iv):- $(a^{\frac{1}{3}} + b^{\frac{2}{3}}) \times (a^{\frac{2}{3}} - a^{\frac{1}{3}}b^{\frac{2}{3}} + b^{\frac{4}{3}})$

$= a^{\frac{1}{3}}(a^{\frac{2}{3}} - a^{\frac{1}{3}}b^{\frac{2}{3}} + b^{\frac{4}{3}}) + b^{\frac{2}{3}}(a^{\frac{2}{3}} - a^{\frac{1}{3}}b^{\frac{2}{3}} + b^{\frac{4}{3}})$

$= a^{\frac{1}{3}}a^{\frac{2}{3}} - a^{\frac{1}{3}}a^{\frac{1}{3}}b^{\frac{2}{3}} + a^{\frac{1}{3}}b^{\frac{4}{3}} + b^{\frac{2}{3}}a^{\frac{2}{3}} - b^{\frac{2}{3}}a^{\frac{1}{3}}b^{\frac{2}{3}} + b^{\frac{2}{3}}b^{\frac{4}{3}}$

$= a^{\frac{1}{3}+\frac{2}{3}} - a^{\frac{1}{3}+\frac{1}{3}}b^{\frac{2}{3}} + a^{\frac{1}{3}}b^{\frac{4}{3}} + b^{\frac{2}{3}}a^{\frac{2}{3}} - b^{\frac{2}{3}+\frac{2}{3}}a^{\frac{1}{3}} + b^{\frac{2}{3}+\frac{4}{3}}$

$= a - a^{\frac{2}{3}}b^{\frac{2}{3}} + a^{\frac{1}{3}}b^{\frac{4}{3}} + a^{\frac{2}{3}}b^{\frac{2}{3}} - a^{\frac{1}{3}}b^{\frac{4}{3}} + b^2$

$= a + b^2$

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Exercise 1.2

Q1:- Rationalize the denominator of the following

i):- $\frac{13}{4+\sqrt{3}}$

$= \frac{13}{4+\sqrt{3}} \times \frac{4-\sqrt{3}}{4-\sqrt{3}}$

$= \frac{13(4-\sqrt{3})}{(4)^2-(\sqrt{3})^2}$

$= \frac{13(4-\sqrt{3})}{16-3}$

$= \frac{13(4-\sqrt{3})}{13}$

$= 4-\sqrt{3}$

(ii) $\frac{\sqrt{2}+\sqrt{5}}{\sqrt{3}}$

$\frac{\sqrt{2}+\sqrt{5}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$\frac{(\sqrt{2}+\sqrt{5})\sqrt{3}}{(\sqrt{3})^2}$

$\frac{\sqrt{6}+\sqrt{15}}{3}$

(iii):- $\frac{\sqrt{2}-1}{\sqrt{5}}$

$\frac{\sqrt{2}-1}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$

$\frac{(\sqrt{2}-1)\sqrt{5}}{(\sqrt{5})^2}$

$\frac{\sqrt{10}-\sqrt{5}}{5}$

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iv):- $\frac{6-4\sqrt{2}}{6+4\sqrt{2}}$

$\frac{6-4\sqrt{2}}{6+4\sqrt{2}} \times \frac{6-4\sqrt{2}}{6-4\sqrt{2}}$

$\frac{(6-4\sqrt{2})^2}{(6)^2-(4\sqrt{2})^2}$

$\frac{(6)^2+(4\sqrt{2})^2-2(6)(4\sqrt{2})}{36-(16\times 2)}$

$\frac{36+(16\times 2)-48\sqrt{2}}{36-32}$

$\frac{36+32-48\sqrt{2}}{4}$

$\frac{68-48\sqrt{2}}{4}$

$\frac{4(17-12\sqrt{2})}{4}$

$17-12\sqrt{2}$

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vi):- $\frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$

$$\frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}} \times \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}-\sqrt{2}}$$

$$\frac{3-\sqrt{6}-\sqrt{6}+2}{(\sqrt{3})^2-(\sqrt{2})^2}$$

$$\frac{5-2\sqrt{6}}{3-2}$$

$$\frac{5-2\sqrt{6}}{1}$$

$$5-2\sqrt{6}$$

vii):- $\frac{4\sqrt{3}}{\sqrt{7}+\sqrt{5}}$

$$\frac{4\sqrt{3}}{\sqrt{7}+\sqrt{5}} \times \frac{\sqrt{7}-\sqrt{5}}{\sqrt{7}-\sqrt{5}}$$

