

## Exercise 8

Simplify the following (1 to 20):

1. (i)  $(81/16)^{-3/4}$

**Solution:**

$$\begin{aligned}(81/16)^{-3/4} &= [(3^4/2^4)]^{-3/4} \\ &= [(3/2)^4]^{-3/4} \\ &= (3/2)^{-3/4 \times 4} \\ &= (3/2)^{-3} \\ &= (2/3)^3 \\ &= 2^3/3^3 \\ &= (2 \times 2 \times 2)/(3 \times 3 \times 3) \\ &= 8/27\end{aligned}$$

(ii)  $(1 \frac{61}{64})^{-2/3}$

**Solution:**

$$\begin{aligned}(1 \frac{61}{64})^{-2/3} &= (\frac{125}{64})^{-2/3} = (\frac{5^3}{4^3})^{-2/3} \\ &= (5/4)^{3 \times -2/3} \\ &= (5/4)^{-2} \\ &= (4/5)^2 \\ &= 16/25\end{aligned}$$



2. (i)  $(2a^{-3}b^2)^3$

**Solution:**

$$\begin{aligned}(2a^{-3}b^2)^3 &= 2^3 a^{-3 \times 3} b^{2 \times 3} \\ &= 8a^{-9}b^6\end{aligned}$$

(ii)  $(a^{-1} + b^{-1})/(ab)^{-1}$

**Solution:**

$$\frac{a^{-1} + b^{-1}}{(ab)^{-1}} = \frac{\frac{1}{a} + \frac{1}{b}}{\frac{1}{ab}} = \frac{a + b}{ab} \times \frac{ab}{1} = a + b$$

3. (i)  $(x^{-1} y^{-1})/(x^{-1} + y^{-1})$


**Solution:**

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$$\begin{aligned}\frac{x^{-1}y^{-1}}{x^{-1} + y^{-1}} &= \frac{(xy)^{-1}}{\frac{1}{x} + \frac{1}{y}} \\ &= \frac{\frac{1}{xy}}{\frac{x+y}{xy}} = \frac{1}{xy} \times \frac{xy}{x+y} \\ &= \frac{1}{x+y}\end{aligned}$$

(ii)  $(4 \times 10^7)(6 \times 10^{-5})/(8 \times 10^{10})$

**Solution:**

$$\begin{aligned}\frac{(4 \times 10^7)(6 \times 10^{-5})}{8 \times 10^{10}} \\ &= \frac{4 \times 6 \times 10^7 \times 10^{-5}}{8 \times 10^{10}} \\ &= \frac{24 \times 10^{7+(-5)}}{8 \times 10^{10}} \\ &= 3 \times \frac{10^2}{10^{10}} = 3 \times 10^{2-10} = 3 \times 10^{-8}\end{aligned}$$


4. (i)  $3a/b^{-1} + 2b/a^{-1}$

**Solution:**

$$\begin{aligned}3a/b^{-1} + 2b/a^{-1} \\ &= 3a/(1/b) + 2b/(1/a) \\ &= (3a \times b)/1 + (2b \times a)/1 \\ &= 3ab + 2ab = 5ab\end{aligned}$$

(ii)  $5^0 \times 4^{-1} + 8^{1/3}$

**Solution:**

$$\begin{aligned}5^0 \times 4^{-1} + 8^{1/3} \\ &= 1 \times (1/4) + (2)^3 \times 1/3 \\ &= \frac{1}{4} + 2 \\ &= (1 + 8)/4 \\ &= 9/4 = 2\frac{1}{4}\end{aligned}$$

5. (i)  $(8/125)^{-1/3}$

**Solution:**

$$(8/125)^{-1/3}$$

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$$\begin{aligned} &= [(2 \times 2 \times 2)/(5 \times 5 \times 5)]^{-1/3} \\ &= (2^3/5^3)^{-1/3} \\ &= (2/5)^{3 \times -1/3} \\ &= (2/5)^{-1} \\ &= 5/2 = 2\frac{1}{2} \end{aligned}$$

**(ii)  $(0.027)^{-1/3}$**

**Solution:**

$$\begin{aligned} &(0.027)^{-1/3} \\ &= (27/1000)^{-1/3} \\ &= [(3 \times 3 \times 3)/(10 \times 10 \times 10)]^{-1/3} \\ &= (3^3/10^3)^{-1/3} \\ &= (3/10)^{3 \times -1/3} \\ &= (3/10)^{-1} \\ &= 10/3 \end{aligned}$$

**6. (i)  $(-1/27)^{-2/3}$**

**Solution:**

$$\begin{aligned} &(-1/27)^{-2/3} \\ &= (-1/3^3)^{-2/3} \\ &= (-1/3)^{3 \times -2/3} \\ &= (-1/3)^{-2} \\ &= (-3)^2 \\ &= 9 \end{aligned}$$



**(ii)  $(64)^{-2/3} \div 9^{-3/2}$**

**Solution:**

$$(64)^{-2/3} \div 9^{-3/2}$$

We can write it as

$$= (4^3)^{-2/3} \div (3^2)^{-3/2}$$

By further calculation

$$= 4^{3 \times -2/3} \div 3^{2 \times -3/2}$$

So we get

$$= 4^{-2} \div 3^{-3}$$

$$= 4^{-2} / 3^{-3}$$

It can be written as

$$= 1/4^2 \times 1/3^3$$

$$= 3^3/4^2$$

We get

$$= 27/16$$

$$= 1 \frac{11}{16}$$

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$$7.(i) \frac{(27)^{\frac{2n}{3}} \times (8)^{\frac{-n}{6}}}{(18)^{\frac{-n}{2}}}$$

$$(ii) \frac{5 \cdot (25)^{n+1} - 25 \cdot (5)^{2n}}{5 \cdot (5)^{2n+3} - (25)^{n+1}}$$

**Solution:**

$$(i) \frac{(27)^{\frac{2n}{3}} \times (8)^{\frac{-n}{6}}}{(18)^{\frac{-n}{2}}}$$

We can write it as

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

By further calculation

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

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

So we get

$$= \frac{(3)^{2n} \times 1}{1 \times 3^{-n}}$$

It can be written as

$$= (3)^{2n} \times (3)^n$$

$$= 3^{2n+n}$$

$$= 3^{3n}$$

$$(ii) \frac{5 \cdot (25)^{n+1} - 25 \cdot (5)^{2n}}{5 \cdot (5)^{2n+3} - (25)^{n+1}}$$

