

CLASS 10 (2025-26)



# MATHEMATICS

## MADE EASY

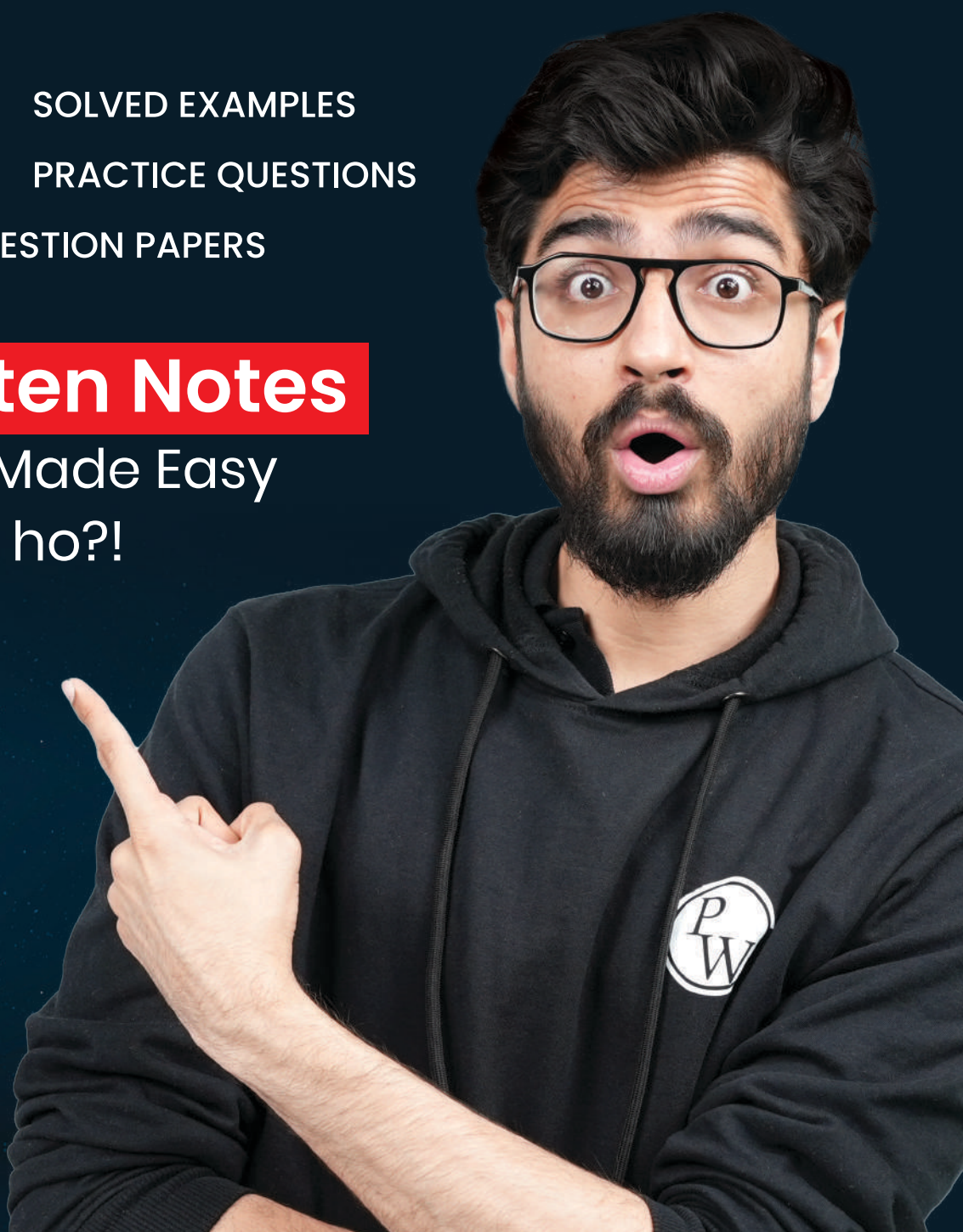
- FORMULAS
- SOLVED EXAMPLES
- THEOREMS
- PRACTICE QUESTIONS
- SOLVED CBSE QUESTION PAPERS

**Handwritten Notes**

Other Books Made Easy  
Samajh rahe ho?!



Ritik Mishra



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## SOLVED PAPERS

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# Theorems and Formulas

## REAL NUMBERS

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

**NOTE:** Fundamental theorem of arithmetic is called a Unique Factorisation Theorem.

Composite number = Product of prime numbers.

### Important Formulas

- For any two positive integers  $a$  and  $b$  we have,

$$\text{H.C.F (a, b)} \times \text{L.C.M (a, b)} = a \times b.$$

## POLYNOMIAL

**Theorem:** If  $\alpha$  and  $\beta$  are the zeroes of a quadratic polynomial  $f(x)$ , then the polynomial  $f(x)$  is given by

$$f(x) = k\{x^2 - (\alpha + \beta)x + \alpha\beta\}$$

OR

$f(x) = k\{x^2 - (\text{Sum of the zeroes})x + \text{Product of the zeroes}\}$  where  $k$  is any non-zero real number.

### Important Formulas

**Relationship between Zeroes and Coefficients of a Polynomial:** In general,

If  $\alpha$  and  $\beta$  are the zeroes of the quadratic polynomial  $p(x) = ax^2 + bx + c$ ,  $a \neq 0$ , then

$$\alpha + \beta = -\frac{b}{a} = -\frac{\text{coefficient of } x}{\text{coefficient of } x^2} \text{ and}$$

$$\alpha\beta = \frac{c}{a} = \frac{\text{constant term}}{\text{coefficient of } x^2}.$$

## PAIR OF LINEAR EQUATIONS OF TWO VARIABLES

### Important Formulas

Algebraic condition for nature of lines and the number of solutions:

| Pair of linear equations<br>$a_1x + b_1y + c_1 = 0$<br>$a_2x + b_2y + c_2 = 0$ | Algebraic conditions                                     | Graphical representation | Algebraic interpretation               |
|--------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------|----------------------------------------|
| Consistent (Independent)                                                       | $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$                   | Intersecting lines       | Exactly one solution (unique solution) |
| Consistent (Dependent)                                                         | $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$    | Coincident lines         | Infinitely many solutions – dependent  |
| In-consistent                                                                  | $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ | Pair of parallel lines   | No solution                            |

## QUADRATIC EQUATION

Let the given equation be  $ax^2 + bx + c = 0$ , where  $a \neq 0$ . Then, the discriminant is given by  $D = b^2 - 4ac$ , and the roots of the given equation are

$$\alpha = \frac{-b + \sqrt{D}}{2a} \text{ and } \beta = \frac{-b - \sqrt{D}}{2a}.$$

**Case 1:** When  $D > 0$

In this case, the roots are real and distinct. These roots are given by

$$\alpha = \frac{-b + \sqrt{D}}{2a} \text{ and } \beta = \frac{-b - \sqrt{D}}{2a}.$$

**Case 2:** When  $D = 0$

In this case, the roots are real and equal.

$$\text{Each root} = \frac{(-b)}{2a}.$$

**Case 3:** When  $D < 0$

In this case, the roots are imaginary, and we say that the given equation has no real roots.

**Note:**

In this case  $D > 0$ , if  $D$  is a perfect square then roots are rational and if  $D$  is a non-perfect square then roots are irrational.

### Important Formulas

- **Quadratic Formula (Shridharacharya Formula):** The roots of a quadratic equation  $ax^2 + bx + c = 0$  are given by 
$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

## ARITHMETIC PROGRESSION

### Important Formulas

- Common difference  $d = a_2 - a_1 = a_3 - a_2 = \dots = a_n - a_{n-1}$
- In an AP with first term  $a$  and common difference  $d$ , the  $n^{\text{th}}$  term (or the general term) is given by 
$$a_n = a + (n - 1)d.$$

- The  $n^{\text{th}}$  term of an AP from the end with first term  $a$ , common difference  $d$  and last term  $l$  is given by  $a_n = l - (n - 1)d$ .

- The sum of first  $n$ -terms of an AP is given by

$$S_n = \frac{n}{2}[2a + (n - 1)d]$$

Here  $a$  = first term,  $n$  = number of terms and  $d$  = common difference.

- If  $l$  is the last term of an AP., then sum of all terms is given by

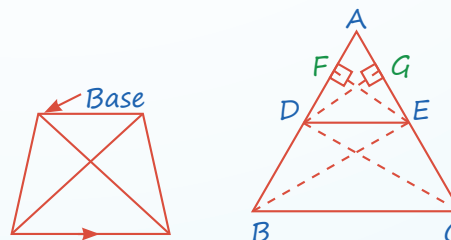
$$S_n = \frac{n}{2}[a + l]$$

- The  $n^{\text{th}}$  term of an AP is the difference of the sum to first  $n$  terms and the sum to first  $(n-1)$  terms of it, i.e.,  $a_n = S_n - S_{n-1}$ .

## TRIANGLES

**Theorem 1:** If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, the other two sides are divided in the same ratio.

**Proof:**



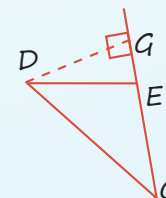
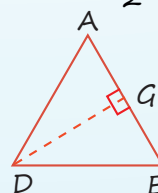
**Given:**  $DE \parallel BC$

**To Prove:**  $\frac{AD}{BD} = \frac{AE}{EC}$

**Construction:** Draw  $DG \perp AE$  and  $EG \perp AD$ . Also, Join  $DC$  and  $BE$ .

**Proof:** Area of  $\triangle ADE = \frac{1}{2} \times AE \times DG \dots (1)$

Area of  $\triangle DEC = \frac{1}{2} \times EC \times DG \dots (2)$

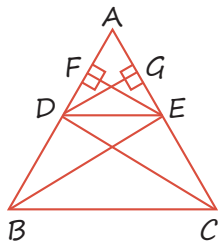




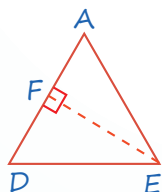
(1) ÷ (2)

$$\frac{\text{Ar}(\triangle ADE)}{\text{Ar}(\triangle DEC)} = \frac{\frac{1}{2} \times AE \times DG}{\frac{1}{2} \times EC \times DG}$$

$$\frac{\text{Ar}(\triangle ADE)}{\text{Ar}(\triangle DEC)} = \frac{AE}{EC}$$



$$\text{Ar}(\triangle ADE) = \frac{1}{2} \times AD \times EF \quad \dots(3)$$



$$\text{Ar}(\triangle DBE) = \frac{1}{2} \times DB \times EF \quad \dots(4)$$

(3) ÷ (4)

$$\frac{\text{Ar}(\triangle ADE)}{\text{Ar}(\triangle DBE)} = \frac{\frac{1}{2} \times AD \times EF}{\frac{1}{2} \times DB \times EF}$$

$$\rightarrow \frac{\text{Ar}(\triangle ADE)}{\text{Ar}(\triangle DBE)} = \frac{AD}{DB}$$

$$\text{Ar}(\triangle DEC) = \text{Ar}(\triangle DBE)$$

Since,  $\Delta$ 's on the same base and between same parallel

$$\frac{\text{Ar}(\triangle ADE)}{\text{Ar}(\triangle DEC)} = \frac{\text{Ar}(\triangle ADE)}{\text{Ar}(\triangle DBE)}$$

$$\frac{AE}{EC} = \frac{AD}{DB} \quad \text{Hence Proved}$$

**Theorem 2:** (Converse of Basic Proportionality theorem (BPT)). If a line divides any two sides of a triangle in the same ratio, then the line must be parallel to the third side.

**Proof:**

$$\text{Given: } \frac{AD}{DB} = \frac{AE}{EC} \quad \dots(1)$$

**To prove:**  $DE \parallel BC$

**Construction:** Draw DF parallel to BC, such that

$$\frac{AD}{DB} = \frac{AF}{FC} \quad \dots(2)$$

**Proof:** By (1) and (2),  $\frac{AE}{EC} = \frac{AF}{FC}$

add 1 to both sides

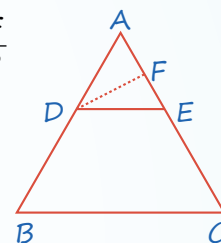
$$\Rightarrow \frac{AE}{EC} + 1 = \frac{AF}{FC} + 1$$

$$\frac{AE}{EC} + 1 = \frac{AF}{FC} + 1, \quad \frac{AE + EC}{EC} = \frac{AF + FC}{FC}$$

$$\frac{AC}{EC} = \frac{AC}{FC}, \quad \frac{1}{EC} = \frac{1}{FC}$$

$FC = EC$  This means that 'E' & 'F' coincides

$\therefore DE \parallel BC$  Hence, Proved.



**Criteria for similarity of Triangles**

- (i) AAA similarity criterion
- (ii) SSS similarity criterion
- (iii) SAS similarity criterion

## COORDINATE GEOMETRY

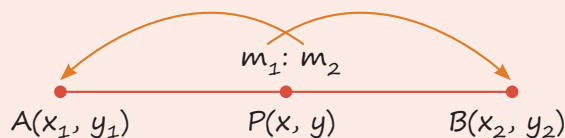
### Important Formulas

Distance Formula: The distance between  $P(x_1, y_1)$  and  $Q(x_2, y_2)$  is

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Distance from Origin: The distance of a point  $P(x, y)$  from origin is  $\sqrt{x^2 + y^2}$ .

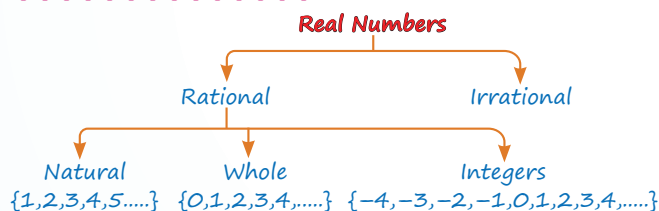
Section Formula: The coordinates of the point  $P(x, y)$  which divides the line segment joining the points  $A(x_1, y_1)$  and  $B(x_2, y_2)$  internally in the ratio  $m_1 : m_2$  are  $\left( \frac{m_1 x_2 + m_2 x_1}{m_1 + m_2}, \frac{m_1 y_2 + m_2 y_1}{m_1 + m_2} \right)$



(iii)

# Real Numbers

## REAL NUMBERS



### Important Term

1. Negative Integer  
{-1, -2, -3, -4, -5, .....}
2. Non-negative integers → Whole no.s  
{+ve + 0} ⇒ {0, 1, 2, 3, 4, 5, .....}
3. Positive Integers  
{1, 2, 3, 4, 5, .....}
4. Non positive integers  
{-ve + 0}



### Rational Numbers

A number that can be written in the form of  $\frac{p}{q}$  where  $p$  and  $q$  are integers and  $q \neq 0$ .

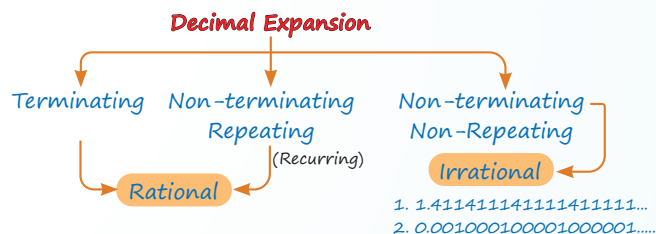
$$\frac{3}{2}, -\frac{1}{2}, \frac{7}{3}, -\frac{4}{3}, \frac{5}{700}, \dots$$

$$-1, -100, -300, 500, \frac{750}{2}$$

$$2 = \frac{2}{1} = \frac{p}{q} \quad 1 = \frac{1}{1}$$

$$0 = \frac{0}{1} = \frac{p}{q} \quad -100 = \frac{-100}{1}$$

## Decimal Expansion



e.g.  $\frac{1}{2} = 0.5 \rightarrow$  Terminating

$\frac{2}{9} = 0.222222\ldots$  Non-terminating repeating

1.4141414141...

$$\begin{array}{r} .222 \\ 9 \overline{) 20} \\ \underline{18} \\ 20 \\ \underline{18} \\ 20 \\ \underline{18} \\ 2 \end{array}$$

## Irrational Numbers

e.g.  $\sqrt{2}, \sqrt{3}, \dots$

### Example of Irrational Numbers

**Type 1:** Non-terminating non repeating

$$0.211211314256790\ldots$$

**Type 2:** If  $m$  is a positive integer which is not a perfect square then  $\sqrt{m}$  is irrational.

$$\sqrt{3}, \sqrt{7}, \sqrt{8}, \sqrt{11}, \sqrt{13}, \sqrt{82}$$

$\sqrt{9} =$  Rational  
Perfect square

1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121.....

