

$$3^2 = 3 \times 3 = 9, \checkmark$$

$$3^3 = 3 \times 3 \times 3 = 27, \checkmark$$

$$3^{-2} = \frac{1}{3^2} = \frac{1}{9}, \checkmark$$

$$\frac{3^{-2}}{2^{-2}} = \frac{2^2}{3^2} = \frac{4}{9}, \checkmark$$

$$\left\{ \frac{3^{-2}}{2^{-2}} \right\}^6 = \frac{3^{-4}}{2^{-4}} = \frac{2^4}{3^4} = \frac{16}{81}, \checkmark$$

$$3^{(2^2)} = 3^4 = 81, \checkmark$$

$$\{(3^2)^0\}^2 = 3^8$$

Surds & Indices

$\frac{2}{3} \rightarrow$ Power
 $\frac{2}{3} \rightarrow$ Root

$F = \frac{2}{0} \rightarrow$ Power
 $F = \frac{2}{0} \rightarrow$ Root

$$3^{\frac{2}{5}} = \sqrt[5]{3^2}$$

$$\sqrt[5]{27^2}$$

$$= 27^{\frac{2}{5}}$$

$$\frac{3^{\frac{2}{5}}}{5^{\frac{2}{5}}} = \sqrt[5]{5^3}$$

$$\left. \begin{aligned} 27^{\frac{2}{3}} &= \sqrt[3]{27^2} \\ &= \sqrt[3]{729} \\ &= \boxed{9} \end{aligned} \right\} \begin{aligned} 27^{\frac{2}{3}} &= \frac{27^2}{3^2} \\ &= \frac{729}{9} \\ &= \boxed{81} \end{aligned}$$

$$\frac{2}{4} = \sqrt[4]{1024^2}$$

$$\frac{2}{4} = \sqrt[4]{1024} = 2$$

$$\boxed{= 32}$$

$$\begin{array}{r} 2 \overline{) 1024} \\ \underline{412} \\ 256 \\ \underline{256} \\ 0 \end{array}$$

$$\begin{array}{r} 2 \overline{) 128} \\ \underline{64} \\ 64 \\ \underline{64} \\ 0 \end{array}$$

$$\begin{array}{r} 2 \overline{) 32} \\ \underline{16} \\ 16 \\ \underline{16} \\ 0 \end{array}$$

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

Surds → (Root)

Type-one { Express as pure Surds }

$$\begin{aligned} \sqrt{12} &= \sqrt{4 \times 3} \\ &= 2\sqrt{3} \\ \boxed{\sqrt{12} = 2\sqrt{3}} \end{aligned} \quad \left\{ \begin{aligned} 2\sqrt{3} &= \sqrt{2^2 \times 3} \\ &= \sqrt{4 \times 3} \\ &= \sqrt{12} \checkmark \end{aligned} \right.$$

$$\textcircled{1} \quad 2\sqrt{5} = \sqrt{2^2 \times 5} = \sqrt{4 \times 5} = \sqrt{20} \checkmark$$

$$\textcircled{2} \quad 3\sqrt[4]{5} = \sqrt[4]{3^4 \times 5} = \sqrt[4]{81 \times 5} = \sqrt[4]{405} \checkmark$$

$$\textcircled{3} \quad 3\sqrt{16} = \sqrt{3^2 \times 16} = \sqrt{9 \times 16} = \sqrt{144} = \underline{12}$$

$$\textcircled{4} \quad \frac{3}{2}\sqrt[4]{\frac{32}{243}} = \sqrt[4]{\frac{3^4}{2^4} \times \frac{32}{243}} = \sqrt[4]{\frac{81}{16} \times \frac{32}{243}} = \sqrt[4]{\frac{2}{3}}$$

Type-two Convert the following :-

$$\begin{aligned} \textcircled{1} \quad \sqrt[3]{9} &\text{ into a Surd of order of "6"} \\ &= 9^{\frac{1}{3}} = 9^{\frac{2}{6}} = 9^2 = \sqrt[6]{81} \checkmark \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad \sqrt{3} &\text{ into a Surd of order of "12"} \checkmark \\ &= 3^{\frac{1}{2}} = 3^{\frac{12}{24}} = 3^6 = \sqrt[12]{729} \end{aligned}$$

$$\begin{aligned} \textcircled{3} \quad \sqrt[5]{7} &\text{ into a Surd of order of "125"} \\ &= 7^{\frac{1}{5}} = 7^{\frac{125}{125}} = 7^{25} = \sqrt[125]{7^{25}} \end{aligned}$$