We can write it as

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

$$= \frac{5 \cdot (5)^{2(n+1)} - (5)^2 \cdot (5)^{2n}}{5^3 \cdot (5)^{2n+3} - (5)^{2(n+1)}}$$



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*By further calculation*

$$\begin{aligned} &= \frac{(5)^{2(n+1)+1} - (5)^{2 \times 2n}}{(5)^{2n+3+1} - (5)^{2n+2}} \\ &= \frac{(5)^{2n+3} - (5)^{2n+2}}{(5)^{2n+4} - (5)^{2n+2}} \end{aligned}$$

*On further simplification*

$$= \frac{(5)^{2n} \cdot (5)^3 - (5)^{2n} \cdot (5)^2}{(5)^{2n} \cdot (5)^4 - (5)^{2n} \cdot (5)^2}$$

*Taking out the common terms*

$$= \frac{(5)^{2n} [(5)^3 - (5)^2]}{(5)^{2n} [(5)^4 - (5)^2]}$$

*So we get*

$$\begin{aligned} &= \frac{125 - 25}{625 - 25} \\ &= 100/600 \\ &= 1/6 \end{aligned}$$



8.(i)  $[8^{\frac{-4}{3}} \div 2^{-2}]^{\frac{1}{2}}$

(ii)  $(\frac{27}{3})^{2/3} - (\frac{1}{4})^{-2} + 5^0$ .

**Solution:**

(i)  $[8^{\frac{-4}{3}} \div 2^{-2}]^{\frac{1}{2}}$

*It can be written as*

$$= [(2 \times 2 \times 2)^{\frac{-4}{3}} \div (2)^{-2}]^{\frac{1}{2}}$$

*By further calculation*

$$\begin{aligned} &= [(2)^{3 \times \frac{-4}{3}} \div \frac{1}{(2)^2}]^{\frac{1}{2}} \\ &= [(2)^{-4} \div \frac{1}{4}]^{\frac{1}{2}} \end{aligned}$$

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*On further simplification*

$$\begin{aligned} &= \left[ \frac{1}{(2)^4} \div \frac{1}{4} \right]^{\frac{1}{2}} \\ &= \left[ \frac{1}{2 \times 2 \times 2 \times 2} \times \frac{4}{1} \right]^{\frac{1}{2}} \end{aligned}$$

*So we get*

$$\begin{aligned} &= \left[ \frac{4}{16} \right]^{\frac{1}{2}} \\ &= \left[ \frac{1}{4} \right]^{\frac{1}{2}} \end{aligned}$$

*We can write it as*

$$\begin{aligned} &= \left[ \frac{1}{2} \times \frac{1}{2} \right]^{\frac{1}{2}} \\ &= \left[ \frac{1}{2} \right]^{2 \times \frac{1}{2}} \\ &= (1/2)^1 \\ &= 1/2 \end{aligned}$$



$$(ii) \left( \frac{27}{8} \right)^{2/3} - \left( \frac{1}{4} \right)^{-2} + 5^0$$

*We can write it as*

$$\begin{aligned} &= \left( \frac{3 \times 3 \times 3}{2 \times 2 \times 2} \right)^{2/3} - \left( \frac{1 \times 1}{2 \times 2} \right)^{-2} + 1 \\ &= \left( \frac{3}{2} \times \frac{3}{2} \times \frac{3}{2} \right)^{2/3} - \left( \frac{1}{2} \times \frac{1}{2} \right)^{-2} + 1 \end{aligned}$$

*By further calculation*

$$\begin{aligned} &= \left[ \left( \frac{3}{2} \right)^3 \right]^{2/3} - \left[ \left( \frac{1}{2} \right)^2 \right]^{-2} + 1 \\ &= \left( \frac{3}{2} \right)^{3 \times \frac{2}{3}} - \left( \frac{1}{2} \right)^{2 \times -2} + 1 \end{aligned}$$

*So we get*

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

It can be written as

$$\begin{aligned} &= \frac{3}{2} \times \frac{3}{2} - \frac{1}{\left(\frac{1}{2}\right)^4} + 1 \\ &= \frac{9}{4} - \frac{1}{\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}} + 1 \end{aligned}$$

We get

$$\begin{aligned} &= \frac{9}{4} - \frac{1}{\left(\frac{1}{16}\right)} + 1 \\ &= \frac{9}{4} - \frac{1 \times 16}{1} + 1 \end{aligned}$$

By further calculation

$$\begin{aligned} &= \frac{9}{4} - 16 + 1 \\ &= \frac{9}{4} - 15 \end{aligned}$$



Taking LCM

$$\begin{aligned} &= \frac{9 - 60}{4} \\ &= \frac{-51}{4} \\ &= -12\frac{3}{4} \end{aligned}$$

9. (i)  $(3x^2)^{-3} \times (x^9)^{2/3}$

(ii)  $(8x^4)^{1/3} \div x^{1/3}$ .

**Solution:**

(i)  $(3x^2)^{-3} \times (x^9)^{2/3}$

We can write it as

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$$\begin{aligned} &= \frac{1}{(3x^2)^3} \times (x^9)^{\frac{2}{3}} \\ &= \frac{1}{(3)^3(x^2)^3} \times (x)^{3 \times 2} \end{aligned}$$

*By further calculation*

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

*So we get*

$$\begin{aligned} &= \frac{1}{27x^6} \times x^6 \\ &= \frac{x^6}{27x^6} \\ &= \frac{1}{27} \end{aligned}$$

(ii)  $(8x^4)^{1/3} \div x^{1/3}$

We can write it as

$$\begin{aligned} &= (8)^{\frac{1}{3}}(x^4)^{\frac{1}{3}} \div (x)^{\frac{1}{3}} \\ &= \frac{(2 \times 2 \times 2)^{\frac{1}{3}}(x^4)^{\frac{1}{3}}}{x^{\frac{1}{3}}} \end{aligned}$$



*By further calculation*

$$\begin{aligned} &= \frac{(2)^{3 \times \frac{1}{3}}(x)^{\frac{4}{3}}}{x^{\frac{1}{3}}} \\ &= (2)^1(x)^{\frac{4}{3} - \frac{1}{3}} \end{aligned}$$

*Taking LCM*

$$\begin{aligned} &= (2)^1 \times x^{(\frac{4-1}{3})} \\ &= 2 \times x^{3/3} \end{aligned}$$

So we get

$$\begin{aligned} &= 2 \times x^1 \\ &= 2 \times x \\ &= 2x \end{aligned}$$

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10. (i)  $(3^2)^0 + 3^{-4} \times 3^6 + (1/3)^{-2}$

