# KUMAR CLASSES

KUMARNETIC PVT. LTD.

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CLASS 10 MATHEMATICS

CHAPTER 11

# AREAS RELATED TO CIRCLES

PART 1 OF 12

## 1. INTRODUCTION

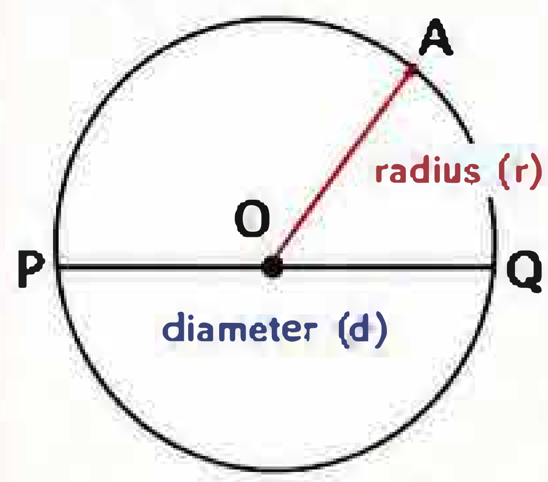
In this chapter, we learn how to find:

- ★ Area of a Sector
- ★ Length of an Arc
- ★ Area of a Segment
- ★ Applications of sectors and segments in daily life.

These concepts are useful in clocks, wheels, parks, circular fields, umbrellas, and many engineering designs.

## 2. CIRCLE – QUICK REVISION

A circle is a set of all points in a plane that are at the same distance from a fixed point called the centre.




### IMPORTANT TERMS

| | | |
|---|---|---|
| Centre | : | Fixed point of circle |
| Radius (r) | : | Distance from centre to circle |
| Diameter (d) | : | Twice the radius |
| Chord | : | Line joining two points on circle |
| Arc | : | Curved part of circle |
| Circumference | : | Boundary length of circle |

### FORMULAE

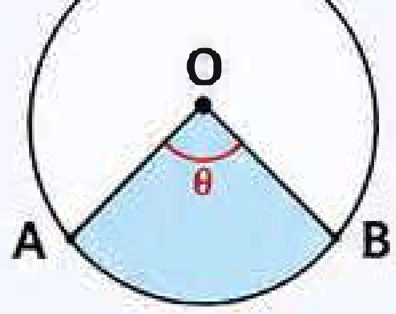
- Circumference $= 2\pi r$
- Area of Circle $= \pi r^2$

(where $\pi = \frac{22}{7}$ or 3.14)

## 3. SECTOR OF A CIRCLE

A sector is the region enclosed by:

1) Two radii
2) One arc




Example: If OA and OB are radii and AB is an arc, then region OAB is called a Sector.

### TYPES OF SECTOR

(A) Minor Sector

Smaller region formed by two radii and the smaller arc.

Angle at centre < 180°

(B) Major Sector

Larger region formed by two radii and the larger arc.

Angle at centre > 180°

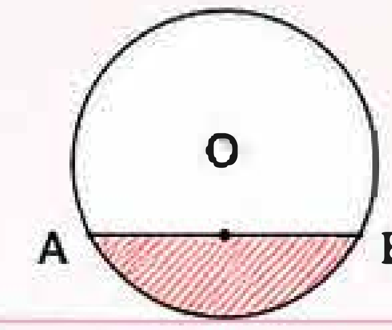
### RELATION

Major Sector Angle = 360° − Minor Sector Angle

## 4. SEGMENT OF A CIRCLE

A segment is the region enclosed by:

1) A chord
2) Its corresponding arc



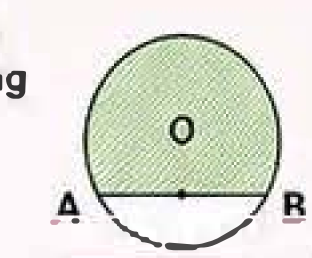

### TYPES OF SEGMENT

(A) Minor Segment

Smaller region between chord and arc.


(B) Major Segment

Larger remaining region.




### RELATION

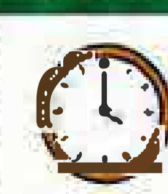
Area of Circle = Area of Minor Segment + Area of Major Segment

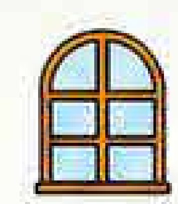
## 5. DIFFERENCE BETWEEN SECTOR AND SEGMENT

| Basis | Sector | Segment |
|---|---|---|
| Formed by | Two radii and an arc | A chord and an arc |
| Contains centre | Contains centre generally | May not contain centre |
| Angle at centre | Angle at centre is important | Chord is important |

## 6. REAL LIFE APPLICATIONS


Pizza slice

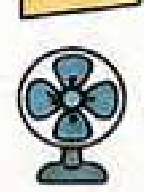

Clock hands movement

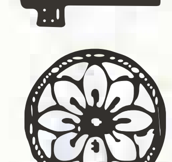

Window designs


Cake slice


Bridge arches


Stadium boundaries


Fan rotation area


Decorative patterns


Umbrella covers

## 7. IMPORTANT NCERT QUESTIONS

Q1. Name the smaller region enclosed by two radii and an arc.