④ $2\sqrt{3}$ into a Surd of order of "4"
 $= \sqrt{2^2 \times 3} = \sqrt{4 \times 3} = \sqrt{12} = 12^{\frac{1}{2}} = 12^{\frac{2}{4}} = \sqrt[4]{144}$

⑤ $5\sqrt{5}$ into a Surd of order of "8"
 $= \sqrt{5^2 \times 5} = \sqrt{125} = 125^{\frac{1}{2}} = 125^{\frac{4}{8}} = \sqrt[8]{125^4}$

⑥ $\frac{3}{2}\sqrt{8}$ into a Surd of order of "4"
 $= \sqrt{\frac{3^2}{2^2} \times 8} = \sqrt{\frac{9}{4} \times 8} = \sqrt{18} = 18^{\frac{1}{2}} = 18^{\frac{2}{4}} = \sqrt[4]{324}$

Type-3 Arrangement

⑦ $\sqrt[4]{2}, \sqrt[3]{3}, \sqrt[5]{16}$ Arrange in the same order.
 LCM of 4, 3, 5 = 60
 $\sqrt[4]{2} \rightarrow 60 \Rightarrow 2^{\frac{60}{4}} \Rightarrow 2^{15}$
 $\sqrt[3]{3} \rightarrow 60 \Rightarrow 3^{\frac{60}{3}} \Rightarrow 3^{20}$
 $\sqrt[5]{16} \rightarrow 60 \Rightarrow 16^{\frac{60}{5}} \Rightarrow 16^{12}$
 $\sqrt[60]{2^{15}}, \sqrt[60]{3^{20}}, \sqrt[60]{16^{12}}$

⑧ $\sqrt[3]{4}, \sqrt{3}, \sqrt[4]{7}$ Arrange in the ascending order.
 LCM of 3, 2, 4 = 12
 $\sqrt[3]{4} = 4^{\frac{1}{3}} \Rightarrow 4^{\frac{4}{12}} = \sqrt[12]{256}$
 $\sqrt{3} = 3^{\frac{1}{2}} \Rightarrow 3^{\frac{6}{12}} = \sqrt[12]{729}$
 $\sqrt[4]{7} = 7^{\frac{1}{4}} \Rightarrow 7^{\frac{3}{12}} = \sqrt[12]{343}$
 $\sqrt[12]{256}, \sqrt[12]{343}, \sqrt[12]{729}$
 $\sqrt[3]{4}, \sqrt[4]{7}, \sqrt{3}$

Type-4, Addition & Subtraction. (Surds has to be same)

$$\begin{aligned} \textcircled{1} \quad 2\sqrt{3} + \sqrt{27} &= 2\sqrt{3} + \sqrt{9 \times 3} \\ &= 2\sqrt{3} + 3\sqrt{3} \\ &= 5\sqrt{3} \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad \sqrt[3]{2} + \sqrt[3]{16} + \sqrt[3]{54} \\ &= \sqrt[3]{2} + \sqrt[3]{2^3 \times 2} + \sqrt[3]{3^3 \times 2} \\ &= 0\sqrt[3]{2} + 2\sqrt[3]{2} + 3\sqrt[3]{2} \\ &= 6\sqrt[3]{2} \end{aligned}$$

$$\begin{aligned} \textcircled{3} \quad 5\sqrt{3} - 3\sqrt{75} + 5\sqrt{27} \\ &= 5\sqrt{3} - 3\sqrt{25 \times 3} + 5\sqrt{9 \times 3} \\ &= 5\sqrt{3} - 3 \times 5 \times \sqrt{3} + 5 \times 3 \times \sqrt{3} \\ &= 5\sqrt{3} - 15\sqrt{3} + 15\sqrt{3} \\ &= \boxed{5\sqrt{3}} \checkmark \end{aligned}$$

Type-5 Multiplication & Division

$$\begin{aligned} \textcircled{1} \quad \sqrt[3]{4} \times \sqrt[3]{22} &= \sqrt[3]{4 \times 22} = \sqrt[3]{88} = \sqrt[3]{11 \times 8} \\ &= \boxed{2\sqrt[3]{11}} \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad 4\sqrt{28} \div 3\sqrt{7} &= \frac{4\sqrt{28}}{3\sqrt{7}} = \frac{4\sqrt{4}}{3\sqrt{1}} = \frac{4 \times 2}{3 \times 1} = \frac{8}{3} \text{ or } \boxed{2\frac{2}{3}} \end{aligned}$$

③ $\sqrt[10]{3} \div \sqrt[5]{4}$

LCM of 10, 5 = 10.

