Real Numbers

Previous Years' CBSE Board Questions

1.1 Introduction

MCQ

1. The total number of factors of a prime number is
(a) 1
(b) 0
(c) 2
(d) 3 (2020)

1.2 The Fundamental Theorem of Arithmetic

MCQ

2. The ratio of HCF to LCM of the least composite number and the least prime number is
(a) 1:2
(b) 2:1
(c) 1:1
(d) 1:3 (2023)

3. If HCF (39,91) = 13, then LCM (39,91) is
(a) 91
(b) 273
(c) 39
(d) 3549 (Term I, 2021-22)

4. Two positive numbers have their HCF as 12 and their product as 6336. The number of pairs possible for the numbers, is
(a) 2
(b) 3
(c) 4
(d) 1 (Term I, 2021-22)

5. If 'n' is any natural number, then (12)" cannot end with the digit
(a) 2
(b) 4
(c) 8
(d) 0 (Term I, 2021-22)

6. The number 385 can be expressed as the product of prime factors as
(a) 5x11x13
(c) 5x7x13
(b) 5x7x11
(d) 5x11x17 (Term I, 2021-22)

7. The HCF and the LCM of 12, 21 and 15 respectively, are
(a) 3, 140
(c) 3,420
(b) 12,420
(d) 420, 3 (2020)

VSA (1 mark)

8. The LCM of two numbers is 182 and their HCF is 13. If one of the numbers is 26, find the other. (2020)

9. The LCM of two numbers is 9 times their HCF. The sum of LCM and HCF is 500. Find the HCF of the two numbers. (2019C)

10. If HCF (336, 54) = 6, find LCM (336, 54). (2019)

11. The HCF of two numbers a and b is 5 and their LCM is 200 Find the product ab. (AI 2019)

12. What is the HCF of smallest prime number and the smallest composite number? (2018)

13. Show that any number of the form 6", where n∈N can never end with digit 0. (Board Term 1, 2017)

14. The HCF of two numbers is 27 and their LCM is 162, if one of the number is 54, find the other number. (Board Term 1, 2017)

15. The LCM of two numbers is 2079 and their HCF is 27. If one of the number is 297. Find the other number. (Board Term 1, 2015)

SAI (2 marks)

16. Find the least number which when divided by 12, 16 and 24 leaves remainder 7 in each case. (2023)

17. Two numbers are in the ratio 2 : 3 and their LCM is 180 What is the HCF of these numbers? (2023)

18. Explain why 2 x 3 x 5 +5 and 5 x 7 x 11 + 7 x 5 are composite numbers. (2021C)

19. If HCF of 65 and 117 is expressible in the form 65n-117, then find the value of n. (2019)

20. Find the HCF of 612 and 1314 using prime factorisation. (Al 2019)

21. Express 5050 as product of its prime factors. Is it unique? (Board Term 1, 2017)

22. Show that the numbers 231 and 396 are not (Board Term 1, 2017)

SA II (3 marks)

23. Find HCF and LCM of 404 and 96 and verify that HCF x LCM = Product of the two given numbers. (2018)

24. An army contingent of 678 soldiers is to march behind an army band of 36 members in a Republic Day parade. The two groups are to march in the same number of columns. What is the maximum number of columns they can march? (Board Term 1, 2017)

25. On a morning walk, three persons steps off together and their steps measure 40 cm, 42 cm, and 45 cm respectively. What is the minimum distance each should walk so that each can cover same distance in complete steps? (Board Term 1, 2015)

LA (4/5/6 marks)

26. A sweet shopkeeper prepares 396 gulab jamuns and 342 ras-gullas. He packs them into containers. Each container consists of either gulab jamun or ras-gullas but have equal number of pieces. Find the number of pieces he should put in each box so that number of boxes are least. (Board Term 1, 2017)

27. Find the largest possible positive integer that divides 125, 162 and 259 leaving remainder 5, 6 and 7 respectively. (Board Term 1, 2017)

1.3 Revisiting Irrational Numbers

SAI (2 marks)

28.

