# CLASS 10TH MID TERM

# SCORE BOOSTER

## REAL NUMBERS

MATHS

# Fundamental Theorem of Arithmetic

**According to the fundamental theorem of arithmetic, every composite number can be written (factorized) as the product of primes and this factorization is unique, apart from the order in which the prime factors occur.**

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

$14 = 2 \times 7$

**Q. Explain why $4 \times 11 \times 5 + 11$ is a composite number?**

$$\Rightarrow \overbrace{4 \times 11 \times 5} + 11$$

$$11(4 \times 5 + 1)$$

$$11(20 + 1)$$

$$11 \times 21 = \underline{11} \times \underline{7} \times \underline{3}$$

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13th Sept 2024

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# Prime factorization:

$$\begin{array}{r|l} 2 & 196 \\ \hline 2 & 98 \\ \hline 7 & 49 \\ \hline & 7 \end{array}$$

$196 = 2 \times 2 \times 7 \times 7$

$= 2^2 \times 7^2$

$$\begin{array}{r|l} 2 & 1024 \\ \hline 2 & 512 \\ \hline 2 & 256 \\ \hline 2 & 128 \\ \hline 2 & 64 \\ \hline 2 & 32 \\ \hline 2 & 16 \\ \hline 2 & 8 \\ \hline 2 & 4 \\ \hline & 2 \end{array}$$

$1024 = 2^{10}$

# Important note:

Let x = $\frac{p}{q}$, p and q are co-prime, be a rational number whose decimal expansion terminates. Then, the prime factorization of q is of the form $2^m \times 5^n$; m, n are non-negative integers.

pf.

16, 25 → 1

Example: $\frac{12}{30} = \frac{\cancel{3} \times 4}{\cancel{3} \times 10}$

$= \frac{4}{10}$ 10 → q

$10 = 2 \times 5$

$= 0.4$

$= \frac{2}{5} = 0.4$ ✓

$5 = 5^1 \times 2^0$

$125 = 5 \times 5 \times 5$

$375 = 5 \times 5 \times 5 \times 3$

$1280 = 128 \times 10$

$= 2^7 \times 2 \times 5$

$= 2^8 \times 5 \Rightarrow m = 8, n = 1$

**Q.** **Show that $12^n$ cannot end with the digit 0 or 5 for any natural number 'n'.**

$$12^n = (2 \times 2 \times 3)^n$$
$$= (2^2 \times 3)^n$$
$$= 2^{2n} \times 3^n$$

no (5)

$$(a^m)^n = a^{m \times n}$$

$$2 \times 5 = 10$$

# H.C.F & L.C.M. of real numbers

- **HCF** : - the largest integer that two or more numbers can be divided by.

$16 , 28 \rightarrow 4$

$4 \times 4 \quad 4 \times 7$

$28 \rightarrow 28 \times 1$
$14 \times 2$

$16 \rightarrow 16 \times 1$
$8 \times 2$

- **LCM** : - the smallest integer (whole number) that belongs to the multiplication table of two or more composite numbers.

$6 \rightarrow 6, 12, \underline{18}, 24 \ldots\ldots$

$9 \rightarrow 9, \underline{18},$

$LCM(6, 9) = 18$

# HCF & LCM of two distinct prime numbers a & b:

$\rightarrow HCF = 1$

$LCM = a \times b$
$= ab$

$32 = 2^1 \times 2^1 \times 2^1 \times 2^1 \times 2^1 = 2^5$

$64 = 2^6$

$HCF = 2^5 = 32$

$LCM = 2^6 = 64$

all the factors taken once + max. power

$2 , 3$

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

$HCF = 1$

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

**Q. Find the LCM & HCF of 52 & 39.**

$52 = 2 \times 2 \times 13$

$39 = 3 \times 13$

$LCM = 2^2 \times 3 \times 13 = 12 \times 13 = 156$

$HCF = 13$

$LCM \times HCF = 156 \times 13 = 1928$

$52 \times 39 = 1928$

$$\begin{array}{r} 156 \\ 13 \\ \hline 368 \\ 156 \\ \hline 1928 \end{array}$$

$52 \times 40$

$= 2080 - 52$

$= 1928$

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**For any two positive integers a and b, HCF (a, b) × LCM (a, b) = a × b.**

**Q. The ratio of two numbers is 3:4, and their HCF is 4. find their LCM**

⇒ let the no. be $3x$ & $4x$

$3x = 3 \times x$ ; $4x = 4 \times x$

$\text{HCF} = \boxed{x = 4}$

$3x = 3 \times 4 = 12$ ; $4x = 4 \times 4 = 16$

$12 \times 16 = 4 \times \text{LCM}$

$\text{LCM} = \frac{12 \times \cancel{16}\,4}{\cancel{4}} = 48 \rightarrow \text{LCM}$

