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CHAPTER NOTES

Areas Related to Circles Class 10 Notes | CBSE Maths Chapter 11

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Explain Areas Related to Circles simply

What can the board exam ask?

Most important formulas

Quiz me on this chapter

Ask Ira anything...



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Areas Related to Circles Class 10 Notes | CBSE Maths Chapter 11

Areas Related to Circles is Chapter 11 of CBSE Class 10 Maths. It starts from two facts you already know, the circumference of a circle is $2\pi r$ and its area is πr^2 , and uses the unitary method to find the length of an arc, the area of a sector and the area of a segment of a circle. The chapter covers minor and major sectors, minor and major segments, and everyday problems on clock hands, grazing animals, car wipers, umbrellas and lighthouses.

For board exams this chapter is short and formula-driven, so marks come from accuracy. Every question comes down to two numbers, the radius and the angle at the centre, followed by one of three formulas. The hardest step is the area of a segment, where you must also find the area of the triangle formed by the chord and two radii. Careful use of $\pi = 22/7$ or $\pi = 3.14$, correct units and exact surd answers such as $441\sqrt{3}/4$ decide whether a final answer is right

Quick Answer - Areas Related to C

A **sector** is the region between two radii and a chord and an arc. For a circle of radius r and angle θ at the centre, the area of sector is $(\theta/360) \times 2\pi r^2$ and **area of sector** = $(\theta/360) \times \pi r^2$ since the whole circle is a sector of 360°. The area of the **triangle OAB**. The major sector or major segment is the rest of the circle. Otherwise, "sector" and "segment" mean the same.



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All Key Formulas at a Glance

Quantity	Formula	Use it when
Circumference of a circle	$2\pi r$	Finding the radius from the circumference, or the length of wire in a ring
Area of a circle	πr^2	Whole disc, and the starting point for major sectors and segments
Length of an arc (angle θ)	$(\theta/360) \times 2\pi r$	Crust of a slice, path of a pendulum bob, tip of a clock hand
Area of a sector (angle θ)	$(\theta/360) \times \pi r^2$	Region swept by a hand, wiper or rope
Area of sector from arc length l	$(1/2) \times l \times r$	
Perimeter of a sector	$2r + (\theta/360) \times 2\pi r$	
Area of a major sector	$\pi r^2 - \text{area of minor sector, or } ((360 - \theta)/360) \times \pi r^2$	
Area of a minor segment	$(\theta/360) \times \pi r^2 - \Delta OAB$	
Area of a major segment	$\pi r^2 - \text{area of minor segment}$	
Area of ΔOAB for $\theta = 60^\circ, 90^\circ, 120^\circ$	$(\sqrt{3}/4)r^2, (1/2)r^2, (\sqrt{3}/4)r^2$	



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Key Concepts

1. Circle Basics You Need Before This Chapter

Every formula in this chapter is built on two results about a full circle of radius r :

- **Circumference (perimeter) of a circle = $2\pi r$** , which is also πd , where $d = 2r$ is the diameter.
- **Area of a circle (circular region or disc) = πr^2** .

The number π is the same for every circle: it is the ratio of the circumference to the diameter. It is irrational, so in calculations you use an approximation. The question tells you which one: $\pi = 22/7$ or $\pi = 3.14$. In the NCERT exercise the instruction is “Unless stated otherwise, use $\pi = 22/7$ ”, and some questions ask for $\pi = 3.14$ instead.

Radius	Value of π used	Circumference $2\pi r$	Area πr^2
7 cm	$22/7$	220 cm	154 cm ²
14 cm	$22/7$	880 cm	616 cm ²
21 cm	$22/7$	1386 cm	1519.5 cm ²
3.5 cm	$22/7$	22 cm	4.125 cm ²
10 cm	3.14	62.8 cm	31.4 cm ²

Tip: $\pi = 22/7$ makes the working short when you use 3.5, because the 7 cancels. Always use the same value of π throughout a question.

Lengths are measured in cm, m or km. Area is measured in cm², m² or km². Always use the same unit with the answer.

Finding r from the circumference. If the circumference is 22 cm, then $22 = 2\pi r$, so $r = 22 \times 7 / 44 = 3.5$ cm. Many questions give the circumference and ask for the radius. Convert to the radius before using a formula.

2. Sector and Segment: Minor and Major

Take a circle with centre O and two points A and B on the circumference. The line segment AB is a chord. The region bounded by the chord AB and the minor arc AB is a minor segment. The region bounded by the chord AB and the major arc AB is a major segment.



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Sector. The portion of the circular region enclosed by two radii and the corresponding arc is called a **sector** of the circle. Join OA and OB. The region bounded by radius OA, the arc from A to B, and radius OB is a sector. The angle $\angle AOB$ at the centre is called the **angle of the sector**.

The two radii split the disc into two sectors. The smaller one, OAPB (where P is a point on the shorter arc), is the **minor sector**. The larger one, OAQB (where Q is on the longer arc), is the **major sector**. Since the angles at the centre make a full turn:

Angle of the major sector = $360^\circ - \angle AOB$

Segment. The portion of the circular region enclosed between a chord and the corresponding arc is called a **segment** of the circle. Draw chord AB. The region between chord AB and the shorter arc APB is the **minor segment**. The region between chord AB and the longer arc AQB is the **major segment**.