Show that $5+2\sqrt{7}$ is an irrational number, where $\sqrt{7}$ is given to be an irrational number. *(2020)*

29.

Show that $\frac{3+\sqrt{7}}{5}$ is an irrational number, given that $\sqrt{7}$ is irrational. *(2019C)*

30. Given that √2 is irrational, prove that (5+3√2) is an irrational number. (2018)

31. How many irrational numbers lie between √2 and √3 ? Write any two of them. (Board Term I, 2017)

SA II (3 marks)

32. Prove that √3 is an irrational number. (2023)

33. Prove that √5 is an irrational number. (2023, NCERT, AI 2019)

34. Prove that √2 is an irrational number. (2020 C, NCERT, Delhi 2019)

35. Prove that 2+5√√3 is an irrational number, given that √3 is an irrational number. (2019)

LA (4/5/6 marks)

36. Define irrational number and prove that 3+2√5 is an irrational number. (NCERT, Board Term 1, 2017)

37. Prove that 2+√√5 is an irrational number. (Board Term 1, 2015)

1.2 The Fundamental Theorem of Arithmetic

MCQ

1. Let a and b be two positive integers such that a = p3 q4 and b = p2 q3, where p and q are prime numbers. If HCF(a, b) = pmqn and LCM(a, b) = pr qs, then (m + n)(r + s) =
(a) 15
(b) 30
(c) 35
(d) 72 (2022-23)

2. Statement A (Assertion): If product of two numbers is 5780 and their HCF is 17, then their LCM is 340.
Statement R (Reason): HCF is always a factor of LCM.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true and reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true. (2022-23)

3. The ratio of LCM and HCF of the least composite and the least prime number is
(a) 1: 2
(b) 2: 1
(c) 1: 1
(d) 1: 3 (Term I, 2021-22)

4. If LCM (x, 18) = 36 and HCF (x, 18) = 2, then x is
(a) 2
(b) 3
(c) 4
(d) 5 (Term I, 2021-22)

5. If sum of two numbers is 1215 and their HCF is 81, then the possible number of pairs of such numbers are
(a) 2
(b) 3
(c) 4
(d) 5 (Term I, 2021-22)

6. The LCM of two prime numbers p and q (p > q) is 221. Find the value of 3p – q.
(a) 4
(b) 28
(c) 38
(d) 48 (Term I, 2021-22)

VSA (1 mark)

7. If xy = 180 and HCF (x, y) = 3, then find the LCM (x,y). (2020-21)

SAI (2 marks)

8. 3 bells ring at an interval of 4, 7 and 14 minutes. All three bells rang at 6 am, when the three bells will ring together next? (2020-21)

SA II (3 marks)

9. Given that √3 is irrational,prove that 5 + 2+2√3 is irrational. (2022-23)

1.3 Revisiting Irrational Numbers

MCQ

10.

If $a^2 = \frac{23}{25}$, then a is

(a) rational
(b) irrational
(c) whole number
(d) integer (Term I, 2021-22)

SA II (3 marks)

11. Prove that 2 - √3 is irrational, given that √3 is irrational. (2020-21)

SOLUTIONS

Previous Years' CBSE Board Questions

1. (c): Total number of factors of a prime number is 2 i.e., 1 and number itself.

2. (a): Least composite number = 4 Least prime number = 2
.. HCF = 2, LCM = 4

$\therefore$ Required ratio = $\frac{2}{4}$ *i.e.*, 1:2

3. (b): We know that,
HCF x LCM = Product of two numbers

$$\Rightarrow \quad 13 \times \text{LCM} = 39 \times 91 \Rightarrow \text{LCM} = \frac{39 \times 91}{13} = 273$$

4. (a): Given, HCF = 12
Let two numbers be 12a and 12b
So, 12a × 12b = 6336 => ab = 44
We can write 44 as product of two numbers in these ways:
ab=1x44 = 2x22=4x11
Here, we will take a = 1 and b = 44; a = 4 and b = 11.
We do not take ab = 2 × 22 because 2 and 22 are not
co-prime to each other.
For a = 1 and b = 44, 1st no. = 12a = 12, 2nd no. = 12b = 528
For a = 4 and b = 11, 1st no. = 12a = 48, 2nd no. =
12b = 132
Hence, we get two pairs of numbers, (12, 528) and (48, 132).

