2026 EXAMINATION

CBSE QUESTION & CONCEPT BANK

Chapter-wise & Topic-wise

with 50% Competency Questions

CLASS 10

- Chapter-wise with PYQs Tagging
  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
STANDARD

Chapter-wise Weightage and Trend Analysis of

CBSE Past 6 Years' Papers

MATHEMATICS										
CHAPTERS	2020		2022		2023		2024		2025	
	DL	ODL	DL	ODL	DL	ODL	DL	ODL	DL	ODL
Real Numbers	6	6	–	–	6	6	6	6	6	6
Polynomials	8	3	–	–	4	3	3	5	4	2
Pair of Linear Equations in Two Variables	4	8	–	–	5	4	6	6	6	6
Quadratic Equations	3	7	6	5	6	5	5	4	6	7
Arithmetic Progressions	8	5	4	5	5	6	6	5	4	5
Triangles	7	7	–	–	7	7	7	8	9	8
Coordinate Geometry	6	6	–	–	6	8	6	6	6	6
Introduction to Trigonometry	5	7	–	–	6	6	7	7	7	7
Some Applications of Trigonometry	7	5	7	7	6	6	5	5	5	5
Circles	4	4	6	6	8	8	8	7	6	7
Constructions (*Rationalised*)	4	4	3	3	–	–	–	–	–	–
Areas Related to Circles	2	5	–	–	5	4	5	–	4	4
Surface Areas and Volumes	8	9	6	6	5	6	5	10	6	6
Statistics	7	7	8	8	6	5	6	5	7	5
Probability	4	4	–	–	5	6	5	6	4	6

**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. Here, DL is Delhi, ODL is Outside Delhi.*

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

Question Typology

YEAR	Objective Questions		Subjective Questions			
	MCQs	**A/R**	**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 (Term-II)			6	3	2	2
2022 (Term-I)	40					2
2021	Exam Not Conducted					

Evolving Trends in CBSE Exam Patterns

2021

- Exam Not Conducted

2022

Term I

- Rationalized Syllabus Onwards.
- Term I is totally MCQ based without negative marking
- Choice among the 10 questions was given only this year.

Term II

- Question paper contains 14 questions
- Term II is descriptive paper which contains very short question (2 marks), short questions (3 marks), long questions (4 marks), and two case studies with 10 MCQ
- Internal choice has given in section A.B and C.

2023

- Rationalised Content Onwards
- Assertion/Reason questions are introduced from this year onwards.
- 3 case based questions with internal choices are added.
- The number of sections in the paper increased to 5 sections (A, B, C, D and E) compared to 2022
- Competency based questions are increased in number.
- Internal choice has given in section B,C,D and E
- MCQ (1 Mark), VSA (2 Marks), SA (3 Marks), LA (5 Marks), Case-Based (4 Marks) 2023 onwards,

2024

- No changes in exam pattern

2025

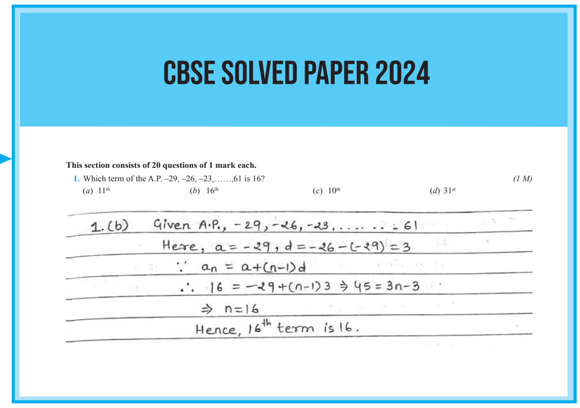
- 50% of the marks were allocated to competency-based questions, while the rest of the exam pattern remained unchanged.

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, 2024 & 2023 with Handwritten Answers: *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 2024

This section consists of 20 questions of 1 mark each.

1. Which term of the A.P. –29, –26, –23,…….,61 is 16? (1 M)

(a) 11th (b) 16th (c) 10th (d) 31st

1. (b) Given A.P., –29, –26, –23, ……, 61

Here, a = –29, d = –26 – (–29) = 3

∵ an = a + (n–1)d

∴ 16 = –29 + (n–1)3 ⇒ 45 = 3n – 3

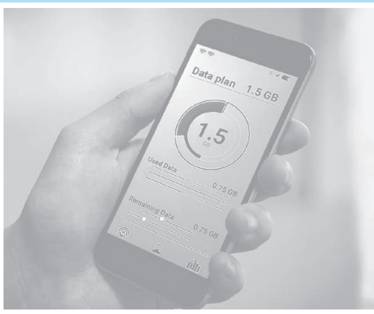
⇒ n = 16

Hence, 16th term is 16.

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.

Preview



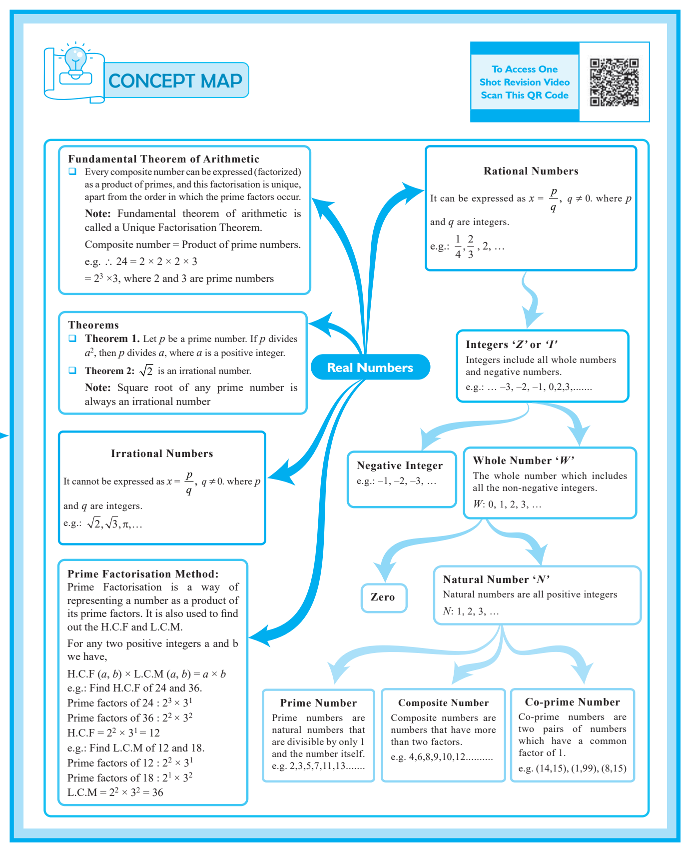
"Smartphone uses real numbers to calculate the amount of data you have used. If your data plan includes 1.5 GB of data per day, and you've used 0.75 GB, the phone calculates the remaining data using subtraction in the set of real numbers."

SYLLABUS & WEIGHTAGE

List of Concept Names	Years				
	2020	2021	2022	2023	2024
Fundamental Theorem of Arithmetic (Fundamental Theorem of Arithmetic - statements after reviewing work done earlier and after illustrating and motivating through examples)	1 Q (1 M)	Exam not Conducted	–	1 Q (1 M) 1 Q (2 M) 1 Q (3 M)	1 Q (1 M) 1 Q (2 M)
Irrational Numbers (Proofs of irrationality of $\sqrt{2}, \sqrt{3}, \sqrt{5}$)	1 Q (4 M)		–	1 Q (3 M)	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.



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:** $p(x) = a_n x^n + a_{(n-1)} x^{(n-1)} + a_{(n-2)} x^{(n-2)} + \ldots + a_1 x^1 + a_0$. (where n is a whole number and $a_0, a_1, a_2, \ldots, a_n$ 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.,* $2x^2 - 3$, $x^2 + \sqrt{3}\ x + 5$, $\frac{y}{5} + y^2 - \sqrt{2}$, 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 Zeroes of a Polynomial:**

  (*i*) The linear polynomial $ax + b$, $a \neq 0$, has exactly one zero, namely, $\left(-\frac{b}{a}, 0\right)$.

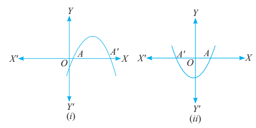
  (*ii*) The zeroes of a quadratic polynomial $ax^2 + bx + c$, $a \neq 0$, are precisely the x-coordinates of the points where the parabola $(ax^2 + bx + c)$ representing $y = ax^2 + bx + c$ intersects the x-axis.

  Equation $y = ax^2 + bx + c$ has one of the two shapes either open upwards like ∪ or open downwards like ∩ 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. *i* & *ii*)



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:

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.

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:

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

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

  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 $p^1, p^2, \ldots, p^n$. So p is one of $p^1, p^2, \ldots, p^n$.

  Now, since $a = p^1, p^2, \ldots p^n$.

  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 = πr^2
- Curved surface area (C.S.A) of the cylinder = (circumference of circle × 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 = πrl
- Total surface area (T.S.A) of cone = $\pi r(r + l) = \pi r(r + \sqrt{(h^2 + r^2)})$

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 $\Rightarrow 44 \div 2 = 22$

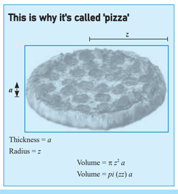
22 is divisible by 2. So, divide it again by 2 $\Rightarrow 22 \div 2 = 11$

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



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. **Which of the following is not irrational?** *(Un)*
   (a) $(2-\sqrt{3})^2$ (b) $(\sqrt{2}+\sqrt{3})^2$
   (c) $(\sqrt{2}-\sqrt{3})(\sqrt{2}+\sqrt{3})$ (d) $\frac{2\sqrt{7}}{7}$

Sol. $(\sqrt{2}-\sqrt{3})(\sqrt{2}+\sqrt{3})$
$= (\sqrt{2})^2 - (\sqrt{3})^2$
$= 2 - 3 = -1$ $[\because (a-b)(a+b) = a^2 - b^2]$

Mistakes 101 : What not to do!
Students often make mistakes when applying basic formulas. Take your time, understand the concepts, and practice to improve accuracy.

2. **The product of a non-zero rational and an irrational number is** *(Re)* (NCERT Exemplar)
   (a) always irrational (b) always rational
   (c) rational or irrational (d) one

Sol. Let r be a rational number, and i be an irrational number.
We'll choose $r = \frac{2}{3}$ and $i = \sqrt{2}$ for this example.
Now, the product of r and i is $\frac{2}{3}\cdot\sqrt{2}$ which is an irrational number.

3. **The sum of a rational and irrational number is:** *(An)*
   (a) Rational (b) Irrational
   (c) both of above (d) None of above

Sol. Let a be a rational number, and b be an irrational number.
We'll choose $a = \frac{1}{2}$ and $b = \sqrt{2}$ for this example.
Now, the sum of a and b is $\frac{1}{2}+\sqrt{2}$ which is an irrational number.

4. $\pi - \frac{22}{7}$ **is:** *(An)*
   (a) a rational number
   (b) a prime number
   (c) an irrational number
   (d) an even number

Sol. π is an irrational number because it cannot be written as $\frac{p}{q}$ form.
Irrational number – Rational number = Irrational number
This expression is a combination of a rational number $\left(\frac{22}{7}\right)$ and an irrational number (π).
Hence $\pi - \frac{22}{7}$ is an irrational number.

Nailing the Right Answer
Students should know that π is an irrational number because it cannot be expressed in the form of p/q.

Answer Key
1. (c) 2. (a) 3. (b) 4. (c)

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): There lies exactly one rational number between 2023 and 2024.**
   Reason (R): There are infinitely many rational- numbers between two rational numbers. *(An)*

Sol. There exists infinite rational numbers between two rational numbers. 2023 and 2024 are also rational numbers. Hence, There lies infinite rational numbers between 2023 and 2024. Assertion (A) is false, but reason (R) is true.

