WORKSHEET

EXPONENTS & POWERS.
Class 7
Ch. 13

(i) In $(-1)^{66}$, the power is even

$\therefore (-1)^{66} = 1$

(ii) In $(-1)^{95}$, the power is odd

$\therefore (-1)^{95} = -1$

(iii) In $(-1)^{19}$, the power is odd

$\therefore (-1)^{19} = -1$

(iv) In $(-1)^{100}$, the power is even

$\therefore (-1)^{100} = 1$

EXPONENTS AND POWERS.

Exercise 13.1

1. Write the following in the exponential form.

(i) $(-7) \times (-7) \times (-7) \times (-7) \times (-7) \times (-7)$

(ii) $5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$

(iii) $(-104) \times (-104) \times (-104)$

(iv) (-7)

(v) $18 \times 18 \times 18 \times 18 \times 18 \times 18$

2. Write the base and exponent for each of the following.

(i) 8^{14} (ii) $\left(\frac{9}{3}\right)^2$ (iii) $(8.25)^{-5}$ (iv) $(-7)^7$

(v) $(-37)^4$ (vi) $(4)^3$ (vii) $(0.01)^1$ (viii) $(-1)^{16}$

3. Find the value of.

(i) $5^3 \times 2^5$ (ii) 19^2 (iii) $(-3)^5$ (iv) 1^{63}

(v) $(-7)^4 \times (3)^1$ (vi) $(-12)^3$ (vii) $8^3 \times (-8)^2$ (viii) $(-1)^{111} \times (-1)^{65}$

(ix) $(-1)^{72}$ (x) $(-16)^3 \times 5^2$ (xi) $(-9)^2 \times (-3)^5$ (xii) $(-2)^7 \times 0 \times (-1)^{164}$

4. Express in exponential form.

(i) $\frac{81}{256}$ (ii) -1331 (iii) 1024

5. (i) What power of 6 is 1296? (ii) What power of -3 is -2187?

6. Fill in the blanks.

(i) $\left(-\frac{1}{4}\right)^4 =$ ___ (ii) $(-9)^3 =$ ___ (iii) $0^7 =$ ___ (iv) $(-5)^2 \times (-5)^2 =$ ___

Laws of Exponents

Let us look at these examples carefully.

$7 \times 7 \times 7 \times 7 = 7^4$ and $7 \times 7 \times 7 = 7^3$

If we multiply these two let's see what do we get

$7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 = 7^4 \times 7^3$ or, we may write it as $(7)^7 = 7^4 \times 7^3$

(iii) $\frac{1}{5}\times\frac{1}{5}\times\frac{1}{5}\times\frac{1}{5}\times\frac{1}{5} = \left(\frac{1}{5}\right)^5$, and is read as $\frac{1}{5}$ raised to the power 5.

> **Quick Note**
> Any number to the power one is the number itself,. *i.e.*, $x^1 = x$.

Powers of Negative Integers

Study the following examples.

(i) $(-1)^1 = -1$

(ii) $(-1)^2 = (-1)\times(-1) = 1$

(iii) $(-1)^3 = (-1)\times(-1)\times(-1) = -1$

(iv) $(-1)^4 = (-1)\times(-1)\times(-1)\times(-1) = 1$

(v) $(-1)^5 = (-1)\times(-1)\times(-1)\times(-1)\times(-1) = -1$

(vi) $(-1)^6 = (-1)\times(-1)\times(-1)\times(-1)\times(-1)\times(-1) = 1$

Here, when the exponent is 1, 3 and 5, ... the result is – 1 whereas when the exponent is 2, 4 and 6 the result is 1.

Thus, we may conclude that

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

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

Solved Examples

Example 1: *Simplify.*

(i) $(-3)^2\times(-1)^7\times(-4)^2$ *(ii)* $(-0.5)^2\times 9^3\times(-7)^2$

(i) $(-3)^2\times(-1)^7\times(-4)^2 = (-3)\times(-3)\times(-1)\times(-4)\times(-4)$ $[\because (-1)^7 = -1]$

$= 9\times(-1)\times 16 = \mathbf{-144}$

(ii) $(-0.5)^2\times 9^3\times(-7)^2 = (-0.5)\times(-0.5)\times 9\times 9\times 9\times(-7)\times(-7)$

$= 0.25\times 729\times 49 = \mathbf{8930.25}$

Example 2: *Write the base and exponent of each of the following.*

(i) $(-6)^3$ *(ii)* $(3.5)^5$ *(iii)* $(7)^{11}$ *(iv)* $(-2)^6$

(i) In $(-6)^3$

Base → **– 6**

Exponent → **3**

(ii) $(3.5)^5$

Base → **3.5**

Exponent → **5**

(iii) $(7)^{11}$

Base → **7**

Exponent → **11**

(iv) $(-2)^6$

Base → **– 2**

Exponent → **6**

Example 3: *Compute the following.*

(i) $(-1)^{66}$ *(ii)* $(-1)^{95}$ *(iii)* $(-1)^{19}$ *(iv)* $(-1)^{100}$

Example 2: *Find the value of.*

(i) $5^3 \times 5^4$ *(ii)* $(-4)^6 \div (-4)^2$

(i) $5^3 \times 5^4$

Using law of exponent $x^m \times x^n = x^{m+n}$, we get $5^3 \times 5^4 = 5^{3+4} = 5^7 = \mathbf{78125}$.