$\sqrt[10]{3} = 3^{\frac{10}{10}} = \sqrt[10]{3}$, $\sqrt[5]{4} = 4^{\frac{10}{10}} = \sqrt[10]{16}$

$= \frac{\sqrt[10]{3}}{\sqrt[10]{16}} = \sqrt[10]{\frac{3}{16}}$ ✓

Practice Question:-

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

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

③ $\frac{2}{3\sqrt{3}} = \frac{2}{3\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{2\sqrt{3}}{9}$

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

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

$= \frac{12 + 2\sqrt{35}}{2} = \frac{2(6 + \sqrt{35})}{2}$

$= \boxed{6 + \sqrt{35}}$ ✓

⑥ $\frac{5+\sqrt{6}}{5-\sqrt{6}}$

1) $a-b$ 2) $a+b$ 3) ab 4) $a \div b$ 5) $\sqrt{ab}$

$$\frac{5+\sqrt{6}}{5-\sqrt{6}} \times \frac{5+\sqrt{6}}{5+\sqrt{6}} = \frac{5^2 + (\sqrt{6})^2 + 2 \times 5 \times \sqrt{6}}{(5)^2 - (\sqrt{6})^2} = \frac{25 + 6 + 10\sqrt{6}}{25 - 6}$$

$$= \frac{31 + 10\sqrt{6}}{19} = \frac{31}{19} + \frac{10\sqrt{6}}{19}$$

$\downarrow \quad \downarrow$
 $a+b$

⑦ $\frac{5+\sqrt{4}}{5-\sqrt{4}} = \frac{5+2}{5-2} = \boxed{\frac{7}{3}}$ ✓

OR $\frac{25+4+10\sqrt{4}}{21} = \frac{25+4+10 \times 2}{21} = \frac{49}{21} = \boxed{\frac{7}{3}}$

⑧ $(\cancel{2+\sqrt{2}}) + \frac{1}{\cancel{2+\sqrt{2}}} + \frac{1}{\cancel{2-\sqrt{2}}} + (\cancel{2-\sqrt{2}})$

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

⑨ $\frac{1+\sqrt{2}}{\sqrt{5}+\sqrt{3}} = \frac{1+\sqrt{2}}{\sqrt{5}+\sqrt{3}} \times \frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}-\sqrt{3}}$

$$= \frac{\sqrt{5}-\sqrt{3} + \sqrt{10}-\sqrt{6}}{(\sqrt{5})^2 - (\sqrt{3})^2} = \boxed{\frac{\sqrt{5}-\sqrt{3} + \sqrt{10}-\sqrt{6}}{2}}$$

(10) $\frac{1+\sqrt{2}}{\sqrt{5}+\sqrt{3}} + \frac{1-\sqrt{2}}{\sqrt{5}-\sqrt{3}}$

$$= \frac{\sqrt{5}-\sqrt{3} + \sqrt{10}-\sqrt{6} + \sqrt{5}+\sqrt{3} - \sqrt{10}-\sqrt{6}}{(\sqrt{5}+\sqrt{3})(\sqrt{5}-\sqrt{3})} = \frac{2(\sqrt{5}-\sqrt{6})}{2} = \boxed{\sqrt{5}-\sqrt{6}} \checkmark$$

~~$-3^4 \times \frac{5^4}{3^4} = -3^{\cancel{4}} \times \frac{5^4}{\cancel{3^4}} = -625$~~ ~~BODMAS~~

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

$\cancel{9} \times \frac{625}{\cancel{81}} = \boxed{625} \checkmark$

BODMAS

B $\rightarrow$ -, (,), {, }

O $\rightarrow$ of OR Order of power.

PEODMAS

BODMAS $\checkmark$

① $54 \div 6 \times 3 \times 1 + 18$

$\frac{54}{6} \times 3 \times 1 + 18$

$= 9 \times 3 \times 1 + 18$

$= \boxed{45}$

$54 \div 18 \times 1 + 18$

$\frac{54}{18} \times 1 + 18 = \boxed{21} \checkmark$

$\sqrt{256} \rightarrow 2^2 \times 6^2$

$\downarrow$

$\boxed{16} = 1$

$2+1 = \boxed{2}$

$\sqrt{676} \rightarrow 2^2 \times 13^2$

$\downarrow$

$\boxed{26} \rightarrow \boxed{26^2}$

$2^2 + 2 = \boxed{6}$



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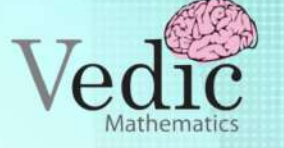
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