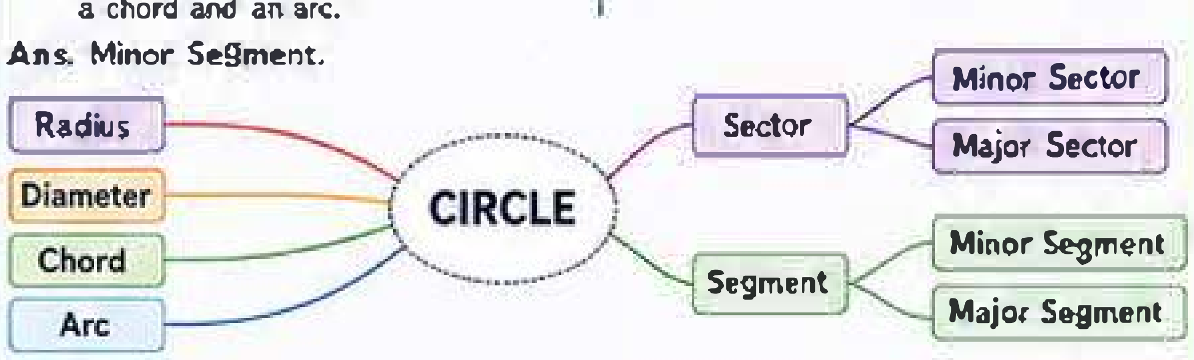
Ans. Minor Sector.

Q2. Name the smaller region enclosed by a chord and an arc.

Ans. Minor Segment.

Q3. What is the difference between a chord and a radius?

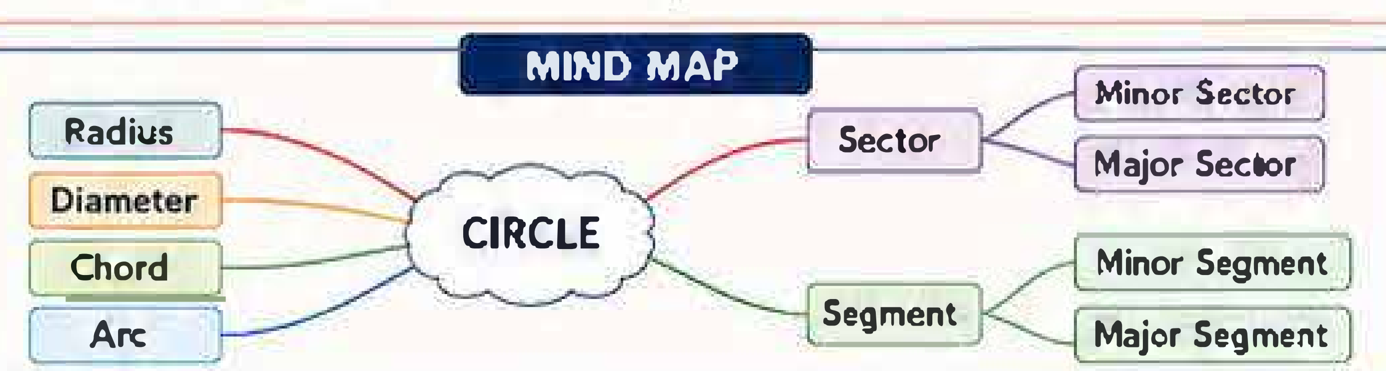
Ans. Radius joins centre to circle. Chord joins any two points on the circle.




### EXAM – ORIENTED NOTES

- ✅ Sector = Two Radii + Arc
- ✅ Segment = Chord + Arc
- ✅ Minor Sector + Major Sector = Whole Circle
- ✅ Minor Segment + Major Segment = Whole Circle
- ✅ Area of Circle $= \pi r^2$

### MIND MAP



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CLASS 10 MATHEMATICS

CHAPTER 11

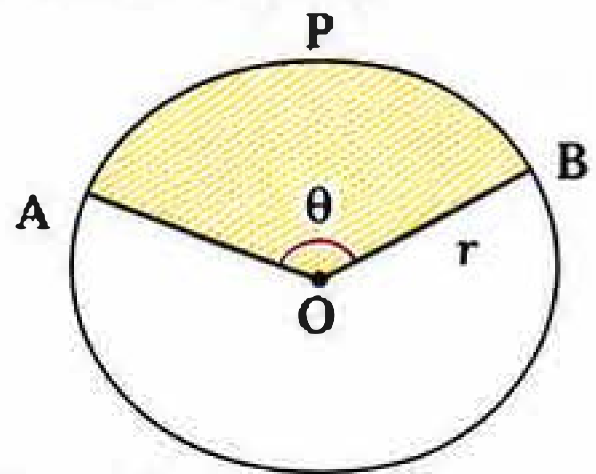
# AREAS RELATED TO CIRCLES



## 2. Area of a Sector of a Circle

### 1. Derivation of Formula

Let OAPB be a sector of a circle with centre O and radius $r$.
Let $\angle AOB = \theta$ (in degrees).




Area of whole circle $= \pi r^2$

This is the area of a sector with angle $360°$.

When angle at centre $= 360°$, Area $= \pi r^2$

When angle at centre $= 1°$, Area $= \dfrac{\pi r^2}{360}$

When angle at centre $= \theta°$, Area $= \left(\dfrac{\pi r^2}{360}\right) \times \theta$

$\therefore$ Area of sector of angle $\theta = \boxed{\dfrac{\theta}{360} \times \pi r^2}$

Where, $r$ = radius of circle

$\theta$ = angle of sector in degrees

### 2. Length of an Arc

Length of the whole circle (angle $360°$) $= 2\pi r$

Length of an arc of a sector of angle $\theta$ (in degrees) $= \dfrac{\theta}{360} \times 2\pi r$

### 3. Key Formulae

★ Area of a sector of angle $\theta$

$= \dfrac{\theta}{360} \times \pi r^2$ (square units)

★ Length of an arc of angle $\theta$

$= \dfrac{\theta}{360} \times 2\pi r$ (length units)