Remark from NCERT: when we write "segment" and "sector", we mean the minor segment and the minor sector, unless stated otherwise.

Feature	Sector
Boundary	Two radii and an arc
Does it use the centre?	Yes, its corner is at centre O
Everyday picture	A slice of pizza cut from the centre
Minor + major	Minor sector + major sector = whole circle

Special sectors. A sector of angle 90° is a **quadrant**. A sector of angle 180° is a **semicircle** (half the circle). When you cut a circle into two equal parts, each is a semicircle.

Link between the two. The minor sector OAPB and the minor segment APB form a **segment of a circle** triangle OAB. This single picture gives the



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3. Length of an Arc

Let OAPB be a sector of a circle with centre O and radius r , and let the degree measure of $\angle AOB$ be θ . NCERT uses the **unitary method**:

- The whole circle can be thought of as a sector of angle 360° . Its arc is the whole circumference, $2\pi r$.
- So an angle of 1° at the centre gives an arc of length $2\pi r/360$.
- So an angle of θ° gives an arc of length $(2\pi r/360) \times \theta$.

Length of an arc of a sector of angle $\theta = (\theta/360) \times 2\pi r$

The fraction $\theta/360$ tells you what part of the full circle you have. A 90° arc is $90/360 = 1/4$ of the circumference, a 60° arc is $1/6$ of it, and a 120° arc is $1/3$ of it.

Illustration 1. Radius 21 cm, angle 60° . Arc = $(60/360) \times 2 \times 22/7 \times 21 = (1/6) \times 132 = 22$ cm.

Illustration 2. Radius 14 cm, angle 90° . Arc = $(90/360) \times 2 \times 22/7 \times 14 = (1/4) \times 616 = 154$ cm.

Finding the angle from the arc. Rearranging the formula for a circle of radius 21 cm: $2\pi r = 132$ cm, so $\theta = (132 \times 360) / (2 \times 22 \times 21) = 60^\circ$.

Perimeter of a sector. The boundary of a sector is the sum of the two radii and the arc length.

Perimeter of a sector = $2r + (\theta/360) \times 2\pi r$

For a quadrant of radius 7 cm, arc = $(1/4) \times 2\pi r = 11$ cm. Students often give only the arc (11 cm) when asked for the perimeter.

How the arc changes. Arc length is directly proportional to r when θ is fixed. Double the radius, the arc doubles.

4. Area of a Sector

The same unitary method works for area.

- When the degree measure of the angle is 360° , the area is the whole disc).
- When the degree measure of the angle at the centre is 1, the area of the sector is $\pi r^2/360$.



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- When the degree measure of the angle at the centre is θ , the area of the sector is $(\pi r^2/360) \times \theta$.

Area of the sector of angle $\theta = (\theta/360) \times \pi r^2$, where r is the radius of the circle and θ is the angle of the sector in degrees.

Illustration 1. Radius 14 cm, angle 90° . Area = $(1/4) \times 22/7 \times 196 = (1/4) \times 616 = \mathbf{154 \text{ cm}^2}$.

Illustration 2. Radius 7 cm, angle 45° . Area = $(45/360) \times 154 = (1/8) \times 154 = \mathbf{19.25 \text{ cm}^2}$.

Major sector. Two ways, and both give the same answer:

- Area of the major sector = $\pi r^2 - \text{area of the minor sector}$.
- Area of the major sector = $((360 - \theta)/360) \times \pi r^2$, using the angle of the major sector directly.

For radius 14 cm and $\theta = 90^\circ$: major sector = $616 - 154 = 462 \text{ cm}^2$, or $(270/360) \times 616 = (3/4) \times 616 = 462 \text{ cm}^2$.

A shortcut linking area and arc. Write the area of the sector as $\frac{1}{2} \times l \times r$. Here $2\pi r$ is the arc length l . So

Area of a sector = $(1/2) \times l \times r$

This looks like the area of a triangle with base l and height r .
Check: radius 14 cm, arc 22 cm gives $(1/2) \times 22 \times 14 = 154 \text{ cm}^2$, which matches the area of the sector when the arc length is given and the angle is 90° .

How the area changes. For a fixed radius, the area of a sector is proportional to r^2 : double the radius, the area becomes four times as much. This is why the grazing area jumps so much when the radius is doubled.

5. Area of a Segment

Let AB be a chord of a circle with centre O . The area of the sector $OAPB$ is made up of the minor segment APB and the triangle AOB . So, the area of the segment APB is the area of the sector $OAPB$ minus the area of the triangle AOB .

Area of the segment $APB = \text{area of the sector } OAPB - \text{area of the triangle } \Delta OAB$



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And for the other side of the chord:

Area of the major segment AQB = πr^2 – area of the minor segment APB

The sector part is routine. The real work is the **area of triangle OAB**. Triangle OAB is always isosceles because OA = OB = r. Here is how to handle the angles that appear in the NCERT exercises.

