1 REAL NUMBERS

SUMMARY

1. **Euclid's Division Lemma:**

   Given positive integers a and b, there exist whole numbers q and r satisfying $a = bq + r$, $0 \le r < b$.

2. **Euclid's Division Algorithm :** To obtain the HCF of any two positive integers, say a and b, with $a > b$, follow the steps below :

   Step 1 : Apply Euclid's division lemma, to a and b. So, we find whole numbers, q and r such that $a = bq + r$, $0 \le r < b$.

   Step 2 : If $r = 0$, the HCF is b. If $r \ne 0$, apply Euclid's division lemma to b and r.

   Step 3 : Continue the process till the remainder is zero. The divisor at this stage will be HCF (a, b).

   Also, HCF (a, b) = HCF (b, r), where the symbol HCF (a, b) denotes the HCF of a and b.

3. **The Fundamental Theorem of Arithmetic :**

   Every composite number can be expressed (factorised) as a product of primes, and this factorisation is unique, apart from the order in which the prime factors occur.

4. If p is a prime and p divides a^2, then p divides a, where a is a positive integer.

5. Let x be a rational number whose decimal expansion terminates. Then we can express x in the form $\frac{p}{q}$, where p and q are coprime, and the prime factorisation of q is of the form 2^n5^m, where n, m are non-negative integers.

6. Let $x = \frac{p}{q}$ be a rational number, such that the prime factorisation of q is of the form 2^n5^m, where n, m are non-negative integers. Then x has a decimal expansion which terminates.

7. Let $x = \frac{p}{q}$, where p and q are coprimes, be a rational number, such that the prime factorisation of q is not of the form 2^n5^m, where n, m are non-negative integers. Then x has a decimal expansion which is non-terminating repeating (recurring).

MULTIPLE CHOICE QUESTIONS (MCQ)

1-MARK

1. How many factors are there in the prime factorisation of 5005?

(a) 2 **(b) 4**

(c) 6 **(d) 7**

Sol. $5005 = 5 \times 7 \times 11 \times 13$

5	5005
7	1001
11	143
13	13
	1

There are 4 prime factors in the prime factorisation of 5005.

Hence, option (b) is correct.

2. The product of two consecutive positive integers is always divisible by

(a) 2 **(b) 3**

(c) 4 **(d) 5**

Sol. The product of two consecutive positive integers is divisible by 2. Since, the product of any two consecutive numbers, say $n(n + 1)$ will always be even as one out of n or $(n + 1)$ must be even.

Hence, option (a) is correct.

3. Which of the following is not an irrational number?

(*a*) $6+\sqrt{9}$ **(*b*)** $5-\sqrt{3}$

(*c*) $\sqrt{2}+\sqrt{3}$ **(*d*)** $4+\sqrt{2}$

Sol. Since, $\sqrt{3}$ and $\sqrt{2}$ are irrational numbers but $\sqrt{9}$ equals 3, which is a rational number. Therefore, $6+\sqrt{9}$ equals 6 + 3 *i.e.*, 9 which is not an irrational number.

Hence, option (*a*) is correct.

4. Which of the following rational numbers will have a terminating decimal expansion?

(*a*) $\frac{71}{210}$ **(*b*)** $\frac{29}{343}$

(*c*) $\frac{63}{90}$ **(*d*)** $\frac{15}{1700}$

Sol. $\frac{71}{210} = \frac{71}{2\times3\times5\times7}$, $\frac{29}{343} = \frac{29}{7^3}$

$\frac{63}{90} = \frac{3\times3\times7}{2\times3\times3\times5} = \frac{7}{2\times5}$, $\frac{15}{1700} = \frac{5\times3}{2^2\times5^2\times17}$

The decimal expansion of a rational number $\frac{p}{q}$ terminates if the prime factorisation of q is of the form 2^n5^m, where n, m are non-negative integers.

Hence, option (*c*) is correct.

5. If two positive integers *a* and *b* are written as $a = x^3y^2$ and $y = xy^3$, where *x*,*y* are prime numbers, then HCF (*a*, *b*) is

(*a*) xy **(*b*)** xy^2

(*c*) x^3y^3 **(*d*)** x^2y^2

Sol. Here, $a = x^3y^2$ and $b = xy^3$

$\Rightarrow$ HCF (*a*, *b*) = $x \times y \times y = x \times y^2 = xy^2$

Hence, option (*b*) is correct.