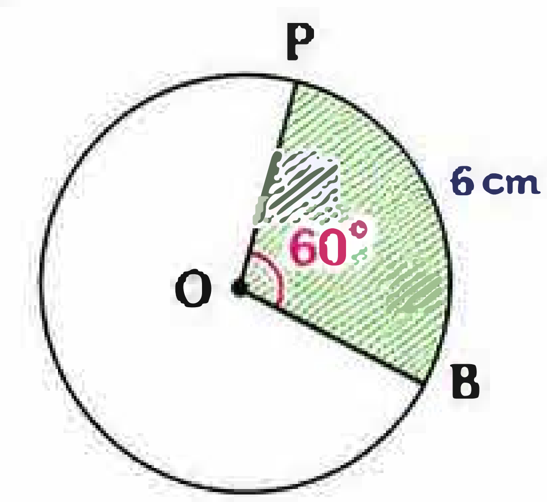
**NOTE**

- If $\theta = 360°$, sector is the whole circle.
- If $\theta = 180°$, sector is a semicircle.
- If $\theta = 90°$, sector is a quadrant.

### 4. Examples

**Example 1 :** Find the area of a sector of a circle with radius 6 cm and angle $60°$.

**Solution :**




Here, $r = 6$ cm, $\theta = 60°$

Area of sector $= \dfrac{\theta}{360} \times \pi r^2$

$= \dfrac{60}{360} \times \pi \times 6 \times 6$

$= \dfrac{1}{6} \times \pi \times 36$

$= 6\pi$ cm$^2$

$= 6 \times \dfrac{22}{7}$ cm$^2$ $\left(\pi = \dfrac{22}{7}\right)$

$= \dfrac{132}{7}$ cm$^2$

$= 18\dfrac{6}{7}$ cm$^2$

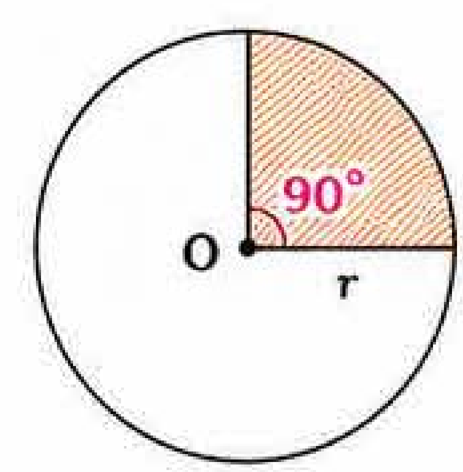
**Example 2 :** Find the area of a quadrant of a circle whose circumference is 22 cm.

**Solution :**

Circumference $= 22$ cm

$2\pi r = 22$

$r = \dfrac{22}{2\pi} = \dfrac{11}{\pi} = \dfrac{11}{\frac{22}{7}} = \dfrac{7}{2}$ cm




Area of quadrant $= \dfrac{90}{360} \times \pi r^2$

$= \dfrac{1}{4} \times \pi \times \left(\dfrac{7}{2}\right)^2$

$= \dfrac{1}{4} \times \pi \times \dfrac{49}{4}$

$= \dfrac{49\pi}{16}$ cm$^2$

$= \dfrac{49 \times 22}{16 \times 7}$ cm$^2$

$= \dfrac{77}{8}$ cm$^2$ $= 9\dfrac{5}{8}$ cm$^2$

### 5. Exercise 11.1 (Qs. 1 & 2)

1. Find the area of a sector of a circle with radius 6 cm if angle of the sector is $60°$.

   Ans. $18\dfrac{6}{7}$ cm$^2$

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

   Ans. $9\dfrac{5}{8}$ cm$^2$

### ONE LINE MEMORY

★ Area of sector $= \left(\dfrac{\theta}{360}\right) \times \pi r^2$

★ Length of arc $= \left(\dfrac{\theta}{360}\right) \times 2\pi r$

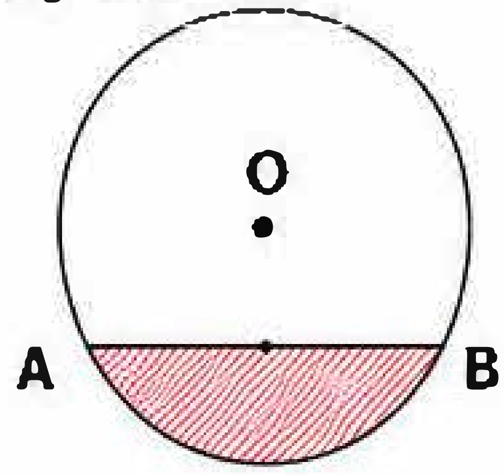
Practice Makes Perfect ! ☺

# AREAS RELATED TO CIRCLES

## 3. AREA OF A SEGMENT OF A CIRCLE

### UNDERSTANDING THE SEGMENT

A segment of a circle is the region enclosed by a chord and its corresponding arc.




Shaded part APB is the minor segment.

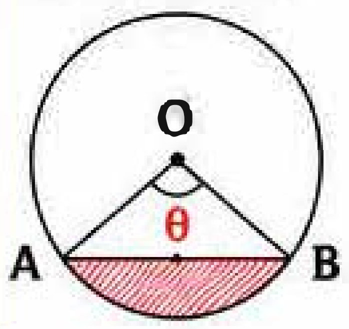
The remaining region AQB is the major segment.

**Relation**

Area of Circle = Area of Minor Segment + Area of Major Segment

### 2. FORMULA FOR AREA OF A SEGMENT

Consider a circle of radius r.
A chord AB subtends an angle $\angle AOB = \theta$ at the centre.