$(1)^2, (2)^2, (3)^2, (4)^2, (5)^2$

**Type 3:** If  $m$  is a positive integer which is not a perfect cube then  $\sqrt[3]{m}$  is irrational.

$$\sqrt[3]{3}, \sqrt[3]{4}, \sqrt[3]{5}, \dots$$

1, 8, 27, 64, 125

$(2)^3, (3)^3, (4)^3, (5)^3$

$\sqrt[3]{2} = 2^{\frac{1}{3}}$   
 $\sqrt{2} = 2^{\frac{1}{2}}$

### Important Points

- (i) Sum of a rational and irrational is irrational.  
 $3 + \sqrt{3} = \text{Irr}$   
 $\text{R} + \text{Irr} = \text{Irr}$   
 $4 + \sqrt{8} = \text{Irr}$
- (ii) Difference of a rational and an irrational is irrational.  
 $\text{R} - \text{Irr} = \text{Irr}$
- (iii) Product of a non-zero rational and an irrational is irrational.  
 $25 \times \sqrt{2} = 25\sqrt{2} (\text{Irr})$   
 $2 \times \sqrt{2} = \text{Irr}$   $\text{R} \times \text{Irr} = \text{Irr}$
- (iv) Quotient of a non-zero rational and an irrational is irrational.  
 $\frac{\text{R}}{\text{Irr}} = \text{Irr}$
- (v) Sum of two irrationals need not be an irrational.  
 $\text{Irr} + \text{Irr} = \text{R or Irr}$   
 1.  $\sqrt{2} + \sqrt{3} = \text{Irr}$   
 2.  $2 + \sqrt{2} + (3 - \sqrt{2}) = 5$   $\text{Irr} + \text{Irr} = \text{R}$
- (vi) Difference of two irrational need not be an irrational.  
 $\text{Irr} - \text{Irr} = \text{R or Irr}$   
 1.  $\sqrt{2} - \sqrt{5} = \text{Irr}$   
 2.  $2 + \sqrt{2} - (3 + \sqrt{2}) = -1$   $\text{Irr} - \text{Irr} = \text{R}$
- (vii) Product of two irrational need not be an irrational.  
 $\text{Irr} \times \text{Irr} = \text{Irr or R}$
- (viii) Quotient of two irrational need not be an irrational.  
 $\frac{\text{Irr}}{\text{Irr}} = \text{Irr or R}$

Q. Are the square roots of all positive integers irrational? If no, give two examples?.

Ans.  $\sqrt{2} - \text{Irr}$  No  $\sqrt{81}, \sqrt{100}, \sqrt{121}$   
 $\sqrt{4} - \text{R}$   
 $\sqrt{5} - \text{Irr}$   
 $\sqrt{7} - \text{Irr}$   
 $\sqrt{9} - \text{R}$

Q. Which of these is a rational number?

(a)  $3\pi \rightarrow \text{Irr}$

(b)  $\sqrt[3]{5} \rightarrow \text{Irr}$

(c)  $0.34666666\ldots \rightarrow \text{R}$

(d)  $0.345210651372489\ldots \rightarrow \text{Irrational}$

Ans.  $\pi = \frac{22}{7}$  or 3.14

$\pi = 3.14528\ldots$

$\uparrow$   
Irrational

### HOMEWORK

Order of operations was Invented in 1912

People in 2021:

$$6 \div 2 (1 + 2) =$$



### Homework Discussion

Order of operations was Invented in 1912

People in 2021:  $6 \div 2(1 + 2)$

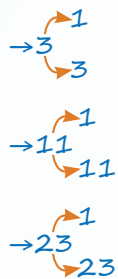
$$6 \div 2(3)$$

$$6 \div 6 = 1$$

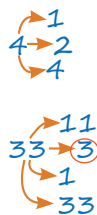




## Prime Numbers (only two Factors)



Composite Nos  
(more than 2 Factors)  
4, 8, 12, 14, 32, 100, ...



Q. Is (1) prime or composite?

Ans.  $1 \rightarrow 1$  1 is neither prime nor composite.

### THEOREM 1

#### (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 factor's occur.

Composite Number = product of primes.

$$18 = 3 \times 2 \times 3 \rightarrow 3^2 \times 2^1$$

$$100 = 2 \times 2 \times 5 \times 5 \rightarrow 2^2 \times 5^2$$

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

$$45 = 3 \times 3 \times 5$$

$$45 = 3^2 \times 5$$

composite      Prime no.s

$$98 = 2^1 \times 7^2$$

$$\begin{array}{r|l} 2 & 98 \\ \hline 7 & 49 \\ 7 & 7 \\ & 1 \end{array} \quad \begin{array}{r|l} 3 & 45 \\ \hline 3 & 15 \\ 5 & 3 \\ & 1 \end{array}$$

Q. Check whether  $4^n$  can end with the digit 0 for any natural number  $n$ .

[Board Term-I, 2015]

Ans.  $4^n \rightarrow$  natural no

$$n = 1, 4^1 = 4$$

$$n = 2, 4^2 = 16$$

$$n = 3, 4^3 = 64$$

$$n = 4, 4^4 = 256$$

$$4^n = (2 \times 2)^n = (2^2)^n = 2^{2n}$$

$$10 = 2, 5$$

$$50 = 2, 5$$

$$500 = 2, 5$$

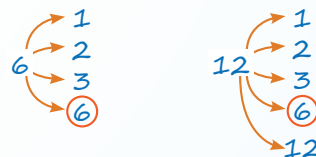
If the number  $4^n$ , for any natural number  $n$ , were to end with the digit zero, then it would be divisible by 5 and 2.

That is, the prime factorization of  $4^n$  would contain the primes 5 and 2. This is not possible because  $4^n = (2)^{2n}$ ; So, the only prime in the factorization of  $4^n$  is 2. So, the uniqueness of the Fundamental Theorem of Arithmetic guarantees that there are no other primes in the factorization of  $4^n$ . So, there is no natural number  $n$  for which  $4^n$  ends with the digit zero.

### H.C.F. and L.C.M. using Prime Factorisation Method

Example: 6, 12

Highest common factor.



$$H.C.F = 6$$

Least common multiple.

$$6 = 6, 12, 18, 24, 30, 36, 42, 48$$

$$12 = 12, 24, 36, 48, \dots$$

$$\text{Least common multiple} = 12$$

- 6 key factor ka matlab jo '6' ko divide kardein
- 6 key multiple ka matlab Jo '6' ke table me aayein.

Q. 18, 54 L.C.M

$$\text{Ans. } 18 = 18, 36, 54 \dots$$

$$54 = 54, 108, \dots$$

$$LCM = 54$$

**H.C.F:** Product of the smallest power of each common prime factor in the numbers.

**L.C.M:** Product of the greatest power of prime factor, involved in the number.

Q. Find the L.C.M and H.C.F of 80 and 300 by prime factorization method.

Ans.  $80 = 2^4 \times 5^1 \times 3^0$   
 $300 = 2^2 \times 5^2 \times 3^1$   
 $\Rightarrow \text{H.C.F} = 2^2 \times 5^1 \times 3^0 = 20$   
 $\Rightarrow \text{L.C.M} = 2^4 \times 5^2 \times 3^1$   
 $= 1200$

|   |    |
|---|----|
| 2 | 80 |
| 2 | 40 |
| 2 | 20 |
| 2 | 10 |
| 5 | 5  |
| 1 | 1  |

|   |     |
|---|-----|
| 2 | 300 |
| 2 | 150 |
| 5 | 75  |
| 5 | 15  |
| 3 | 3   |
| 1 | 1   |

**H.C.F:** Common Factor ki lowest power.  
**L.C.M:** Common factor ki highest power.



When the whole class is fighting over whether the answer is 17 or 18 but you got 157

Q. Find the L.C.M of 40, 36 and 126 by applying the prime factorization method.

Ans.  $40 = 2^3 \times 5^1 \times 7^0 \times 3^0$   
 $36 = 2^2 \times 3^2 \times 5^0 \times 7^0$   
 $126 = 2^1 \times 3^2 \times 7^1 \times 5^0$   
 $\text{H.C.F} = 2^1 \times 3^0 \times 5^0 \times 7^0$   
 $= 2$   
 $\text{L.C.M} = 2^3 \times 3^2 \times 7^1 \times 5^1$   
 $= 2520$

|   |    |
|---|----|
| 2 | 40 |
| 2 | 20 |
| 2 | 10 |
| 5 | 5  |
| 1 | 1  |

|   |    |
|---|----|
| 2 | 36 |
| 2 | 18 |
| 3 | 9  |
| 3 | 3  |
| 1 | 1  |

|   |     |
|---|-----|
| 2 | 126 |
| 3 | 63  |
| 3 | 21  |
| 7 | 7   |
| 1 | 1   |

Q. Write the smallest number which is divisible by both 306 and 657. [CBSE 2019]

Ans.  $306 = 2^1 \times 3^2 \times 17^1 \times 73^0$   
 $657 = 3^2 \times 73^1 \times 2^0 \times 17^0$

|    |     |
|----|-----|
| 2  | 306 |
| 3  | 153 |
| 3  | 51  |
| 17 | 17  |
| 1  | 1   |

|    |     |
|----|-----|
| 3  | 657 |
| 3  | 219 |
| 73 | 73  |
| 1  | 1   |

$\text{LCM} = 2^1 \times 3^2 \times 73^1 \times 17 = 22338$



Girl: mujhe break up krna hai  
 Boy: kyon?  
 Girl: kynki hamare beech main kuch common hi nhi hai  
 Boy: Abey pyaar krna hai ya lem nikalna hai.

Q. Find the H.C.F and L.C.M of 30, 72 and 432 using the prime factorization method.

Ans.  $30 = 2^1 \times 5^1 \times 3^1$   
 $72 = 2^3 \times 3^2 \times 5^0$   
 $432 = 2^4 \times 3^3 \times 5^0$   
 $\text{H.C.F} = 2^1 \times 3^1 \times 5^0 = 6$   
 $\text{L.C.M} = 2^4 \times 3^3 \times 5^1 = 2160$

|   |    |
|---|----|
| 2 | 30 |
| 5 | 15 |
| 3 | 3  |
| 1 | 1  |

|   |    |
|---|----|
| 2 | 72 |
| 3 | 36 |
| 3 | 12 |
| 2 | 4  |
| 2 | 2  |
| 1 | 1  |

|   |     |
|---|-----|
| 2 | 432 |
| 2 | 216 |
| 2 | 108 |
| 2 | 54  |
| 3 | 27  |
| 3 | 9   |
| 3 | 3   |
| 1 | 1   |

Q. If the HCF of 85 and 153 is expressible in the form  $85n - 153$  then the value of  $n$  is

- (a) 3    ~~(b) 2~~    (c) 4    (d) 1

Ans.

|    |    |
|----|----|
| 5  | 85 |
| 17 | 17 |
| 1  | 1  |

|    |     |
|----|-----|
| 3  | 153 |
| 3  | 51  |
| 17 | 17  |
| 1  | 1   |

$85 = 5^1 \times 17^1 \times 3^0$   
 $153 = 3^2 \times 17^1 \times 5^0$   
 $\text{HCF} = 3^0 \times 5^0 \times 17^1 = 17$   
 $\text{HCF} = 85n - 153$   
 $17 = 85n - 153$   
 $17 + 153 = 85n$   
 $\frac{170}{85} = n$   
 $2 = n$

**Relation b/w H.C.F and L.C.M for Two Positive Integers**

For any two positive integers  $a$  and  $b$

$\text{H.C.F}(a, b) \times \text{L.C.M}(a, b) = a \times b$

80, 300

$\text{H.C.F} = (80, 300) = 20$

$\text{L.C.M} = (80, 300) = 1200$

$80 \times 300 = \text{H.C.F}(80, 300) \times \text{L.C.M}(80, 300)$

$24000 = 20 \times 1200$

$24000 = 24000$

Important (only for two positive integers)

Q. If H.C.F (336, 54) = 6, find L.C.M (336, 54).

Ans. H.C.F (a, b)  $\times$  L.C.M(a, b) = a  $\times$  b

$$6 \times \text{L.C.M} = (336 \times 54)$$

$$\text{L.C.M} = \frac{336 \times 54}{6} = \boxed{3024}$$

Q. The H.C.F and L.C.M of two numbers are 9 and 360 respectively. If one number is 45, find the other number. [CBSE SQP 2019]

Ans. H.C.F = 9

$$\text{L.C.M} = 360$$

$$\text{H.C.F (a, b)} \times \text{L.C.M (a, b)} = a \times b$$

$$9 \times 360 = 45 \times b \Rightarrow b = \frac{9 \times \frac{72}{5}}{45} = 72$$

$$b = 72$$

Press your forehead every time you Write wrong answer



Me after Math Exam



Q. If LCM (32, a) = 64 and HCF (32, a) = 4 is equal to

(a) 16 ~~(b) 8~~ (c) 20 (d) 10

Ans. HCF  $\times$  LCM = a  $\times$  b

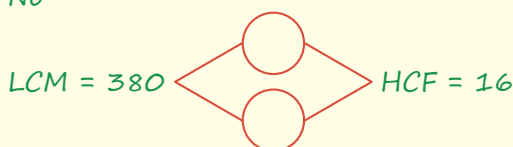
$$4 \times 64 = 32 \times a$$

$$\frac{1}{4} \times \frac{8}{1} = a$$

$$\boxed{a = 8}$$

Q. Can two numbers have 16 as their HCF and 380 as their LCM? Given reason.

Ans. No



HCF is always a factor of LCM

Q. The exponent of 5 in the prime factorization of 3750 is [CBSE Board Term-I, 2021]

(a) 3 ~~(b) 4~~  
(c) 5 (d) 6

Ans. 
$$\begin{array}{r|l} 5 & 3750 \\ \hline 5 & 750 \\ 5 & 150 \\ 5 & 30 \\ 3 & 6 \\ 2 & 2 \\ \hline & 1 \end{array} \quad 3750 = 5^4 \times 3^1 \times 2^1$$

Q. P and Q are two positive integers such that  $P = p^3 q$  and  $Q = (pq)^2$ , where p and q are prime numbers. What is L.C.M(P, Q)?

[CBSE Q.B., 2021-22]

(a) pq (b)  $p^2 q^2$   
~~(c)  $p^3 q^2$~~  (d)  $p^5 q^3$

Ans.  $P = p^3 q$

$$Q = (pq)^2 = p^2 q^2$$

$$\text{L.C.M} = \boxed{p^3 q^2}$$

Q. If two positive integers a and b are written as  $a = x^3 y^2$  and  $b = xy^3$ , x, y are prime numbers, then H.C.F (a, b) is:

[NCERT Exemplar]

(a) xy ~~(b)  $xy^2$~~   
(c)  $x^3 y^3$  (d)  $x^2 y^2$

Ans. H.C.F  $\begin{matrix} a = x^3 y^2 \\ b = xy^3 \end{matrix}$

$$\boxed{\text{H.C.F} = x^1 \times y^2}$$

Q. The largest number which divides 70 and 125, leaving remainders 5 and 8 respectively, is: [NCERT Exemplar]

~~(a) 13~~ (b) 65  
(c) 875 (d) 1750

Ans. 
$$\begin{array}{r|l} 5 & 65 \\ \hline 13 & 13 \\ & 1 \end{array} \quad \begin{array}{r|l} 13 & 117 \\ \hline 3 & 9 \\ & 3 \\ & 1 \end{array} \quad \begin{array}{l} 70 \div a \rightarrow R = 5 \\ 125 \div a \rightarrow R = 8 \\ 65 \div a \rightarrow R = 0 \\ 117 \div a \rightarrow R = 0 \end{array}$$

$$65 = 5^1 \times 13^1 \times 3^0$$

$$117 = 13^1 \times 3^2 \times 5^0$$

$$\text{H.C.F} = 5^0 \times 3^0 \times 13^1 = 13$$

Q. Find the greatest number which divides 85 and 72 leaving remainders 1 and 2 respectively. [CBSE 2023]

Ans.

$$85 \rightarrow R = 1$$

$$72 \rightarrow R = 2$$

$$84 \rightarrow R = 0$$

$$70 \rightarrow R = 0$$

|   |    |
|---|----|
| 2 | 84 |
| 2 | 42 |
| 7 | 21 |
| 3 | 7  |
|   | 1  |

$$84 = 2^2 \times 7^1 \times 3^1 \times 5^0$$

$$70 = 2^1 \times 5^1 \times 7^1 \times 3^0$$

$$HCF = 2^1 \times 5^0 \times 7^1 \times 3^0 = 14$$

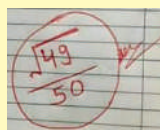
Q. What is the H.C.F of smallest prime number and the smallest composite number?

Ans. Smaller prime no: = 2

Smallest composite no = 4

$$H.C.F (2, 4) = 2$$

When a maths teacher doesn't want to hurt the feelings of students on announcing the maths results



Q. The LCM of the smallest two digit composite number and the smallest composite number is

(a) 12

~~(b) 20~~

(c) 4

(d) 44

Ans. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, .....

Smallest composite number

Smallest two digit composite number

$$4 = 2^2 \times 5^0$$

$$10 = 2^1 \times 5^1$$

$$LCM = 2^2 \times 5^1 = 20$$

Q. Explain why  $7 \times 11 \times 13 + 13$  and  $7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 + 5$  are composite numbers.