6. If two positive integers *p* and *q* can be expressed as $p = ab^2$ and $q = a^3b$; where *a*, *b* and prime numbers, then LCM (*p*, *q*) is

(*a*) ab **(*b*)** a^2b^2

(*c*) a^3b^2 **(*d*)** a^2b^3

Sol. Here, $p = ab^2$ and $q = a^3b$

$\Rightarrow$ LCM (*p*, *q*) = $a \times a \times a \times b \times b = a^3b^2$

Hence, option (*c*) is correct.

7. If $n = 2^3 \times 3^4 \times 5^4 \times 7$, then the number of consecutive zeroes in *n*, where *n* is a natural number, is

(*a*) 2 **(*b*)** 3

(*c*) 4 **(*d*)** 7

Sol. $n = 2^3 \times 3^4 \times 5^4 \times 7$

$\Rightarrow n = 2^3 \times 3^4 \times 5^3 \times 5 \times 7$

$\Rightarrow n = 3^4 \times 5 \times 7 \times 2^3 \times 5^3$

$\Rightarrow n = 3^4 \times 5 \times 7 \times 10^3$

Thus, the number of zeores in the end of the given number *n* is 3.

Hence, option (*b*) is correct.

8. 2.13113111311113... is

(*a*) **an integer**

(*b*) **a rational number**

(*c*) **an irrational number**

(*d*) **none of these**

Sol. 2.13113111311113... is a non terminating, non repeating decimal.

So, it is irrational.

Hence, option (*c*) is correct.

9. The number 3.24636363... is

(*a*) **an integer**

(*b*) **a rational number**

(*c*) **an irrational number**

(*d*) **none of these**

Sol. 3.24636363... *i.e.*, $3.24\overline{63}$ is a non terminating repeating decimal.

So, it is a rational number.

Hence, option (*b*) is correct.

10. If *p* and *q* are co-prime numbers, then p^2 and q^2 are

(*a*) **co-prime** **(*b*)** **not co-prime**

(*c*) **even** **(*d*)** **odd**

Sol. If p and q are co-prime numbers, then p^2 and q^2 are also co-prime.

Hence, option (a) is correct.

11. If n is any natural number, then $6^n - 5^n$ always ends with

(a) 1 **(b) 3**

(c) 5 **(d) 7**

Sol. For any $n \in$ N, 6^n and 5^n end with 6 and 5 respectively. Therefore, $6^n - 5^n$ always ends with 6 – 5 = 1

Hence, option (a) is correct.

12. What is the L.C.M of the smallest prime number and the smallest composite number?

(a) 1 **(b) 2**

(c) 3 **(d) 4**

Sol. Smallest prime number = 2

Smallest composite number = 4

LCM (2, 4) = 4

Hence, option (d) is correct.

13. Given that HCF (306, 657) = 9, find LCM (306, 657). [NCERT]

(a) 22338 **(b) 22337**

(c) 24356 **(d) 33228**

Sol. HCF (306, 657) = 9

We know that, LCM × HCM = product of the two numbers

$\therefore$ LCM × 9 = 306 × 657

$$\Rightarrow \text{HCF} = \frac{360 \times 657}{9} = 22338$$

Hence, option (a) is correct.

14. After how many places of decimal will the decimal expansion of $\frac{43}{2^4 \times 5^3}$ terminate?

(a) 1 **(b) 2**

(c) 3 **(d) 4**

Sol. $$\frac{43}{2^4 \times 5^3} = \frac{43 \times 5}{2^4 \times 5^3 \times 5} = \frac{43 \times 5}{2^4 \times 5^4} = \frac{215}{(2 \times 5)^4}$$

$$= \frac{215}{10^4} = \frac{215}{10000} = 0.0215$$

Thus, the decimal expansion of $\frac{43}{2^4 \times 5^3}$ will terminate after 4 places of decimal.

Hence, option (d) is correct.

15. Find the largest number which divides 70 and 125 leaving remainders 5 and 8 respectively.

(a) 10 **(b) 11**

(c) 12 **(d) 13**

Sol. On dividing 70 and 125 by the required number, the remainders are 5 and 8 respectively.

Thus, 70 – 5 = 65 and 125 – 8 = 117 are exactly divisible by the required number.

Required number = HCF (65, 117)

= 13

65) 117 (1
   – 65
   52) 65 (1
      – 52
      13) 52 (4
         – 52
         0

Thus, the required number is 13.