**Q. Find the LCM & HCF of 48, 72 & 80 using prime factorization method.**

$$\begin{array}{r|l} 2 & 48 \\ \hline 2 & 24 \\ \hline 2 & 12 \\ \hline 2 & 6 \\ \hline & 3 \end{array} \qquad \begin{array}{r|l} 2 & 72 \\ \hline 2 & 36 \\ \hline 2 & 18 \\ \hline 3 & 9 \\ \hline & 3 \end{array} \qquad \begin{array}{r|l} 2 & 80 \\ \hline 2 & 40 \\ \hline 2 & 20 \\ \hline 2 & 10 \\ \hline & 5 \end{array}$$

$48 = 2^4 \times 3^1$ | $72 = 2^3 \times 3^2$ | $80 = 2^4 \times 5^1$

$LCM = 2^4 \times 3^2 \times 5^1 = \underbrace{16 \times 9 \times 5} = 80 \times 9 = 720$

$HCF = 2^3 = 8$

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**Q.** If the HCF of 65 & 117 is expressible in the form 65m – 117, then the value of m is ____

[NCERT exemplar]

13

$65 = 13 \times 5$

$117 = 13 \times 9$

$HCF = 13$

$13 = 65m - 117$

$13 + 117 = 65m$

$\frac{\cancel{130}^{2}}{\cancel{65}} = m$

$\Rightarrow m = 2$

**Q.** If LCM of two numbers is 48, then which of the following number cannot be their HCF?

a. 3

b. 16

c. 15

d. 24

$15(\ ) = 48$

**Q.** If LCM of two numbers is 48, then which of the following number cannot be their HCF?

a. 3
b. 16
c. 15
d. 24

Note: HCF is always a factor of LCM

**Q.** If two positive integers a and b are written as $a = x^3y^2$ and $b = xy^3$; x, y are prime numbers, then HCF & LCM (a, b) is____

[NCERT exemplar]

$a = (x)(x)(x)(y)(y) = x^3y^2$

$b = x^1y^3$

$LCM = x^3y^3$

$HCF = xy^2$

**Q.** If 7 is the least prime factor of p & 11 is the least prime factor of q, then least prime factor of (p + q) is 2 ____

$98 = 2 \times 49 = 2 \times 7 \times 7$

$49 = 7 \times 7$

$81 = 3^4$

odd ← p → 7

odd ← q → 11

$\cancel{2}$

$$\begin{array}{r} 49 \\ +\ 81 \\ \hline 130 \end{array}$$

for all even no. → l.p.f. → (2)

(p + q) = even → l.p.f = 2

**Q.** **Find the largest number which divides 70 & 125, leaving remainder 5 & 8.**

$x$

$\boxed{x} \to 70 \to \text{Rem} = 5$

$\boxed{x} \to 125 \to \text{Rem} = 8$

$70 - 5 = 65$

$125 - 8 = 117$

$\to \boxed{x}$

$H.C.F\,(65, 117) = 13$

**Q.** **Find the smallest number which when increased by 20 is exactly divisible by 90 & 144.**

$x = 700$

$x + 20 = 720$

$x = 700$

$x + 20$

$720$

$144$ $90$

$x + 20 \geq \frac{144}{90}$

$144 = 12 \times 12 = 3 \times 4 \times 3 \times 4 = 3 \times 3 \times 4^2$

$= 3 \times 3 \times 2^4$

$90 = 9 \times 10 = 3^2 \times 2 \times 5^1$

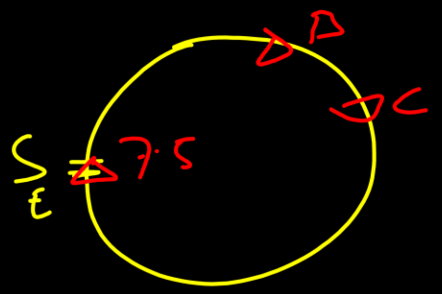
$LCM = 3^2 \times 2^4 \times 5^1$

$= 9 \times 16 \times 5 = 9 \times 80 = 720$

**Q.** A circular field has a circumference 360 km. Three cyclist start together and can cycle 48, 60 & 72 km a day around the field. When will they meet again?

in how many days meet again

A → 48 km/day
B → 60 km/day
C → 72 km/day




$A \rightarrow \frac{\cancel{360}\,30}{\cancel{48}\,4} = \frac{15}{2}$ days

$B \rightarrow \frac{360}{60} = 6$ days

$C \rightarrow \frac{\cancel{360}\,10}{\cancel{72}\,2} = 5$ days

$x$ days

$$\mathrm{LCM}\left(\frac{15}{2}, \frac{6}{1}, \frac{5}{1}\right)$$

$$= \frac{\mathrm{LCM}(15, 6, 5)}{\mathrm{HCF}(2, 1, 1)}$$

$$= \frac{30}{1}$$

$$= 30 \text{ days}$$

LCM of a fracⁿ

$$= \frac{\text{LCM of N}^r}{\text{HCF of D}^r}$$

$$\underline{\text{HCF}} = \frac{\text{HCF of N}^r}{\text{LCM of D}^r}$$

$$\left.\begin{array}{l} A \to 4 \\ B \to 5 \\ C \to 6 \end{array}\right\} \underline{\text{revol.}}$$

**Q.** A rectangular hall is 18m 72cm long and 13m 20cm broad. It is to be paved with square tiles of the same size. Find the least possible number of such tiles.