5. (d): For n = 1, 2, 3, 4 ...
$(12)^n$ cannot end with 0.

6.
(b) : We have,

5	385
7	77
11	11
	1

:- Prime factorisation of 385 = 5 x 7 x 11

7. (c): We have, $12=2x2x3=2^2x3$
21=3×7
15=3x5
:- HCF (12, 21, 15) = 3 and
LCM (12, 21, 15) = $2^2x3x5x7$ = 420

8. Let the other number be x.
As, HCF (a, b) x LCM (a, b) = axb

$$\Rightarrow \quad 13 \times 182 = 26 \times x \Rightarrow x = \frac{13 \times 182}{26} = 91$$

Hence, other number is 91.

9. Let a and b be two number such that
LCM (a, b) = 9.HCF (a, b) ...(i)
and LCM (a, b) + HCF (a, b) = 500 ...(ii)
Using (i) in (ii), we get
9HCF (a, b) + HCF (a, b) = 500
⇒ 10 HCF (a, b) = 500 ⇒ HCF (a, b) = 50

10. Since, HCF (a, b) x LCM (a, b) = axb
:- HCF (336, 54) × LCM (336, 54) = 336 × 54
6 x LCM(336, 54) = 18144

$$\Rightarrow \quad \text{LCM}(336, 54) = \frac{18144}{6} = 3024$$

11. We know that, HCF (a, b) x LCM (a, b) = axb
⇒ 5×200= ab⇒ ab = 1000

12. Smallest prime number = 2
Smallest composite number = 4
HCF (2, 4) = 2

13. The prime factor of 6" = $(2 \times 3)^n = 2^n \times 3^n$.
Therefore prime factorisation of 6^n does not contain any prime factor 5. Hence, 6^n can never ends with the digit 0 for any natural number.

14. Let the other number be x.
As, HCF (a, b) x LCM (a, b) = axb

$$\therefore \quad 27 \times 162 = 54x \Rightarrow x = \frac{27 \times 162}{54} = 81$$

Hence, other number is 81.

15. Let the other number be x.
We know that, HCF (a, b) x LCM (a, b) = axb
:. 27 × 2079 = 297 × x

$$\Rightarrow \quad x = \frac{2079 \times 27}{297} = 189$$

Hence, other number is 189.

16. Given, least number which when divided by 12, 16 and 24 leaves remainder 7 in each case
:- least number = LCM(12, 16, 24)+7=48 +7 = 55

17. Let the two numbers be 2x and 3x.
LCM of 2x and 3x = 6x, HCF(2x, 3x) = x
Now, 6x = 180 [Given]

$$\Rightarrow \quad x = \frac{180}{6} = 30$$

:- HCF (2x, 3x) = x = 30

18. We have, 2 x 3 x 5 +5 and 5 x 7 x 11+7x5.
We can write these numbers as:
2×3×5+5=5(2×3+1)
= 1x5x7
and 5 x 7 x 11+7x5=5×7 (11+1)
=5x7x12
1x5x7x12
Since, on simplifying, we find that both the numbers have more than two factors. So, these are composite numbers.

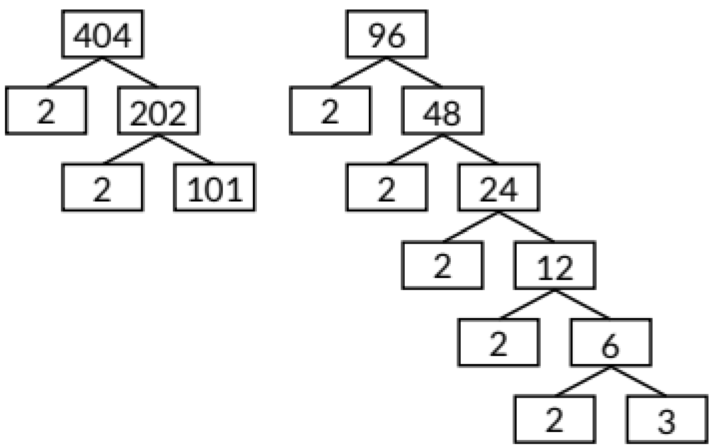
19. Since, HCF (65, 117) = 13
Given HCF (65, 117) = 65n - 117
13=65n - 117
65n=13+ 117⇒n=2.

