$= 5.2 \times 10^{14} \left(\frac{1-10}{10}\right) = -46.8 \times 10^{?}$

(c) Dinesh did not try to solve the ~~two~~ expression.

MENTAL MATHS

Write T for true and F for false statements :

1. **In the exponential notation, we cannot interchange base and exponent.** T
2. **For any rational number** $\frac{x}{y}$, $\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}$. T
3. $(-1)^{\text{an even integer}} = -1$. F
4. $\left[\left(\frac{p}{q}\right)^m\right]^n = \left(\frac{p}{q}\right)^{m+n}$. F
5. $\left(\frac{p}{q}\right)^0 = 1$. T
6. $x^{-m} = \frac{1}{x^m}$. T
7. $\left[\left(\frac{2}{3}\right)^{-2}\right]^4$ **when expressed with a positive exponent, we get** $\left(\frac{3}{2}\right)^8$. T
8. **The value of** $(5^0 - 4^0) \times 3^0 = 1$. F
9. **The value of** $\left[(-2)^{-1}\right]^{-1}$ **is** -2. T
10. 0.000000000025 **can be expressed as** 2.5×10^{-11}. T

VALUE BASED QUESTIONS

1. The people of the town Hamidpur always use ecofriendly devices to fullfil their energy needs. They always try to use renewable sources of energy. For irrigation purposes, they use solar powered water pumps. A solar powered water pump system in Hamidpur has two solar pannels, each containing 6 rows of modules, each row has 6 modules. How many modules are in each pannel. Here what value is depicted by the people of Hamidpur?

Sol. Number of modules in each pannels

$= 6 \times 6 = 36$.

Any natural resource that can be replenished naturally with the passage of time. Not harmful to the environment.

2. Ms Kulkarni is a maths teacher. One day she gave the following question to her students.

Express 0.000000000000052 in the standard form.

Manish wrote the given number as 5.2×10^{-15}. His friend Dinesh did not try to solve it, but just copied the answer from the Manish's notebook. While checking the answers Ms Kulkarni immediately realised what has happened. She asked the boys to tell the truth. Dinesh immediately told the truth.

(a) Can you express the given number in the standard form?

(b) What is the difference between the correct answer and the Manish's answer?

(c) Here which value is depicted by Dinesh?

(d) As per your opinion what kind of boy is Manish?

Sol. (a) 5.2×10^{-14}.

(b) Required difference $= 5.2 \times 10^{-15} - 5.2 \times 10^{-14}$

$= 5.2 \times 10^{-14} \left(\frac{1-10}{10}\right) = -46.8 \times 10^{-15}$.

(c) Dinesh did not try to solve the expression.

MULTIPLE CHOICE QUESTIONS

Tick (✓) the correct option :

1. The value of $\left(\frac{-4}{5}\right)^0$ is :

(a) 0 (b) 1 (c) $-\frac{4}{5}$ (d) $\frac{4}{5}$

2. The value of $\left(\frac{1}{-3}\right)^2$ is :

(a) $\frac{1}{9}$ (b) $-\frac{1}{9}$ (c) -9 (d) 9

3. The value of $1^0 + 2^0 + 3^0 + \ldots + 10^0$ is :

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

4. If n is an odd positive integer, then $(-1)^n$ is equal to :

(a) 1 (b) -1 (c) 0 (d) none of these

5. Which of the following is not equal to $\frac{8}{-27}$?

(a) $\left(\frac{-2}{3}\right) \times \left(\frac{-2}{3}\right) \times \left(\frac{-2}{3}\right)$ (b) $\left(\frac{-2}{3}\right)^3$

(c) $-\left(\frac{2}{3}\right)^3$ (d) $\left(\frac{2}{3}\right)^{-3}$

6. $\left(\frac{5}{7}\right)^{-2}$ is same as :

(a) $\left(\frac{-5}{7}\right)^2$ (b) $\left(\frac{5}{7}\right)^2$ (c) $\left(\frac{7}{5}\right)^2$ (d) $\left(\frac{7}{5}\right)^{-2}$

7. $\left(\frac{-3}{2}\right)^{-1}$ is equal to :