(ii)  $9^{5/2} - 3.(5)^0 - (1/81)^{-1/2}$

**Solution:**

(i)  $(3^2)^0 + 3^{-4} \times 3^6 + (1/3)^{-2}$

We can write it as

$$= (3)^{2 \times 0} + (3)^{-4+6} + \frac{1}{(\frac{1}{3})^2}$$

$$= (3)^0 + (3)^2 + \frac{1}{\frac{1}{3} \times \frac{1}{3}}$$

*By further calculation*

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

$$= 1 + 9 + \frac{9 \times 1}{1}$$

So we get

$$= 1 + 9 + 9$$

$$= 19$$

(ii)  $9^{5/2} - 3.(5)^0 - (1/81)^{-1/2}$

We can write it as

$$= (3 \times 3)^{\frac{5}{2}} - 3 \times 1 - \frac{1}{(\frac{1}{81})^{1/2}}$$

*By further calculation*

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

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

*So we get*

$$= (3)^5 - 3 - \frac{1}{(\frac{1}{9})^1}$$

$$= (3 \times 3 \times 3 \times 3 \times 3) - 3 - \frac{1}{(\frac{1}{9})}$$

Here

$$= 243 - 3 - (9 \times 1)/1$$

$$= 240 - 9$$

$$= 231$$



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11. (i)  $16^{3/4} + 2 (1/2)^{-1} (3)^0$

(ii)  $(81)^{3/4} - (1/32)^{-2/5} + (8)^{1/3} (1/2)^{-1} (2)^0$ .

**Solution:**

(i)  $16^{3/4} + 2 (1/2)^{-1} (3)^0$

We can write it as

$$= (2 \times 2 \times 2 \times 2)^{3/4} + 2 \times \frac{1}{(1/2)^1} \times 1$$

*By further calculation*

$$= (2)^{4 \times \frac{3}{4}} + 2 \times \frac{2}{1} \times 1$$

So we get

$$= (2)^3 + 4$$

$$= 2 \times 2 \times 2 + 4$$

$$= 8 + 4$$

$$= 12$$

(ii)  $(81)^{3/4} - (1/32)^{-2/5} + (8)^{1/3} (1/2)^{-1} (2)^0$

We can write it as

$$= (3 \times 3 \times 3 \times 3)^{3/4} - \left(\frac{1}{2 \times 2 \times 2 \times 2 \times 2}\right)^{-2/5} + (2 \times 2 \times 2)^{1/3} \times \frac{1}{(1/2)^1} \times 1$$

*By further calculation*

$$= (3)^{4 \times \frac{3}{4}} - \left(\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}\right)^{-2/5} + (2)^{3 \times \frac{1}{3}} \times \frac{1 \times 2}{1} \times 1$$

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

*So we get*

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

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

$$= 27 - \frac{1}{\frac{1}{2} \times \frac{1}{2}} + 4$$

*Here*

$$= 27 - \frac{1}{1/4} + 4$$

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$$\begin{aligned} &= 27 - \frac{4 \times 1}{1} + 4 \\ &= 27 - 4 + 4 \\ &= 27 \end{aligned}$$

$$12.(i) \left(\frac{64}{125}\right)^{-\frac{2}{3}} \div \frac{1}{\left(\frac{256}{625}\right)^{\frac{1}{4}}} + \left(\frac{\sqrt{25}}{\sqrt[3]{64}}\right)^0$$

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

**Solution:**

$$(i) \left(\frac{64}{125}\right)^{-\frac{2}{3}} \div \frac{1}{\left(\frac{256}{625}\right)^{\frac{1}{4}}} + \left(\frac{\sqrt{25}}{\sqrt[3]{64}}\right)^0$$

*We can write it as*

$$\begin{aligned} &= \left(\frac{4 \times 4 \times 4}{5 \times 5 \times 5}\right)^{-\frac{2}{3}} \div \frac{1}{\left(\frac{4 \times 4 \times 4 \times 4}{5 \times 5 \times 5 \times 5}\right)^{\frac{1}{4}}} + 1 \\ &= \left(\frac{4 \times 4 \times 4}{5 \times 5 \times 5}\right)^{-\frac{2}{3}} \div \frac{1}{\left(\frac{4}{5} \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5}\right)^{\frac{1}{4}}} + 1 \end{aligned}$$

*By further calculation*

$$\begin{aligned} &= \left(\frac{4}{5}\right)^{3 \times \frac{2}{3}} \div \frac{1}{\left(\frac{4}{5}\right)^{4 \times \frac{1}{4}}} + 1 \\ &= \left(\frac{4}{5}\right)^{-2} \div \frac{1}{\frac{4}{5}} + 1 \end{aligned}$$

*So we get*

$$\begin{aligned} &= \frac{1}{\left(\frac{4}{5}\right)^2} \div \frac{5 \times 1}{4} + 1 \\ &= \frac{1}{\frac{4}{5} \times \frac{4}{5}} \div \frac{5}{4} + 1 \end{aligned}$$

*On further simplification*

$$\begin{aligned} &= \frac{1}{\frac{16}{25}} \times \frac{4}{5} + 1 \\ &= \frac{25 \times 1}{16} \times \frac{4}{5} + 1 \end{aligned}$$

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We get

$$= \frac{5}{4} + 1$$

Taking LCM

$$= \frac{5+4}{4}$$

$$= 9/4$$

$$= 2\frac{1}{4}$$

$$(ii) \frac{5 \cdot (25)^{n+1} - 25 \cdot (5)^{2n}}{5 \cdot (5)^{2n+3} - (25)^{n+1}}$$

We can write it as

$$= \frac{5^n \cdot 5^3 - 6 \times 5^n \cdot 5}{9 \times 5^n - 4 \cdot 5^n}$$

Taking  $5^n$  as common

$$= \frac{5^n(5^3 - 6 \times 5)}{5^n(9 - 4)}$$

By further calculation

$$= \frac{5^3 - 30}{5}$$

$$= \frac{125 - 30}{5}$$

So we get

$$= \frac{95}{5}$$

$$= 19$$

13. (i)  $[(64)^{-2/3} 2^{-2} + 8^0]^{-1/2}$

(ii)  $3^n \times 9^{n+1} \div (3^{n-1} \times 9^{n-1})$ .

