Name : ____________________________

Grade : VIII

Subject : Mathematics

Chapter : 12. Exponents and Powers

Objective Type Questions **1 Marks.**

I. Multiple choice questions

1. The multiplicative inverse of $\left(\frac{-5}{9}\right)^{-99}$ is **[NCERT Exemplar]**

a. $\left(\frac{-5}{9}\right)^{-99}$ b. $\left(\frac{5}{9}\right)^{-99}$ c. $\left(\frac{9}{-5}\right)^{-99}$ d. $\left(\frac{9}{5}\right)^{99}$

2. What is the value of 'm' if $(-2)^2 \times (-5)^2 = 50$ m?

a. 10 b. 2 c. 100 d. -100

3. What is the scientific notation of 0.0023?

a. 2.3 x 10-3 b. 23 x 10-3 c. 2.3 x 103 d. 23 x 103

4. The usual from for 2.03 x10-5: **[NCERT Exemplar]**

a. 0.203 b. 0.00203 c. 203000 d. 0.0000203

5. $\left(\frac{1}{10}\right)^0$ is equal to:

a. 0 b. $\frac{1}{10}$ c. 1 d. 10

6. $\left(\frac{-7}{5}\right)^{-1}$ is equal to: **[NCERT Exemplar]**

a. $\frac{5}{7}$ b. $\frac{-5}{7}$ c. $\frac{7}{5}$ d. $\frac{-7}{5}$

7. The value of $(7^{-1} - 8^{-1})^{-1} - (3^{-1} - 48^{-1})^{-1}$ is:

a. 44 b. 56 c. 68 d. 12

8. $(2^{-1} + 3^{-1} + 4^{-1})^{-1}$ is:

a. $\frac{1}{2} + \frac{1}{3} + \frac{1}{4}$ b. 2 + 3 + 4 c. 1 + 1 + 1 d. 1

9. $\left(\frac{3}{4}\right)^5 \div \left(\frac{5}{3}\right)^5$ is equal to:

a. $\left(\frac{3}{5} \div \frac{5}{3}\right)^5$ b. $\left(\frac{3}{4} \div \frac{5}{3}\right)^1$ c. $\left(\frac{3}{4} \div \frac{5}{3}\right)^0$ d. $\left(\frac{3}{4} \div \frac{5}{3}\right)^{10}$

10. $(-7^3 \div 7^{-8}) \div 7^5 =$

a. 7^6 b. 7^{-6} c. -1 d. 1

11. The value of p, for which $7^7 \div 7^{-p} = 7^{10}, is$:

a. 1 b. 2 c. 3 d. 4

12. When $x = 2, x(x^x) - x$ is equal to

a. 4 b. 6 c. 8 d. 10

13. Let x be any non-zero integer and m, n be negative integer. The $x^m \times x^n$ is equal to

[NCERT Exemplar]

a. x^m b. x^{m+n} c. x^n d. x^{m-n}

14. The standard form for 0.000064 is: **[NCERT Exemplar]**

a. 64×10^4 b. 64×10^{-4} c. 6.4×10^5 d. 6.4×10^{-5}

15. $(-9)^3 \div (-9)^8$ is equal to **[NCERT Exemplar]**

a. $(9)^5$ b. $(9)\ -^5$ c. $(-9)^5$ d. $(-9)^{-5}$

16. For a non-zero rational number z, $(z^{-2})^3$ is equal to: **[NCERT Exemplar]**

a. z^6 b. z^{-6} c. z^1 d. z^4

17. Which of the following is not the reciprocal of $\left(\frac{2}{3}\right)^4$?

a. $\left(\frac{3}{2}\right)^4$ b. $\left(\frac{3}{2}\right)^{-4}$ c. $\left(\frac{2}{3}\right)^4$ d. $\frac{3^4}{2^4}$

18. In $2^2, n$ is known as **[NCERT Exemplar]**

a. base b. constant c. exponent d. variable

19. Cube of $-\frac{1}{2}$ is:

a. $-\frac{1}{8}$ b. $\frac{1}{16}$ c. $-\frac{1}{8}$ d. $-\frac{1}{16}$

20. For a non-zero integer $x, x^7 \div x^{12}$ is equal to:

a. x^5 b. x^{19} c. x^{-5} d. x^{-19}

1. c	2. b	3. a	4. d	5. c	6. b	7. a	8. d	9. a	10. c
11. c	12. b	13. b	14. d	15. d	16. b	17. b	18. c	19. c	20. c

II. Multiple choice questions

1. Multiplicative inverse of 2^7 is **[NCERT Exemplar]**

a. 2^{-7} b. 7^2 c. -2^7 d. 2^7

2. Then value of $\frac{1}{4^{-2}}$ is **[NCERT Exemplar]**

a. 16 b. 8 c. $\frac{1}{16}$ d. $\frac{1}{8}$

3. Then reciprocal of $\left(\frac{2}{5}\right)^{-1}$ is [NCERT Exemplar]

a. 16 b. 8 c. $\frac{1}{16}$ d. $\frac{1}{8}$

4. If y be any non-zero integer, then y^0 is equal to [NCERT Exemplar]

a. 1 b. 0 c. -1 d. Not defined

5. Which of the following is equal to $\left(-\frac{3}{4}\right)^{-3}$?

a. $\left(\frac{3}{4}\right)^{-3}$ b. $\left(-\frac{4}{3}\right)^{-3}$ c. $\left(\frac{4}{3}\right)^{3}$ d. $\left(-\frac{4}{3}\right)^{3}$