(ii) $(-4)^6 \div (-4)^2$

Using $x^m \div x^n = x^{m-n}$, we get

$(-4)^6 \div (-4)^2 = (-4)^{6-2} = (-4)^4 = (-4) \times (-4) \times (-4) \times (-4) = \mathbf{256}$.

Exercise 13.2

1. Find the value of.

(i) $(-3)^5 \div (-3)^2$ (ii) $\left(\frac{-1}{2}\right)^7 \div \left(\frac{-1}{2}\right)^4$ (iii) $x^5 \div x^4$ (iv) $(4)^9 \div (4)^7$

(v) $a^n \div a^m$ (vi) $(-12)^6 \div (-12)^4$ (vii) $\frac{7^4}{7}$ (viii) $(-b)^p \div (-b)^q$

2. Simplify the following.

(i) $2^5 \times 2^3$ (ii) $8^2 \times 8^3$ (iii) $a^4 \times a^7$ (iv) $\left(\frac{7}{5}\right)^3 \times \left(\frac{7}{5}\right)^4$

(v) $(-9)^3 \times (-9)$ (vi) $x^p \times x^q$ (vii) $\left(\frac{-1}{5}\right)^2 \times \left(\frac{-1}{5}\right)^3$ (viii) $a^m \times a^3$

(ix) $(-2)^5 \times (-2)^3 \times (-2)^2$ (x) $(-p)^6 \times (-p)^2 \times (-p)^3$

3. Express as a single power.

(i) $p^m \times q^m$ (ii) $3^8 \times 2^8$ (iii) $a^x \times b^x$ (iv) $7^9 \times 2^9$

(v) $4^x \cdot 2^x$ (vi) $(-5)^p \cdot (-3)^p$ (vii) $a^m \times a^n$ (viii) $5^3 \cdot a^3$

4. Simplify.

(i) $(2 \times 7)^3$ (ii) $(3 \times 4)^4$ (iii) $(-6 \times -2)^3$

(iv) $\left(\frac{-1}{7} \times 3\right)^2$ (v) $(a \times b)^x$ (vi) $\left\{8 \times \left(\frac{-1}{2}\right)\right\}^3$

5. Evaluate.

(i) $(6^2)^2$ (ii) $\{(-3)^2\}^3$ (iii) $\left\{\left(\frac{1}{5}\right)^3\right\}^2$ (iv) $(10^3)^4$

(v) $\left\{\left(\frac{-1}{3}\right)^4\right\}^2$ (vi) $(x^2)^a$ (vii) $(b^m)^n$ (viii) $\{(-2)^x\}^3$

6. Simplify.

(i) $(-3)^6 \times \left(\frac{1}{4}\right)^2 \times (-3)^4 \times \left(\frac{1}{3}\right)^8$ (ii) $(2^3)^2 \times 2^7 \times \left(\frac{-1}{2}\right)^{10}$

Expressing Large Numbers in the Standard Form

Here in this section, we explain the method to write a given number in scientific notation or standard form.

Standard form: Any number can be expressed as a decimal number between 1.0 and 10.0 including 1.0 multiplied by a power of 10. Such a form is called its standard form or scientific notation. It may also be written as $k \times 10^n$ where k is a terminating decimal and $1 \leq k < 10$ and n in an integer.

Solved Examples

Example 1: *Write the following in scientific notation.*

(i) 23 lakh *(ii) 60,000,000* *(iii) 0.038*

(i) 23 lakh = 23,00,000 = $\mathbf{2.3 \times 10^6}$ (ii) 60,000,000 = $\mathbf{6.0 \times 10^7}$

(iii) 0.038 = $\mathbf{3.8 \times 10^{-2}}$

Example 2: *Express the following in the standard form.*

(i) 30564235 *(ii) 1090856007*

(i) 30564235 = $\mathbf{3.0564235 \times 10^7}$ (ii) 1090856007 = $\mathbf{1.090856007 \times 10^9}$

From the above examples, we observe that in standard form:

- There is only one digit to the left of decimal point.
- If the given number is greater than 10, then the power of 10 is a positive integer equal to the number of places the decimal has been moved from right to left.
- If the given number is less than 1, then the power of 10 is a negative integer equal to the number of places the decimal has been moved from left to right.
- If the number is greater than or equal to 1, but less than 10, then the power of 10 is zero.