(a) $\frac{2}{3}$ (b) $\frac{-2}{3}$ (c) $\frac{3}{2}$ (d) none of these

8. For a non-zero rational number x, $\left(x^3\right)^{-2}$ is equal to :

(a) x^6 (b) x^{-6} (c) x^{-5} (d) x^5

9. The value of $\left(4^{-1} - 5^{-1}\right)^{-1} - \left(2^{-1} - 3^{-1}\right)^{-1}$ is :

(a) 10 (b) $\frac{1}{14}$ (c) 14 (d) 15

10. The expression $\frac{0.00085}{730 + 270}$ in the standard form is :

(a) 8.5×10^{-6} (b) 8.5×10^{-7} (c) 8.5×10^{-5} (d) 8.5×10^{-4}

Sol. (i) $0.00000007 = 7 \times 10^{-8}$.

(ii) $0.0000000000000036 = 3.6 \times 10^{-13}$.

(iii) $0.00000003486 = 3.486 \times 10^{-8}$.

(iv) $0.000000000040b = 4.0b \times 10^{-11}$.

(v) $0.000000036 = 3.6 \times 10^{-8}$.

(vi) $0.000000000000128 = 1.28 \times 10^{-13}$.

2. Express the following in the usual form :

(i) 2.1×10^{-7} (ii) 5.07×10^{-8} (iii) 4.932×10^{-12}

(iv) 1.35×10^{-15} (v) 7.03×10^{-9} (vi) 4.132×10^{-10}

Sol. (i) $2.1 \times 10^{-7} = 0.00000021$.

(ii) $5.07 \times 10^{-8} = 0.000000507$.

(iii) $4.932 \times 10^{-12} = 0.000000000004932$.

(iv) $1.35 \times 10^{-15} = 0.00000000000000135$.

(v) $7.03 \times 10^{-9} = 0.000000007703$.

(vi) $4.132 \times 10^{-10} = 0.000000000 4132$.

3. Express the numbers appearing in the following statements in standard form :

(i) Average diameter of a red blood cell is 0.000007 mm.

(ii) The size of a plant cell is 0.00001275 m.

(iii) Thickness of a piece of paper is 0.000016 m.

(iv) Charge of an electron is 0.00000000000000000016 coulomb.

(v) Mass of an electron is 0.000000000000000000000000009 g.

Sol. (i) $0.000007 \text{ mm} = 7 \times 10^{-6}$ mm

(ii) $0.00001275 \text{ m} = 1.275 \times 10^{-5}$ m

(iii) $0.000016 \text{ m} = 1.6 \times 10^{-5}$ m

(iv) $0.00000000000000000016 \text{ coulomb} = 1.6 \times 10^{-19}$ coulomb.

(v) $0.000000000000000000000000009 \text{ g} = 9 \times 10^{-28}$ g

4. Diameter of a wire on a computer chip is 3×10^{-6} m. Express it in the usual form.

Sol. Diameter of a wire on a computer chip $= 3 \times 10^{-6}$ m

Usual form $= 0.000003$ m.

21. Find the value of m if $5^{m-3} \times 3^{2m-8} = 225$ [HOTS]

Sol. $5^{m-3} \times 3^{2m-8} = 225$

$\Rightarrow 5^m \times 5^{-3} \times 3^{2m} \times 3^{-8} = 5^2 \times 3^2$

$\Rightarrow \frac{5^m}{5^3} \times \frac{3^{2m}}{3^8} = 5^2 \times 3^2$

$\Rightarrow 5^m \times (3^2)^m = 5^2 \times 5^3 \times 3^2 \times 3^8$

$\Rightarrow 5^m \times 9^m = 5^{2+3} \times 3^{2+8} = 5^5 \times 3^{10}$

$\Rightarrow (5\times9)^m = 5^5 \times (3^2)^5 = (5\times9)^5$

$\Rightarrow (45)^m = (45)^5$

$\Rightarrow m = 5.$

EXERCISE 2.3

1. Express the following numbers in the standard form :

(i) 0.00000007 (ii) 0.00000000000036 (iii) 0.00000003486
(iv) 0.0000000000408 (v) 0.000000036 (vi) 0.000000000000128

Sol. (i) $0.00000007 = 7 \times 10^{-8}$.

(ii) $0.00000000000036 = 3.6 \times 10^{-13}$.

(iii) $0.00000003486 = 3.486 \times 10^{-8}$.

(iv) $0.0000000000408 = 4.08 \times 10^{-11}$.