$$\frac{4\sqrt{3}(\sqrt{7}-\sqrt{5})}{(\sqrt{7})^2-(\sqrt{5})^2}$$

$$\frac{4(\sqrt{21}-\sqrt{15})}{7-5}$$

$$\frac{4(\sqrt{21}-\sqrt{15})}{2}$$

$$2(\sqrt{21}-\sqrt{15})$$

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Q2:- Simplify the following:

i):- $\left(\frac{81}{16}\right)^{-\frac{3}{4}}$

$= \left(\frac{16}{81}\right)^{\frac{3}{4}}$

$= \frac{(16)^{\frac{3}{4}}}{(81)^{\frac{3}{4}}}$

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

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

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

$= \frac{8}{27}$

2	16
2	8
2	4
2	2
	1

3	81
3	27
3	9
3	3
	1

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(ii) $\left(\frac{3}{4}\right)^{-2} \div \left(\frac{4}{9}\right)^{3} \times \frac{16}{27}$

$\left(\frac{4}{3}\right)^{2} \times \frac{1}{\left(\frac{4}{9}\right)^{3}} \times \frac{16}{27}$

$\frac{(4)^2}{(3)^2} \times \frac{1}{\frac{(4)^3}{(9)^3}} \times \frac{16}{27}$

$$= \frac{16}{9} \times \frac{1}{\frac{64}{729}} \times \frac{16}{27}$$

$$= \frac{16}{9} \times \frac{729}{64} \times \frac{16}{27}$$

$$= \frac{\cancel{16}^{4}}{\cancel{9}_{1}} \times \frac{\cancel{729}^{81}}{\cancel{64}_{1}} \times \frac{\cancel{16}^{1}}{\cancel{27}_{1}}$$

$$= \frac{12}{1}$$

$$= 12$$

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⑤

iii):- $(0.027)^{\frac{-1}{3}}$

$$\left(\frac{0.027}{1000}\right)^{\frac{-1}{3}}$$

$$\left(\frac{1000}{27}\right)^{\frac{1}{3}}$$

$$\frac{(1000)^{\frac{1}{3}}}{(27)^{\frac{1}{3}}}$$

$$\frac{(10^3)^{\frac{1}{3}}}{(3^3)^{\frac{1}{3}}}$$

$$\frac{\sqrt[3]{10^3}}{\sqrt[3]{3^3}} = \frac{10}{3}$$

iv):- $\sqrt[7]{\dfrac{x^{14} \times y^{21} \times z^{35}}{y^{14} z^{7}}}$

$= \sqrt[7]{x^{14} \times y^{21} \times z^{35} \times y^{-14} \times z^{-7}}$

$= \sqrt[7]{x^{14} \times y^{21-14} \times z^{35-7}}$

$= \sqrt[7]{x^{14} \times y^{7} \times z^{28}}$

$= \sqrt[7]{x^{14}} \times \sqrt[7]{y^{7}} \times \sqrt[7]{z^{28}}$

$= (x^{14})^{\frac{1}{7}} \times y \times (z^{28})^{\frac{1}{7}}$

$= x^{14 \times \frac{1}{7}} \times y \times z^{28 \times \frac{1}{7}}$

$= x \times y \times z$

$= x^{2} \times y \times z^{4}$

$= x^{2} y z^{4}$

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VI):- $$\frac{5.(25)^{n+1} - 25.(5)^{2n}}{5.(5)^{2n+3} - (25)^{n+1}}$$

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

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

$$= \frac{5^{1+2n+2} - 5^{2+2n}}{5^{4+2n} - 5^{2n+2}}$$

$$\frac{5^{3+2n} - 5^{2+2n}}{5^{4+2n} - 5^{2n+2}}$$

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

$$\frac{5^2(5^1 - 1)}{5^2(5^2 - 1)}$$

$$\frac{5-1}{25-1}$$

$$\frac{4}{24} = \frac{1}{6}$$

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vi):- $\dfrac{(16)^{x+1} + 20(4)^{2x}}{2^{x-3} \times 8^{x+2}}$