Case $\theta = 90^\circ$. The triangle is right-angled at O, with both legs equal to r. Area = $(1/2) \times r \times r = r^2/2$. For r = 10 cm the triangle is 50 cm².

Case $\theta = 60^\circ$. OA = OB and the angle between them is 60°, so the base angles are $(180^\circ - 60^\circ)/2 = 60^\circ$ each. The triangle is equilateral with side r. Area = $(\sqrt{3}/4) r^2$. For r = 21 cm, the triangle is $441\sqrt{3}/4$ cm².

Case $\theta = 120^\circ$ (the NCERT method). Draw OM perpendicular to AB. In the right triangles OMA and OMB, the hypotenuses OA = OB and the angles at O are congruent. So M is the mid-point of AB and OM is perpendicular to AB.

- OM/OA = cos 60° = 1/2, so OM = r/2.
- AM/OA = sin 60° = $\sqrt{3}/2$, so AM = $(\sqrt{3}/2) r$.
- Area of $\Delta OAB = (1/2) \times AB \times OM = (1/2) \times 2AM \times OM = AM \times OM$.

Notice that the triangle for 120° has the same base as the triangle for 60°, but the heights are different, the areas are equal.

Case $\theta = 180^\circ$. The chord is a diameter and the area of the segment is zero. The area of the circle is πr^2 .

θ	Sector area	Area of triangle OAB
60°	$\pi r^2/6$	$(\sqrt{3}/4) r^2$
90°	$\pi r^2/4$	$r^2/2$
120°	$\pi r^2/3$	$(\sqrt{3}/4) r^2$

Illustration. Radius 14 cm, $\theta = 90^\circ$, $\pi = 22/7$. Minor segment = $154 - 98 = 56$ cm².



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Exact or approximate? When the question gives no value of $\sqrt{3}$, leave the answer in surd form, as NCERT does in Example 2: $(462 - 441\sqrt{3}/4) \text{ cm}^2$. When it says “use $\sqrt{3} = 1.73$ ”, give a decimal answer.

6. Real-Life Problems on Sectors and Segments

The NCERT exercise is full of everyday situations. Each one hides a sector: your job is to find its **radius** and its **angle**, then decide whether the question wants an arc, a sector area or a segment area.

Situation	Radius is	Angle is	Usually asked
Minute hand of a clock	Length of the hand	6° per minute (360° in 60 minutes)	Area swept
Hour hand of a clock	Length of the hand		
Animal tied at the corner of a square or rectangular field	Length of the rope		
Umbrella with n equally spaced ribs	Radius of the umbrella		
Brooch or wheel with k diameters	Half the diameter of the circle		
Car wiper	Length of the blade		
Lighthouse beam	Distance the light reaches		

Method for any word problem:

1. Read the radius. If a diameter or a circu



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2. Read or work out the central angle θ in degrees.
3. Decide what is asked: a length (arc or perimeter), a sector area, or a segment area.
4. Write the formula, substitute, and simplify with the value of π the question asks for.
5. Write the unit: cm, m or km for length; cm^2 , m^2 or km^2 for area.

Clock illustration. The minute hand turns 360° in 60 minutes, so in 5 minutes it turns $5 \times 6^\circ = 30^\circ$. In 20 minutes it turns 120° . The hour hand turns 360° in 12 hours, so in 1 hour it turns 30° .

Grazing illustration. A goat is tied with a 7 m rope to a corner of a square field of side 20 m. The field's corner is a right angle, so the goat grazes a quadrant of radius 7 m: $(1/4) \times 22/7 \times 49 = 38.5 \text{ m}^2$. This works because the rope (7 m) is shorter than the side of the field (20 m), so the quadrant stays inside the field.



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Formula and Theorem Sheet

Result	Formula	Notes
Circumference of a circle	$2\pi r = \pi d$	$d = 2r$
Area of a circle	πr^2	Area of the whole disc
Angle of major sector	$360^\circ - \theta$	θ = angle of the minor sector
Length of an arc	$l = (\theta/360) \times 2\pi r$	θ in degrees
Angle from arc length	$\theta = (l/2\pi r) \times 360$	Rearranged arc formula
Perimeter of a sector	$2r + l$	Two radii plus the arc
Area of a sector	$(\theta/360) \times \pi r^2$	
Area of a sector in terms of arc	$(1/2) \times l \times r$	
Area of a major sector	$\pi r^2 - \text{minor sector}$ $(\theta/360) \times \pi r^2$	
Area of a minor segment	$(\theta/360) \times \pi r^2$	
Area of a major segment	$\pi r^2 - \text{minor segment}$	
ΔOAB when $\theta = 90^\circ$	$r^2/2$	
ΔOAB when $\theta = 60^\circ$	$(\sqrt{3}/4) r^2$	
ΔOAB when $\theta = 120^\circ$	$(\sqrt{3}/4) r^2$	
Clock hands	Minute hand $30^\circ/\text{h}$	



