Affiliated to CBSE, New Delhi (Affiliation No. 1030642)

GNPS

GOMTI NANDAN PUBLIC SCHOOL

Gandhi Ward, Bina (M.P.) 470113. | 9165 609 333. | info@mygnps.com | www.mygnps.com

CLASS X · MATHEMATICS STANDARD (041) · CBSE BOARD EXAMINATION 2027

CHAPTER 10

Circles

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

51 practice questions | 4 case studies | Board question index | Original diagrams

INSIDE THIS BOOKLET

1	**Chapter Notes** Tangent and secant, the two theorems with proofs, tangent lengths, angles at the centre, circles inside triangles and quadrilaterals, model answers + exam snapshot	2
A	**NCERT Practice** 16 questions	5
B	**Exemplar Practice** 14 questions	6
C	**Board Pattern Practice** 15 questions, with frequency stars	7
D	**Case-Based Questions** 4 case studies	8
E	**Challenge Questions** 6 questions for 95+	10
F	**Board PYQ Index** Real board questions by type	11
G	**My Mistakes** Your error log	12

STUDENT DETAILS

NAME _____

CLASS & SECTION _____

ROLL NO. _____

BOOKLET STARTED ON _____

CHAPTER TEST SCORE _____ / 20

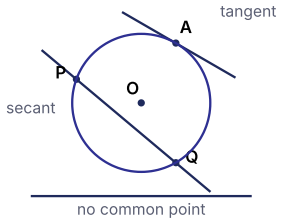
1

READ THIS FIRST

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.

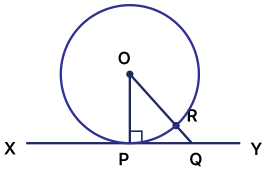
1 A line and a circle



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

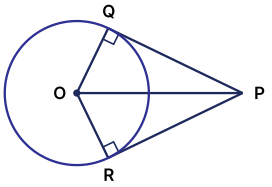


The tangent at any point of a circle is perpendicular to the radius through the point of contact.

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 $\angle POQ = \angle POR$.

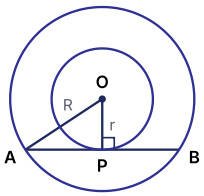
4 Lengths and angles with tangents

- **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



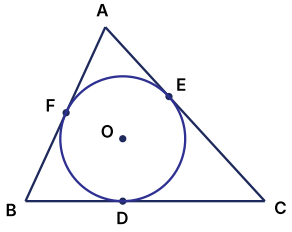
A chord AB of the bigger circle that touches the smaller circle at P is bisected at P (the perpendicular from the centre bisects a chord).

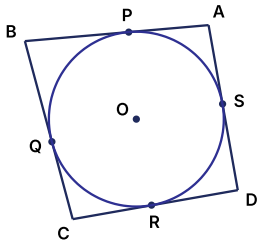
$$AP = \sqrt{R^2 - r^2}, \quad AB = 2\sqrt{R^2 - r^2}$$

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 (Triangles and Circles) together. Every paper checked had at least two questions from Circles: 1-mark angle questions, a 2-mark tangent length, and a 3-mark proof. Two papers also had a 4-mark case study on tangents. In all, about 6–8 marks.

MOST ASKED IN BOARD PAPERS, 2024–2026 + SAMPLE PAPER 2026–27 (4 PAPERS CHECKED)

How often	Question type	Marks	Papers
★★★	3 marks: prove a result with equal tangents (rhombus, ½ perimeter, angles at the centre)	3	4 of 4
★★★	1 mark: angle between tangents, angle at the centre, tangent and radius	1	3 of 4
★★☆	2 marks: tangent length or radius by Pythagoras; concentric circles	2	2 of 4
★★☆	4 marks: case study (circular track, incircle of a right triangle)	4	2 of 4

MISTAKES THAT COST MARKS

- Taking $\angle QOR = \angle QPR$; they add up to 180°.
- Not joining the centre to the point of contact, so the right angle is missed.
- Using the wrong congruence rule: it is RHS, not SAS.
- Writing $AB + BC = CD + DA$ for a quadrilateral round a circle (pair the opposite sides).
- Proofs with no figure, Given or To prove.
- Forgetting that a tangent from a point inside the circle is impossible.

HOW TO USE THIS BOOKLET

1. **Day 1:** Notes, then Part A (NCERT) and Part B (Exemplar). Do every MUST DO question first.
2. **Day 2:** Part C (board pattern) and Part D (case studies).
3. **Day 3:** Part E (challenge) and the real board questions in Part F.
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 $r = \frac{a+b-c}{2}$

PART A · NCERT PRACTICE

A NCERT Practice

The same skills as the NCERT examples and exercises, with new numbers. Finish every question before moving on.

