m.

(d) Diameter of the sun $= 1,400,000,000$ m

$= 14 \times 100,000,000$ m

$= 1.4 \times 10 \times 100,000,000$ m

$= 1.4 \times 10^1 \times 10^8$ m

$= 1.4 \times 10^{1+8}$ m

$= 1.4 \times 10^9$ m.

(*e*) Average of stars = 100,000,000,000
$= 1 \times 100000000000$
$= 1 \times 10^{11}$.

(*f*) Years of Universe = 12,000,000,000 years
= 12 × 1000000000 years
$= 1.2 \times 10 \times 1000000000$ years
$= 1.2 \times 10^1 \times 10^9$ years
$= 1.2 \times 10^{1+9}$ years
$= 1.2 \times 10^{10}$ years.

(*g*) Distance of the Sun from the centre of the Milky Way Galaxy
= 300,000,000,000,000,000,000 m
$= 3 \times 100000000000000000000$ m
$= 3 \times 10^{20}$ m.

(*h*) Number of molecules in a drop of water weighing 1.8 gm
= 60,230,000,000,000,000,000,000
$= 6023 \times 10000000000000000000$
$= 6.023 \times 1000 \times 10000000000000000000$
$= 6.023 \times 10^3 \times 10^{19}$
$= 6.023 \times 10^{3+19}$
$= 6.023 \times 10^{22}$.

(*i*) The Earth has sea water
$= 1{,}353{,}000{,}000\ \text{km}^3$
$= 1{,}353 \times 1000000\ \text{km}^3$
$= 1.353 \times 1000 \times 1000000\ \text{km}^3$
$= 1.353 \times 10^3 \times 10^6\ \text{km}^3$
$= 1.353 \times 10^{3+6}\ \text{km}^3$
$= 1.353 \times 10^9\ \text{km}^3$.

(*j*) The population of India
= 1,027,000,000
= 1027 × 1000000
$= 1.027 \times 1000 \times 1000000$
$= 1.027 \times 10^3 \times 10^6$
$= 1.027 \times 10^{3+6}$
$= 1.027 \times 10^9$.

□□