Ans.  $a = 7 \times 11 \times 13 + 13$

$$a = 13(77 + 1)$$

$$a = 13 \times 78 \rightarrow \text{Clearly more than 2 factors}$$

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

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

$$b = 5 \times 1009$$

Q. Find the greatest number that divide 445, 572 and 699 leaving remainder 4, 5 and 6 respectively.

~~(a) 63~~ (b) 65 (c) 67 (d) 69

Ans.  $445 \div a \rightarrow r = 4$

$$572 \div a \rightarrow r = 5$$

$$699 \div a \rightarrow r = 6$$

$$441 \div a \rightarrow r = 0$$

$$567 \div a \rightarrow r = 0$$

$$693 \div a \rightarrow r = 0$$

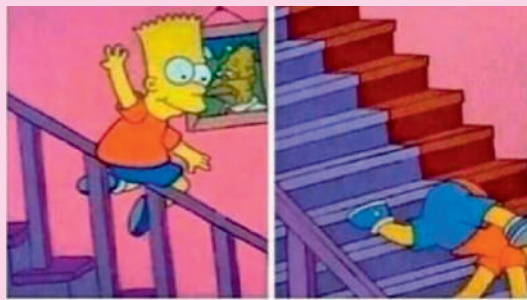
$$441 = 3^2 \times 7^2$$

$$567 = 3^4 \times 7^1$$

$$693 = 3^2 \times 7 \times 11$$

$$H.C.F = 3^2 \times 7 = 63$$

Me: wow I finally understand math  
\*moves on to next question\*



Q. Is the L.C.M of 140 and 170 is 2380?

|    |     |
|----|-----|
| 2  | 170 |
| 5  | 85  |
| 17 | 17  |
|    | 1   |

$$140 \rightarrow 2^2 \times 5^1 \times 7^1 \times 17^0$$

$$170 \rightarrow 2^1 \times 5^1 \times 17^1 \times 7^0$$

$$H.C.F = 2^1 \times 5^1 = 10$$

$$L.C.M = 2^2 \times 5^1 \times 7^1 \times 17^1 = 2380$$

H.C.F is the  
Factor of  
L.C.M.

Q. 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

Ans.  $pq = 221$

|    |     |
|----|-----|
| 17 | 221 |
| 13 | 13  |
|    | 1   |

$$221 = 17 \times 13$$

$$221 = p \times q$$

$$3p - q = 3(17) - 13$$

$$= 51 - 13$$

$$= 38$$



### That Moments

Knowledge is power I will top this year

I can solve more

I think I'm genius



When I accidentally solve two problems of Math Those moments

Q. The least number that is divisible by all the number from 1 to 10 (both inclusive) is [NCERT Exemplar]

- (a) 10 (b) 100  
(c) 504 (d) 2520

Ans. L.C.M =  $2 \times 2 \times 3 \times 5 \times 7 \times 2 \times 3 = 2520$

1 to 10  
include

|   |                               |
|---|-------------------------------|
| 2 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 |
| 2 | 1, 1, 3, 2, 5, 3, 7, 4, 9, 5  |
| 3 | 1, 1, 3, 1, 5, 3, 7, 2, 9, 5  |
| 5 | 1, 1, 1, 1, 5, 1, 7, 2, 3, 5  |
| 7 |                               |
| 2 |                               |
| 3 |                               |

Q. If  $n$  is an even prime number, then  $2(7^n + 8^n)$  ends with

- (a) 1 (b) 4 (c) 2 (d) 6

Ans. 2, 3, 5, 7, 11, 13, 17, 19, 23,.....

Only one even Prime

$$n = 2$$

$$2(7^2 + 8^2) = 2(49 + 64) = 226$$

Q. 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

Ans. Let the numbers be  $81x, 81y$

Co-prime number

$$81x + 81y = 1215$$

$$81(x + y) = 1215$$

$$x + y = \frac{1215}{81}$$

$$x + y = 15$$

- (14, 1), (13, 2), (12, 3), (11, 4), (10, 5),  
(9, 6), (8, 7)

Q. Find the number of possible pairs if the product of two numbers and HCF are 4500 and 15 respectively.

- (a) 1 (b) 2 (c) 3 (d) 4

Ans. HCF = 15

$$\text{Product} = 4500$$

$$\text{Let, the numbers be } = 15x, 15y$$

Co-prime number

$$15x \times 15y = 4500$$

$$xy = \frac{4500}{15 \times 15} = 20$$

$$xy = 20$$

- (1, 20), (4, 5), (10, 2)

Q. If  $x = 2^5 \times 7$ ,  $y = 2^2 \times 3^2 \times 5$  and  $z = 3^n \times 5^2$  and L.C.M( $x, y, z$ ) =  $2^5 \times 3^4 \times 5^2 \times 7$ , then  $n =$

- (a) 2 (b) 3 (c) 4 (d) 5

Ans.  $x = 2^5 \times 7^1 \times 3^0$

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

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

$$\text{L.C.M}(x, y, z) = 2^5 \times 3^4 \times 5^2 \times 7 \Rightarrow n = 4$$

### MATH



The only place where people buy 64 watermelons and no one wonders why...

Q. H.C.F of 144 and 180 is expressed in the form  $13m - 16$ . Find the value of  $m$ .

[CBSE SQP, 2020]

Ans.  $144 = 2^4 \times 3^2 \times 5^0$

$$180 = 2^2 \times 3^2 \times 5^1$$

$$\text{H.C.F} = 2^2 \times 3^2 \times 5^0$$

$$= 36$$

$$36 = 13m - 16$$

$$52 = 13m$$

$$m = 4$$

|   |     |   |     |
|---|-----|---|-----|
| 2 | 144 | 2 | 180 |
| 2 | 72  | 2 | 90  |
| 2 | 36  | 3 | 45  |
| 2 | 18  | 5 | 15  |
| 3 | 9   | 3 | 3   |
| 3 | 3   |   | 1   |
|   | 1   |   |     |



3. The zeroes of the quadratic polynomial

$$4\sqrt{3}x^2 + 5x - 2\sqrt{3} \text{ are}$$

- (a)  $\frac{2}{\sqrt{3}}, \frac{\sqrt{3}}{4}$  (b)  $-\frac{2}{\sqrt{3}}, \frac{\sqrt{3}}{4}$   
 (c)  $\frac{2}{\sqrt{3}}, -\frac{\sqrt{3}}{4}$  (d)  $-\frac{2}{\sqrt{3}}, -\frac{\sqrt{3}}{4}$

#### Answer Key

1. (b) 2. (b) 3. (b)

#### KHUD KARO-3 (#KK)

1. The zeroes of the quadratic polynomial  $4x^2 - 4x - 3$  are

- (a)  $\frac{-3}{2}, \frac{1}{2}$  (b)  $\frac{3}{2}, \frac{-1}{2}$   
 (c)  $\frac{3}{2}, \frac{1}{2}$  (d)  $\frac{-3}{2}, \frac{-1}{2}$

2. If  $k$  is any non-zero constant, then the quadratic polynomial whose zeroes are 2 and  $-6$  is

- (a)  $k[x^2 + 4x + 12]$  (b)  $k[x^2 - 4x - 12]$   
 (c)  $k[x^2 + 4x - 12]$  (d)  $k[x^2 - 4x + 12]$

3. If  $\alpha$  and  $\beta$  are the zeroes of the quadratic polynomial  $f(x) = x^2 - 5x + 4$ , then the value of  $\frac{1}{\alpha} + \frac{1}{\beta} - 2\alpha\beta$  is

- (a)  $\frac{-27}{4}$  (b)  $\frac{27}{4}$   
 (c)  $\frac{25}{4}$  (d)  $\frac{-25}{4}$

4. If  $\alpha$  and  $\beta$  are the zeroes of the polynomial  $x^2 + 7x + 3$ , then the value of  $(\alpha - \beta)^2$  is

- (a) 34 (b) 37 (c) 39 (d) 41

5. If  $\alpha$  and  $\beta$  are zeroes of the polynomial  $x^2 - p(x + 1) + c$  such that  $(\alpha + 1)(\beta + 1) = 0$ , then the value of  $c$  is

- (a)  $-2$  (b)  $2$  (c)  $-1$  (d)  $1$

6. The zeroes of the quadratic polynomial  $x^2 + 9x + 127$  are

- (a) Both positive  
 (b) Both negative  
 (c) One positive and negative.  
 (d) Both equal

7. If one zero of the polynomial  $f(x) = (k^2 + 4)x^2 + 13x + 4k$  is reciprocal of the other, then 'k' =

- (a) 2 (b)  $-2$  (c) 1 (d)  $-1$

#### Answer Key

1. (b) 2. (c) 3. (a) 4. (b) 5. (c)  
 6. (b) 7. (a)



Ye Bolrahe kya sunai nhi de rha, bro  
 mat bol main koi bhai nhi tera, bola  
 aayega time nhi mera, abh top pey  
 betha main dikhai nhi dera.

**2026**  
EXAMINATION



# CBSE QUESTION & CONCEPT BANK

Chapter-wise & Topic-wise  
with Competency Questions

## CLASS 10



Chapter-wise

**CONCEPT MAPS**



Important Questions with Detailed Explanations

**NCERT & EXEMPLAR**



Handpicked & High yield from Past 10 Years

**PYQs**



Revision Blue Print & Solved Questions

**COMPETENCY FOCUSED**



CBSE 2025 Past Year & SQP Solved Papers

**LATEST CBSE PAPERS**



As per Latest Pattern

**MOCK TESTS**



# MATHEMATICS

BASIC

# Chapter-wise Weightage and Trend Analysis of CBSE Past 6 Years' Papers

| MATHEMATICS                               |      |      |      |      |      |
|-------------------------------------------|------|------|------|------|------|
| CHAPTERS                                  | 2020 | 2022 | 2023 | 2024 | 2025 |
| Real Numbers                              | 5    | –    | 6    | 6    | 6    |
| Polynomials                               | 5    | –    | 2    | 5    | 4    |
| Pair of Linear Equations in Two Variables | 4    | –    | 5    | 6    | 6    |
| Quadratic Equations                       | 5    | 4    | 8    | 4    | 5    |
| Arithmetic Progressions                   | 5    | 6    | 5    | 5    | 5    |
| Triangles                                 | 6    | –    | 7    | 8    | 8    |
| Coordinate Geometry                       | 6    | –    | 6    | 6    | 6    |
| Introduction to Trigonometry              | 7    | –    | 6    | 7    | 6    |
| Some Applications of Trigonometry         | 4    | 7    | 6    | 5    | 6    |
| Circles                                   | 3    | 6    | 8    | 7    | 7    |
| Areas Related to Circles                  | 3    | –    | 5    | 5    | 4    |
| Surface Areas and Volumes                 | 4    | 4    | 5    | 5    | 6    |
| Statistics                                | 5    | 8    | 6    | 7    | 6    |
| Probability                               | 6    | –    | 5    | 4    | 5    |

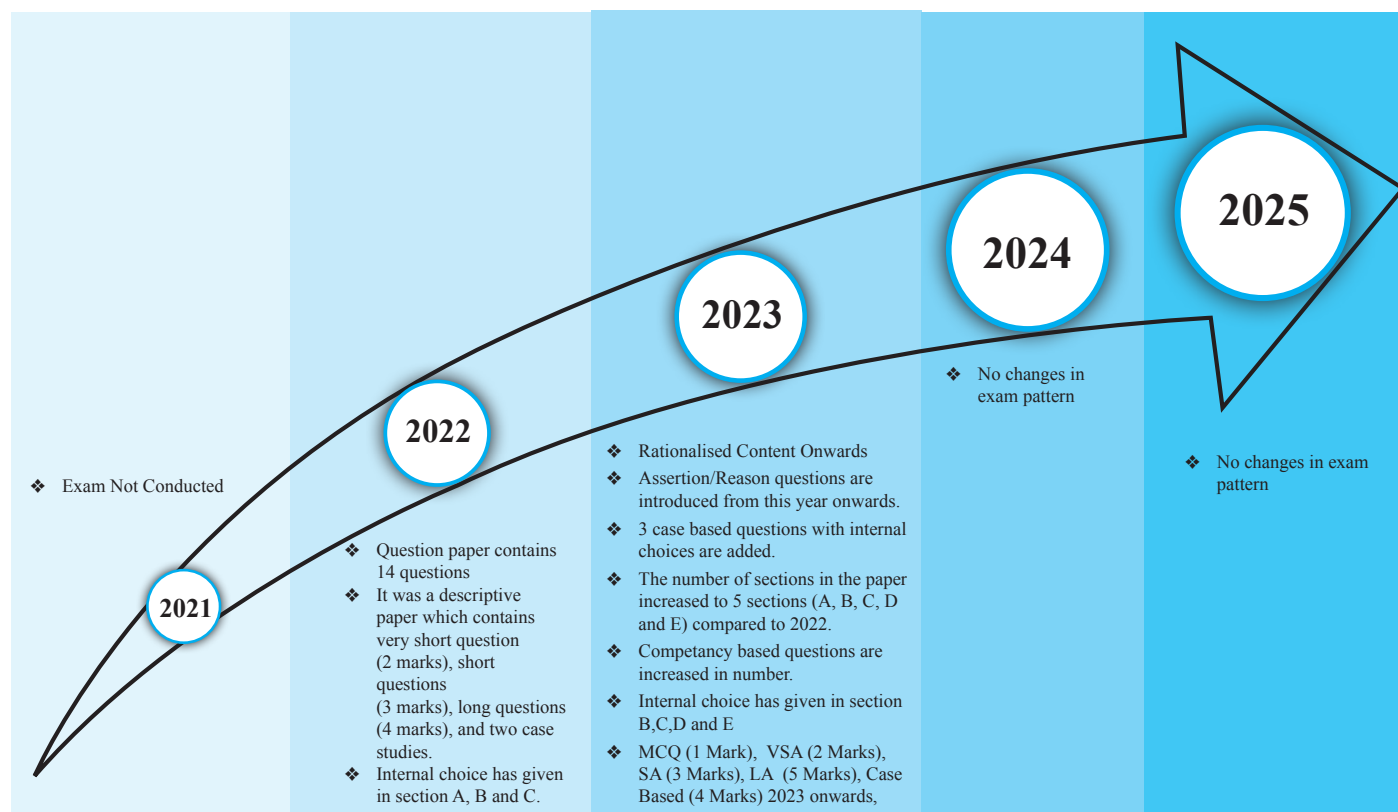
\*The marks allotment mentioned above is chapter-wise and includes internal choice questions as well. Therefore, the total might not match the Maximum Marks of the respective Previous Year Paper.

\*For the year 2021, the exam was not conducted.

## Question Typology

| YEAR | Objective Questions |     | Subjective Questions |     |    |    |                 |
|------|---------------------|-----|----------------------|-----|----|----|-----------------|
|      | MCQs                | A/R | Fill in the Blanks   | VSA | SA | LA | Case Based type |
| 2025 | 18                  | 2   | —                    | 5   | 6  | 4  | 3               |
| 2024 | 18                  | 2   | —                    | 5   | 6  | 4  | 3               |
| 2023 | 18                  | 2   | —                    | 5   | 6  | 4  | 3               |
| 2022 | —                   | —   | —                    |     | 10 | 2  | 2               |
| 2021 | Exam Not Conducted  |     |                      |     |    |    |                 |

## Evolving Trends in CBSE Exam Patterns



# HOW TO USE THIS BOOK

This book is structured to support your learning journey of preparing for your board exams through a variety of engaging and informative elements. Here's how to make the most of it:

**CBSE Solved Paper of 2025 with Handwritten Answer:** Get yourself updated with the latest Board Question Papers. With handwritten answers, learn the practical application of concepts and effective answering techniques to achieve higher scores.

CBSE Solved Paper

## CBSE SOLVED PAPER 2025

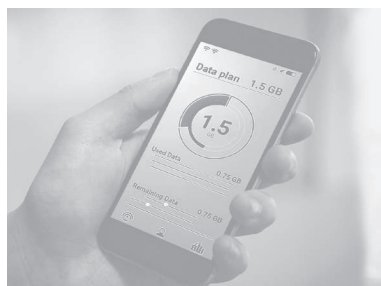
**SECTION - A**  
(Multiple Choice Questions)  
(20 × 1 = 20)

Section - A consists of 20 Multiple Choice Questions of 1 mark each.

1. In two concentric circles centred at  $O$ , a chord  $AB$  of the larger circle touches the smaller circle at  $C$ . If  $OA = 3.5$  cm,  $OC = 2.1$  cm, then  $AB$  is equal to

(a) 5.6 cm (b) 2.8 cm (c) 3.5 cm (d) 4.2 cm

1. (a) Given,  $OA = 3.5$  cm,  $OC = 2.1$  cm  
Since  $AB$  is tangent to the smaller circle at  $C$ ,  
 $OC$  is perpendicular to  $AB$ . Thus, triangle  $OAC$  is a



"Smartphone uses real numbers to calculate the amount of data you have used. If your data plan includes 1.5 GB of data per day, and you've used 0.75 GB, the phone calculates the remaining data using subtraction in the set of real numbers."

Preview

At the start of every chapter, you'll find a thoughtfully chosen image and a quote that captures the main idea and motivation of the topic. This approach aims to get your interest and give you a glimpse of the theme ahead.

