Solutions for Class 9 Maths Chapter 2 Exponents of Real Numbers

Exercise 2.1

Question 1: Simplify the following

(i) $3(a^4 b^3)^{10} \times 5 (a^2 b^2)^3$

(ii) $(2x^{-2} y^3)^3$

(iii) $\frac{(4\times10^7)(6\times10^{-5})}{8\times10^4}$

(iv) $\frac{4ab^2(-5ab^3)}{10a^2b^2}$

(v) $\left(\frac{x^2y^2}{a^2b^3}\right)^n$

(vi) $\frac{(a^{3n-9})^6}{a^{2n-4}}$

Solution:

Using laws: $(a^m)^n = a^{mn}$, $a^0 = 1$, $a^{-m} = 1/a$ and $a^m \times a^n = a^{m+n}$]

(i) $3(a^4 b^3)^{10} \times 5 (a^2 b^2)^3$

On simplifying the given equation, we get;

$= 3(a^{40} b^{30}) \times 5 (a^6 b^6)$

$= 15 (a^{46} b^{36})$

[using laws: $(a^m)^n = a^{mn}$ and $a^m \times a^n = a^{m+n}$]

(ii) $(2x^{-2} y^3)^3$

On simplifying the given equation, we get;

$= (2^3 x^{-2\times3} y^{3\times3})$

$= 8 x^{-6} y^9$

(iii)

$$\frac{(4\times10^{7})(6\times10^{-5})}{8\times10^{4}}$$

$$= \frac{(24\times10^{7}\times10^{-5})}{8\times10^{4}}$$

$$= \frac{(24\times10^{7-5})}{8\times10^{4}}$$

$$= \frac{(24\times10^{2})}{8\times10^{4}}$$

$$= \frac{(3\times10^{2})}{10^{4}}$$

$$= \frac{3}{100}$$

(iv) $\frac{4ab^2\ (-5ab^3)}{10a^2b^2} = \frac{4\times(-5)}{10} \times a^{1+1-2}\ b^{2+3-2}$

$= -2 \times a^0 b^3$

$= -2b^3$

(v) $\left(\frac{x^2y^2}{a^2b^3}\right)^n$

$= \frac{x^{2n}\times y^{2n}}{a^{2n}\ b^{3n}} = \frac{x^{2n}\times y^{2n}}{a^{2n}\ b^{3n}}$

(vi) $\frac{(a^{3n-9})^6}{a^{2n-4}} = \frac{a^{(3n-9)6}}{a^{2n-4}}$

$= \frac{a^{18n-54}}{a^{2n-4}}$

$= a^{18n-54-2n+4} = a^{16n-50}$

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Question 2: If a = 3 and b =-2, find the values of:
(i) $a^a + b^b$
(ii) $a^b + b^a$
(iii) $(a+b)^{ab}$

Solution:
(i) $a^a + b^b$

Now putting the values of ‘a’ and ‘b’, we get;

$= 3^3 + (-2)^{-2}$

$= 3^3 + (-1/2)^2$

$= 27 + 1/4$

$= 109/4$

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

Now putting the values of ‘a’ and ‘b’, we get;

$= 3^{-2} + (-2)^3$

$= (1/3)^2 + (-2)^3$

$= 1/9 - 8$

$= -71/9$

(iii) $(a+b)^{ab}$

Now putting the values of ‘a’ and ‘b’, we get;

$= (3 + (-2))^{3(-2)}$

$= (3-2))^{-6}$

$= 1^{-6}$

$= 1$

Question 3: Prove that

$$(i)\ \left(\frac{x^a}{x^b}\right)^{a^2+ab+b^2} \times \left(\frac{x^b}{x^c}\right)^{b^2+bc+c^2} \times \left(\frac{x^c}{x^a}\right)^{c^2+ca+a^2} = 1$$

$$(ii)\ \left(\frac{x^a}{x^{-b}}\right)^{a^2-ab+b^2} \times \left(\frac{x^b}{x^{-c}}\right)^{b^2-bc+c^2} \times \left(\frac{x^c}{x^{-a}}\right)^{c^2-ca+a^2} = 1$$

$$(iii)\ \left(\frac{x^a}{x^b}\right)^{c} \times \left(\frac{x^b}{x^c}\right)^{a} \times \left(\frac{x^c}{x^a}\right)^{b} = 1$$

