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Chapter-13: Exponents and Powers

Exercise 13.1 (Page 252)

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

Difficulty Level. Medium

What is known.
Base and power.

What is unknown.
Value of the given exponents.

Solution:
A larger number can be written in short form using exponential form in which there is a base and a smaller raised number called its power or exponent. Exponent represents how many times base will be multiplied. For example, 64 can be written as 2^6 here 2 is base and 6 is the exponent. 2^6 means that 2 is multiplied 6 times 8^2 means 8 is multiplied 2 times.

(i) $2^6 = 2\times2\times2\times2\times2\times2 = 64$

(ii) $9^3 = 9\times9\times9 = 729$

(iii) $11^2 = 11\times11 = 121$

(iv) $5^4 = 5\times5\times5\times5 = 625$

Q2. Express the following in exponential form:

(i) $6\times6\times6\times6$ (ii) $t\times t$ (iii) $b\times b\times b\times b$
(iv) $5\times5\times7\times7\times7$ (v) $2\times2\times a\times a$ (vi) $a\times a\times a\times c\times c\times c\times c\times d$

Difficulty Level. Medium

What is known.
Base of exponent.

What is unknown.
Power of the base.

Reasoning:
In this question, a number is multiplied number of times and we have to express it in exponential form. As we know exponent is the number of times base is multiplied. So, will find the exponent and write it in exponential form.

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(i) $6 \times 6 \times 6 \times 6$
6 is multiplied 4 times
Base = 6 and Exponent = 4
So, exponential form is 6^4
(ii) $t \times t$
t is multiplied 2 times
Base = t and Exponent = 2
So, exponential form is = t^2

(iii) $b \times b \times b \times b$
b is multiplied 4 times
Base = b, exponent = 4
So, exponential form is b^4

(iv) $5 \times 5 \times 7 \times 7 \times 7$
5 is multiplied 2 times and 7 is multiplied 3 times.
Base is 5 and 7 and exponent of 5 is 2 and 7 is 3.
So, exponential form is $= 5^2 \times 7^3$

(v) $2 \times 2 \times a \times a$
2 is multiplied 2 times, a is multiplied 2 times
Base is 2 and a and exponent of 2 is 2 and a is 2
So, exponential form is $= 2^2 \times a^2$

(vi) $a \times a \times a \times c \times c \times c \times c \times d$
In this, a is multiplied 3 times, c is multiplied 4 times and d once.
Base is a, c and d. Exponent of a is 3, c is 4 and d is 1
So, exponential form is $a^3 \times c^4 \times d$

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

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

Difficulty Level. Medium

What is given/known.
Numbers

What is unknown:
Base and Exponent of the given numbers.

Reasoning.
In this question, first find factors of the given number and then form its exponential form.

Solution:

(i) 512

$\text{Factors} = 2\times2\times2\times2\times2\times2\times2\times2\times2$

Base = 2 and exponent = 9

So, exponential form is 2^9

(ii) 343

$\text{Factors} = 7\times7\times7$

Base = 7 and exponent = 3

So, exponential form is = 7^3

(iii) 729

$\text{Factors} = 3\times3\times3\times3\times3\times3$

Base = 3 and exponent = 6

So, exponential form 3^6

(iv) 3125

$\text{Factor} = 5\times5\times5\times5\times5$

Base = 5 and exponent = 5

So, exponential form 5^5

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

Difficulty Level: Medium

What is known:

Exponential form

Reasoning:

In this question exponential form of the number is given. That means, we know the base and exponent. We will solve by multiplying the given base to the number of times of its exponent and then compare the two number to find which is greater.

(i) 4^3 or 3^4

$3 \text{ times } 4 = 4\times4\times4 = 64$

$4 \text{ times } 3 = 3\times3\times3\times3 = 81$

$\text{Since } 81 > 64$

So, 3^4 isgreater than 4^3

(ii) 5^3 or 3^5

$3 \text{ times } 5 = 5\times5\times5 = 125$

$5 \text{ times } 3 = 3\times3\times3\times3\times3 = 243$

$\text{Since } 243 > 125$

So, 3^5 is greater than 5^3

(iii) 2^8 or 8^2

$8 \text{ times } 2 = 8 \times 8 = 256$

$2 \text{ times } 8 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 64$

Since $256 > 64$

So, 2^8 is greater than 8^2

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

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

$100 \text{ times } 2 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times \; \ldots\ldots\ldots \; \times 100 \text{ times} = 16,384$

Since $16,384 > 10,000$

So, 100^2 is greater than 100^2

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

$10 \text{ times } 2 = 1024$

$2 \text{ times } 10 = 100$

Since $1024 > 100$

So, 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

Difficulty Level: Medium

What is known/given:

Numbers.

