

①

$$Ex = 1.1$$

1. Identify each of the following as a rational or irrational number:

(i) 2.353535

Sol.

$$2.353535$$

• Due to Recurring and Terminating
it is Rational number.

(ii) $0.\bar{6}$

Sol:

$$0.\bar{6}$$

$$0.6666\dots$$

• Due to Recurring It is Rational
number.

(iii) $2.236067\dots$

Sol:-

$$2.236067\dots$$

Due to not Terminating it is
Irrational

(iv) $\sqrt{7}$

Sol

$$\sqrt{7}$$

• It is irrational because Prime
number under Square root.

$\therefore \sqrt{n}$ is irrational
if n is prime

(2)

(v) e

Sol:-

we know

$$e = 2.7182 \dots$$

It is irrational due to non-terminating

(vi) π

Sol:-

we know

$$3.141592 \dots$$

It is irrational due to non-terminating

(vii) $5 + \sqrt{11}$

Sol:-

$$5 + \sqrt{11}$$

5 is Rational

$\sqrt{11}$ is irrational

we know

Rational + irrational = irrational

So, $5 + \sqrt{11}$ is irrational number

(viii) $\sqrt{3} + \sqrt{13}$

Sol:-

$$\sqrt{3} + \sqrt{13}$$

$\sqrt{3}$ is irrational

$\sqrt{13}$ is irrational

Irrational + irrational = irrational

So, $\sqrt{3} + \sqrt{13}$ is irrational

(3)

(ix) $\frac{15}{4}$

Sol

$$\frac{15}{4}$$

$$= 3.75$$

$$\begin{array}{r} 3.75 \\ 4 \overline{) 15} \\ \underline{12} \\ 30 \\ \underline{28} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

Due to Terminating it is Rational

(x) $(2 - \sqrt{2})(2 + \sqrt{2})$

Sol

$$(2 - \sqrt{2})(2 + \sqrt{2})$$

$$\therefore (a+b)(a-b) = a^2 - b^2$$

$$= (2)^2 - (\sqrt{2})^2$$

$$= 4 - 2$$

$$= 2$$

Rational

It is rational number

$$\therefore \text{irrational} \times \text{irrational} = \text{rational}$$

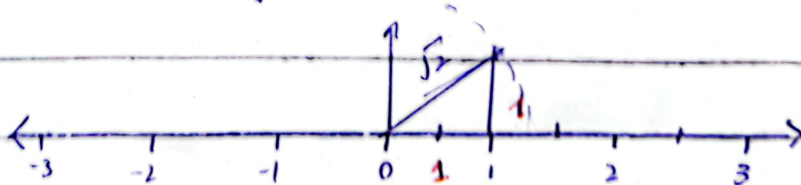
2. ~~Represent~~ Represent the following number on number line

(i) $\sqrt{2}$

Sol:-

$$\sqrt{(1)^2 + (1)^2} = \sqrt{2}$$

$$x=1, y=1$$



(4)

(ii) $\sqrt{3}$

Sol:-

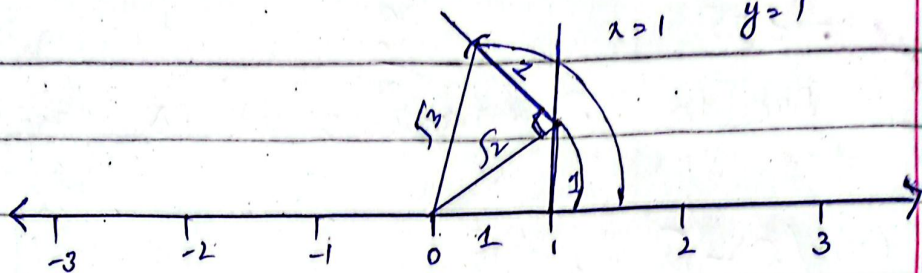
$$\sqrt{3} = \sqrt{(\sqrt{2})^2 + (1)^2}$$

$$x = \sqrt{2}$$

$$y = 1$$

$$\sqrt{2} = \sqrt{(1)^2 + (1)^2}$$

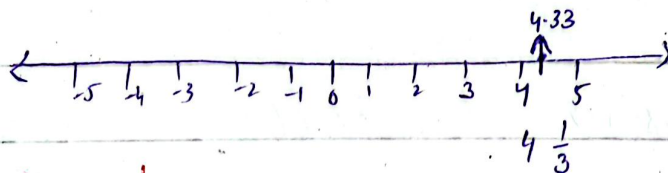
$$x=1 \quad y=1$$



(iii) $4\frac{1}{3}$

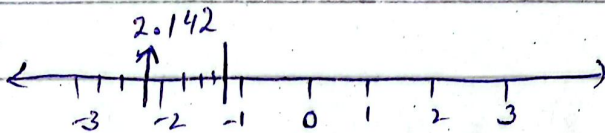
Sol:-

$$4\frac{1}{3} = \frac{13}{3} = 4.333\ldots$$



(iv) $-2\frac{1}{7}$

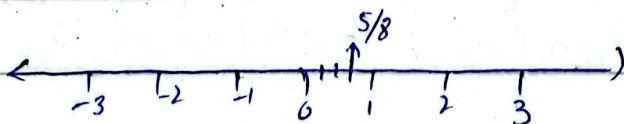
$$\text{Sol:- } -\frac{15}{7} = -2.142857143\ldots$$



(v) $\frac{5}{8}$

Sol

$$\frac{5}{8} = 0.625$$

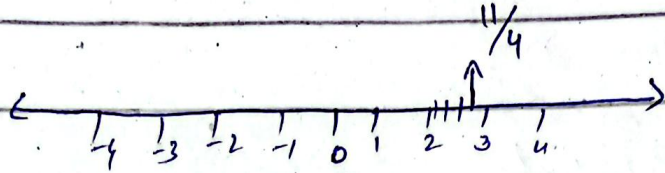


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⑤

(vi) $2\frac{3}{4}$

Sol:- $2\frac{3}{4} = \frac{11}{4} = 2.75$



3 Express the following as a rational number $\frac{p}{q}$ where p and q are integers and $q \neq 0$

(i) $0.\bar{4}$

Sol:-

$0.\bar{4}$

Let

$x = 0.4444 \dots$ (i)

(x) by eq (i)

$10x = 0.4444 \dots \times 10$

$10x = 4.4444 \dots$ (ii)

(ii) - (i)

$10x - x = 4.4444 \dots - 0.4444$

$9x = 4$

$x = \frac{4}{9}$

⑥

(ii) $0.\overline{37}$

Sol:-

$$0.\overline{37}$$

Let

$$x = 0.373737\ldots \quad (i)$$

(x) by 100 eq (i)

$$100x = 0.373737\ldots \times 100$$

$$100x = 37.373737\ldots \quad (ii)$$

(ii) - (i)

$$100x - x = 37.373737\ldots - 0.373737\ldots$$

$$99x = 37$$

$$\boxed{x = \frac{37}{99}}$$

(iii) $0.\overline{21}$

Sol:-

$$0.\overline{21}$$

Let

$$x = 0.\overline{21}$$

$$x = 0.212121\ldots \quad (i)$$

(x) by 100 eq (i)

$$100x = 0.212121\ldots \times 100$$

$$100x = 21.212121\ldots \quad (ii)$$

(ii) - (i)

$$100x - x = 21.212121\ldots - 0.212121\ldots$$

$$99x = 21$$

$$\boxed{x = \frac{21}{99}}$$

(7)

4. Name the property used in the following

(i) $(a+u) + b = a + (u+b)$

Sol

$$(a+u) + b = a + (u+b)$$

Associative property w.r.t. $(+)$

(ii) $\sqrt{2} + \sqrt{3} = \sqrt{3} + \sqrt{2}$

Sol

$$\sqrt{2} + \sqrt{3} = \sqrt{3} + \sqrt{2}$$

we know commutative law

$$a, b \in \mathbb{R} \text{ if } a+b = b+a$$

$$\sqrt{2} + \sqrt{3} = \sqrt{3} + \sqrt{2}$$

Commutative property hold w.r.t. $(+)$

(iii) $x - x = 0$

Sol:-

$$x - x = 0$$

$$x + (-x) = 0$$

we Additive inverse

$$a + (-a) = 0$$

so additive inverse property hold.

(iv) $a(b+c) = ab+ac$

Sol:-

$$a(b+c) = ab+ac$$

left distributive property of multiplication over addition.

(8)

$$v) 16 + 0 = 16$$

Sol/ $16 + 0 = 16$

we know Additive Identity

$$a + 0 = a$$

So, this property hold.

$$(vi) 100 \times 1 = 100$$

Sol:-

$$100 \times 1 = 100$$

we know multiplicative Identity

$$a \times 1 = a$$

So, This Property hold.

$$vii) 4 \times (5 \times 8) = (4 \times 5) \times 8$$

Sol:-

$$4 \times (5 \times 8) = (4 \times 5) \times 8$$

we know Associative property

w.r.t. (x)

$$a \times (b \times c) = (a \times b) \times c$$

So, this property hold.

$$viii) ab = ba$$

Sol:-

$$ab = ba$$

we know Commutative law

w.r.t. (x)

$$ab = ba$$

So, This Property hold.

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5. Name the property used in the following

(i) $-3 < -1 \Rightarrow 0 < 2$

Sol

$$-3 < -1 \Rightarrow 0 < 2$$

Take

$$-3 < -1$$

Add +3 b/s

$$-3 + 3 < -1 + 3$$

$$0 < 2$$

we know additive Property

$$a < b \Rightarrow a + c < b + c$$

So, this property hold.

(ii) If $a < b$ Then $\frac{1}{a} > \frac{1}{b}$

Sol:-

$$a < b \text{ Then } \frac{1}{a} > \frac{1}{b}$$

Reciprocal property.

(iii) If $a < b$ Then $a + c < b + c$

Sol

$$a < b \text{ Then } a + c < b + c$$

Additive property hold.

(iv) If $ac < bc$ and $c > 0$ then $a < b$

$$ac < bc \text{ then } a < b \text{ when } c > 0$$

we know multiplicative property hold.

(10)

(v) If $a < b$ and $c < 0$ Then $a > b$

Sol

 $a < b$ and $c < 0$ Then $a > b$

Multiplicative property hold.