$= \dfrac{(2^4)^{x+1} + 20(2^2)^{2x}}{2^{x-3} \times (2^3)^{x+2}}$

$= \dfrac{(2)^{4x+4} + 20(2)^{4x}}{2^{x-3} \times (2)^{3x+6}}$

$= \dfrac{2^{4x}(2^4 + 20)}{2^{x-3+3x+6}}$

$\dfrac{2^{4x}(16+20)}{2^{4x+3}}$

$= \dfrac{2^{4x}(36)}{2^{4x} \cdot 2^3}$

$= \dfrac{36}{8}$

$= \dfrac{9}{2}$

vii):- $(64)^{\frac{-2}{3}} \div (9)^{\frac{-3}{2}}$

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

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

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

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

$$= \frac{3^3}{4^2}$$

$$= \frac{27}{16}$$

(viii) $$\frac{3^n \times 9^{n+1}}{3^{n-1} \times 9^{n-1}}$$

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

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

$$= \frac{3^{n+2n+2}}{3^{n-1+2n-2}}$$

$$= \frac{3^{3n+2}}{3^{3n-3}}$$

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

$$= 3^5$$

$$= 243$$

⑨

(ix) $$\frac{5^{n+3} - 6 \times 5^{n+1}}{9 \times 5^n - 4 \times 5^n}$$

$$= \frac{5^n(5^3 - 6 \times 5^1)}{5^n(9-4)}$$

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

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

$$= 19$$

Q3:- If $x = 3 + \sqrt{8}$ then find the value of

$$x = 3 + \sqrt{8}$$

$$\frac{1}{x} = \frac{1}{3+\sqrt{8}}$$

$$= \frac{1}{3+\sqrt{8}} \times \frac{3-\sqrt{8}}{3-\sqrt{8}}$$

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

$$= \frac{3-\sqrt{8}}{9-8}$$

$$= \frac{3-\sqrt{8}}{1}$$

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$$x = 3 + \sqrt{8}$$

$$\frac{1}{x} = 3 - \sqrt{8}$$

i):- $x + \frac{1}{x}$

$$x + \frac{1}{x} = 3+\sqrt{8} + 3 - \sqrt{8}$$

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

ii):- $x - \frac{1}{x}$

$$x - \frac{1}{x} = 3+\sqrt{8} - (3 - \sqrt{8})$$

$$= 3+\sqrt{8} - 3 + \sqrt{8}$$

$$x - \frac{1}{x} = 2\sqrt{8}$$

iii):- $x^2 + \frac{1}{x^2}$

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

Taking square on both sides

$$\left(x + \frac{1}{x}\right)^2 = (6)^2$$

$$(x)^2 + \left(\frac{1}{x}\right)^2 + 2(x)\left(\frac{1}{x}\right) = 36$$

$$x^2 + \frac{1}{x^2} + 2 = 36$$

$$x^2 + \frac{1}{x^2} = 36 - 2$$

$$x^2 + \frac{1}{x^2} = 34.$$

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v):- $x^4 + \frac{1}{x^4}$

$$x^2 + \frac{1}{x^2} = 34$$

Taking square on both sides

$$\left(x^2 + \frac{1}{x^2}\right)^2 = (34)^2$$

$$(x^2)^2 + \left(\frac{1}{x^2}\right)^2 + 2(x^2)\left(\frac{1}{x^2}\right) = 11$$

$$x^4 + \frac{1}{x^4} + 2 = 1156$$

$$x^4 + \frac{1}{x^4} = 1156 - 2$$

$$x^4 + \frac{1}{x^4} = 1154$$

iv):- $x^2 - \frac{1}{x^2}$

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

$= (6)(2\sqrt{8})$

$x^2 - \frac{1}{x^2} = 12\sqrt{8}$

vi):- $(x - \frac{1}{x})^2$

$x - \frac{1}{x} = 2\sqrt{8}$

$(x - \frac{1}{x})^2 = (2\sqrt{8})^2$

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

$(x - \frac{1}{x})^2 = 32.$

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Q4:- Find the rational number P and P such that

$$\frac{8 - 3\sqrt{2}}{4 + 3\sqrt{2}} = P + q\sqrt{2}$$

$$\frac{8 - 3\sqrt{2}}{4 + 3\sqrt{2}} \times \frac{4 - 3\sqrt{2}}{4 - 3\sqrt{2}} = P + q\sqrt{2}$$

$$\frac{32 - 24\sqrt{2} - 12\sqrt{2} + 9(2)}{(4)^2 - (3\sqrt{2})^2} = P + q\sqrt{2}$$