20. Prime factorisation of 612 and 1314 are
612 = 2×2×3× 3 × 17
1314=2×3× 3 × 73
:- HCF (612, 1314) = 2 × 3 × 3 = 18

21. 50502x5x5x 101 = 2 x 52 x 101 Yes, it is unique.

22. Prime factorisation of 231 and 396 are
231 = 3 × 7×11
396=2×2×3×3×11
HCF (231, 396) = 3 × 11=33+1
Hence, the two numbers are not co-prime.

23. Using the factor tree method, we have



= 404 = 2 x 2 x 101 and 96 = 2 × 2 × 2 × 2 × 2 × 3
:- HCF of 404 and 96 = 2 x 2 = 4
LCM of 404 and 96 = 2×2×2×2×2×3× 101 = 9696
Also 404 × 96 = 38784
LCM X HCF = 9696 × 4 = 38784
Thus, HCF x LCM = Product of two numbers.

24. Number of soldiers in an army contingent
=678=2×3× 113
Number of members in an army band = 36 = 2×2×3×3 The maximum number of columns such that two groups can march in same number of columns is HCF of 678 and 36.

HCF (678, 36)=2×3=6
So, the maximum number of columns they can march is 6.

25. The prime factorisation of 40, 42, 45 are
$40=2\times2\times2\times5=2^3x51$
$42=2\times3\times7$
45=3x3x5=32x5
:- LCM (40, 42, 45) = 23 x 3^2 x 5^1 x 7^1
=8×9×5×7 = 2520
:- Required distance = 2520 cm or 0.0252 km.

26. Number of gulab jamuns = 396 = 2×2×3×3×11 Number of ras-gullas = 342 = 2×3×3×19
HCF (396, 342) = 2 × 3 × 3 = 18
So, shopkeeper will put 18 sweets in each box such that number of boxes are least.

27. It is given that the required number when divides 125, 162, 259 leaves the remainder 5, 6, 7 respectively. This means that 125 - 5 = 120, 162-6=156, 259-7 = 252 are divisible by the required number. The required number is HCF of all these numbers. The prime factorisation of 120, 156, 252 are
120=2×2×2×3×5
156=2×2×3× 13; 252 = 2×2×3×3×7
HCF (120, 156, 252) = 2 × 2 × 3 = 12
Hence, the required number is 12.

28. Suppose 5+2√7 is a rational number.
:- We can find two integers a, b(b + 0) such that

$5+2\sqrt{7}=\frac{a}{b}$, where a and b are co-prime.

$\Rightarrow 2\sqrt{7}=\frac{a}{b}-5 \Rightarrow \sqrt{7}=\frac{1}{2}\left[\frac{a}{b}-5\right]$

$\Rightarrow \sqrt{7}$ is a rational number

[$\because$ a, b are integers, so $\frac{1}{2}\left(\frac{a}{b}-5\right)$ is a rational number]

But this contradicts the fact that √7 is an irrational number. Hence, our assumption is wrong. Thus, 5+2√7 is an irrational number.

29.

Suppose $\frac{3+\sqrt{7}}{5}$ is rational number.

$\therefore$ We can find two integers p and q $(q \neq 0)$ such that

$\frac{3+\sqrt{7}}{5} = \frac{p}{q}$, where p and q are co-prime.

$\Rightarrow \quad 3+\sqrt{7} = \frac{5p}{q}$

$\Rightarrow \quad \sqrt{7} = \frac{5p}{q} - 3 \Rightarrow \sqrt{7}$ is a rational number.