Area of segment APB

$= $ Area of sector OAPB − Area of $\Delta OAB$

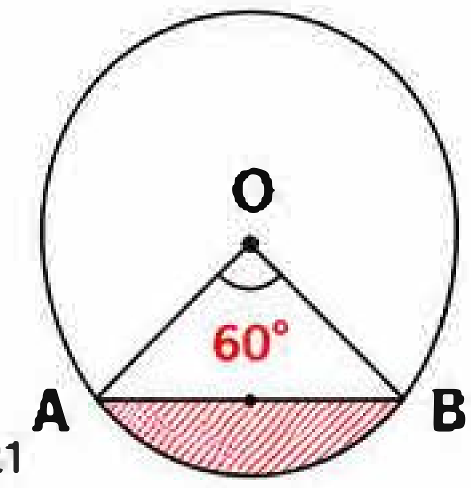
$$= \frac{\theta}{360} \times \pi r^2 - \frac{1}{2} r^2 \sin\theta$$

### EXAMPLES

**Example 1** : Find the area of the minor segment of a circle of radius 21 cm if $\angle AOB = 60^\circ$.

**Solution :**

$r = 21$ cm, $\theta = 60^\circ$




$$\text{Area of sector} = \frac{\theta}{360} \times \pi r^2$$

$$= \frac{60}{360} \times \pi \times 21 \times 21$$

$$= \frac{1}{6} \times \pi \times \frac{22}{7} \times 21 \times 21$$

$$= 231 \text{ cm}^2$$

$$\text{Area of } \Delta AOB = \frac{1}{2} r^2 \sin\theta$$

$$= \frac{1}{2} \times 21 \times 21 \times \sin 60^\circ$$

$$= \frac{441\sqrt{3}}{4} \text{ cm}^2$$

$$\text{Area of segment} = 231 - \frac{441\sqrt{3}}{4} \text{ cm}^2$$

$$= 231 - 190.9$$

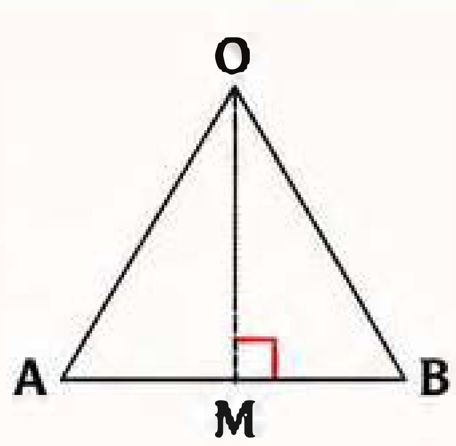
$$= 40.1 \text{ cm}^2$$

Practice Makes Perfect ! ☺

### Finding Area of $\Delta OAB$

- Draw $OM \perp AB$. Then M is midpoint of AB.
- In $\Delta OMA$, $\angle AOM = \frac{\theta}{2}$
- $OM = r\cos\left(\frac{\theta}{2}\right)$ and $AM = r\sin\left(\frac{\theta}{2}\right)$
- Therefore, $AB = 2AM = 2r\sin\left(\frac{\theta}{2}\right)$

$$\text{Area of } \Delta OAB = \frac{1}{2} \times AB \times OM$$




### KEY POINT

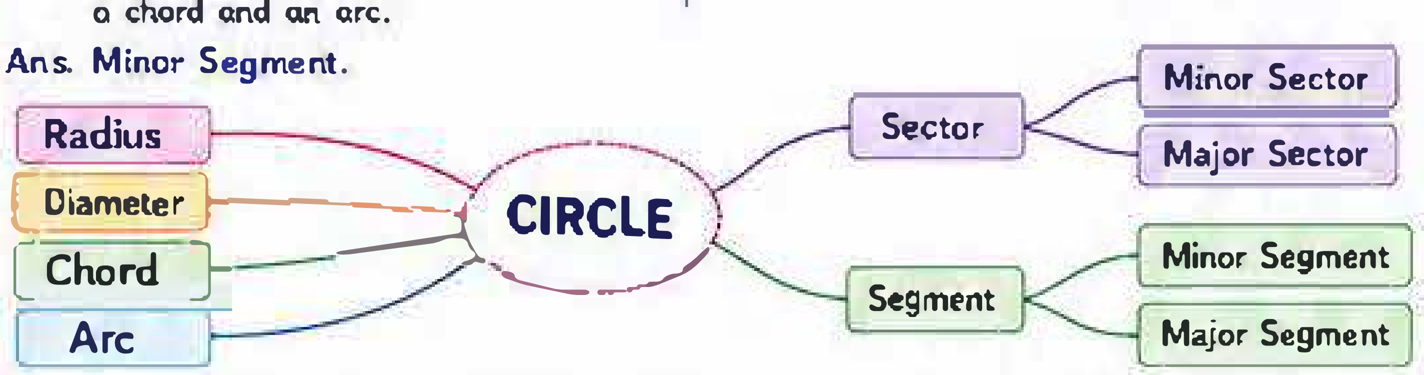
Area of segment = Area of sector − Area of triangle formed by two radii and the chord.

### IMPORTANT NCERT QUESTIONS

Q1. Name the smaller region enclosed by two radii and an arc.
Ans. Minor Sector.

Q2. Name the smaller region enclosed by a chord and an arc.
Ans. Minor Segment.

Q3. What is the difference between a chord and a radius?
Ans. Radius joins centre to circle. Chord joins any two points on the circle.