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Important Definitions

- **Circle:** the set of all points in a plane at a fixed distance (the radius) from a fixed point (the centre).
- **Circular region (disc):** the circle together with all the points inside it. Its area is πr^2 .
- **Arc:** a part of the circle between two points on it. The shorter one is the minor arc and the longer one is the major arc.
- **Chord:** a line segment joining two points on a circle. A chord through the centre is a diameter.
- **Sector:** the portion (or part) of the circular region enclosed by two radii and the corresponding arc.
- **Angle of the sector:** the angle $\angle AOB$ formed at the centre by the two radii of the sector.
- **Minor sector:** the smaller of the two sectors made by two radii; its angle is θ .
- **Major sector:** the larger of the two sectors made by two radii; its angle is $360^\circ - \theta$.
- **Segment:** the portion (or part) of the circle cut off by a chord and the corresponding arc.
- **Minor segment:** the smaller region cut off by a chord.
- **Major segment:** the larger region cut off by a chord.
- **Quadrant:** a sector of angle 90° , one quarter of a circle.
- **Semicircle:** a sector of angle 180° , half of a circle.
- **Length of an arc:** the distance along the circumference of a circle subtended by an angle θ at the centre.
$$l = \frac{\theta}{360} \times 2\pi r$$



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Solved Examples (NCERT)

Example 1: Sector and major sector

Find the area of the sector of a circle with radius 7 cm and angle 60° at the centre. Also find the area of the corresponding major sector (Use $\pi = 3.14$)

Solution:

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Area of the sector = $(\theta/360) \times \pi r^2 = (30/360) \times 3.14 \times 4 \times 4 \text{ cm}^2 = 12.56/3 \text{ cm}^2 = \mathbf{4.19 \text{ cm}^2}$
(approx.)

Area of the major sector = $\pi r^2 - \text{area of the minor sector} = (3.14 \times 16 - 4.19) \text{ cm}^2 = (50.24 - 4.19) \text{ cm}^2 = 46.05 \text{ cm}^2 = \mathbf{46.1 \text{ cm}^2}$ (approx.)

Check with the other route: $((360 - 30)/360) \times 3.14 \times 16 = (330/360) \times 50.24 = 46.05 \text{ cm}^2$. Both agree.

Example 2: Segment with a 120° angle (NCERT Example 2)

Find the area of the segment AYB if the radius of the circle is 21 cm and $\angle AOB = 120^\circ$. (Use $\pi = 22/7$)

Solution:

Area of segment AYB = area of sector OAYB - area of $\triangle OAB$

Area of sector OAYB = $(120/360) \times 22/7 \times 21 \times 21$

For $\triangle OAB$, draw $OM \perp AB$. Since $OA = OB$, M is the mid-point of AB and $\angle AOM = \angle BOM = 60^\circ$.

In $\triangle OMA$: $OM/OA = \cos 60^\circ = 1/2$, so $OM = 10.5$ cm and $AB = 2 AM = 21\sqrt{3}$ cm.

Area of $\triangle OAB = (1/2) \times AB \times OM = (1/2) \times 21\sqrt{3} \times 10.5$

Area of segment AYB = $(462 - 441\sqrt{3}/4) \text{ cm}^2$

(Check: $(21/4) \times 88 = 462$ and $(21/4) \times 21\sqrt{3} \times 10.5 = 441\sqrt{3}/4$)

Example 3: Area of a sector (NCERT Example 3)

Find the area of a sector of a circle with radius 6 cm and angle 60° .

Solution: Area = $(60/360) \times 22/7 \times 6 \times 6 = 39.27 \text{ cm}^2 \approx \mathbf{18.86 \text{ cm}^2}$.

Example 4: Quadrant from the circle (NCERT Example 4)

Find the area of a quadrant of a circle whose circumference is 22 cm.



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Solution: $2\pi r = 22$, so $2 \times \frac{22}{7} \times r = 22$, giving $r = \frac{7}{2} = 3.5$ cm.

Area of the quadrant = $(\frac{1}{4}) \times \pi r^2 = (\frac{1}{4}) \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} = (\frac{1}{4}) \times \frac{77}{2} = \frac{77}{8} \text{ cm}^2 = 9.625 \text{ cm}^2$.

Example 5: Minute hand of a clock (NCERT Exercise 11.1, Q3)

The length of the minute hand of a clock is 14 cm. Find the area swept by the minute hand in 5 minutes.

Solution: The minute hand turns 360° in 60 minutes, so 6° per minute. In 5 minutes it turns $\theta = 30^\circ$. The radius is the length of the hand, $r = 14$ cm.

Area swept = $(\frac{30}{360}) \times \frac{22}{7} \times 14 \times 14 = (\frac{1}{12}) \times 616 = \frac{154}{3} \text{ cm}^2 = 51 \frac{1}{3} \text{ cm}^2 \approx 51.33 \text{ cm}^2$.