Answer Key
1. (d)

Subjective Questions

Very Short Answer Type Questions (1 or 2 M)

1. **Find a rational number between $\sqrt{2}$ and $\sqrt{3}$.** *(Ap)* (CBSE DL, 2019)

Sovled 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: (CBSE SQP, 2023)
   (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) $a = -5, b = -1$
4. The system $x + 2y = 3$ and $5x + ky + 7 = 0$ has no solution when
   (a) $k = 10$ (b) $k \neq 10$
   (c) $k = -73$ (d) $k = -21$
5. The pair of equations $x + 2y + 5 = 0$ and $-3x - 6y + 1 = 0$ have (CBSE SQP, 2023)
   (a) A unique solution
   (b) Exactly two solution
   (c) Infinitely many solution
   (d) No solution

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

HINTS & EXPLANATIONS

Multiple Choice Questions

1. (a) Given: $x - y = 2$ … (i)
   $x + y = 4$ … (ii)
   Adding eqn. (i) and (ii), we get $2x = 6 \Rightarrow x = 3$
   Put the value of x in equation (i), we get
   $3 - y = 2 \Rightarrow y = 1$
   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.

Answer Key

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.

MOCK TEST PAPER-1

Time allowed : 3 hours **Maximum Marks : 80**

GENERAL INSTRUCTIONS:

Read the following instructions carefully and 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 number **1** to **18** are multiple choice questions (MCQs) and question number **19** and **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 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 in **Section E**.*
(ix) *Draw neat figures wherever required. Take π = 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. Find the median of the following data:
   25, 34, 31, 23, 22, 26, 35, 28, 20, 24, 32, 33
   (a) 27 (b) 28 (c) 29 (d) 30
2. The mean of $x, x + 2, x + 4, x + 6$ and $x + 8$ is
   (a) $x + 6$ (b) $x + 4$ (c) $x + 8$ (d) None of these
3. If the probability of an event is P, then the probability of its complementary will be
   (a) $P - 1$ (b) P (c) $1-\frac{1}{P}$ (d) $1 - P$
4. If n is any natural number then $6n - 5n$ always ends with:
   (a) 1 (b) 3 (c) 5 (d) 7
5. A tangent QT of length 8 cm is drawn from a point Q, which is 10 cm away from the centre of a circle. Find the radius of the circle.
   (a) 5 cm (b) 6 cm (c) 7 cm (d) 8 cm

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.

Contents

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

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*) This question paper is divided into **five** Sections - **A**, **B**, **C**, **D** and **E**.

(*iii*) In **Section A**, Question numbers **1** to **18** are Multiple Choice Questions (MCQs) and question numbers **19** and **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, carrying **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 Study based** Questions carrying **4** marks each. Internal choice is provided in **2** marks questions 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 diagrams wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.

(*x*) Use of calculators is **NOT allowed**.

SECTION - A

(20 marks)

This section has *20* Multiple Choice Questions (MCQs) carrying 1 mark each. **20 × 1= 20**

1. The diameter of a wheel is 63 cm. The distance travelled by the wheel in 100 revolutions is: ***(Ap)* (*1 Mark*)**

(*a*) 99 m (*b*) 198 m (*c*) 63 m (*d*) 136 m

Ans. (b) Given diameter of the wheel = 163 cm

Radius of the wheel = $\frac{63}{2}$ cm

Number of revolution = 100

The distance covered in one complete revolution of the wheel is equal to the circumference of the circle.

Circumference $= 2\pi r = 2 \times \frac{22}{7} \times \frac{63}{2}$

$= 22 \times 9 = 198$ cm

Total Distance = circumference × Number of revolutions

$= 198 \times 100 = 19800$ cm

Since 1 m = 100 cm

We convert the distance into meters

$= \frac{19800}{100} = 198$ m.

2. The mean of seven observations is 17. If the mean of the first four observations is 15 and that of the last four observations is 18, then the fourth observation is: **(*An*) (*1 Mark*)**

(*a*) 14 (*b*) 13 (*c*) 12 (*d*) 10

Ans. (b) The mean of seven observation is given as 17, so the total sum of these observation is $17 \times 7 = 119$

The mean of the first four observation is 15, so their sum is $15 \times 4 = 60$

The mean of the last four observation is 18, so their sum is $18 \times 4 = 72$

Fourth observation = sum of first four + sum of last four − Total sum

$= 60 + 72 - 119 = 13$

3. The distance of the point (4,0) from x -axis is: **(*Un*) (*1 Mark*)**

(*a*) 4 units (*b*) 16 units (*c*) 0 units (*d*) $4\sqrt{2}$ units

Ans. (c) The distance of a point from the x-axis is given by the absolute value of its y-coordinate

Given point is (4, 0)

Here, the y-coordinate is 0, so the distance from the x-axis is: $|0| = 0$ unit.

4. If α and β are zeroes of the polynomial $p(x) = kx^2 - 30x + 45k$ and $\alpha + \beta = \alpha\beta$, then the value of '$k$' is : **(*Ap*) (*1 Mark*)**

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

Ans. (d). The given polynomial is $p(x) = kx^2 - 30x + 45k$ and given α and β are the zeroes of the polynomial.

$\therefore \alpha + \beta = -\frac{-30}{k} = \frac{30}{k}$

and $\alpha\beta = \frac{45k}{k} = 45$

It is given that $\alpha + \beta = \alpha\beta$

$\Rightarrow \frac{30}{k} = 45 \Rightarrow k = \frac{30}{45} = \frac{2}{3}$

7 COORDINATE GEOMETRY

"Coordinate Geometry is used in air traffic controllers. Air traffic controllers keep an eye on every plane in the sky by using coordinates, which are like points on a map. They keep updating these points as the planes move, so they always know exact location where each plane is."

SYLLABUS & WEIGHTAGE

List of Concept Names	Years				
	2021	2022	2023	2024	2025
Distance Formula (Concepts of coordinate geometry, graphs of linear equations)	Exam not Conducted	–	1 Q (1 M) 1 Q (2 M)	1 Q (1 M) 2 Q (2 M each)	1 Q (1 M)
Section Formula (Section formula (in division), Mid-point formula)		–	2 Q (1 M each) 1 Q (3 M)	1 Q (1 M) 1 Q (2 M)	2 Q (1 M each) 1 Q (3 M)

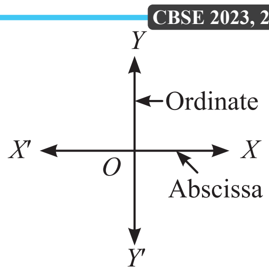
CONCEPT MAP

To Access One Shot Revision Video Scan This QR Code

Coordinate Geometry

Coordinate Axis

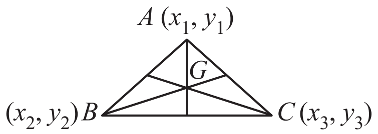
CBSE 2023, 2020



Horizontal = x-axis (Abscissa)

Vertical = y-axis (Ordinate)

Centroid



$$G = \left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_2}{3}\right)$$

Example: Determine the centroid of a triangle whose vertices are (5, 3), (6, 1) and (7, 8)

Sol. Given parameters are,

$(x_1, y_1) = (5, 3)$, $(x_2, y_2) = (6,1)$

and $(x_3, y_3) = (7, 8)$

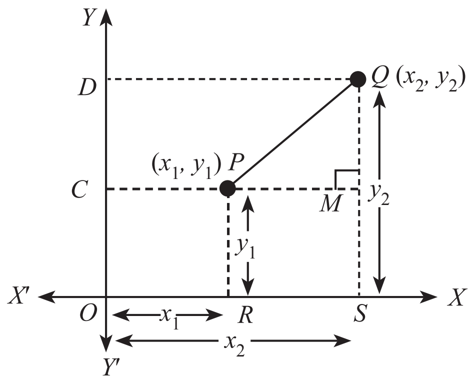
$$G = \left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_2}{3}\right)$$

$$G = \left(\frac{5+6+7}{3}, \frac{3+1+8}{3}\right)$$

$$G = \left(\frac{18}{3}, \frac{12}{3}\right) = (6,4)$$

Distance Formula

CBSE 2025, 2024, 2023, 2022 Term-I, 2020, 2019



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

Example: Find the distance between the point $P(-5,7)$ and $Q(-1,3)$.

Sol. We have,

Distance formula: $d = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

Given, $x_1 = -5, x_2 = -1, y_1 = 7, y_2 = 3$

So, $d = \sqrt{(-1-(-5))^2+(3-7)^2} = \sqrt{(4)^2+(-4)^2}$

$= \sqrt{16+16} = \sqrt{32} = 4\sqrt{2}$ units

Section Formula

CBSE 2025, 2024, 2023, 2022 Term-I, 2020, 2019

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 $\left(\frac{m_1x_2+m_2x_1}{m_1+m_2}, \frac{m_1y_2+m_2y_1}{m_1+m_2}\right)$.

Example: Find the coordinates of the point which divides the line joining of (–1, 7) and (4, –3) in the ratio 2 : 3.

Sol. Let $P(x, y)$ be the required point. Thus, we have

$$x = \frac{m_1x_2+m_2x_1}{m_1+m_2} \text{ and } y = \frac{m_1y_2+m_2y_1}{m_1+m_2}$$

Therefore,

$$x = \frac{2\times4+3\times(-1)}{2+3} = \frac{8-3}{5} = \frac{5}{5} = 1$$

$$y = \frac{2\times(-3)+3\times7}{2+3} = \frac{-6+21}{5} = \frac{15}{5} = 3$$

So, the coordinates of P are (1, 3).

Mid-point Line Segment

CBSE 2025, 2024, 2022 Term-I, 2020, 2019

The mid-point of the line segment joining the points $P(x_1, y_1)$ and $Q(x_2, y_2)$ is $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$.

Example: Find the coordinates of mid-point of the line segment joining (4, –1) and (–2, –3).

Sol. Let the given points be $P(4, -1)$ and $Q(-2, -3)$

Since, the mid-point of the line segment joining the points $P(4, -1)$ and $Q(-2, -3)$

$$= \left(\frac{4-2}{2}, \frac{-1-3}{2}\right) = \left(\frac{2}{2}, \frac{-4}{2}\right) = (1,-2)$$

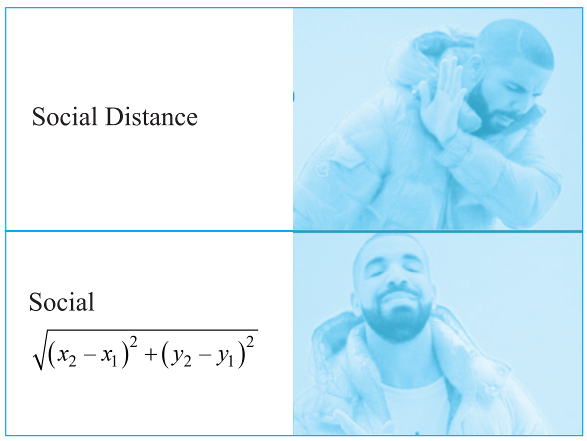
1 DISTANCE FORMULA

Important Terms

- **Coordinate geometry:** The location of any point on a plane is expressed by a pair of values (x, y) and these pairs are known as the coordinates.
- **Abscissa:** The distance of a point from the y-axis is called its x-coordinate or abscissa.
- **Ordinate:** The distance of a point from the x-axis is called its y-coordinate, or ordinate.
- **Origin:** The point at which the axes intersect is known as the origin and generally it is denoted by O.

Important Formulas

- **Distance Formula:** The distance between $P(x_1, y_1)$ and $Q(x_2, y_2)$ is $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.



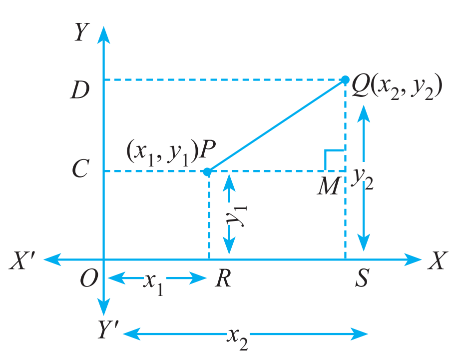
- **Distance from Origin:** The distance of a point $P(x,y)$ from origin is $\sqrt{x^2 + y^2}$.