### EXAM – ORIENTED NOTES

- ✅ Sector = Two Radii + Arc
- ✅ Segment = Chord + Arc
- ✅ Minor Sector + Major Sector = Whole Circle
- ✅ Minor Segment + Major Segment = Whole Circle
- ✅ Area of Circle = $\pi r^2$

"FOCUS • PRACTICE • ACHIEVE"

# AREAS RELATED TO CIRCLES

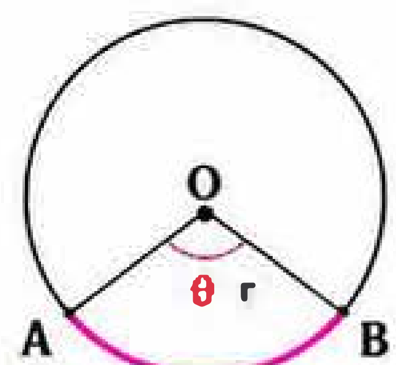


## 5. LENGTH OF AN ARC

### 1. LENGTH OF AN ARC

Length of the arc of a sector of angle $\theta$ (in degrees) of a circle of radius r is:

$$\text{Length of arc} = \frac{\theta}{360} \times 2\pi r$$



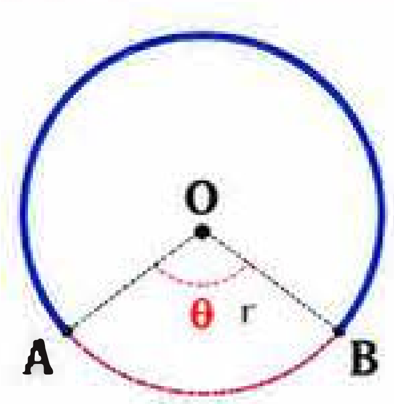

**Special Cases**

- ★ When $\theta = 360°$, arc is the whole circle. Length $= 2\pi r$
- ★ When $\theta = 180°$, arc is a semicircle. Length $= \pi r$
- ★ When $\theta = 90°$, arc is a quadrant. Length $= \frac{\pi r}{2}$

### 2. LENGTH OF A MAJOR ARC

Length of a major arc of angle $\theta$ (in degrees) is:

$$\text{Length of major arc} = \frac{\theta}{360} \times 2\pi r$$




### 3. IMPORTANCE

- ☑ Arc length is used to calculate the distance along the curved part of a circle.
- ☑ It is useful in wheels, gears, circular track, and many real life situations.
- ☑ It is also used in finding the area of sector and segment.

### 5. EXERCISE 11.1 (Qs. 3, 6, 7 & 8)

**3.** What is the difference between a chord and a radius?

Ans. Radius joins centre to circle.
Chord joins any two points on the circle.

**6.** A chord of a circle of radius 15 cm subtends an angle of 60° at the centre. Find the length of the corresponding minor arc.

Ans. $\frac{5\pi}{2}$ cm

**7.** The length of an arc of a sector of angle 60° of a circle is 22 cm. Find (i) radius of the circle (ii) area of the sector.

Ans. (i) 21 cm (ii) 231 $cm^2$

**8.** The length of an arc of a sector of angle 90° of a circle is $11\pi$ cm. Find (i) radius of the circle (ii) area of the sector.

Ans. (i) 22 cm (ii) 242 $cm^2$

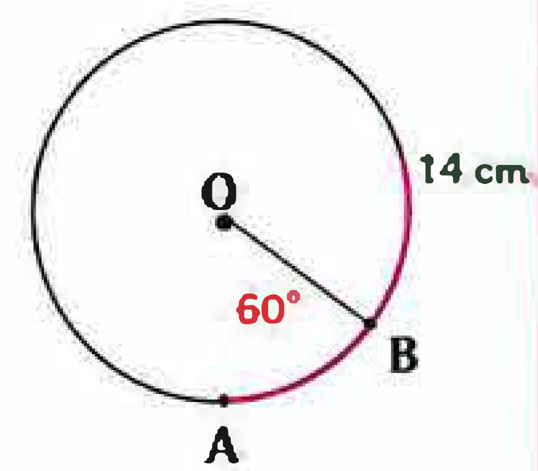
### 4. EXAMPLES

**Example 1 :** Find the length of an arc of a sector of angle 60° of a circle of radius 14 cm.

**Solution :**

$r = 14$ cm, $\theta = 60°$

$$\text{Length of arc} = \frac{\theta}{360} \times 2\pi r$$
$$= \frac{60}{360} \times 2 \times \frac{22}{7} \times 14$$
$$= \frac{1}{6} \times 2 \times \frac{22}{7} \times 14$$
$$= \frac{88}{6} = \frac{44}{3} \text{ cm}$$
$$= 14\frac{2}{3} \text{ cm}$$

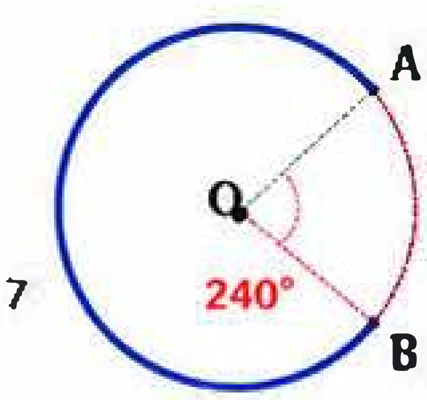



**Example 2 :** Find the length of a major arc of angle 240° of a circle of radius 7 cm.

**Solution :**

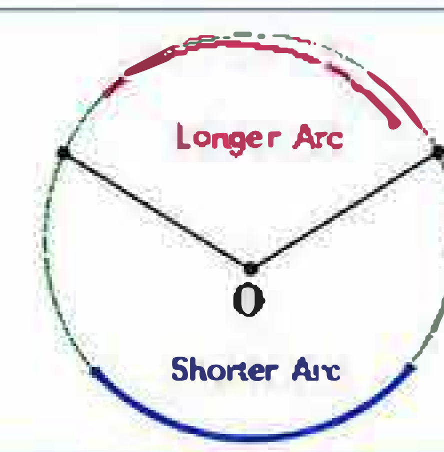
$r = 7$ cm, $\theta = 240°$

$$\text{Length of major arc} = \frac{\theta}{360} \times 2\pi r$$
$$= \frac{240}{360} \times 2 \times \frac{22}{7} \times 7$$
$$= \frac{2}{3} \times 2 \times 22$$
$$= \frac{88}{3} = 29\frac{1}{3} \text{ cm}$$




### KEY POINTS

- Arc length depends on angle and radius.
- Larger angle or larger radius → longer arc.
- Arc length is directly proportional to both angle and radius.