[$\because$ p and q are integers, so $\frac{5p}{q} - 3$ is a rational number]

But this contradicts the fact that √7 is an irrational number. Hence, our supposition is wrong.

Thus, $\frac{3+\sqrt{7}}{5}$ is an irrational number.

30. Let (5+ 3√√2) is rational.

Then, $5 + 3\sqrt{2} = \frac{a}{b}$, where a, b $(\neq 0)$ are coprime numbers

$\therefore \quad 3\sqrt{2} = \frac{a}{b} - 5 \quad \Rightarrow \quad \sqrt{2} = \frac{a-5b}{3b}$

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

[$\because$ a, b are integers $\therefore$ $\frac{a-5b}{3b}$ is rational]

But this contradicts the fact that √2 is irrational. Hence, 5+3√2 an also irrational number.

31. There are infinite irrational numbers between √2 and √3. Examples are √2.1 and √2.3.

32. Let us assume that √3 is a rational number

Then $\sqrt{3} = \frac{a}{b}$; where a and b $(\neq 0)$ are co-prime positive integers.

Squaring on both sides, we get

$$3 = \frac{a^2}{b^2} \Rightarrow a^2 = 3b^2 \Rightarrow 3 \text{ divides } a^2$$

⇒ 3 divides a ...(i)
⇒ a = 3c, where c is an integer
Again, squaring on both sides, we get
$a^2 = 9c^2$
⇒ $3b^2 = 9c^2 = b^2 = 3c^2$ ⇒ 3 divides b^2
⇒ 3 divides b ...(ii)
From (i) and (ii), we get 3 divides both a and b.
⇒ a and b are not co-prime integers.
This contradicts the fact that a and b are co-primes. Hence, √3 is an irrational number.

33. Let us assume that √5 is a rational number.

Then $\sqrt{5} = \frac{a}{b}$; where a and b ($\neq 0$) are co-prime integers.
Squaring on both sides, we get

$$5 = \frac{a^2}{b^2} \Rightarrow a^2 = 5b^2$$

5 divides q^2
5 divides a
⇒ a = 5c, where c is an integer Again, squaring on both sides, we get
$a^2 = 25c^2$
= $5b^2 = 25c^2 = b^2 = 5c2$
= 5 divides b^2
= 5 divides b
From (i) and (ii), we get 5 divides both a and b.
⇒ a and b are not co-prime integers. Hence, our supposition is wrong. Thus,

√5 is an irrational number.

34. Let us assume √2 be a rational number.

Then, $\sqrt{2}=\frac{p}{q}$, where $p, q\ (q \neq 0)$ are integers and co-prime.

On squaring both sides, we get

$$2=\frac{p^2}{q^2} \Rightarrow p^2=2q^2 \qquad \text{...(i)}$$

= 2 divides p^2 = 2 divides p

So, p = 2a, where a is some integer. Again squaring on both sides, we get

= $q^2 = 4a^2 = 2q^2 = 4a^2$

⇒ $q^2 = 2a^2$

⇒ 2 divides q^2 = 2 divides q

From (ii) and (iii), we get

2 divides both p and q.

:- p and q are not co-prime integers.

Hence, our assumption is wrong.

Thus, √2 is an irrational number.

35. Suppose 2+5 √3 is a rational number.

:- We can find two integers a, b (b + 0) such that

$2+5\sqrt{3}=\frac{a}{b}$, where a and b are co-prime integers.

$$\Rightarrow \quad 5\sqrt{3}=\frac{a}{b}-2 \Rightarrow \sqrt{3}=\frac{1}{5}\left[\frac{a}{b}-2\right]$$

⇒ $\sqrt{3}$ is a rational number.

[∵ a, b are integers, so $\frac{1}{5}\left[\frac{a}{b}-2\right]$ is a rational number.]

But this contradicts the fact that √3 is an irrational number.

Hence, our assumption is wrong. Thus, 2+5√3 is an irrational number.

36. Irrational number is a number which can not be written in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

First, we prove that $\sqrt{5}$ is an irrational number.

Let us assume that $\sqrt{5}$ is a rational number.

