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CLASS X · MATHEMATICS BASIC (241) · CBSE BOARD EXAMINATION 2027

CHAPTER 10 BASIC

# Circles

Chapter Practice Booklet · Questions only · Answers in the separate Answer Booklet

6 guided method questions | 25 practice questions | 3 case studies

Basic (430 series) board question index

## INSIDE THIS BOOKLET


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## STUDENT DETAILS

NAME _____

CLASS & SECTION _____

ROLL NO. _____

BOOKLET STARTED ON _____

CHAPTER TEST SCORE _____ / 20

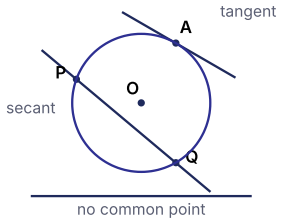
1

READ THIS FIRST · MATHEMATICS BASIC

# Chapter Notes

The whole chapter in short-note form: every definition, formula, method and model answer. Revise from here – you should not need the textbook again.

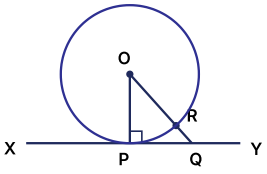
## 1 A line and a circle




A line can meet a circle in **no point**, in **two points** (a **secant**) or in **exactly one point** (a **tangent**). The common point of a tangent and the circle is the **point of contact**.

- At each point of a circle there is exactly one tangent.
- From a point **inside** the circle: no tangent. From a point **on** the circle: one tangent. From a point **outside**: exactly two tangents.
- A tangent is a secant whose two points of intersection have come together.

## 2 Theorem 1: tangent ⊥ radius

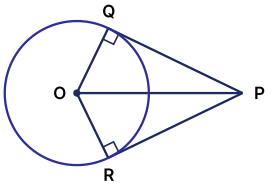



The tangent at any point of a circle is perpendicular to the radius through the point of contact.

**Proof.** Let $XY$ touch the circle with centre $O$ at $P$. Take any other point $Q$ on $XY$. $Q$ lies outside the circle (a tangent meets the circle only at $P$), so $OQ$ cuts the circle at $R$ and $OQ > OR = OP$. So $OP$ is the shortest of all the segments from $O$ to $XY$. The shortest segment from a point to a line is the perpendicular, so $OP \perp XY$.

- The perpendicular to a tangent at its point of contact passes through the centre.
- Tangents at the two ends of a diameter are parallel (both are perpendicular to the diameter).

## 3 Theorem 2: two tangents from a point are equal




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

**Proof.** $PQ$ and $PR$ are tangents from $P$ to the circle with centre $O$. Join $OQ$, $OR$, $OP$. In $\triangle OQP$ and $\triangle ORP$: $\angle OQP = \angle ORP = 90^\circ$ (tangent $\perp$ radius), $OQ = OR$ (radii), $OP$ is common. So $\triangle OQP \cong \triangle ORP$ (RHS), and $PQ = PR$ (CPCT).

- The same congruence gives $\angle OPQ = \angle OPR$: $OP$ bisects the angle between the tangents, and $\angle POQ = \angle POR$.

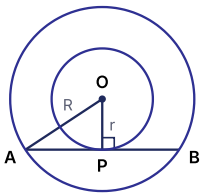
## 4 Lengths and angles with tangents

- **Tangent length:** in right $\triangle OQP$, $PQ^2 = OP^2 - r^2$. Example: $r = 5$, $OP = 13$ gives $PQ = 12$.
- **Angle at the centre:** $OQPR$ has two right angles, so $\angle QPR + \angle QOR = 180^\circ$.
- **Half-angle:** $\angle OPQ = \frac{1}{2}\angle QPR$, and $\angle QPR = 2\angle OQR$.
- If the tangents meet at 60°, then $\angle OPQ = 30^\circ$, so $OP = 2r$ and $PQ = \sqrt{3}r$.

EXAMPLE

Tangents from $P$ meet at $\angle QPR = 50^\circ$. Then $\angle QOR = 130^\circ$ and $\angle OPQ = 25^\circ$; in isosceles $\triangle PQR$, $\angle PQR = 65^\circ$.

## 5 Concentric circles



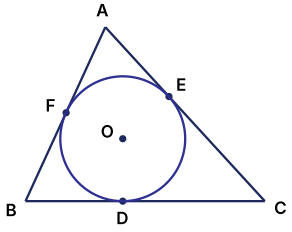

A chord $AB$ of the bigger circle that touches the smaller circle at $P$ is bisected at $P$ (the perpendicular from the centre bisects a chord).