6. The value of $(7^{-1} - 8^{-1})^{-1} - (3^{-1} - 4^{-1})^{-1}$ is [NCERT Exemplar]

a. 44 b. 56 c. 68 d. 12

7. The standard form for 0.000064 is [NCERT Exemplar]

a. 64×10^4 b. 6.4×10^5

c. 6.4×10^{-5} d. None of these

8. The usual form for 2.03×10^{-5}

a. 0.203 b. 0.00203 c. 203000 d. 0.0000203

9. $\left[\left\{\left(-\frac{1}{2}\right)^2\right\}^{-2}\right]^{-1}$ is equal to

a. 16 b. -16 c. $-\frac{1}{16}$ d. $\left(\frac{3}{7}\right)^{-6}$

10. If $x = \left(\frac{3}{7}\right)^{-3}$, then x^{-2} equals

a. $\left(\frac{3}{7}\right)^{-3}$ b. $\left(\frac{3}{7}\right)^{9}$ c. $\left(\frac{3}{7}\right)^{6}$ d. $\left(\frac{3}{7}\right)^{-6}$

1. a	2. a	3. a	4. a	5. d	6. a	7. c	8. d	9. d	10. c

I. Fill in the blanks

1. The standard form of 12340000 is ________________. [NCERT Exemplar]

2. The usual form of 3.41 x 10^6 is ________________. [NCERT Exemplar]

3. If 36 = 6 x 6 = 6^2, then $\frac{1}{36}$ expressed as a power with the base 6 is ________________.

[NCERT Exemplar]

4. The value of $\left(\frac{1}{2^3}\right)^3$ is equal to ________________. [NCERT Exemplar]

5. By multiplying $(10)^5$ by $(10)^{-10}$, we get ________________. [NCERT Exemplar]

1 . 1.234 x 10^7	2. 3410000	3. 6^{-2}	4. $\frac{1}{2^6}$	5. 6^{-2}

I. True or False

1. The multiplicative inverse of $\left(\frac{3}{2}\right)^2$ is not equal to $\left(\frac{2}{3}\right)^{-2}$ [NCERT Exemplar]

2. $(-5)^{-2} \times (-g)^{-3} = (-5)^{-6}$. [NCERT Exemplar]

3. The multiplicative inverse of $(-4)^{-2}$ is $(4)^{-2}$. [NCERT Exemplar]

4. $\frac{x^m}{y^m} = \left(\frac{y}{x}\right)^{-m}$ [NCERT Exemplar]

5. $(-4)^{-4} \times (-7)^{-4} = (-7)^{-2}$ [NCERT Exemplar]

1. True	2. False	3. False	4. True	5. False

I. Very short answer type questions.

1. Write 0.000005678 in the standard form. **[NCERT Exemplar]**

Sol. $0.000005678 = \frac{5678}{1000000000} = \frac{5.678}{10^9} \times 10^3$

$= 5.678 \times 10^{-6}$

2. What is the usual form for 2.3 x 10^{-10}? **[NCERT Exemplar]**

Sol. $2.3 \times 10^{-10} = 23 \times 10^{-1} \times 10^{-10}$

$= 23 \times 10^{-11}$

$= \frac{23}{100000000000}$

$= 0.0000000023$

3. Express 16^{-2} as a power with the base 2. **[NCERT Exemplar]**

Sol. $16^{-2} = \frac{1}{(16)^2} = \frac{1}{(2^4)^2} = \frac{1}{2^8}$

$[\because (a^m)^n = a^{mn}]$

$= 2^{-8}$

4. Write 39,00,00,000 in the standard form. **[NCERT Exemplar]**

Sol. 39,00,00,000 = 3.9 x 10^8

5. Divide 293 by 10,00,000 and express the result in standard form. **[NCERT Exemplar]**

Sol. $\frac{293}{1000000} = \frac{2.93 \times 10^2}{10^6}$

6. Express each of the following in standard form: **[NCERT Exemplar]**

a. The mass of a proton in gram is

$\frac{1673}{1000000000000000000000000000}$

b. A Helium atom has a diameter of 0.000000022 cm.