**Solution:**

(i)  $[(64)^{-2/3} 2^{-2} + 8^0]^{-1/2}$

We can write it as



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$$= [(4 \times 4 \times 4)^{\frac{2}{3}} \times \frac{1}{(2)^2} \div 1]^{-\frac{1}{2}}$$

By further calculation

$$\begin{aligned} &= [(4)^{3 \times \frac{2}{3}} \times \frac{1}{2 \times 2} \div 1]^{-\frac{1}{2}} \\ &= [(4)^2 \times \frac{1}{4} \div 1]^{-\frac{1}{2}} \end{aligned}$$

So we get

$$\begin{aligned} &= [4 \times 4 \times \frac{1}{4} \times 1]^{-\frac{1}{2}} \\ &= [4 \times 1 \times 1]^{-1/2} \\ &= (4)^{-1/2} \\ \text{Here} \\ &= (2 \times 2)^{-1/2} \\ &= (2)^{2 \times -1/2} \\ &= (2)^{-1} \\ &= 1/(2)^1 \\ &= \frac{1}{2} \end{aligned}$$

$$(ii) 3^n \times 9^{n+1} \div (3^{n-1} \times 9^{n-1})$$

We can write it as

$$= 3^n \times (3 \times 3)^{n+1} \div (3^{n-1} \times (3 \times 3)^{n-1})$$

By further calculation

$$\begin{aligned} &= 3^n \times (3)^{2 \times (n+1)} \div (3^{n-1} \times (3)^{2(n-1)}) \\ &= 3^n \times (3)^{2n+2} \div (3^{n-1} \times (3)^{2n-2}) \end{aligned}$$

So we get

$$\begin{aligned} &= (3)^{n+2n+2} \div (3)^{n-1+2n-2} \\ &= (3)^{3n+2} \div (3)^{3n-3} \end{aligned}$$

Here

$$\begin{aligned} &= (3)^{3n+2-3n+3} \\ &= (3)^5 \end{aligned}$$

We get

$$\begin{aligned} &= 3 \times 3 \times 3 \times 3 \times 3 \\ &= 243 \end{aligned}$$

$$14. (i) \frac{\sqrt{2^2} \times \sqrt[4]{256}}{\sqrt[3]{64}} - \left(\frac{1}{2}\right)^{-2}$$

$$(ii) \frac{3^{-\frac{6}{7}} \times 4^{-\frac{3}{7}} \times 9^{\frac{3}{7}} \times 2^{\frac{6}{7}}}{2^2 + 2^0 + 2^{-2}}$$

**Solution:**

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$$(i) \frac{\sqrt{2^2} \times \sqrt[4]{256}}{\sqrt[3]{64}} - \left(\frac{1}{2}\right)^{-2}$$

We can write it as

$$= \frac{(2^2)^{\frac{1}{2}} \times (256)^{\frac{1}{4}}}{(64)^{\frac{1}{3}}} - \left(\frac{1}{2}\right)^{-2}$$

By further calculation

$$\begin{aligned} &= \frac{(2)^{2 \times \frac{1}{2}} \times (4 \times 4 \times 4 \times 4)^{\frac{1}{4}}}{(4 \times 4 \times 4)^{\frac{1}{3}}} - \left(\frac{1}{2}\right)^{-2} \\ &= \frac{(2)^1 \times (4)^{4 \times \frac{1}{4}}}{(4)^{3 \times \frac{1}{3}}} - \left(\frac{1}{2}\right)^{-2} \end{aligned}$$

So we get

$$\begin{aligned} &= \frac{2 \times (4)^1}{(4)^1} - \frac{1}{\frac{1}{2} \times \frac{1}{2}} \\ &= \frac{2 \times 1}{1} - \frac{1}{\frac{1}{4}} \end{aligned}$$

Here

$$\begin{aligned} &= 2 - \frac{1 \times 4}{1} \\ &= 2 - 4 \\ &= -2 \end{aligned}$$

$$(ii) \frac{3^{-\frac{6}{7}} \times 4^{-\frac{3}{7}} \times 9^{\frac{3}{7}} \times 2^{\frac{6}{7}}}{2^2 + 2^0 + 2^{-2}}$$

We can write it as

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

By further calculation

$$= \frac{(3)^{-\frac{6}{7}} \times (2)^{2 \times -\frac{3}{7}} \times (3)^{2 \times \frac{3}{7}} \times (2)^{\frac{6}{7}}}{4 + 1 + \frac{1}{(2 \times 2)}}$$



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$$= \frac{(3)^{-\frac{6}{7}} \times (2)^{-\frac{6}{7}} \times (3)^{\frac{6}{7}} \times (2)^{\frac{6}{7}}}{5 + \frac{1}{(4)}}$$

So we get

$$= \frac{(3)^{\frac{6}{7} + \frac{6}{7}} \times (2)^{-\frac{6}{7} + \frac{6}{7}}}{\frac{5 \times 4 + 1}{4}}$$

$$= \frac{(3)^0 \times (2)^0}{\frac{21}{4}}$$

Here

$$= \frac{1 \times 1}{\frac{21}{4}}$$

$$= \frac{1 \times 1 \times 4}{21}$$

$$= \frac{4}{21}$$

15. (i)  $\frac{(32)^{\frac{2}{5}} \times (4)^{-\frac{1}{2}} \times (8)^{\frac{1}{3}}}{2^{-2} \div (64)^{-1/3}}$

(ii)  $\frac{5^{2(x+6)} \times (25)^{-7+2x}}{(125)^{2x}}$

**Solution:**

$$(i) \frac{(32)^{\frac{2}{5}} \times (4)^{-\frac{1}{2}} \times (8)^{\frac{1}{3}}}{2^{-2} \div (64)^{-1/3}}$$

We can write it as

$$= \frac{(2 \times 2 \times 2 \times 2 \times 2)^{\frac{2}{5}} \times (2 \times 2)^{-\frac{1}{2}} \times (2 \times 2 \times 2)^{\frac{1}{3}}}{\frac{1}{(2)^2} \div \frac{1}{(64)^{1/3}}}$$

By further calculation

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

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$$= \frac{(2)^2 \times (2)^{-1} \times (2)^1}{\frac{1}{4} \div \frac{1}{(4)^{3 \times \frac{1}{3}}}}$$

On further simplification

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

So we get

$$\begin{aligned} &= \frac{4 \times \frac{1}{1} \times 1}{\frac{1}{4} \times 4} \\ &= \frac{4}{1} \\ &= 4 \end{aligned}$$

$$(ii) \frac{5^{2(x+6)} \times (25)^{-7+2x}}{(125)^{2x}}$$

We can write it as

$$= \frac{5^{2(x+6)} \times (5 \times 5)^{-7+2x}}{(5 \times 5 \times 5)^{2x}}$$

By further calculation

$$\begin{aligned} &= \frac{(5)^{2x+12} \times (5)^{2(-7+2x)}}{[(5)^3]^{2x}} \\ &= \frac{(5)^{2x+12} \times (5)^{-14+4x}}{(5)^{6x}} \end{aligned}$$