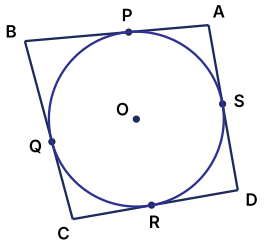
$$AP = \sqrt{R^2 - r^2}, \quad AB = 2\sqrt{R^2 - r^2}$$

**EXAMPLE**

$R = 10$ cm, $r = 6$ cm: $AP = \sqrt{100 - 36} = 8$, so $AB = 16$ cm.

## 6 Circle inside a triangle or a quadrilateral




- **Triangle:** the two tangents from each vertex are equal: $AF = AE$, $BF = BD$, $CD = CE$. Call them $x$, $y$, $z$; then $x + y = AB$, $y + z = BC$, $z + x = CA$.
- **Right triangle** with legs $a$, $b$ and hypotenuse $c$: the incircle radius is $r = \dfrac{a + b - c}{2}$ (the two tangents from the right-angle vertex are both $r$).
- **Quadrilateral** round a circle: $AB + CD = AD + BC$ (pair the tangent lengths from each vertex).
- So a parallelogram round a circle is a rhombus, and a rectangle round a circle is a square.

## 7 Model answer: a parallelogram round a circle (3 marks)

**Prove that a parallelogram circumscribing a circle is a rhombus.**

1. Let $ABCD$ touch the circle at $P$ (on $AB$), $Q$ ($BC$), $R$ ($CD$), $S$ ($DA$). Tangents from a point are equal: $AP = AS$, $BP = BQ$, $CR = CQ$, $DR = DS$ 1
2. Adding: $AB + CD = AD + BC$ 1
3. In a parallelogram $AB = CD$ and $AD = BC$, so $2AB = 2BC$, $AB = BC$: all four sides are equal and $ABCD$ is a rhombus 1

## 8 Model answer: tangent length (2 marks)

**A point $P$ is 17 cm from the centre of a circle of radius 8 cm. Find the length of the tangent from $P$.**

1. $OT \perp PT$ (tangent $\perp$ radius), so $PT^2 = OP^2 - OT^2 = 289 - 64$ 1
2. $PT = \sqrt{225} = 15$ cm 1

## 9 Checks that save marks

- Always join the centre to the point of contact: it gives a right angle.
- Write the reason beside each step: "tangent $\perp$ radius", "tangents from an external point are equal", "RHS".
- In a proof, draw the figure and write Given, To prove and Construction first.
- The angle between the tangents and the angle at the centre add up to 180°: they are not equal.
- For a triangle or quadrilateral round a circle, name the equal tangent lengths $x$, $y$, $z$ first.

## Exam snapshot

What the board asks, and how to prepare

### SYLLABUS 2026–27

- Tangent to a circle at a point of contact.
- **(Prove)** The tangent at any point of a circle is perpendicular to the radius through the point of contact.
- **(Prove)** The lengths of the tangents drawn from an external point to a circle are equal.

### BOARD WEIGHTAGE

**15** / 80

Unit IV Geometry together. Basic papers give 1-mark questions on tangent lengths and angles, a 2-mark question on tangents or concentric circles, and a 3-mark proof.

### MOST ASKED IN BASIC BOARD PAPERS + SAMPLE PAPER 2026–27 (3 PAPERS CHECKED)

| How often | Question type | Marks | Papers |
|---|---|---|---|
| ★★☆ | 1 mark: tangent length or radius, angle between tangents | 1 | 2 of 3 |
| ★★☆ | 3 marks: proof with equal tangents (square, ½ perimeter, ∠APB = 2∠OAB) | 3 | 2 of 3 |
| ★★☆ | 2 marks: concentric circles, or tangent lengths on a common tangent | 2 | 2 of 3 |

### MISTAKES THAT COST MARKS

- Adding instead of subtracting: tangent$^2$ = $OP^2 - r^2$.
- Thinking the angle between the tangents equals the angle at the centre.
- Forgetting that the radius meets the tangent at 90°.
- Using half the chord as the whole chord in concentric circles.
- Pairing the wrong sides of a quadrilateral round a circle.
- Writing a proof without reasons.