Sol. a. $\frac{1673}{1000000000000000000000000000}$

$= \frac{1.673 \times 10^3}{10^{27}}$

$= 1.673 \times 10^{-24}\ gm$

b. 0.000000022 = 2.2 x 10^{-8} cm

7. Simplify and write in exponential form:

a. $(-2)^{-3} \times (-2)^{-4}$

b. $p^3 \times p^{-10}$

c. $3^2 \times 3^{-5} \times 3^6$

Sol. a. $(-2)^{-3} \times (-2)^{-4} = (-2)^{(-3)+(-4)}$

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

$= (-2)^{-7}\ or \frac{1}{(-2)^7}$

b. $p^3 \times p^{-10} = (p)^{3+(-10)} = (p)^{-70}\ or \frac{1}{(p)^7}$

c. $3^2 \times 3^{-5} \times 3^6 = 3^{2+(-5)+6}$

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

8. Find the product of the cube of (-2) and the square of (+4). **[NCERT Exemplar]**

Sol. $(2)^3 \times (+4)^2 = (-8) \times (16)$

$= -128$

9. Simplify: $(2^5 \div 2^8) \times 2^{-7}$.

Sol. $(2^5 \div 2^8) \times 2^{-7} = \left(\frac{2^5}{2^8}\right) \times 2^{-7}$

$= (2^{-3}) \times 2^{-7} = 20^{-10}$

10. Express $3^{-5} \times 3^{-4}$ as a power of 3 with positive exponent. **[NCERT Exemplar]**

Sol. $3^{-5} \times 3^{-4} = 3^{-9} = \frac{1}{3^9}$

II. Very short answer type questions.

1. Find the value of x for the expression $3^{5x-1} \div 27 = 3^{-5}$

Sol. $3^{5x-1} \div 27 = 3^{-5}$

$\Rightarrow 3^{5x-1} \div 27 = 3^{-5}$

$\Rightarrow \frac{3^{5x-1}}{3^3} = 3^{-5}$ $\Rightarrow 3^{5x-1-3} = 3^{-5}$

$\Rightarrow \frac{3^{5x-4}}{3^3} = 3^{-5}$

Comparing exponent of 3

$5x - 4 = -5$

$5x - 4 = -5 \quad \Rightarrow \quad 5x = -1 \quad \Rightarrow \quad x = \frac{-1}{5}$

2. What is the value of k if 385600000 is written in the form $k \times 10^n$ with $n = 7$?

Sol. $x = 385600000 \quad \Rightarrow \quad x = 38.56 \times 10^7$

Hence, the value of $k = 38.56$.

3. What is the value of $(6^{-1} + 8^{-1} + 12^{-1})^0$?

Sol. As we know that 0 exponent of any base equals 1.

Hence, $(6^{-1} + 8^{-1} + 12^{-1})^0 = 1$

4. Express 300970000 in standard form.

Sol. Standard form of 300970000 is = 3.0097×10^8

5. What is the reciprocal of $\left(\frac{8}{5}\right)^{-4}$?

Sol. For finding reciprocal we just reverse the fraction

$\therefore$ Its reciprocal = $\left(\frac{5}{8}\right)^{-4} = \left(\frac{8}{5}\right)^4$

6. What is the multiplicative inverse of $\left(-\frac{5}{9}\right)^{-99}$?

Sol. Let the multiplicative inverse be x.

then $\left(-\frac{5}{9}\right)^{-99} \times x = 1$ [$\because$ 1 is identity]

$x = \left(-\frac{5}{9}\right)^{99}$

7. What is the usual form for 2.3×10^{-10}?

Sol. Its usual form will be 0.00000000023.

8. What is the expression for 4^{-3} as a power with the base 2?

Sol. $(4)^{-3} = (2^2)^{-3}$

$= (2)^{-6}$, which is the required expression.

9. Express 16^{-2} as a power with the base 2. **[NCERT Exemplar]**

Sol. $16 = \frac{1}{16^2} = \frac{1}{(2^4)^2} = \frac{1}{2^8}$

I. Short answer type questions.

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

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

$= \frac{1}{\frac{1}{16}} + \frac{1}{\frac{1}{4}} + \frac{1}{\frac{1}{9}}$

$= 16 + 4 + 9$

$= 29$

2. Simplify: $\frac{(-2)^3 \times (-2)^7}{3 \times 4^6}$

Sol. $\frac{(-2)^3 \times (-2)^7}{3 \times 4^6} = \frac{(-2)^{3+7}}{3 \times (2^2)^6}$

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

$= \frac{(-2)^{10}}{3 \times 2^{12}} \{(a^m)^n \times a^{m \times n}\}$

$= \frac{(-2)^{10}}{3 \times 2^{12}} = \frac{2^{10-12}}{3}$

$\{a^m \times a^n = a^{m-n}, (-2)^{10} = 2^{10}\}$

$\frac{2^{-2}}{2} = \frac{1}{3 \times 2^2} = \frac{1}{12}$

3. Find the multiplicative inverse of $(-7)^{-2} \div (90)^{-1}$

Sol. $(-7)^{-2} \div (90)^{-1} = \frac{1}{(-7)^2} \div \frac{1}{90}$

$= \frac{1}{49} \div \frac{1}{90}$

$= \frac{90}{49}$

$Multiplicative\ inverse\ of\ (-7)^{-2} \div (90)^{-1}$

4. Evaluate: $(5^{-1} \times 2^{-1}) \times 6^{-1}$

Sol. $(5^{-1} \times 2^{-1}) \times 6^{-1} = (5 \times 2)^{-1} \times 6^{-1}$

$= (10)^{-1} \times 6^{-1}$

$= (10 \times 6)^{-1}$

$= (60)^{-1} = \frac{1}{60}$

5. Find the value of x, so that

$$\left(\frac{5}{3}\right)^{-2} \times \left(\frac{5}{3}\right)^{-14} = \left(\frac{5}{3}\right)^{8x}$$

Sol. $\left(\frac{5}{3}\right)^{-2} \times \left(\frac{5}{3}\right)^{-14} = \left(\frac{5}{3}\right)^{8x}$

$\left(\frac{5}{3}\right)^{-2+(-14)} = \left(\frac{5}{3}\right)^{8x}$ $\therefore a^m \times a^n = a^{m+n}$