Example 6: Chord subtending a right angle (NCERT Exercise 11.1, Q4)

A chord of a circle of radius 10 cm subtends a right angle at the centre. Find the areas of the corresponding: (i) minor segment (ii) major segment

Solution:

Area of the minor sector = $(\frac{90}{360}) \times 3.14 \times 10^2 = 78.5 \text{ cm}^2$

$\triangle OAB$ is right-angled at O with $OA = OB = 10$ cm

(i) Minor segment = $78.5 - 50 = 28.5 \text{ cm}^2$

(ii) Major sector = $\pi r^2 - \text{minor sector} = 314 - 78.5 = 235.5 \text{ cm}^2$

Example 7: Arc, sector and segment

In a circle of radius 21 cm, an arc subtends an angle of 60° at the centre. Find (i) the length of the arc (ii) area of the sector formed by the arc and the radii (iii) area of the segment formed by the arc and the corresponding chord.

Solution:

(i) Arc = $(\frac{60}{360}) \times 2 \times \frac{22}{7} \times 21 = \frac{1}{6} \times 2 \times \frac{22}{7} \times 21 = 22$ cm

(ii) Sector = $(\frac{60}{360}) \times \frac{22}{7} \times 21 \times 21 = \frac{1}{6} \times \frac{22}{7} \times 21 \times 21 = 231$ cm²



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(iii) With $\theta = 60^\circ$ and $OA = OB$, $\triangle OAB$ is equilateral with side 21 cm. Its area = $(\sqrt{3}/4) \times 21^2 = 441\sqrt{3}/4 \text{ cm}^2$. Segment = $(231 - 441\sqrt{3}/4) \text{ cm}^2$.

Example 8: Minor and major segments with 60° (NCERT Exercise 11.1, Q6)

A chord of a circle of radius 15 cm subtends an angle of 60° at the centre. Find the areas of the corresponding minor and major segments of the circle. (Use $\pi = 3.14$ and $\sqrt{3} = 1.73$)

Solution:

Sector = $(60/360) \times 3.14 \times 225 = 706.5/6 = 117.75 \text{ cm}^2$.

$\triangle OAB$ is equilateral with side 15 cm: area = $(1.73/4) \times 225 = 389.25/4 = 97.3125 \text{ cm}^2$.

Minor segment = $117.75 - 97.3125 = 20.4375 \text{ cm}^2$.

Area of the circle = $3.14 \times 225 = 706.5 \text{ cm}^2$.

Example 9: Segment with 120° (NCERT Exercise 11.1, Q7)

A chord of a circle of radius 12 cm subtends an angle of 120° at the centre. Find the area of the corresponding segment of the circle. (Use $\pi = 3.14$ and $\sqrt{3} = 1.73$)

Solution:

Sector = $(120/360) \times 3.14 \times 144 = 452.16/3 = 150.72 \text{ cm}^2$.

Draw $OM \perp AB$. As in NCERT Example 2, $\angle AOM = 60^\circ$, $OM = 6 \text{ cm}$, so $AB = 12\sqrt{3} \text{ cm}$.

Area of $\triangle OAB = (1/2) \times 12\sqrt{3} \times 6 = 36\sqrt{3} = 62.28 \text{ cm}^2$.

Segment = $150.72 - 62.28 = 88.44 \text{ cm}^2$.

Example 10: The grazing horse (NCERT Exercise 11.2, Q6)

A horse is tied to a peg at one corner of a square field of side 15 m long rope. Find (i) the area of that part of the field in which the horse can graze. (ii) increase in the grazing area if the rope were 10 m long instead of 5 m.

Solution: The corner of a square is 90° , and the horse grazes a quadrant whose radius is the rope length.



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(i) Area = $(1/4) \times 3.14 \times 5 \times 5 = 78.5/4 = \mathbf{19.625\ m^2}$.

(ii) With a 10 m rope: $(1/4) \times 3.14 \times 100 = 78.5\ m^2$. Increase = $78.5 - 19.625 = \mathbf{58.875\ m^2}$.

Doubling the rope made the area four times as large ($19.625 \times 4 = 78.5$), because area depends on r^2 .

Example 11: The silver brooch (NCERT Exercise 11.1, Q9)

A brooch is made with silver wire in the form of a circle with diameter 35 mm. The wire is also used in making 5 diameters which divide the circle into 10 equal sectors. Find: (i) the total length of the silver wire required. (ii) the area of each sector of the brooch.

Solution: $r = 35/2 = 17.5\ \text{mm}$.

(i) Circumference = $\pi d = 22/7 \times 35 = 110\ \text{mm}$. Five diameters = $5 \times 35 = 175\ \text{mm}$. Total wire = $110 + 175 = \mathbf{285\ \text{mm}}$.

(ii) Ten equal sectors, so each angle = $360/10 = 36^\circ$. Area of each sector = $(36/360) \times \pi r^2 = (1/10) \times 962.5 = \mathbf{96.25\ mm^2}$ (= 385/4 mm^2).

Example 12: Umbrella ribs (NCERT Exercise 12.1, Q1)

An umbrella has 8 ribs which are equally spaced. Each rib is 45 cm long, find the area between the two consecutive ribs.

Solution: 8 equally spaced ribs make 8 equal sectors.

Area = $(45/360) \times 22/7 \times 45 \times 45 = (1/8) \times 962.5 = \mathbf{120.3125\ cm^2}$.

Example 13: Car wipers (NCERT Exercise 13.1, Q1)

A car has two wipers which do not overlap. Each wiper has a blade of length 25 cm and sweeps through an angle of 115° . Find the total area swept by both blades.