(v) $0.000000036 = 3.6 \times 10^{-8}$.

(vi) $0.000000000000128 = 1.28 \times 10^{-13}$.

Hence, the reciprocal of the number $\left(\frac{3}{4}\right)^{-2} \times \left[\left(\frac{-3}{16}\right)^{-3}\right]^2 = \left(\frac{3}{4}\right)^{10}$.

18. Find $\left(\frac{p}{q}\right)^{-2}$, if $\left(\frac{3}{5}\right)^{-6} \times \left(\frac{10}{9}\right)^{-6} = \left(\frac{p}{q}\right)^{-6}$.

Sol. $\left(\frac{3}{5}\right)^{-6} \times \left(\frac{10}{9}\right)^{-6} = \left(\frac{p}{q}\right)^{-6}$

$\Rightarrow \left(\frac{3}{5} \times \frac{10}{9}\right)^{-6} = \left(\frac{p}{q}\right)^{-6} \Rightarrow \frac{p}{q} = \frac{\cancel{3}^{1}}{\cancel{5}_{1}} \times \frac{\cancel{10}^{2}}{\cancel{9}_{3}}$

$\Rightarrow \frac{p}{q} = \frac{2}{3} \Rightarrow \left(\frac{p}{q}\right)^{-2} = \left(\frac{2}{3}\right)^{-2} = \left(\frac{3}{2}\right)^{2} = \frac{9}{4}$.

19. Find the value of m, if $\left(\frac{7}{11}\right)^{2m} \times \left(\frac{11}{7}\right)^{4} = \left(\frac{49}{121}\right)^{-3}$.

Sol. $\left(\frac{7}{11}\right)^{2m} \times \left(\frac{11}{7}\right)^{4} = \left(\frac{49}{121}\right)^{-3}$

$\Rightarrow \left(\frac{7}{11}\right)^{2m} \times \left(\frac{7}{11}\right)^{-4} = \left[\left(\frac{7}{11}\right)^{2}\right]^{-3}$

$\Rightarrow \left(\frac{7}{11}\right)^{2m-4} = \left(\frac{7}{11}\right)^{-6} \Rightarrow 2m-4 = -6$

$\Rightarrow 2m = -6+4 = -2 \Rightarrow m = -1$.

20. By what number should $\left(\frac{4}{5}\right)^{-2}$ be divided so that the quotient is 125?

Sol. ~~Let x be the required number.~~

$\Rightarrow \left(\frac{4}{5}\right)^{-2} \div x = 125 \Rightarrow \left(\frac{5}{4}\right)^{2} \times \frac{1}{x} = 125$

$\Rightarrow x = \frac{5 \times 5}{4 \times 4 \times 125} = \frac{1}{80}$.

Hence, the required number is $\frac{1}{80}$.

15. By what number should $\left(\frac{4}{3}\right)^{-3}$ be divided so that the quotient is $\left(\frac{16}{9}\right)^{-2}$?

Sol. Let x be the number.

$$\Rightarrow \left(\frac{4}{3}\right)^{-3} \div x = \left(\frac{16}{9}\right)^{-2}$$

$$\Rightarrow \left(\frac{3}{4}\right)^{3} \times \frac{1}{x} = \left(\frac{9}{16}\right)^{2} \Rightarrow x = \frac{1}{\cancel{3}} \times \frac{\cancel{3}}{\cancel{4}} \times \frac{\cancel{4}}{\cancel{4}} \times \frac{\cancel{16}}{\cancel{9}} \times \frac{\cancel{9}}{\cancel{16}}$$

$$\Rightarrow x = \frac{4}{3}.$$

Hence, the required number is $\frac{4}{3}$.

16. By what number should $(-5)^{-3}$ be multiplied to get $\left(\frac{1}{5}\right)^{2}$?

Sol. Let x be the required number.

$$\Rightarrow (-5)^{-3} \times x = \left(\frac{1}{5}\right)^{2}$$

$$\Rightarrow x = \frac{1}{5^2} \div (-5)^{-3} = \frac{1}{5^2} \times \frac{1}{(-5)^{-3}}$$

$$\Rightarrow x = \frac{1}{5^2} \times (-5)^{3} = (-1)^{3} \times 5^{3-2} = -5$$

Hence, the required number is -5.