Before diving into the details, we outline the syllabus and analyze the weightage given to each topic over the past five years. This helps you prioritize your study focus based on the significance of each section.

### SYLLABUS & WEIGHTAGE

| List of Concept Names                                                                                                                                                                     | Years              |      |                             |                        |                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|-----------------------------|------------------------|------------------------|
|                                                                                                                                                                                           | 2021               | 2022 | 2023                        | 2024                   | 2025                   |
| <b>The Fundamental Theorem of Arithmetic</b><br>(Fundamental Theorem of Arithmetic - statements after reviewing work done earlier and after illustrating and motivating through examples) | Exam not Conducted | —    | 2 Q (1 M each)<br>1 Q (4 M) | 1 Q (2 M)<br>1 Q (3 M) | 1 Q (2 M)              |
| <b>Revisiting Irrational Numbers</b><br>(Proofs of irrationality of $\sqrt{2}, \sqrt{3}, \sqrt{5}$ )                                                                                      | —                  | —    | —                           | 1 Q (1 M)<br>1 Q (2 M) | 1 Q (1 M)<br>1 Q (3 M) |

Concept Map

The concept map appears to be a comprehensive study aid that outlines key concepts in a structured format, featuring definitions, diagrams, and processes. For a student, it would serve as a visual summary, making complex ideas more accessible and aiding in revision and understanding of concept for their curriculum.



### CONCEPT MAP

To Access One Shot Revision Video Scan This QR Code



#### Fundamental Theorem of Arithmetic

Every composite number can be expressed (factorized) as a product of primes, and this factorisation is unique, apart from the order in which the prime factors occur.  
**Note:** Fundamental theorem of arithmetic is called a Unique Factorisation Theorem.  
Composite number = Product of prime numbers.  
e.g.:  $24 = 2 \times 2 \times 2 \times 3$   
 $= 2^3 \times 3$ , where 2 and 3 are prime numbers

#### Theorems

**Theorem 1:** Let  $p$  be a prime number. If  $p$  divides  $a^2$ , then  $p$  divides  $a$ , where  $a$  is a positive integer.  
**Theorem 2:**  $\sqrt{2}$  is an irrational number.  
**Note:** Square root of any prime number is always an irrational number

#### Irrational Numbers

It cannot be expressed as  $x = \frac{p}{q}$ ,  $q \neq 0$ , where  $p$  and  $q$  are integers.  
e.g.:  $\sqrt{2}, \sqrt{3}, \pi, \dots$

#### Prime Factorisation Method:

Prime Factorisation is a way of representing a number as a product of its prime factors. It is also used to find out the H.C.F. and L.C.M.  
For any two positive integers  $a$  and  $b$  we have,  
 $H.C.F.(a, b) \times L.C.M.(a, b) = a \times b$   
e.g.: Find H.C.F. of 24 and 36.  
Prime factors of 24:  $2^3 \times 3^1$   
Prime factors of 36:  $2^2 \times 3^2$   
 $H.C.F. = 2^2 \times 3^1 = 12$   
e.g.: Find L.C.M. of 12 and 18.  
Prime factors of 12:  $2^2 \times 3^1$   
Prime factors of 18:  $2^1 \times 3^2$   
 $L.C.M. = 2^2 \times 3^2 = 36$

#### Rational Numbers

It can be expressed as  $x = \frac{p}{q}$ ,  $q \neq 0$  where  $p$  and  $q$  are integers.  
e.g.:  $\frac{1}{4}, \frac{2}{3}, 2, \dots$

#### Integers 'Z' or 'I'

Integers include all whole numbers and negative numbers.  
e.g.:  $\dots -3, -2, -1, 0, 2, 3, \dots$

#### Whole Number 'W'

The whole number which includes all the non-negative integers.  
 $W: 0, 1, 2, 3, \dots$

#### Natural Number 'N'

Natural numbers are all positive integers  
 $N: 1, 2, 3, \dots$

#### Zero

#### Prime Number

Prime numbers are natural numbers that are divisible by only 1 and the number itself.  
e.g. 2, 3, 5, 7, 11, 13, .....

#### Composite Number

Composite numbers are numbers that have more than two factors.  
e.g. 4, 6, 8, 9, 10, 12, .....

#### Co-prime Number

Co-prime numbers are two pairs of numbers which have a common factor of 1.  
e.g. (14, 15), (1, 99), (8, 15)



# 1

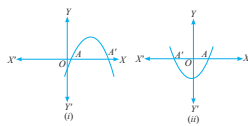
## GEOMETRICAL MEANING OF THE ZEROES OF A POLYNOMIAL

### Important Terms

- Polynomial:** Polynomial has two words, Poly (meaning "many") and Nomial (meaning "terms"). A polynomial is defined as an expression that includes variables, constants, and exponents.
- General form of the Polynomial:**  $p(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x^1 + a_0$  (where  $n$  is a whole number and  $a_0, a_1, a_2, \dots, a_n$  are real numbers) is called a polynomial in one variable  $x$  of degree  $n$ .
- Degree of the Polynomial:** The highest power of the variable  $x$  in the given polynomial  $p(x)$ , is known as the degree of the polynomial.
- Linear Polynomial:** If the degree of the given polynomial is one then, it is known as the linear polynomial. e.g.,  $2x - 3, x + 5$
- Quadratic Polynomial:** If the degree of the given polynomial is two then, it is known as the quadratic polynomial. e.g.,  $2x^2 - 3, x^2 + \sqrt{5}x + 5, \frac{x}{5} + y^2 - \sqrt{2}$ , etc.
- Cubic Polynomial:** If the degree of the given polynomial is three then, it is known as the cubic polynomial. e.g.,  $2 - x^3, x^3, 3 - x^2 + x^3, 3x^3 - 2x^2 + x - 1$ , etc.
- The value of  $p(x)$  at  $x = k$ :** If  $p(x)$  is a polynomial in  $x$ , and if  $k$  is any real number, then the value obtained by replacing  $x$  by  $k$  in  $p(x)$ , is called the value of  $p(x)$  at  $x = k$ , and is denoted by  $p(k)$ .
- Zero of a Polynomial  $p(x)$ :** If  $p(k) = 0$ , then the real number  $k$  is said to be a zero of a polynomial  $p(x)$ .
- Zero of the Linear Polynomial:** If  $k$  is a zero of  $p(x) = ax + b$ , then  $p(k) = ak + b = 0$ , i.e.,  $k = -\frac{b}{a}$ .

### Important Concepts

- Geometrical Meaning of the Zeros of a Polynomial:**
  - The linear polynomial  $ax + b, a \neq 0$ , has exactly one zero, namely,  $\left(-\frac{b}{a}, 0\right)$ .
  - The zeroes of a quadratic polynomial  $ax^2 + bx + c, a \neq 0$ , are precisely the  $x$ -coordinates of the points where the parabola  $(ax^2 + bx + c)$  representing  $y = ax^2 + bx + c$  intersects the  $x$ -axis.  
Equation  $y = ax^2 + bx + c$  has one of the two shapes either open upwards like  $\vee$  or open downwards like  $\wedge$  depending on whether  $a > 0$  or  $a < 0$ . (These curves are called parabolas.)  
From our observation about the shape of the graph of  $y = ax^2 + bx + c$ , the following three cases arise:  
**Case (i):** Here, the graph cuts  $x$ -axis at two distinct points  $A$  and  $A'$ .  
The  $x$ -coordinates of  $A$  and  $A'$  are the two zeroes of the quadratic polynomial  $ax^2 + bx + c$  in this case (see Fig. 1 & ii)



### Important Derivations:

Derivations bridge the gap between theoretical concepts and their practical application, showing students how abstract ideas translate into real-world scenarios.

### Important Formulas:

Introducing important formulas upfront brings clarity to the chapter's objectives, guiding students' focus towards essential mathematical principles that will be explored further.

### Real Life Applications

Here are some real-life applications of real numbers:

#### 1. Banking and Finance:

- Interest rates:** Real numbers are used to represent interest rates on loans and investments.
- Account balances:** Real numbers are used to represent the balances in bank accounts, investments, and financial transactions.



### Different Problem Types

#### Type I: Expressing a Positive Integer as a Product of its Prime Factors

Suppose we need to find the prime factorisation of 176

**Solution:**

**Step I:** Divide the given number by the smallest prime number 2.

Here, we divide 176 by 2  $\Rightarrow 176 \div 2 = 88$

**Step II:** Again, divide the quotient of step 1 by the smallest prime number 2.

So, 88 is again divided by 2  $\Rightarrow 88 \div 2 = 44$

**Step III:** Repeat the process, until the quotient becomes 1.

Now, again divide 44 by 2  $\Rightarrow 44 \div 2 = 22$

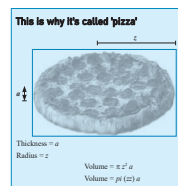
22 is divisible by 2. So, divide it again by 2  $\Rightarrow 22 \div 2 = 11$

As 11 is a prime number, divide it by 11 to get 1  $\Rightarrow 11 \div 11 = 1$

|    |     |
|----|-----|
| 2  | 176 |
| 2  | 88  |
| 2  | 44  |
| 2  | 22  |
| 11 | 11  |
| 1  |     |

**Step IV:** Finally, multiply all the prime factors that are the divisors. Prime factorisation of 176 is  $2 \times 2 \times 2 \times 2 \times 11 = 2^4 \times 11$

### Memes



### Important Terms:

Important terms often serve as foundational concepts upon which more complex ideas are built. Introducing them early ensures students have a solid understanding before delving into more advanced topics.

### Important Concepts:

Familiarizing with key concepts in advance helps prepare cognitive framework for processing and integrating new information. By highlighting important concepts upfront, students are better equipped to identify connections and relationships between various ideas presented in the chapter.

### Important Derivations

- Theorem 1:** Let  $p$  be a prime number. If  $p$  divides  $a^2$ , then  $p$  divides  $a$ , where  $a$  is a positive integer.

**Proof:** Let the prime Factorisation of  $a$  be as follows:

$a = p^1 \cdot p^2 \cdot \dots \cdot p^n$ , where  $p^1, p^2, \dots, p^n$  are primes, not necessarily distinct.

Therefore,  $a^2 = (p^1 \cdot p^2 \cdot \dots \cdot p^n)^2 = (p^1)^2 \cdot (p^2)^2 \cdot \dots \cdot (p^n)^2$ .

Now, we are given that  $p$  divides  $a^2$ . Therefore, from the Fundamental Theorem of Arithmetic, it follows that  $p$  is one of the prime factors of  $a^2$ . However, using the uniqueness part of the Fundamental Theorem of Arithmetic, we realize that the only prime factors of  $a^2$  are  $p^1, p^2, \dots, p^n$ . So  $p$  is one of  $p^1, p^2, \dots, p^n$ .

Now, since  $a = p^1 \cdot p^2 \cdot \dots \cdot p^n$ ,  $p$  divides  $a$ .

### Important Formulas

#### Cube

- Area of four walls = Lateral surface area  $= 4a^2$
- Total surface area (T.S.A) of the cube  $= 6a^2$
- Length of diagonal of the cube  $= \sqrt{3}a$

#### Cuboid

- Area of four walls of a room = Lateral surface area  $= 2h(l + b)$
- Total surface area (T.S.A) of the cuboid  $= 2(lb + bh + lh)$
- Length of diagonal of the cuboid  $= \sqrt{l^2 + b^2 + h^2}$

#### Sphere

- Surface area (S.A.) of the sphere  $= 4\pi r^2$

#### Hemisphere

- Curved surface area (C.S.A.) of the hemisphere  $= 2\pi r^2$
- Total surface area (T.S.A.) of the hemisphere  $= 3\pi r^2$

#### Right Circular Cylinder

- Area of each end of the cylinder  $= \pi r^2$
- Curved surface area (C.S.A.) of the cylinder = (circumference of circle  $\times$  height of cylinder)  $= 2\pi rh$
- Total surface area (T.S.A) of the cylinder  $= 2\pi r(h + r)$

#### Cone

- Slant Height ( $l$ )  $= \sqrt{r^2 + h^2}$
- Curved surface area (C.S.A.) of cone  $= \pi rl$
- Total surface area (T.S.A) of cone  $= \pi r(r + l) = \pi r(r + \sqrt{h^2 + r^2})$

### Real Life Applications:

Connecting abstract math to real scenarios deepens comprehension and aids in problem-solving.

Learning how math connects with other subjects shows that it's useful in many areas and helps us understand different topics better.

### Different Problem Types:

Presenting different types of problems encourages critical thinking and creativity by challenging students to approach each problem uniquely, analyse it, develop strategies, and adapt their approaches to find solutions.

Different problem types challenge students to analyse problems from diverse angles, fostering critical thinking skills essential for problem-solving.

### Memes:

Memes are a popular form of internet humour and culture. With creativity we have captured students' attention to make them more receptive to the material that follows.

Memorable memes help students retain and recall key mathematical ideas more effectively during studying and assessments

## COMPETENCY BASED SOLVED EXAMPLES

### Multiple Choice Questions

(1 M)

1. If the H.C.F. of 360 and 64 is 8, then their L.C.M. is:  
(a) 2480 (b) 2780 (c) 512 (d) 2880

Sol. We are given:

$$\text{H.C.F.}(360, 64) = 8$$

The formula to find L.C.M. using H.C.F. and product of the numbers is:

$$\text{L.C.M.}(a, b) = \frac{a \times b}{\text{H.C.F.}(a, b)}$$

Substituting the given values:

$$a = 360, b = 64$$

$$\text{L.C.M.}(360, 64) = \frac{360 \times 64}{8} = \frac{23040}{8} = 2880$$

2. The least number that is divisible by all the natural numbers from 1 to 10 (both inclusive) is  
(a) 10 (b) 100 (c) 504 (d) 2520

Sol. The least number divisible by all the numbers from 1 to 10 will be the L.C.M. of the following number: 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10.

Prime factorisation of these numbers are  $1 = 1, 2 = 2, 3 = 3, 4 = 2 \times 2, 5 = 5, 6 = 2 \times 3, 7 = 7, 8 = 2 \times 2 \times 2, 9 = 3 \times 3, 10 = 2 \times 5$

So, the L.C.M. of these numbers is  $1 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 7 = 2520$

### Key Takeaways

Check that the correct option should be divisible by all the natural numbers 1–10 as the L.C.M. is the lowest common multiple.

3. 120 can be expressed as a product of its prime factors as  
(a)  $5 \times 8 \times 3$  (b)  $15 \times 2^3$   
(c)  $10 \times 2^2 \times 3$  (d)  $5 \times 2^3 \times 3$

Sol. Let's find the prime factors of 120:

$$120 = 2 \times 60 = 2 \times 2 \times 30$$

$$= 2 \times 2 \times 2 \times 15 = 2 \times 2 \times 2 \times 3 \times 5$$

$$\Rightarrow 2 \times 2 \times 2 \times 15 = 2 \times 2 \times 2 \times 3 \times 5$$

4. If two positive integers  $a$  and  $b$  are written as  $a = x^3y^2$  and  $b = xy^2$ ,  $x, y$  are prime numbers, then H.C.F. of  $a, b$  is  
(a)  $xy$  (b)  $xy^2$  (c)  $x^3y^2$  (d)  $x^3y^2$

Sol. It is given that,  $a = x^3y^2$  and  $b = xy^2$ , where  $x$  and  $y$  are prime numbers.

$$\text{L.C.M.}(a, b) = \text{L.C.M.}(x^3y^2, xy^2)$$

$$= \text{The highest of powers of } x \text{ and } y = x^3y^2$$

$$\text{H.C.F.}(a, b) = \text{H.C.F.}(x^3y^2, xy^2)$$

$$\text{The lowest of powers of } x \text{ and } y = xy^2$$

$$\text{Hence, H.C.F.}(a, b) = xy^2 \text{ and L.C.M.}(a, b) = x^3y^2$$

5. The L.C.M. of smallest two-digit composite number and smallest composite number is  
(a) 12 (b) 4 (c) 20 (d) 44

Sol. By prime factorisation, we get;

$$4 = 1 \times 2 \times 2$$

$$10 = 1 \times 2 \times 5$$

$$\text{Now, L.C.M. of } 4, 10 = 2 \times 2 \times 5 = 20$$

Therefore, the L.C.M. of the smallest two-digit composite number and the smallest composite number is 20.

### Key Takeaways

The smallest 2-digit number = 10 and the smallest composite number = 4

6. If two positive integers  $a$  and  $b$  can be expressed as  $p = ab^2$  and  $q = a^2b$ ;  $a, b$  being prime numbers, then L.C.M. of  $p, q$  is  
(a)  $ab$  (b)  $a^2b^2$  (c)  $a^2b^2$  (d)  $a^2b^2$

Sol. Let's express each polynomial as a product of the power of irreducible factors.

$$p = ab^2 = a \times b^2, q = a^2b = a^2 \times b$$

To find the L.C.M., raise each irreducible factor to the greatest exponent.

$$\therefore \text{L.C.M.} = a^2 \times b^2 = a^2b^2$$

### Mistakes 101: What not to do!

Sometimes, students take the term with the lower power from numbers to calculate the L.C.M. of numbers.