### HOW TO USE THIS BOOKLET

1. **Day 1:** Notes, then Part A (guided methods) – fill every blank.
2. **Day 2:** Part B (NCERT practice). Do every MUST DO question first.
3. **Day 3:** Part C (board pattern), Part D (case studies) and the real board questions in Part E.
4. **Sun 10 Jan: Sunday chapter test on Circles and Areas Related to Circles – 20 marks in 40 minutes, without the booklet.**
5. Check every answer in the Answer Booklet. Write each mistake on the My Mistakes page.

### RULES AT A GLANCE

| | |
|---|---|
| **Tangent and radius** | $OP \perp$ tangent at $P$ |
| **Two tangents from $P$** | $PQ = PR$; $OP$ bisects $\angle QPR$ |
| **Tangent length** | $PQ^2 = OP^2 - r^2$ |
| **Angles** | $\angle QPR + \angle QOR = 180^\circ$ |
| **Round a circle** | $AB + CD = AD + BC$; right triangle $r = \frac{a+b-c}{2}$ |

## A

PART A · LEARN THE METHODS

# Guided Practice

Fill in the blanks to learn each board method step by step. Then use the same steps on your own in Part B.

### Tangent lengths and angles

**A1.** A point $P$ is 10 cm from the centre $O$ of a circle of radius 6 cm. Complete the steps to find the length of the tangent $PT$. MUST DO [2]

$\angle OTP =$ ___ (tangent $\perp$ radius). $PT^2 = OP^2 - OT^2 =$ ___ $-$ ___ $=$ ___ $\rightarrow PT =$ ___ cm

**A2.** Two concentric circles have radii 10 cm and 6 cm. Complete the steps to find the chord of the bigger circle that touches the smaller one. [2]

Half-chord $= \sqrt{R^2 - r^2} = \sqrt{\quad - \quad} =$ ___ cm. Chord $= 2\times$ ___ $=$ ___ cm

**A3.** $PQ$ and $PR$ are tangents to a circle with centre $O$, and $\angle QPR = 50^\circ$. Fill in the steps to find $\angle QOR$. [2]

$\angle OQP = \angle ORP =$ ___. $\angle QOR = 360^\circ -$ ___ $-$ ___ $-$ ___ $=$ ___

## Equal tangents

**A4.** A quadrilateral $ABCD$ circumscribes a circle, with $AB = 5$ cm, $BC = 7$ cm and $CD = 8$ cm. Complete the steps to find $AD$. MUST DO [2]

Round a circle: $AB +$ ___ $= AD +$ ___. $5 +$ ___ $= AD +$ ___ $\rightarrow AD =$ ___ cm

**A5.** Complete the proof: the tangents $PQ$ and $PR$ from an external point $P$ to a circle with centre $O$ are equal. MUST DO [3]

Join $OQ$, $OR$, $OP$. In $\triangle OQP$ and $\triangle ORP$: $\angle OQP = \angle ORP =$ ___ (_____)

$OQ =$ ___ (radii), $OP = OP$ (_____). So $\triangle OQP \cong \triangle ORP$ by ____, and $PQ = PR$ by ____

**A6.** A circle is inscribed in a right triangle with legs 6 cm and 8 cm. Complete the steps to find its radius $r$. [2]

Hypotenuse $= \sqrt{36 + 64} =$ ___ cm. Tangents from the other two vertices: $6 - r$ and ___.

$(6 - r) + (\quad) = 10 \rightarrow r =$ ___ cm

# B

PART B · NCERT PRACTICE

## NCERT Practice

The same skills as the NCERT examples and exercises, with new numbers. Basic papers are built on NCERT, so finish every question.

## Tangent and radius

**B1.** From a point inside a circle, the number of tangents that can be drawn to the circle is: [1]

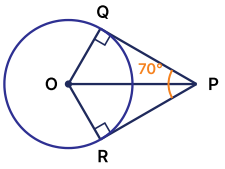
(a) 0 (b) 1 (c) 2 (d) infinitely many

**B2.** A point $P$ is 17 cm from the centre of a circle. The tangent from $P$ to the circle is 15 cm long. Find the radius. MUST DO [2]

**B3.** Find the length of the tangent drawn from a point 10 cm from the centre of a circle of radius 6 cm. [2]

**B4.** Two concentric circles have radii 13 cm and 5 cm. Find the length of the chord of the bigger circle that touches the smaller circle. MUST DO [2]