On further simplification

$$\begin{aligned} &= \frac{(5)^{2x+12+(-14+4x)}}{(5)^{6x}} \\ &= \frac{(5)^{2x+12-14+4x}}{(5)^{6x}} \end{aligned}$$

So we get



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$$\begin{aligned}
 &= \frac{(5)^{6x-2}}{(5)^{6x}} \\
 &= 5^{6x-2-6x} \\
 &= 5^{-2} \\
 &= 1/(5)^2 \\
 &= 1/25
 \end{aligned}$$

16.(i)  $\frac{7^{2n+3} - (49)^{n+2}}{((343)^{n+1})^{2/3}}$

(ii)  $(27)^{\frac{4}{3}} + (32)^{0.8} + (0.8)^{-1}$ .

**Solution:**

(i)  $\frac{7^{2n+3} - (49)^{n+2}}{((343)^{n+1})^{2/3}}$

We can write it as

$$= \frac{7^{2n+3} - (7 \times 7)^{n+2}}{((7 \times 7 \times 7)^{n+1})^{2/3}}$$

By further calculation

$$\begin{aligned}
 &= \frac{(7)^{2n} \cdot (7)^3 - [(7)^2]^{n+2}}{((7)^{3(n+1)})^{\frac{2}{3}}} \\
 &= \frac{(7)^{2n} \cdot (7)^3 - (7)^{2(n+2)}}{(7)^{3(n+1) \times \frac{2}{3}}}
 \end{aligned}$$

On further simplification

$$\begin{aligned}
 &= \frac{(7)^{2n} \cdot (7)^3 - (7)^{2n} \cdot (7)^4}{(7)^{2(n+1)}} \\
 &= \frac{(7)^{2n} [(7)^3 - (7)^4]}{(7)^{2n} \cdot (7)^2}
 \end{aligned}$$

So we get

$$= \frac{(7)^3 - (7)^4}{(7)^2}$$

It can be written as

$$\begin{aligned}
 &= \frac{7 \times 7 \times 7 - 7 \times 7 \times 7 \times 7}{7 \times 7} \\
 &= \frac{7 \times 7(7 - 7 \times 7)}{7 \times 7}
 \end{aligned}$$

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*So we get*

$$\begin{aligned} &= \frac{1 \times (7 - 7 \times 7)}{1} \\ &= 7 - 7 \times 7 \\ &= 7 - 49 \\ &= -42 \end{aligned}$$

(ii)  $(27)^{4/3} + (32)^{0.8} + (0.8)^{-1}$

We can write it as

$$= (3 \times 3 \times 3)^{\frac{4}{3}} + (2 \times 2 \times 2 \times 2 \times 2)^{0.8} + \frac{1}{(0.8)^1}$$

*By further calculation*

$$\begin{aligned} &= (3)^{3 \times \frac{4}{3}} + (2)^{5 \times 0.8} + \frac{1}{0.8} \\ &= (3)^4 + (2)^{4.0} + \frac{10}{8} \end{aligned}$$

*So we get*

$$\begin{aligned} &= (3 \times 3 \times 3 \times 3) + (2 \times 2 \times 2 \times 2) + \frac{5}{4} \\ &= 81 + 16 + \frac{5}{4} \end{aligned}$$

*On further simplification*

$$= \frac{97}{1} + \frac{5}{4}$$

*Taking LCM*

$$\begin{aligned} &= \frac{97 \times 4 + 5 \times 1}{4} \\ &= \frac{388 + 5}{4} \\ &= \frac{393}{4} \\ &= 98.25 \end{aligned}$$

**ML Aggarwal Solutions for Class 9 Maths Chapter 8:  
Indices**

$$17.(i)(\sqrt{32} - \sqrt{5})^{\frac{1}{3}}(\sqrt{32} + \sqrt{5})^{\frac{1}{3}}$$

$$(ii)(x^{\frac{1}{3}} - x^{-\frac{1}{3}})(x^{\frac{2}{3}} + 1 + x^{-\frac{2}{3}}).$$

**Solution:**

$$(i)(\sqrt{32} - \sqrt{5})^{\frac{1}{3}}(\sqrt{32} + \sqrt{5})^{\frac{1}{3}}$$

*We can write it as*

$$= [(\sqrt{32} - \sqrt{5})(\sqrt{32} + \sqrt{5})]^{\frac{1}{3}}$$

$$= [(\sqrt{32})^2 - (\sqrt{5})^2]^{\frac{1}{3}}$$

*By further calculation*

$$= (32 - 5)^{\frac{1}{3}}$$

$$= (27)^{\frac{1}{3}}$$

*So we get*

$$= (3 \times 3 \times 3)^{\frac{1}{3}}$$

$$= (3)^{3 \times \frac{1}{3}}$$

$$= (3)^1$$

$$= 3$$



$$(ii)(x^{\frac{1}{3}} - x^{-\frac{1}{3}})(x^{\frac{2}{3}} + 1 + x^{-\frac{2}{3}})$$

*We can write it as*

$$= (x^{\frac{1}{3}} - x^{-\frac{1}{3}})[(x^{\frac{1}{3}})^2 + x^{\frac{1}{3}} \times x^{-\frac{1}{3}} + (x^{-\frac{1}{3}})^2]$$

*By further calculation*

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

$$= x^{3 \times \frac{1}{3}} - x^{3 \times -\frac{1}{3}}$$

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So we get

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

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

18.(i)  $\left(\frac{x^m}{x^n}\right)^1 \cdot \left(\frac{x^n}{x^1}\right)^m \cdot \left(\frac{x^1}{x^m}\right)^n$

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

**Solution:**

(i)  $\left(\frac{x^m}{x^n}\right)^1 \cdot \left(\frac{x^n}{x^1}\right)^m \cdot \left(\frac{x^1}{x^m}\right)^n$