(vi) Either $a > b$ or $a = b$ or $a < b$

Sol

 $a > b$ or $a = b$ or $a < b$

Trichotomy property

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Insert Two rational numbers between

1) $\frac{1}{3}$ and $\frac{1}{4}$

Sol

 $\frac{1}{3}$ and $\frac{1}{4}$

$$\frac{1}{3} + \frac{1}{4} = \frac{\frac{1 \times 4}{3 \times 4} + \frac{1 \times 3}{4 \times 3}}{2} = \frac{\frac{4}{12} + \frac{3}{12}}{2}$$

$$= \frac{\frac{4+3}{12}}{2} = \frac{7/12}{2} = \frac{7}{2 \times 12} = \frac{7}{24}$$

 $\frac{1}{3}, \frac{7}{24}, \frac{1}{4}$

Second Rational number Take Average

$$\frac{7}{24} + \frac{1}{4} = \frac{7}{24} + \frac{6 \times 1}{4 \times 6}$$

$$= \frac{7}{24} + \frac{6}{24} = \frac{7+6}{24} = \frac{13}{24}$$

(11)

$$(x) \frac{1}{2} = \frac{1}{2} \times \frac{13}{24} = \frac{13}{48}$$

Ans: $\frac{7}{24}$, $\frac{13}{48}$ are two Rational
number b/w $\frac{1}{3}$ and $\frac{1}{4}$

(ii) 3 and 4

Sol:-

3 and 4

We find first Rational number
b/w 3 and 4 Taking Average

$$\frac{3+4}{2} = \frac{7}{2}$$

For Second Rational number we
find average b/w $\frac{7}{2}$ and 4

$$\frac{1}{2} \left(\frac{7}{2} + 4 \right) = \frac{1}{2} \left(\frac{7}{2} + \frac{4 \times 2}{2} \right)$$

$$= \frac{1}{2} \left(\frac{7}{2} + \frac{8}{2} \right)$$

$$= \frac{1}{2} \left(\frac{7+8}{2} \right)$$

$$= \frac{15}{4}$$

Ans: $\frac{7}{2}$ and $\frac{15}{4}$ are two Rational
number b/w 3 and 4

(12)

(iii) $\frac{3}{5}$ and $\frac{4}{5}$

Sol:-

 $\frac{3}{5}$ and $\frac{4}{5}$

First integer

we find average b/w $\frac{3}{5}$ and $\frac{4}{5}$

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

$$= \frac{1}{2} \left(\frac{3+4}{5} \right) = \frac{1}{2} \left(\frac{7}{5} \right) = \frac{7}{10}$$

Second integer

we find average b/w $\frac{7}{10}$ and $\frac{4}{5}$

$$= \frac{1}{2} \left(\frac{7}{10} + \frac{4}{5} \right)$$

$$= \frac{1}{2} \left(\frac{7}{10} + \frac{4 \times 2}{5 \times 2} \right)$$

$$= \frac{1}{2} \left(\frac{7}{10} + \frac{8}{10} \right)$$

$$= \frac{1}{2} \left(\frac{7+8}{10} \right) = \frac{15}{20} = \frac{3}{4}$$

Ans: $\frac{7}{10}$, $\frac{3}{4}$ is two Rational
number b/w $\frac{3}{5}$ and $\frac{4}{5}$

(2)

$$\frac{\sqrt{5} \times 2 - \sqrt{5}}{5} = \frac{\sqrt{10} - \sqrt{5}}{5}$$

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

sol

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

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

$$= \frac{36 - 24\sqrt{2} - 24\sqrt{2} + 16 \times 2}{36 - 32}$$

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

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

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

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

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

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

③

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

$$= \frac{\sqrt{9} - \sqrt{6} - \sqrt{6} + \sqrt{4}}{1}$$

$$= 3 - 2\sqrt{6} + 2$$

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

$$(vi) \frac{4\sqrt{3}}{\sqrt{7} + \sqrt{5}}$$

Sol

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

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

$$= \frac{4\sqrt{3}\sqrt{7} - 4\sqrt{3}\sqrt{5}}{7 - 5}$$

$$= \frac{4\sqrt{3 \times 7} - 4\sqrt{3 \times 5}}{2}$$

$$= \frac{4\sqrt{21} - 4\sqrt{15}}{2}$$

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

(4)

Q3 Simplify the following

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

Sol $\left(\frac{81}{16}\right)^{-3/4}$

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

$= \frac{(2^4)^{3/4}}{(3^4)^{3/4}} = \frac{2^3}{3^3} = \frac{8}{27}$

$$\begin{array}{r} 2 \overline{)16} \\ \underline{2 \times 8} \\ 0 \end{array}$$

$$\begin{array}{r} 3 \overline{)81} \\ \underline{3 \times 27} \\ 0 \end{array}$$

$$2^3 = 2 \times 2 \times 2 = 8$$

$$3^3 = 3 \times 3 \times 3 = 27$$

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

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

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

$= \frac{4^2/3^2}{4^3/9^3} \times \frac{16}{27} = \frac{4^2 \times 9^3}{4^3 \times 3^2} \times \frac{16}{27}$

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

$$9 = 3^2 =$$

⑤

$$= \underline{3^6 \times 4}$$

$$3 \times 3 \times 3 \times 3 \times 3$$

$$= \underline{3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 4}$$

$$3 \times 3 \times 3 \times 3 \times 3$$

$$= 3 \times 4 = 12$$

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

Sol

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

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

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

$$= \left(\frac{10^3}{3^3} \right)^{\frac{1}{3}}$$

$$= \left(\frac{10}{3} \right)^{3 \times \frac{1}{3}}$$

$$= \frac{10}{3}$$

Sol

$$10 = 10^1$$

$$100 = 10^2$$

$$1000 = 10^3$$

$$10000 = 10^4$$

$$\begin{array}{r} 3 \overline{) 27} \\ 3 \overline{) 9} \\ 3 \overline{) 3} \\ \hline \end{array}$$

$$(iv) \sqrt[7]{\frac{x^{14} \times y^{21} \times z^{35}}{y^{14} z^7}}$$

Sol

$$\sqrt[7]{\frac{x^{14} \times y^{21} \times z^{35}}{y^{14} z^7}} = \left(x^{14} \times y^{21-14} \times z^{35-7} \right)^{\frac{1}{7}}$$

$$\begin{aligned}
 &= (x^{14} y^7 x z^{28})^{\frac{1}{7}} \\
 &= x^{14 \times \frac{1}{7}} y^{7 \times \frac{1}{7}} x z^{28 \times \frac{1}{7}} \\
 &= x^2 y^1 z^4 = x^2 y z^4
 \end{aligned}$$

$$\begin{aligned}
 (v) & \frac{5 \cdot (25)^{n+1} - 25 \cdot (5)^{2n}}{5 \cdot (5)^{2n+3} - (25)^{n+1}}
 \end{aligned}$$

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

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

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

$$= \frac{5^{2n+2} [5 - 1]}{5^{2n+2} [5 \times 5 - 1]}$$

$$= \frac{4}{25-1} = \frac{4}{24} = \frac{1}{6}$$

7

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

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

$$= \frac{2^{4x+4} + 2^2 \cdot 5 \cdot 2^{4x}}{2^{x-3} \times 2^{3x+6}}$$

$$= \frac{2^{4x+4} + 2^{2+4x} \cdot 5}{2^{x-3+3x+6}}$$

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

$$= \frac{2^{4x+2} \cdot 2^2 + 2^{4x+2} \cdot 5}{2^{4x+2} \cdot 2^1}$$

$$= \frac{\cancel{2^{4x+2}} \cdot 2^2}{\cancel{2^{4x+2}} \cdot 2^1} + \frac{\cancel{2^{4x+2}} \cdot 5}{\cancel{2^{4x+2}} \cdot 2^1}$$

$$= \frac{4}{2} + \frac{5}{2} = \frac{4+5}{2} = \frac{9}{2}$$

$$\begin{array}{r} 2 \overline{) 16} \\ 2 \overline{) 8} \\ 2 \overline{) 4} \\ 2 \overline{) 2} \\ \hline 1 \end{array}$$

$$\begin{array}{r} 2 \overline{) 20} \\ 2 \overline{) 16} \\ \hline 4 \\ 5 \overline{) 8} \\ \hline 1 \end{array}$$

(8)

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

$$\text{sol } \frac{(64)^{-2/3}}{9^{-3/2}} = \frac{9^{3/2}}{64^{2/3}} = \frac{(3^2)^{3/2}}{(4^3)^{2/3}}$$

$$= \frac{3^3}{4^2} = \frac{27}{8}$$

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

sol

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

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

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

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

$$= 81 \times 3$$
$$= 243$$

(9)

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

Simplify

$$\frac{5^n \cdot 5^3 - 6 \cdot 5^1 \cdot 5^n}{9 \times 5^n - 4 \times 5^n}$$

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

$$= \frac{5^n (125 - 30)}{5^n (9 - 4)}$$

$$= \frac{125 - 30}{9 - 4}$$

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

$$= 19$$

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

$$(i) x + \frac{1}{x}$$

Ans) we know

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

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

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

$$\frac{1}{x} = \frac{3 - \sqrt{8}}{(3)^2 - (\sqrt{8})^2} = \frac{3 - \sqrt{8}}{9 - 8} = 3 - \sqrt{8}$$

(10)

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

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

$$(ii) \quad x - \frac{1}{x}$$

sol

$$\begin{aligned} x - \frac{1}{x} &= 3 + \sqrt{8} - (3 - \sqrt{8}) \\ &= 3 + \sqrt{8} - 3 + \sqrt{8} \end{aligned}$$

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

$$(iii) \quad x^2 + \frac{1}{x^2}, ?$$

we know

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

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

$$6^2 = x^2 + \frac{1}{x^2} + 2$$

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

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

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

(11)

$$(i) \quad x^2 - \frac{1}{x^2}$$

sol

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

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

$$= 12\sqrt{8}$$

$$= 12\sqrt{4 \times 2}$$

$$= 12 \times 2\sqrt{2}$$

$$= 24\sqrt{2}$$

$$\begin{array}{r} 34 \\ \times 34 \\ \hline 136 \\ 1020 \\ \hline 1156 \end{array} \quad \textcircled{D}$$

$$(ii) \quad \text{we know } x^2 + \frac{1}{x^2} = 34$$

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

$$(34)^2 = x^4 + \frac{1}{x^4} + 2$$

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

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

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

(12)

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

$$= (28)^2 = 2^2 \times 8$$

$$= 4 \times 8$$

$$= 32$$

Q4 Find the Rational numbers p and q
 s.t $\frac{8-3\sqrt{2}}{4+3\sqrt{2}} = p + q\sqrt{2}$

Sol $\frac{8-3\sqrt{2}}{4+3\sqrt{2}}$

L.H.S $\frac{8-3\sqrt{2}}{4+3\sqrt{2}} \times \frac{4-3\sqrt{2}}{4-3\sqrt{2}}$

$$= \frac{8 \times 4 - 8 \times 3\sqrt{2} - 3 \times 4\sqrt{2} + 3 \times 3\sqrt{2} \times \sqrt{2}}{(4)^2 - (3\sqrt{2})^2}$$

$$= \frac{32 - 24\sqrt{2} - 12\sqrt{2} + 9\sqrt{2}^2}{16 - 9 \times 2}$$

$$= \frac{32 - 36\sqrt{2} + 9 \times 2}{16 - 18}$$

$$= \frac{32 - 36\sqrt{2} + 18}{-2}$$

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

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

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

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

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

$$p = -25, q = 18$$

(13)

Q5 Simplify the following

$$i) (25)^{3/2} \times (243)^{3/5}$$

$$(16)^{5/4} \times 8^{4/3}$$

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

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

$$= \frac{5^3 \times 3^3}{2^5 \times 2^4} = \frac{125 \times 27}{2^{5+4}}$$

$$= \frac{125 \times 27}{2^9}$$

$$= \frac{3375}{512}$$

$$= 6 \frac{303}{512}$$

$$\begin{array}{r} 5 \overline{) 25} \\ 5 \overline{) 5} \\ \hline 1 \end{array}$$

$$\begin{array}{r} 2 \overline{) 16} \\ 2 \overline{) 8} \\ \hline 2 \overline{) 4} \\ 2 \overline{) 2} \\ \hline 2 \overline{) 2} \\ \hline 1 \end{array}$$

$$\begin{array}{r} 3 \overline{) 243} \\ 3 \overline{) 81} \\ \hline 3 \overline{) 27} \\ \hline 3 \overline{) 9} \\ \hline 3 \overline{) 3} \\ \hline 1 \end{array}$$

$$\begin{array}{r} 2 \overline{) 8} \\ \hline 2 \overline{) 4} \\ \hline 2 \overline{) 2} \\ \hline 2 \overline{) 2} \\ \hline 1 \end{array}$$

$$\begin{array}{r} \times 125 \quad ② \quad ① \\ 27 \\ \hline 875 \quad ⑥ \\ 250x \\ \hline 3375 \end{array}$$

$$\begin{array}{r} 6 \\ 512 \overline{) 3375} \\ \underline{3072} \\ 303 \end{array}$$

(14)