$\left(\frac{5}{3}\right)^{-2+(-14)} = \left(\frac{5}{3}\right)^{8x}$

$\left(\frac{5}{3}\right)^{-16} = \left(\frac{5}{3}\right)^{8x}$

$-16 = 8x$

$x = -2$

6. Express $\frac{1.5 \times 10^6}{2.5 \times 10^{-4}}$ **in the standard form.** **[NCERT Exemplar]**

Sol. $\frac{1.5 \times 10^6}{2.5 \times 10^{-4}} = 0.6 \times 10^{10}$

$= 6 \times 10^{-1} \times 10^{10}$

$= 6 \times 10^{9}$

7. Find the value of n $\frac{2^n \times 2^6}{2^{-3}} = 2^{18}$

Sol. $\frac{2^n \times 2^6}{2^{-3}} = 2^{18}$

$2^n \times 2^6 = 2^{18} \times 2^{-3}$

$2^{n+6} = 2^{18-3}$

$2^{n+6} = 2^{15}$

$n + 6 = 15$

$n = 9$

8. Find x, so that $(-5)^{x+1} \times (-5)^5 = (-5)^7$ **[NCERT Exemplar]**

Sol. $(-5)^{x+1} \times (-5)^5 = (-5)^7$

$(-5)^{x+1+5} = (-5)^7$ $[a^m \times a^n = a^{m+n}]$

$(-5)^{x+6} = (-5)^7$

On both sides, powers have the same base, so their exponents must be equal.

Therefore, $x + 6 = 7$

$x = 7 - 6 = 1$

$x = 1$

9. If $5^{2x+1} \div 25 = 125$, find the value of x.

Sol. Since, $\frac{5^{2x+1}}{25} = 125$

Then $\frac{5^{2x+1}}{5^2} = 5^3$

or $5^{2x+1} \times 5^{-2} = 5^3$

or $5^{2x+1} \times 5^{-2} = 5^3$ $\left[\because \frac{1}{x^n} = x^{-n}\right]$

or $5^{2x-1} = 5^3$ $[\because x^m \times x^n = x^{m+n}]$

Comparing powers

$2x - 1 = 3$

or $2x = 3 + 1$

or $2x = 4$

or $x = \frac{4}{2} = 2$

Hence, $x = 2$

10. By what number should $\left(\frac{1}{2}\right)^{-1}$ be multiplied to that the product is $\left(\frac{-5}{4}\right)^{-1}$?

Sol. Let, the number $= x$

According to problem,

$$x \times \left(\frac{1}{2}\right)^{-1} = \left(\frac{-5}{4}\right)^{-1}$$

or $\quad x \times \frac{2}{1} = \frac{4}{-5}$

or $\quad 2x = \frac{-4}{5}$

or $\quad x = \frac{-4}{5} \times \frac{1}{2} = \frac{-2}{5}$

Hence, required number = $-\frac{2}{5}$

II. Very short answer type questions.

1. Express $\frac{16}{81}$ and $\frac{-8}{27}$ as powers of a rational number. **[NCERT Exemplar]**

Sol. $\frac{16}{81} = \frac{2^4}{3^4} = \left(-\frac{2}{3}\right)^3$

and $\frac{-8}{27} = \frac{(-2)^3}{3^3} = \left(\frac{2}{3}\right)^3$

2. Express as a power of a rational number with negative exponent $\left[\left(\frac{-3}{2}\right)^{-2}\right]^{-3}$ **[NCERT Exemplar]**

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

$$= \left(\frac{-3}{2}\right)^{-2 \times -3} = \left(\frac{-3}{2}\right)^{6}$$

But we have to express the power with negative sign.

Hence, it will become $\left(\frac{-2}{3}\right)^{-6}$.

3. Find the value of x so that $\left(\frac{5}{3}\right)^{-2} \times \left(\frac{5}{3}\right)^{-14} = \left(\frac{5}{3}\right)^{8x}$. **[NCERT Exemplar]**

Sol. $\left(\frac{5}{3}\right)^{-2} \times \left(\frac{5}{3}\right)^{-14} = \left(\frac{5}{3}\right)^{8x}$

$\left(\frac{5}{3}\right)^{-2-14} \times \left(\frac{5}{3}\right)^{8x}$ $\quad [a^m \times a^n = a^{m+n}]$

$\left(\frac{5}{3}\right)^{-16} = \left(\frac{5}{3}\right)^{8x}$

$8x = -16$ $\quad$ (Comparing the exponents)

$x = \frac{-16}{8} = -2.$

4. Find the multiplicative inverse of $(-7)^{-2} \div (90)^{-1}$ **[NCERT Exemplar]**

Sol. $(-7)^{-2} \div (90)^{-1}$

$\frac{1}{(7)^2} \div \frac{1}{90}$ $\quad \left[a^{-m} = \frac{1}{a^m}\right]$

$= \frac{1}{49} \times \frac{90}{1} = \frac{90}{49}$

Hence, the multiplicative inverse will be the reciprocal of it $i.e. \frac{49}{90}$.