17. Find the reciprocal of the number $\left(\frac{-3}{4}\right)^{-2} \times \left[\left(\frac{-9}{16}\right)^{-3}\right]^{2}$ [NOTS]

Sol. $\left(\frac{-3}{4}\right)^{-2} \times \left[\left(\frac{-9}{16}\right)^{-3}\right]^{-2} = \left(\frac{-4}{3}\right)^{2} \times \left[\left(\frac{-16}{9}\right)^{3}\right]^{-2}$

$$= \left(\frac{-4}{3}\right)^{2} \times \left[\left(\frac{-16}{9}\right)^{-6}\right] = \left(\frac{-4}{3}\right)^{2} \times \left(\frac{9}{-16}\right)^{6}$$

$$= +\frac{\cancel{4}}{\cancel{3}} \times +\frac{\cancel{4}}{\cancel{3}} \times \frac{\cancel{9}}{\cancel{+16}} \times \frac{9}{+16} \times \frac{9}{+16} \times \frac{9}{+16} \times \frac{9}{+16} \times \frac{9}{+16} = \left(\frac{9}{16}\right)^{5} = \left(\frac{3}{4}\right)^{10}.$$

$\Rightarrow \left(\frac{-4}{7}\right)^2 \times x = \left(\frac{49}{16}\right)^{-2} \Rightarrow x = \frac{16}{49} \times \frac{16}{49} \times \frac{7}{4} \times \frac{7}{4}$

$\Rightarrow x = \left(\frac{4}{7}\right)^2$. Hence, the required number is $\left(\frac{4}{7}\right)^2$.

12. **By what number should $(3)^{-2}$ be divided to get $(9)^{-3}$?**

Sol. Let x be the required number.

$$(3)^{-2} \div x = (9)^{-3} \Rightarrow \frac{1}{3^2} \div x = \frac{1}{9^3}$$

$$\Rightarrow x = \frac{9^3}{3^2} = \frac{9 \times 9 \times 9}{3 \times 3} = 9^2 = (3^2)^2 = 3^4 = 81$$

Hence, the required number is $3^4 = 81$.

13. **The product of two numbers is $\left(\frac{2}{5}\right)^{-3}$. If one of them is $\left(\frac{5}{4}\right)^{-2}$, find the other.**

Sol. Let the other number be x.

$$\Rightarrow x \times \left(\frac{5}{4}\right)^{-2} = \left(\frac{2}{5}\right)^{-3}$$

$$\Rightarrow x \times \left(\frac{4}{5}\right)^2 = \left(\frac{5}{2}\right)^3$$

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

$$\Rightarrow x = \frac{5^5}{2^3 \times 2^4} = \frac{5^5}{2^7}.$$

Hence, the required number is $\frac{5^5}{2^7}$.

14. **If $(3^{2x+1} + 9) \div 9 = 10$, find the value of x.** [HOTS]

Sol. $\left(3^{2x+1} + 9\right) \div 9 = 10 \Rightarrow 3^{2x+1} + 9 = 10 \times 9$

$$\Rightarrow 3^{2x+1} = 90 - 9 = 81 \Rightarrow 3^{2x+1} = 3^4$$

$$\Rightarrow 2x + 1 = 4 \Rightarrow 2x = 3 \Rightarrow x = \frac{3}{2}.$$

8. Find the value of x for which $\left(\frac{5}{8}\right)^{-2} \times \left(\frac{5}{8}\right)^{-4} = \left(\frac{5}{8}\right)^{3x+3}$.

Sol. $\left(\frac{5}{8}\right)^{-2} \times \left(\frac{5}{8}\right)^{-4} = \left(\frac{5}{8}\right)^{3x+3}$

$\Rightarrow \left(\frac{5}{8}\right)^{-2-4} = \left(\frac{5}{8}\right)^{3x+3} \Rightarrow \left(\frac{5}{8}\right)^{-6} = \left(\frac{5}{8}\right)^{3x+3}$

$\Rightarrow -6 = 3x+3 \Rightarrow 3x = -6-3 = -9$

$\Rightarrow x = -3.$

[HOTS]