Then $\sqrt{5} = \frac{a}{b}$; where a and b ($\neq 0$) are co-prime integers.

Squaring on both sides, we get

$5 = \frac{a^2}{b^2} \Rightarrow a^2 = 5b^2 \Rightarrow 5$ divides a^2

= 5 divides a ...(i)

a = 5c, where c is an integer

= Again, squaring on both sides, we get

$a^2 = 25c^2$

$\Rightarrow 5b^2 = 25c^2 = b^2 = 5c^2 \Rightarrow 5$ divides b^2

$\Rightarrow$ 5 divides b ...(ii)

From (i) and (ii), we get 5 divides both a and b.

⇒ a and b are not co-prime integers. This contradicts the fact that a and b are co-primes. Hence, √5 is an irrational number. Now, to prove 3+2√5 is an irrational number. Suppose 3+2√√5 is a rational number

:- We can find two integers a, b(b + 0) such that

$3+2\sqrt{5} = \frac{a}{b}$ (where a and b are co-prime)

$\Rightarrow \quad 2\sqrt{5} = \frac{a}{b} - 3 \Rightarrow \sqrt{5} = \frac{1}{2}\left(\frac{a}{b} - 3\right)$

$\Rightarrow \quad \sqrt{5}$ is a rational number

$$\left[\begin{array}{l} \because\ a, b \text{ are integers,} \\ \therefore \frac{1}{2}\left(\frac{a}{b} - 3\right) \text{is a rational number} \end{array}\right]$$

But this contradicts the fact that √5 is an irrational number.

Hence, our assumption is wrong. Thus, 3+2√5 is an irrational number.

37. First we prove that √5 is an irrational number. Let us assume that √5 is a rational number.

Then $\sqrt{5} = \frac{a}{b}$; where a and b ($\neq 0$) are co-prime integers.

Squaring on both sides, we get

$5 = \frac{a^2}{b^2} \Rightarrow a^2 = 5b^2 \Rightarrow 5$ divides a^2

5 divides a ...(i)
⇒ a = 5c, where c is an integer
Again, squaring on both sides, we get
$a^2 = 25c^2$
⇒ $5b2 = 25c^2 = b^2 = 5c^2$
5 divides b^2
5 divides b ...(ii)
From (i) and (ii), we get 5 divides both a and b.
⇒ a and b are not co-prime integers.
This contradicts the fact that a and b are co-primes.
Hence, √5 is an irrational number.
Now, to prove that 2+√5 is an irrational number.
Suppose 2+√5 is a rational number.
:- We can find two integers a, b (b + 0) such that

$3+2\sqrt{5} = \frac{a}{b}$ (where a and b are co-prime)

$\Rightarrow \quad 2\sqrt{5} = \frac{a}{b} - 3 \Rightarrow \sqrt{5} = \frac{1}{2}\left(\frac{a}{b} - 3\right)$

$\Rightarrow \quad \sqrt{5}$ is a rational number

$$\left[\begin{array}{l} \because \ a, b \text{ are integers,} \\ \therefore \ \frac{1}{2}\left(\frac{a}{b} - 3\right) \text{is a rational number} \end{array}\right]$$

But this contradicts the fact that √√5 is an irrational number.
Hence, our assumption is wrong. Thus, 3+2√5 is an irrational number.

37. First we prove that √5 is an irrational number. Let us assume that √5 is a rational number.

Then $\sqrt{5} = \frac{a}{b}$; where a and b ($\neq 0$) are co-prime integers.

Squaring on both sides, we get

$5 = \frac{a^2}{b^2} \Rightarrow a^2 = 5b^2 \Rightarrow$ 5 divides a^2

⇒ 5 divides a ...(i)
⇒ a = 5c, where c is an integer
Again, squaring on both sides, we get
$a^2 = 25c^2$
$\Rightarrow 5b^2 = 25c^2 \Rightarrow b^2 = 5c^2$
5 divides b^2
5 divides b ...(ii)
From (i) and (ii), we get 5 divides both a and b.
⇒ a and b are not co-prime integers.
This contradicts the fact that a and b are co-primes.
Hence, √5 is an irrational number.
Now, to prove that 2+√5 is an irrational number.
Suppose 2+√5 is a rational number.
:- We can find two integers a, b (b + 0) such that

$2 + \sqrt{5} = \frac{a}{b}$ (where a, b are co-prime)

$\Rightarrow \quad \sqrt{5} = \frac{a}{b} - 2$

= √5 is a rational number as a, b are integers and so,

$\frac{a}{b} - 2$ is rational number.