(ii)

$$54 \times \sqrt[3]{(27)^{2x}}$$

$$9^{x+1} + 216(3^{2x-1})$$

$$\text{Suf } 2 \times 3^3 \times [(3^3)^{2x}]^{\frac{1}{3}}$$

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

$$= 2 \times \cancel{3^3} \times \cancel{3^{6x}} \times \frac{1}{\cancel{3}} \\ 3^{2x+2} + 2^3 \times 3^{6x-3}$$

$$= 2 \times 3^3 \times [3^{6x} \times \frac{1}{3}]$$

$$3^{2x+2} + 2^3 \times 3^{3+2x-1}$$

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

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

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

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

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

$$\frac{2 \times 3}{1+8} = \frac{6}{9} = \frac{2}{3}$$

$$\begin{array}{r} 2 \overline{) 54} \\ \underline{3} \\ 27 \\ \underline{3} \\ 9 \\ \underline{3} \\ 3 \\ \underline{3} \\ 0 \end{array}$$

$$\begin{array}{r} 3 \overline{) 27} \\ \underline{3} \\ 9 \\ \underline{3} \\ 3 \\ \underline{3} \\ 0 \end{array}$$

$$\begin{array}{r} 2 \overline{) 216} \\ \underline{2} \\ 108 \\ \underline{2} \\ 54 \\ \underline{3} \\ 27 \\ \underline{3} \\ 9 \\ \underline{3} \\ 3 \\ \underline{3} \\ 0 \end{array}$$

$$\begin{array}{r} 3 \overline{) 12} \\ \underline{3} \\ 9 \\ \underline{3} \\ 0 \end{array}$$

(15)

(iii)

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

$$\text{sol} \int \sqrt{(216)^{2/3} (25)^{1/2} \times (0.04)^{3/2}}$$

$$= \sqrt{(2^3 \times 3^3)^{2/3} \times (5^2)^{1/2} \times \left(\frac{4}{100}\right)^{3/2}}$$

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

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

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

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

$$= \frac{6}{5}$$

(16)

$$(iv) \left(a^{1/3} + b^{2/3}\right) \times \left(a^{2/3} - a^{1/3}b^{2/3} + b^{4/3}\right)$$

Sol

$$a^{1/3} \times a^{2/3} - a^{1/3}a^{1/3}b^{2/3} + a^{1/3}b^{4/3} \\ + b^{2/3}a^{2/3} - a^{1/3}b^{2/3}b^{2/3} + b^{2/3}b^{4/3}$$

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

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

$$= a + b^2$$

①

$$Ex = 1.3$$

2. The Sum of Three consecutive integers is forty-Two, find the three integers.

Sol

Let three consecutive integers

$$x, x+1, x+2$$

Sum

$$x + x + 1 + x + 2 = 42$$

$$3x + 3 = 42$$

$$3x = 42 - 3$$

$$3x = 39$$

$$x = \frac{39}{3}$$

$$\boxed{x = 13}$$

$$13, 13+1, 13+2$$

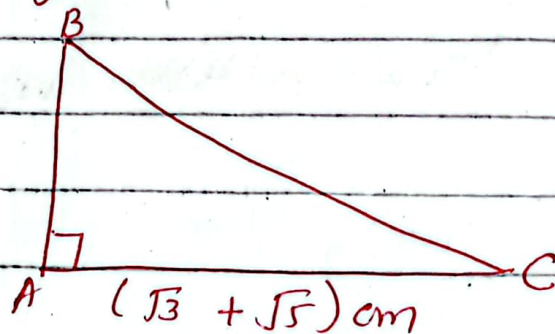
Ans:

$$13, 14, 15$$

$$13 + 14 + 15 = 42$$

②

2. The diagram shows right angled $\triangle ABC$ in which the length of $\overline{AC}$ is $(\sqrt{3} + \sqrt{5})$ cm. The area of $\triangle ABC$ is $(1 + \sqrt{15})$ cm². Find the length $\overline{AB}$ in the form $(a\sqrt{3} + b\sqrt{5})$ cm, where a and b are integers.



Sol

$$\overline{AB} = ?$$

$$\text{Area of } \triangle ABC = \sqrt{3} + \sqrt{5} (1 + \sqrt{15}) \text{ cm}^2$$

$$\text{Length of } \overline{AC} = (\sqrt{3} + \sqrt{5}) \text{ cm}$$

we know

$$\text{Area of Triangle} = \frac{1}{2} (\overline{AC}) \times (\overline{AB})$$

Putting value

$$1 + \sqrt{15} = \frac{1}{2} (\sqrt{3} + \sqrt{5}) (\overline{AB})$$

$$\frac{2(1 + \sqrt{15})}{\sqrt{3} + \sqrt{5}} = \overline{AB}$$

$$\frac{2 + 2\sqrt{15}}{\sqrt{3} + \sqrt{5}} = \overline{AB}$$

③

$$\bar{AB} = \frac{2+2\sqrt{5}}{\sqrt{3}+\sqrt{5}} \times \frac{\sqrt{3}-\sqrt{5}}{\sqrt{3}-\sqrt{5}}$$

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

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

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

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

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

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

$$= \frac{2\sqrt{3} - 2\sqrt{5} + 6\sqrt{5} - 10\sqrt{3}}{-2}$$

$$= \frac{2\sqrt{3} - 10\sqrt{3} - 2\sqrt{5} + 6\sqrt{5}}{-2}$$

$$= \frac{-8\sqrt{3} + 4\sqrt{5}}{-2} = -2(4\sqrt{3} - 2\sqrt{5})$$

$$\bar{AB} = (4\sqrt{3} - 2\sqrt{5}) \text{ cm}$$

(4)

3. A Rectangle has sides of length $(2 + \sqrt{18})\text{m}$ and $(5 - \frac{4}{\sqrt{2}})\text{m}$. Express the Area of the rectangle in the form $a + b\sqrt{2}$ where a and b are integers.

Sol

$$\text{Length of Rectangle} = (2 + \sqrt{18})\text{m}$$

$$\text{Breadth of Rectangle} = (5 - \frac{4}{\sqrt{2}})\text{m}$$

$$\text{Area of Rectangle} = \text{length} \times \text{breadth}$$

$$= (2 + \sqrt{18}) (5 - \frac{4}{\sqrt{2}})$$

$$= (2 + \sqrt{18}) (5 - \frac{4}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}})$$

$$= (2 + \sqrt{18}) (5 - \frac{4\sqrt{2}}{\sqrt{2} \times 2})$$

$$= (2 + \sqrt{18}) (5 - \frac{4\sqrt{2}}{\sqrt{2}^2})$$

$$= (2 + \sqrt{18}) (5 - \frac{4\sqrt{2}}{2})$$

$$= (2 + \sqrt{18}) (5 - 2\sqrt{2})$$

$$= 2 \times 5 + 5\sqrt{18} - 2 \times 2\sqrt{2} - 2\sqrt{2}\sqrt{18}$$

$$= 10 + 5\sqrt{18} - 4\sqrt{2} - 2\sqrt{2 \times 18}$$

(5)

$$\begin{aligned} &= 10 + 5\sqrt{2 \times 3 \times 3} - 4\sqrt{2} - 2\sqrt{2 \times 2 \times 3 \times 3} \\ &= 10 + 5\sqrt{2 \times 3^2} - 4\sqrt{2} - 2\sqrt{2^2 \times 3^2} \end{aligned}$$

$$\begin{aligned} &= 10 + 5 \times 3\sqrt{2} - 4\sqrt{2} - 2 \times 2 \times 3 \\ &= 10 + 15\sqrt{2} - 4\sqrt{2} - 12 \end{aligned}$$

$$= 10 - 12 + 15\sqrt{2} - 4\sqrt{2}$$

$$\text{Area} = (-2 + 11\sqrt{2}) \text{ m}^2$$

Q₇ Find Two integer whose Sum is 68 and difference is 22.

Sol:-

Let first integer = x

Let second integer = y

Sum

$$x + y = 68 \quad \text{--- (i)}$$

Difference

$$x - y = 22 \quad \text{--- (ii)}$$

Add (i) and (ii)

$$x + y = 68$$

$$x - y = 22$$

$$\hline 2x = 90$$

$$x = \frac{90}{2}$$

$$x = 45$$

⑥

Put $x = 45$ in eq (i)

$$45 + y = 68$$

$$y = 68 - 45$$

$$\boxed{y = 23}$$

5. The weather in Lahore was usually warm during the Summer of 2024. The TV news reported temperature as high as 48°C . By using the formula ($^{\circ}\text{F} = \frac{9}{5}^{\circ}\text{C} + 32$)

find the Temperature as Fahrenheit scale.

Sol/

$$^{\circ}\text{F} = \frac{9}{5}^{\circ}\text{C} + 32$$

$$^{\circ}\text{C} = 48^{\circ}$$

$$^{\circ}\text{F} = \frac{9}{5} \times 48 + 32$$

$$= \frac{9}{5} \times 48 + 32$$

$$= \frac{432}{5} + 32$$

$$= \frac{432}{5} + \frac{32 \times 5}{5} = \frac{432}{5} + \frac{160}{5}$$

⑦

48

$\times 9$

432

(7)

$$^{\circ}F = \frac{432 + 160}{5}$$

$$^{\circ}F = \frac{592}{5}$$
$$= 86.4^{\circ}F$$

Q6

The Sum of the ~~integer~~ ages of the father and son is 72.

Six years ago, the father's age was 2 times the age of son what was ~~was~~ son's age six years ago.

Sol:-

Let Father Age = F

Let Son age = S

$$\text{Sum} = 72$$

$$F + S = 72 \quad \text{---(i)}$$

Six years ago Father Age = F - 6

Six years ago Son age = S - 6

$$F - 6 = 2(S - 6)$$

$$F - 6 = 2S - 12$$

$$F - 2S = -12 + 6$$

$$F - 2S = -6$$

$$-F + 2S = 6 \quad \text{---(ii)}$$

8

Add (i) and (ii)

$$F + S = 72$$

$$- F + 2S = 6$$

$$\hline 3S = 78$$

$$S = \frac{78}{3}$$

$$S = 26$$

$$\begin{aligned} \text{Son age six years ago} &= S - 6 \\ &= 26 - 6 \\ &= 20 \text{ years.} \end{aligned}$$

Q7 Mishra bought a Toy for
Rs. 1500 and sold for Rs. 1520.
What was her profit percentage.

Sol:-

$$\text{Cost Price of Toy} = \text{Rs } 1500$$

$$\text{Selling Price of Toy} = \text{Rs } 1520$$

$$\text{Profit} = ?$$

we know

$$\begin{aligned} \text{Profit} &= \text{Selling price} - \text{cost price} \\ &= 1520 - 1500 \end{aligned}$$

$$\text{Profit} = \text{Rs. } 20$$

W

(9)

we know

$$\text{Profit\%} = \frac{\text{Profit}}{\text{Cost Price}} \times 100$$

$$= \frac{20}{1500} \times 100$$

$$\text{profit\%} = \frac{20}{15} = \frac{4}{3} \quad \begin{array}{r} 1 \\ 3 \overline{)4} \\ \underline{3} \\ 1 \end{array}$$

$$P\% = 1\frac{1}{3}\%$$

Q8

The annual income of Taryar is Rs 9,60,000, while the exempted amount is Rs 1,30,000. How much tax would he have to pay at the rate of 0.75%?

Sol

$$\text{Annual income} = \text{Rs } 9,60,000$$

$$\text{exempted amount} = \text{Rs } 1,30,000$$

$$\text{Tax} = 0.75\%$$

$$\text{Taxable income} = \text{Annual income} -$$

$$\begin{aligned} & \text{exempted income} \\ & = 9,60,000 - 1,30,000 \\ & = \text{Rs } 8,30,000 \end{aligned}$$

$$\text{Tax amount} = 0.75\% \text{ of } 8,30,000$$

$$= \frac{0.75}{100} \text{ of } 8,30,000$$

$$= 0.0075 \times 8,30,000$$

$$\text{Tax amount} = \text{Rs } 6225$$

Q9 Find the Compound markup
on Rs 3,75,000 for one year
at the rate of 14%
compound annually.