Solution: Each blade sweeps a sector of radius 25 cm. Area of one sector = $(115/360) \times \pi r^2$. so total area = $2 \times$ one sector.

Total = $2 \times (115/360) \times 22/7 \times 25 \times 25 = (115/18) \times 962.5 = \mathbf{158125/126\ cm^2 \approx 1254.96\ cm^2}$.



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Example 14: Lighthouse warning zone (NCERT Exercise 11.1, Q12)

To warn ships for underwater rocks, a lighthouse spreads a red coloured light over a sector of angle 80° to a distance of 16.5 km. Find the area of the sea over which the ships are warned. (Use $\pi = 3.14$)

Solution: $r = 16.5$ km, $\theta = 80^\circ$. $r^2 = 272.25$.

Area = $(80/360) \times 3.14 \times 272.25 = (2/9) \times 854.865 = 1709.73/9 = \mathbf{189.97 \text{ km}^2}$ (approx.).

Competency-Based Questions (with answers)

1. Case-based: The pizza party

A round pizza of radius 14 cm is cut from the centre into 8 equal slices. (Use $\pi = 22/7$)

(a) What is the angle of each slice at the centre?

(b) Find the area of one slice. $(45/360) \times \pi \times r^2$

(c) Find the length of crust on one slice and the perimeter of the sector. $22/7 \times 14 = (1/8) \times 88 = 11$ cm. Perimeter =

(d) Three friends eat 5 slices. What area of the pizza is left? 3 slices form one sector of angle $3 \times 45^\circ = 135^\circ$.

2. Case-based: The garden sprinkler

A lawn sprinkler fixed at a point throws water over a sector of angle of 120° . (Use $\pi = 22/7$)

(a) What shape is the watered region? A sector of a circle.

(b) Find the area watered. $(120/360) \times \pi \times r^2$

(c) Find the length of the curved edge of the watered region. $2\pi r \times (120/360) = 44$ m.

(d) If the gardener wants to water 693 m^2 of the lawn, what should be the angle of the sprinkler? $\theta/360 \times \pi \times 1386 = 693$, so $\theta/360 = 1/2$ and $\theta = 180^\circ$.



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3. Case-based: The swinging pendulum

The bob of a pendulum 35 cm long swings through an angle of 72° from one extreme position to the other. (Use $\pi = 22/7$)

(a) Find the length of the path of the bob in one swing. Arc = $(72/360) \times 2 \times 22/7 \times 35 = (1/5) \times 220 = 44$ cm.

(b) Find the area swept by the string in one swing. Using $(1/2) \times l \times r = (1/2) \times 44 \times 35 = 770$ cm². Check: $(1/5) \times 22/7 \times 1225 = (1/5) \times 3850 = 770$ cm².

4. Source-based: The unitary method

NCERT derives the area of a sector like this: "When degree measure of the angle at the centre is 360, area of the sector = πr^2 . So, when the degree measure of the angle at the centre is 1, area of the sector = $\pi r^2/360$."

(a) For a circle of radius 6 cm, what is the area of a sector of 1°?
= $113.04/360 = 0.314$ cm².

(b) Using (a), find the area of a sector of 60°.

(c) Apply the same reasoning to arc length. 1° gives $2\pi r/360$ and θ° gives $(\theta/360) \times 2\pi r$.

5. Assertion-Reason

Assertion (A): The area of a sector of radius 7 cm and angle 11° is 38.5 cm².

Reason (R): The area of a sector with arc length 7 cm and angle 11° is 38.5 cm².

Choose: (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.

Answer: (a) $(1/2) \times 11 \times 7 = 38.5$ cm², and $(11/360) \times \pi \times 7^2 = 38.5$ cm².

6. Assertion-Reason

Assertion (A): If the radius of a circle is doubled, the area of a sector of fixed angle is also doubled.

Reason (R): For a fixed angle, the area of a sector is directly proportional to the square of the radius.



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Choose: (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.

Answer: (d) Area = $(\theta/360)\pi r^2$, so doubling r multiplies the area by 4. A is false and R is true.

7. Assertion-Reason

Assertion (A): A chord of a circle of radius 10 cm subtends a right angle at the centre. The area of the minor segment is 28.5 cm^2 (use $\pi = 3.14$).

Reason (R): Area of a segment = area of the corresponding sector + area of the corresponding triangle.

Choose: (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.

Answer: (c) $78.5 - 50 = 28.5 \text{ cm}^2$, so A is true. The triangle is subtracted, so R is false.

8. Error analysis: The wrong triangle

A student finds the area of the minor segment subtending 60° at the centre. The working is $(1/2) \times 14 \times 14 = 98 \text{ cm}^2$; segment = $308/3$

(a) Find the error. The formula $(1/2) \times r \times r \times \sin \theta$ for ΔOAB is equilateral with side 14 cm.

(b) Correct the answer (use $\sqrt{3} = 1.73$). The area of the sector = $308/3 \approx 102.67 \text{ cm}^2$. Segment $\approx 102.67 - 98 = 4.67 \text{ cm}^2$.