We can write it as

$$= (x^{m-n})^1 \cdot (x^{n-1})^m \cdot (x^{1-m})^n$$

By further calculation

$$= (x)^{(m-n) \cdot 1} \cdot (x)^{(n-1) \cdot m} \cdot (x)^{(1-m) \cdot n}$$

$$= x^{m-n} \cdot x^{nm-lm} \cdot x^{ln-mn}$$

So we get

$$= x^{m-n+nm-lm+ln-mn}$$

$$= x^0$$

$$= 1$$

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

We can write it as

$$= (x^{a+b-c})^{a-b} \cdot (x^{b+c-a})^{b-c} \cdot (x^{c+a-b})^{c-a}$$

By further calculation

$$= x^{(a+b-c)(a-b)} \cdot x^{(b+c-a)(b-c)} \cdot x^{(c+a-b)(c-a)}$$

So we get  $= x^{a^2-b^2-ac+bc+b^2-c^2-ab+ac+c^2-a^2-bc+ab}$

$$= x^0$$

$$= 1$$

19.(i)  $\sqrt[m]{\frac{x^l}{x^m}} \cdot \sqrt[n]{\frac{x^m}{x^n}} \cdot \sqrt[l]{\frac{x^n}{x^l}}$

(ii)  $\left(\frac{x^a}{x^b}\right)^{a^2+ab+b^2} \cdot \left(\frac{x^b}{x^c}\right)^{b^2+bc+c^2} \cdot \left(\frac{x^c}{x^a}\right)^{c^2+ac+a^2}$

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$$(iii) \left(\frac{x^a}{x^{-b}}\right)^{a^2-ab+b^2} \cdot \left(\frac{x^b}{x^{-c}}\right)^{b^2-bc+c^2} \cdot \left(\frac{x^c}{x^a}\right)^{c^2-ca+a^2}.$$

**Solution:**

$$(i) \sqrt[l]{\frac{x^l}{x^m}} \cdot \sqrt[m]{\frac{x^m}{x^n}} \cdot \sqrt[n]{\frac{x^n}{x^l}}$$

We can write it as

$$= \sqrt[l]{x^{l-m}} \cdot \sqrt[m]{x^{m-n}} \cdot \sqrt[n]{x^{n-l}}$$

By further calculation

$$= x^{\frac{l-m}{l}} \cdot x^{\frac{m-n}{m}} \cdot x^{\frac{n-l}{n}}$$

$$= x^{\frac{l-m}{l} + \frac{m-n}{m} + \frac{n-l}{n}}$$

So we get

$$= x^{\frac{nl-mn+lm-nl+mn-lm}{lmn}}$$

$$= x^0$$

$$= 1$$



$$(ii) \left(\frac{x^a}{x^b}\right)^{a^2+ab+b^2} \cdot \left(\frac{x^b}{x^c}\right)^{b^2+bc+c^2} \cdot \left(\frac{x^c}{x^a}\right)^{c^2+ac+a^2}$$

We can write it as

$$= (x^{a-b})^{a^2+ab+b^2} \cdot (x^{b-c})^{b^2+bc+c^2} \cdot (x^{c-a})^{c^2+ac+a^2}$$

By further calculation

$$= x^{(a-b)(a^2+ab+b^2)} \cdot x^{(b-c)(b^2+bc+c^2)} \cdot x^{(c-a)(c^2+ac+a^2)}$$

$$= x^{a^3-b^3} \cdot x^{b^3-c^3} \cdot x^{c^3-a^3}$$

So we get

$$= x^{a^3-b^3+b^3-c^3+c^3-a^3}$$

$$= x^0$$

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= 1

$$(iii) \left(\frac{x^a}{x^{-b}}\right)^{a^2-ab+b^2} \cdot \left(\frac{x^b}{x^{-c}}\right)^{b^2-bc+c^2} \cdot \left(\frac{x^c}{x^{-a}}\right)^{c^2-ca+a^2}$$

We can write it as

$$= (x^{a+b})^{a^2-ab+b^2} \cdot (x^{b+c})^{b^2-bc+c^2} \cdot (x^{c+a})^{c^2-ca+a^2}$$

By further calculation

$$= x^{(a+b)(a^2-ab+b^2)} \cdot x^{(b+c)(b^2-bc+c^2)} \cdot x^{(c+a)(c^2-ca+a^2)}$$

$$= x^{a^3+b^3} \cdot x^{b^3+c^3} \cdot x^{c^3+a^3}$$

So we get

$$= x^{a^3+b^3+b^3+c^3+c^3+a^3}$$

$$= x^{2a^3+2b^3+2c^3}$$

$$= x^{2(a^3+b^3+c^3)}$$



**20. (i)**  $(a^{-1} + b^{-1}) \div (a^{-2} - b^{-2})$

**(ii)**  $\frac{1}{1 + a^{m-n}} + \frac{1}{1 + a^{n-m}}$

**Solution:**

**(i)**  $(a^{-1} + b^{-1}) \div (a^{-2} - b^{-2})$

We can write it as

$$= \left(\frac{1}{a} + \frac{1}{b}\right) \div \left(\frac{1}{a^2} - \frac{1}{b^2}\right)$$

Taking LCM

$$= \left(\frac{b+a}{ab}\right) \div \left(\frac{b^2-a^2}{a^2b^2}\right)$$

By further calculation

$$= \frac{b+a}{ab} \times \frac{a^2b^2}{b^2-a^2}$$

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$$= \frac{b+a}{ab} \times \frac{(ab)(ab)}{(b-a)(b+a)}$$

So we get

$$\begin{aligned} &= \frac{1}{1} \times \frac{ab \times 1}{(b-a) \times 1} \\ &= \frac{ab}{b-a} \end{aligned}$$

$$(ii) \frac{1}{1+a^{m-n}} + \frac{1}{1+a^{n-m}}$$

We can write it as

$$\begin{aligned} &= \frac{1}{a^0 + a^{m-n}} + \frac{1}{a^0 + a^{n-m}} \\ &= \frac{1}{a^{m-m} + a^{m-n}} + \frac{1}{a^{n-n} + a^{n-m}} \end{aligned}$$

Taking out the common terms

$$= \frac{1}{a^m(a^{-m} + a^{-n})} + \frac{1}{a^n(a^{-n} + a^{-m})}$$

By further calculation

$$= \frac{1}{a^m\left(\frac{1}{a^m} + \frac{1}{a^n}\right)} + \frac{1}{a^n\left(\frac{1}{a^n} + \frac{1}{a^m}\right)}$$

Taking LCM

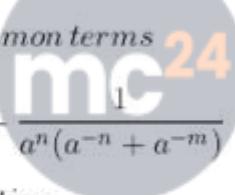
$$\begin{aligned} &= \frac{1}{a^m\left(\frac{a^n+a^m}{a^{m+n}}\right)} + \frac{1}{a^n\left(\frac{a^m+a^n}{a^{m+n}}\right)} \\ &= \frac{1}{a^m(a^n + a^m)} + \frac{1}{a^n(a^m + a^n)} \end{aligned}$$