$24cm = a$

$\underbrace{1872\ cm}_{l} \times \underbrace{1320\ cm}_{b}$

HCF = (l & b)

$= 2^3 \times 3^1$

$= 8 \times 3 = \underline{\underline{24}}$

$$\begin{array}{r|l} 9 & 1872 \\ \hline 4 & 208 \\ \hline 4 & 52 \\ \hline & 13 \end{array} \rightarrow 2^4 \times 3^2 \times 13$$

$1872 = 4 \times 4 \times 9 \times 13$

$1320 = 10 \times 6 \times 2 \times 11$

$= 5 \times 2 \times 2 \times 3 \times 2 \times 11$

$= 2^3 \times 3^1 \times 5 \times 11$

$$\begin{array}{r|l} 10 & 1320 \\ \hline 6 & 132 \\ \hline 2 & 22 \\ \hline & 11 \end{array}$$

no. of tiles $= \dfrac{\text{ar (hall)}}{\text{ar (1 tile)}}$

$$= \frac{\overset{39}{\cancel{\overset{78}{\cancel{\overset{156}{\cancel{1872}}}}}} \times \overset{110}{\cancel{1320}}}{\underset{2}{\cancel{24}} \times \underset{2}{\cancel{24}}}$$

$$\begin{array}{r} 39 \\ 39 \\ \hline 429 \end{array}$$

$= 39 \times 110$

$= 4290$ tiles

**Q.** **If two positive integers a and b are written as $a = pq, b = pq^2$. HCF (a, b) = $p^x q^y$ & LCM (a, b) = $p^m q^n$, then find $\frac{x+y}{m+n}$.** $= 2/3$

p & q are prime

$a = p^1 q^1 \quad b = p^1 q^2$

$LCM(a, b) = p^1 q^2 = p^m q^n \Rightarrow m = 1, n = 2$

$HCF(a, b) = p^1 q^1 = p^x q^y$

$x = 1$

$y = 1$

$\frac{x+y}{m+n} = \frac{1+1}{1+2} = 2/3$

# Irrational number

- A number which cannot be expressed in $\frac{p}{q}$ form
- Non terminating – non repeating decimals
- **Examples:** $\sqrt[3]{4}, \sqrt{8}, 1.657650765007 \ldots\ldots$
- P is a prime number, if p divides $a^2$ then p divides 'a'.

**Q.** **Prove $\sqrt{2}$ is irrational.**

$\boxed{\sqrt{2} \rightarrow \text{rational}} = \frac{p}{q}$, where $p$ & $q$ are co-prime (1)

$\sqrt{2} = \frac{p}{q}$

$p = \sqrt{2}\, q$ [Sq. B. S]

$p^2 = 2q^2$ — (1)

2 is a factor of $p^2$ $\Rightarrow$ 2 divides $p$

$34 = 2 \times 17$

3 is factor of 81

$81 = 3 \times 27$

$p = 2K$

$p^2 = 4K^2$ — (ii) [Sq. B. S]

$$2q^2 = 4k^2$$

$$q^2 = 2k^2$$

2 is a factor of $q^2$

$\Rightarrow$ 2 divides $q$

$\therefore$ 2 is common factor of $p$ & $q$.

$\sqrt{2} \longrightarrow$ irrational

**Q. Prove $5 + 2\sqrt{3}$ is irrational.**

Rational $\rightarrow (5 + 2\sqrt{3})$

$$\frac{p}{q} = 5 + 2\sqrt{3}$$

$$\frac{p}{q} - 5 = 2\sqrt{3}$$

$$\underbrace{\left(\frac{1}{2}\right)\left(\frac{p}{q} - 5\right)}_{R} = \underbrace{\sqrt{3}}_{Ir.}$$

$5 + 2\sqrt{3}$ is irrational

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**Q.** **Prove $\sqrt{3} + \sqrt{5}$ is irrational.**

$\sqrt{3}+\sqrt{5} \rightarrow$ rational.

$$\sqrt{3}+\sqrt{5} = \frac{p}{q}$$

[Sq. B. S]

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

$$\underbrace{3+5}+2\sqrt{3}\sqrt{5} = \frac{p^2}{q^2}$$

$$2\sqrt{15} = \frac{p^2}{q^2} - 8$$

$$\underbrace{\sqrt{15}}_{Ir} = \frac{1}{2}\underbrace{\left(\frac{p^2}{q^2} - 8\right)}_{R}$$

$\sqrt{3}+\sqrt{5} \rightarrow$ irrational

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# Homework Questions

1. If two positive integers p & q can be expressed as $p = ab^2$ & $q = a^3b$. Where a & b are prime numbers, then LCM (p, q) is__

2. The least number that is divisible by all the numbers from 1 to 10(both inclusive) is __

   1, 2, --- 10

3. Prove $\sqrt{2} + \sqrt{3}$ is irrational

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