Important Derivations

Distance Formula: The distance between two points (x_1, y_1) and (x_2, y_2) in a coordinate system is given by formula $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

This is known as the distance formula.

Proof: Let $P(x_1, y_1)$ and $Q(x_2, y_2)$ are the two points. Draw the line PR and QS perpendicular to the x-axis. A perpendicular is drawn from point P on QS to meet at the point M.



$\therefore$ $OR = x_1$, $OS = x_2$

$RS = x_2 - x_1 = PM$

$SQ = y_2$, $SM = PR = y_1$

$\therefore \quad QM = y_2 - y_1$

On applying the pythagoras theorem in ΔPMQ, we get

$$PQ^2 = PM^2 + QM^2$$

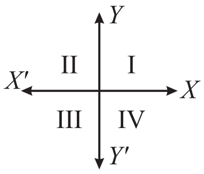
$$PQ2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

$$\Rightarrow \quad PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

[Since, distance can never be negative, only positive square root is taken.]

Important Concepts

Quadrants in Co-ordinate Geometry: A plane is divided into four parts known as quadrants by the axes of a two-dimensional Cartesian system. These quadrants are denoted by Roman Numerals (with the signs of the (x, y) coordinates).



Quadrant	*X*-coordinate	*Y*-coordinate
First quadrant	+	+
Second quadrant	–	+
Third quadrant	–	–
Fourth quadrant	+	–

❒ The coordinate of a point on the x-axis are of the form $(x, 0)$ and that of the point on y-axis are $(0, y)$

Real Life Applications

The Global Positioning System (GPS) is a space based satellite navigation system that provides information of location and time all weather conditions.

In a GPS, the longitude and the latitude of a place are its coordinates. The distance between 2 places in GPS is found using the distance formula.

Different Problem Types

Type I: Distance Between Two Given Points:

Find the distance between the points *P*(–6, 7) and *Q*(–1, –5)

Solution:

Step I: Find the differences between the x-coordinates and y-coordinates of the two points:

$$x_2 - x_1 = -1 - (-6) = 5, \; y_2 - y_1 = -5 - 7 = -12$$

Step II: Square the differences obtained in the previous step and add them together.

$$5^2 + (-12)^2 = 25 + 144 = 169$$

Step III: Take the square root of the sum calculated in the previous step to obtain the distance between the two points:

$$PQ = \sqrt{169} = 13$$

Example: Find the distance between the points A (0, 6) and B (0, –2).

Solution: We have,

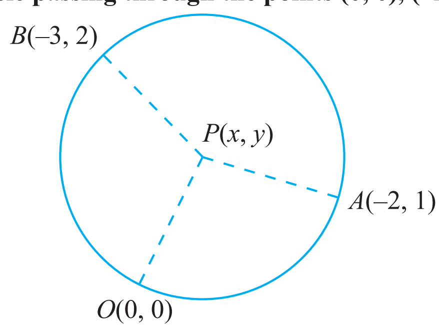
Distance formula: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Given, $x_1 = 0, x_2 = 0, y_1 = 6, y_2 = -2$

So, $d = \sqrt{(0-0)^2 + (-2-6)^2} = \sqrt{(0)^2 + (-8)^2} = \sqrt{64} = 8$ units

Type II: Applications of Distance Formula:

Find the coordinates of the center of the circle passing through the points (0, 0), (–2, 1) and (–3, 2). Also, find its radius.



Solution:

Step I: Let $P(x, y)$ be the centre of the circle passing through the points $O(0, 0)$, $A(-2, 1)$ and $B(-3, 2)$. Then, $OP = AP = BP$

Step II: Since, $OP = AP$

$\Rightarrow OP^2 = AP^2$

$\Rightarrow x^2 + y^2 = (x + 2)^2 + (y - 1)^2$

$\Rightarrow x^2 + y^2 = x^2 + y^2 + 4x - 2y + 5$

$\Rightarrow 4x - 2y + 5 = 0$ … (*i*)

Step III: Also, $OP = BP$

$\Rightarrow OP^2 = BP^2$

$\Rightarrow x^2 + y^2 = (x + 3)^2 + (y - 2)^2$

$\Rightarrow x^2 + y^2 = x^2 + y^2 + 6x - 4y + 13$

$\Rightarrow 6x - 4y + 13 = 0$ … (*ii*)

On solving equations (*i*) and (*ii*), we get: $x = \frac{3}{2}$ and $y = \frac{11}{2}$.

Thus, the coordinates of the Center are $\left(\frac{3}{2}, \frac{11}{2}\right)$

Step IV:

$\therefore$ Radius $= OP = \sqrt{x^2 + y^2} = \sqrt{\frac{9}{4} + \frac{121}{4}} = \frac{1}{2}\sqrt{130}$ units.

Example: Find a relation between x and y such that the point (x , y) is equidistant from the points (7, 1) and (3, 5). **(NCERT Intext)**

Solution:

Let $P(x, y)$ be equidistant from the points $A(7, 1)$ and $B(3, 5)$.

We are given that $AP = BP$. So, $AP^2 = BP^2$

i.e., $(x - 7)^2 + (y - 1)^2 = (x - 3)^2 + (y - 5)^2$

i.e., $x^2 - 14x + 49 + y^2 - 2y + 1 = x^2 - 6x + 9 + y^2 - 10y + 25$

i.e., $x - y = 2$

Which is the required relation.

COMPETENCY BASED SOLVED EXAMPLES

Multiple Choice Questionc

(1 M)

1. **The distance of the point (– 1, 7) from x-axis is:** **(*Ap*) (CBSE DL, 2023)**

(*a*) –1 (*b*) 7 (*c*) 6 (*d*) $\sqrt{50}$

Sol. The distance of any point from x-axis is the y-coordinate. Therefore, the distance of the point (–1, 7) from x-axis is 7.

2. **The distance of the point (–6, 8) from origin is:** **(*Ap*) (CBSE DL, 2023)**

(*a*) 6 (*b*) –6 (*c*) 8 (*d*) 10

Sol. From the distance formula, we have

Distance of point (–6, 8) from $O(0, 0)$

$= \sqrt{(8-0)^2+(-6-0)^2} = \sqrt{64+36}$

$= \sqrt{100} = 10$ unit

3. **Points $A(-1, y)$ and $B(5, 7)$ lie on a circle with centre $O(2, -3y)$. The values of y are** **(*An*)(CBSE Term-I, 2022)**

(*a*) 1, –7 (*b*) –1, 7 (*c*) 2, 7 (*d*) –2, –7

Sol. Since, A and B are equidistant from O [radii]

$\therefore AO = BO$

By distance formula

$\Rightarrow \sqrt{(-1-2)^2+(y-(-3y))^2} = \sqrt{(5-2)^2+(7-(-3y))^2}$

$\Rightarrow \sqrt{(-3)^2+(y+3y)^2} = \sqrt{(3)^2+(7+3y)^2}$

$\Rightarrow 9 + (4y)^2 = 9 + (7 + 3y)^2$ [squaring on both sides]

$\Rightarrow 16y^2 = 49 + 9y^2 + 42y$

$\Rightarrow 7y^2 - 42y - 49 = 0$

$\Rightarrow y(y-7) + 1(y-7) = 0 \Rightarrow (y+1)(y-7) = 0$

$\Rightarrow y + 1 = 0$ or $y - 7 = 0 \Rightarrow y = -1$ or $y = 7$

$\therefore$ The values of y are –1, 7

4. **The point P on x-axis equidistant from the points $A(-1, 0)$ and $B(5, 0)$ is** **(*An*)(CBSE ODL, 2020)**

(*a*) (2, 0) (*b*) (0, 2)

(*c*) (3, 0) (*d*) (2, 2)

Sol. The given points are $A(-1, 0)$ & $B(5, 0)$

Now, point P lies on x-axis, that means the y-coordinate is zero. i.e. $P(x, 0)$ given, let the point $P(x, 0)$ is equidistant from A and B

$\therefore$ According to question,

$PA = PB$.

$\Rightarrow \sqrt{(x+1)^2+(0-0)^2} = \sqrt{(x-5)^2+(0-0)^2}$

$\Rightarrow \sqrt{x^2+1+2x} = \sqrt{x^2+25-10x}$

$\Rightarrow x^2 + 1 + 2x = x^2 + 25 - 10x$ [squaring both sides]

$\Rightarrow 12x = 24 \Rightarrow x = 2$

$\therefore$ The point P is $P(2, 0)$

5. **If the distance between the points (3, –5) and (x, –5) is 15 units, then the values of x are:** **(*Ap*) (CBSE DL, 2024)**

(*a*) 12, –18 (*b*) –12, 18

(*c*) 18, 5 (*d*) –9, –12

Sol. Let $A = (3, -5)$ and $B = (x, -5)$

Given $AB = 15$

$\Rightarrow \sqrt{(x-3)^2+(-5+5)^2} = 15$

Squaring on both sides, we get

$\Rightarrow (x-3)^2 = 15^2 \Rightarrow x - 3 = \pm 15$

$\Rightarrow x - 3 = 15$ or $\Rightarrow x - 3 = -15$

$\Rightarrow x = 18$ or $\Rightarrow x = -15 + 3 = -12$

6. **The distance between the points (m, –n) and (–m, n) is** **(*Ap*) (CBSE, 2020)**

(*a*) $\sqrt{m^2+n^2}$ (*b*) $m + n$

(*c*) $2\sqrt{m^2+n^2}$ (*d*) $\sqrt{2m^2+2n^2}$

Sol. Given points are $(m, -n)$ and $(-m, n)$

Let, $x_1 = m$, $y_1 = -n$

$x_2 = -m$, $y_2 = n$

Distance between A and B

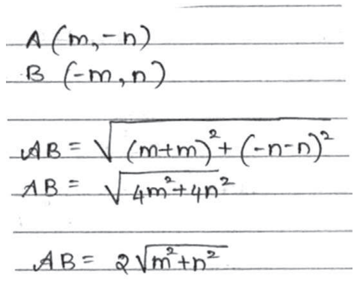
$AB = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$\Rightarrow AB = \sqrt{(-m-m)^2+(n-(-n))^2}$

$\Rightarrow AB = \sqrt{(-2m)^2+(2n)^2}$

$\Rightarrow AB = 2\sqrt{m^2+n^2}$

Topper's Explanation ***(CBSE 2020)***



Mistakes 101 : What not to do!

In this type of problem, students often mistakenly enter incorrect coordinates into the formula.

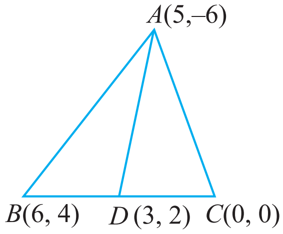
7. AD is a median of ΔABC with vertices $A(5, –6)$, $B(6, 4)$ and $C(0, 0)$. Length AD is equal to:

(*Ev*) (CBSE DL, 2024)

(*a*) $\sqrt{68}$ units (*b*) $2\sqrt{15}$ units

(*c*) $\sqrt{101}$ units (*d*) 10 units

Sol.