Sol:-

Principal Amount = 3,75,000

Rate = 14%

Time = 1 years

we know

$$\text{Compound \cancel{pr} markup} = \frac{(P) \times R \times T}{100}$$

$$= \frac{3,75,000 \times 14 \times 1}{100}$$

$$= 3750 \times 14$$

$$= \underline{52500}$$

$$\begin{array}{r} 3750 \\ \times 14 \\ \hline 15000 \\ 3750 \times \\ \hline 52500 \end{array}$$

REVIEW EXERCISE 1

1. Four options are given against each statement. Encircle the correct option

(i) ~~Integer~~ $\sqrt{3}$ is :

- (a) integer (b) Rational number (c) ☒ Irrational number (d) natural number

Explain: c is correct option because 3 is prime number under square root.

(ii) π and e are :

- (a) Natural numbers (b) integer
(c) rational numbers (d) ☒ irrational numbers

Explain: we know $\pi = 3.14159\ldots$ and $e = 2.71828\ldots$ is non-terminating and non-recurring decimals so, it is irrational number.

(iii) If n is not a perfect square, then $\sqrt{n}$ is :

- (a) Rational number (b) natural number
(c) integer (d) ☒ irrational number

Explain: $\sqrt{n}$ is not perfect square

mean $\sqrt{48}$ $48 \neq 49$ $48 = 2 \times 2 \times 2 \times 2 \times 3$

$$\sqrt{2^2 \times 2^2 \times 3} = 4\sqrt{3} \rightarrow \text{Prime}$$

(iv) For all $x \in R$, $x = x$ is called :

- (a) ☒ Reflexive property (b) Transitive number
(c) Symmetric property (d) Trichotomy property

Explain: Reflex mean $\overbrace{a}^a$

$$\begin{array}{c} 3 \in 3 \\ \downarrow \\ \text{mirror} \end{array}$$

(vi) Let $a, b, c \in \mathbb{R}$, then $a > b$ and $b > c \Rightarrow a > c$ is called transitive property

- (a) Trichotomy (b) Transitive
(c) additive (d) multiplicative

Explain: $2, 3, 4 \in \mathbb{R}$

$$4 > 3 \text{ and } 3 > 2 \Rightarrow 4 > 2$$

(vii) $2^x \times 8^x = 64$ then $x =$

- (a) $\frac{3}{2}$ (b) $\frac{3}{4}$ (c) $\frac{5}{6}$ (d) $\frac{2}{3}$
Explains

$$2^x \times 8^x = 64$$

$$2^x \times (2 \times 2 \times 2)^x = (2 \times 2 \times 2 \times 2 \times 2 \times 2)$$

$$2^x \times (2^3)^x = 2^6$$

$$2^x \times 2^{3x} = 2^6$$

$$2^{x+3x} = 2^6$$

$$\therefore a^n = a^m$$

$$2^{4x} = 2^6$$

$$n = m$$

$$4x = 6$$

$$x = \frac{6}{4} = \frac{3}{2}$$

(viii) Let $a, b \in \mathbb{R}$, then $a = b$ and $b = a$ is called reflexive property

- (a) Reflexive (b) Symmetric
(c) Transitive (d) additive

~~Explain~~ Explain

$$3.99 \approx 4 \text{ and } 4 = 3.99$$

(ix) $\sqrt{75} + \sqrt{27}$

- (a) $\sqrt{102}$ (b) $9\sqrt{3}$ (c) $5\sqrt{3}$ (d) $8\sqrt{3}$

Explain:

$$\sqrt{75} + \sqrt{27}$$

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

$$\begin{array}{r|l} 5 & 75 \\ \hline 5 & 15 \\ \hline 3 & 3 \\ \hline & 1 \end{array}$$

$$\begin{array}{r|l} 3 & 27 \\ \hline 3 & 9 \\ \hline 3 & 3 \\ \hline & 1 \end{array}$$

$$= \sqrt{5^2 \times 3} + \sqrt{3^2 \times 3}$$

$$= 5\sqrt{3} + 3\sqrt{3}$$

$$= (5+3)\sqrt{3}$$

$$= 8\sqrt{3}$$

(X) The product of $(3+\sqrt{5})(3-\sqrt{5})$ is:

(a) Prime number (b) odd number

(c) irrational number (d) rational number

Explain:-

$$(3+\sqrt{5})(3-\sqrt{5})$$

$$a^2 - b^2 = (a+b)(a-b)$$

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

$$9 - 5 = 4$$

8

It is Rational number.

Q. If $a = \frac{3}{2}$, $b = \frac{5}{3}$ and $c = \frac{7}{5}$

then verify that

(i) $a(b+c) = ab+ac$

Sol:- L.H.S

$$= \frac{3}{2} \left(\frac{5}{3} + \frac{7}{5} \right) = \frac{3}{2} \left(\frac{3 \times 5}{3 \times 5} + \frac{7 \times 3}{5 \times 3} \right)$$

$$= \frac{3}{2} \left(\frac{25 + 21}{15} \right)$$

$$= \frac{3}{2} \left(\frac{46}{15} \right) = \frac{3 \times 23}{15} = \frac{23}{5}$$

R.H.S $ab+ac$

$$\left(\frac{3}{2} \right) \left(\frac{5}{3} \right) + \left(\frac{3}{2} \right) \left(\frac{7}{5} \right)$$

$$= \frac{15}{6} + \frac{21}{10}$$

$$= \frac{5}{2} + \frac{21}{10}$$

$$= \frac{5 \times 5}{2 \times 5} + \frac{21}{10} = \frac{25}{10} + \frac{21}{10}$$

$$= \frac{25+21}{10} = \frac{46}{10} = \frac{23}{5}$$

Hence prove L.H.S = R.H.S

$$a(b+c) = ab+ac$$

$$(ii) (a+b)c = ac + bc$$

L.H.S

$$= \left(\frac{3}{2} + \frac{5}{3} \right) \left(\frac{7}{5} \right)$$

$$= \left(\frac{3 \times 3}{2 \times 3} + \frac{5 \times 2}{3 \times 2} \right) \left(\frac{7}{5} \right)$$

$$= \left(\frac{9}{6} + \frac{10}{6} \right) \left(\frac{7}{5} \right) = \left(\frac{9+10}{6} \right) \left(\frac{7}{5} \right)$$

$$= \left(\frac{19}{6} \right) \left(\frac{7}{5} \right) = \frac{133}{30}$$

R.H.S

$$ac + bc = \left(\frac{3}{2} \right) \left(\frac{7}{5} \right) + \left(\frac{5}{3} \right) \left(\frac{7}{5} \right)$$

$$= \frac{21}{10} + \frac{35}{15}$$

$$= \frac{21}{10} + \frac{7}{3}$$

$$= \frac{21 \times 3}{10 \times 3} + \frac{7 \times 10}{3 \times 10}$$

$$= \frac{63}{30} + \frac{70}{30}$$

$$= \frac{63+70}{30} = \frac{133}{30}$$

$$2. \frac{4}{3} + \frac{5}{2} + \frac{7}{4}, \text{ using } \frac{a}{b} + \frac{c}{d} = \frac{ad+bc}{bd}$$

now verify the associative property of real numbers using addition and multiplication.

$$(i) \text{ in addition}$$

$$(a+b)+c = a+(b+c)$$

$$\text{L.H.S}$$

$$(a+b)+c$$

$$= \left(\frac{4}{3} + \frac{5}{2} \right) + \frac{7}{4}$$

$$= \left(\frac{2 \times 4 + 3 \times 5}{2 \times 3} \right) + \frac{7}{4}$$

$$= \left(\frac{8}{6} + \frac{5}{2} \right) + \frac{7}{4}$$

$$= \left(\frac{8+15}{6} \right) + \frac{7}{4}$$

$$\frac{23}{6} + \frac{7}{4}$$

$$= \frac{8 \times 2}{6 \times 2} + \frac{7}{4} = \frac{2 \times 4}{3 \times 2} + \frac{7 \times 3}{4 \times 3} = \frac{8}{6} + \frac{21}{12}$$

$$= \frac{8+21}{12} = \frac{29}{12}$$

$$\text{R.H.S}$$

$$a+(b+c) = \frac{4}{3} + \left(\frac{5}{2} + \frac{7}{4} \right)$$

$$= \frac{4}{3} + \left(\frac{5 \times 2}{2 \times 2} + \frac{7}{4} \right)$$

$$= \cancel{5x} \frac{4}{3} + \left(\frac{10}{4} + \frac{7}{4} \right)$$

$$= \frac{4}{3} + \left(\frac{10+7}{4} \right)$$

$$= \frac{4}{3} + \frac{17}{4}$$

$$= \frac{4 \times 4}{3 \times 4} + \frac{17 \times 3}{4 \times 3}$$

$$= \frac{16}{12} + \frac{51}{12}$$

$$= \frac{67}{12}$$

4. Is 0 a rational number? Explain.

Sol:- Yes, 0 is a rational number

because 0 is not negative and positive number $0 \in \mathbb{R}$ but 0 is not decimal part 0 is Integral part.

5. State trichotomy property of real numbers

$\forall a, b \in \mathbb{R}$, either $a = b$ or $a > b$ or $a < b$

6. Find two rational numbers between 4 and 5.

Sol:- 4 and 5

$$\frac{4+5}{2} = \frac{9}{2}, \frac{9}{2} \text{ is b/w 4 and 5}$$

$$4, \frac{9}{2}, 5$$

$$\frac{9}{2} + \frac{5}{1} = \frac{9+10}{2}$$

$$\frac{9}{2} + \frac{5 \times 2}{2 \times 1} = \frac{9}{2} + \frac{10}{2}$$

$$= \frac{9+10}{2} = \frac{19}{2}$$

$\frac{19}{2}$ is another rational number
b/w 4 and 5.

7. Simplify the following

$$(i) \sqrt[5]{\frac{x^{15}y^{35}}{z^{20}}}$$

$$\text{sol} \sqrt[5]{\frac{x^{15}y^{35}}{z^{20}}}$$

$$\left(\frac{x^{15} \cdot y^{35}}{z^{20}} \right)^{\frac{1}{5}} = \left(\frac{x^{15 \times \frac{1}{5}} \cdot y^{35 \times \frac{1}{5}}}{z^{20 \times \frac{1}{5}}} \right)$$

$$= \frac{x^3 y^7}{z^4}$$

$$(ii) \sqrt[3]{(27)^{2x}}$$

$$\text{sol} \sqrt[3]{(27)^{2x}}$$

$$((27)^{2x})^{\frac{1}{3}} = (27)^{\frac{2x}{3}} = (3^3)^{\frac{2x}{3}} = 3^{2x}$$

$$= (3^2)^x = 9^x$$

$$\begin{array}{r} 3 \overline{) 27} \\ 3 \overline{) 9} \\ 3 \overline{) 3} \\ 1 \end{array}$$

$$(iii) \quad \frac{6(3)^{n+2}}{3^{n+1} - 3^n}$$

Sol:-

$$\begin{aligned} \frac{6(3)^{n+2}}{3^{n+1} - 3^n} &= \frac{6 \times 3^n \times 3^2}{3^n \cdot 3^1 - 3^n} \\ &= \frac{6 \times 3^n \times 9}{3^n(3-1)} = \frac{6 \times 9}{2} \\ &= 3 \times 9 \\ &= 27 \end{aligned}$$

8 The Sum of three consecutive odd integers is 51. Find the three integers.

Sol:-

Let Three consecutive ^{odd} integers

$$x, x+2, x+4 \text{ where } x=1$$

$$\text{Sum} = 51$$

$$x + x+2 + x+4 = 51$$

$$3x + 6 = 51$$

$$3x = 51 - 6$$

$$3x = 45$$

$$x = \frac{45}{3}$$

$$3$$

$$\boxed{x = 15}$$

$$x, x+2, x+4$$

$$15, 15+2, 15+4:$$

$$15, 17, 19 = 15+17+19 = 51$$

9. Abdulla picked up 96 balls and placed them into two buckets. One bucket has Twenty-eight more balls than the other bucket. How many balls were in each bucket?