9. Competency MCQ: Which expression

The area of a sector of angle p (in degrees) of a circle with radius R is

(A) $(p/180) \times 2\pi R$ (B) $(p/180) \times \pi R^2$ (C) $(p/360) \times 2\pi R$ (D) $(p/360) \times \pi R^2$

Answer: (D) $(p/720) \times 2\pi R^2 = (p/360) \times \pi R^2$. (A) is twice the arc length and (B) is twice the area of the sector.



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Important Questions for Board Exams

1-Mark Questions

Q1. Find the area of a quadrant of a circle of radius 7 cm. (Use $\pi = 22/7$)

$$(1/4) \times 22/7 \times 49 = 38.5 \text{ cm}^2.$$

Q2. An arc of a circle of radius 21 cm subtends 60° at the centre. Find its length.

$$(1/6) \times 2 \times 22/7 \times 21 = 22 \text{ cm}.$$

Q3. The angle of a minor sector is 75° . What is the angle of the corresponding major sector?

$$360^\circ - 75^\circ = 285^\circ.$$

Q4. The area of a sector is one-fifth of the area of its circle. Find the angle of the sector.

$$\theta/360 = 1/5, \text{ so } \theta = 72^\circ.$$

Q5. Find the perimeter of a semicircular protractor.

Curved part $\pi r = 22 \text{ cm}$, plus the diameter



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2-Mark Questions

Q6. The minute hand of a clock is 21 cm long. Find the area of the sector it sweeps in 20 minutes.

$$\text{Angle} = 20 \times 6^\circ = 120^\circ. \text{ Area} = (120/360) \times \pi r^2$$

Q7. The area of a sector of angle 40° is $352/7 \text{ cm}^2$. Find the radius of the circle.

$$(40/360) \times 22/7 \times r^2 = 352/7 \Rightarrow (1/9) \times 22 \times r^2 = 352/7$$

Q8. An arc of length 44 cm lies on a circle of radius 70 cm. Find the angle subtended by the arc at the centre and the area of the sector.

$$\text{Circumference} = 132 \text{ cm, so } \theta = (44/132) \times 360^\circ$$

Q9. Find the perimeter of a quadrant of a circle of radius 14 cm.

$$\text{Arc} = (1/4) \times 88 = 22 \text{ cm. Perimeter} = 14 + 14 + 22$$

3-Mark Questions

Q10. A chord of a circle of radius 14 cm subtends an angle of 90° at the centre. Find the area of the minor and major segments. (Use $\pi = 22/7$)

$$\text{Sector} = (1/4) \times 616 = 154 \text{ cm}^2. \text{ Triangle} = (1/2) \times 14 \times 14 = 98 \text{ cm}^2. \text{ Circle} = 616 \text{ cm}^2, \text{ so major segment} = 616 - 154 + 98$$



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Q11. A cow is tied with a 14 m rope at one corner of a rectangular field 20 m long and 16 m wide. Find the area of the field the cow can graze and the area it cannot graze. (Use $\pi = 22/7$)

The corner is 90° and 14 m is less than both sides, so the grazed region is a quadrant: $(1/4) \times 22/7 \times 196 = 154 \text{ m}^2$. Field = $20 \times 16 = 320 \text{ m}^2$. Ungrazed = $320 - 154 = 166 \text{ m}^2$.

Q12. A chord of a circle of radius 12 cm subtends 60° at the centre. Find the area of the minor segment. (Use $\pi = 3.14$, $\sqrt{3} = 1.73$)

Sector = $(1/6) \times 3.14 \times 144 = 75.36 \text{ cm}^2$. Equilateral triangle = $(1.73/4) \times 144 = 62.28 \text{ cm}^2$.

Segment = $75.36 - 62.28 = 13.08 \text{ cm}^2$.

Q13. The minute hand of a clock is 7 cm long. Find the area swept by it between 9:00 a.m. and 9:35 a.m. (Use $\pi = 22/7$)

35 minutes = $35 \times 6^\circ = 210^\circ$. Area = $(210/360) \times 22/7 \times 49 = (7/12) \times 154 = 1078/12 = 539/6 \text{ cm}^2 \approx 89.83 \text{ cm}^2$.

5-Mark Questions

Q14. In a circle of radius 21 cm, a chord AB subtends 120° at the centre. Find (i) the length of the minor arc AB, (ii) the area of the minor sector, (iii) the area of the minor segment, (iv) the perimeter of the minor segment.

(i) Arc = $(1/3) \times 132 = 44 \text{ cm}$.

(ii) Sector = $(1/3) \times 1386 = 462 \text{ cm}^2$.

(iii) Draw $OM \perp AB$. $\angle AOM = 60^\circ$, $OM = 21 \cos 60^\circ = 10.5$.
Triangle = $(1/2) \times 21\sqrt{3} \times 10.5 = 441\sqrt{3}/4 = 190.73 = 271.27 \text{ cm}^2$ (approx.).

(iv) The segment is bounded by the arc and the chord.
 $44 + 36.33 = 80.33 \text{ cm}$.