On further simplification

$$= \frac{a^n}{(a^n + a^m)} + \frac{a^m}{(a^m + a^n)}$$

So we get

$$= \frac{a^n + a^m}{a^m + a^n}$$



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$$\begin{aligned} &= \frac{a^m + a^n}{a^m + a^n} \\ &= 1 \end{aligned}$$

**21. Prove the following:**

(i)  $(a + b)^{-1} (a^{-1} + b^{-1}) = 1/ab$

(ii)  $\frac{x + y + z}{x^{-1}y^{-1} + y^{-1}z^{-1} + z^{-1}x^{-1}} = xyz.$

**Solution:**

(i)  $(a + b)^{-1} (a^{-1} + b^{-1}) = 1/ab$

Here

LHS =  $(a + b)^{-1} (a^{-1} + b^{-1})$

We can write it as

$$= (a + b)^{-1} \left( \frac{1}{a} + \frac{1}{b} \right)$$

*Taking LCM*

$$= \frac{1}{(a + b)^1} \left( \frac{b + a}{ab} \right)$$

*By further calculation*

$$= \frac{1}{a + b} \cdot \frac{a + b}{ab}$$

$$= \frac{1}{ab}$$

= RHS

Hence, proved.



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$$(ii) \frac{x + y + z}{x^{-1}y^{-1} + y^{-1}z^{-1} + z^{-1}x^{-1}} = xyz$$

Here

$$LHS = \frac{x + y + z}{x^{-1}y^{-1} + y^{-1}z^{-1} + z^{-1}x^{-1}}$$

We can write it as

$$\begin{aligned} &= \frac{x + y + z}{\frac{1}{xy} + \frac{1}{yz} + \frac{1}{zx}} \\ &= \frac{x + y + z}{\frac{1}{xy} + \frac{1}{yz} + \frac{1}{zx}} \end{aligned}$$

Taking LCM

$$= \frac{x + y + z}{\frac{z + x + y}{xyz}}$$

By further calculation

$$\begin{aligned} &= \frac{(x + y + z) \times xyz}{(z + x + y)} \\ &= \frac{(x + y + z) \times xyz}{(x + y + z)} \end{aligned}$$

So we get

$$= \frac{1 \times xyz}{1}$$

$$= xyz$$

$$= RHS$$

Hence, proved.

**22. If  $a = c^z$ ,  $b = a^x$  and  $c = b^y$ , prove that  $xyz = 1$ .**

**Solution:**

It is given that

$$a = c^z, b = a^x \text{ and } c = b^y$$

We can write it as

$$a = (b^y)^z \text{ where } c = b^y$$

So we get

$$a = b^{yz}$$

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Here

$$a = (a^x)^{yz}$$

$$a^1 = a^{xyz}$$

By comparing both

$$xyz = 1$$

Therefore, it is proved.

**23. If  $a = xy^{p-1}$ ,  $b = xy^{q-1}$  and  $c = xy^{r-1}$ , prove that  $a^{q-r} \cdot b^{r-p} \cdot c^{p-q} = 1$ .**

**Solution:**

It is given that

$$a = xy^{p-1}$$

Here

$$a^{q-r} = (xy^{p-1})^{q-r} = x^{q-r} \cdot y^{(q-r)(p-1)}$$

$$b = xy^{q-1}$$

Here

$$b^{r-p} = (xy^{q-1})^{r-p} = x^{r-p} \cdot y^{(q-1)(r-p)}$$

$$c = xy^{r-1}$$

Here

$$c^{p-q} = (xy^{r-1})^{p-q} = x^{p-q} \cdot y^{(r-1)(p-q)}$$

Consider

$$\text{LHS} = a^{q-r} \cdot b^{r-p} \cdot c^{p-q}$$

Substituting the values

$$= x^{q-r} \cdot y^{(q-r)(p-1)} \cdot x^{r-p} \cdot y^{(q-1)(r-p)} \cdot x^{p-q} \cdot y^{(r-1)(p-q)}$$

By further calculation

$$= x^{q-r+r-p-q} \cdot y^{(p-1)(q-r) + (q-1)(r-p) + (r-1)(p-q)}$$

So we get

$$= x^0 \cdot y^{pq - pr - q + r + qr - pr - r + p + rp - qr - p + q}$$

$$= x^0 \cdot y^0$$

$$= 1 \times 1$$

$$= 1$$

$$= \text{RHS}$$

**24. If  $2^x = 3^y = 6^{-z}$ , prove that  $1/x + 1/y + 1/z = 0$ .**

**Solution:**

Consider

$$2^x = 3^y = 6^{-z} = k$$

Here

$$2^x = k$$

We can write it as

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$$2 = (k)^{1/x}$$

$$3^y = k$$

We can write it as

$$3 = (k)^{1/y}$$

$$6^{-z} = k$$

We can write it as

$$6 = (k)^{-1/z}$$

So we get

$$2 \times 3 = 6$$

$$(k)^{1/x} \times (k)^{1/y} = (k)^{-1/z}$$

By further calculation

$$(k)^{1/x + 1/y} = (k)^{-1/z}$$

We get

$$1/x + 1/y = -1/z$$

$$1/x + 1/y + 1/z = 0$$

Therefore, it is proved.

**25. If  $2^x = 3^y = 12^z$ , prove that  $x = 2yz/y - z$ .**

**Solution:**

It is given that

$$2^x = 3^y = 12^z$$

Consider

$$2^x = 3^y = 12^z = k$$

Here

$$2^x = k \text{ where } 2 = (k)^{1/x}$$

$$3^y = k \text{ where } 3 = (k)^{1/y}$$

$$12^z = k \text{ where } 12 = (k)^{-1/z}$$

We know that

$$12 = 2 \times 2 \times 3$$



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$$(k)^{\frac{1}{z}} = (k)^{\frac{1}{x}} \times (k)^{\frac{1}{x}} \times (k)^{\frac{1}{y}}$$

*By further calculation*

$$(k)^{\frac{1}{z}} = (k)^{\frac{1}{x} + \frac{1}{x} + \frac{1}{y}}$$

$$(k)^{\frac{1}{z}} = (k)^{\frac{2}{x} + \frac{1}{y}}$$

*So we get*

$$\frac{1}{z} = \frac{2}{x} + \frac{1}{y}$$

$$\frac{1}{z} - \frac{1}{y} = \frac{2}{x}$$

*By taking LCM*

$$\frac{y - z}{yz} = \frac{2}{x}$$

*By cross multiplication*

$$x(y - z) = 2yz$$

$$x = \frac{2yz}{y - z}$$

Therefore, it is proved.