Sol.

$$\text{Total Balls} = 96$$

$$\text{Bucket 1} = x$$

$$\text{Bucket 2} = x + 28$$

$$\text{Sum} = x + x + 28$$

$$x + x + 28 = 96$$

$$2x = 96 - 28$$

$$2x = 68$$

$$x = 34$$

$$\text{Bucket 1} = 34$$

$$\text{Bucket 2} = 34 + 28 = 62$$

$$34, 62$$

(10) Salma invested Rs 3,50,000 in a bank which paid Simple profit at the rate of $7\frac{1}{4}\%$ per annum. After 2 years the rate was increased to 8% per annum. Find the amount she had at the end of 7 years.

sol:-

$$A = \text{Invested Amount} = \text{Rs. } 3,50,000$$

$$R = \text{Rate} = 7\frac{1}{4}\% = \frac{29}{4}\%$$

$$T = \text{Time} = 2 \text{ years}$$

$$\text{Profit} = \frac{A \times R \times T}{100}$$

$$= \frac{3,50,000 \times \frac{29}{4} \times 2}{100}$$

$$= \frac{3,50,000 \times 29 \times 2}{4 \times 100}$$

$$= \frac{3,50,000 \times 29 \times 2}{100} = \frac{20,300,000}{100}$$

$$P_1 = 50,750$$

$$\text{Time} = 5 \text{ year}$$

$$R = 8\%$$

$$A = 3,50,000$$

$$P_2 = \frac{A \times R \times T}{100} = \frac{3,50,000 \times 8 \times 5}{100}$$

$$P_2 = \frac{14,000,000}{100}$$

$$= 14,0000$$

$$= 140,000$$

$$Total = A + P_1 + P_2$$

$$= 350,000 + 50,750 + 140,000$$

$$= 540,750$$

①

Ex = 2.1

Q.1 Express the following numbers in Scientific notation:

(i) 2000000

$$\text{Sol: } 2000000 = 2 \times 1000000 \\ = 2 \times 10^6$$

(ii) 48900

$$\text{Sol: } 48900 = 489 \times 100 \\ = 489 \times 10^2 \\ = 4.89 \times 10^2 \times 10^2 = 4.89 \times 10^{2+2} \\ = 4.89 \times 10^4$$

(iii) 0.0042

$$\text{Sol: } 0.0042 = \frac{42}{10000} = \frac{42}{10^4} = 42 \times 10^{-4}$$

$$4.2 \times 10^1 \times 10^{-4} = 4.2 \times 10^{1-4} \\ = 4.2 \times 10^{-3}$$

(iv) 0.0000009

$$\text{Sol: } 0.0000009 = \frac{9}{1000000} = \frac{9}{10^6} = 9 \times 10^{-6}$$

(v) 73×10^3

$$\text{Sol: } 73 \times 10^3 = 7.3 \times 10^1 \times 10^3 \\ = 7.3 \times 10^{1+3} = 7.3 \times 10^4$$

(vi) 0.65×10^2

$$\text{Sol: } 0.65 \times 10^2 = \frac{65}{100} \times 10^2 = \frac{65}{10^2} \times 10^2 = 65 \times 10^{2-2} \\ 65 \times 10^0 = 65 = 6.5 \times 10^1$$

(2)

Q2. Express the following numbers in Scientific ordinary notation.

(i) 8.04×10^2

Sol:- 8.04×10^2

$$= \frac{804}{100} \times 10^2 = \frac{804}{10^2} \times 10^2 = 804 \times 10^{2-2}$$

$$= 804$$

(ii) 3×10^5

Sol:- $3 \times 10^5 = 3 \times 100000 = 300000$

(iii) 1.5×10^{-2}

$$\text{Sol:- } 1.5 \times 10^{-2} = \frac{15}{10} \times 10^{-2} = \frac{15}{10 \times 10^2} = \frac{15}{10^{+2}}$$

$$= \frac{15}{10^3} = \frac{15}{1000} = 0.0015$$

(iv) 1.77×10^7

Sol $1.77 \times 10^7 = \frac{177}{100} \times 10000000$

$$= 177 \times 100000 = 17700000$$

(v) 5.5×10^{-6}

Sol:- $5.5 \times 10^{-6} = \frac{55}{10} \times \frac{1}{10^6}$

$$= \frac{55}{10} \times \frac{1}{1000000} = \frac{55}{10000000}$$

$$= 0.00000055$$

(3)

(vi) 4×10^{-5}

Sol:- $4 \times 10^{-5} = \frac{4}{10^5} = \frac{4}{100000}$

$= 0.00004$

Q₃ The Speed of light is approximately 3×10^8 meters per second. Express it in standard form.

Sol:- $v = 3 \times 10^8 \text{ m/s}$

Speed $= 3 \times 100000000 \text{ m/s}$
 $= 300000000 \text{ m/s}$

Q₄ The Circumference of the earth at the equator is about 40075000 meters. Express this number in Scientific notation.

Sol:-

Circumference $= 40075000$

$= 40075 \times 1000$

$= 4.0075 \times 10^4 \times 10^3$

$= 4.0075 \times 10^{4+3}$

$= 4.0075 \times 10^7$

=

(1)

Q5 The diameter of Mars is 6.7779×10^3 km
Express this number in standard form

~~Sol - 6.777~~

Sol:-

$$\text{Diameter} = 6.7779 \times 10^3 \text{ km}$$

$$= \frac{67779}{10000} \times 10^3$$

$$= \frac{67779 \times 1000}{10000}$$

$$= \frac{67779}{10}$$

$$= 6777.9 \text{ km}$$

Q6 The diameter of Earth is about 1.2756×10^4 km. Express this number in standard form

Sol:-

$$\text{Diameter of Earth} = 1.2756 \times 10^4 \text{ km}$$

$$= \frac{12756}{10000} \times 10000$$

$$= 12756 \text{ km}$$

(5)

2.2

Q1 Express each of the following in logarithmic form.

(i) $10^3 = 1000$

$$10^3 = 1000$$

we know

$$a^y = x$$

$$\therefore \log_a a = 1$$

Taking Log

$$\log_a x = y$$

$$\log_{10} 10^3 = 3 \log_{10} 10$$

$$\log_{10} 1000 = 3$$

$$= 3(1)$$

(ii) $2^8 = 256$

Sol: - $2^8 = 256$

Taking Log

$$\log_2 256 = 8$$

$$\log_2 2^8 = 8$$

$$\therefore \log_a a = 1$$

$$8 \log_2 2 = 8$$

$$8(1) = 8$$

$$8 = 8$$

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

Sol $3^{-3} = \frac{1}{27}$

$$\log_3 \frac{1}{3^3} = -3$$

Taking Log

$$\log_3 3^{-3} = -3$$

$$\log_3 \frac{1}{27} = -3$$

$$-3 \log_3 3 = -3$$

$$-3 \log_3 3 = -3$$

$$-3(1) = -3$$

$$-3 = -3$$

6

(iv) $20^2 = 400$

Sol:-

$$20^2 = 400$$

Taking log

$$\log_{20} 400 = 2$$

$$\log_{20} 20^2 = 2$$

$$2 \log_{20} 20 = 2$$

$$2(1) = 2$$

(v) $(16)^{-\frac{1}{4}} = \frac{1}{2}$

Sol:- $(16)^{-\frac{1}{4}} = \frac{1}{2}$

$$\log_{16} \frac{1}{2} = -\frac{1}{4}$$

$$\log_{16} (16)^{-\frac{1}{4}} = -\frac{1}{4}$$

$$-\frac{1}{4} \log_{16} 16 = -\frac{1}{4}$$

$$-\frac{1}{4}(1) = -\frac{1}{4}$$

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

(7)

(vi) $11^2 = 121$

Sol:-

$$11^2 = 121$$

Taking

$$\log_{11} 121 = 2$$

$$\log_{11} 11^2 = 2$$

$$2 \log_{11} 11 = 2$$

$$2(1) = 2$$

$$2 = 2$$

(vii) $P = 9^x$

sol $P = 9^x$

Taking log

$$\log P = x$$

$$\log_{9} P$$

(viii) $(32)^{-\frac{1}{5}} = \frac{1}{2}$

$$32^{-\frac{1}{5}} = \frac{1}{2}$$

Taking log

$$\log 32^{\frac{1}{2}} = -\frac{1}{5}$$

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

$$-\frac{1}{5} \log_{32} 32 = -\frac{1}{5} \log(1)$$

(8)

Q. Express each of the following in exponential form.

(i) $\log_{125} 5 = 3$
Sol:-

$$\log_5 125 = 3$$

$$5^3 = 125$$

(vi) $\frac{1}{2} = \log_9 3$

Sol:-

$$\frac{1}{2} = \log_9 3$$

(ii) $\log_2 16 = 4$
Sol:-

$$\log_2 16 = 4$$

$$2^4 = 16$$

$$3 = 9^{\frac{1}{2}}$$

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

$$3 = 3$$

(iii) $\log_{23} 1 = 0$
Sol:-

$$\log_{23} 1 = 0$$

$$23^0 = 1$$

(vii) $5 = \log_{10} 100000$
Sol:-

$$5 = \log_{10} 100000$$

$$100000 = 10^5$$

$$100000 = 100000$$

(iv) $\log_5 5 = 1$
Sol:-

$$\log_5 5 = 1$$

$$5^{-1} = 5$$

(viii)

$$\log_4 \frac{1}{16} = -2$$

Sol:-

(v) $\log_2 \frac{1}{8} = -3$
Sol:-

$$\log_2 \frac{1}{8} = -3$$

$$2^{-3} = \frac{1}{8}$$

$$\frac{1}{2^3} = \frac{1}{8}$$

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

$$\log_4 \frac{1}{16} = -2$$

$$4^{-2} = \frac{1}{16}$$

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

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

(9)

Q3 Find the value of x in each of the following

i) $\log_x 64 = 3$

sol:- $\log_x 64 = 3$

$$x^3 = 64$$

$$x^3 = 2^3 \times 2^3$$

$$x^3 = (2 \times 2)^3$$

we know

$$a^m = b^m$$

$$a = b$$

$$x = 2 \times 2$$

$$\boxed{x = 4}$$

$$\begin{array}{r|l} 2 & 64 \\ \hline 2 & 32 \\ \hline 2 & 16 \\ \hline 2 & 8 \\ \hline 2 & 4 \\ \hline 2 & 2 \\ \hline 2 & 1 \end{array}$$

ii) $\log_5 \frac{1}{5} = x$

sol:- $\log_5 \frac{1}{5} = x$

$$5^x = \frac{1}{5}$$

$$5^x = 5^{-1}$$

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

iii) $\log_x 8 = 1$

sol:-

$$\log_x 8 = 1$$

$$x^1 = 8$$

$$\boxed{x = 8}$$

(10)

$$(iv) \log_{10} x = -3$$

Sol:-

$$\log_{10} x = -3$$

$$10^{-3} = x$$

$$\frac{1}{10^3} = x$$

$$\boxed{x = \frac{1}{1000}}$$

$$(v) \log_4 x = \frac{3}{2}$$

$$\text{Sol} \log_4 x = \frac{3}{2}$$

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

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

$$2^3 = x$$

$$\therefore 2^3 = 2 \times 2 \times 2 = 8$$

$$\boxed{8 = x}$$

$$(vi) \log_2 1024 = x$$

$$\text{Sol} \log_2 1024 = x$$

$$2^x = 1024$$

$$2^x = 2^{10}$$

$$\boxed{x = 10}$$

$$\begin{array}{r} 2 \overline{) 1024} \\ \underline{2} 512 \\ 2 \overline{) 512} \\ \underline{2} 256 \\ 2 \overline{) 256} \\ \underline{2} 128 \\ 2 \overline{) 128} \\ \underline{2} 64 \\ 2 \overline{) 64} \\ \underline{2} 32 \\ 2 \overline{) 32} \\ \underline{2} 16 \\ 2 \overline{) 16} \\ \underline{2} 8 \\ 2 \overline{) 8} \\ \underline{2} 4 \\ 2 \overline{) 4} \\ \underline{2} 2 \\ 2 \overline{) 2} \\ \underline{2} 0 \end{array}$$

(11)

Ex = 2.3

① Find characteristics of the following numbers.