Hence, option (d) is correct.

VERY SHORT ANSWER (VSA) TYPE QUESTIONS (1- MARK)

16. Find the LCM and HCF of 12, 15 and 21 by applying the prime factorisation method. [NCERT]

Sol. $12 = 2 \times 2 \times 3 = 2^2 \times 3$

$15 = 3 \times 5$

$21 = 3 \times 7$

HCF = 3

LCM = $2^2 \times 3 \times 5 \times 7 = 420$

17. Without actually performing the long division, state whether $\frac{13}{3125}$ will have a terminating decimal expansion or a non-terminating repeating decimal expansion. [NCERT]

Sol. $\frac{13}{3125} = \frac{13}{5^5} = \frac{13}{2^0 \times 5^5}$

The denominator is of the form $2^n\ 5^m$, where $n = 0$, $m = 5$.

Hence, $\frac{13}{3125}$ will have terminating decimal expansion.

18. Without actually performing the long division, state whether $\frac{15}{1600}$ will have a terminating decimal expansion or a non-terminating repeating decimal expansion. [NCERT]

Sol. $\frac{15}{1600} = \frac{15}{2^6 \times 5^2}$

The denonimator is of the form $2^n\ 5^m$, where $n = 6$, $m = 2$.

Hence, $\frac{15}{1600}$ will have terminating decimal expansion.

19. Without actually performing the long division, state whether $\frac{129}{2^2 \times 5^7 \times 7^5}$ will have a terminating decimal expansion or a non-terminating repeating decimal expansion. [NCERT]

Sol. The denominator is not of the form 2^n5^m.

$\frac{129}{2^2 \times 5^7 \times 7^5}$ will have a non-terminating repeating decimal expansion.

20. Without actually performing the long division, state whether $\frac{35}{50}$ will have a terminating decimal expansion or a non-terminating repeating decimal expansion. [NCERT]

Sol. $\frac{35}{50} = \frac{7 \times 5}{10 \times 5} = \frac{7}{10} = \frac{7}{2 ´ 5}$

The denominator is of the form $2^n\ 5^m$, where $n = 1$, $m = 1$.

Hence, $\frac{35}{50}$ will have terminating decimal expansion.

21. Find a rational number between $\sqrt{2}$ and $\sqrt{7}$.

Sol. Rational number between $\sqrt{2}$ and $\sqrt{7}$ is $\sqrt{2.25} = 1.5 = \frac{3}{2}$.

22. Write whether $\frac{2\sqrt{45} + 3\sqrt{20}}{2\sqrt{5}}$ on simplification gives a rational or irrational number.

Sol. $\frac{2\sqrt{45} + 3\sqrt{20}}{2\sqrt{5}} = \frac{2\sqrt{3 \times 3 \times 5} + 3\sqrt{2 \times 2 \times 5}}{2\sqrt{5}}$

$= \frac{2 \times 3\sqrt{5} + 3 \times 2\sqrt{5}}{2\sqrt{5}} = \frac{6\sqrt{5} + 6\sqrt{5}}{2\sqrt{5}} = \frac{12\sqrt{5}}{2\sqrt{5}} = 6$

Hence, $\frac{2\sqrt{45} + 3\sqrt{20}}{2\sqrt{5}}$ is a rational number.

SHORT ANSWER (SA) TYPE I QUESTIONS (2-MARKS)

23. Use Euclid's division algorithm to find the HCF of 867 and 255. [NCERT]

Sol. Since 867 > 255, we apply the division lemma to 867 and 225 to get

$867 = 255 \times 3 + 102$

Since the remainder 102 > 0, we apply the division lemma to 255 and 102 to get

$255 = 102 \times 2 + 51$

We consider the new divisor 102 and new remainder 51, and apply the division lemma to get

$102 = 51 \times 2 + 0$

Since the remainder is zero, the process stops.

Since the divisor at this stage is 51, therefore, HCF of 867 and 255 is 51.