9. Find the value of x for which $6^{2x+1} \div 36 = 216$.

Sol. $6^{2x+1} \div 36 = 216 \Rightarrow 6^{2x+1} \div 6^2 = 6^3$

$\Rightarrow 6^{2x+1-2} = 6^3 \Rightarrow 6^{2x-1} = 6^3$

$\Rightarrow 2x-1 = 3 \Rightarrow 2x = 4 \Rightarrow x = 2.$

10. If $5^{4x} \times 5^{-2x} = 125 \times 5^x$, find x.

Sol. $5^{4x} \times 5^{-2x} = 125 \times 5^x$

$\Rightarrow 5^{4x-2x} = 5^3 \times 5^x \Rightarrow 5^{2x} = 5^{3+x}$

$\Rightarrow 2x = 3+x \Rightarrow 2x-x = 3$

$\Rightarrow x = 3.$

11. By what number should $\left(\frac{-4}{7}\right)^2$ be multiplied to get $\left(\frac{49}{16}\right)^{-2}$?

Sol. let x be the required number.

$\Rightarrow \left(\frac{-4}{7}\right)^2 \times x = \left(\frac{49}{16}\right)^{-2} \Rightarrow x = \frac{4}{49} \times \frac{49}{16} \times \frac{x}{4} \times \frac{x}{4}$

$\Rightarrow x = \left(\frac{4}{7}\right)^2$. Hence, the required number is $\left(\frac{4}{7}\right)^2$.

5. If $\frac{x}{y}=\left(\frac{2}{3}\right)^{-2}\times\left(\frac{3}{5}\right)^{-2}$, find $\left(\frac{y}{x}\right)^{-1}$. [HOTS]

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

$\frac{x}{y}=\frac{3}{2}\times\frac{3}{2}\times\frac{5}{3}\times\frac{5}{3}=\frac{5\times5}{2\times2}=\left(\frac{5}{2}\right)^{2}$

$\frac{y}{x}=\left(\frac{2}{5}\right)^{+2}\Rightarrow\left(\frac{y}{x}\right)^{-1}=\left(\frac{2}{5}\right)^{-2}=\left(\frac{5}{2}\right)^{2}=\frac{25}{4}$.

6. If $\frac{x}{y}=\left(\frac{4}{7}\right)^{-1}\times\left(\frac{14}{20}\right)^{-2}$, find $\left(\frac{x}{y}\right)^{-2}$.

Sol. $\frac{x}{y}=\left(\frac{4}{7}\right)^{-1}\times\left(\frac{14}{20}\right)^{-2}=\left(\frac{7}{4}\right)\times\left(\frac{20}{14}\right)^{2}$

$\frac{x}{y}=\frac{7}{4}\times\frac{5}{\cancel{20}}\times\frac{\cancel{20}^{10}}{14}=\frac{25}{7}$

$\left(\frac{x}{y}\right)^{-2}=\left(\frac{25}{7}\right)^{-2}=\left(\frac{7}{25}\right)^{2}=\frac{49}{625}$.

7. If $\frac{p}{q}=\left(\frac{4}{9}\right)^{-3}\div\left(\frac{4}{9}\right)^{-2}$, find $\left(\frac{p}{q}\right)^{-1}+\left(\frac{q}{p}\right)^{-1}$. [HOTS]

Sol. $\frac{p}{q}=\left(\frac{4}{9}\right)^{-3}\div\left(\frac{4}{9}\right)^{-2}=\left(\frac{4}{9}\right)^{-3+2}=\left(\frac{4}{9}\right)^{-1}=\frac{9}{4}$

$\frac{q}{p}=\frac{4}{9}$.

$\left(\frac{p}{q}\right)^{-1}+\left(\frac{q}{p}\right)^{-1}=\left(\frac{9}{4}\right)^{-1}+\left(\frac{4}{9}\right)^{-1}=\frac{4}{9}+\frac{9}{4}=\frac{16+81}{36}$

$=\frac{97}{36}$.