Tangent and radius

A1. From a point inside a circle, the number of tangents that can be drawn to the circle is: [1]

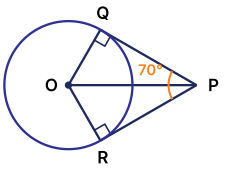
(a) 0 (b) 1 (c) 2 (d) infinitely many

A2. 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]

A3. Find the length of the tangent drawn from a point 10 cm from the centre of a circle of radius 6 cm. [2]

A4. 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]

A5. 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°

A6. 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°

A7. Prove that the tangents drawn at the ends of a diameter of a circle are parallel. MUST DO [2]

A8. 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

A9. Prove that the lengths of the tangents drawn from an external point to a circle are equal. MUST DO [3]

A10. A quadrilateral $ABCD$ is drawn to circumscribe a circle. Prove that $AB + CD = AD + BC$. MUST DO [2]

A11. 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]

A12. Prove that a parallelogram circumscribing a circle is a rhombus. MUST DO [3]

A13. Tangents TA and TB are drawn from a point T to a circle with centre O. Show that $\angle ATB = 2\angle OAB$. [3]

A14. 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]

A15. A triangle ABC is drawn to circumscribe a circle of radius 3 cm. The point of contact D divides BC into $BD = 9$ cm and $DC = 6$ cm. Find AB and AC. [3]

A16. PQ is a chord of length 24 cm of a circle of radius 13 cm. The tangents at P and Q meet at T. Find TP. [3]

B

PART B · EXEMPLAR PRACTICE

Exemplar Practice

Exemplar-style questions on the same ideas, one step harder. Give a reason for every 2-mark answer.

Multiple choice

1 mark each

B1. If the angle between two radii of a circle is 130°, the angle between the tangents at their ends is: [1]

(a) 130° (b) 50° (c) 90° (d) 65°

B2. AB is a chord of a circle with centre O and AT is the tangent at A. If $\angle OAB = 35^\circ$, then $\angle BAT$ is: [1]

(a) 35° (b) 45° (c) 55° (d) 70°

B3. Tangents PA and PB to a circle of radius 6 cm make $\angle APB = 60^\circ$. The length of PA is: [1]

(a) 6 cm (b) $6\sqrt{3}$ cm (c) 12 cm (d) $12\sqrt{3}$ cm

B4. Two concentric circles have radii 10 cm and 6 cm. The chord of the bigger circle that touches the smaller one has length: [1]

(a) 8 cm (b) 12 cm (c) 16 cm (d) 20 cm

B5. Two tangents at right angles to each other are drawn from a point to a circle of radius 5 cm. The length of each tangent is: [1]

(a) 2.5 cm (b) $5\sqrt{2}$ cm (c) 10 cm (d) 5 cm

B6. ASSERTION–REASON [1]

Assertion (A): A tangent can be drawn to a circle from a point inside it.

Reason (R): A tangent meets a circle at exactly one point.

B7. ASSERTION–REASON [1]

Assertion (A): If a circle touches all four sides of a parallelogram, the parallelogram is a rhombus.

Reason (R): The tangents from an external point to a circle are equal.

Short answer with reasons

2–3 marks

B8. Prove that the centre of a circle that touches two intersecting lines lies on the bisector of the angle between the lines. [2]

B9. In $\triangle ABC$, $\angle B = 90^\circ$, $AB = 5$ cm and $BC = 12$ cm. Find the radius of the circle inscribed in the triangle. [2]

B10. A circle touches the side BC of $\triangle ABC$ at P, and touches AB and AC produced at Q and R. Prove that $AQ = \frac{1}{2}$ (perimeter of $\triangle ABC$). MUST DO [3]

B11. Tangents PA and PB are drawn from P to a circle. A tangent at a point C on the minor arc AB meets PA at E and PB at F. If $PA = 10$ cm, find the perimeter of $\triangle PEF$. [2]

Long answer

3–4 marks

B12. Prove that the tangent at any point of a circle is perpendicular to the radius through the point of contact. MUST DO [3]

B13. AB is a diameter of a circle with centre O and AC is a chord with $\angle BAC = 30^\circ$. The tangent at C meets AB produced at D. Prove that $BC = BD$. [4]

B14. A circle is inscribed in $\triangle ABC$ with $AB = 12$ cm, $BC = 8$ cm and $CA = 10$ cm. It touches AB, BC, CA at D, E, F. Find AD, BE and CF. [3]

C

PART C · BOARD PATTERN

Board Pattern Practice

Question types from real 2024–2026 board papers and the 2026–27 Sample Paper, grouped by type. ★★★ = asked in 3 or 4 of the 4 papers checked · ★★ = 2 papers · ★ = 1 paper.