What is unknown?

Prime factors and powers of given numbers.

Reasoning:

In this question, first find prime factors of the given number and then raise the prime factor to its powers.

Solution:

(i) 648

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

Prime factorization of $648 = 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3$

In this, 3 is the exponent of 2 and 4 is the exponent of 3

So, 648 can be expressed as product of powers of their prime factors as $2^3 \times 3^4$

(ii) 405

3	405
3	135
3	45
3	15
	5

Prime factorization of $405 = 3 \times 3 \times 3 \times 3 \times 5$

In this, 4 is the exponent of 3 and 1 is the exponent of 5

So, product of powers of prime factors $= 3^3 \times 5$

(iii) 540

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

Prime factorization of $540 = 2 \times 2 \times 3 \times 3 \times 3 \times 5$

In this, 2 is the exponent of 2. 3 is the exponent of 3 and 1 is the exponent of 5

So, product of powers of prime factors $= 2^2 \times 3^3 \times 5 = 2^2$ x 3^3 x 5

(iv) 3,600

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

Prime factorization of $540 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 5$

In this, 4 is the exponent of 2. 2 is the exponent of 3 and 2 is the exponent of 5

So, product of powers of prime factors $= 2^4 \times 3^2 \times 5^2$

Q6. Simplify:

(i) 2×10^{3} (ii) $7^{2}\times2^{2}$ (iii) $2^{3}\times5$ (iv) 3×4^{4}
(v) 0×10^{2} (vi) $5^{2}\times3^{3}$ (vii) $2^{4}\times3^{2}$ (viii) $3^{2}\times10^{4}$

Difficulty Level: Medium

What is known/given?
Base and exponent.

What is unknown?
Simple form of the number.

Reasoning.
In this question we will multiply the base and the number of times it's exponent to simplify the given statement.

(i) $2\times10^{3}=2\times(10\times10\times10)=2\times1000=2000$

(ii) $7^{2}\times2^{2}=(7\times7)\times(2\times2)=49\times4=196$

(iii) $2^{3}\times5=(2\times2\times2)\times5=8\times5=40$

(iv) $3\times4^{4}=3\times(4\times4\times4\times4)=3\times256=768$

(v) $0\times10^{2}=0\times10\times10=0$

(vi) $5^{2}\times3^{3}=(5\times5)\times(3\times3\times3)=25\times27=675$

(vii) $2^{4}\times3^{2}=(2\times2\times2\times2)\times(3\times3)=16\times9=144$

(viii) $3^{2}\times10^{4}=(3\times3)\times(10\times10\times10\times10)=9\times10000=90000$

Q7. Simplify:

(i) $(-4)^{3}$ (ii) $(-3)\times(-2)^{3}$ (iii) $(-3)^{2}\times(-5)^{2}$ (iv) $(-2)^{3}\times(-10)^{3}$

Difficulty Level. Medium

What is unknown:
Base and Exponent

Reasoning.
In this question we will multiply the base and the number of times it's exponent to simplify the given statement.Solution:

Solution:

(i) $(-4)^3 = (-4)\times(-4)\times(-4) = -64$

(ii) $(-3)\times(-2)^3 = (-3)\times(-2)\times(-2)\times(-2) = (-3)\times(-8) = 24$

(iii) $(-3)^2\times(-5)^2 = (-3)\times(-3)\times(-5)\times(-5) = 9\times 25 = 225$

(iv) $(-2)^3\times(-10)^3 = (-2)\times(-2)\times(-2)\times(-10)\times(-10)\times(-10) = (-8)\times(-1000) = 8000$

Q8. Compare the following numbers:

(i) $2.7\times10^{12}; 1.5\times10^{8}$

(ii) $4\times10^{14}; 3\times10^{17}$

Difficulty Level: Medium

What is known/given:

Two numbers with base 10 but different powers.

What is unknown:

Out of the given two numbers, which number is greater or smaller.

Reasoning:

In this question, simplify the numbers and decide which one is greater. Another way is to look at the power of 10. The number with higher power of 10 is greater than the other.