7. The ratio between the L.C.M. and H.C.F. of 5, 15, 20 is  
(a) 9 : 1 (b) 4 : 3  
(c) 11 : 1 (d) 12 : 1

Sol. Prime factorisations are:

$$5 = 5^1, 15 = 3^1 \times 5^1, 20 = 2^2 \times 5^1$$

$$\text{L.C.M.}(5, 15, 20) = 2^2 \times 3^1 \times 5^1 = 60$$

$$\text{H.C.F.}(5, 15, 20) = 5^1 = 5$$

$$\text{Ratio} = \frac{\text{L.C.M.}}{\text{H.C.F.}} = \frac{60}{5} = 12$$

$$\text{Ratio} = 12 : 1$$

## Solved Examples

For each topic, solved examples are provided including tagging of Competencies, PYQs, CBSE SQPs etc that exemplify how to approach and solve questions. This section is designed to reinforce your learning and improve problemsolving skills.

## MISCELLANEOUS EXERCISE

### Multiple Choice Questions

(1 M)

1. The solution of equations  $x - y = 2$  and  $x + y = 4$  is:

(a) 3 and 1 (b) 4 and 3 (c) 5 and 1 (d) -1 and -3

2. If a pair of linear equations is inconsistent then their graph lines will be

- (a) parallel (b) always coincident  
(c) always intersecting (d) intersecting or coincident  
3. If  $2x - 3y = 7$  and  $(a + b)x - (a + b - 3)y = 4a + b$  have an infinite number of solutions then  
(a)  $a = 5, b = 1$  (b)  $a = -5, b = 1$   
(c)  $a = 5, b = -1$  (d)  $a = -5, b = -1$

## ANSWER KEYS

### Multiple Choice Questions

1. (a) 2. (a) 3. (d) 4. (a) 5. (d) 6. (c) 7. (c) 8. (c) 9. (a) 10. (c)  
11. (a) 12. (c) 13. (a) 14. (c)

### Assertion and Reason

1. (b) 2. (a) 3. (d) 4. (c)

### Case Based Questions

#### Case Based-I

- (i) (c) (ii) (b) (iii) (a) (iv) (c) (v) (d)

#### Case Based-V

- (i) (d) (ii) (c) (iii) (b) (iv) (d) (v) (c)

## HINTS & EXPLANATIONS

### Multiple Choice Questions

1. (a) Given:  $x - y = 2$  ... (i)

$$x + y = 4 \quad \dots (ii)$$

Adding eqn. (i) and (ii), we get  $2x = 6 \Rightarrow x = 3$

Put the value of  $x$  in equation (i), we get

$$3 - y = 2 \Rightarrow y = 1$$

$$\text{Hence, } x = 3, y = 1$$

2. (a) A pair of linear equations is inconsistent when there is no solution to the pair, which is possible if there is no common points in the lines represented by the pair of linear equations, which is possible if the lines are parallel.

3. (d) We have,

$$2x - 3y = 7 \quad \dots (i)$$

$$\text{and } (a + b)x - (a + b - 3)y = 4a + b \quad \dots (ii)$$

$$\Rightarrow a_1 = 2, b_1 = -3, c_1 = -7$$

$$a_2 = a + b, b_2 = -a - b + 3 \text{ and } c_2 = 4a + b$$

For infinite number of solutions,

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2} \Rightarrow \frac{2}{a+b} = \frac{-3}{-a-b+3} = \frac{-7}{-(4a+b)}$$

$$\Rightarrow \frac{2}{a+b} = \frac{3}{a+b-3} = \frac{7}{4a+b}$$

$$\text{For } \frac{2}{a+b} = \frac{3}{a+b-3}$$

$$\Rightarrow 2a + 2b - 6 = 3a + 3b \Rightarrow a + b = -6 \quad \dots (i)$$

$$\text{For } \frac{3}{a+b-3} = \frac{7}{4a+b}$$

$$\Rightarrow 12a + 3b - 7a + 7b - 21 = 5a - 4b - 21 \quad \dots (ii)$$

$$\text{Adding eqn (i) and eqn (ii) by multiplying eqn (i) by 4,}$$

$$4(a + b) + 5b - 4b - 21 = -6 + 4 + (-21)$$

$$\Rightarrow 9a = -45 \Rightarrow a = -5$$

$$\text{Substituting this in eqn (i)}$$

$$-5 + b = -6$$

$$b = -6 + 5 = -1$$

$$\text{Hence, } a = -5 \text{ and } b = -1$$

At the end of each chapter, you'll find additional exercises intended to test your grasp of the material. These are great for revision and to prepare for exams.

Answer Key and Explanations including Topper's Explanations, Mistake 101, Nailing the right answer and Key takeaway to know how to write the ideal answer.

## Answer Key

## Mock Test

Mock Test Papers: Test your preparedness with our Mock Test Papers designed to mirror the format and difficulty of real exams. Use the detailed explanations to identify areas of strength and opportunities for improvement.

## MOCK TEST PAPER-1

Time allowed : 3 hours

Maximum Marks : 80

### GENERAL INSTRUCTIONS:

Read the following instructions very carefully and follow them:

- This question paper contains 38 questions. All questions are compulsory.
- Question Paper is divided into 5 Sections: Section A, B, C, D and E.
- In Section A question number 1 to 18 are Multiple Choice Questions (MCQs) and question number 19 & 20 are Assertion-Reason based questions of 1 mark each.
- In Section-B question number 21 to 25 are Very Short Answer (VSA) type questions of 2 marks each.
- In Section-C question number 26 to 31 are Short Answer (SA) type questions carrying 3 marks each.
- In Section-D question number 32 to 35 are Long Answer (LA) type questions carrying 5 marks each.
- In Section-E question number 36 to 38 are Case Study based questions carrying 4 marks each. Internal choice is provided in 2 marks question in each case-study.
- There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.
- Draw neat figures wherever required. Take  $\pi = 22/7$  wherever required if not stated.
- Use of calculators is NOT allowed.

### SECTION - A

Section - A consists of Multiple Choice type questions of 1 mark each.

- The least number that is divisible by all the natural numbers from 1 to 10 (both inclusive) is  
(a) 10 (b) 100 (c) 504 (d) 2520
- If the zeroes of the quadratic polynomial  $ax^2 + bx + c$ ,  $a \neq 0$  are equal, then  
(a)  $c$  and  $a$  have opposite signs (b)  $c$  and  $b$  have same sign  
(c)  $c$  and  $a$  have same sign (d)  $c$  and  $b$  have opposite signs
- The given pair of linear equations  $x + 2y - 5 = 0$  and  $-3x - 6y + 15 = 0$  have  
(a) Exactly one solution (b) Exactly two solutions  
(c) Infinitely many solutions (d) No solution
- If  $ax^2 + bx + c = a(x - p)^2$ , the relation among  $a, b$  and  $c$  is:  
(a)  $abc = 1$  (b)  $a + c - 2b = 0$   
(c)  $b^2 - ac = 0$  (d)  $b^2 = 4ac$
- If the numbers  $n - 2, 4n - 1$  and  $5n + 2$  are in AP then value of  $n$  is  
(a) 1 (b) 4 (c) -4 (d) -2

# CONTENTS

Upcoming CBSE  
SQPs/APQs can  
be accessed  
through this QR



Questions have been categorized according to the Bloom's Taxonomy (as per CBSE Board).

The following abbreviations have been used in the book:

(Un) - Understanding

(Re) - Remembering

(Ap) - Applying

(An) - Analysing

(Cr) - Creating

(Ev) - Evaluating

## ❖ CBSE SOLVED PAPER 2025 (Handwritten Solutions)

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# CBSE SOLVED PAPER 2025

Time allowed : 3 hours

Maximum Marks : 80

## GENERAL INSTRUCTIONS:

Read the following instructions very carefully and strictly follow them:

- (i) This question paper contains **38** questions. **All** questions are compulsory.
- (ii) Question Paper is divided into **FIVE** Sections-**SECTION A, B, C, D** and **E**.
- (iii) In Section -**A**, question numbers **1** to **18** are Multiple Choice Questions (MCQs) and question numbers **19** & **20** are Assertion-Reason based questions of **1** mark each.
- (iv) In Section-**B**, question numbers **21** to **25** are Very Short Answer (VSA) type questions of **2** marks each.
- (v) In Section-**C**, question numbers **26** to **31** are Short Answer (SA) type questions carrying **3** marks each.
- (vi) In Section-**D**, question numbers **32** to **35** are Long Answer (LA) type questions carrying **5** marks each.
- (vii) In Section-**E**, question numbers **36** to **38** are **case - based integrated units** of assessment questions carrying **4** marks each. Internal choice is provided in **2** marks question in each case-study.
- (viii) There is no overall choice. However, an internal choice has been provided in **2** questions in Section-**B**, **2** questions in Section-**C**, **2** questions in Section-**D** and **3** questions of **2** marks in Section-**E**.
- (ix) Draw neat figures wherever required. Take  $\pi = 22/7$  wherever required if not stated.
- (x) Use of calculators is **NOT** allowed.

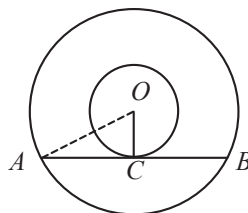
## SECTION – A

(20 × 1 = 20)

(Multiple Choice Questions)

Section - A consists of 20 Multiple Choice Questions of 1 mark each.

1. In two concentric circles centred at  $O$ , a chord  $AB$  of the larger circle touches the smaller circle at  $C$ . If  $OA = 3.5$  cm,  $OC = 2.1$  cm, then  $AB$  is equal to (1 M)



- (a) 5.6 cm                      (b) 2.8 cm                      (c) 3.5 cm                      (d) 4.2 cm

1. (a) Given,  $OA = 3.5$  cm,  $OC = 2.1$  cm

Since  $AB$  is tangent to the smaller circle at  $C$ ,  
 $OC$  is perpendicular to  $AB$ . Thus, triangle  $OAC$  is a  
right angled triangle at  $C$ .



Using Pythagoras theorem in  $\triangle OAC$ ,

$$\begin{aligned} OA^2 &= OC^2 + AC^2 \\ \Rightarrow (3.5)^2 &= (2.1)^2 + AC^2 \\ \Rightarrow 12.25 &= 4.41 + AC^2 \\ \Rightarrow AC^2 &= 12.25 - 4.41 = 7.84 \\ \Rightarrow AC &= \sqrt{7.84} = 2.8 \text{ cm} \end{aligned}$$

$\therefore$  AB is a chord and C is the midpoint (as OC is perpendicular to AB).

$$\therefore AB = 2AC$$

$$\text{Hence, } AB = 2 \times 2.8 = 5.6 \text{ cm.}$$

2. Three coins are tossed together. The probability that at least one head comes up, is

(1 M)

(a)  $\frac{3}{8}$

(b)  $\frac{7}{8}$

(c)  $\frac{1}{8}$

(d)  $\frac{3}{4}$

2. (b)

When three coins are tossed, the total number of possible outcomes is  $2^3 = 8$

And, The outcomes are HHH, HHT, HTH, THH, HTT, THT, TTH, TTT.

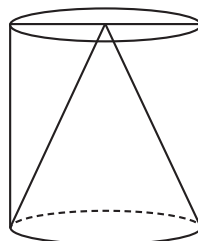
The number of favorable outcomes for at least one head = 7

Hence, The probability of getting at least one head

$$= \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}} = \frac{7}{8}$$

3. The volume of air in a hollow cylinder is  $450 \text{ cm}^3$ . A cone of same height and radius as that of cylinder is kept inside it. The volume of empty space in the cylinder is

(1 M)



(a)  $225 \text{ cm}^3$

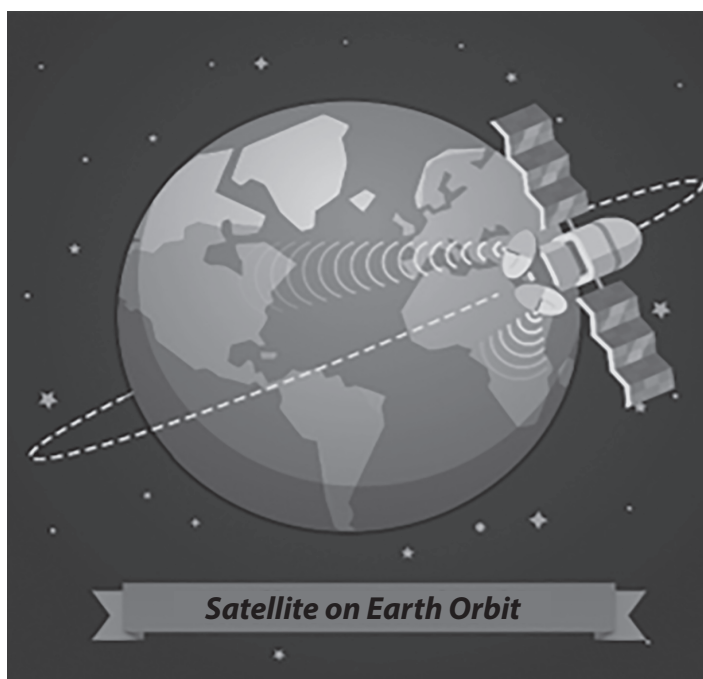
(b)  $150 \text{ cm}^3$

(c)  $250 \text{ cm}^3$

(d)  $300 \text{ cm}^3$

# CIRCLES

10



*“Circles are used to describe the paths, or orbits, that satellites follow around the Earth. These circular orbits help satellites stay at the same height, which is important for tasks like broadcasting TV, reporting weather, and helping with GPS navigation. Understanding these orbits helps people keep track of satellites and ensure they function properly.”*

## SYLLABUS & WEIGHTAGE



| List of Concept Names                                                                                                                                                   | Years                  |                        |                                          |                        |                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------|------------------------------------------|------------------------|-----------------------------|
|                                                                                                                                                                         | 2021                   | 2022                   | 2023                                     | 2024                   | 2025                        |
| <b>Tangent to a Circle</b><br>(The tangent at any point of a circle is perpendicular to the radius through the point of contact)                                        | Exam was not Conducted | 1 Q (2 M)<br>1 Q (4 M) | 2 Q (1 M each)<br>1 Q (2 M)<br>1 Q (3 M) | 1 Q (1 M)<br>1 Q (5 M) | 1 Q (5 M)<br>2 Q (1 M each) |
| <b>Number of Tangents from a Point on a Circle</b><br>(The length of tangent from an external point to a circle are equal, Number of tangents from a point to a circle) |                        | –                      | 1 Q (1 M)                                | 1 Q (1 M)              | 1 Q (5 M)                   |



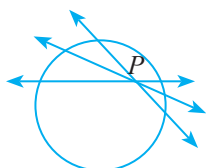
## CONCEPT MAP

To Access One  
Shot Revision Video  
Scan This QR Code

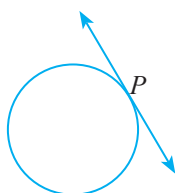


### Number of tangents

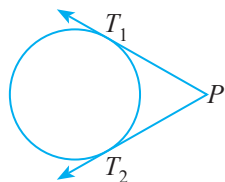
- There are no tangents to a circle passing through a point lying inside the circle.



- There is one and only one tangent to a circle passing through a point lying on the circle.



- There are exactly two tangents to a circle through a point lying outside the circle.

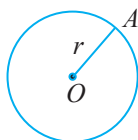


### Terms Related to Circle:

- Chord
- Arc
- Sector
- Segment
  - Minor segment
  - Major segment

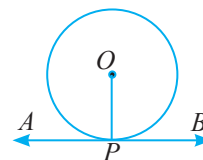
### Definition

The locus of a point that is equidistant from a fixed point is known as a circle. The fixed point is called centre and the distance between the fixed point and the point on the circle is called radius.



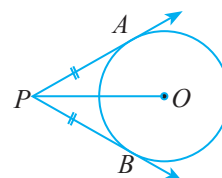
### Theorem 1

The tangent at any point of a circle is perpendicular to the radius through the point of contact.



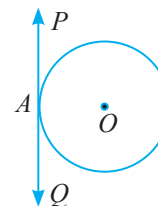
### Theorem 2

The lengths of tangents drawn from an external point to a circle are equal.



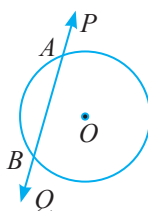
### Tangent

A line intersecting a circle at only one point is known as tangent and the intersecting point is known as point of contact.



### Secant

A line intersecting a circle at two different points is known as secant.

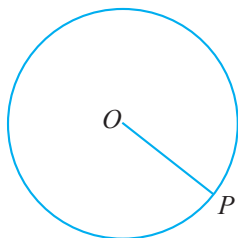


# 1 | TANGENT TO A CIRCLE

## Important Terms

- **Circle:** The collection of all the points whose distance from a fixed point is constant is known as a circle.

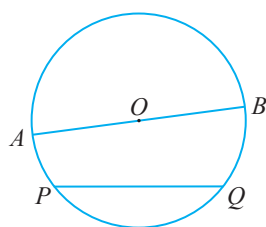
Here, the fixed point is called the Centre of the circle, and the distance between the fixed point (centre) and any point on the circle is called the Radius of the circle.