**26. Simplify and express with positive exponents:**

$$(3x^2)^0, (xy)^{-2}, (-27a^9)^{2/3}.$$

**Solution:**

We know that

$$(3x^2)^0 = 1$$



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$$(xy)^{-2} = \frac{1}{(xy)^2} = \frac{1}{x^2y^2}$$

$$(-27a^9)^{\frac{2}{3}} = [(-3) \times (-3) \times (-3)]^{\frac{2}{3}} \times (a^9)^{\frac{2}{3}}$$

*By further calculation*

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

*So we get*

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

$$= (-3) \times (-3) \times a^6$$

$$= 9a^6$$

**27. If  $a = 3$  and  $b = -2$ , find the values of:**

**(i)  $a^a + b^b$**

**(ii)  $a^b + b^a$ .**

**Solution:**

It is given that

$$a = 3 \text{ and } b = -2$$

(i)  $a^a + b^b = (3)^3 + (-2)^{-2}$

We can write it as



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

*By further calculation*

$$= 27 + \frac{1}{4}$$

*Taking LCM*

$$= \frac{27 \times 4 + 1}{4}$$

$$= \frac{108 + 1}{4}$$

$$= \frac{109}{4}$$

$$= 27\frac{1}{4}$$

(ii)  $a^b + b^a = (3)^{-2} + (-2)^3$

We can write it as

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

*By further calculation*

$$= \frac{1}{9} + (-8)$$

$$= \frac{1}{9} - 8$$

*Taking LCM*

$$= \frac{1 - 8 \times 9}{9}$$

$$= \frac{1 - 72}{9}$$

$$= \frac{-71}{9}$$

$$= -7\frac{8}{9}$$



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28. If  $x = 10^3 \times 0.0099$ ,  $y = 10^{-2} \times 110$ , find the value of  $\sqrt{\frac{x}{y}}$ .  
**Solution:**

It is given that

$$x = 10^3 \times 0.0099, y = 10^{-2} \times 110$$

We know that

$$\sqrt{\frac{x}{y}} = \sqrt{\frac{10^3 \times 0.0099}{10^{-2} \times 110}}$$

*By further calculation*

$$= \frac{10^3 \times 10^2 \times 0.0099}{110}$$

$$= \frac{10^5 \times 0.0099}{110}$$

*So we get*

$$= \sqrt{\frac{100000 \times 0.0099}{110}}$$

$$= \sqrt{\frac{990}{110}}$$

$$= \sqrt{9}$$

$$= \sqrt{3 \times 3}$$

$$= 3$$

29. Evaluate  $x^{1/2} \cdot y^{-1} \cdot z^{2/3}$  when  $x = 9$ ,  $y = 2$  and  $z = 8$ .

**Solution:**

It is given that

$$x = 9, y = 2 \text{ and } z = 8$$

We know that

$$x^{1/2} \cdot y^{-1} \cdot z^{2/3} = (9)^{1/2} \cdot (2)^{-1} \cdot (8)^{2/3}$$

*It can be written as*

$$= (3 \times 3)^{\frac{1}{2}} \cdot \frac{1}{(2)^1} \cdot (2 \times 2 \times 2)^{\frac{2}{3}}$$

*By further calculation*

$$= (3)^{2 \times \frac{1}{2}} \cdot \frac{1}{2} \cdot (2)^{3 \times \frac{2}{3}}$$

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

So we get

$$= 3 \times \frac{1}{2} \times 2 \times 2$$

$$= 3 \times \frac{1}{1} \times 1 \times 2$$

$$= \frac{6}{1}$$

$$= 6$$

**30. If  $x^4y^2z^3 = 49392$ , find the values of  $x$ ,  $y$  and  $z$ , where  $x$ ,  $y$  and  $z$  are different positive primes.**

**Solution:**

It is given that

$$x^4y^2z^3 = 49392$$

We can write it as

$$x^4y^2z^3 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 7 \times 7 \times 7$$

$$x^4y^2z^3 = (2)^4 (3)^2 (7)^3 \dots\dots (1)$$

|   |       |
|---|-------|
| 2 | 49392 |
| 2 | 24696 |
| 2 | 12348 |
| 2 | 6174  |
| 3 | 3087  |
| 3 | 1029  |
| 7 | 343   |
| 7 | 49    |
| 7 | 7     |
| 1 |       |



Now compare the powers of 4, 2 and 3 on both sides of equation (1)

$$x = 2, y = 3 \text{ and } z = 7$$

**31. If  $\sqrt[3]{a^6b^{-4}} = a^x \cdot b^{2y}$ , find  $x$  and  $y$ , where  $a$ ,  $b$  are different positive primes.**

**Solution:**

It is given that

$$\sqrt[3]{a^6b^{-4}} = a^x \cdot b^{2y}$$

We can write it as

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$$(a^6 b^{-4})^{\frac{1}{3}} = a^x . b^{2y}$$

*By further calculation*

$$(a)^{6 \times \frac{1}{3}} . (b)^{-4 \times \frac{1}{3}} = a^x . b^{2y}$$

$$(a)^2 . (b)^{-\frac{4}{3}} = a^x . b^{2y}$$

By comparing the base on both sides

$$2 = x$$

$$x = 2$$

$$-4/3 = 2y$$

$$2y = -4/3$$

By further calculation

$$y = -4/3 \times 1/2 = -2/3$$

**32. If  $(p + q)^{-1} (p^{-1} + q^{-1}) = p^a q^b$ , prove that  $a + b + 2 = 0$ , where  $p$  and  $q$  are different positive primes.**

**Solution:**

It is given that

$$(p + q)^{-1} (p^{-1} + q^{-1}) = p^a q^b$$

We can write it as

$$\frac{1}{p + q} \left( \frac{1}{p} + \frac{1}{q} \right) = p^a q^b$$

*Taking LCM*

$$\frac{1}{p + q} \times \left( \frac{q + p}{pq} \right) = p^a q^b$$

$$\frac{1}{pq} = p^a q^b$$

By cross multiplication

$$p^{-1} q^{-1} = p^a q^b$$

By comparing the powers

$$a = -1 \text{ and } b = -1$$

Here

$$\text{LHS} = a + b + 2$$

Substituting the values

$$= -1 - 1 + 2$$

$$= 0$$

$$= \text{RHS}$$