Real Numbers

: The set of numbers containing all rationals and Irrationals is called Real Numbers.

- Denoted by R ($\mathbb{R}$)
- If a number is not rational, it must be irrational and vice versa.
- Any point on the Real Number line represents either a rational or irrational number.

Number Sets

N : Natural numbers $\{1, 2, 3, \ldots\}$

W : Whole numbers $\{0, 1, 2, 3, \ldots\}$

I or Z : $\{-\infty, \ldots -2, -1, 0, 1, 2, \ldots \infty\}$

in $\in$ $x \in N$

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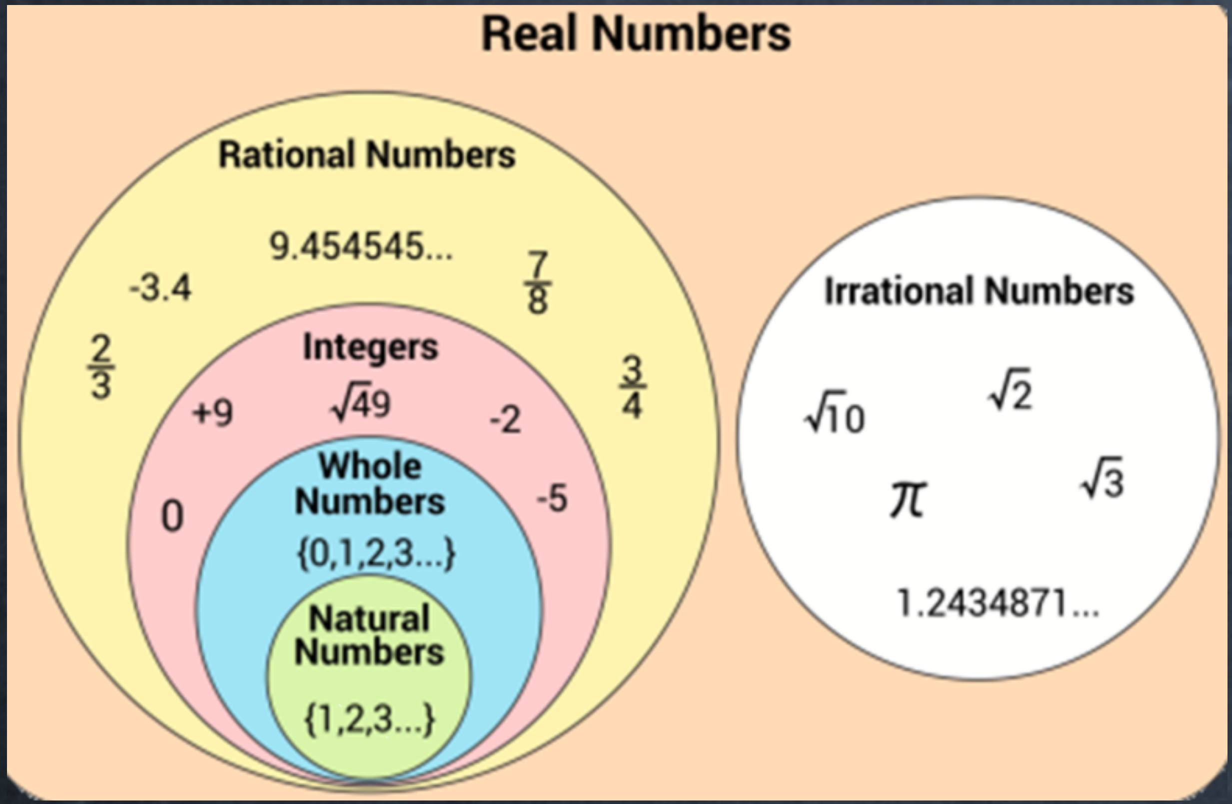

"$\in$" belongs to

Rational Number :

Any number that can be expressed in the form $\frac{p}{q}$, $p, q \in \mathbb{Z}$, $q \neq 0$, p, q are Co primes

Eg: -4, 3.28, $1.333\ldots$

Irrational Number

Any number which is not rational.

Eg: $\sqrt{2}$, $\sqrt[3]{7}$, $7.67667667\ldots$

Fundamental Theorem of Arithmetic

· Let us take the primes : 2, 3, 5

* Multiply two at a time } $2 \times 3 = 6$ $\quad 3 \times 5 = 15$
$2 \times 5 = 10$

* Multiply three at a time } $2 \times 3 \times 5 = 30$

$2^2 \times 3 \times 5 =$

$2 \times 3^2 \times 5 =$

$2 \times 3 \times 5^2 =$

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Statement of FTA : Every composite number can be expressed as a product of primes and this factorization is Unique, apart from the order in which the primes occur.

Composite Number : A number which can be divided by atleast one number other than one and itself is a composite number

Eg: 4, 9, 15, ...

Prime Number : A number which is divisible only by one and itself.

Eg : 2, 3, 5, 7, ...

NOTE : 1 is neither prime nor composite
2 is the only even prime

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Applications of FTA

(i) To find HCF & LCM

(ii) To prove Irrational numbers

GCD → Greatest Common Divisor

(i) To find HCF / LCM

$$\boxed{HCF(a,b) = \text{Product of the lowest powers of common prime factors}}$$

Note: HCF of two or more numbers is always $\leq$ the smallest of them

$$\boxed{LCM(a,b) = \text{Product of highest powers of ALL prime factors}}$$

Note: LCM of two or more numbers is $\geq$ the largest of them.