(i) 5287

Sol:- 5287

$$5.287 \times 10^3 \rightarrow \text{characteristics}$$

characteristics = 3

(ii) 59.28

$$\text{Sol:- } 5.928 \times 10^1 \rightarrow \text{characteristics}$$

characteristics = 1

(iii) 0.0567

$$\text{Sol:- } 0.0567$$

$$= 5.67 \times 10^{-2} \rightarrow \text{characteristics}$$

characteristics = -2

(iv) 234.7

$$\text{Sol:- } 234.7$$

$$= 2.347 \times 10^2 \rightarrow \text{characteristics}$$

characteristics = 2

(v) 0.000049

$$\text{Sol:- } 0.000049$$

$$= 4.9 \times 10^{-5} \rightarrow \text{characteristics}$$

characteristics = -5

(vi) 145000

$$\text{Sol:- } 145000$$

(12)

Q₂ Find logarithm of the following numbers.

(i) 43

Sol $\log 43$
 4.3×10^1

characteristics = 1 characteristics + Mantissa

Mantissa = 0.6335 1 + 0.6335

$\log(43) = 1.6335$

(ii) 579

Sol:- 579

5.79×10^2

characteristics = 2

Mantissa = 0.7627

characteristics + Mantissa

2 + 0.7627

= 2.7627

(iii) 1.982

Sol:- 1.982

$\log(1.982)$

1.982×10^0

characteristics = 0

Mantissa = 0.2971

characteristics + mantissa

0 + 0.2971 = 0.2971

(iv) 0.0876

Sol: 0.0876

$$= \log(0.0876)$$

$$= 0.0876 = 876 \times 10^{-1}$$

$$\text{characteristics} = -1$$

$$\text{mantissa} = 0.0575$$

$$\text{characteristics} + \text{mantissa}$$

$$= -1 + 0.0575$$

$$= -1.0575$$

(v) 0.047

Sol: 0.047

$$\log(0.047)$$

$$= 47 \times 10^{-1}$$

$$\text{characteristics} = -1$$

$$\text{mantissa} = 0.3279$$

$$\text{Characteristics} + \text{mantissa}$$

$$= -1 + 0.3279$$

$$= -1.3279$$

(14)

(vi) 0.000354

$$\text{Sol:- } \log(0.000354)$$

$$= 0.000354$$

$$= 354 \times 10^{-3}$$

$$\text{characteristics} = -3$$

$$\text{mantissa} = 0.4510$$

$$\text{characteristics} + \text{mantissa}$$

$$= -3 + 0.4510$$

$$= -3.4510$$

Q3 If $\log 3.177 = 0.5019$ then find

ii $\log(3177)$

$$\log(3177)$$

$$3.177 \times 10^3$$

$$\text{characteristics} = 3$$

$$\text{mantissa} = 0.5019$$

$$\text{characteristics} + \text{mantissa}$$

$$= 3 + 0.5019$$

$$= 3.5019$$

(ii) $\log(31.77)$

$$\log(31.77)$$

$$= 31.77$$

$$= 3.177 \times 10^1$$

$$\text{characteristics} = 1$$

$$\text{mantissa} = 0.5019$$

$$\text{characteristics} + \text{mantissa}$$

$$= 1 + 0.5019$$

$$= 1.5019$$

(15)

(iii) $\log 0.03177$

Sol:-

$$\log(0.03177)$$

$$= 0.03177$$

$$3177 \times 10^{-1}$$

$$\text{characteristics} = -1$$

$$\text{Mantissa} = 0.4981$$

$$\text{characteristics} + \text{mantissa}$$

$$= -1 + 0.4981$$

$$= -1.4981$$

$$\text{Ex} = 2.3$$

Q4 Find the value of x

(i) $\log x = 0.0065$

Sol:- $\log x = 0.0065$

$$x = \text{Antilog}(0.0065)$$

$$\text{Characteristics} = 0$$

$$\text{Mantissa} = 0.0065$$

$$\text{Antilog } x = 1.015$$

$$\boxed{x = 1.015}$$

(ii) $\log x = 1.192$

Sol:- $\log x = 1.192$

$$x = \text{Antilog}(1.192)$$

$$\text{characteristics} = 1$$

$$\text{Mantissa} = 0.192$$

$$\boxed{x = 15.56}$$

(16)

(iii)

$$\log x = -3.434$$

$$\text{Sol.} - \log x = -3.434$$

$$x = \text{antilog} (-3.434)$$

$$\text{characteristics} = -3$$

$$\text{Mantissa} = 0.434$$

$$\log x = -4 + 4 - 3.434$$

$$= -4 + 4.000 - 3.434$$

$$\log x = -4 + 0.566$$

$$\text{characteristics} = -4$$

$$\text{Mantissa} = 0.566$$

$$x = 0.0003681$$

(iv)

$$\log x = -1.5726$$

Sol. -

$$\log x = -1.5726$$

$$\log x = -2 + 2 - 1.5726$$

$$\log x = -2 + 0.4274$$

$$\log x = \bar{2}.4274$$

$$x = \text{antilog} (\bar{2}.4274)$$

$$\text{characteristics} = -2$$

$$\text{Mantissa} = 0.4274$$

$$x = 0.02675$$

(v)

$$\log x = 4.3561$$

$$\text{Sol.} - \log x = 4.3561$$

$$\text{characteristics} = 4$$

$$\text{mantissa} = 0.3561$$

(17)

$$X = \text{Antilog}(4.3561)$$
$$\boxed{X = 22710}$$

(vi) $\log x = -2.0184$
S/-

$$\log x = -2.0184$$

$$= -2 + 3 - 3 + 0.0184$$

$$= -3 + 3 - 2.0184$$

$$= -3 + 0.9816$$

$$= \bar{3}.9816$$

$$\text{characteristics} = \bar{3}$$

$$\text{mantissa} = 0.9816$$

$$\boxed{X = 0.009585}$$

EX = 2.31

Q, without using calculator, evaluate the following

i) $\log_2 18 - \log_2 9$

Sol:- $\log_2 18 - \log_2 9$

we know

$$\log_a A - \log_a B = \log_a \left(\frac{A}{B} \right)$$

$$\log_2 \left(\frac{18}{9} \right) = \log_2 2 = 1 \quad \because \log_a a = 1$$

ii) $\log_2 64 + \log_2 2$

Sol:- $\log_2 64 + \log_2 2$

we know $\log_a A + \log_a B$

$$\log_a (A \times B)$$

$$\log_2 (64 \times 2) = \log_2 (2^6 \times 2^1)$$

$$= \log_2 2^7 = 7 \log_2 2 \quad \because \log_a a = 1$$

$$= 7(1) = 7$$

Date: _____

Day: _____

$$(iii) \quad \frac{1}{3} \log_3 8 - \log_3 18$$

Sol:-

$$= \frac{1}{3} \log_3 8 - \log_3 18$$

$$= \log_3 (8)^{\frac{1}{3}} - \log_3 18$$

$$= \log_3 (2^3)^{\frac{1}{3}} - \log_3 18$$

$$= \log_3 2 - \log_3 18$$

$$= \log_3 \left(\frac{2}{18} \right)$$

$$= \log_3 \left(\frac{1}{9} \right) = \log_3 \left(\frac{1}{3^2} \right)$$

$$= \log_3 3^{-2} = -2 \log_3 3$$

$$= -2(1) = -2$$

∴

$$n \log_a m = \log_a m^n$$

$$\begin{array}{r} 2 \overline{) 8} \\ 2 \overline{) 4} \\ 2 \overline{) 2} \\ 1 \end{array}$$

$$2^3 = 8$$

$$\begin{array}{r} 3 \overline{) 9} \\ 3 \overline{) 3} \\ 1 \end{array}$$

$$3^2 = 9$$

(iv) $2 \log 2 + \log 25$

Sol

$$2 \log 2 + \log 25$$

$$= \log 2^2 + \log 25$$

$$= \log 4 + \log 25$$

$$= \log (4 \times 25)$$

$$= \log (100)$$

$$\log_{10} 10^2 \text{ (i)}$$

$$= \log 10^2 = 2 \log (10)$$

$$= 2(1)$$

(v) $\frac{1}{3} \log_4 64 + 2 \log_5 25$

Sol: $\frac{1}{3} \log_4 64 + 2 \log_5 25$

$$\log_4 (64)^{\frac{1}{3}} + \log_5 (25)^2$$

$$\log_4 (4)^3 \times \frac{1}{3} + \log_5 (5^2)^2$$

~~4~~

$$4^3 = 64$$

$$\log_4 4^4 + \log_5 5^4$$

$$= \log_4 4^4 + 4 \log_5 5$$

$$= 1 + 4(1)$$

$$= 1 + 4 = 5$$

Date: _____

Day: _____

(vi) $\log_3 12 + \log_3 0.25$

Sol. -

$$\log_3 12 + \log_3 0.25$$

$$= \log_3 12 + \log_3 \frac{25}{100}$$

$$= \log_3 12 + \log_3 \frac{1}{4}$$

$$= \log_3 \left(12 \times \frac{1}{4} \right)$$

$$= \log_3 3 = (1) = 1$$

Date: _____

Day: _____

Q₂ Write the following as a single logarithm

(ii) $\frac{1}{2} \log 25 + 2 \log 3$

Sol:-

$$= \log(25)^{\frac{1}{2}} + \log(3)^2$$

$\therefore$

$$\log_a m^n = n \log_a m$$

$$= \log[(25)^{\frac{1}{2}} \times (3)^2]$$

$$= \log[(5^2)^{\frac{1}{2}} \times 9]$$

$$\therefore \log_a(mn) = \log_a m + \log_a n$$

$$= \log[5 \times 9]$$

$$= \log(45)$$

(iii) $\log 9 - \log \frac{1}{3}$

Sol:-

$$\log 9 - \log \frac{1}{3}$$

$$\therefore \log_a \left(\frac{m}{n} \right) = \log_a m - \log_a n$$

$$= \log \left(\frac{9}{\frac{1}{3}} \right)$$

$$= \log \left[9 \div \frac{1}{3} \right] = \log(9 \times 3)$$

$$= \log \left[9 \times \frac{1}{3} \right] = \log(27)$$

$$(iii) \log_5 b^2 \cdot \log_a 5^3$$

sol:-

$$= \log_5 b^2 \cdot \log_a 5^3$$

$$= \frac{\log b^2}{\log 5} \cdot \frac{\log 5^3}{\log a}$$

$$= \frac{2 \log b}{\log 5} \cdot \frac{3 \log 5}{\log a}$$

$$= \frac{6 \log b}{\log a} = 6 \log_a b$$

Date:

Day:

$$(iv) 2 \log_3 x + \log_3 y$$

Sol:-

$$= 2 \log_3 x + \log_3 y$$

$$= \log_3 x^2 + \log_3 y$$

$$= \log_3 (x^2 y)$$

$$(v) 4 \log_5 x - \log_5 y + \log_5 z$$

Sol:-

$$= 4 \log_5 x - \log_5 y + \log_5 z$$

$$= \log_5 x^4 + \log_5 z - \log_5 y$$

$$= \log_5 (x^4 z) - \log_5 y$$

$$= \log_5 \left(\frac{x^4 z}{y} \right)$$

$$(vi) 2 \ln a + 3 \ln b - 4 \ln c$$

Sol:-

$$2 \ln a + 3 \ln b - 4 \ln c$$

$$\ln a^2 + \ln b^3 - \ln c^4$$

$$\ln (a^2 b^3) - \ln c^4$$

$$\ln \left(\frac{a^2 b^3}{c^4} \right)$$

3 Expand the following using Law of Logarithm

(i) $\log\left(\frac{11}{5}\right)$

Sol:-

$$\log\left(\frac{11}{5}\right) = \log(11) - \log 5$$

(ii) $\log_5 \sqrt{8a^6}$

Sol:-

$$= \log_5 \sqrt{8a^6}$$

$$= \log_5 (8a^6)^{\frac{1}{2}}$$

$$\begin{array}{r|l} 2 & 8 \\ \hline 2 & 4 \\ \hline 2 & 2 \\ \hline \end{array}$$

$$= \log_5 (2^3 a^6)^{\frac{1}{2}}$$

$$= \log_5 (2^{3 \times \frac{1}{2}} a^{6 \times \frac{1}{2}})$$

$$= \log_5 (2^{\frac{3}{2}} \cdot a^3)$$

$$= \log_5 (2^{\frac{3}{2}}) + \log_5 a^3$$

$$= \frac{3}{2} \log_5 2 + 3 \log_5 a$$

(iii) $\ln\left(\frac{a^2 b}{c}\right)$

Sol:- $\ln\left(\frac{a^2 b}{c}\right)$

$$= \ln(a^2 b) - \ln c$$

$$= \ln(a^2) + \ln(b) - \ln c$$

$$= 2 \ln(a) + \ln b - \ln c$$

Date: _____ Day: _____

$$(iv) \log\left(\frac{xy}{z}\right)^{\frac{1}{q}}$$

Sol:-

$$\log\left(\frac{xy}{z}\right)^{\frac{1}{q}} = \frac{1}{q} \log\left(\frac{xy}{z}\right)$$

$$= \frac{1}{q} [\log[xy] - \log(z)]$$

$$= \frac{1}{q} [\log x + \log y - \log z]$$

$$(v) \ln \sqrt[3]{16x^3}$$

Sol:- $\ln \sqrt[3]{16x^3}$

$$16 = 2 \times 2 \times 2 \times 2$$

$$= \ln (16x^3)^{\frac{1}{3}}$$

$$= 2^4$$

$$= \ln (2^4 x^3)^{\frac{1}{3}}$$

$$= \ln [(2^4)^{\frac{1}{3}} (x^3)^{\frac{1}{3}}]$$

$$= \ln [2^{\frac{4}{3}} x]$$

$$= \ln (2)^{\frac{4}{3}} + \log x$$

$$= \frac{4}{3} \log 2 + \log x$$

$$(vi) \log_2 \left(\frac{1-a}{b}\right)^5$$

Sol:- $\log_2 \left(\frac{1-a}{b}\right)^5$

$$= 5 \log_2 \left(\frac{1-a}{b}\right)$$

$$= 5 [\log_2 (1-a) - \log_2 (b)]$$

4. Find the value of x in the following equation

(i) $\log_2 + \log x = 1$

Sol: $\log_2 + \log x = 1$

$$\log(2x) = 1$$

$$\log(2x) = \log 10$$

$$2x = 10$$

$$x = \frac{10}{2}$$

$$\boxed{x = 5}$$

(ii) $\log_2 x + \log_2 8 = 5$

Sol: -

$$\log_2 x + \log_2 8 = 5$$

$$\log_2 (x \times 8) = 5$$

$$\log_2 (8x) = 5 \cdot \log_2 2$$

∴

$$\log_a a = 1$$

$$\log_2 2 = 1$$

$$\log_2 (8x) = \log_2 2^5$$

$$2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$$

$$\log_2 (8x) = \log_2 (32)$$

$$8x = 32$$

$$x = \frac{32}{8}$$

$$4$$

$$\boxed{x = 4}$$

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$$(iii) (81)^x = (243)^{x+2}$$

Sol

$$(81)^x = (243)^{x+2}$$

$$(3^4)^x = (3^5)^{x+2}$$

$$\begin{array}{r|l} 3 & 81 \\ \hline 3 & 27 \\ \hline 3 & 9 \\ \hline 3 & 3 \\ \hline 1 & \end{array}$$

$$\begin{array}{r|l} 3 & 243 \\ \hline 3 & 81 \\ \hline 3 & 27 \\ \hline 3 & 9 \\ \hline 3 & 3 \\ \hline 1 & \end{array}$$

$$3^{4x} = 3^{5(x+2)}$$

$$3^{4x} = 3^{5x+10}$$

$$4x = 5x + 10$$

$$4x - 5x = 10$$

$$-x = 10$$

$$\boxed{x = -10}$$

(iv)

$$\left(\frac{1}{27}\right)^{x-6} = 27$$

Sol:-

$$\left(\frac{1}{27}\right)^{x-6} = 27$$

$$27 = 3 \times 3 \times 3 = 3^3$$

$$\text{Sol } \left(\frac{1}{3^3}\right)^{x-6} = 3^3$$

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

$$3^{-3x+18} = 3^3$$

$$-3x + 18 = 3$$

$$-3x = 3 - 18$$

$$-3x = -15$$

$$\Rightarrow \boxed{x = 5}$$

$$x = -15/-3$$

Date: _____

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$$(v) \log(5x-10) = 2$$

Sol:-

$$\log(5x-10) = 2$$

$$\log(5x-10) = 2 \log 10$$

$$\log(5x-10) = \log(10)^2$$

$$5x-10 = 10^2$$

$$10^2 = 10 \times 10 = 100$$

$$5x - 10 = 100$$

$$5x = 100 + 10$$

$$5x = 110$$

$$x = \frac{110}{5}$$

$$\boxed{x = 22}$$

$$vi) \log_2(x+1) - \log_2(x-4) = 2$$

$$\text{Sol:- } \log_2(x+1) - \log_2(x-4) = 2$$

$$\log_2 \left(\frac{x+1}{x-4} \right) = 2(1)$$

$$\log_2 \left(\frac{x+1}{x-4} \right) = 2 \log_2 2$$

$$2^2 = 2 \times 2 = 4$$

$$\log_2 \left(\frac{x+1}{x-4} \right) = \log_2 (2)^2$$

$$\frac{x+1}{x-4} = 4$$

$$x+1 = 4(x-4)$$

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$$x + 1 = 4x - 16$$

$$x - 4x = -16 - 1$$

$$-3x = -17$$

$$x = \frac{-17}{-3}$$

$$\begin{array}{r} 5 \\ 3 \overline{) 17} \\ 15 \\ \hline 2 \end{array}$$

$$x = \frac{17}{3}$$

$$x = 5\frac{2}{3}$$

Q5 Find the value of the following with the help of Logarithm table.

ii) $\frac{3.68 \times 4.21}{5.234}$

Sol:-

$$3.68 \times 4.21$$

$$5.234$$

Let $x = \frac{3.68 \times 4.21}{5.234}$

Taking log both side

$$\log x = \log \left[\frac{3.68 \times 4.21}{5.234} \right]$$

$$= \log(3.68 \times 4.21) - \log(5.234)$$

$$= \log(3.68) + \log(4.21) - \log(5.234)$$

$$= 0.5658 + 0.6243 - 0.7188$$

$$\log x = 0.4713$$

$$\text{characteristics} = 0$$

$$\text{mantissa} = 0.4713$$

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$$x = \text{Antilog} (0.4713)$$

$$x = 2.960$$

(ii) $4.67 \times 2.11 \times 2.397$

Soln -

$$4.67 \times 2.11 \times 2.397$$

Let

$$x = 4.67 \times 2.11 \times 2.397$$

Taking Log b/s

$$\log x = \log (4.67 \times 2.11 \times 2.397)$$

$$\log x = \log (4.67) + \log (2.11) + \log (2.397)$$

$$= 0.6693 + 0.3243 + 0.3797$$

$$\log x = 1.3733$$

$$x = \text{Antilog} (1.3733)$$

$$\text{Characteristics} = 1$$

$$\text{mantissa} = 0.3733$$

$$x = 23.62$$

Date: _____

Day: _____

$$(iii) \quad \frac{(20.46)^2 \times (2.4122)}{754.3}$$

Soln -

$$\text{Let } x = \frac{(20.46)^2 \times (2.4122)}{754.3}$$

Taking log b/s

$$\log x = \log \left[\frac{(20.46)^2 \times (2.4122)}{754.3} \right]$$

$$= \log[(20.46)^2 \times (2.4122)] - \log(754.3)$$

$$= \log(20.46)^2 + \log(2.4122) - \log(754.3)$$

$$= 2\log(20.46) + \log(2.4122) - \log(754.3)$$

$$= 2(1.3109) + 0.3824 - 2.8775$$

$$= 2.6218 + 0.3824 - 2.8775$$

$$\log(x) = 0.1267$$

$$x = \text{Antilog}(0.1267)$$

characteristics = 0

$$\text{mantissa} = 0.1267$$

$$\boxed{x = 1.339}$$

Date: _____

Day: _____

$$(iv) \frac{\sqrt[3]{9.364} \times 21.64}{3.21}$$

Sol:- Let $x = \frac{\sqrt[3]{9.364} \times 21.64}{3.21}$

Taking log b/s

$$\log x = \log \left[\frac{\sqrt[3]{9.364} \times 21.64}{3.21} \right]$$

$$\log x = \log [(9.364)^{\frac{1}{3}} \times 21.64] - \log (3.21)$$

$$\log x = \log [(9.364)^{\frac{1}{3}}] + \log (21.64) - \log (3.21)$$

$$\log x = \frac{1}{3} \log (9.364) + \log (21.64) - \log (3.21)$$

$$\log x = \frac{1}{3} (0.9715) + 1.3353 - 0.5065$$

$$\log x = 0.3238 + 1.3353 - 0.5065$$

$$\log x = 1.1526$$

$$x = \text{Antilog} (1.1526)$$

$$\text{characteristics} = 1$$

$$\text{mantissa} = 0.1526$$

$$\boxed{x = 14.21}$$

Q6 The formula to measure the magnitude of earthquakes is given by $M = \log_{10} \left(\frac{A}{A_0} \right)$ if amplitude (A) is 10,000 and reference amplitude (A_0) is 10 what is magnitude of the earthquake?

Sol:-

Data:-

$$M = \log_{10} \left(\frac{A}{A_0} \right)$$

$$A = 10,000$$

$$A_0 = 10$$

$$M = \log_{10} \left(\frac{10000}{10} \right)$$

$$= \log_{10} (1000)$$

$$= \log_{10} 10^3$$

$$= 3 \log_{10} 10$$

$$= 3(1)$$

$$\boxed{M = 3}$$

$$10^3 = 1000$$

$$\log_{10} 10 = 1$$

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Q7 Abdullah invested Rs 100,000 in a Saving Scheme and gains interest at the rate of 5% per annum so that the total value of this investment after t years is Rs y . This is modelled by an equation $y = 100,000(1.05)^t$. Find After how many years the investment will be double.

Sol: -

$$y = 100000(1.05)^t$$

~~$$2 \times 100000 = (1.05)^t$$~~

$$2 \times 100000 = 100000(1.05)^t$$

$$2 = (1.05)^t$$

Taking log

$$\log 2 = \log(1.05)^t$$

$$\log 2 = t \log(1.05)$$

$$t = \frac{\log 2}{\log(1.05)}$$

$$\log_2 = 0.3010$$

$$t = \frac{0.3010}{0.0212} = \frac{3012}{212}$$

$$t = 14.20 \approx 14 \text{ years}$$

$$\boxed{t = 14 \text{ years}}$$

Q8

Husia is hiking up a mountain where the temperature (T) decrease by 3% (or a factor of 0.97)

for every 100 meters gain in altitude. The initial Temperature (T_i) at sea level is 20°C using the formula $T = T_i \times 0.97^{\frac{h}{100}}$, calculate the Temperature at an altitude (h) of 500 meters.