(viii) $(6^{-2}+3^{-2}) \times \left(\frac{5}{6}\right)^{-2} = \left(\frac{1}{6^2}+\frac{1}{3^2}\right) \times \left(\frac{6}{5}\right)^2$

$= \left(\frac{1}{36}+\frac{1}{9}\right) \times \frac{(6)^2}{(5)^2} = \left(\frac{1+4}{36}\right) \times \frac{6^2}{5^2}$

$= \frac{5}{6^2} \times \frac{6^{\cancel{2}1}}{5^2} = \frac{1 \cancel{8} \times 1}{5^2} = \frac{1}{5}.$

(ix) $(5^{-3} \div 5^{-2}) \div \left(\frac{1}{5}\right)^{-2} = 5^{-3+2} \div 5^2$

$= 5^{-1} \div 5^2 = 5^{-1-2} = 5^{-3} = \frac{1}{5^3} = \frac{1}{125}.$

(x) $\left[7^0 \div (-0.6)^0 \times \left(\frac{-2}{5}\right)^{-3}\right] \div \left(\frac{8}{125}\right)^{-2}$

$= \left[1 \div 1 \times \left(\frac{5}{-2}\right)^3\right] \div \left(\frac{125}{8}\right)^2$

$= \left[1 \div \frac{5^3}{(-2)^3}\right] \div \left(\frac{125}{8}\right)^2 = 1 \times \frac{(-2)^3}{5^3} \times \frac{8^2}{(5^3)^2}$

$= \frac{(-1)^3 \times 2^3 \times (2^3)^2}{5^3 \times 5^6} = \frac{(-1)^3 \times 2^{3+6}}{5^{3+6}} = \frac{-1 \times 2^9}{5^9}$

$= \frac{-2^9}{5^9} = \left(\frac{-2}{5}\right)^9.$

(iv) $\left\{\left(\frac{1}{2}\right)^{-3} - \left(\frac{1}{3}\right)^{-3}\right\} \div \left(\frac{1}{4}\right)^{-3}$

$= \left\{(2)^3 - (3)^3\right\} \div 4^3 = \left\{8-27\right\} \div 4^3$

$= -19 \times \frac{1}{4^3} = \frac{-19}{64}.$

(v) $\left\{\left(\frac{3}{7}\right)^{-2} \times \left(\frac{7}{36}\right)^{-1}\right\}^{-1} = \left\{\left(\frac{7}{3}\right)^2 \times \frac{36}{7}\right\}^{-1}$

$= \left\{\frac{7\times7}{3\times3} \times \frac{\cancel{36}^{4}}{\cancel{7}}\right\}^{-1} = (28)^{-1} = \frac{1}{28}.$

(vi) $\left[\left(\frac{-8}{5}\right)^{-1} + \left(\frac{-16}{3}\right)^{-1}\right] \times \left(\frac{5}{32}\right)^{-1}$

$= \left[\frac{5}{-8} + \frac{3}{-16}\right] \times \left(\frac{32}{5}\right) = \frac{(-10-3)}{16} \times \frac{32}{5}$

$= \frac{-13}{\cancel{16}_{1}} \times \frac{\cancel{32}^{2}}{5} = \frac{-26}{5}.$

(vii) $\left[\left(\frac{-6}{5}\right)^{-2} \times \left(\frac{-6}{5}\right)^{-3}\right]^{-1} \div \left(\frac{36}{125}\right)^{-1}$

$= \left[\left(\frac{5}{-6}\right)^2 \times \left(\frac{5}{-6}\right)^3\right]^{-1} \div \left(\frac{6^2}{5^3}\right)^{-1}$

$= \left[\left(\frac{5}{-6}\right)^5\right]^{-1} \div \left(\frac{6^2}{5^3}\right)^{-1} = \frac{(-6)^5}{(5)^5} \times \frac{(5)^{-3}}{(6)^{-2}}$

$= \frac{(-1)^5 \times 6^{5+2}}{5^{5+3}} = (-1)^5 \times \frac{6^7}{5^8} = -\frac{6^7}{5^8}.$

4. **Evaluate :**

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

(ii) $\left[\left(\frac{4}{3}\right)^{-1}+\left(\frac{3}{4}\right)^{2}\right]^{-1}$

(iii) $\left[\left(\frac{3}{5}\right)^{-2}\times\left(\frac{3}{5}\right)^{4}\right]\div\left(\frac{9}{5}\right)^{2}$

(iv) $\left\{\left(\frac{1}{2}\right)^{-3}-\left(\frac{1}{3}\right)^{-3}\right\}\div\left(\frac{1}{4}\right)^{-3}$

(v) $\left\{\left(\frac{3}{7}\right)^{-2}\times\left(\frac{7}{36}\right)^{-1}\right\}^{-1}$