Rules to find HCF/LCM

(i) Arrange prime factors in ascending order.

(ii) Factors must be expressed in exponential form.

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Example 1 : Consider the numbers 4^n, where n is a natural number. Check whether there is any value of n for which 4^n ends with the digit zero.

Note: Any number ending with zero must have both 2 & 5 as its prime factors

$4^n = (2\times2)^n$

$\therefore$ There is no 5 in the prime factors
4^n can never end with the digit zero.

4^n

$n=2 \quad 4^2 = 16$

$n=3 \quad 4^3 = 64$

$n=4 \quad 4^4 = 256$

783500

$= 78350 \times 10$

$\boxed{} \times (2\times5)$

Example 2 : Find the LCM and HCF of 6 and 20 by the prime factorisation method.

$6 = 2\times3$

$20 = 2^2\times5$

HCF $= 2$

LCM $= 2^2\times3\times5 = 60$

$\boxed{HCF(6,20) = 2 \quad LCM(6,20) = 60}$

$$\begin{array}{r|l}
2 & 32760 \\
2 & 16380 \\
2 & 8190 \\
3 & 4095 \\
3 & 1365 \\
5 & 455 \\
13 & 91 \\
7 & 7 \\
 & 1
\end{array}$$

4×5

$2\times2\times5$

$32760 = 2^3\times3^2\times5\times7\times13$

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Relation b/w HCF & LCM of two numbers

$$\boxed{HCF \times LCM = a \times b}$$

** HCF is a factor of LCM

$\Downarrow$

$\boxed{\text{HCF can divide LCM fully}}$

* In Example 2:

$$2 \times 60 = 6 \times 20$$
$$120 = 120$$

Example 3: Find the HCF of 96 and 404 by the prime factorisation method. Hence, find their LCM.

$$96 = 2^2 \times 101$$
$$404 = 2^5 \times 3$$

$$HCF = 2^2 \Rightarrow \boxed{HCF(96, 404) = 4}$$

$$\begin{array}{r|l} 2 & 404 \\ \hline 2 & 202 \\ \hline & 101 \end{array} \qquad \begin{array}{r|l} 2 & 96 \\ \hline 2 & 48 \\ \hline 2 & 24 \\ \hline 2 & 12 \\ \hline 2 & 6 \\ \hline & 3 \end{array}$$

We know, $a \times b = LCM \times HCF$

$$\therefore LCM = \frac{a \times b}{HCF} = \frac{96 \times \overset{101}{\cancel{404}}}{\cancel{4}} =$$

$$\boxed{LCM(96, 404) = 9696}$$

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Example 4 : Find the HCF and LCM of 6, 72 and 120, using the prime factorisation method.

$$6 = 2^1 \times 3$$

$$72 = 2^3 \times 3^2$$

$$120 = 2^3 \times 3 \times 5$$

$$HCF = 2 \times 3 = 6$$

$$LCM = 2^3 \times 3^2 \times 5 = 360$$

$$\begin{array}{r|l} 2 & 72 \\ 2 & 36 \\ 2 & 18 \\ 3 & 9 \\ & 3 \end{array}$$

120

12   10

$2^2 \times 3$ 2×5

$$\boxed{\begin{aligned} HCF(6, 72, 120) &= 6 \\ LCM(6, 72, 120) &= 360 \end{aligned}}$$

$$\begin{array}{r} 72 \\ \times\ 6 \\ \hline 432 \end{array}$$

Check

$$6 \times 72 \times 120 = 51840$$

$$6 \times 360 = 2160$$

$$6 \times 72 \times 120 \neq 6 \times 360$$

$$\boxed{a \times b \times c \neq HCF \times LCM}$$

↳ Only works for 2 digits

For 3 Nos

$$\boxed{LCM(p, q, r) = \frac{(p \cdot q \cdot r)\ HCF(p, q, r)}{HCF(p, q) \cdot HCF(q, r) \cdot HCF(p, r)}}$$

$$\boxed{HCF(p, q, r) = \frac{(p \cdot q \cdot r)\ LCM(p, q, r)}{LCM(p, q) \cdot LCM(q, r) \cdot LCM(p, r)}}$$

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Finding Square roots

a) Of perfect square Nos

(i) $\sqrt{1225} = \boxed{35}$

(ii) $\sqrt{2209} = 4\ 3/7 \Rightarrow 43$ or 47

$45^2 = 2025$

$= \boxed{47}$

(iii) $\sqrt{2704} = 5\ 2/8 \Rightarrow 52$ or 58

$55^2 = 3025 > 2704$

$= \boxed{52}$

(iv) $\sqrt{10609} = 10\ 3/7 \Rightarrow 103$ or 107

$105^2 = 11025 > 10609$

$= \boxed{103}$

5 $45^2 = 2025$

2 $85^2 = 7225$

7 $65^2 = 4225$

$105^2 = 11025$

$1^2 = 1$	$11^2 = 121$
$2^2 = 4$	$12^2 = 144$
$3^2 = 9$	$13^2 = 169$
$4^2 = 16$	$14^2 = 196$
$5^2 = 25$	$15^2 = 225$
$6^2 = 36$	$16^2 = 256$
$7^2 = 49$	$17^2 = 289$
$8^2 = 64$	$18^2 = 324$
$9^2 = 81$	$19^2 = 361$
$10^2 = 100$	$20^2 = 400$

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