**B5.** In the figure, $PQ$ and $PR$ are tangents to the circle with centre $O$, and $\angle QPR = 70^\circ$. Then $\angle QOR$ is: [1]




(a) $70°$ (b) $110°$ (c) $140°$ (d) $90°$

**B6.** Tangents $PA$ and $PB$ from $P$ to a circle with centre $O$ are inclined at $70°$. Then $\angle POA$ is: [1]

(a) $35°$ (b) $45°$ (c) $55°$ (d) $70°$

**B7.** Prove that the tangents drawn at the ends of a diameter of a circle are parallel. MUST DO [2]

**B8.** Prove that the perpendicular to a tangent at its point of contact passes through the centre of the circle. [2]

## Tangents from an outside point

**B9.** Prove that the lengths of the tangents drawn from an external point to a circle are equal. [3]
MUST DO

**B10.** A quadrilateral $ABCD$ is drawn to circumscribe a circle. Prove that $AB + CD = AD + BC$. [2]
MUST DO

**B11.** Prove that the angle between the two tangents drawn from an external point to a circle is supplementary to the angle at the centre made by the segment joining the points of contact. [2]

**B12.** Prove that a parallelogram circumscribing a circle is a rhombus. MUST DO [3]

**B13.** Tangents $TA$ and $TB$ are drawn from a point $T$ to a circle with centre $O$. Show that $\angle ATB = 2\angle OAB$. [3]

**B14.** Two parallel tangents to a circle with centre $O$ touch it at $P$ and $Q$. A third tangent touches the circle at $R$ and meets the parallel tangents at $A$ and $B$. Prove that $\angle AOB = 90^\circ$. [3]

C

PART C · BOARD PATTERN (BASIC)

# Board Pattern Practice

Question types from real Mathematics Basic papers (430 series) and the 2026–27 Sample Paper. ★★★ = asked in all 3 papers checked · ★★ = 2 papers · ★ = 1 paper.

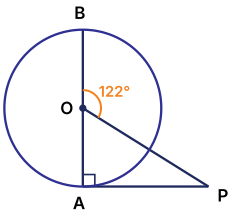
**ASSERTION–REASON: HOW TO ANSWER**

**(a)** Both A and R are true, and R is the correct explanation of A.
**(b)** Both A and R are true, but R is not the correct explanation of A.
**(c)** A is true, but R is false.
**(d)** A is false, but R is true.

## Tangent and radius: lengths and angles

★★☆ 2 of 3 papers · 1–2 marks

**C1.** In the figure, $AB$ is a diameter of the circle with centre $O$ and $PA$ is the tangent at $A$. If $\angle POB = 122^\circ$, then $\angle APO$ is: [1]




MUST DO

(a) 32° (b) 58° (c) 61° (d) 28°

**C2.** $PQ$ and $PR$ are tangents to a circle with centre $O$. If $\angle QOR = 135^\circ$, then $\angle QPR$ is: MUST DO [1]

(a) 67.5° (b) 45° (c) 90° (d) 135°

**C3.** The tangents drawn at the two ends of a diameter of a circle are: [1]

(a) perpendicular (b) meeting at the centre
(c) parallel (d) equal to the diameter

**C4.** ASSERTION–REASON [1]

**Assertion (A):** If the tangent from $P$ to a circle of radius 5 cm is 12 cm long, then $P$ is 13 cm from the centre.

**Reason (R):** The tangent at a point is perpendicular to the radius through that point.

**C5.** The tangent from a point $P$ to a circle of radius 9 cm is 12 cm long. The distance of $P$ from the centre is: [1]

(a) 3 cm (b) 21 cm (c) $\sqrt{63}$ cm (d) 15 cm

**C6.** The tangent from a point $P$ to a circle is 20 cm long and $P$ is 29 cm from the centre. Find the radius of the circle. MUST DO [2]

**C7.** Two concentric circles have radii 17 cm and 8 cm. Find the length of the chord of the bigger circle that touches the smaller circle. MUST DO [2]

## Tangents from an outside point: proofs, polygons, incircles

★★☆ 2 of 3 papers · 2–3 marks

**C8.** Prove that a rectangle circumscribing a circle is a square. MUST DO [3]

**C9.** A circle is inscribed in a right triangle with legs 8 cm and 15 cm. Find its radius. MUST DO [3]

**C10.** Tangents $PA$ and $PB$ are drawn from $P$ to a circle with centre $O$. Prove that $\angle APB = 2\angle OAB$. [3]

**C11.** Tangents $PQ$ and $PR$ are drawn from an external point $P$. Prove that $OP$ is the perpendicular bisector of $QR$. [2]

## D

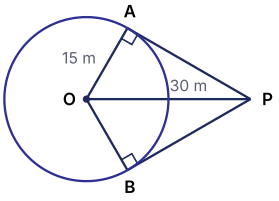
PART D · SECTION E STYLE

# Case-Based Questions

Each case carries 4 marks (1 + 1 + 2), as in Section E of the board paper. Underline the numbers in the passage before you start.