(vi) $\left[\left(\frac{-8}{5}\right)^{-1}+\left(\frac{-16}{3}\right)^{-1}\right]\times\left(\frac{5}{32}\right)^{-1}$

(vii) $\left[\left(\frac{-6}{5}\right)^{-2}\times\left(\frac{-6}{5}\right)^{-3}\right]^{-1}\div\left(\frac{36}{125}\right)^{-1}$

(viii) $(6^{-2}+3^{-2})\times\left(\frac{5}{6}\right)^{-2}$

(ix) $(5^{-3}+5^{-2})\div\left(\frac{1}{5}\right)^{-2}$

(x) $\left[7^{0}+(-0.6)^{0}\times\left(\frac{-2}{5}\right)^{-3}\right]\div\left(\frac{8}{125}\right)^{-2}$

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

$= 2^2 + 3^3 + 4^2 = 4+27+16 = 47.$

(ii) $\left[\left(\frac{4}{3}\right)^{-1}+\left(\frac{3}{4}\right)^{2}\right]^{-1}=\left[\frac{3}{4}+\frac{9}{16}\right]^{-1}$

$=\left(\frac{12+9}{16}\right)^{-1}=\left(\frac{21}{16}\right)^{-1}=\frac{16}{21}.$

(iii) $\left[\left(\frac{3}{5}\right)^{-2}\times\left(\frac{3}{5}\right)^{4}\right]\div\left(\frac{9}{5}\right)^{2}$

$=\left[\left(\frac{3}{5}\right)^{-2+4}\right]\div\left(\frac{9}{5}\right)^{2}$

$=\left[\left(\frac{3}{5}\right)^{2}\right]\div\left(\frac{9}{5}\right)^{2}=\frac{3^2}{5^2}\times\frac{5^2}{9^2}$

$=\frac{3^2}{(3^2)^2}=\frac{3^2}{3^4}=\frac{1}{3^{4-2}}=\frac{1}{3^2}=\frac{1}{9}.$

(iv) $\left\{\left(\frac{1}{2}\right)^{-3}-\left(\frac{1}{3}\right)^{-3}\right\}\div\left(\frac{1}{4}\right)^{-3}$

$=\left\{(2)^3-(3)^3\right\}\div 4^3=\left\{8-27\right\}\div 4^3$

(v) $\left[\left(\frac{2}{7}\right)^4 \div \left(\frac{2}{7}\right)^2\right]^{-1} = \left[\left(\frac{2}{7}\right)^{4-2}\right]^{-1} = \left[\left(\frac{2}{7}\right)^2\right]^{-1}$

$= \left[\left(\frac{2}{7}\right)^{-2}\right] = \left(\frac{7}{2}\right)^2 = \frac{7}{2} \times \frac{7}{2} = \frac{49}{4}.$

(vi) $\left[\left(\frac{7}{5}\right)^{-2} \times \left(\frac{7}{5}\right)^3\right]^{-2} = \left[\left(\frac{7}{5}\right)^{-2+3}\right]^{-2} = \left[\left(\frac{7}{5}\right)^1\right]^{-2}$

$= \left(\frac{7}{5}\right)^{-2} = \left(\frac{5}{7}\right)^2 = \frac{25}{49}.$

(vii) $\left[\left(\frac{4}{5}\right)^{-2}\right]^{-1} = \left[\left(\frac{5}{4}\right)^2\right]^{-1} = \left[\frac{25}{16}\right]^{-1} = \frac{16}{25}.$

3. Express each of the following as a power of rational number with negative exponent :

(i) $\frac{25}{64}$ (ii) $\frac{216}{343}$ (iii) $4^2 \times \left(\frac{-3}{4}\right)^2$ (iv) $(6^5 + 6^2) \times 6^3$

(v) $\frac{-32}{243}$ (vi) $\left(\frac{6}{5}\right)^2 \times \left(\frac{10}{9}\right)^2$ (vii) $\left(\frac{-2}{7}\right)^2 \times \left(\frac{-3}{7}\right)^2$ (viii) $\frac{16}{169}$

(ix) $\left(\frac{8}{9}\right)^{-5} \times \left(\frac{8}{9}\right)^2$ (x) $\left(\frac{1}{2}\right)^3 + \left(\frac{1}{2}\right)^4$