### REMEMBER

- ★ Arc Length $= \frac{\theta}{360} \times 2\pi r$
- ★ Major Arc Length $= \frac{\theta}{360} \times 2\pi r$
- ★ Whole Circle Arc $= 2\pi r$
- ★ Semicircle Arc $= \pi r$
- ★ Quadrant Arc $= \frac{\pi r}{2}$

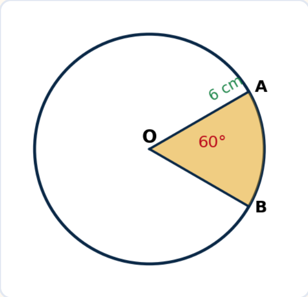
### ONE LINE MEMORY

★ Arc Length $= \frac{\theta}{360} \times 2\pi r$ | ★ Major Arc Length $= \frac{\theta}{360} \times 2\pi r$

# CHAPTER 11 : AREAS RELATED TO CIRCLES

Exercise 11.1

**Q1. Find the area of a sector of a circle with radius $6$ cm if the angle of the sector is $60^\circ$. $\left(\text{Use } \pi = \frac{22}{7}\right)$**




TIP Area of a sector of angle $\theta = \frac{\theta}{360^\circ} \times \pi r^2$.

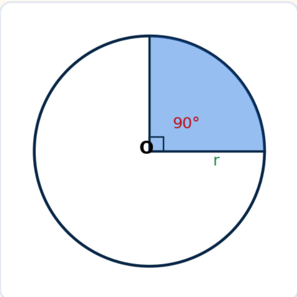
Here $r = 6$ cm, $\theta = 60^\circ$.

Area $= \frac{60^\circ}{360^\circ} \times \frac{22}{7} \times (6)^2 = \frac{1}{6} \times \frac{22}{7} \times 36.$

$= \frac{132}{7}\ \text{cm}^2\ (\approx 18.86\ \text{cm}^2).$

$\boxed{\frac{132}{7}\ \text{cm}^2}$

**Q2. Find the area of a quadrant of a circle whose circumference is $22$ cm. $\left(\text{Use } \pi = \frac{22}{7}\right)$**




Circumference $= 2\pi r = 22 \Rightarrow r = \frac{22}{2 \times \frac{22}{7}} = \frac{7}{2} = 3.5$ cm.

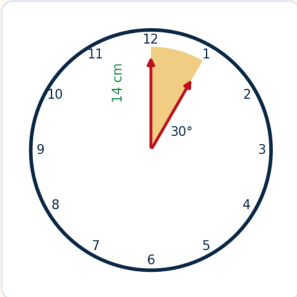
A quadrant subtends $90^\circ$ at the centre.

Area $= \frac{90^\circ}{360^\circ} \times \frac{22}{7} \times \left(\frac{7}{2}\right)^2 = \frac{1}{4} \times \frac{22}{7} \times \frac{49}{4}.$

$= \frac{77}{8}\ \text{cm}^2\ (= 9.625\ \text{cm}^2).$

$\boxed{\frac{77}{8}\ \text{cm}^2}$

**Q3. The length of the minute hand of a clock is $14$ cm. Find the area swept by the minute hand in $5$ minutes. $\left(\text{Use } \pi = \frac{22}{7}\right)$**




In $60$ min the minute hand turns $360^\circ$, so in $5$ min it turns $\frac{360^\circ}{60} \times 5 = 30^\circ$.

The area swept is a sector of $30^\circ$ in a circle of radius $14$ cm.

Area $= \frac{30^\circ}{360^\circ} \times \frac{22}{7} \times (14)^2 = \frac{1}{12} \times \frac{22}{7} \times 196.$

$= \frac{154}{3}\ \text{cm}^2\ (\approx 51.33\ \text{cm}^2).$

$\boxed{\frac{154}{3}\ \text{cm}^2}$

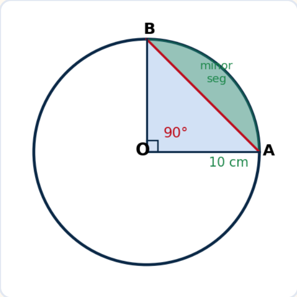
**Q4. A chord of a circle of radius $10$ cm subtends a right angle at the centre. Find the area of the corresponding**

**(i)**

**minor segment**

**(ii)**

**major sector.** $(\text{Use } \pi = 3.14)$




**TIP** Area of a segment = area of the sector − area of the triangle.

Here $r = 10$ cm, $\theta = 90^\circ$.

**(i)** Area of minor sector

$= \frac{90^\circ}{360^\circ} \times 3.14 \times 100 = 78.5 \text{ cm}^2$.

Area of $\triangle$ (right angle at O) $= \frac{1}{2} \times 10 \times 10 = 50 \text{ cm}^2$.

Minor segment $= 78.5 - 50 = 28.5 \text{ cm}^2$.

**(ii)** Major sector

$= \pi r^2 - \text{minor sector} = 314 - 78.5 = 235.5 \text{ cm}^2$.