Given AD is a median of ΔABC

$\therefore D$ is a midpoint of BC

$$D \equiv \left(\frac{6+0}{2}, \frac{4+0}{2}\right) = (3, 2)$$

Now, length of AD can be obtained using distance formula

$$\therefore AD = \sqrt{(5-3)^2 + (-6-2)^2}$$

$$= \sqrt{2^2 + (-8)^2} = \sqrt{4+64} = \sqrt{68} \text{ units}$$

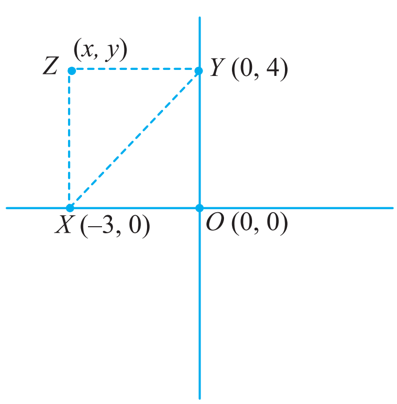
8. $XOYZ$ is a rectangle with vertices $X(–3, 0)$, $O(0, 0)$, $Y(0, 4)$ and $Z(x, y)$. The length of its each diagonal is

(*Ap*) (CBSE ODL, 2024)

(*a*) 5 units (*b*) $\sqrt{5}$ units

(*c*) $x^2 + y^2$ units (*d*) 4 units

Sol.



$$\text{Diagonal } (XY) = \sqrt{(0+3)^2 + (4-0)^2}$$

$$= \sqrt{9+16} = 5 \text{ units}$$

9. The points (–1, –2), (1, 0), (–1, 2), (–3, 0) form a quadrilateral of type: **(*An*)**

(*a*) Square (*b*) Rectangle

(*c*) Parallelogram (*d*) Rhombus

Sol. Let $A(–1, –2)$, $B(1, 0)$, $C(–1, 2)$ and $D(–3, 0)$

Distance between two points (x_1, y_1) and (x_2, y_2) can be calculated using the formula $\sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$

Distance between the points $A(–1, –2)$ and B (1, 0)

$$= \sqrt{(1+1)^2 + (0+2)^2} = \sqrt{8}$$

Distance between the points $B(1, 0)$ and C (–1, 2)

$$= \sqrt{(-1-1)^2 + (2-0)^2} = \sqrt{8}$$

Distance between the points $C(–1, 2)$ and $D(–3, 0)$

$$= \sqrt{(-3+1)^2 + (0-2)^2} = \sqrt{8}$$

Distance between the points $A(–1, –2)$ and D (–3, 0) =

$$\sqrt{(-3+1)^2 + (0+2)^2} = \sqrt{8}$$

Since, length of the sides between all vertices are equal, they are the vertices of a square.

10. The distance between the points ($a\cos\theta + b\sin\theta$, 0) and (0, $a\sin\theta - b\cos\theta$), is **(*Ap*)(CBSE DL, 2020)**

(*a*) $a^2 + b^2$ (*b*) $a^2 – b^2$

(*c*) $\sqrt{a^2+b^2}$ (*d*) $\sqrt{a^2-b^2}$

Sol. By distance formula

$$= \sqrt{(0-(a\cos\theta + b\sin\theta))^2 + (a\sin\theta - b\cos - 0)}$$

$$= \sqrt{a^2\cos^2\theta + b^2\sin^2\theta + 2ab\sin\theta\cos\theta + a^2\sin^2\theta + b^2\cos^2\theta - 2ab\sin\theta\cos\theta}$$

$$= \sqrt{a^2+b^2}$$

Nailing the Right Answer

Label intermediate steps in your calculation to keep track of each part of the process and ensure clarity in your solution.

11. The points (-4,0),(4,0),(0,3) are the vertices of a

(*An*)(NCERT Exemplar)

(*a*) right triangle (*b*) isosceles triangle

(*c*) equilateral triangle (*d*) scalene triangle

Sol. Let $A(–4, 0)$, $B(4, 0)$, $C(0, 3)$ are the given vertices.

So, distancse between $A(–4, 0)$ and $B(4, 0)$.

$AB^2 = (4 – (– 4))^2 + (0 – 0)^2 = 64$

$\Rightarrow AB = \sqrt{64} = 8$

Now, distance between $B(4, 0)$ and $C(0, 3)$,

$BC^2 = (0 – (4))^2 + (3 – 0)^2 = 25$

$\Rightarrow BC = \sqrt{25} = 5$

Now, distance between $A(–4, 0)$ and $C(0, 3)$

$AC^2 = (0 – (–4))^2 + (3 – 0)^2 = 25$

$\Rightarrow AC = \sqrt{25} = 5$

As, $BC = AC$

ΔABC is an isosceles triangle because an isosceles triangle has two sides equal.

Key Takeaways

Follow the properties of the given triangle to prove with the given coordinates.

12. If A (4, –2), B(7, –2) and C(7, 9) are the vertices of a ΔABC, then ΔABC is **(*Un*)(CBSE Term-I, 2022)**

(*a*) equilateral triangle
(*b*) isosceles triangle
(*c*) right angled triangle
(*d*) isosceles right angled triangle

Sol. Right angled triangle

A(4, –2), B(7, –2) and C(7, 9) are the vertices of a triangle.
Using distance formula,

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

$$AB = \sqrt{[7-4]^2 + [-2(-2)]2} = \sqrt{3^2 + 0} = 3$$

$$BC = \sqrt{[7-7]^2 + [9-(-2)]^2} = \sqrt{0 + 11^2} = 11$$

$$AC = \sqrt{[7-4]^2 + [9-(-2)]^2} = \sqrt{3^2 + 11^2}$$

$$= \sqrt{9 + 121} = \sqrt{130}$$

Clearly, they are not equilateral or isosceles.
Also, $AC^2 = AB^2 + BC^2$
This mean it is following Pythagoras theorem.
$\therefore$ ΔABC is a right angled triangle.

Nailing the Right Answer

If possible, represent the given points graphically on the coordinate plane to visualize their positions and the distance between them. This can aid in understanding the problem and verifying the accuracy of the calculated distance.

13. If $A(3, \sqrt{3})$, B(0, 0) and C(3, k) are the three vertices of an equilateral triangle ABC, then the value of k is **(*Ap*)(CBSE Term-I, 2022)**

(*a*) 2 (*b*) – 3 (*c*) $\pm\sqrt{3}$ (*d*) $\pm\sqrt{2}$

Sol. $A(3, \sqrt{3})$, B(0, 0) and C(3, k) are the vertices of the triangle ABC. As in the equilateral triangle ABC all sides are equal.

Then, apply distance formula for sides AB and BC.
According to the distance formula,

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

$$AB = \sqrt{(3-0)^2 + (\sqrt{3} - 0)^2}$$

$$= \sqrt{9 + 3} = \sqrt{12} \text{ units}$$

$$BC = \sqrt{(3-0)^2 + (k-0)^2}$$

$$= \sqrt{9 + k^2} \text{ units}$$

Now, $AB = BC$

$$\sqrt{12} = \sqrt{9 + k^2}$$

or $12 = 9 + k^2$
or $k^2 = 3$
or $k = \pm\sqrt{3}$

Answer Key

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

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): The distance point P(2, 3) from the x-axis is 3.

Reason (R): The distance from x-axis is equal to its ordinate.

Sol. Assertion (A): The distance between the point (2, 3) and x-axis can be determined by assuming a point (2, 0) on x-axis

$\therefore$ Distance between (2, 3) and (2, 0) $= \sqrt{(2-2)^2 + (0-3)^2}$

$= \sqrt{3^2} = \sqrt{9} = 3$ (Ordinate)

Hence, Assertion is true

Reason (R): We know, the distance from x-axis is equal to its ordinate. Hence, reason is true.
Hence, Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).

2. Assertion (A): The point (0, 3) lies on y-axis.

Reason (R): The x-coordinate on the point on y-axis is not zero.

Sol. Assertion (A): Since, x-coordinate of the point (0, 3) is zero.
We know that if the point lies on y-axis, its x-coordinate is 0.
So, point (0, 3) lies on y-axis.
Hence, Assertion is true.
Reason (R): Given reason is false.
Hence, Assertion (A) is true, but Reason (R) is false.

Answer Key

1. (*a*) 2. (*c*)

Subjective Questions

Very Short Answer Type Questions (1 or 2 M)

1. Points $A(3, 1)$, $B(5, 1)$, $C(a, b)$ and $D(4, 3)$ are vertices of a parallelogram $ABCD$. Find the values of a and b. **(*Re*)(CBSE, 2019)**

Sol. (*i*) Given points for A & B are $A(3, 1)$ and $C(a, b)$.

$\therefore$ The coordinates of the mid point of diagonal AC are $\left(\frac{3+a}{2}, \frac{1+b}{2}\right)$ *(½ M)*

(*ii*) Given points for B and D are $B(5, 1)$ and $D(4, 3)$.

$\therefore$ The coordinates of the mid point of diagonal BD are $\left(\frac{5+4}{2}, \frac{1+3}{2}\right) = \left(\frac{9}{2}, 2\right)$ *(½ M)*

(*iii*) Since the coordinates of the midpoint of diagonal AC are the same as the coordinates of the midpoint of diagonal BD

Therefore, $\left(\frac{3+a}{2}, \frac{1+b}{2}\right) = \left(\frac{9}{2}, 2\right)$

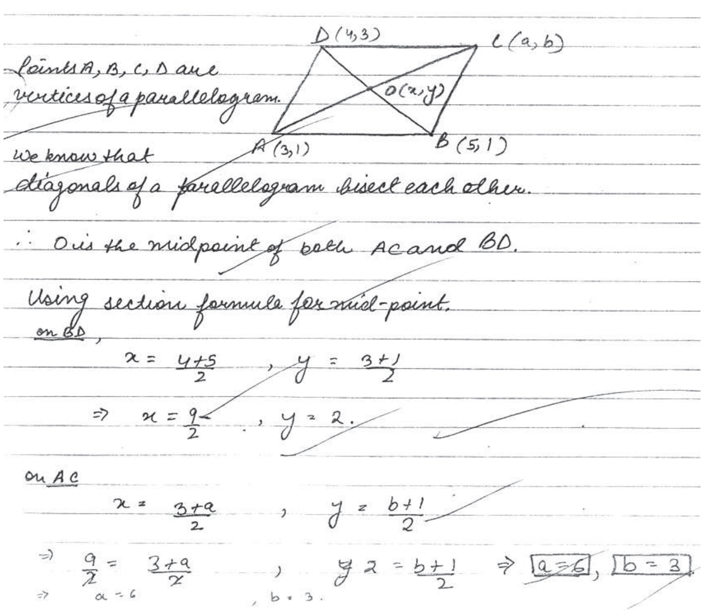
$\Rightarrow \frac{3+a}{2} = \frac{9}{2}$ and $\frac{1+b}{2} = 2$

$\Rightarrow 3 + a = 9$ and $1 + b = 4 \Rightarrow a = 9 - 3$ and $b = 4 - 1$

$\Rightarrow a = 6$ and $b = 3$

Hence, the value of a is 6 and the value of b is 3. *(1 M)*

Topper's Explanation ***(CBSE 2019)***


Points A, B, C, D are vertices of a parallelogram.

We know that diagonals of a parallelogram bisect each other.

$\therefore$ O is the midpoint of both AC and BD.

Using section formula for mid-point.

on BD,

$x = \frac{4+5}{2}$, $y = \frac{3+1}{2}$

$\Rightarrow x = \frac{9}{2}$, $y = 2$.

on AC

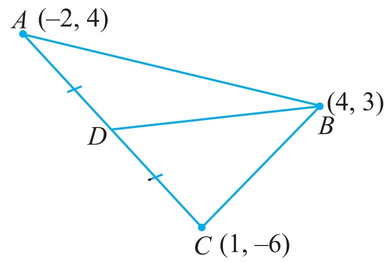
$x = \frac{3+a}{2}$, $y = \frac{b+1}{2}$

$\Rightarrow \frac{9}{2} = \frac{3+a}{2}$, $2 = \frac{b+1}{2}$ $\Rightarrow$ $a = 6$, $b = 3$

$\Rightarrow a = 6$, $b = 3$.

2. The vertices of a ΔABC are $A(-2, 4)$, $B(4, 3)$ and $C(1, -6)$. Find length of the median BD. **(*Ap*) (CBSE ODL, 2024)**

Sol. Since BD is median



D is midpoint of AC.

Now, Let $D = (x, y)$

Here, $x = \frac{-2+1}{2} = \frac{-1}{2}$

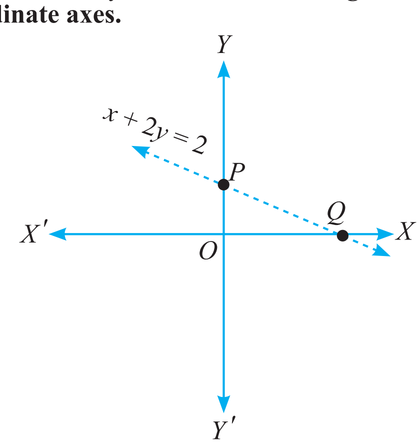
$y = \frac{-6+4}{2} = -1$ *(1 M)*

$\therefore D = \left(\frac{-1}{2}, -1\right)$

Now, distance $BD = \sqrt{\left(4+\frac{1}{2}\right)^2 + (3+1)^2} = \sqrt{\frac{81}{4}+16}$

$= \sqrt{\frac{81+64}{4}} = \sqrt{\frac{145}{4}}$ *(1 M)*

3. The line $x + 2y = 2$ forms a triangle OPQ, with the coordinate axes. **(*Un*)**



(*i*) What are the coordinates of points P and Q?