$$\frac{32 - 24\sqrt{2} - 12\sqrt{2} + 18}{16 - (9 \times 2)} = P + q\sqrt{2}$$

$$\frac{50 - 36\sqrt{2}}{16 - 18} = P + q\sqrt{2}$$

$$\frac{50 - 36\sqrt{2}}{-2} = P + q\sqrt{2}$$

$$\frac{50}{-2} - \frac{36\sqrt{2}}{-2} = P + q\sqrt{2}$$

$$-25 + 18\sqrt{2} = P + q\sqrt{2}$$

$P = -25, \quad q = 18$

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Q5:- Simplify the following

i):-
$$\frac{(25)^{\frac{3}{2}} \times (243)^{\frac{3}{5}}}{(16)^{\frac{5}{4}} \times (8)^{\frac{4}{3}}}$$

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

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

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

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

$$= \frac{5^3 \times 3^3}{2^9}$$

$$= \frac{125 \times 27}{512} = \frac{3375}{512}$$

$=$

3	243
3	81
3	27
3	9
3	3
	1

Exercise 1.2

Q5 Simplify the following

i):- $\dfrac{(25)^{\frac{3}{2}} \times (243)^{\frac{3}{5}}}{(16)^{\frac{5}{4}} \times (8)^{\frac{4}{3}}}$

$$\frac{(5^2)^{\frac{3}{2}} \times (3^5)^{\frac{3}{5}}}{(2^4)^{\frac{5}{4}} \times (2^3)^{\frac{4}{3}}}$$

$$\frac{(5)^{2 \times \frac{3}{2}} \times (3)^{5 \times \frac{3}{5}}}{(2)^{4 \times \frac{5}{4}} \times (2)^{3 \times \frac{4}{3}}}$$

$$\frac{5^3 \times 3^3}{2^5 \times 2^4}$$

$$\frac{125 \times 27}{32 \times 16}$$

$$\frac{3,375}{512}$$

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ii):-

$$\frac{54 \times \sqrt[3]{(27)^{2x}}}{9^{x+1} + 216(3^{2x-1})}$$

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

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

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2	54
3	27
3	9
3	3
	1

2	216
2	108
2	54
3	27
3	9
3	3
	1

$(x^2)^3 = x^{2\times3} = x^6$

$(x^a)^b = x^{a\times b} = x^{ab}$

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

$x^2 \cdot x^3 = x^{2+3} = x^5$

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

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

$$= \frac{2 \times 3^{3} \times 3^{2x}}{3^{2x+2}(1 + 8)}$$

$$= \frac{2 \times 3^{3+2x}}{3^{2x+2}(9)}$$

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

$$= \frac{2 \times 3^{3+2x}}{3^{2x+2+2}}$$

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

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

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Q5(iii)

$$\sqrt{\frac{(216)^{\frac{2}{3}} \times (25)^{\frac{1}{2}}}{(0.04)^{-\frac{3}{2}}}}$$

$$= \sqrt{\frac{(2^3 \times 3^3)^{\frac{2}{3}} \times (5^2)^{\frac{1}{2}}}{\left(\frac{0.04}{100}\right)^{-\frac{3}{2}}}}$$

$$= \sqrt{\frac{(2^3)^{\frac{2}{3}} \times (3^3)^{\frac{2}{3}} \times 5^{2 \times \frac{1}{2}}}{\left(\frac{1}{25}\right)^{-\frac{3}{2}}}}$$

$$= \frac{2}{3^4 \times 3^{-3}}$$

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

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

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

2	216
2	108
2	54
3	27
3	9
3	3
	1

6	216
6	36
6	6
	1

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$$\sqrt{\frac{2^{3\times\frac{2}{3}} \times 3^{3\times\frac{2}{3}} \times 5^{\frac{1}{2}}}{\left(\frac{25}{1}\right)^{\frac{3}{2}}}}$$

$$\sqrt{\frac{2^2 \times 3^2 \times 5^1}{(5^2)^{3/2}}}$$

$$\sqrt{\frac{2^2 \times 3^2 \times 5^1}{5^{2\times\frac{3}{2}}}}$$

$$\sqrt{\frac{2^2 \times 3^2 \times 5^1}{5^3}}$$

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

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

$$\sqrt{\frac{2^2 \times 3^2}{5^2}}$$

$$\frac{\sqrt{2^2} \times \sqrt{3^2}}{\sqrt{5^2}}$$

$$\frac{2\times 3}{5} = \frac{6}{5}$$

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