But this contradicts the fact that √5 is an irrational number.
Hence our assumption is wrong.
Thus, 2+√5 is an irrational number.

CBSE Sample Questions

1. (c): Given $a = p^3q^*$ and $b = p^2q3$
:- LCM (a, b) = p^3q^4 and HCF (a, b) = p^2q^3
Comparing the obtained LCM and HCF with the given LCM and HCF, we get
m=2, n=3, r = 3 and s = 4
.. (m + n) (r+s) = 5x7 = 35 (1)

2. (b): Product of two numbers is equal to Product of their HCF and LCM.
So, 5780 = 340 × 17 = 5780
HCF is always a factor of LCM.
So, both Assertion (A) and Reason (R) are true but reason is not correct explanation of Assertion (A). (1)

3. (b): Least composite number is 4 and the least prime number is 2.
LCM (4, 2): HCF (4, 2) = 4 : 2 = 2:1 (1)

4. (c): We know that, LCM x HCF = product of the numbers.
36×2=18xx ⇒ x=4 (1)

5. (c): Since HCF = 81, two numbers can be taken as 81x and 81y.
According to question, we have
81x+81y=1215 ⇒ x+y=15
which gives four pairs as
(1, 14), (2, 13), (4, 11), (7, 8) (1)

6. (c): LCM of two prime numbers = product of the numbers
⇒ 221=px q
Also, 221 = 13 x 17
So, p = 17 and q = 13 (p > q)
:- 3p-q=51-13=38 (1)

7. Given HCF (x, y) = 3
⇒ (LCM) (3) = 180 (1/2)

[HCF x LCM = Product of the numbers]
LCM = 60 (1/2)

8. Let us first write the prime factorisation of 4, 7 and 14, which is given below.
4=2x2 (1/2)
7=7x1 (1/2)
14=2x7 (1/2)
:- LCM (4, 7, 14)=2x2x7=28 (1/2)
Thus, the three bells will ring together again at 6:28 am.

9. Suppose $5 + 2\sqrt{3}$ is rational, then it must be in the form of p/q where p and q are co-prime integers and $q \neq 0$. That is,

$5 + 2\sqrt{3} = p/q$ **(1/2)**

So $\sqrt{3} = \frac{p-5q}{2q}$ ...(i) **(1/2)**

Since p, q, 5 and 2 are integers and $q \neq 0$, R.H.S. of equation (i) is rational. But L.H.S. of (i) is $\sqrt{3}$ which is irrational. This contradicts the fact. (1)
This contradiction has arisen due to our wrong assumption that $5 + 2\sqrt{3}$ is rational. So, $5 + 2\sqrt{3}$ is irrational. (1)

10.

(b): $a^2 = \frac{23}{25}$, then $a = \pm\frac{\sqrt{23}}{5}$, which is irrational. **(1)**

11. Let us suppose that $(2-\sqrt{3})$ is rational. (1/2)
So, we can find co-prime numbers a and b(b + 0) such that

$(2-\sqrt{3}) = \frac{a}{b}$. **(1/2)**

$\Rightarrow \quad 2 - \frac{a}{b} = \sqrt{3} \Rightarrow \sqrt{3} = \frac{2b-a}{b}$ **(1/2)**

$\Rightarrow \quad \sqrt{3}$ is a rational number.

[$\because$ a and b are integers $\frac{2b-a}{b}$ is a rational number]

But this contradicts the fact that $\sqrt{3}$ is irrational. (1/2)
So, our supposition is wrong. (1/2)
Hence, 2-√$\sqrt{3}$ is irrational. (1/2)