Q15. ABCD is a square of side 14 cm. With each vertex as centre, a quarter circle of radius 7 cm is drawn inside the square. Find the area of the region bounded by the four quadrants. (Use $\pi = 22/7$)

Each quadrant has radius 7 cm and angle 90° . The four quadrants just touch at the centre of the square.

Area of one quadrant = $(1/4) \times 22/7 \times 49 = 38.5 \text{ cm}^2$.
Area of four quadrants = $4 \times 38.5 = 154 \text{ cm}^2$.
Area of square = $14 \times 14 = 196 \text{ cm}^2$.
Area of the region = $196 - 154 = 42 \text{ cm}^2$.



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Area of the square = $14 \times 14 = 196 \text{ cm}^2$. Uncovered area = $196 - 154 = 42 \text{ cm}^2$.

Q16. ABC is an equilateral triangle of side 12 cm. With each vertex as centre, a sector of radius 6 cm is drawn inside the triangle. Find the area of the triangle not covered by the three sectors. (Use $\pi = 3.14$, $\sqrt{3} = 1.73$)

Each angle of an equilateral triangle is 60° , so each sector has angle 60° and radius 6 cm. Since $6 + 6 = 12$, the sectors meet at the mid-points of the sides without overlapping.

Total angle of the three sectors = $3 \times 60^\circ = 180^\circ$, so together they equal a semicircle of radius 6 cm: $(1/2) \times 3.14 \times 36 = 56.52 \text{ cm}^2$.

Area of the triangle = $(\sqrt{3}/4) \times 144 = 36\sqrt{3} = 36 \times 1.73 = 62.28 \text{ cm}^2$.

Uncovered area = $62.28 - 56.52 = 5.76 \text{ cm}^2$.

Common Mistakes and Ex

1. **Using the diameter as the radius.** In the mm. Fix: write "r = ..." as your first line i
2. **Mixing up arc and area formulas.** Arc c comes out in cm, an area in cm^2 .
3. **Giving the arc when the perimeter is a** underline the word "perimeter" and add
4. **Adding the triangle in a segment ques** sector as a slice, then cut off the triang
5. **Using $(1/2) \times r \times r$ for every triangle OA** equilateral triangle $(\sqrt{3}/4)r^2$; for 120° dr
6. **Wrong angle for clock hands.** The mini per hour. Fix: convert time to degrees b
7. **Forgetting the second wiper.** Two non- read "two" and "do not overlap" as "mu
8. **Using the wrong value of π .** Fix: use th style question, use $22/7$, as the exercise



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9. **Rounding too early.** Rounding the sector area and then subtracting a rounded triangle area can shift the final digit. Fix: keep full decimals until the last step, or keep the answer exact in surd form when no value of $\sqrt{3}$ is given.
10. **Finding the major segment as πr^2 minus the minor sector.** Fix: major segment = πr^2 – minor segment; major sector = πr^2 – minor sector. Match the words.
11. **Wrong unit or no unit.** Fix: km for the lighthouse radius gives km^2 for the area; mm for the brooch gives mm^2 .
12. **Using the wrong number of sectors.** 8 ribs make 8 sectors, but 5 diameters make 10 sectors. Fix: count the regions the lines actually create.

Quick Revision Points

- Circumference of a circle = $2\pi r$; area = πr^2 .
- A sector is bounded by two radii and an arc.
- $\angle AOB$ is the angle of the sector; the major sector is the rest of the circle.
- "Sector" and "segment" on their own mean nothing.
- Length of an arc = $(\theta/360) \times 2\pi r$.
- Area of a sector = $(\theta/360) \times \pi r^2$.
- Area of a sector = $(1/2) \times \text{arc length} \times r$.
- Perimeter of a sector = $2r + \text{arc length}$.
- Major sector = πr^2 – minor sector = $((360 - \theta)/360) \times \pi r^2$.
- Area of a segment = area of sector – area of triangle.
- Major segment = πr^2 – minor segment.
- $\triangle OAB$ for 90° : $r^2/2$. For 60° : equilateral, area = $(\sqrt{3}/4)r^2$.
- A quadrant is a 90° sector; a semicircle is a 180° sector.
- Minute hand: 6° per minute. Hour hand: 0.5° per minute.
- A rope tied at the corner of a square or circle sweeps out a sector.
- n equally spaced ribs make n sectors of a circle.
- For a fixed angle, doubling the radius doubles the area.
- Use $\pi = 22/7$ unless the question says 3.14.



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- Leave $\sqrt{3}$ in the answer unless a decimal value is given.

Weightage in Board Exams

The marks for this chapter are set in the current CBSE Class 10 Maths course structure, so check that document for the exact figure. The chapter is assessed in a predictable way because the whole chapter rests on three formulas: arc length, sector area and segment area.

Question type	What is usually asked
MCQ and Assertion-Reason	Choosing the correct sector formula; angle of a major sector; the effect of doubling the radius; area from arc length
Short answers	Area swept by a clock hand; area of a quadrant from its circumference; r
Longer answers	Minor and major OAB step; grazing
Case-based	A real object, su into parts: angle,

Most errors in this chapter are small slips: instead of subtracted, the wrong value of question and both solved examples first, t is automatic.



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