5. Express $\frac{1.5 \times 10^6}{2.5 \times 10^{-4}}$ in the standard form. **[NCERT Exemplar]**

Sol. $\frac{1.5 \times 10^6}{2.5 \times 10^{-4}} = \frac{1.5}{2.5} \times 10^6 \times 10^4$

$= 0.6 \times 10^{10} = 6.0 \times 10^9$

6. Express each of the following in standard form. **[NCERT Exemplar]**

i. The mass of a proton in gram is

$\frac{1673}{1000000000000000000000000000}$

ii. Mass of a molecule of hydrogen gas is about

$\frac{1673}{1000000000000000000000000000}$

Sol. i. $\frac{1673}{1000000000000000000000000000}$

$= \frac{1.673 \times 1000}{10^{27}} = 1.673 \times 10^{-24}\, g$

ii. $0.00000000000000000000334$

$= 3.34 \times 10^{-21}$ tons.

7. If $a = -1, b = 2$, then find the value of the following. **[NCERT Exemplar]**

i. $a^b - b^a$ ii. $a^b \div b^a$

Sol. i. $a^b - b^a = (-1)^2 - (2)^{-1} = 1 - \frac{1}{2} = \frac{1}{2}$

ii. $a^b \div b^a = (-1)^2 \div (2)^{-1}$

$= 1 \div \frac{1}{2} = 1 \times \frac{2}{1} = 2$

8. By what number should we multiply $(-29)^0$ so that the product becomes $(+29)^0$?

[NCERT Exemplar]

Sol. Since any base having exponent 0 is equal to 1

$\therefore (-29)^0$ *and* $(+29)^0 = 1$

$\Rightarrow$ 1 and product of a number equal 1

$\therefore 1 \times 1 = 1$

Hence 1 is the required number.

9. Express $\frac{400}{3969}$ in exponential form.

Sol. $400 = 2 \times 2 \times 2 \times 2 \times 5 \times 5 = 4^2 \times 5^2$

$3696 = 3 \times 3 \times 3 \times 3 \times 7 \times 7 = 9^2 \times 7^2$

$$\therefore \frac{400}{3969} = \frac{4^2 \times 5^2}{9^2 \times 7^2} = \frac{(4 \times 5)^2}{(9 \times 7)^2}$$

$$= \left(\frac{4 \times 5)}{9 \times 7}\right)^2 = \left(\frac{20}{63}\right)^2$$

I. Long answer type questions.

1. Simplify:

a. $\left(\left(\frac{2}{3}\right)^3\right)^3 \times \left(\frac{1}{2}\right)^{-4} \times 3^{-1} \times \frac{1}{6}$

b. $\frac{49 \times z^{-3}}{7^3 \times 10 \times z^{-5}}\ (z \neq 0)$ **[NCERT Exemplar]**

Sol. a. $\left(\left(\frac{2}{3}\right)^3\right)^3 \times \left(\frac{1}{2}\right)^{-4} \times 3^{-1} \times \frac{1}{6}$

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

$$= \left(\frac{9}{4}\right)^3 \times 81 \times \frac{1}{3} \times \frac{1}{6}$$

$$= \frac{729}{64} \times 81 \times \frac{1}{3} \times \frac{1}{6}$$

$$= \frac{243 \times 27}{128} = \frac{(3)^5 \times (3)^3}{2^7} = \frac{3^8}{2^7}$$

b. $\frac{49 \times z^{-3}}{7^{-3} \times 10 \times z^{-5}}(z \neq 0)$

$$= \frac{7^2 \times 7^3 \times z^{-3} \times z^5}{10}$$

$$= \frac{7^{\,2+3} \times z^{5-3}}{10} = \frac{7^5 \times z^2}{10}$$

2. Find x, so that $\left(\frac{2}{9}\right)^3 \times \left(\frac{2}{9}\right)^{-6} = \left(\frac{2}{9}\right)^{2x-1}$

Sol. $\left(\frac{2}{9}\right)^3 \times \left(\frac{2}{9}\right)^{-6} = \left(\frac{2}{9}\right)^{2x-1}$

$\left(\frac{2}{9}\right)^{3+(-6)} = \left(\frac{2}{9}\right)^{2x-1}$ $[a^m \times a^n = a^{m=n}]$

$\left(\frac{2}{9}\right)^{-3} = \left(\frac{2}{9}\right)^{2x-1}$

$-3 = 2x - 1$

$-3 + 1 = 2x$

$2x = -1$

$x = -1$

3. $\boldsymbol{If\ \frac{5^m \times 5^3 5^{-2}}{5^{-5}} = 5^{12}, find\ m.}$

Sol. $\frac{5^m \times 5^3 5^{-2}}{5^{-5}} = 5^{12}$

$5^m \times 5^3 - 5^{-2} \times 5^5 = 5^{12}$

$5^m \times 5^{3-2+5} = 5^{12}$

$5^m \times 5^6 = 5^{12}$

$m + 6 = 12 - 6$

$m = 6$

4. Simplify: $\left(\frac{1}{5}\right)^{45} \times \left(\frac{1}{5}\right)^{-60} - \left(\frac{1}{5}\right)^{+28} \times \left(\frac{1}{5}\right)^{-43}$

Sol. $\left(\frac{1}{5}\right)^{45} \times \left(\frac{1}{5}\right)^{-60} - \left(\frac{1}{5}\right)^{+28} \times \left(\frac{1}{5}\right)^{-43}$

$\Rightarrow \left(\frac{1}{5}\right)^{45-60} - \left(\frac{1}{5}\right)^{28-43}$

$\Rightarrow \left(\frac{1}{5}\right)^{45-60} - \left(\frac{1}{5}\right)^{28-43}$