(*ii*) What is the area of the triangle formed? Show your steps.

Sol. (*i*) Since P & Q lies on line $x + 2y = 2$

Also P lies on y-axis, $\therefore x = 0$

and Q lies on x-axis, $\therefore y = 0$

$\Rightarrow$ For P, $0 + 2y = 2 \Rightarrow y = 1$

Hence $P(0, 1)$

For Q,

$x + 2 \times 0 = 2$

$\Rightarrow Q(2, 0)$ *(1 M)*

(*ii*) Area of $\Delta POQ = \frac{1}{2} \times OQ \times PO$

$= \frac{1}{2} \times 2 \times 1$

$= 1$ sq. unit. *(1 M)*

Key Takeaways

A point on the x-axis is of the form $(a, 0)$, and a point on the y-axis is of the form $(0, b)$

4. Find the point(s) on the x-axis which is at a distance of $\sqrt{41}$ units from the point (8, –5).

***(Ap)* (CBSE SQP, 2024)**

Sol. Let the required point be $(x, 0)$

$\sqrt{(8-x)^2 + 25} = \sqrt{41}$ *(½ M)*

$\Rightarrow (8 - x)^2 = 16$ *(½ M)*

$\Rightarrow 8 - x = \pm 4$

$\Rightarrow x = 4, 12$

Two points on the x-axis are (4, 0) & (12, 0). *(1 M)*

5. If the distances of $P(x, y)$ from $A(5, 1)$ and $B(-1, 5)$ are equal, then prove that $3x = 2y$. ***(Re)* (CBSE, 2017)**

Sol. Since, P is the equidistant from A and B

By using distance formula.

$\therefore PA = PB \Rightarrow (PA)^2 = (PB)^2$

$\Rightarrow (x - 5)^2 + (y - 1)^2 = (x + 1)^2 + (y - 5)^2$ *(½ M)*

$\Rightarrow x^2 - 10x + 25 + y^2 - 2y + 1 = x^2 + 2x + 1 + y^2 - 10y + 25$

$\Rightarrow -10x - 2x - 2y + 10y = 0$ *(½ M)*

$\Rightarrow -12x + 8y = 0$

$\Rightarrow 12x = 8y \Rightarrow 3x = 2y$ *(1 M)*

Short Answer Type Questions (2 or 3 M)

1. Find the points on x-axis which are at a distance of 5 units from the point $Q(-1, 4)$. ***(An)***

Sol. Let us suppose the point on x-axis be $P(x, 0)$.

$\therefore$ distance $PQ = 5$ units

We know that distance between two points $P(x_1, y_1)$ and $Q(x_2, y_2) = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ *(½ M)*

Here, $x_1 = -1, y_1 = 4, x_2 = x$ and $y_2 = 0$.

$\Rightarrow \sqrt{(x-(-1))^2 + (0-4)^2} = 5$ *(1 M)*

Squaring on both sides, we get

$\Rightarrow (x + 1)^2 + (0 - 4)^2 = 25$ *(½ M)*

$\Rightarrow (x + 1)^2 + (-4)^2 = 25$

$\Rightarrow x^2 + 2x + 1 + 16 = 25$

$\Rightarrow x^2 + 2x - 8 = 0$

$\Rightarrow (x + 4)(x - 2) = 0$

$\Rightarrow x = 2, -4$

Hence, the required points on x-axis are (2, 0) and (–4, 0). *(1 M)*

2. Find the point on y-axis which is equidistant from the points (5, –2) and (–3, 2). ***(Un)* (CBSE, 2019)**

Sol. Let a point $P(0, y)$ on the y-axis, $A(5, -2)$ and $B(-3, 2)$ which is equidistant from P.

$\therefore PA = PB \quad \Rightarrow (PA)^2 = (PB)^2$ *(½ M)*

By using distance formula.

$(0 - 5)^2 + (y + 2)^2 = (0 + 3)^2 + (y - 2)^2$

$\Rightarrow 25 + y^2 + 4y + 4 = 9 + y^2 - 4y + 4$ *(1 M)*

$8y = 9 - 25$ *(½ M)*

$8y = -16 \Rightarrow y = -2$

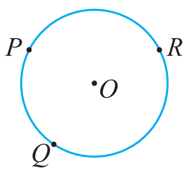
$\therefore$ the required point is $P(0, -2)$ *(1 M)*

Long Answer Type Questions (4 or 5 M)

1. Find the centre of a circle passing through points (6, –6), (3, –7) and (3, 3). ***(Ap)* (NCERT Intext)**

Sol. Let us suppose, $P = (6, -6)$, $Q = (3, -7)$, $R = (3, 3)$ are the points on a circle.

If O is the centre of the circle, then $OP = OQ = OR$ (radii of the circle are equal). *(½ M)*



Let coordinates of $O = (x, y)$, then by using distance formula

$= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ *(½ M)*

$OP = \sqrt{(x-6)^2 + (y+6)^2}$ *(½ M)*

$OQ = \sqrt{(x-3)^2 + (y+7)^2}$

$OR = \sqrt{(x-3)^2 + (y+3)^2}$

As, $OP = OQ$ *(½ M)*

$\therefore (x - 6)^2 + (y + 6)^2 = (x - 3)^2 + (y + 7)^2$

$\Rightarrow x^2 + 36 - 12x + y^2 + 36 + 12y = x^2 + 9 - 6x + y^2 + 49 + 14y$

$\Rightarrow x^2 + y^2 - 12x + 12y + 72 = x^2 + y^2 + 14y + 58 - 6x$ *(½ M)*

On simplifying the above equation, we get

$-6x = 2y - 14$ … (i)

In the same way: $OQ = OR$

$(x - 3)^2 + (y + 7)^2 = (x - 3)^2 + (y - 3)^2$

$\Rightarrow (y + 7)^2 = (y - 3)^2$

$\Rightarrow y^2 + 14y + 49 = y^2 - 6y + 9$ *(½ M)*

$\Rightarrow 20y = -40$

or $y = -2$ *(½ M)*

On putting the value of y in equation (i), we get

$\Rightarrow -6x = 2y - 14$

$\Rightarrow -6x = -4 - 14 = -18$

$\Rightarrow x = 3$ *(½ M)*

Therefore, centre of the circle is located at point (3,–2). *(1 M)*

Mistakes 101 : What not to do!

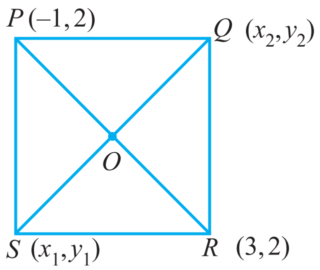
Neglecting to include negative signs in coordinate values when plotting points or calculating distances or slopes, resulting in errors in calculations or interpretations.

2. The two opposite vertices of a square are (–1, 2) and (3, 2). Find the coordinates of the other two vertices.
(*Cr*) (NCERT Intext)

Sol. Let us suppose *PQRS* is a square, where $S(x_1, y_1)$ and $Q(x_2, y_2)$ are opposite vertices of a square. And point *O* is the point of intersection of *PR* and *QS*.

We know that the distance between two points (x_1, y_1) and (x_2, y_2) is given by the distance formula

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$ *(1 M)*



(½ M)

Distance between *P* and *R* is calculated by using distance formula.

$$PR = \sqrt{(3+1)^2 + (2-2)^2}$$ *(½ M)*

$= 4 = QS$ [As diagonals of the square are equal]

We know that the sides of the square are equal to each other.

$\therefore PQ = QR$ *(½ M)*

$$\Rightarrow \sqrt{(x_2-(-1))^2 + (y_2-2)^2} = \sqrt{(x_2-3)^2 + (y_2-2)^2}$$

$\Rightarrow (x_2 + 1)^2 = (x_2 - 3)^2$

$\Rightarrow x_2^2 + 1 + 2x_2 = x_2^2 + 9 - 6x_2 \Rightarrow x_2 = 1$ *(½ M)*

Let '*a*' be the side of square.

In right angled triangle ΔPQR using pythagoras theorem, we get

$PQ^2 + QR^2 = PR^2$

$a^2 + a^2 = 4^2$

$2a^2 = 16$

$a^2 = 8$

$a = 2\sqrt{2}$ *(½ M)*

$\therefore PQ = 2\sqrt{2}$

$$\Rightarrow \sqrt{(x_2-(-1))^2 + (y_2-2)^2} = 2\sqrt{2}$$

$(1 + 1)^2 + (y_2 - 2)^2 = 8$

$(y_2 - 2)^2 = 8 - 4$

$(y_2 - 2)^2 = 4$

$y_2 - 2 = 2$

$y_2 = 4$ *(½ M)*

Hence, the coordinates of *Q* are (1, 4).

As we know that diagonal of a square are equal and bisect each other.

$$\therefore \text{Coordinartes of } O = \left(\frac{3-1}{2}, \frac{2+2}{2}\right) = (1, 2)$$

Now, coordinates of S can be calculated, as follows:

As *O* is the mid-point of RS.

$$\therefore (1, 2) = \left(\frac{x_1+1}{2}, \frac{y_1+4}{2}\right)$$ *(½ M)*

On equating *x* and *y* term, we get

$1 = \frac{x_1+1}{2}$ and $2 = \frac{y_1+4}{2}$

$2 = x_1 + 1$ and $4 = y_1 + 4$

$x_1 = 1$ and $y_1 = 0$

Coordinates of *S* are (1, 0).

Hence, the required vertices are *S*(1, 0) and *Q*(1, 4). *(½ M)*

Mistakes 101 : What not to do!

Students may misidentify the quadrants on the coordinate plane, leading to errors in determining the signs of coordinates or interpreting the direction of movement of geometric objects.

3. Three players are standing on the circle at points *A*(–5, 0), *B*(1, 0) and *C*(3, 4). A ball is placed at a point that is equidistant from all 3 players.
(*Cr*) (CBSE CFPQ, 2023)

(*i*) What are the coordinates of the ball?

(*ii*) The fourth player is standing at the point *D*(–5, 4). Is he/she standing on the circle?

Show your steps and give valid reasons.

Sol. (*i*) Consider the coordinates of the ball as *O*(*x*, *y*) and considering *OA* = *OB* = *OC*, apply distance formula and write the equations: *(1 M)*

$OA = OB \Rightarrow (x + 5)^2 + (y)^2 = (x - 1)^2 + (y)^2$ and

$OB = OC \Rightarrow (x - 1)^2 + (y)^2 = (x - 3)^2 + (y - 4)^2$

Simplifying the above equations to find the coordinates of the ball as *O*(–2, 4). *(2 M)*

(*ii*) Consider *O* as the centre and finds the radius of the circle by finding either *OA* or *OB* or *OC*. *(1 M)*

$$OA = \sqrt{\{(-2+5)^2 + (4-0)\}^2} = \sqrt{25} = 5 \text{ units}$$

The distance between *O* and *D* as 3 units and the fourth player is not standing on the circle as the distance between the player and the centre of the circle is not equal to the radius of the circle. *(1 M)*

4. If the point *C*(–1, 2) divides internally the line segment joining *A*(2, 5) and *B*(*x*,*y*) in the ratio 3 : 4, find the coordinates of *B*. **(*Ap*) (CBSE, 2019)**

Sol. Let the coordinates of *B* be (*x, y*). It is given that *AC* : *BC* = 3 : 4.