(i) $28.5 \text{ cm}^2$ (ii) $235.5 \text{ cm}^2$

**Q5. In a circle of radius $21$ cm, an arc subtends an angle of $60^\circ$ at the centre. Find**

**(i)**

**the length of the arc**

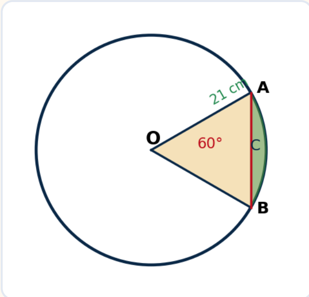
**(ii)**

**area of the sector formed by the arc**

**(iii)**

**area of the segment formed by the corresponding chord.**

$\left(\text{Use } \pi = \frac{22}{7}\right)$




$r = 21$ cm, $\theta = 60^\circ$.

**(i)** Arc

$= \frac{\theta}{360^\circ} \times 2\pi r = \frac{60^\circ}{360^\circ} \times 2 \times \frac{22}{7} \times 21 = 22 \text{ cm}.$

**(ii)** Sector $= \frac{60^\circ}{360^\circ} \times \frac{22}{7} \times (21)^2 = 231 \text{ cm}^2$.

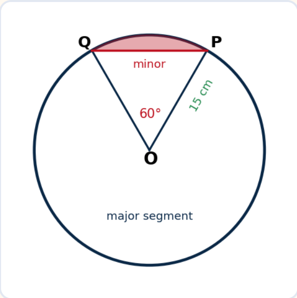
**(iii)** In $\triangle OAB$, $OA = OB$ and $\angle AOB = 60^\circ \Rightarrow$ it is equilateral (side $21$).

Area of $\triangle OAB = \frac{\sqrt{3}}{4}(21)^2 = \frac{441\sqrt{3}}{4} \text{ cm}^2$.

Segment $= 231 - \frac{441\sqrt{3}}{4} \text{ cm}^2 \ (\approx 40.05 \text{ cm}^2)$.

(i) 22 cm (ii) $231 \text{ cm}^2$ (iii) $\left(231 - \frac{441\sqrt{3}}{4}\right)\text{cm}^2$

**Q6. A chord of a circle of radius $15$ cm subtends an angle of $60^\circ$ at the centre. Find the areas of the corresponding minor and major segments.** (Use $\pi = 3.14,\ \sqrt{3} = 1.73$)




$r = 15$ cm, $\theta = 60^\circ$.

Sector $OPRQ = \dfrac{60^\circ}{360^\circ} \times 3.14 \times 225 = 117.75\ \mathrm{cm}^2$.

$\triangle OPQ$ is equilateral (side $15$): area

$= \dfrac{\sqrt{3}}{4}(225) = \dfrac{1.73 \times 225}{4} = 97.3125\ \mathrm{cm}^2$.

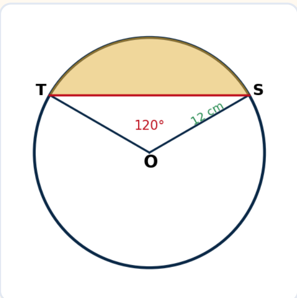
Minor segment $= 117.75 - 97.3125 = 20.4375\ \mathrm{cm}^2$.

Major segment

$= \pi r^2 - \text{minor segment} = 706.5 - 20.4375 = 686.0625\ \mathrm{cm}^2$.

$\boxed{\text{Minor } = 20.4375\ \mathrm{cm}^2;\ \text{Major } = 686.0625\ \mathrm{cm}^2}$

**Q7. A chord of a circle of radius $12$ cm subtends an angle of $120^\circ$ at the centre. Find the area of the corresponding segment.** (Use $\pi = 3.14,\ \sqrt{3} = 1.73$)




$r = 12$ cm, $\theta = 120^\circ$.

Sector $OSUT = \dfrac{120^\circ}{360^\circ} \times 3.14 \times 144 = 150.72\ \mathrm{cm}^2$.

For $\triangle OST$: area

$= \dfrac{1}{2} r^2 \sin 120^\circ = \dfrac{1}{2}(144)\dfrac{\sqrt{3}}{2} = 36\sqrt{3} = 62.28\ \mathrm{cm}^2$.

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

$\boxed{88.44\ \mathrm{cm}^2}$

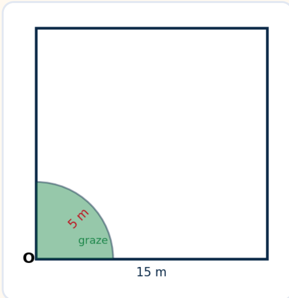
**Q8. A horse is tied to a peg at one corner of a square field of side $15$ m by a $5$ m long rope. Find**

**(i)**

**the area the horse can graze**

**(ii)**

**the increase in grazing area if the rope were $10$ m instead of $5$ m.** (Use $\pi = 3.14$)




At a corner the horse grazes a quarter circle ($90^\circ$).

**(i)** Area $= \dfrac{90^\circ}{360^\circ} \times 3.14 \times (5)^2 = 19.625\ \mathrm{m}^2$.

With a $10$ m rope: $\dfrac{90^\circ}{360^\circ} \times 3.14 \times (10)^2 = 78.5\ \mathrm{m}^2$.