24. An army contingent of 616 members is to march behind an army band of 32 members in a parade. The two groups are to march in the same number of columns. What is the maximum number of columns in which they can march? [NCERT]

Sol. Total number of army members = 616

Total number of members in army band = 32

Maximum number of columns such that the two groups can march in the same number of columns = HCF of 616 and 32

$\therefore$ Applying Euclid's division lemma on 616 and 32, we get

$616 = 32 \times 19 + 8$

$$\begin{array}{r|l} & 19 \\ 32 & 616 \\ & -608 \\ \hline & 8 \end{array}$$

Since the remainder $8 \neq 0$, again applying the division lemma on 32 and 8, we get

$32 = 8 \times 4 + 0$

Since the remainder is zero at this stage,

$\therefore$ HCF of 616 and 32 is 8.

Hence, the required number of columns = 8.

25. Check whether 6^n can end with the digit 0 for any natural number *n*. [NCERT]

Sol. If any number ends with the digit 0, it should be divisible by 10 *i.e.*, it will also be divisible by 2 and 5 as $10 = 2 \times 5$.

Prime factorisation of $6^n = (2 \times 3)^n$

In the prime factorisation of 6^n, there is no prime factor as 5.

By Fundamental Theorem of Arithmetic, every composite number can be expressed as a product of primes in a unique way.

For any value of n, 6^n will not be divisible by 5.

Hence, 6^n cannot end with the digit 0 for any natural number n.

26. Explain why $7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 + 5$ is a composite number. [NCERT]

Sol. Numbers are of two types – prime and composite. Prime numbers can be divided by 1 and itself, whereas composite numbers have factors other than 1 and itself.

$7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 + 5$

$= 5 \times (7 \times 6 \times 4 \times 3 \times 2 \times 1 + 1)$

$= 5 \times (1008 + 1) = 5 \times 1009$

1009 cannot be factorised further. The given expression has 5 and 1009 as its factors. Hence, it is a composite number.

27. Show that every positive even integer is of the form $2q$, and that every positive odd integer is of the form $2q + 1$, where q is some integer. [NCERT]

Sol. Let a be any positive integer and $b = 2$. Then, by Euclid's algorithm, $a = 2q + r$, for some integer $q \geq 0$, and $r = 0$ or $r = 1$, because $0 \leq r < 2$. So, $a = 2q$ or $2q + 1$.

If a is of the form $2q$, then a is an even integer. Also, a positive integer can be either even or odd. Therefore, any positive odd integer is of the form $2q + 1$.

28. Show that any positive odd integer is of the form $4q + 1$ or $4q + 3$, where q is some integer. [NCERT]

Sol. Let us start with taking a, where a is a positive odd integer. We apply the division algorithm with a and $b = 4$.

Since $0 \leq r < 4$, the possible remainders are 0, 1, 2 and 3.

That is, a can be $4q$, or $4q + 1$, or $4q + 2$, or $4q + 3$, where q is the quotient.

However, since a is odd, a cannot be $4q$ or $4q + 2$ (since they are both divisible by 2).

Therefore, any odd integer is of the form $4q + 1$ or $4q + 3$.

SHORT ANSWER (SA) TYPE II QUESTIONS (3-MARKS)

29. Show that any positive odd integer is of the form $6q + 1$, or $6q + 3$, or $6q + 5$, where q is some integer. [NCERT]

Sol. Let 'a' be any positive odd integer. On dividing integer 'a' by 6, let q be the quotient and r be the remainder.

Using Euclid's division lemma, we have

$a = 6q + r$, where $0 \leq r < 6$

i.e., $r = 0, 1, 2, 3, 4$ or 5

If $r = 0$, then $a = 6q = 2(3q)$

If $r = 1$, then $a = 6q + 1$

If $r = 2$, then $a = 6q + 2 = 2(3q + 1)$

If $r = 3$, then $a = 6q + 3$

If $r = 4$, then $a = 6q + 4 = 2(3q + 2)$

If $r = 5$, then $a = 6q + 5$

But $a = 6q$, $6q + 2$ and $6q + 4$ are even integers as they are divisible by 2.

Therefore, any odd integer is of the form $6q + 1$ or $6q + 3$ or $6q + 5$.

30. Use Euclid's division lemma to show that the square of any positive integer is either of the form 3*m* or 3*m* + 1 for some integer *m*. [NCERT]

Sol. Let x be any arbitrary positive integer.

Then by Euclid's division lemma, corresponding to positive integers x and 3, there exist unique integers q and r such that

$$x = 3q + r, \text{ where } 0 \le r < 3$$

i.e., $r = 0, 1 \text{ or } 2$

Case I : When $r = 0$, we have

$$x = 3q$$

$$\Rightarrow \quad x^2 = (3q)^2 = 9q^2 = 3(3q^2) = 3m,$$

where $m = 3q^2$ is an integer.