Solution:

(i) In numbers, 2.7×10^{12} and 1.5×10^{8}

$2.7 \times 10^{12} = 2.7 \times 12$ times $10 = 2.7 \times 1000000000000 = 27,00,00,00,00,000$

And,

$1.5 \times 10^{8} = 1.5 \times 8$ times $10 = 1.5 \times 100000000 = 15,00,00,000$

So, 2.7×10^{12} is greater than 1.5×10^{8}

(ii) In numbers, 4×10^{14}; 3×10^{17}

$4 \times 10^{14} = 4$ x 14 times $10 = 4 \times 100000000000000 = 4,00,00,00,00,00,000$

And,

$3 \times 10^{17} = 3 \times 17$ times $10 = 3 \times 100000000000000000 = 3,00,00,00,00,00,00,00,000$

So, 3×10^{17} is greater than 4×10^{14}

Exercise 13.2 (Page 260)

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) $\left(5^2\right)^3 \div 5^3$ (vi) $2^5 \times 5^5$

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

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

Difficulty Level:
Low

What is given /known?
Exponential form of numbers.

What is unknown?
Exponential form by using laws of exponents.

(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) $\left(5^2\right)^3 \div 5^3$ (vi) $2^5 \times 5^5$

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

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

Reasoning:
To solve this question, you must remember the laws of exponents. Here are some important laws of exponents:

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

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

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

4) $\left(a^m\right)^n = a^{mn}$

5) $a^o = 1$

Solution:

(i) $3^2 \times 3^4 \times 3^8 = 3^{2+4+8} = 3^{14}$ $\quad \left[a^m \times a^n = a^{m+n}\right]$

(ii) $6^{15} \div 6^{10} = 6^{15-10} = 6^5$ $\quad \left[a^m \div a^n = a^{m-n}\right]$

(iii) $a^3 \times a^2 = a^{3+2} = a^5$ $\quad \left[a^m \times a^n = a^{m+n}\right]$

(iv) $7^x \times 7^2 = 7^{x+2}$ $\quad \left[a^m \times a^n = a^{m+n}\right]$

(v) $\left(5^2\right)^3 \div 5^3 = 5^6 \div 5^3$ $\quad \left[\left(a^m\right)^n = a^{mn}\right]$

$= 5^{6-3}$ $\quad \left[a^m \div a^n = a^{m-n}\right]$

$= 5^3$

(vi) $2^5 \times 5^5 = (2 \times 5)^5 = (10)^5$ $\quad \left[a^m \times b^m = (ab)^m\right]$

(vii) $a^4 \times b^4 = (ab)^4$ $\quad \left[a^m \times b^m = (ab)^m\right]$

(viii) $\left(3^4\right)^3 = (3)^{12}$ $\quad \left[\left(a^m\right)^n = a^{mn}\right]$

(ix) $\left(2^{20} \div 2^{15}\right) \times 2^3 = 2^{20-15} \times 2^3$ $\quad \left[a^m \div a^n = a^{m-n)}\right]$

$= 2^5 \times 2^3$ $\quad \left[a^m \times a^n = a^{m+n}\right]$

$= 2^8$

(x) $8^t \div 8^2 = 8^{t-2}$ $\quad \left[a^m \div a^n = a^{m-n}\right]$

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

(i) $\dfrac{2^3 \times 3^3 \times 4}{3 \times 32}$ (ii) $\left[\left(5^2\right)^3 \times 5^4\right] \div 5^7$ (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) $\left(3^0 + 2^0\right) \times 5^0$ (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) $\left(2^3 \times 2\right)^2$

Difficulty Level-Easy

What is unknown?

Exponential form by using laws of exponents.

What is given /known?

(i) $\dfrac{2^3 \times 3^3 \times 4}{3 \times 32}$ (ii) $\left[\left(5^2\right)^3 \times 5^4\right] \div 5^7$ (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) $\left(3^0 + 2^0\right) \times 5^0$ (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) $\left(2^3 \times 2\right)^2$

How can you use the known information to arrive at the solution?

To solve this question, you must remember the laws of exponents given in question 1.