So, the coordinates of *C* are *(1 M)*

$$\left(\frac{3x+4\times 2}{3+4}, \frac{3y+4\times 5}{3+4}\right) = \left(\frac{3x+8}{7}, \frac{3y+20}{7}\right)$$

But, the coordinates of *C* are (–1, 2) *(1 M)*

$$\frac{3x+8}{7} = -1 \text{ and } \frac{3y+20}{7} = 2$$

$x = -5$ and $y = -2$ *(1 M)*

Thus, the coordinates of *B* are (–5, –2). *(1 M)*

MISCELLANEOUS EXERCISE

Multiple Choice Questions (1 M)

1. The distance of the point (–4, 3) from y-axis is: **(CBSE ODL, 2023)**

(a) –4 (b) 4
(c) 3 (d) 5

2. The point on the x- axis nearest to the point (–4, –5) is **(CBSE SQP, 2024)**

(a) (0, 0) (b) (–4, 0)
(c) (–5, 0) (d) $(\sqrt{41}, 0)$

3. In a geometry class, students are tasked with determining the type of triangle formed by three given points on a coordinate plane. The points are $A(5, 1)$, $B(1, 4)$, and $C(8, 5)$. The teacher asks them to identify whether the triangle is right-angled and, if so, what specific type of triangle it is.

(a) Equilateral triangle
(b) Scalene right-angled triangle
(c) Isosceles right-angled triangle
(d) Isosceles acute-angled triangle

4. If $(a/3, 4)$ is the mid-point of the segment joining the points $P(-6, 5)$ and R(–2, 3), then the value of 'a' is

(a) 12 (b) –6
(c) –12 (d) –4

5. Point P divides the line segment joining the points $A(4, -5)$ and $B(1, 2)$ in the ratio 5:2. Co-ordinates of point P are **(CBSE ODL, 2024)**

(a) $\left(\frac{5}{2}, \frac{-3}{2}\right)$ (b) $\left(\frac{11}{7}, 0\right)$
(c) $\left(\frac{13}{7}, 0\right)$ (d) $\left(0, \frac{13}{7}\right)$

6. A park has two landmarks at points $P(3c, 2)$ and $Q(-4, -d)$. The midpoint of the line segment connecting these landmarks is $\left(-\frac{1}{2}, 2\right)$. Using this information, certain statements about the values of c and d can be derived.

Statement (i): $c = 1$
Statement (ii): $d = 4$
Statement (iii): $c \times d = -2$

Which of the given statements is/are correct?

(a) Only (i) is correct
(b) (ii) and (iii) are correct
(c) (i) and (iii) are correct
(d) Only (iii) is correct

7. A river flows between two points (–3, 4) and (5, –6). A fisherman places his boat at point Q, which divides the line segment joining these points in the ratio 3:2. Determining the coordinates of point Q.

Statement (i): The x-coordinate of point Q is $\frac{9}{5}$.

Statement (ii): The y-coordinate of point Q is $\frac{-10}{5}$.

Statement (iii): The sum of the coordinates of point Q is 1.

Which of the given statements is/are correct?

(a) Only (i) is correct
(b) (ii) and (iii) are correct
(c) (i) and (ii) are correct
(d) (iii) and (iv) are correct.

8. A satellite is following a path in space, and its position can be described at different times by two coordinates. At one moment, its position is given by $(a\cos\theta + b\sin\theta, 0)$ and at another moment, its position is given by $(0, a\sin\theta + b\cos\theta)$. The mission control team needs to determine the distance the satellite has traveled between these two positions.

Statement (i): The distance between the points can be found using the formula

$\sqrt{(a\cos\theta + b\sin\theta)^2 + (a\sin\theta - b\cos\theta)^2}$.

Statement (ii): The distance formula simplifies to $\sqrt{a^2+b^2}$ after applying trigonometric identities.

Statement (iii): Using the Pythagorean theorem in the context of the coordinates provided, the distance is $\sqrt{a^2+b^2}$.

Which of the given statements is/are correct?

(a) Only (i) is correct
(b) (ii) and (iii) are correct
(c) (i) and (iii) are correct
(d) Only (iii) is correct

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):** The value of y is 6, for which the distance between the points $A(2, -3)$ and $B(10, y)$ is 10

Reason (R): Distance between two given points $P(x_1, y_1)$ and $Q(x_2, y_2)$ is given by:

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

2. **Assertion (A):** The point $M(-1, 6)$ divides the line segment joining the points $A(-3, 10)$ and $B(6, -8)$ in the ratio 2 : 7 internally.

Reason (R): Three points P, Q and R are collinear if area of $\Delta PQR = 0$.

Subjective Questions

Very Short Answer Type Questions (1 or 2 M)

1. A city planning team needs to place a water fountain exactly halfway between two playgrounds located at coordinates $(2, -3)$ and $(x, 5)$. The midpoint must also lie on the line $3x + 2y = 7$.

Determine the value of x.

2. $A(3, 0)$, $B(6, 4)$ and $C(-1, 3)$ are vertices of a triangle ABC. Find length of its median BE. **(CBSE ODL, 2024)**

3. A geologist is plotting three key locations on a map: $A(-2,3)$, $B(1,k)$, and $C(5,-1)$. The locations form an isosceles triangle where the distances AB and BC are equal. The geologist needs to determine the value of k, knowing it must be a rational number.

4. Show that the points $A(-5, 6)$, $B(3, 0)$ and $C(9, 8)$ are the vertices of an isosceles triangle. **(CBSE SQP, 2024)**

5. Find the type of triangle ABC formed whose vertices are $A(1, 0)$, $B(-5, 0)$ and $C(-2, 5)$. **(CBSE ODL, 2024)**

Short Answer Type Questions (2 or 3 M)

1. Two treasure hunters, Alex and Jamie, start at point $A(2, -1)$ and point $B(6,3)$ respectively. They are heading towards the treasure located at point $T(x,y)$ such that the ratio of their distances from T is 3:4. Determine the coordinates of the treasure. Additionally, if T lies on the line $y = 2x - 5$, find the specific value of y with the determined coordinate value of x.

2. The three vertices of a rhombus $PQRS$ are $P(2, -3)$, $Q(6, 5)$ and $R(-2, 1)$.

(*a*) Find the coordinates of the point where both the diagonals PR and QS intersect.

(*b*) Find the coordinates of the fourth vertex S.

Show your steps and give valid reasons.

3. $ABCD$ is a rectangle formed by the points $A(-1, -1)$, $B(-1, 6)$, $C(3, 6)$ and $D(3, -1)$. P, Q, R and S are mid-points of sides AB, BC, CD and DA respectively. Show that diagonals of the quadrilateral $PQRS$ bisect each other. **(CBSE DL, 2024)**

4. Find the ratio in which the point $\left(\frac{8}{5}, y\right)$ divides the line segment joining the points (1, 2) and (2, 3). Also, find the value of y. **(CBSE DL, 2024)**

Long Answer Type Questions (4 or 5 M)

1. A rectangular garden is designed in a park. The diagonals of the garden intersect at point $E(5,3)$. One diagonal runs through the points $A(2,1)$ and $B(x,y)$.

(*i*) Determine the coordinates of point B.

(*ii*) If point $C(8, 2)$ is one vertex of the rectangle, find the coordinates of the fourth vertex D.

(*iii*) Calculate the area of the rectangle formed by these vertices.

2. Preeti and Arun are both driving to their respective offices from the same home. Preeti drives towards the east at an average speed of 30 km per hour for 12 minutes and then towards the south at an average speed of 60 km per hour for 3 minutes. Arun drives towards the west at an average speed of 30 km per hour for 4 minutes and then towards the north at an average speed of 45 km per hour for 4 minutes.

What is the straight-line distance between Preeti's office and Arun's office? Show your steps and represent the given scenario on the coordinate plane. **(CBSE CFPQ, 2023)**

3. Three players are standing on the circle at points $A(-5, 0)$, $B(1, 0)$ and $C(3, 4)$. A ball is placed at a point that is equidistant from all 3 players.

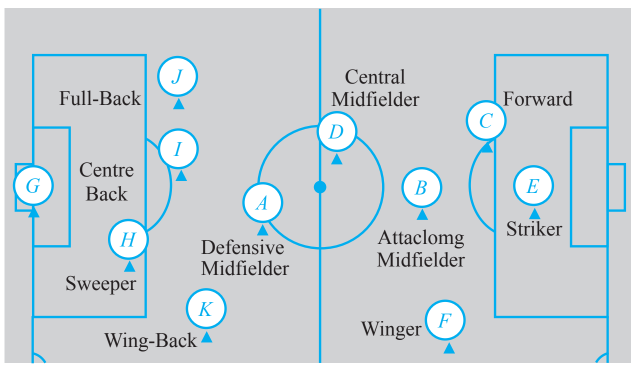
(*i*) What are the coordinates of the ball?

(*ii*) The fourth player is standing at the point $D(-5, 4)$. Is he/she standing on the circle?

Show your steps and give valid reasons.

Case Based Questions

Case Based-I: Tharunya was thrilled to know that the football tournament is fixed with a monthly timeframe from 20th July to 20th August 2023 and for the first time in the FIFA Women's World Cup's history, two nations host in 10 venues. Her father felt that the game can be better understood if the position of players is represented as points on a coordinate plane.



(CBSE SQP, 2023)

(*i*) At an instance, the midfielders and forward formed a parallelogram. Find the position of the central midfielder (D) if the position of other players who formed the parallelogram are :- $A(1,2)$, $B(4,3)$ and $C(6,6)$

(*ii*) Check if the Goal keeper $G(-3,5)$, Sweeper $H(3,1)$ and Wing-back $K(0,3)$ fall on a same straight line.

OR

Check if the Full-back $J(5, -3)$ and centre-back $I(-4,6)$ are equidistant from forward $C(0,1)$ and if C is the mid-point of IJ.

(*iii*) If Defensive midfielder $A(1,4)$, Attacking midfielder $B(2,-3)$ and Striker $E(a, b)$ lie on the same straight line and B is equidistant from A and E, find the position of E.

Case Based-II: A city planning committee is designing a new residential area. They're using a coordinate system where each unit represents 100 meters. Key locations are:

Water Tower (W): (2,5)
Community Center (C): (–3,1)
Park Entrance (P): (4,–2)
Residential Block (R): (–1,–3)

Based on the above information, answer the following questions:

(*i*) The city wants to place a fire hydrant (H) on the line segment joining the Water Tower (W) and the Residential Block (R), such that $WH : HR = 2 : 3$. What are the coordinates of the fire hydrant?

(*ii*) A circular WiFi zone needs to be established so that it just reaches the Community Center and the Park Entrance. If the WiFi tower is placed at the midpoint of the line joining these two points, what is the area covered by the WiFi signal? (Use $\pi = 3.14$)

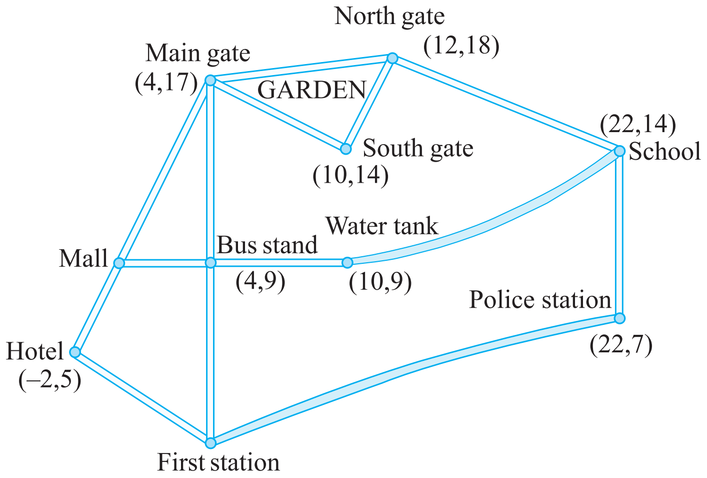
(*iii*) The distance between the Water Tower (W) and the Residential Block (R) is 'd' units. Find the value of d.

OR

If a point Q divides the line segment CR externally in the ratio 3:2, then Q is closer to R than to C is true?

Case Based-III: Answer the questions based on the information given.

Show below is a map of Giri's neighbourhood.



(CBSE CFPQ, 2023)

Giri did a survey of his neighbourhood and collected the following information.