Here,  $O$  is the fixed point or the Centre of the Circle and  $OP$  is the radius of the circle.

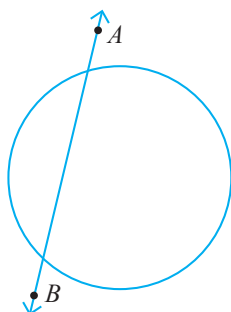
- **Chord:** A line segment joining any two different points on a circle is called the Chord of the circle.

If a chord passes through the centre of a circle then the chord is known as the Diameter of the circle.



In the figure,  $PQ$  is a chord of the circle, and  $AOB$ , or simply  $AB$  is the diameter of the circle.

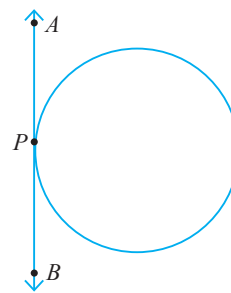
- **Secant:** A line that intersects a circle at two different points is called a Secant of that circle.



In the figure,  $AB$  is secant to the circle.

- **Tangent:** A line that touches the circle at a point (or intersects the circle at only one point) is called a Tangent to the circle.

The point at which the tangent touches a circle is called the Point of Contact.



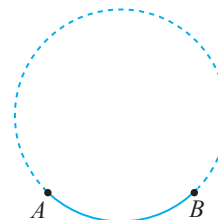
Here,  $APB$  is tangent to the circle and  $P$  is the point of contact.

- **Note:** (i) Tangent is a special case of secant when the two endpoints of its corresponding chord coincide.

(ii) At any point on a circle, only one tangent can be drawn.

- **Arc:** A piece of a circle between any two different points is called an Arc of that circle.

Between any two points on a circle, there are two arcs. One is smaller than the other. The smaller arc is known as Minor Arc and the larger is called Major Arc.



In the figure,  $AB$  (solid) represents a minor arc and  $AB$  (dotted) represents a major arc.

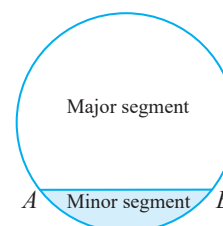
**Note:** When both the arcs, major and minor, are equal then each is called Semicircle.

- **Circumference:** The length of the whole circle is known as Circumference.

- **Segment:** In a circle, the region between a chord and an arc is called a Segment of the circle.

As in the case of arc, there are two types of segments.

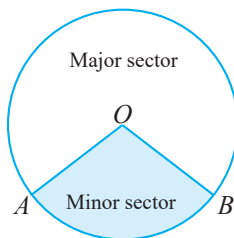
- **Minor Segment:** The region between a chord and a minor arc is called Minor Segment.
- **Major Segments:** The region between a chord and a major arc is called Major Segment.



□ **Sector:** A sector of a circle is the region between an arc and two radii, joining the endpoints of the arc and the centre.

○ **Minor Sector:** The region between a minor arc and two radii, joining the endpoints of the arc and the centre, of a circle is known as the Minor Sector of the circle.

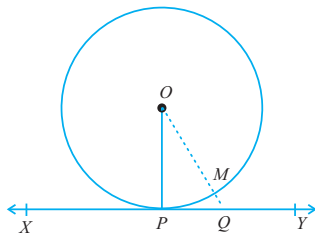
○ **Major Sector:** The region between a major arc and two radii, joining the endpoints of the arc and the centre, of a circle is known as the Major Sector of the circle.



## Important Derivations

□ **Theorem 1:** The tangent at any point of a circle is perpendicular to the radius through the point of contact. The tangent at any point of a circle is perpendicular to the radius through the point of contact.

**Given:** A circle with centre  $O$  and a tangent  $XY$  at a point  $P$  of the circle. (CBSE, 2016)



**To prove:**  $OP \perp XY$ .

**Construction:** Other than  $P$ , take a point  $Q$ , on  $XY$  and join  $OQ$ .

**Proof:**  $Q$  is a point on the tangent  $XY$ , other than the point of contact  $P$ . Hence  $Q$  lies outside the circle.

Let  $OQ$  intersect the circle at  $M$ .

Then,  $OM < OQ$  [ $\because$  a part ( $OM$ ) of line segment ( $OQ$ ) is less than the whole line segment ( $OQ$ )]  
... (i)

But,  $OP = OM$  [radii of the same circle]. ...  
(ii)

From equation (i) and (ii), we get

$$OP < OQ$$

Therefore,  $OP$  is shorter than any other line segment drawn from  $O$  to any point on  $XY$ , except  $P$ .

Or, we can say that,  $OP$  is the shortest distance between the point  $O$  and the line  $XY$ .

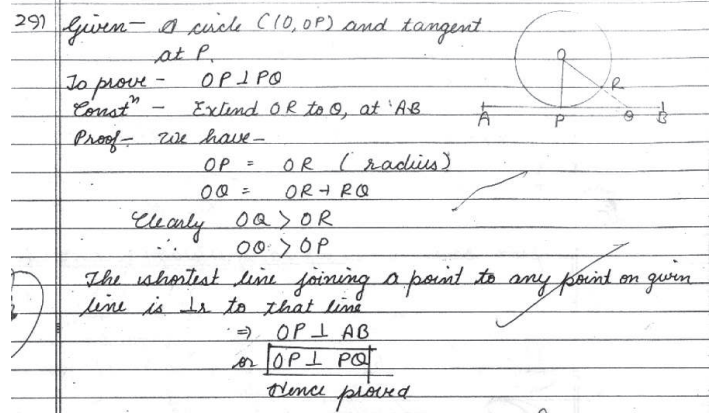
And also we know that the shortest distance of a point from the given line is the perpendicular distance.

Therefore,  $OP \perp XY$ . Hence, proved.

**Note:** Converse of the above theorem is also valid and is given as- **A line drawn through the end of a radius of a circle and perpendicular to the radius is tangent to the circle.**

## Topper's Explanation

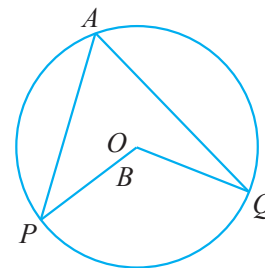
(CBSE 2016)



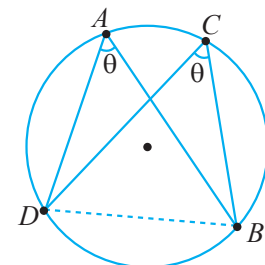
## Important Concepts

Some important concepts related to a circle are given below:

- Equal chords of a circle subtend equal angles at the centre.
- The perpendicular from the centre of a circle to a chord bisects the chord.
- The perpendicular distances of equal chords of a circle (or of congruent circles) are equal from the centre (or centres).
- Congruent arcs (or equal arcs) of a circle subtend equal angles at the centre.
- The angle subtended by an arc at the centre is double the angle subtended by it at any point on the remaining part of the circle i.e.,  $\angle POQ = 2\angle PAQ$

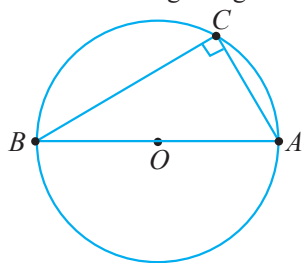


- Angles in the same segment of a circle are equal.





- An angle in a semicircle is a right angle.



- The sum of either pair of opposite angles of a cyclic quadrilateral is  $180^\circ$ .

## Real Life Applications

- Cycling is a great way to keep our bodies fit, and when riding a bicycle, you may have noticed that the wheel moves along a road. Since the wheel is circular and the road is straight, the road touches the circle at only one point, and so the road becomes tangent to the circle at each point where the wheels roll on it. This is an example of a tangent to a circle.



## Different Problem Types

### Type I: On Finding the Length of the Tangent or Radius of a Circle:

**Step I:** Identify circle-related lengths and points.

**Step II:** Recognize tangent's perpendicularity to the radius.

**Step III:** Formulate a right triangle with radius, tangent, and line to the center.

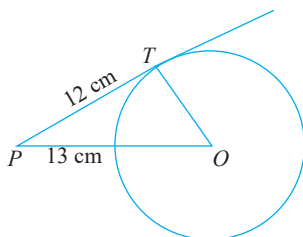
**Step IV:** Apply Pythagoras theorem.

**Step V:** Solve for radius or tangent length.

**Example:** A point  $P$  is 13 cm from the centre of the circle. The length of the tangent drawn from  $P$  to the circle is 12 cm. Find the radius of the circle.

**Solution:** Since tangent to a circle is perpendicular to the radius through the point of contact.

$$\therefore \angle OTP = 90^\circ$$



In right triangle  $OTP$ , we have

$$OP^2 = OT^2 + PT^2$$

$$\Rightarrow 13^2 = OT^2 + 12^2$$

$$\Rightarrow OT^2 = 13^2 - 12^2 = (13 - 12)(13 + 12) = 25$$

$$\Rightarrow OT = 5.$$

Hence, radius of the circle is 5 cm.

### TYPE II: Question Based on the Result that the Tangent to a Circle at a Point is Perpendicular to the Radius through the Point:

**Step I:** Identify key elements such as the circle's center, tangent segments, and any mentioned angles.

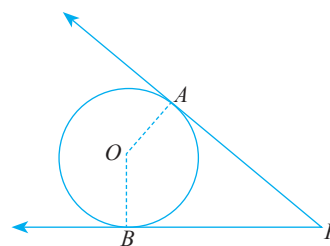
**Step II:** Apply the property that a tangent to a circle is perpendicular to the radius, forming a  $90^\circ$  angle at the point of tangency.

**Step III:** Recognize that in a cyclic quadrilateral, opposite angles sum to  $180^\circ$ , indicating the quadrilateral is cyclic.

**Step IV:** Utilize the tangent property to establish  $90^\circ$  angles between tangent segments and radii. Then, use angle sum properties to confirm the sum of opposite angles is  $180^\circ$ .

**Example:** In the given figure,  $O$  is the centre of the circle.  $PA$  and  $PB$  are tangent segments. Show that the quadrilateral  $AOBP$  is cyclic.

**Solution:** Since tangent at a point to a circle is perpendicular to the radius through the point.



$$\therefore OA \perp AP \text{ and } OB \perp BP$$

$$\Rightarrow \angle OAP = 90^\circ \text{ and } \angle OBP = 90^\circ$$

$$\Rightarrow \angle OAP + \angle OBP = 90^\circ + 90^\circ = 180^\circ$$

In quadrilateral  $OAPB$ , we have

$$\angle OAP + \angle APB + \angle AOB + \angle OBP = 360^\circ$$

$$\Rightarrow (\angle APB + \angle AOB) + (\angle OAP + \angle OBP) = 360^\circ$$

$$\Rightarrow \angle APB + \angle AOB + 180^\circ = 360^\circ$$

$$\Rightarrow \angle APB + \angle AOB = 180^\circ$$

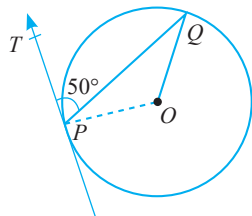
We can say that the quadrilateral  $AOBP$  is cyclic.

# COMPETENCY BASED SOLVED EXAMPLES

## Multiple Choice Questions

(1 M)

1. In Fig. 1, O is the centre of circle. PQ is a chord and PT is tangent at P which makes an angle of  $50^\circ$  with PQ.  $\angle POQ$  is  
(Un) (CBSE, 2020)



- (a)  $130^\circ$  (b)  $90^\circ$   
(c)  $100^\circ$  (d)  $75^\circ$

**Sol.** Radius from the centre makes an angle of  $90^\circ$  at the point where the tangent meets the circle.

$$\angle OPQ = (90 - 50)^\circ = 40^\circ \quad \angle OPQ = \angle OQP = 40^\circ$$

(Triangle  $OPQ$  is isosceles)

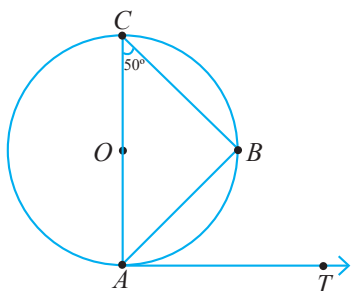
By Angle sum property of triangle we get,

$$\angle POQ = (180 - 80)^\circ = 100^\circ$$

2. In the figure,  $AB$  is a chord of the circle and  $AOC$  is its diameter such that  $\angle ACB = 50^\circ$ . If  $AT$  is the tangent to the circle at the point  $A$ , then  $\angle BAT$  is equal to

(Re) (NCERT Exemplar)

- (a)  $65^\circ$  (b)  $60^\circ$  (c)  $50^\circ$  (d)  $40^\circ$



**Sol.** Since, the angle in a semicircle is  $90^\circ$ .

$$\text{So, } \angle ABC = 90^\circ$$

In  $\triangle ACB$ ,

$$\angle A + \angle B + \angle C = 180^\circ \quad [\text{Angle sum property}]$$

$$\Rightarrow \angle A + 90^\circ + 50^\circ = 180^\circ \quad [\angle C = 50^\circ]$$

$$\Rightarrow \angle A = 180^\circ - 140^\circ = 40^\circ \Rightarrow \angle A \text{ or } \angle OAB = 40^\circ$$

Since tangent to a circle is perpendicular to the radius drawn through the point of contact.

So,  $OA$  is perpendicular to  $AT$ .

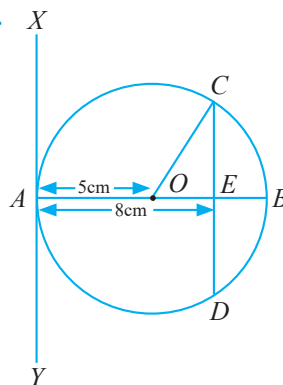
$$\Rightarrow \angle OAT = 90^\circ \Rightarrow \angle OAB + \angle BAT = 90^\circ$$

$$\Rightarrow \angle BAT = 90^\circ - 40^\circ = 50^\circ \quad [\text{Since, } \angle OAB = 40^\circ]$$

3. At one end  $A$  of a diameter  $AB$  of a circle of radius 5 cm, tangent  $XAY$  is drawn to the circle. The length of the chord  $CD$  parallel to  $XY$  and at a distance 8 cm from  $A$  is  
(Un) (NCERT Exemplar)

- (a) 4 cm (b) 5 cm (c) 6 cm (d) 8 cm

**Sol.**



Since,  $XY \parallel CD$

$$\Rightarrow CD \perp AO \Rightarrow CD \perp AE \Rightarrow \angle OEC = 90^\circ$$

$\therefore$  In  $\triangle OEC$ ,

$$CE^2 = OC^2 - OE^2 \quad [\text{By Pythagoras theorem}]$$

$$\Rightarrow CE^2 = 5^2 - 3^2 = 25 - 9 = 16$$

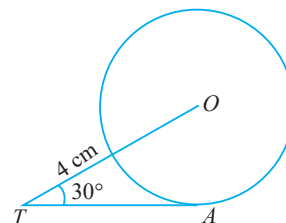
$$\therefore CE = 4 \text{ cm} \Rightarrow CD = 2 \times 4 = 8 \text{ cm}$$



## Mistakes 101 : What not to do!

Students misinterpret that all chords drawn in a circle are equal in length, overlooking variations in chord lengths based on their positions relative to the centre.

4. In the given figure,  $TA$  is a tangent to the circle with centre  $O$  such that  $OT = 4$  cm,  $\angle OTA = 30^\circ$ , then length of  $TA$  is:  
(An)



- (a)  $2\sqrt{3}$  cm (b) 2 cm (c)  $2\sqrt{2}$  cm (d)  $\sqrt{3}$  cm

**Sol.** We know tangent makes  $90^\circ$  with the Radius.

Given  $\angle ATO = 30^\circ$  &  $OT = 4$  cm

$$\cos 30^\circ = \frac{AT}{OT} = \frac{AT}{4} \Rightarrow \frac{\sqrt{3}}{2} = \frac{AT}{4}$$

$$\Rightarrow AT = 4 \times \frac{\sqrt{3}}{2} = 2\sqrt{3} \text{ cm}$$

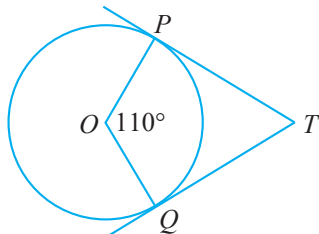


### Mistakes 101 : What not to do!

Students may incorrectly apply properties related to tangents, such as the angle between a tangent and a radius being  $90^\circ$ . They might forget to consider the subtended angle or misinterpret the angle formed by a tangent and a chord.