$\Rightarrow \left(\frac{1}{5}\right)^{-15} - \left(\frac{1}{5}\right)^{-15}$

$\Rightarrow (5)^{15} - (5)^{-15}$

$\Rightarrow 0$

5. By what number should $(-8)^{-3}$ be multiplied so that the product may be equal to $(-6)^{-3}$?

Sol. Let the number be x

$(-8)^{-3} \times x = (-6)^{-3}$

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

$\frac{1}{512} \times x = \frac{1}{216}$

$x = \frac{512}{216}$

$x = \frac{64}{27}$

6. Simplify: $\frac{(3^{-2})^2 \times (5^2)^2 \times (t^{-3})^2}{(3^{-2})^5 \times (5^3)^{-2} \times (t^{-4})^3}$

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

$= \frac{(3)^{-4} \times (5)^{-6} \times (t)^{-6}}{(3)^{-10} \times (5)^{-6} \times (t)^{-12}}$

$= (3)^{-4} \times (3)^{10} \times (5)^{-6} \times (5)^{6} \times (t)^{-6} \times (t)^{12}$

$= (3)^6 \times (5)^{-6+6} \times t^{-6+12}$

$= (3)^6 \times (5)^0 \times (t)^6$

$= 729\, t^6$

7. Simplify : $\frac{2^{-5} \times 3^{-5} \times 125}{5^{-4} \times 6^{-5}}$

Sol. Since, $125 = 5 \times 5 \times 5 = 5^3$

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

$\therefore \quad \frac{2^{-5} \times 3^{-5} \times 125}{5^{-4} \times 6^{-5}} = \frac{2^{-5} \times 3^{-5} \times 5^3}{5^{-4} \times 2^{-5} \times 3^{-5}}$

$= \frac{2^{-5}}{2^{-5}} \times \frac{3^{-5}}{3^{-5}} 1 \times 1 \times 5^7$

= 5 x 5 x 5 x 5 x 5 x 5 x 5

= 78125

8. Find x

a. $\left(\frac{2}{5}\right)^{2x+6} \times \left(\frac{2}{5}\right)^3 = \frac{2^{x+2}}{5}$

b. $2^x + 2^x + 2^x = 192$

Sol. a. $\left(\frac{2}{5}\right)^{2x+6} \times \left(\frac{2}{5}\right)^3 = \left(\frac{2}{5}\right)^{x+2}$

$\left(\frac{2}{5}\right)^{2x+6+3} = \left(\frac{2}{5}\right)^{x+2}$

$\left(\frac{2}{5}\right)^{2x+9} = \left(\frac{2}{5}\right)^{x+2}$

$2x + 9 = x + 2$

$2x - x = 2 - 9$

$x = -7$

b. $2^x + 2^x + 2^x = 192$

$2^x\,(1 + 1 + 1) = 192$

$2^x = \frac{192}{3}$

$2^x = 64$

$2^x = (2)^6$

$x = 6$

9. Simplify:

a. $\left(\frac{4}{13}\right)^4 \times \left(\frac{13}{2}\right)^2 \times \left(\frac{7}{4}\right)^3$

b. $\left(\frac{4}{13}\right)^4 \times \left(\frac{13}{2}\right)^2 \times \left(\frac{7}{4}\right)^3$

Sol. a. $\left(\frac{4}{13}\right)^4 \times \left(\frac{13}{2}\right)^2 \times \left(\frac{7}{4}\right)^3$

$= \frac{4 \times 4 \times 4 \times 4}{13 \times 13 \times 13 \times 13} \times \frac{13 \times 13}{7 \times 7} \times \frac{7 \times 7 \times 7}{4 \times 4 \times 4}$

$= \frac{4 \times 7}{13 \times 13} \times \frac{28}{169}$

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

10. By what number should $\left(-\frac{3}{2}\right)^2$ be divided so that the quotient is $\left(\frac{9}{4}\right)^{-2}$?

Sol. Let the required number = x

According to problem,

$$\left(-\frac{3}{2}\right)^2 \div x = \left(\frac{9}{4}\right)^{-2}$$

or $\left(\frac{2}{-3}\right)^3 \div x = \left(\frac{4}{9}\right)^2$

or $\frac{8}{-27} \times x^{-1} = \frac{16}{81}$ $\left[\because \frac{1}{x^a} = x^{-a}\right]$

or $x^{-1} = \frac{16}{81} \times \frac{-27}{8}$

or $x^{-1} = \frac{-2}{3}$

or $\frac{1}{x} = \frac{-2}{3}$

or $\frac{1}{x} = \frac{-2}{3}$

or $x = \frac{-3}{2}$

Hence, required number = $\frac{-3}{2}$

II. Long answer type questions.

1. Simplify:

i. $\left[\left(\frac{2}{3}\right)^{-2}\right]^3 \times \left(\frac{1}{3}\right)^{-4} \times 3^{-1} \times \frac{1}{6}$

ii. $\frac{49 \times z^{-3}}{7^{-3} \times 10 \times z^{-5}}$ $(z \neq 0)$

Sol. i. $\left[\left(\frac{2}{3}\right)^{-2}\right]^3 \times \left(\frac{1}{3}\right)^{-4} \times 3^{-1} \times \frac{1}{6}$