Solution:

(i) $\dfrac{2^3 \times 3^4 \times 4}{3 \times 32} = \dfrac{2^3 \times 3^4 \times 2^2}{3 \times 2^5}$ $\quad a^m \times a^n = a^{m+n}$

$= \dfrac{2^{3+2} \times 3^4}{3^1 \times 2^5}$ $\quad a^m \div a^n = a^{m-n}$

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

$= 3^2$

(ii) $\left[\left(5^2\right)^3 \times 5^4\right] \div 5^7 = \left[5^6 \times 5^4\right] + 5^7$ $\qquad a^m \times a^n = a^{m+n}$

$= \left[5^{6+4}\right] \div 5^7$ $\qquad a^m \div a^n = a^{m-n}$

$= [5^{10}] \div 5^7$

$= \left[5^{10-7}\right]$

$= 5^3$

(iii) $25^4 \div 5^3 = \left(5^2\right)^4 \div 5^3$

$= 5^8 \div 5^3$

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

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

$= \dfrac{7^2 \times 11^8}{7 \times 11^3}$

$= 7^{2-1} \times 11^{8-3}$ $\qquad a^m \div a^n = a^{m-n}$

$= 7 \times 11^5$

(v) $\dfrac{3^7}{3^4 \times 3^3} = \dfrac{3^7}{3^{4+3}} = \dfrac{3^7}{3^7}$ $\qquad \left[a^m \times a^v = a^{n+r}\right]$

$= 3^{7-7}$ $\qquad \left[a^m \div a^n = a^{m-n}\right]$

$= 3^0$

$= 1$

(vi) $2^0 + 3^0 + 4^0 = 1 + 1 + 1$ $\qquad a^0 = 1$

$= 3$

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

$= 1$

(viii) $\left(3^0 + 2^0\right) \times 5^0 = (1+1) \times 1$ $\qquad a^0 = 1$

$= 2 \times 1 = 2$

(ix) $\dfrac{2^8 \times a^5}{4^3 \times a^3} = \dfrac{2^8 \times a^5}{\left(2^2\right)^3 \times a^3} = \dfrac{2^8 \times a^5}{(2)^6 \times a^3}$ $\qquad a^m \div a^n = a^{m-n}$

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

$= (2a)^2$

(x) $\left(\frac{a^5}{a^3}\right)\times a^8 = \left(a^{5-3}\right)\times a^8$ $\qquad a^m \div a^n = a^{m-n}$

$= a^2 \times a^8$

$= a^{2+8}$ $\qquad a^m \times a^n = a^{m+n}$

$= a^{10}$

(xi) $\frac{4^5 \times a^8 b^3}{4^5 \times a^5 b^2} = 4^{5-5} \times a^{8-5} \times b^3$ $\qquad a^m \div a^n = a^{m-n}$

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

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

(xii) $\left(2^3 \times 2\right)^2 = \left(2^{3+1}\right)^2 = \left(2^4\right)^2$

$= 2^{4\times 2}$ $\qquad \left(a^m\right)^n = a^{mn}$

$= 2^8$

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) $3^0 = 1000^0$

Difficulty Level-Easy

Solution:

(i)

$10 \times 10^{11} = 100^{11}$

$LHS = 10 \times 10^{11} = 10^{11+1} = 10^{12}$

$RHS = 100^{11} = \left(10^2\right)^{11} = 10^{22}$

$\therefore 10^{12} \neq 10^{22}$

$\therefore$ *Thus, the statement is false.*

(ii)

$2^3 > 5^2$

$LHS = 2^3 = 2\times 2\times 2 = 8$

$RHS = 5^2 = 5\times 5 = 25$

$\therefore 2^3 < 5^2$

$\therefore$ *Thus, the statement is false.*

(iii)

$$2^3 \times 3^2 = 6^5$$
$$LHS = 2^3 \times 3^2 = 2 \times 2 \times 2 \times 3 \times 3 = 72$$
$$RHS = 6^5 = 6 \times 6 \times 6 \times 6 \times 6 = 7776$$
$$\therefore 2^3 \times 3^2 \neq 6^5$$
$$\therefore \textit{Thus, the statement is false.}$$

(iv)

$$3^0 = 1000^0 = 1$$
$$\therefore \textit{Thus, the statement is true.}$$

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

Difficulty Level-Easy

What is unknown?

Product of prime factors only in exponential form.

What is given /known?

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

How can you use the known information to arrive at the solution?

To solve this question, you must remember the laws of exponents. Here are some important laws of exponents.