Case II : When $r = 1$, we have

$$x = 3q + 1$$

$$\Rightarrow \quad x^2 = (3q + 1)^2 = 9q^2 + 6q + 1 = 3(3q^2 + 2q) + 1 = 3m + 1,$$

where $m = 3q^2 + 2q$ is an integer.

Case III : When $r = 2$, we have

$$x = 3q + 2$$

$$\Rightarrow \quad x^2 = (3q + 2)^2 = 9q^2 + 12q + 4 = 9q^2 + 12q + 3 + 1 = 3(3q^2 + 4q + 1) + 1 = 3m + 1,$$

where $m = 3q^2 + 4q + 1$ is an integer.

Hence, the square of any positive integer is either of the form $3m$ or $3m + 1$ for some integer m.

31. Find the LCM and HCF of 336 and 54 and verify that LCM × HCF = product of the two numbers. [NCERT]

Sol.

2	336
2	168
2	84
2	42
3	21
7	7
	1

2	54
3	27
3	9
3	3
	1

$336 = 2 \times 2 \times 2 \times 2 \times 3 \times 7 = 2^4 \times 3 \times 7$

$54 = 2 \times 3 \times 3 \times 3 = 2 \times 3^3$

HCF = product of the smallest power of each common prime factor in the numbers

$= 2 \times 3 = 6$

LCM = product of the greatest power of each prime factor involved in the numbers

$= 2^4 \times 3^3 \times 7 = 3024$

Product of the two numbers

$= 336 \times 54 = 18144$

LCM × HCF = $3024 \times 6 = 18144$

Hence, product of the two numbers = LCM × HCF.

32. Prove that $\sqrt{5}$ is irrational. [NCERT]

Sol. Let $\sqrt{5}$ be a rational number.

Therefore, we can find two integers a and b ($b \neq 0$) such that $\sqrt{5} = \frac{a}{b}$.

Let a and b have a common factor other than 1. Then, we can divide them by the common factor, and assume that a and b are co-prime.

So, $a = \sqrt{5}b \Rightarrow a^2 = 5b^2$

Therefore, a^2 is divisible by 5 and it can be said that a is also divisible by 5.

Let $a = 5k$, where k is an integer.

Thus, $a^2 = 5b^2$ can be written as

$(5k)^2 = 5b^2 \Rightarrow 25k^2 = 5b^2 \Rightarrow b^2 = 5k^2$

This means that b^2 is divisible by 5 and so, b is also divisible by 5.

This implies that a and b have 5 as a common factor.

This contradicts the fact that a and b are co-prime.

This contradiction has arisen because of our incorrect assumption that $\sqrt{5}$ is rational.

Thus, $\sqrt{5}$ cannot be expressed as $\frac{p}{q}$.

Hence, $\sqrt{5}$ is irrational.

Note: *In the same manner, we can prove that $\sqrt{2}$ and $\sqrt{3}$ are irrationals.*

33. Prove that $3+2\sqrt{5}$ is irrational. [NCERT]

Sol. Let us assume that $3+2\sqrt{5}$ is rational, then $3+2\sqrt{5}$ can be expressed in the form $\frac{p}{q}$ where p, q are integers and $q \neq 0$.

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

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

$\Rightarrow \sqrt{5}$ = Rational number

$\left[\because \frac{p-3q}{2q} \text{ is a rational number}\right]$

$\Rightarrow \sqrt{5}$ is rational number.

But this contradicts the fact that $\sqrt{5}$ is irrational.

$\therefore$ Our assumption that $3+2\sqrt{5}$ being rational is wrong.

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

34. Prove that $\frac{1}{\sqrt{2}}$ is irrational. [NCERT]

Sol. $\frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{1}{2}\sqrt{2}$

Let $\frac{1}{\sqrt{2}}$ be rational *i.e.,* $\frac{1}{2}\sqrt{2}$ is rational.

Let $\frac{1}{2}\sqrt{2} = \frac{p}{q}$

where p, q are integers, $q \neq 0$ and p, q are coprime.

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

Since quotient of two integers is rational,

$\therefore\ \frac{2p}{q}$ is rational.

$\Rightarrow \sqrt{2}$ is rational.