5. In figure, if TP and TQ are the two tangents to a circle with centre O so that  $\angle POQ = 110^\circ$ , then  $\angle PTQ$  is equal to (Ap) (CBSE SQP, 2023)

- (a)  $60^\circ$  (b)  $70^\circ$   
(c)  $80^\circ$  (d)  $90^\circ$



**Sol.** Given,  $\angle POQ = 110^\circ$

We know,

$\angle OPT = \angle OQT = 90^\circ$  (Angle between the tangent and the radial line at the point of intersection of the tangent at the circle)

Now, in quadrilateral POQT

Sum of angles =  $360^\circ$

$$\Rightarrow \angle OPT + \angle OQT + \angle PTQ + \angle POQ = 360^\circ$$

$$90^\circ + 90^\circ + \angle PTQ + 110^\circ = 360^\circ$$

$$\Rightarrow \angle PTQ = 360^\circ - 290^\circ$$

$$\Rightarrow \angle PTQ = 70^\circ$$

### Answer Key

- (q) 5. (v) 4. (d) 3. (c) 2. (c) 1.

### Assertion and Reason

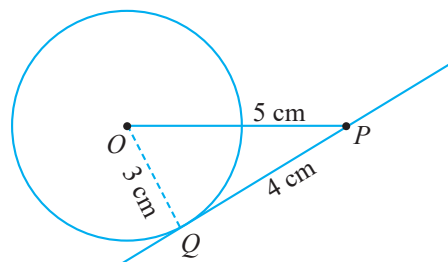
(1 M)

**Direction:** In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

- (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, but 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.

1. **Assertion (A):** If in a circle with centre O, the radius of the circle is 3 cm and distance of a point P, from the centre of a circle is 5 cm, then length of tangent PQ, where Q is a point on the circle, will be 4 cm.

**Reason (R):** (hypotenuse)<sup>2</sup> = (base)<sup>2</sup> + (height)<sup>2</sup> (Cr)



**Sol.** In the given figure.

$$(OP)^2 = (OQ)^2 + (PQ)^2$$

$$25 = 9 + 16$$

$$25 = 25$$

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

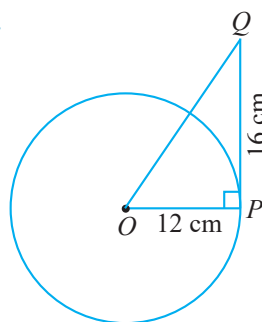
$\therefore$  Both assertion (A) and reason (R) is true and reason (R) is the correct explanation of assertion (A).

2. **Assertion (A):** At a point P of a circle with centre O and radius 12 cm, a tangent PQ of length 16 cm is drawn. Then, OQ = 20 cm.

**Reason (R):** The tangent at any point of a circle is perpendicular to the radius through the point of contact.

(Cr)

**Sol.**



PQ = 16 cm and OP = 12 cm

Tangent drawn through the end point of a radius is perpendicular to the radius.

So,  $OP \perp PQ$

Now, by Pythagoras theorem

$$(\text{hypotenuse})^2 = (\text{base})^2 + (\text{height})^2$$

$$\Rightarrow OQ^2 = OP^2 + PQ^2$$

$$\Rightarrow OQ^2 = 12^2 + 16^2 = 144 + 256 = 400$$

$$\Rightarrow OQ = \sqrt{400} = 20 \text{ cm}$$

Assertion is true.

Reason is also true by theorem.

As we used a theorem to prove assertion.

So, reason is correct explanation of the assertion



### Nailing the Right Answer

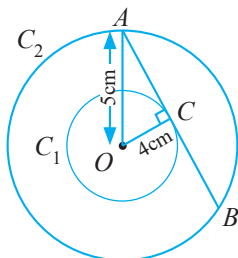
Always draw accurate diagrams representing the given information in the problem. Pay attention to the positions of points, lines, and circles, and use a ruler and compass if necessary to ensure precision.

3. **Assertion (A):** If the radii of two concentric circles are 4 cm and 5 cm, then the length of each chord of one circle which is tangent to the other circle is 3 cm.

**Reason (R):** The tangent at any point of a circle is perpendicular to the radius through the point of contact.

(Re)

Sol.



We have,  $AO = 5$  cm,  $OC = 4$  cm

and  $OC \perp AC$  (By theorem 1)

$$\therefore AC^2 = AO^2 - OC^2$$

$$= 5^2 - 4^2 = 25 - 16 = 9 \Rightarrow AC = 3$$

Also, in  $C_2$ , as the line passing through the centre and  $\perp$  to a chord, bisects the chord.

$$\therefore \text{Length of the required chord} = AB = 2 \times AC = 2 \times 3 = 6 \text{ cm}$$

So, assertion is False.

Reason is true by theorem 1.

Thus, assertion is false and reason is true.



### Key Takeaways

Apply the Pythagoras as theorem and properties of right triangles in problems involving tangent-secant or secant-secant intersections.

### Answer Key

(p) 3 (v) 2 (v) 1

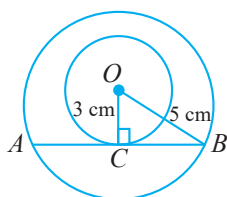
### Subjective Questions

#### Very Short Answer Type Questions

(1 or 2 M)

1. Two concentric circles are of radii 5 cm and 3 cm. Find the length of the chord of larger circle which touches the smaller circle. (Ev) (CBSE, 2020)

Sol.



In  $\triangle OCB$

$$BC = \sqrt{5^2 - 3^2} = 4 \text{ cm}$$

$$AB = 2 \times BC = 8 \text{ cm}$$

(½ M)

(1 M)

(½ M)

2. Two concentric circles are of radii 5 cm and 3 cm. Find the length of the chord of the larger circle which touches the smaller circle. (Cr)

Sol. Given: Two concentric circles are of radii 5 cm and 3 cm.

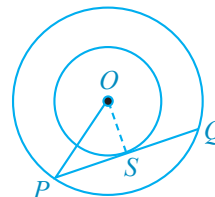
To find: The length of the chord of the larger circle which touches the smaller circle.

$PQ$  is chord of a larger circle and tangent of a smaller circle.

As, tangent is perpendicular to the radius at the point of contact  $S$ .

$$\therefore \angle OSP = 90^\circ$$

(½ M)



In  $\triangle OSP$  (Right angled triangle) using Pythagoras Theorem, we get

$$OP^2 = OS^2 + SP^2 \Rightarrow 5^2 = 3^2 + SP^2$$

(½ M)

$$\Rightarrow SP^2 = 25 - 9 = 16 \Rightarrow SP = \pm 4$$

$SP$  is length of tangent and cannot be negative

$$\therefore SP = 4 \text{ cm.}$$

(½ M)

$QS = SP$  (Perpendicular from center bisects the chord considering the larger circles)

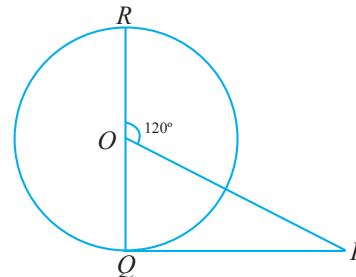
Therefore,  $QS = SP = 4$  cm

Length of the chord,  $PQ = QS + SP = 4 + 4 = 8$  cm

Therefore, the length of the chord of the larger circle is 8 cm.

(½ M)

3.  $PQ$  is a tangent drawn from an external point  $P$  to a circle with centre  $O$  and  $QOR$  is the diameter of the circle. If  $\angle POR = 120^\circ$ , What is the measure of  $\angle OPQ$ ? (An)



Sol.  $\therefore OQ \perp QP$

(By Theorem 1)

So,  $\angle OQP = 90^\circ$

Also,

$$\therefore \angle ROP + \angle QOP = 180^\circ$$

(Supplementary angles)

$$\Rightarrow 120^\circ + \angle QOP = 180^\circ$$

$$\Rightarrow \angle QOP = 180^\circ - 120^\circ = 60^\circ$$

(1 M)

$\therefore$  In  $\triangle OQP$ ,

$$\angle QOP + \angle OQP + \angle OPQ = 180^\circ$$

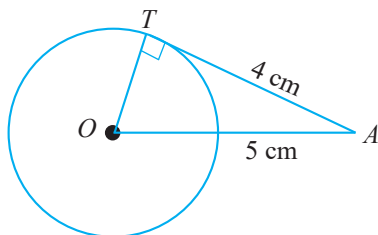
$$\Rightarrow 60^\circ + 90^\circ + \angle OPQ = 180^\circ$$

$$\Rightarrow \angle OPQ = 180^\circ - 60^\circ - 90^\circ = 30^\circ$$

(1 M)

4. The length of a tangent from a point A at distance 5 cm from the centre of the circle is 4 cm. Find the radius of the circle. (Ev) (CBSE SQP, 2023)

Sol.



In  $\triangle OTA$ ,  $\angle OTA = 90^\circ$

By Pythagoras theorem

$$\Rightarrow OA^2 = OT^2 + AT^2$$

$$\Rightarrow (5)^2 = OT^2 + (4)^2$$

$$\Rightarrow 25 - 16 = OT^2$$

$$\Rightarrow 9 = OT^2$$

$$\Rightarrow OT = 3 \text{ cm}$$

$$\Rightarrow \text{Radius of circle} = 3 \text{ cm}$$

(½ M)

(½ M)

(½ M)

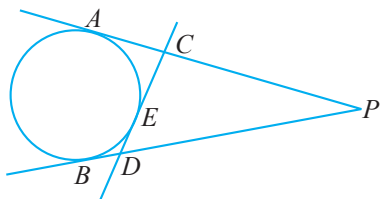
(½ M)

### Short Answer Type Questions

(2 or 3 M)

1. From an external point P, two tangents, PA and PB are drawn to a circle with centre O. At a point E on the circle, a tangent is drawn to intersect PA and PB at C and D, respectively. If PA = 10 cm, find the perimeter of  $\triangle PCD$ .

(Ap)



Sol.  $PA = PB$ ;  $CA = CE$ ;  $DE = DB$  [Tangents to a circle]

(½ M)

$$\text{Perimeter of } \triangle PCD = PC + CD + PD$$

$$= PC + CE + ED + PD = PC + CA + BD + PD$$

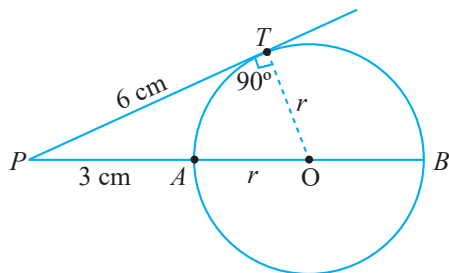
$$= PA + PB$$

(1 M)

$$\text{Perimeter of } \triangle PCD = PA + PA = 2PA = 2(10) = 20 \text{ cm}$$

(½ M)

2. In the figure, O is the centre of the circle and PT is the tangent drawn from the point P to the circle. Secant PAB passes through the centre O of the circle. If PT = 6 cm and PA = 3 cm, then find the radius of the circle. (Cr)



Sol. In the figure AB is diameter of the circle and  $OA = r$  (radius of the circle)

Join OT.

$$\therefore \angle OTP = 90^\circ.$$

[ $\because$  Radius is  $\perp$  to tangent at the point of contact] (½ M)

In right angled  $\triangle OTP$ ,  $OP = OA + PA = (r + 3)$  cm (½ M)

By Pythagoras theorem,

$$OP^2 = OT^2 + PT^2 \Rightarrow (r + 3)^2 = r^2 + (6)^2$$

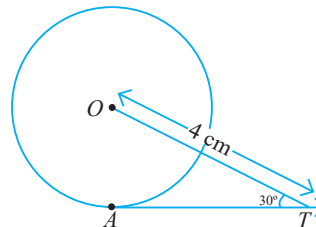
(½ M)

$$\Rightarrow r^2 + 6r + 9 = r^2 + 36 \Rightarrow 6r = 27 \Rightarrow r = \frac{9}{2} = 4.5$$

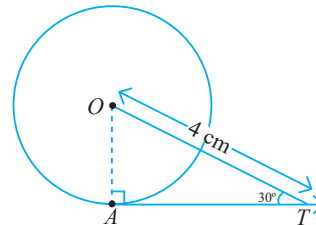
Hence, the radius of the circle = 4.5 cm.

(½ M)

3. In the given figure, AT is a tangent to the circle with centre 'O' such that  $OT = 4$  cm and  $\angle OTA = 30^\circ$ . Find AT. (Un)



Sol. Join OA.



(½ M)

$$\therefore OA \perp AT$$

[Radius is  $\perp$  to tangent at the point of contact]

(½ M)

$$\Rightarrow \angle OAT = 90^\circ$$

$$\text{Now, in } \triangle OAT, \cos 30^\circ = \frac{AT}{OT}$$

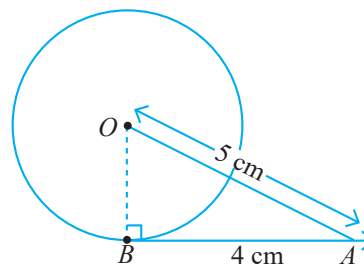
(½ M)

$$\Rightarrow AT = \cos 30^\circ \times OT = \frac{\sqrt{3}}{2} \times 4 = 2\sqrt{3} \text{ cm}$$

(½ M)

4. The length of a tangent from a point A at distance 5 cm from the centre of the circle is 4 cm. Find the radius of the circle. (An) (NCERT Intext)

Sol.  $\because$  Radius, OB, is  $\perp$  to the tangent, BA, at the point of contact B.



(½ M)

$$\text{So, } \angle OBA = 90^\circ$$

(½ M)

Now, by Pythagoras Theorem,

$$OB = \sqrt{OA^2 - BA^2}$$

(½ M)

$$= \sqrt{5^2 - 4^2} = \sqrt{25 - 16} = \sqrt{9} = 3$$

$$\therefore \text{Radius, } OB = 3 \text{ cm}$$

(½ M)



5. Two tangents  $PQ$  and  $PR$  are drawn from an external point to a circle with centre  $O$ . Prove that  $QORP$  is a cyclic quadrilateral. (Cr) (NCERT Exemplar)

**Sol.** Since, Radius  $\perp$  Tangent

So,  $OR \perp PR$

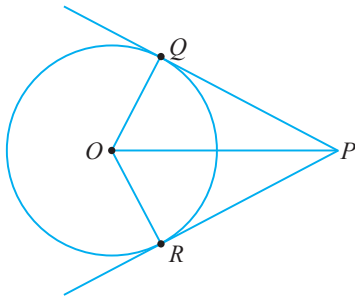
Therefore,  $\angle ORP = 90^\circ$  ( $\frac{1}{2}$  M)

Similarly,

Since, Radius  $\perp$  Tangent

So,  $OQ \perp PQ$

Therefore,  $\angle OQP = 90^\circ$  ( $\frac{1}{2}$  M)



Now, in quadrilateral  $ORPQ$ ,

Sum of all interior angles =  $360^\circ$

$\angle ORP + \angle RPQ + \angle PQO + \angle QOR = 360^\circ$  (1 M)

$\Rightarrow 90^\circ + \angle RPQ + 90^\circ + \angle QOR = 360^\circ$

So,  $\angle QOR + \angle RPQ = 180^\circ$  ( $\frac{1}{2}$  M)

Since sum of opposite angles in the quadrilateral is  $180^\circ$

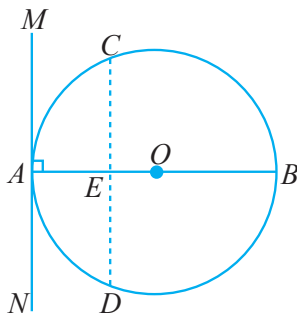
So,  $PROQ$  is a cyclic quadrilateral. ( $\frac{1}{2}$  M)

6. Prove that a diameter  $AB$  of a circle bisects all those chords which are parallel to the tangent at the point  $A$ .

(An) (NCERT Exemplar)

**Sol.** Let  $AB$  be the a diameter of the circle.

Draw a tangent  $MN$  at point  $A$ .



Draw a chord  $CD$  parallel to the tangent  $MN$ .

Therefore,  $CD$  is a chord of the circle and  $OA$  is radius of the circle. (1 M)

Now,

$\angle MAO = 90^\circ$  [Since tangent at any point of a circle is perpendicular to the radius through the point of contact]

( $\frac{1}{2}$  M)

Also,  $\angle CEO = \angle MAO$  [Corresponding angles]

Therefore,  $\angle CEO = 90^\circ$  ( $\frac{1}{2}$  M)

Since, a perpendicular line drawn through the centre of the circle to a chord bisects the chord.

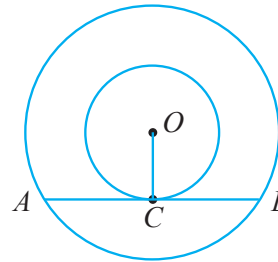
So,  $OE$  bisects  $CD$  or  $AB$  bisects  $CD$ .

Hence, diameter  $AB$  bisects all chords which are parallel to the tangent at the point  $A$ . (1 M)

7. Prove that in two concentric circles, the chord of the larger circle, which touches the smaller circle, is bisected at the point of contact. (Re)

**Sol. Given:** Two concentric circles with centre  $O$  and let  $AB$  is a chord of the larger circle touching the smaller circle at  $C$ .