* The hotel, mall and the main gate of the garden lie in a straight line.
* The distance between the hotel and the mall is half the distance between the mall and the main gate of the garden.
* The bus stand is exactly midway between the main gate of the garden and the fire station.
* The mall, bus stand and the water tank lie in a straight line.

(*i*) What is the x-coordinate of the mall's location?

(*a*) –8 (*b*) 0
(*c*) 1 (*d*) 2

(*ii*) What are the coordinates of the fire station?

(*a*) (0, 8) (*b*) (4, –17)
(*c*) (4, 1) (*d*) (4, 13)

(*iii*) What is the shortest distance between the water tank and the school?

(*a*) $\sqrt{13}$ units (*b*) $\sqrt{65}$ units
(*c*) 13 units (*d*) 169 units

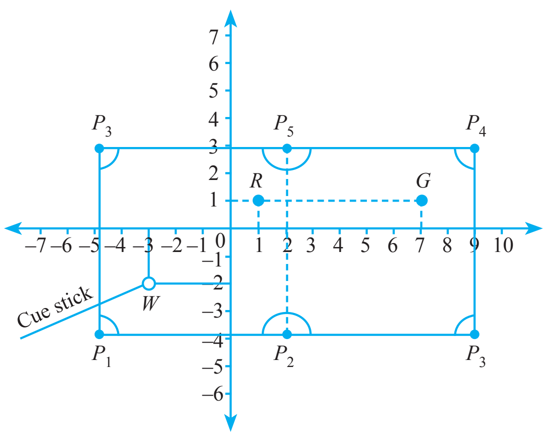
(*iv*) How much more is the shortest distance of the school from the water tank then the distance of the school from the police station?

(*a*) 6 units (*b*) 7 units
(*c*) 13 units (*d*) 20 units

Case Based-IV: Raycasting is a technique used in the creation of computer games. The basic idea of raycasting is as follows: the map is a 2D square grid. Using rays generated from an object, this 2D map can be transformed into a 3D perspective. One of the methods involves sending out a ray from the player's location. To determine how far he/she is from a wall or an obstacle, the distance between the player's coordinates and the coordinate of the wall is calculated. If the player is near the obstacle, it looks larger and vice-versa.

Shown image is a game, Wolf 3D, which was created using raycasting.

Riju wants to create an online snooker game using raycasting. The game in the creation stage on a coordinate map is shown below.



The snooker table has six pockets (P_1, P_2, P_3, P_4, P_5, and P_6) and he has shown three balls-white (W), red (R) and green (G) on the table. The objective of the game is to use the white ball to hit the coloured balls into the pockets using a cue stick.

Based on the given information, answer the following questions:

(i) How much distance will a ray travel if sent from the green ball to the nearest pocket? Show your work.

(ii) Riju wants to place a yellow ball at the midpoint of the line connecting the white and green balls.

Find the coordinates of the point at which he should place the yellow ball. Show your steps.

(iii) Riju is running a trial on his game. He struck the white ball in such a way that it rebound off the rail (line connecting P_4 and P_6) and went into the pocket P_2.

- After the rebound, the ball crossed the x-axis at point $X\left(\frac{2}{7},0\right)$ on the way to the pocket.
- The ratio of the distance between the rail and point X and the distance between point X and the pocket was 3 : 4.

Find the coordinates of the point at which the ball struck the rail. Show your steps.

OR

Riju wants to place a blue ball exactly halfway between the yellow ball at point (–1, 2) and the green ball at point (5, –4)

Find the coordinates of the point where he should place the blue ball. Show your steps.

ANSWER KEYS

Multiple Choice Questions

1. (*b*) **2.** (*b*) **3.** (*b*) **4.** (*c*) **5.** (*c*) **6.** (*c*) **7.** (*c*) **8.** (*a*)

Assertion and Reason

1. (*d*) **2.** (*b*)

Case Based Questions

Case Based-III

(i) (*b*) ***(ii)*** (*c*) ***(iii)*** (*c*) ***(iv)*** (*a*)

HINTS & EXPLANATIONS

Multiple Choice Questions

1. (*b*) The distance of the point (x, y) from y-axis is its x-coordinate.

   Hence, the distance of the point (–4, 3) from y-axis is 4 units.

2. (*b*) (–4, 0)

3. (*b*) We have

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

   Calculating the length of AB:

   $$AB = \sqrt{(1-5)^2 + (4-1)^2}$$

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

   Calculating the length of BC:

   $$BC = \sqrt{(8-1)^2 + (5-4)^2}$$

   $$= \sqrt{7^2 + 1^2} = \sqrt{49+1} = \sqrt{50} = 5\sqrt{2}$$

   Calculating the length of CA :

   $$CA = \sqrt{(8-5)^2 + (5-1)^2}$$

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

   Check if the Triangle is Right-Angled:

   Longest side: $BC = 5\sqrt{2}$

   Checking Pythagorean theorem:

   $AB^2 + CA^2 = BC^2$

   $\Rightarrow 5^2 + 5^2 = (5\sqrt{2})^2$

   $\Rightarrow 25 + 25 = 50 \Rightarrow 50 = 50$

   Therefore, the triangle with vertices at $A(5,1)$, $B(1,4)$, and $C(8, 5)$ is a scalene right-angled triangle.

4. (*c*) The mid-point

   $$= \left(\frac{-6-2}{2}, \frac{5+3}{2}\right)$$

   $$\Rightarrow \left(\frac{a}{3}, 4\right) = (-4, 4)$$

   $$\therefore \frac{a}{3} = -4 \Rightarrow a = -12$$

5. (*c*) If $P(x,y)$ is the dividing point of the line joining AB then by section formula we have,

   $$x = \frac{m_1x_2 + m_2x_1}{m_1 + m_2} \text{ and } y = \frac{m_1y_2 + m_2y_1}{m_1 + m_2}$$

   $$\Rightarrow \frac{2\times 5 + 3\times 2}{2+3} = k$$

   $$\Rightarrow k = \frac{16}{5}$$

6. (*c*) Since, the midpoint formula for the points (x_1, y_1) and (x_2, y_2) is $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

   Substitute the given coordinates $P(3c, 2)$ and $Q(-4, -d)$ into the midpoint formula, we get

   $$\left(\frac{3c-4}{2}, \frac{2-d}{2}\right) = \left(-\frac{1}{2}, 2\right) \text{ (Given)}$$

   Equating the coordinates, we get

   $$\Rightarrow \frac{3c-4}{2} = -\frac{1}{2} \Rightarrow 3c - 4 = -1 \Rightarrow 3c = 3 \Rightarrow c = 1$$

   $$\text{or } \frac{2-d}{2} = 2 \Rightarrow 2 - d = 4 \Rightarrow -d = 2 \Rightarrow d = -2$$

   Hence

   Statement (*i*) is correct ($c = 1$).

   Statement (*ii*) is incorrect because $d = -2$.

   Statement (*iii*) is correct ($c \times d = 1 \times -2 = -2$).

7. (*a*) Statement (*i*): Calculate the x-coordinate of point Q.

   $$x = \frac{(5\times 3) + (-3\times 2)}{3+2} = \frac{15-6}{5} = \frac{9}{5}$$

   Statement (*ii*): Calculate the y-coordinate of point Q.

   $$y = \frac{(-6\times 3) + (4\times 2)}{3+2} = \frac{-18+8}{5} = \frac{-10}{5} = -2$$

   Statement (*iii*): Sum the coordinates of point Q.

   $$x + y = \frac{9}{5} - 2 = \frac{9}{5} - \frac{10}{5} = -\frac{1}{5}$$

   Hence,

   Statement (*i*) is correct.

   Statement (*ii*) is correct.

   Statement (*iii*) is incorrect because the sum is $-\frac{1}{5}$.

8. (*a*) Since, the distance formula for the points (x_1, y_1) and (x_2, y_2) is $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

   Substitute the given coordinates ($a\cos\theta + b\sin\theta$, 0) and (0, $a\sin\theta - b\cos\theta$) into the distance formula:

   Distance

   $$= \sqrt{\{0 - (a\cos\theta + b\sin\theta)\}^2 + \{(a\sin\theta - b\cos\theta) - 0\}^2}$$

   $$= \sqrt{(-a\cos\theta - b\sin\theta)^2 + (a\sin\theta - b\cos\theta)^2}$$

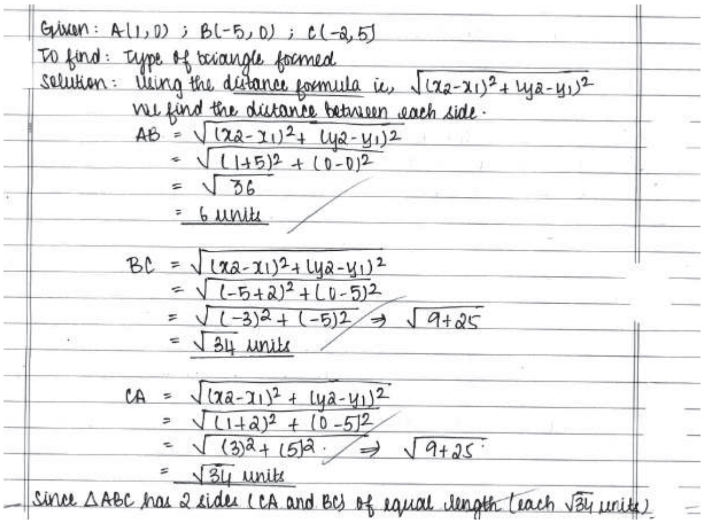
   $$= \sqrt{(a\cos\theta + b\sin\theta)^2 + (a\sin\theta - b\cos\theta)^2}$$

   $$= \sqrt{\begin{aligned}&a^2\cos^2\theta + 2ab\cos\theta\sin\theta + b^2\sin^2\theta \\ &+ a^2\sin^2\theta - 2ab\sin\theta\cos\theta + b^2\cos^2\theta\end{aligned}}$$

   $$= \sqrt{a^2(\cos^2\theta + \sin^2\theta) + b^2(\sin^2\theta + \cos^2\theta)}$$

   $$= \sqrt{a^2(1) + b^2(1)} = \sqrt{a^2 + b^2}$$

Topper's Explanation **(CBSE 2024)**


Given: A(1, 0) ; B(-5, 0) ; C(-2, 5)
To find: Type of triangle formed
Solution: Using the distance formula i.e., $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$
we find the distance between each side.
$AB = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$
$= \sqrt{(1+5)^2+(0-0)^2}$
$= \sqrt{36}$
$=$ 6 units

$BC = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$
$= \sqrt{(-5+2)^2+(0-5)^2}$
$= \sqrt{(-3)^2+(-5)^2} \Rightarrow \sqrt{9+25}$
$= \sqrt{34}$ units

$CA = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$
$= \sqrt{(1+2)^2+(0-5)^2}$
$= \sqrt{(3)^2+(5)^2} \Rightarrow \sqrt{9+25}$
$= \sqrt{34}$ units
Since ΔABC has 2 sides (CA and BC) of equal length (each $\sqrt{34}$ units)

Short Answer Type Questions

1. Let $T(x,y)$ divides the line segment AB in the ratio 3:4.
Given, points are A (2, –1) and B (6, 3)
and Ratio = 3 : 4
Using the section formula, we get

$$x = \frac{3\times6+4\times2}{3+4} = \frac{18+8}{7} = \frac{26}{7} \quad \textit{(½ M)}$$

$$\text{or } y = \frac{3\times3+4\times(-1)}{3+4} = \frac{9-4}{7} = \frac{5}{7} \quad \textit{(½ M)}$$

Thus, the coordinates of T are $T\left(\frac{26}{7},\frac{5}{7}\right)$ *(½ M)*

Given, T lies on the line $y = 2x - 5$, therefore T must be satisfied the eqn. *(½ M)*

We substitute $x = \frac{26}{7}$ into the line equation $y = 2x - 5$

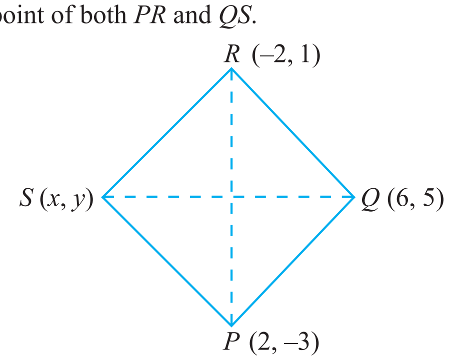
$$\therefore \quad y = 2\left(\frac{26}{7}\right) - 5 = \frac{52}{7} - 5 = \frac{52}{7} - \frac{35}{7} = \frac{17}{7} \quad \textit{(½ M)}$$

Thus, the specific coordinates of T are $\left(\frac{26}{7},\frac{17}{7}\right)$ *(½ M)*

So, the coordinates of the treasure are $\left(\frac{26}{7},\frac{17}{7}\right)$.