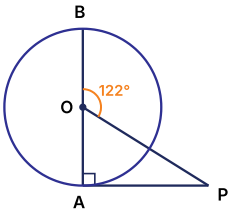
ASSERTION–REASON: HOW TO ANSWER

(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

★★★ 4 of 4 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]

C8. Tangents PA and PB are drawn from P to a circle with centre O, with $\angle APB = 60^\circ$ and $OP = 10$ cm. Find the radius and the length PA. [2]

Tangents from an outside point: proofs, polygons, incircles

★★★ 4 of 4 papers · 3–4 marks

C9. Prove that a rectangle circumscribing a circle is a square. MUST DO [3]

C10. A circle is inscribed in a right triangle with legs 8 cm and 15 cm. Find its radius. MUST DO [3]

C11. Tangents PA and PB are drawn from P to a circle with centre O. Prove that $\angle APB = 2\angle OAB$. [3]

C12. Prove that the opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre. [3]

C13. A circle with centre O touches the sides AB, BC, CD, DA of quadrilateral $ABCD$ at Q, P, R, S. $\angle B = 90^\circ$, $AD = 17$ cm, $AB = 20$ cm and $DS = 6$ cm. Find the radius. [3]

C14. AB is a chord of a circle with centre O and BT is the tangent at B. Prove that $\angle ABT = \frac{1}{2}\angle AOB$. [3]

C15. Tangents PQ and PR are drawn from an external point P. Prove that OP is the perpendicular bisector of QR. [2]

D

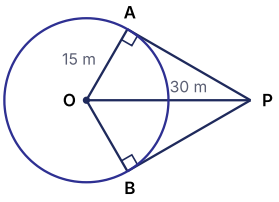
PART D · SECTION E STYLE

Case-Based Questions

Each case carries 4 marks (1 + 1 + 2), as in Section E of the board paper. Read the situation carefully before answering.

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]

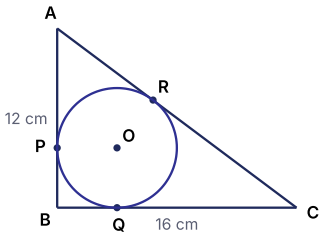
(iii) Show that $\triangle PAB$ is equilateral and find AB. [2]

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]

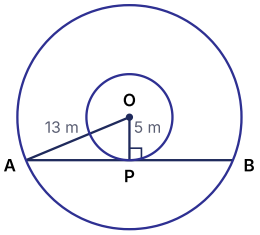
(iii) Find the radius of the circle using tangent lengths. [2]

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]

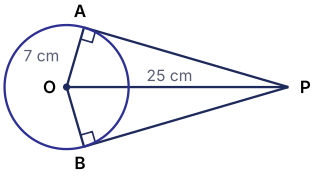
(iii) Two such paths touch the fountain at the two ends of one of its diameters. Show that the paths are parallel and find the distance between them. [2]

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]

D4. Case Study · Pulley and Belt [4]

A belt passes round a circular pulley (centre O, radius 7 cm). Its two straight parts touch the pulley at A and B and meet at P, 25 cm from O.



(i) Find the length PA of each straight part. [1]

(ii) Find the area of the quadrilateral $PAOB$. [1]

(iii) Find the length of AB, the chord joining the points of contact. [2]

OR

(iii) Prove that OP is the perpendicular bisector of AB. [2]

E

PART E · FOR 95+

Challenge Questions

Harder than the usual board question. Try these after Parts A–D: they stretch the same methods to the toughest 3- and 5-mark questions.

E1. Prove that the segment joining the points of contact of two parallel tangents to a circle passes through the centre. [3]

E2. Two circles with centres O and O', of radii 6 cm and 8 cm, meet at P and Q so that OP and $O'P$ are tangents to the two circles. Find the length of the common chord PQ. [3]

E3. An isosceles triangle ABC with $AB = AC$ circumscribes a circle. Prove that the point of contact P on BC bisects BC. [3]

E4. Find the radius of the circle inscribed in a triangle with sides 13 cm, 14 cm and 15 cm. [3]

E5. Tangents PQ and PR are drawn to a circle with centre O, and $\angle QPR = 46^\circ$. S is a point on the major arc QR. Find $\angle QSR$. [2]

E6. From a point P, 26 cm from the centre O of a circle of radius 10 cm, tangents PA and PB are drawn. Find the length of the chord AB. [3]

F

PART F · REAL BOARD QUESTIONS

Board PYQ Index

Real questions from recent Maths Standard board 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
★★★	**Proofs with equal tangents (rhombus, ½ perimeter, angles at the centre, incircle)**	3–4	**2026:** 30/1/1 Q29(A), Q29(B) · **2025:** 30/1/1 Q26(a), Q26(b) · **2024:** 30/1/1 Q30(A), Q30(B), Q38 (case study) · **SQP 2026–27:** Q29, Q37 (case study)	A9–A16, C9–C15, D1–D2, D4
★★★	**Tangent and radius: angles, tangent length, concentric circles**	1–2	**2026:** 30/1/1 Q12, Q13, Q25 · **2025:** 30/1/1 Q7, Q16, Q25 · **2024:** 30/1/1 Q19	A1–A8, C1–C8, D3

PAPERS CHECKED

- **2026:** 30/1/1 (Delhi, Set 1)
- **2025:** 30/1/1 (Delhi, Set 1)
- **2024:** 30/1/1 (Delhi, Set 1)
- **CBSE Sample Paper 2026–27** (Mathematics Standard)

Sets of one code family (30/1/1, 30/1/2, 30/1/3) share most questions, so each counts as one paper. Download the official papers from cbse.gov.in → Previous Year Question Papers, and solve the exact questions listed above.

PART G · YOUR RECORD

G 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 ✓