**(ii)** Increase $= 78.5 - 19.625 = 58.875\ \mathrm{m}^2$.

$\boxed{\text{(i) } 19.625\ \mathrm{m}^2\ \text{(ii) } 58.875\ \mathrm{m}^2}$

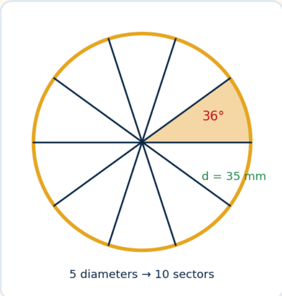
**Q9. A brooch is made with silver wire as a circle of diameter 35 mm. The wire also makes 5 diameters which divide the circle into 10 equal sectors. Find**

**(i)**

**the total length of the silver wire**

**(ii)**

**the area of each sector.** $\left(\text{Use } \pi = \frac{22}{7}\right)$




**(i)** Wire = circumference + 5 diameters $= \pi d + 5d$.

$= \frac{22}{7} \times 35 + 5 \times 35 = 110 + 175 = 285$ mm.

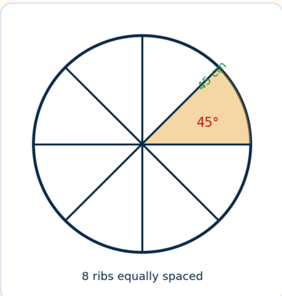
**(ii)** 10 equal sectors ⇒ each angle $= \frac{360°}{10} = 36°$, radius $= \frac{35}{2}$ mm.

Area of each

$= \frac{36°}{360°} \times \frac{22}{7} \times \left(\frac{35}{2}\right)^2 = \frac{385}{4}\ \text{mm}^2\ (= 96.25\ \text{mm}^2)$.

$\boxed{\text{(i) } 285 \text{ mm (ii) } \frac{385}{4}\ \text{mm}^2}$

**Q10. An umbrella has 8 ribs which are equally spaced. Assuming the umbrella to be a flat circle of radius 45 cm, find the area between two consecutive ribs.** $\left(\text{Use } \pi = \frac{22}{7}\right)$




Angle between two consecutive ribs $= \frac{360°}{8} = 45°$.

Area $= \frac{45°}{360°} \times \frac{22}{7} \times (45)^2 = \frac{1}{8} \times \frac{22}{7} \times 2025$.

$= \frac{22275}{28}\ \text{cm}^2\ (\approx 795.54\ \text{cm}^2)$.

$\boxed{\frac{22275}{28}\ \text{cm}^2}$

**Q11. A car has two wipers which do not overlap. Each wiper has a blade of length 25 cm sweeping through 115°. Find the total area cleaned at each sweep.** $\left(\text{Use } \pi = \frac{22}{7}\right)$


Each blade sweeps a sector of 115° with $r = 25$ cm.

Area of one sector

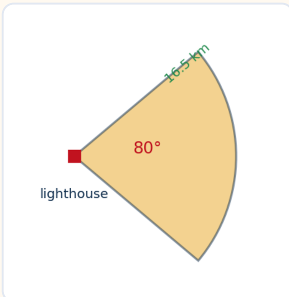
$= \frac{115°}{360°} \times \frac{22}{7} \times (25)^2 = \frac{158125}{252}\ \text{cm}^2$.

Two blades: area

$= 2 \times \frac{158125}{252} = \frac{158125}{126}\ \text{cm}^2\ (\approx 1254.96\ \text{cm}^2)$.

$\boxed{\frac{158125}{126}\ \text{cm}^2 \approx 1254.96\ \text{cm}^2}$

**Q12. A lighthouse spreads a red 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 $\pi = 3.14$)

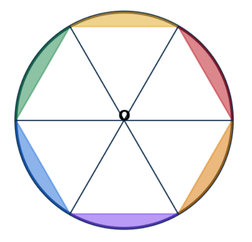



Area $= \frac{80°}{360°} \times 3.14 \times (16.5)^2$.

$= \frac{2}{9} \times 3.14 \times 272.25 = 189.97\ \text{km}^2$ (approx).

$\boxed{\approx 189.97\ \text{km}^2}$

**Q13. A round table cover has six equal designs. If the radius of the cover is $28$ cm, find the cost of making the designs at ₹$0.35$ per $\mathrm{cm}^2$. (Use $\sqrt{3} = 1.7$)**



6 equal designs · r = 28 cm

> TIP Each design is a segment with a $60^\circ$ central angle (six equal parts of $360^\circ$).

Each central angle $= \dfrac{360^\circ}{6} = 60^\circ$. Sector $= \dfrac{60^\circ}{360^\circ} \times \dfrac{22}{7} \times (28)^2 = 410.67\ \mathrm{cm}^2$.

The triangle is equilateral (side $28$): area $= \dfrac{\sqrt{3}}{4}(28)^2 = \dfrac{1.7 \times 784}{4} = 333.2\ \mathrm{cm}^2$.

One design (segment) $= 410.67 - 333.2 = 77.47\ \mathrm{cm}^2$.

Six designs $= 6 \times 77.47 = 464.8\ \mathrm{cm}^2$.

Cost $= 464.8 \times 0.35 = ₹162.68$.

$\boxed{₹162.68}$

**Q14. Tick the correct answer: Area of a sector of angle $p$ (in degrees) of a circle with radius $R$ is: (A) $\dfrac{p}{180} \times 2\pi R$ (B) $\dfrac{p}{180} \times \pi R^2$ (C) $\dfrac{p}{360} \times 2\pi R$ (D) $\dfrac{p}{720} \times 2\pi R^2$**

Area of a sector $= \dfrac{\theta}{360^\circ} \times \pi R^2 = \dfrac{p}{360} \times \pi R^2$.

Rewrite: $\dfrac{p}{360}\pi R^2 = \dfrac{p}{720} \times 2\pi R^2$.

So the correct option is $\mathbf{(D)}$.

$\boxed{\text{(D) } \dfrac{p}{720} \times 2\pi R^2}$