Sol. (i) $\frac{25}{64} = \left(\frac{5}{8}\right)^2 = \left(\frac{8}{5}\right)^{-2}.$

(ii) $\frac{216}{343} = \left(\frac{6}{7}\right)^3 = \left(\frac{7}{6}\right)^{-3}.$

(iii) $4^2 \times \left(\frac{-3}{4}\right)^2 = 4^2 \times \frac{(-3)^2}{4^2} = (-3)^2 = 9 = \left(\frac{1}{9}\right)^{-1}.$

(iv) $(6^5 \div 6^2) \times 6^3 = (6^{5-2}) \times 6^3 = 6^3 \times 6^3 = 6^6 = \left(\frac{1}{6}\right)^{-6}.$

(v) $\frac{-32}{243} = \frac{(-2)^5}{3^5} = \left(\frac{-2}{3}\right)^5 = \left(\frac{-3}{2}\right)^{-5}$.

(vi) $\left(\frac{6}{5}\right)^2 \times \left(\frac{10}{9}\right)^2 = \frac{\cancel{6}^{2}}{\cancel{5}_{1}} \times \frac{\cancel{6}^{2}}{\cancel{5}_{1}} \times \frac{\cancel{10}^{2}}{\cancel{9}_{3}} \times \frac{\cancel{10}^{2}}{\cancel{9}_{3}} = \frac{2^4}{3^2} = \frac{4^2}{3^2}$

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

(vii) $\left(\frac{-2}{7}\right)^2 \times \left(\frac{-3}{7}\right)^2 = \frac{(-2)^2 \times (-3)^2}{7^2 \times 7^2} = \frac{(-2 \times -3)^2}{7^4}$

$= \frac{6^2}{(7^2)^2} = \frac{6^2}{49^2} = \left(\frac{6}{49}\right)^2 = \left(\frac{49}{6}\right)^{-2}$.

(viii) $\frac{16}{169} = \frac{4^2}{13^2} = \left(\frac{4}{13}\right)^2 = \left(\frac{13}{4}\right)^{-2}$.

(ix) $\left(\frac{8}{9}\right)^{-5} \times \left(\frac{8}{9}\right)^2 = \left(\frac{8}{9}\right)^{-5+2} = \left(\frac{8}{9}\right)^{-3}$.

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

$= \frac{2+1}{2^4} = \frac{3}{2^4} = \frac{3^1}{16}$

$= \left(\frac{3}{16}\right)^1 = \left(\frac{16}{3}\right)^{-1}$.

EXERCISE 2.2

1. **Express the following with positive exponents :**

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

Sol. (i) $\left(\frac{4}{7}\right)^{-2} = \left(\frac{7}{4}\right)^{2}$ (ii) $\left(\frac{1}{2}\right)^{-7} = 2^{7}$

(iii) $\left(\frac{3}{5}\right)^{-4} = \left(\frac{5}{3}\right)^{4}$ (iv) $(4)^{-5} = \left(\frac{1}{4}\right)^{5}$.

2. **Express as a rational number :**

(i) $\left(\frac{-2}{3}\right)^{2} \times \left(\frac{-2}{3}\right)^{-1}$ (ii) $\left(\frac{-1}{4}\right)^{-2} \times \left(\frac{-1}{4}\right)^{-2}$ (iii) $(4)^{0} \times (6)^{-2}$ (iv) $7^{-2} \times \left(\frac{1}{14}\right)^{-1}$

(v) $\left[\left(\frac{2}{7}\right)^{4} \div \left(\frac{2}{7}\right)^{2}\right]^{-1}$ (vi) $\left[\left(\frac{7}{5}\right)^{-2} \times \left(\frac{7}{5}\right)^{3}\right]^{-2}$ (vii) $\left[\left(\frac{4}{5}\right)^{-2}\right]^{-1}$

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

$= \frac{-2}{3} \times \frac{-2}{3} \times \frac{3}{-2} = \frac{-2}{3}$.

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

$= 256$.

(iii) $(4)^{0} \times (6)^{-2} = 1 \times \left(\frac{1}{6}\right)^{2} = \frac{1}{36}$.

(iv) $7^{-2} \times \left(\frac{1}{14}\right)^{-1} = \frac{1}{7^{2}} \times 14 = \frac{14}{7 \times 7} = \frac{2}{7}$.