Sol:-

$$T = T_i (0.97)^{\frac{h}{100}}$$

$$T_i = 20^\circ\text{C}$$

$$h = 500\text{m}$$

$$T = 20 \times (0.97)^{\frac{500}{100}}$$

$$T = 20 \times (0.97)^5$$

taking Log b/s

$$\log T = \log (20 \times (0.97)^5)$$

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$$\log T = \log(20) + \log(0.97)^5$$

$$= \log(20) + 5 \log(0.97)$$

$$= 1.3010 + 5(-0.0132)$$

$$= 1.3010 - 0.066$$

$$\log T = 1.235$$

$$= \text{Antilog}(1.235)$$

$$\text{Characteristics} = 1$$

$$\text{mantissa} = 0.235$$

$$T = 17.17$$

$$T = (17.17)^0$$



Review EX=2

1. Encircle the correct option

(i) The standard form of 5.2×10^6 is

(A) 52,000 (B) 520,000

(C) 5,200,000 (D) 52,000,000

Correct option = (C) 5,200,000

$$52 \times 100,000$$

$$5.2 \times 10^1 \times 10^5$$

$$5.2 \times 10^6$$

(ii) Scientific notation of 0.00034 is:

(A) 3.4×10^3 (B) 3.4×10^{-4} (C) 3.4×10^4 (D) 3.4×10^{-3} Correct option = (B) 3.4×10^{-4}

$$\frac{3.4}{10^4} = \frac{34}{10 \times 10000}$$

$$\frac{34}{100000} = 0.00034$$

(iii) The Base of Common logarithm is:

(A) 2 (B) 10 (C) 5 (D) (e)

Correct option = (B) common logarithm
Base = 10(iv) $\log_2 2^3 =$ _____

(A) 1 (B) 2 (C) 5 (D) 3

Correct option = D

$$\begin{aligned} \log_2 2^3 &= 3 \log_2 2 \\ &= 3(1) \\ &= 3 \end{aligned}$$

(v) $\log 100 =$ _____
 (A) 2 (B) 3 (C) 10 (D) 2

correct option (A) = 2

$$\log 100 = \log 10^2$$

$$= 2 \log 10$$

$$= 2(1)$$

$$= 2$$

(vi) If $\log 2 = 0.3010$, then $\log 200$ is:

(A) 1.3010 (B) 0.6010 (C) 2.3010 (D) 2.6010

correct option (C) $\log 200$

$$= \log (2 \times 100)$$

$$= \log 2 + \log 100$$

$$= \log 2 + \log 10^2$$

$$= \log 2 + 2 \log 10$$

$$= 0.3010 + 2(1)$$

$$= 2.3010$$

(vii) $\log(0) = ?$

(A) positive (B) negative (C) 0 (D) undefined

correct option (D) $\log(0) = \infty$

viii) $\log 10,000$ (A) 2 (B) 3 (C) 4 (D) 5

correct option (C) $\log 10,000$

$$\log 10^4 = 4 \log(10)$$

$$= 4(1) = 4$$

(ix) $\log 5 + \log 3 =$ _____

- (A) $\log 0$ (B) $\log 2$ (C) $\log(5/3)$ (D) $\log 15$
 correct option (D)

$$\log 5 + \log 3$$

$$\log(5 \times 3) = \log(15)$$

(x) $3^4 = 81$ in logarithmic form is:-

(A) $\log_3 4 = 81$

(B) $\log_4 3 = 81$

(C) $\log_3 81 = 4$

(D) $\log_4 81 = 3$

correct option (C)

$$3^4 = 81$$

$$\log_3 81 = 4$$

Q₂ Express the following numbers in scientific notation

(i) 0.000567

sol 0.000567

$$\begin{aligned} \frac{567}{1000000} &= \frac{567}{10^6} = 567 \times 10^{-6} \\ &= 5.67 \times 10^2 \times 10^{-6} \\ &= 5.67 \times 10^{2-6} \\ &= 5.67 \times 10^{-4} \end{aligned}$$

(ii) 734

sol :- $734 = 7.34 \times 10^2$

(iii) 0.33×10^3

sol $0.33 \times 10^3 = \frac{33}{100} \times 1000 = 33 \times 10^1$
 $= 3.3 \times 10^1 \times 10^1 = 3.3 \times 10^{1+1} = 3.3 \times 10^2$

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Q3 Express the following number in ordinary notation

(i) 2.6×10^3

Sol:- 2.6×10^3

$$\frac{26}{10} \times 1000$$

$$26 \times 100 = 2600$$

(ii) 8.794×10^{-4}

Sol:- 8.794×10^{-4}

$$\frac{8794}{1000} \times \frac{1}{10^4} = \frac{8794}{1000 \times 10000}$$

$$\frac{8794}{10000000} = 0.0008794$$

iii 6×10^{-6}

Sol:-

$$6 \times 10^{-6} = \frac{6}{10^6} = \frac{6}{1000000} = 0.000006$$

Q4 Express each of the following in logarithm form

(i) $3^7 = 2187$

Sol:- we know

$$a^x = y$$

$$\log_a y = x$$

$$\Rightarrow \log_3 2187 = 7$$

(ii) $(12)^2 = 144$

Sol:- $\log_{12} 144 = 2$

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Q5 Express each of the following in exponential form

(i) $\log_4 8 = x$

Sol:-

$$4^x = 8$$

(ii) $\log_9 729 = 3$

Sol:- $9^3 = 729$

(iii) $\log_4 1024 = 5$

Sol:-

$$4^5 = 1024$$

(iv) ~~$\log_9 x = 0.5$~~

~~Sol:- $9^{0.5} = x$~~

Q6 = Find the value of x in the following

(i) $\log_9 x = 0.5$

Sol:-

$$9^{0.5} = x$$

$$(9)^{\frac{1}{2}} = x$$

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

$$\boxed{3 = x}$$

$$0.5 = \frac{5}{10} = \frac{1}{2}$$

$$3^{-6x} = 3^3$$

$$-6x = 3$$

$$x = \frac{3}{-6}$$

$$\boxed{x = -\frac{1}{2}}$$

(ii)

$$\left(\frac{1}{9}\right)^{3x} = 27$$

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

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

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(iii) $\left(\frac{1}{32}\right)^{2x} = 64$

$$32 = 2 \times 2 \times 2 \times 2 \times 2$$

$$64 = 2 \times 2 \times 2 \times 2 \times 2 \times 2$$

$$\left(\frac{1}{2^5}\right)^{2x} = 2^6$$

$$(2^{-5})^{2x} = 2^6$$

$$2^{-10x} = 2^6$$

$$-10x = 6$$

$$x = \frac{6}{-10} \Rightarrow \boxed{x = -\frac{3}{5}}$$

Q7 (ii) write the following as a single logarithm

i) $7 \log x - 3 \log y^2$

sl:-

$$\log x^7 - \log (y^2)^3$$

$$\log \left(\frac{x^7}{y^6} \right)$$

ii $3 \log 4 - \log 32$

sl:- $\log (4)^3 - \log 32$

$$\log (64) - \log 32$$

$$\log \left(\frac{64}{32} \right) = \log 2$$

$$(iii) \quad \frac{1}{3}(\log_5 8 + \log_5 27) - \log_5 3$$

$$\frac{1}{3} \log_5 (8 \times 27) - \log_5 3$$

$$= \frac{\log_5 (8 \times 27)^{\frac{1}{3}}}{3} - \log_5 3$$

$$= \log_5 \left[\frac{(8 \times 27)^{\frac{1}{3}}}{3} \right]$$

$$= \log_5 \left[\frac{(2^3 \times 3^3)^{\frac{1}{3}}}{3} \right]$$

$$= \log_5 \left[\frac{2 \times 3}{3} \right]$$

$$= \log_5 (2)$$

Q3 Expand the following using laws of logarithms

$$(i) \log(xy z^6)$$

$$\text{sol: } - \log(xy z^6)$$

$$= \log x + \log y + \log z^6$$

$$= \log x + \log y + 6 \log z$$

$$(ii) \log_3 \sqrt[6]{m^5 n^3}$$

$$\text{Sol } \log_3 (m^5 n^3)^{\frac{1}{6}} = \frac{1}{6} \log_3 (m^5 n^3)$$

$$= \frac{1}{6} [\log_3 m^5 + \log_3 n^3]$$

$$= \frac{1}{6} [5 \log_3 m + 3 \log_3 n]$$

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iii $\log \sqrt{8x^3}$

Sol:-

$$= \log (8x^3)^{1/2}$$

$$= \log (2^3 x^3)^{1/2}$$

$$= \log (2x)^{3 \times 1/2} = \log (2x)^{3/2}$$

$$= \frac{3}{2} \log (2x)$$

$$= \frac{3}{2} [\log 2 + \log x]$$

Q9 Find the values of the following with the help of logarithm table.

(i) $\sqrt[3]{68.24}$

Sol. - let $x = \sqrt[3]{68.24}$

Taking log b/s

$$\log x = \log (68.24)^{\frac{1}{3}}$$

$$= \frac{1}{3} \log (68.24)$$

$$= \frac{1}{3} (1.8341) = 0.6114$$

$$x = \text{Antilog } (0.6114)$$

$$\text{Characteristics} = 0 \quad \text{mantissa} = 0.6114$$

$$\boxed{x = 4.087}$$

(ii) 319.8×3.543

let $x = 319.8 \times 3.543$

Taking log b/s

$$\log x = \log (319.8 \times 3.543)$$

$$= \log (319.8) + \log (3.543)$$

$$= 2.5049 + 0.5494$$

$$\log x = 3.0543$$

$$x = \text{Antilog } (3.0543)$$

$$\text{Characteristics} = 3$$

$$\text{mantissa} = 0.0543$$

$$\boxed{x = 1133.18}$$

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$$(iii) \quad \frac{36.12 \times 750.9}{113.2 \times 9.98}$$

$$\text{let } x = \frac{36.12 \times 750.9}{113.2 \times 9.98}$$

Taking log b/s

$$\log x = \log \left(\frac{36.12 \times 750.9}{113.2 \times 9.98} \right)$$

$$= \log[36.12 \times 750.9] - \log[113.2 \times 9.98]$$

$$= \log(36.12) + \log(750.9) - [\log(113.2) + \log(9.98)]$$

$$= \log(36.12) + \log(750.9) - \log(113.2) - \log(9.98)$$

$$\log x = 1.5577 + 2.8756 - 2.0538 - 0.9991$$

$$\log x = 1.3804$$

$$x = \text{Antilog}(1.3804)$$

$$\text{characteristics} = 1$$

$$\text{mantissa} = 0.3804$$

$$\boxed{x = 24.01}$$

10. In the year 2016 the population of a city was 22 millions and was growing at a rate of 2.5% per year. The function $P(t) = 22(1.025)^t$ gives the population in millions t years after 2016. Use the model to determine in which year the population will reach 35 millions. Round the answer to the nearest year.
Sol:-

The function

$$P(t) = 22(1.025)^t$$

$$P(t) = 35 \text{ millions}$$

$$22(1.025)^t = 35$$

$$(1.025)^t = \frac{35}{22}$$

$$(1.025)^t = 1.5909$$

Taking log b/s

$$\log(1.025)^t = \log(1.5909)$$

$$t \log(1.025) = \log(1.5909)$$

$$t = \frac{\log(1.5909)}{\log(1.025)}$$

$$\log(1.025)$$

$$t = 19 \text{ years}$$

$$t = \frac{0.2016}{0.0167} = 12.07 \approx 12$$

$$0.0167$$