**To Prove:**  $AC = BC$ .



(1 M)

**Construction:** Join  $OC$ .

**Proof:**  $AB$  is a tangent to the smaller circle at the point  $C$  and  $OC$  is the radius through the point of contact  $C$ .

$\therefore OC \perp AB$ . (1 M)

But, the perpendicular drawn from the centre of a circle to a chord bisects the chord and  $AB$  is the chord of the larger circle.

So,  $OC$  bisects  $AB$  ( $\frac{1}{2}$  M)

Hence,  $AC = BC$ . ( $\frac{1}{2}$  M)

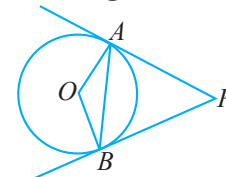


### Key Takeaways

In two concentric circles, the chord of the larger circle that touches the smaller circle is bisected at the point of contact.

8.  $PA$  and  $PB$  are tangents drawn to a circle of centre  $O$  from an external point  $P$ . Chord  $AB$  makes an angle of  $30^\circ$  with the radius at the point of contact.

If length of the chord is 6 cm, find the length of the tangent  $PA$  and the length of the radius  $OA$ . (Un)



**Sol.**  $\angle OAB = 30^\circ$

$\angle OAP = 90^\circ$  [Angle between the tangent and the radius at the point of contact]

$\angle PAB = 90^\circ - 30^\circ = 60^\circ$  ( $\frac{1}{2}$  M)

$AP = BP$  [Tangents to a circle from an external point]

$\angle PAB = \angle PBA$  [Angles opposite to equal sides of a triangle] ( $\frac{1}{2}$  M)

In  $\triangle ABP$ ,  $\angle PAB + \angle PBA + \angle APB = 180^\circ$  [Angle Sum Property]

$$60^\circ + 60^\circ + \angle APB = 180^\circ$$

$$\angle APB = 60^\circ \quad (\frac{1}{2} M)$$

$\therefore \triangle ABP$  is an equilateral triangle, where  $AP = BP = AB$ .

$$PA = 6 \text{ cm} \quad (\frac{1}{2} M)$$

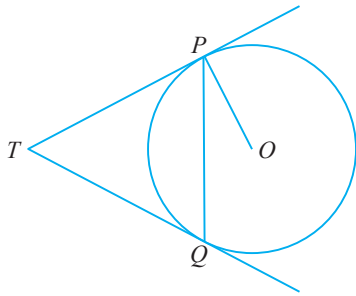
In Right  $\triangle OAP$ ,  $\angle OPA = 30^\circ$

$$\tan 30^\circ = \frac{OA}{PA}$$

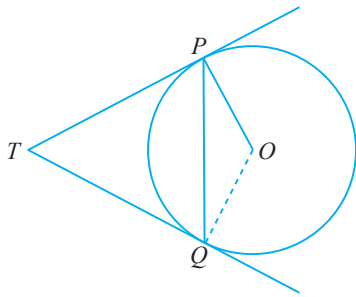
$$\frac{1}{\sqrt{3}} = \frac{OA}{6} \quad (\frac{1}{2} M)$$

$$OA = \frac{6}{\sqrt{3}} = 2\sqrt{3} \text{ cm} \quad (\frac{1}{2} M)$$

9. In the figure, two tangents  $TP$  and  $TQ$  are drawn to a circle with centre  $O$  from an external point  $T$ . Prove that  $\angle PTQ = 2 \angle OPQ$ . (Cr)



**Sol.** Join  $OQ$ .



In  $\triangle POQ$ ,

$$\angle POQ + \angle OQP + \angle OPQ = 180^\circ$$

[Sum of all angles of triangle =  $180^\circ$ ]

$$\therefore PO = QO \quad [\text{Radii of circle}]$$

$$\Rightarrow \angle OPQ = \angle OQP \quad (\frac{1}{2} M)$$

$$\therefore \angle POQ + 2\angle OPQ = 180^\circ \quad \dots (i) \quad (\frac{1}{2} M)$$

In quadrilateral,  $TPOQ$

$$\angle PTQ + \angle TQO + \angle QOP + 2\angle OPQ + \angle TPO = 360^\circ \quad \dots (ii)$$

(Using Angle sum property)

$$TP \perp OP \text{ \& } TQ \perp OQ \quad [\because \text{Tangent} \perp \text{Radius}] \quad (\frac{1}{2} M)$$

$$\Rightarrow \angle TPO = \angle TQO = 90^\circ$$

$\therefore$  from (ii)

$$\angle PTQ + \angle QOP = 360^\circ - 90^\circ - 90^\circ = 180^\circ \quad \dots (iii) \quad (\frac{1}{2} M)$$

From (i) and (iii)

$$\angle PTQ + \angle POQ = \angle POQ + 2\angle OPQ$$

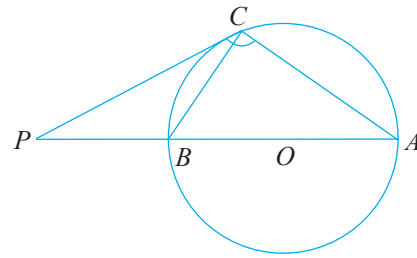
$$\Rightarrow \angle PTQ = 2\angle OPQ \quad (1 M)$$

Hence, proved

## Long Answer Type Questions

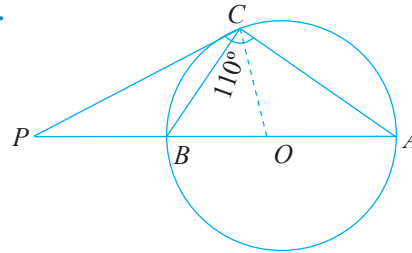
(4 or 5 M)

1. The tangent at a point  $C$  of a circle and a diameter  $AB$  when extended intersect at  $P$ . If  $\angle PCA = 110^\circ$ , find  $\angle CBA$



[Hint: Join  $C$  with centre  $O$ .] (Cr) (NCERT Exemplar))

**Sol.**



Join  $C$  with centre  $O$ . ( $\frac{1}{2} M$ )

In this,  $OC$  is the radius.

Since the tangent at any point of a circle is perpendicular to the radius through the point of contact.

Therefore,  $OC$  perpendicular to  $PC$

$$\Rightarrow \angle PCO = 90^\circ \quad (\frac{1}{2} M)$$

$$\text{Now, } \angle PCA = 110^\circ \quad [\text{Given}]$$

$$\Rightarrow \angle PCO + \angle OCA = 110^\circ \quad (\frac{1}{2} M)$$

$$\Rightarrow 90^\circ + \angle OCA = 110^\circ \quad (\frac{1}{2} M)$$

$$\Rightarrow \angle OCA = 20^\circ \quad (\frac{1}{2} M)$$

$$\text{Also, } OC = OA \quad [\text{Radii of the circle}]$$

$$\text{Therefore, } \angle OCA = \angle OAC = 20^\circ \quad (\frac{1}{2} M)$$

[angles opposite to equal sides are equal]

Now, since the angle in a semicircle is  $90^\circ$ .

$$\text{So, } \angle BCA = 90^\circ \quad (\frac{1}{2} M)$$

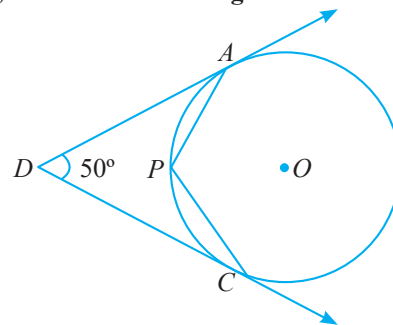
In  $\triangle BCA$ ,

$$\angle BCA + \angle CAB + \angle CBA = 180^\circ \quad (\frac{1}{2} M)$$

$$\Rightarrow 90^\circ + 20^\circ + \angle CBA = 180^\circ \quad [\text{Since, } \angle OAC = \angle CAB] \quad (\frac{1}{2} M)$$

$$\Rightarrow \angle CBA = 180^\circ - 110^\circ = 70^\circ \quad (\frac{1}{2} M)$$

2. In the given figure,  $O$  is the center of the circle. Determine  $\angle APC$ , if  $DA$  and  $DC$  are tangents and  $\angle ADC = 50^\circ$ . (Re)



**Sol.** Join  $OA$  and  $OC$ .

Since, the tangent drawn to a circle is perpendicular to the radius at the point of contact.

# MOCK TEST PAPER-2

**Time allowed : 3 hours**

**Maximum Marks : 80**

### GENERAL INSTRUCTIONS:

***Read the following instructions very carefully and follow them:***

- (i) This question paper contains **38** questions. **All** questions are compulsory.
- (ii) Question Paper is divided into 5 Sections-**Section A, B, C, D and E.**
- (iii) In **Section A** question number **1 to 18** are Multiple Choice Questions (**MCQs**) and question number **19 & 20** are Assertion-Reason based questions of **1 mark each.**
- (iv) In **Section-B** question number **21 to 25** are Very Short Answer (**VSA**) type questions of **2 marks each.**
- (v) In **Section-C** question number **26 to 31** are Short Answer (**SA**) type questions carrying **3 marks each.**
- (vi) In **Section-D** question number **32 to 35** are Long Answer (**LA**) type questions carrying **5 marks each.**
- (vii) In **Section-E** question number **36 to 38** are Case Study based questions carrying **4 marks each. Internal choice is provided in 2 marks question in each case-study.**
- (viii) **There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.**
- (ix) **Draw neat figures wherever required. Take  $\pi = 22/7$  wherever required if not stated.**
- (x) **Use of calculators is NOT allowed.**

## SECTION - A

**Section - A consists of Multiple Choice type questions of 1 mark each.**

1. The HCF and the LCM of 12, 21, 15 respectively are  
(a) 3, 140 (b) 12, 420 (c) 3, 420 (d) 420, 3
2. If  $p - 1$ ,  $p + 1$  and  $2p + 3$  are in A.P., then the value of  $p$  is  
(a)  $-2$  (b)  $4$  (c)  $0$  (d)  $2$
3. If  $\alpha$ ,  $\beta$  are zeroes of a polynomial  $p(x) = 2x^2 - x - 1$  then  $\alpha^2 + \beta^2$  is equal to  
(a)  $-\frac{3}{4}$  (b)  $\frac{5}{4}$  (c)  $\frac{1}{4}$  (d)  $\frac{3}{4}$
4. The distance between the points  $(0, 2\sqrt{5})$  and  $(-2\sqrt{5}, 0)$  is  
(a)  $2\sqrt{10}$  units (b)  $4\sqrt{10}$  units (c)  $2\sqrt{20}$  units (d)  $0$
5.  $A(5, 1)$ ,  $B(1, 5)$  and  $C(-3, -1)$  are the vertices of  $\triangle ABC$ . Then the length of median  $AD$  is  
(a)  $\sqrt{37}$  units (b)  $\sqrt{17}$  units (c)  $\sqrt{45}$  units (d)  $\sqrt{27}$  units

## SECTION - B

**Section - B consists of Very Short Answer (VSA) type questions of 2 marks each.**

21. If the HCF of 408 and 1032 is expressible in the form  $1032 \times 2 + 408 \times p$ , then find the value of  $p$ .
22. (a) The area of the base of a right circular cylinder is  $154 \text{ cm}^2$  and its height is 15 cm. Find the C.S.A of the cylinder.

**OR**

- (b) Find the height of a cylinder whose radius is 7 cm and the total surface area is  $968 \text{ cm}^2$ .
23.  $E$  is a point on the side  $AD$  produced of a parallelogram  $ABCD$  and  $BE$  intersects  $CD$  at  $F$ . Show that  $\triangle ABE \sim \triangle CFB$ .
24. (a) If  $\sin\theta + \sin^2\theta = 1$ , then prove that  $\cos^2\theta + \cos^4\theta = 1$

**OR**

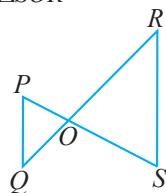
- (b) If  $\sin\alpha = \frac{1}{\sqrt{2}}$  and  $\cot\beta = \sqrt{3}$ , then find the value of  $\operatorname{cosec}\alpha + \operatorname{cosec}\beta$ .
25. Find the mode of the following distribution:

| Marks              | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 |
|--------------------|------|-------|-------|-------|-------|-------|
| Number of Students | 4    | 6     | 7     | 12    | 5     | 6     |

## SECTION - C

**Section - C consists of Short Answer (SA) type questions of 3 marks each.**

26. Prove that  $\sqrt{3}$  is an irrational number.
27. Solve  $2x + 3y = 11$  and  $2x - 4y = -24$  and hence find the value of ' $m$ ' for which  $y = mx + 3$ .
28. Find the roots of the quadratic equation  $\sqrt{2}x^2 + 7x + 5\sqrt{2} = 0$ , by factorisation method.
29. Find the ratio in which the y-axis divides the line segment joining the points  $(6, -4)$  and  $(-2, -7)$ . Also find the point of intersection.
30. (a) In the figure, if  $PQ \parallel RS$ , prove that  $\triangle POQ \sim \triangle SOR$



**OR**

- (b) From an external point  $P$ , tangents  $PA$  and  $PB$  are drawn to a circle with centre  $O$ . If  $\angle PAB = 50^\circ$ , then find  $\angle AOB$ .
31. (a) Prove that  $\frac{\tan\theta + \sec\theta - 1}{\tan\theta - \sec\theta + 1} = \frac{1 + \sin\theta}{\cos\theta}$

**OR**

- (b) Prove that  $(\operatorname{cosec}A - \sin A)(\sec A - \cos A) = \frac{1}{\cot A + \tan A}$

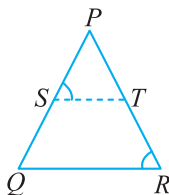
## SECTION - D

**Section - D consists of Long Answer (LA) type questions of 5 Marks each.**

32. The sum of four consecutive numbers in an A.P is 32 and the ratio of the product of the first and the last term to the product of two middle terms is  $7 : 15$ . Find the numbers.
33. Two taps running together can fill a tank in  $3\frac{1}{13}$  hours. If one tap takes 3 hours more than the other to fill the tank, then how much time will each tap take to fill the tank?
34. (a) If a line is drawn parallel to one side of a triangle to intersect the other two sides at distinct points, prove that the other two sides are divided in the same ratio.

**OR**

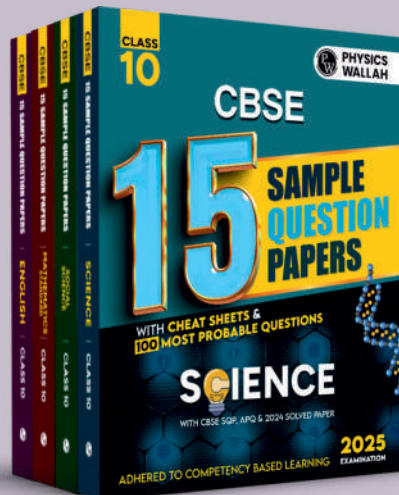
- (b) In the given figure,  $\frac{PS}{SQ} = \frac{PT}{TR}$  and  $\angle PST = \angle PRQ$ . Prove that  $PQR$  is an isosceles triangle.



# Other Helpful Books



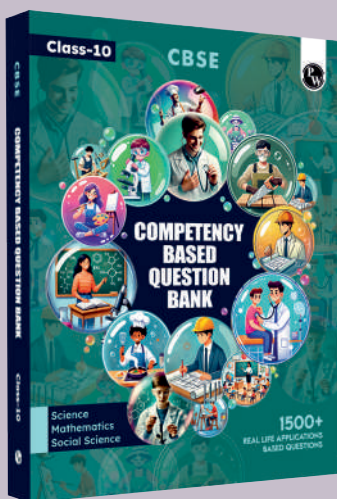
**CBSE QUESTION  
& CONCEPT BANK**



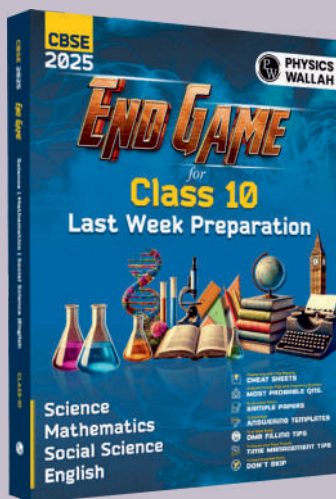
**CBSE 15 SAMPLE  
QUESTION PAPERS**



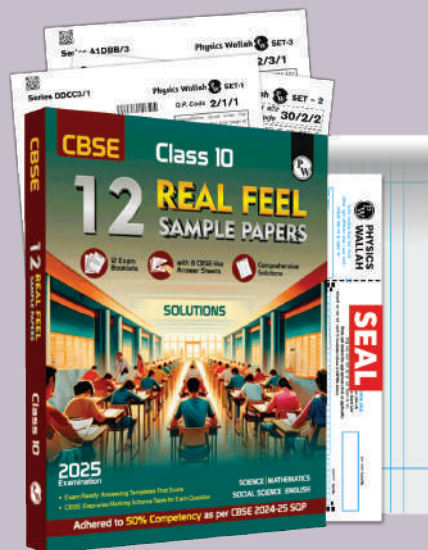
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