$= \left(\frac{-2}{3}\right)^{-6} \times (3^{-1})^{-4} \times 3^{-1} \times \frac{1}{2 \times 3}$

$= \left(\frac{-2}{3}\right)^{-6} \times (3)^6 \times 3^4 \times 3^{-1} \times 3^{-1} \times 2^{-1}$

$= (2)^{-6-1} \times (3)^{6+4-1-1}$ $[\therefore (-2)^m = (2)^m \text{ if } m \text{ is even}]$

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

ii. $\frac{49 \times z^{-3}}{7^{-3} \times 10 \times z^{-5}} (z \neq 0)$

$= \frac{7^2 \times 7^3 \times z^{-3}}{10} \times z^5 = \frac{7^5 z^2}{10}$

2. By what number should $(-8)^{-3}$ be multiplied so that the product may be equal to $(-6)^{-3}$?

[NCERT Exemplar]

Sol. Let the required number be x

$(-8)^{-3} \times x = (-6)^{-3}$

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

$x = \left(-\frac{1}{6}\right)^3 \div \left(\frac{-1}{8}\right)^3 = \left(-\frac{1}{6}\right)^3 \times (-8)^3$

$= \left(-\frac{1}{6} \times -8\right)^3$ $(a^m \times b^m = (ab)^m)$

$$x = \left(\frac{8}{6}\right)^3 = \left(\frac{4}{3}\right)^3 = \frac{64}{27}$$

3. By what number should $\left(\frac{4}{3}\right)^3$ be multiplied, so that the product may be equal to $\left(\frac{-3}{8}\right)^{-3}$?

Sol. Let required number be x.

Now, according to question

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

Dividing both sides by $\left(\frac{1}{2}\right)^3$, we get

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

$\Rightarrow x = \left(\frac{8}{-3}\right)^3 \div \left(\frac{1}{2}\right)^3$ $\quad \left[\because \left(\frac{p}{q}\right)^{-m} = \left(\frac{q}{p}\right)^m\right]$

$\Rightarrow x = \left(\frac{8}{-3}\right)^3 \div \left(\frac{1}{2}\right)^3$ $\quad [\because (-a)^n = -a^n, \text{where } n \text{ is odd}]$

$\Rightarrow x = -\frac{8 \times 8 \times 8}{3 \times 3 \times 3} \div \frac{1}{2 \times 2 \times 2} \Rightarrow x = \frac{8 \times 8 \times 8}{3 \times 3 \times 3} \times \frac{2 \times 2 \times 2}{1}$

$\Rightarrow x = -\left(\frac{16}{3}\right)^3$

4. Mass of Mars is 6.42 x 10^{29}kg and mass of the Sun is 1.99 x 10^{30} kg. What is their total mass?

Sol. Given

Mass of Mars = 6.42 x 10^{29} kg

Mass of the Sun = 1.99 x 10^{30} kg

Converting the standard form into number with the same exponent, we get

Mass of Mars = 6.42 x 10^{29} kg

Mass of the Sun = 1.99 x 10^{30} kg = 1.99 x 10^{29} x 10 kg

∴ Total mass = 6.42 x 10^{29} kg + 1.99 x 10^{29} x 10 kg

= (6.42 + 1.99 x 10) x 10^{29} kg

= 26.32 x 10^{29} kg

5. Divide 256 by 10,00,000 and express the result in standard form.

Sol. We have, $\frac{256}{10,00,000}$

= 256 x 10^{-6}

= 2.56 x 102 x 10^{-6} = 2.56 x 10^{-4}

I. Higher Order Thinking Skills.

1. By what number should $\left(\frac{-3}{2}\right)^{-3}$ be divided so that the quotient may be $\left(\frac{4}{27}\right)^{-4}$?

Sol. Let the required number be x.

Then, $\left(\frac{-3}{2}\right)^{-3} \div x = \left(\frac{4}{27}\right)^{-2}$

$$\left(\frac{2}{3}\right)^{3} \div x = \left(\frac{27}{4}\right)^{2}$$

$$\frac{8}{-27} \times \frac{1}{x} = \left(\frac{27}{4}\right)^{2}$$

$$\frac{1}{x} = \frac{-27}{8} \times \frac{(27)^2}{4^2}$$

$$= \frac{-1 \times (27) \times (27)^2}{2 \times (4) \times (4)^2}$$

$$\frac{1}{x} = \frac{-(27)^3}{2(4)^3}$$

$$x = -2 \times \left(\frac{4}{27}\right)^{3}$$

II. Higher Order Thinking Skills.

1. The size of a red blood cell is 0.000007 m and the size of a plant cell is 0.00001275 m. Compare these two.

Sol. We have,

Size of red blood cell = 0.000007 m = 7 x 10^{-6} m

Size of plant cell = 0.00001275 = 1.275 x 10^{-5} m

$$\therefore \quad \frac{\textit{Size of red blood cell}}{\textit{Size of plant cell}} = \frac{7 \ x\ 10^{-6}}{1.275 \times 10^{-5}} = \frac{7 \ x\ 10^{-6+5}}{1.275} = \frac{7 \ x\ 10^{-1}}{1.275}$$

$$= \frac{0.7}{1.275} = \frac{0.7}{1.3} = \frac{1}{2}$$

So, a red blood cell is approximately half of a plant cell in size.