1. $a^m \times a^n = a^{m+n}$
2. $a^m \div a^n = a^{m-n}$
3. $\left(a^m\right)^n = a^{mn}$
4. $a^0 = 1$

Solution:

(i) 108×192

$$= 2 \times 2 \times 3 \times 3 \times 3 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \qquad \left(a^m \times a^n = a^{m+n}\right)$$
$$= 2^8 \times 3^4$$

(ii) 270

$$= 2 \times 3 \times 3 \times 3 \times 5 \qquad a^m \times a^n = a^{m+n}$$
$$= 2 \times 3^3 \times 5$$
$$= 10 \times 3^3$$

(iii) 729×64

$= 3\times\ 3\times3\times3\times3\times3\times2\times2\times2\times2\times2\times2$ $\qquad a^m \times a^n = a^{m+n}$

$= 3^6 \times 2^6$

$= (3\times2)^6$

(iv) 768

$= 2\times2\times2\times2\times2\times2\times2\times2\times3$ $\qquad a^m \times a^n = a^{m+n}$

$= 2^8 \times 3$

Q5. Simplify:

(i) $\dfrac{(2^5)^2 \times 7^3}{8^3 \times 7}$ (ii) $\dfrac{25\times5^2\times t^8}{10^3\times t^4}$ (iii) $\dfrac{3^5\times10^5\times25}{5^7\times6^5}$

Solution:

(i)

$$\frac{(2^5)^2 \times 7^3}{8^3 \times 7} = \frac{2^{5\times2} \times 7^3}{(2^3)^3 \times 7}$$

$$= \frac{2^{10} \times 7^{3-1}}{2^9} \qquad \left[a^m \div a^n = a^{m-n}\right]$$

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

$$= 2^1 \times 7^2$$

$$= 98$$

(ii)

$$\frac{25\times5^2\times t^8}{10^3\times t^4} = \frac{(5)^2\times5^2\times t^8}{(2\times5)^3\times t^4}$$

$$= \frac{(5)^{2+2}\times t^8}{2^3\times5^3\times t^4} \qquad \left[a^m \times a^n = a^{m+n}\right]$$

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

$$= \frac{(5)^{4-3}\times t^{8-4}}{8} \qquad \left[a^m \div a^n = a^{m-n}\right]$$

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

(iii)

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

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

$$= \frac{3^5 \times 2^5 \times 5^7}{5^7 \times 2^5 \times 3^5} \qquad a^m \times a^n = a^{m+n}$$

$$= 3^{5-5} \times 2^{5-5} \times 5^{7-7} \qquad a^m \div a^n = a^{m-n}$$

$$= 3^0 \times 2^0 \times 5^0 \qquad a^0 = 1$$

$$= 1$$

Chapter-13: Exponents and Powers

Exercise 13.3

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

Difficulty Level: Moderate

Reasoning/ Explanation:
Expanded form of number means expressing a number using powers of 10 as exponents.

(i)
$$\begin{aligned}279404 &= 2\times100000+7\times10000+9\times1000+4\times100+0\times10+4\times1\\ &= 2\times10^5+7\times10^4+9\times10^3+4\times10^2+0\times10^1+4\times10^0\end{aligned}$$

(ii)
$$\begin{aligned}3006194 &= 3\times1000000+0\times100000+0\times10000+6\times1000+1\times100+9\times10+4\times1\\ &= 3\times10^6+0\times10^5+0\times10^4+6\times10^3+1\times10^2+9\times10^1+4\times10^0\end{aligned}$$

(iii)
$$\begin{aligned}2806196 &= 2\times1000000+8\times10000+0\times10000+6\times1000+1\times100+9\times10+6\times1\\ &= 2\times10^6+8\times10^5+0\times10^4+6\times10^3+1\times10^2+9\times10^1+6\times10^0\end{aligned}$$

(iv)
$$\begin{aligned}120719 &= 1\times100000+2\times10000+0\times1000+7\times100+1\times10+9\times1\\ &= 1\times10^5+2\times10^4+0\times10^3+7\times10^2+1\times10^1+9\times10^0\end{aligned}$$

(v)
$$\begin{aligned}20068 &= 2\times10000+0\times1000+0\times100+6\times10+8\times1\\ &= 2\times10^4+0\times10^3+0\times10^2+6\times10^1+8\times10^0\end{aligned}$$

Q2. Find the number from each of the following expanded forms:

(a) $8\times10^4+6\times10^3+0\times10^2+4\times10^1+5\times10^0$

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

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

(d) $9\times10^5+2\times10^2+3\times10^1$

Difficulty Level: Moderate

Reasoning/ Explanation:
Expressing a number means we have to expand the given powers of 10.
(a)

$$\begin{aligned} & 8\times10^4+6\times10^3+0\times10^2+4\times10^1+5\times10^0 \\ & =8\times10000+6\times1000+0\times100+4\times10+5\times1 \\ & =80000+6000+0+40+5 \\ & =86045 \end{aligned}$$

(b)

$$\begin{aligned} & 4\times10^5+5\times10^3+3\times10^2+2\times10^0 \\ & =4\times100000+0\times10000+5\times1000+3\times100+0\times10+2\times1 \\ & =400000+0+5000+300+0+2 \\ & =405302 \end{aligned}$$

(c)

$$\begin{aligned} & 3\times10^4+7\times10^2+5\times10^0 \\ & =3\times10000+0\times10000+7\times100+0\times10+5\times1 \\ & =30000+0+700+0+5 \\ & =30705 \end{aligned}$$

(d)

$$\begin{aligned} & 9\times10^5+2\times10^2+3\times10^1 \\ & =9\times100000+0\times10000+0\times1000+2\times100+3\times10+0\times1 \\ & =900000+0+0+200+30+0 \\ & =900230 \end{aligned}$$

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

Difficulty Level: Moderate

Reasoning/Explanation:
Standard form of numbers is used in case of large numbers. Large numbers can be expressed using exponents of 10.
(i)

$$\begin{aligned} & 5,00,00,000 \\ & =5\times10^7 \end{aligned}$$

(ii)

$$\begin{aligned} & 70,00,000 \\ & =7\times10^6 \end{aligned}$$

(iii)

$$3{,}18{,}65{,}00{,}000$$
$$= 3.1865 \times 10^{9}$$

(iv)

$$3{,}90{,}878$$
$$= 3.90878 \times 10^{5}$$

(v)

$$39087.8$$
$$= 3.90878 \times 10^{4}$$

(vi)

$$3908.78$$
$$= 3.90878 \times 10^{3}$$

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

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

$$\text{Standard Form} = 3.84 \times 10^{8} \text{ m}$$

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

$$\text{Standard Form} = 3 \times 10^{8} \text{ m / s}$$

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

$$\text{Standard Form} = 1.2756 \times 10^{7} \text{ m}$$

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

$$\text{Standard Form} = 1.4 \times 10^{9} \text{ m}$$

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

$$\text{Standard Form} = 1 \times 10^{11} \text{ stars}$$

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

$$\text{Standard Form} = 1.2 \times 10^{10} \text{ years old}$$

(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.

Standard Form $= 3 \times 10^{20}$ m

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

Standard Form $= 6.023 \times 10^{22}$ molecules

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

Standard Form $= 1.353 \times 10^{9}$ cubic km

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

Standard Form $= 1.027 \times 10^{9}$

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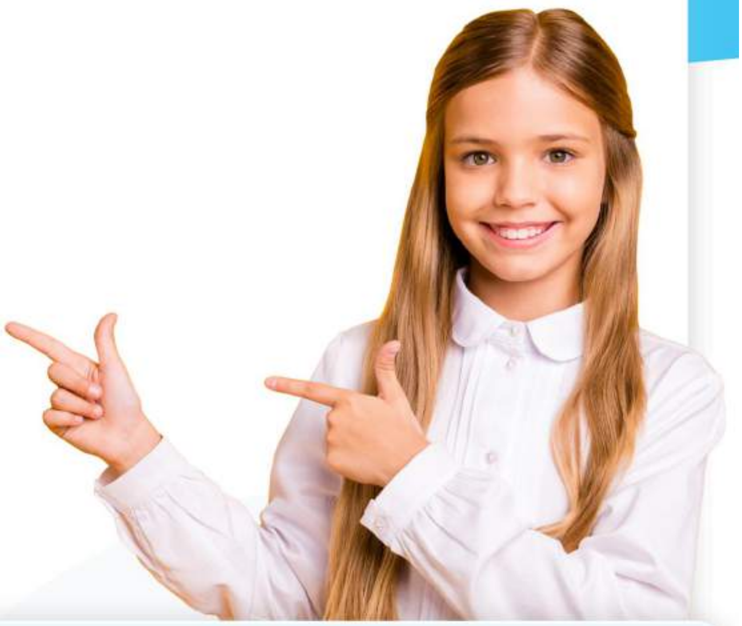

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