Solution:

(i) L.H.S. =

$$\frac{x^{a^3+a^2b+ab^2}}{x^{a^2b+ab^2+b^3}} \times \frac{x^{b^3+b^2c+bc^2}}{x^{b^2c+bc^2+c^3}} \times \frac{x^{c^3+c^2a+ca^2}}{x^{c^2a+ca^2+a^3}}$$

$$= x^{a^3+a^2b+ab^2-(b^3+a^2b+ab^2)} \times x^{b^3+b^2c+bc^2-(c^3+b^2c+bc^2)} \times x^{c^3+c^2a+ca^2-(a^3+c^2a+ca^2)}$$

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

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

$$= x^0$$

$$= 1$$

= R.H.S.

(ii) We have to prove here;

$$\left(\frac{x^a}{x^{-b}}\right)^{a^2-ab+b^2} \times \left(\frac{x^b}{x^{-c}}\right)^{b^2-bc+c^2} \times \left(\frac{x^c}{x^{-a}}\right)^{c^2-ca+a^2} = x^{2(a^3+b^3+c^3)}$$

L.H.S. =

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

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

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

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

=R.H.S.

(iii) L.H.S. =

$$\left(\frac{x^a}{x^b}\right)^c \times \left(\frac{x^b}{x^c}\right)^a \times \left(\frac{x^c}{x^a}\right)^b$$

$$= \left(\frac{x^{ac}}{x^{bc}}\right) \times \left(\frac{x^{ba}}{x^{ca}}\right) \times \left(\frac{x^{bc}}{x^{ab}}\right)$$

$$= x^{ac-bc} \times x^{ba-ca} \times x^{bc-ab}$$

$$= x^{ac-bc+ba-ca+bc-ab}$$

$$= x^0$$

$$= 1$$

Question 4: Prove that

$$(i)\ \frac{1}{1+x^{a-b}} + \frac{1}{1+x^{b-a}} = 1$$

$$(ii)\ \frac{1}{1+x^{b-a}+x^{c-a}} + \frac{1}{1+x^{a-b}+x^{c-b}} + \frac{1}{1+x^{b-c}+x^{a-c}}$$

Solution:
(i) L.H.S

$$= \frac{1}{1+\frac{x^a}{x^b}} + \frac{1}{1+\frac{x^b}{x^a}}$$

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

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

$$= 1$$

= R.H.S.

(ii) L.H.S

$$= \frac{1}{1+\frac{x^b}{x^a}+\frac{x^c}{x^a}} + \frac{1}{1+\frac{x^a}{x^b}+\frac{x^c}{x^b}} + \frac{1}{1+\frac{x^b}{x^c}+\frac{x^a}{x^c}}$$

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

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

$$= 1$$

= R.H.S.

Question 5: Prove that

$$(i) \quad \frac{a+b+c}{a^{-1}b^{-1}+b^{-1}c^{-1}+c^{-1}a^{-1}} = abc$$

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

Solution:

(i) L.H.S.

$$= \frac{a+b+c}{\frac{1}{ab}+\frac{1}{bc}+\frac{1}{ca}}$$

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

$$= abc$$

= R.H.S.

(ii)

L.H.S.

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

$$= \frac{1}{(\frac{1}{a} + \frac{1}{b})}$$

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

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

= R.H.S.

Question 6: If abc = 1, show that

$$\frac{1}{1 + a + b^{-1}} + \frac{1}{1 + b + c^{-1}} + \frac{1}{1 + c + a^{-1}} = 1$$

Solution:

$$= \frac{1}{1+a+\frac{1}{b}} + \frac{1}{1+b+\frac{1}{c}} + \frac{1}{1+c+\frac{1}{a}}$$

$$= \frac{b}{b+ab+1} + \frac{c}{c+bc+1} + \frac{a}{a+ac+1} \quad ...(1)$$

Given, abc = 1

So, c = 1/ab

By putting the value c in equation (1)

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

$$= \frac{b}{b+ab+1} + \frac{\frac{1}{ab}\times ab}{1+b+ab} + \frac{ab}{1+ab+b}$$

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

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

$$= 1$$