Exercise 13.3

1. Express each of the facts in standard form.

(i) Speed of light in vacuum is 300 million metre per second.

(ii) There are 100,000,000,000 stars in a galaxy.

(iii) The mass of Uranus is 86,800,000,000,000,000,000,000,000,000 g.

(iv) The distance between Sun and Earth is 149,600,000,000 m.

(v) The charge of an electron is 0.0000000048 electrostatic units.

(vi) There are 1734480000 seconds in 55 years.

2. Fill in the blanks.

(i) 12 ton = _____ $\times 10^{\square}$ milligram (ii) 21 terabyte = _____ $\times 10^{\square}$ byte

(iii) 9 nenometre = _____ $\times 10^{\square}$ metre (iv) 1 micrometre = _____ $\times 10^{\square}$ metre

(v) 1 millilitre = _____ $\times 10^{\square}$ kilolitre

3. Express the following in standard form.

(i) 18 billion (ii) 245 million (iii) 16300000000 (iv) 893.256

4. Find the number from each of the following expanded form.

(i) $6 \times 10^4 + 2 \times 10^3 + 7 \times 10^1 + 3 \times 10^0$

(ii) $9 \times 10^6 + 8 \times 10^5 + 7 \times 10^4 + 6 \times 10^3 + 5 \times 10^2 + 4 \times 10^1 + 3 \times 10^0$

(iii) $3 \times 10^9 + 1 \times 10^7 + 2 \times 10^5 + 6 \times 10^3 + 4 \times 10^1 + 9 \times 10^0$

5. Write the following in usual form.

(i) 8.5×10^7 (ii) 6.073×10^3 (iii) 2.7×10^6 (iv) 3.33×10^4

QUICK RECALL

- If 'x' is a number then 'n' times the product of x with itself is given as $x \times x \times x \times x \ldots n$ times and is denoted as x^n.
- x^n is called the exponential notation where 'x' is the base and 'n' is the exponent/power/index.
- $(-1)^{\text{odd number}} = -1$ $(-1)^{\text{even number}} = 1$
- If 'x' is any number (whole number, integer, decimal or fraction) and m, n are natural numbers, then

(i) $x^m \times x^n = x^{m+n}$

(ii) $x^m \div x^n = \frac{x^m}{x^n} = x^{m-n}$ where $m > n$ or $m - n \in N$

(iii) $(x^m)^n = x^{mn}$

(iv) $x^m \cdot y^m = (xy)^m$

Objective Type Questions

I. Multiple Choice Questions.

1. $(-1)^{53} =$

(i) 1 ☐ (ii) – 53 ☐ (iii) –1 ☐ (iv) 0 ☐

2. $\left(\frac{-7}{15}\right)^1 =$

(i) $\left(\frac{-15}{7}\right)$ ☐ (ii) $\left(\frac{-7}{-15}\right)$ ☐ (iii) $\frac{7}{15}$ ☐ (iv) $\frac{-7}{15}$ ☐

3. In power notation $\left(\frac{-1}{5}\right)\times\left(\frac{-1}{5}\right)\times\left(\frac{-1}{5}\right)\times\left(\frac{-1}{5}\right)$ can be written as:

(i) $(-5)^4$ ☐ (ii) $\left(\frac{-1}{5}\right)^4$ ☐ (iii) $\left(\frac{-1}{5}\right)^3$ ☐ (iv) $-\left(\frac{1}{5}\right)^4$ ☐

4. 40,000,000,000 in standard form is

(i) 4×10^6 ☐ (ii) 4×10^{10} ☐ (iii) 4×10^8 ☐ (iv) none of these ☐

5. The exponential form of $\frac{-343}{1331}$ is

(i) $\left(\frac{7}{11}\right)^2$ ☐ (ii) $\left(\frac{7}{11}\right)^3$ ☐ (iii) $\left(\frac{-7}{11}\right)^3$ ☐ (iv) $-\left(\frac{7}{121}\right)^2$ ☐

II. Fill in the blanks.

6. $(2^3)^5 =$ _____.

7. $2^2 + 3^2 =$ _____.

8. Cube of $\frac{-1}{7}$ is _____.

9. $\left(\frac{7}{11}\right)^5 \div \left(\frac{7}{11}\right)^3 = \left(\frac{7}{11}\right)^{\square}$

10. 7 megabyte = _____ $\times 10^{\square}$ bytes.

III. Tick (✓) for 'True' and (✗) for 'False'.

11. The value of a^1 is 1. ☐

12. The exponential form of $\frac{32}{243}$ is $\left(\frac{2}{3}\right)^5$. ☐

13. $(x^m)^n = x^{m\times n}$ ☐

14. The reciprocal of 6 is 6^{-1}. ☐

15. $\left(\frac{-5}{3}\right)^3$ is equal to $\left(\frac{-5}{3}\right)\times\left(\frac{-5}{3}\right)\times\left(\frac{-5}{3}\right)$. ☐