2. By what number should $\left(\frac{-3}{2}\right)^{-3}$ be divided so that the quotient may be $\left(\frac{4}{27}\right)^{-2}$?

Sol. Let the required number be x. Then

$$\left(\frac{-3}{2}\right)^{-3} \div x = \left(\frac{4}{27}\right)^{-2}$$

$\Rightarrow \quad \left(\frac{-3}{2}\right)^{-3} \times \frac{1}{x} = \left(\frac{4}{27}\right)^{-2} \qquad \Rightarrow \quad x = \left(\frac{-3}{2}\right)^{-3} \div \left(\frac{4}{27}\right)^{-2}$

$\Rightarrow \quad x = \left(\frac{2}{-3}\right)^{3} \times \left(\frac{4}{27}\right)^{2} = \qquad \left[\because \left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^{n}\right]$

$\Rightarrow \quad x = \left(\frac{2}{-3}\right)^{3} \times \left(\frac{4}{27}\right)^{2} = \left(\frac{2}{-3}\right)^{3} \times \left(\frac{2^2}{3^3}\right)^{2}$

$\Rightarrow \quad x = \frac{2^3}{(-3)^3} \ x\ \frac{2^4}{3^6} = \frac{2^{3+4}}{(-3)^3 \times (-3)^6}$

$$\frac{2^7}{(-3)^9} = \frac{-2^7}{3^9} = \frac{(-2)^7}{3^9}$$

3. What is the value of $\left(x^{\frac{b+c}{c-a}}\right)^{\frac{1}{a-b}}\left(x^{\frac{c+a}{a-b}}\right)^{\frac{1}{b-c}}\left(x^{\frac{a+b}{b-c}}\right)^{\frac{1}{c-a}}$?

Sol. $\left(x^{\frac{b+c}{c-a}}\right)^{\frac{1}{a-b}}\left(x^{\frac{c+a}{a-b}}\right)^{\frac{1}{b-c}}\left(x^{\frac{a+b}{b-c}}\right)^{\frac{1}{c-a}}$

$= \frac{b}{x} + \frac{c}{a} + \frac{a}{b} = \frac{b}{x}$

$= \frac{b}{x} = \frac{0}{x}$

$= x^0 = 1$

I. Value Based Questions.

1. (a) Find the value of $\left[\left\{\left(\frac{1}{2}\right)^2\right\}^{-2}\right]^{-1}$

(b) Planet A is at a distance of 9.35×10^6 km from Earth and Planet B is 6.27×10^7 km from Farth. Which Planet is nearer to earth.

Sol. (a) $\left[\left\{\left(\frac{1}{2}\right)^2\right\}^{-2}\right]^{-1} = \left[\left(\frac{1}{4}\right)^{-2}\right]^{-1}$

$= \left[\left(\frac{4}{1}\right)^2\right]^{-1}$ $\left\{\because \frac{1}{x^a} = x^{-a}\right\}$

$= [16]^{-1}$

$= \frac{1}{16}$

(b) Distance between planet A and earth

$= 9.35 \times 10^6$ km

$= 0.935 \times 10^7$ km

Distance between planet B and earth

= 6.27 x 107 km

By changing both distances in the same exponent

We can say planet A is nearer to earth.

2. (a) Find the value of x for which

$$\left(\frac{4}{9}\right)^4 \times \left(\frac{4}{9}\right)^{-7} = \left(\frac{4}{9}\right)^{2x-1}$$

(b) Find the value of $\left(\frac{3}{5}\right)^0 + \left(\frac{125}{129}\right)^0 + \left(\frac{10}{7}\right)^0$

Sol. (a) Since,

$$\left(\frac{4}{9}\right)^4 \times \left(\frac{4}{9}\right)^{-7} = \left(\frac{4}{9}\right)^{2x-1}$$

or $\left(\frac{4}{9}\right)^{4+(-7)} = \left(\frac{4}{9}\right)^{2x-1}$

or $\left(\frac{4}{9}\right)^{-3} = \left(\frac{4}{9}\right)^{2x-1}$

By comparing with power then,

$-3 = 2x - 1$

or $2x = -3 + 1$

or $2x = -2$

or $x = -\frac{2}{2} = -1$

Hence, $x = -1$

(b) Since, $\left(\frac{3}{5}\right)^0 + \left(\frac{125}{129}\right)^0 + \left(\frac{10}{7}\right)^0$

= 1 + 1 + 1 = 3,

$[\because x^0 = 1]$

3. The cells of a bacteria doubles in every 20 min. A scientist begins with a single cell.

(a) Now many cells will be there after

i. 10 h ? **ii. 25 h ?**

(b) What type of value is depicted by the cells of bacteria ?

Sol. (a) (i) The cell, in bacteria double in every 20 min.

∵ Number of cells in a bacteria after 20 min. = 2

∴ Number of cells in a bacteria after 40 min.

$= 2 \times 2 = 2^2$

∴ Number of cells in a bacteria after 1 hr

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

Number of cells in bacteria after 1 hr 40 min.

$= 2^4 \times 2 = 2^5$

Number of cells in bacteria after 2 hrs

$= 2^5 \times 2 = 2^6$

$= (2^3)^2$

∴ Number of cells in bacteria after 0 hrs

$= (2^3)^{25} = 2^{75}$

(b) The value depicted by the cells of bacteria here is that is double itself after 20 min. in t hrs by $2^{3\times t}$.