This contradicts the fact that $\sqrt{2}$ is irrational. Therefore, our assumption is wrong.

Hence, $\frac{1}{\sqrt{2}}$ is irrational.

35. A sweetseller has 420 *kaju barfis* and 130 *badam barfis*. She wants to stack them in such a way that each stack has the same number, and they take up the least area of the tray. What is the maximum number of *barfis* that can be placed in each stack for this purpose? [NCERT]

Sol. The maximum number of *barfis* in each stack is the HCF (420, 130) and the number of stacks will then be the least. The area of the tray that is used up will be the least.

Let us use Euclid's algorithm to find the HCF of 420 and 130.

$420 = 130 \times 3 + 30$

$130 = 30 \times 4 + 10$

$30 = 10 \times 3 + 0$

So, the HCF of 420 and 130 is 10.

Therefore, the sweetseller can make stacks of 10 for both kinds of *barfi*.

36. Show that $5-\sqrt{3}$ is irrational. [NCERT]

Sol. Let us assume, to the contrary, that $5-\sqrt{3}$ is rational.

That is, we can find coprime a and b ($b \neq 0$) such that $5-\sqrt{3} = \frac{a}{b}$.

Therefore, $5 - \frac{a}{b} = \sqrt{3}$.

Rearranging this equation, we get

$$\sqrt{3} = 5 - \frac{a}{b} \quad \Rightarrow \quad \sqrt{3} = \frac{5b - a}{b}$$

Since a and b are integers, we get $5 - \frac{a}{b}$ is rational, and so $\sqrt{3}$ is rational.

But this contradicts the fact that $\sqrt{3}$ is irrational.

This contradiction has arisen because of our incorrect assumption that $5 - \sqrt{3}$ is rational.

So, we conclude that $5 - \sqrt{3}$ is irrational.

37. Show that one and only one out of *n*, *n* + 2, *n* + 4 is divisible by 3, where *n* is any positive integer.

Sol. Let us divide n by 3. If q is quotient and 'r' remainder, then $n = 3 \times q + r$, where $0 \leq r < 3$ *i.e.*, $r = 0, 1, 2$.

When $r = 0$, then $n = 3q$ ...(*i*)

$r = 1$, then $n = 3q + 1$ ...(*ii*)

$r = 2$, then $n = 3q + 2$ ...(*iii*)

From (*i*), n is divisible by 3.

From (*ii*), $n = 3q + 1$. Adding 2 to both sides, we get

$n + 2 = (3q + 1) + 2$

$\Rightarrow n + 2 = 3q + 3$

$\Rightarrow n + 2 = 3(q + 1)$

$\because 3(q + 1)$ is divisible by 3,

$\therefore n + 2$ is divisible by 3

From (*iii*), $n = 3q + 2$

$\Rightarrow n + 4 = 3q + 2 + 4$

$\Rightarrow n + 4 = 3(q + 2)$

$\because 3(q + 2)$ is divisible by 3,

$\therefore n + 4$ is divisible by 3.

At one time, r has only one value out of 0, 1, 2,

$\Rightarrow$ Only one of n, $n + 2$, $n + 4$ is divisible by 3.

LONG ANSWER (LA) TYPE QUESTIONS (4-MARKS)

38. Use Euclid's algorithm to find the HCF of 4052 and 12576. [NCERT]

Sol. **Step 1 :** Since 12576 > 4052, we apply the division lemma to 12576 and 4052, to get

$$12576 = 4052 \times 3 + 420$$

Step 2 : Since the remainder $420 \neq 0$, we apply the division lemma to 4052 and 420, to get

$$4052 = 420 \times 9 + 272$$

Step 3 : We consider the new divisor 420 and the new remainder 272, and apply the division lemma to get

$$420 = 272 \times 1 + 148$$

We consider the new divisor 272 and the new remainder 148, and apply the division lemma to get

$$272 = 148 \times 1 + 124$$

We consider the new divisor 148 and the new remainder 124, and apply the division lemma to get

$$148 = 124 \times 1 + 24$$

We consider the new divisor 124 and the new remainder 24, and apply the division lemma to get

$$124 = 24 \times 5 + 4$$

We consider the new divisor 24 and the new remainder 4, and apply the division lemma to get

$$24 = 4 \times 6 + 0$$

The remainder has now become zero, so our procedure stops. Since the divisor at this stage is 4, the HCF of 12576 and 4052 is 4.