2. Find the Intersection Point of the Diagonals:

The diagonals of a rhombus bisect each other at right angles. The intersection point (O) of diagonals PR and QS is the midpoint of both PR and QS.



Midpoint formula:

$$O = \left(\frac{x_1+x_2}{2},\frac{y_1+y_2}{2}\right)$$

For diagonal PR with vertices $P(2, -3)$ and $R(-2,1)$:

$$O_{PR} = \left(\frac{2+(-2)}{2},\frac{-3+1}{2}\right) = (0,-1) \quad \textit{(1 M)}$$

For diagonal QS with vertices $Q(6,5)$ and $S(x,y)$:

$$\therefore (0,-1) = \left(\frac{6+x}{2},\frac{5+y}{2}\right)$$

Since the midpoints O are the same, we get:

$$0 = \frac{6+x}{2} \text{ and } -1 = \frac{5+y}{2}$$

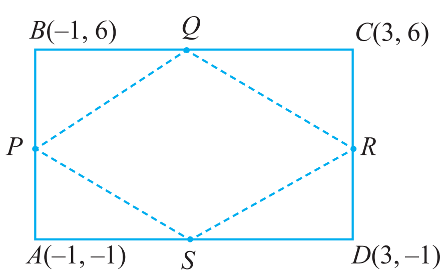
Solving these equations we get,

$$x = -6 \text{ and } y = -7$$

The coordinates of the point where both the diagonals PR and QS intersect are (0, –1). *(1 M)*

The coordinates of the fourth vertex S are (–6, –7). *(1 M)*

3. We have a rectangle $ABCD$ formed by the points. A (–1, –1), B(–1, 6), C(3, 6) and D(3, –1) Also, P, Q, R and S are the mid-points of the sides AB, BC, CD and DA. *(1 M)*



Since P, Q, R and S are the mid-points

$$\therefore \text{ Co-ordinate of } P = \left(\frac{-1-1}{2},\frac{-1+6}{2}\right) = \left(-1,\frac{5}{2}\right)$$

$$\text{Co-ordinate of } Q = \left(\frac{-1+3}{2},\frac{6+6}{2}\right) = (1,6).$$

$$\text{Co-ordinate of } R = \left(\frac{3+3}{2},\frac{-1+6}{2}\right) = \left(3,\frac{5}{2}\right)$$

$$\text{Co-ordinate of } S = \left(\frac{-1+3}{2},\frac{-1-1}{2}\right) = (1,-1) \quad \textit{(1 M)}$$

Now we have to prove that diagonals of the quadrilateral $PQRS$ bisect each other.

$$\text{Here, mid-point of } PR = \left(\frac{-1+3}{2},\frac{\frac{5}{2}+\frac{5}{2}}{2}\right) = \left(1,\frac{5}{2}\right)$$

$$\text{Also, mid-point of } QS = \left(\frac{1+1}{2},\frac{6-1}{2}\right) = \left(1,\frac{5}{2}\right)$$

$\therefore$ Mid points of PR and QS are equal.

Hence diagonals of the quadrilateral $PQRS$ bisect each other. *(1 M)*

MOCK TEST PAPER-1

Time allowed : 3 hours **Maximum Marks : 80**

GENERAL INSTRUCTIONS:

Read the following instructions carefully and 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 number **1** to **18** are multiple choice questions (MCQs) and question number **19** and **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 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 in **Section E**.*

(ix) Draw neat figures wherever required. Take π = 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 zeroes of the quadratic polynomial $x^2 + 99x + 127$ are

(*a*) both positive (*b*) both negative

(*c*) one positive and one negative (*d*) both equal

2. If one equation of a pair of dependent linear equations is $-3x + 5y - 2 = 0$. The second equation will be:

(*a*) $-6x + 10y - 4 = 0$ (*b*) $6x - 10y - 4 = 0$ (*c*) $6x + 10y - 4 = 0$ (*d*) $-6x + 10y + 4 = 0$

3. The product of a non-zero rational and an irrational number is

(*a*) always irrational (*b*) always rational (*c*) rational or irrational (*d*) none of these

4. If $ax^2 + bx + c = 0$ has equal roots, then value of c is

(*a*) $\frac{-b^2}{4a}$ (*b*) $\frac{a}{c}$ (*c*) $\frac{b^2}{4a}$ (*d*) $\frac{-a}{c}$

5. If the mean of the frequency distribution is 6 and $\Sigma f_i x_i = 90$, then $\Sigma f_i =$

(*a*) 12 (*b*) 13 (*c*) 15 (*d*) None of these

31. Prove that $(1 + \cot A - \text{cosec } A)(1 + \tan A + \sec A) = 2$

SECTION - D

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

32. (*a*) Determine the height of a mountain if the elevation of its top at an unknow distance from the base is 30° and at a distance 10 km further off from the mountain, along the same line, the angle of elevation is 15°. (Use, tan 15° = 0.23)

OR

(*b*) The angle of elevation of the top of a vertical tower from a point on the ground is 60°. From another point 10 m vertically above the first, its angle by elevation is 45°. Find the height of the tower.

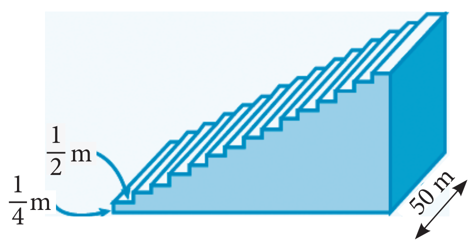
33. (*a*) *O* is the point of intersection of the diagonals *AC* and *BD* of a trapezium *ABCD* with *AB*||*DC*. Through *O*, a line segment *PQ* is drawn parallel to *AB* meeting *AD* in *P* and *BC* in *Q*, then prove that *OP* = *OQ*.

OR

(*b*) A street light bulb is fixed on a pole 6 m, above the level of the street. If a woman of height 1.5 m casts a shadow of 3 m, then find how far she is away from the base of the pole.

34. A factory manufactures 1,20,000 pencils daily. The pencils are cylindrical in shape, each of length 25 cm and circumference of base as 1.5 cm. Determine the cost of colouring the curved surfaces of the pencils manufactured in one day at ₹0.05 per dm^2.

35. A small terrace at a football ground comprises of 15 steps each of which is 50 *m* long and built of solid concrete. Each step has a rise of $\frac{1}{4}$ *m* and a tread of $\frac{1}{2}$ *m*. (see Fig.). Calculate the total volume of concrete required to build the terrace.



SECTION - E

Section - E consists of three Case Based questions of 4 marks each.

36. Raman usually go to a dry fruit shop with his mother. He observes the following two situations:
On 1st day: The cost of 2 kg of almonds and 1 kg of cashew was Rs. 1600 on 2nd day. The cost of 4 kg of almonds and 2 kg by cashew was ₹ 3000.
Denoting the cost of 1 kg almonds by Rs. *x* and cost of 1 kg cashew by Rs. *y* answer the following questions.

(*i*) Represent algebraically the situation of day-I and day-II. **1**

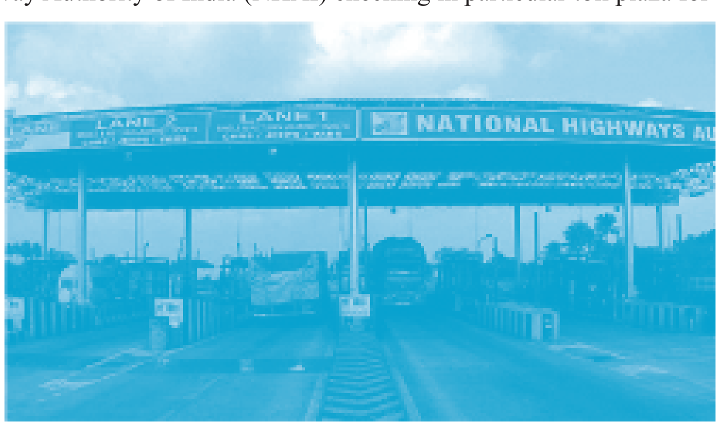
(*ii*) Find the point at which linear equation represented by day I, intersect the *x*-axis. **2**

OR

Find the point at which linear equation represented by day II intersect the *y*-axis.

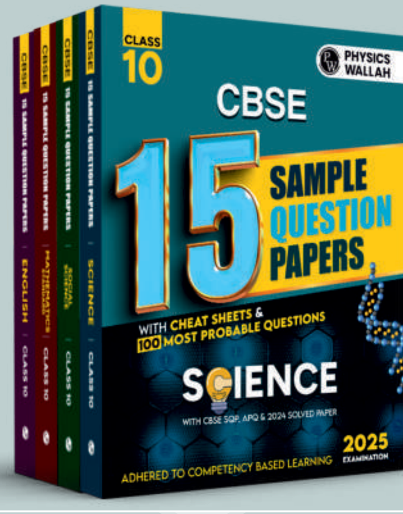
(*iii*) Find the cost of 1 kg almonds and 1 kg of cashew. **1**

37. In Delhi, The Nation Highway Authority of India (NHAI) checking in particular toll plaza for toll tax collection.



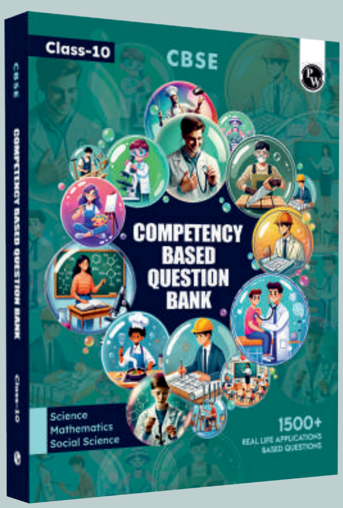
Other Helpful Books

CBSE QUESTION & CONCEPT BANK

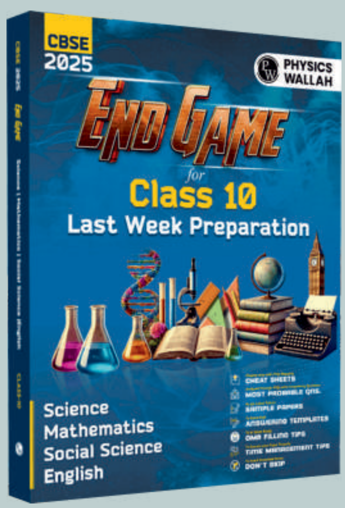


CBSE 15 SAMPLE QUESTION PAPERS

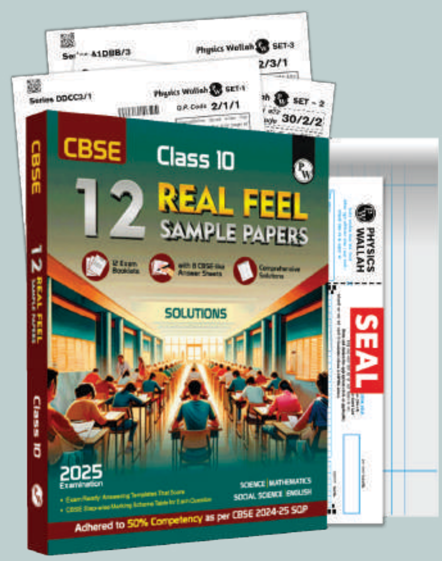
PAST 10 YEARS'



COMPETENCY BASED QUESTION BANK



CBSE END GAME



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