### D1. Case Study · Circular Running Track [4]

Two straight paths $PA$ and $PB$ from a gate $P$ touch a circular running track (centre $O$, radius 15 m) at $A$ and $B$. The gate is 30 m from the centre.




(i) Find the length of the path $PA$. [1]

(ii) Find $\angle APO$. [1]

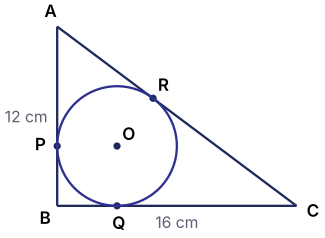
(iii) Show that $\triangle PAB$ is equilateral and find $AB$. [2]

OR

(iii) Find $\angle AOB$ and $\angle OAB$. [2]

### D2. Case Study · Logo with an Incircle [4]

A logo is a right triangle $ABC$ with $\angle B = 90^\circ$, $AB = 12$ cm and $BC = 16$ cm. A circle with centre $O$ is drawn inside it, touching $AB$ at $P$, $BC$ at $Q$ and $AC$ at $R$.




(i) Find $AC$. [1]

(ii) Why is $BP = BQ = r$, the radius of the circle? [1]

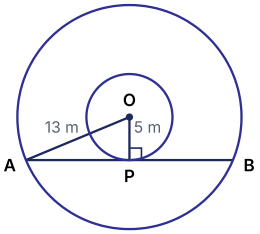
(iii) Find the radius of the circle using tangent lengths. [2]

OR

(iii) Find the radius by writing the area of $\triangle ABC$ in two ways. [2]

## D3. Case Study · Fountain in a Garden [4]

A circular fountain of radius 5 m stands at the centre $O$ of a circular garden of radius 13 m. A straight path $AB$ crosses the garden from edge to edge and just touches the fountain at $P$.




(i) What is $\angle OPA$? Give a reason. [1]

(ii) Find the length of the path $AB$. [1]

(iii) Two such paths touch the fountain at the two ends of one of its diameters. Show that the paths are parallel and find the distance between them. [2]

OR

(iii) A lamp post $L$ stands on the edge of the garden. Find the length of a tangent from $L$ to the fountain, and the total length of two straight wires along both tangents. [2]

# E

PART E · REAL BOARD QUESTIONS

## Board PYQ Index (Basic)

Real questions from the Mathematics Basic (430 series) papers and the 2026–27 Sample Paper, by type. Open the official paper and solve the listed questions.

| Frequency | Question type | Marks | Where asked (year: paper code, question number) | Practise here |
|---|---|---|---|---|
| ★★☆ | **Tangent length, radius, angle between tangents, concentric circles** | 1–2 | **2025:** 430/1/1 Q9, Q23 · **SQP 2026–27:** Q11, Q17 | A1–A3, B1–B8, C1–C7, D3 |
| ★★☆ | **Proofs with equal tangents (square, ½ perimeter, ∠APB = 2∠OAB, common tangent)** | 2–3 | **2025:** 430/1/1 Q29 · **SQP 2026–27:** Q24, Q27(A), Q27(B) | A4–A6, B9–B14, C8–C11, D1–D2 |

**Papers checked (3):** 2026 – 430/1/2 (Section A only could be read online) · 2025 – 430/1/1 · CBSE Sample Paper 2026–27 (Mathematics Basic). Sets of one code family share most questions, so they count as one paper. Download the official papers from cbse.gov.in → Previous Year Question Papers → Mathematics Basic.

PART F · YOUR RECORD

# F My Mistakes

Write down each mistake from this chapter, including the chapter test.

Every wrong answer is a free lesson. Write it here, find the rule you missed, and redo the question after three days. Bring this page to class before the next test.

| Date | Part & Q No. | What went wrong | Correct rule or method | Redone ✓ |
|---|---|---|---|---|
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