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Board: CBSE  
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Exercise: Ex 12.1, Ex 12.2, Ex 12.3  
Number of Questions Solved: 35  
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Formulae Handbook for Class 10 Maths and Science

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NCERT Solutions For Class 10 Maths Chapter 12 Areas Related to Circles

NCERT Solutions For Class 10 Chapter 12 Maths Areas Related to Circles Exercise 12.1

Question-1

The radii of two circles are 19 cm and 9 cm respectively. Find the radius of the circle which has circumference equal to the sum of the circumferences of the two circles.

Solution:
Let $r_1$ and $r_2$ be the radii of the 2 circles then, $r_1 = 19 \text{ cm}$ and $r_2 = 9 \text{ cm}$
Circumference of 1st circle = $2\pi r_1$
= $2 \times 19 \times \pi = 38\pi$
Circumference of 2nd circle = $2\pi r_2$
= $2 \times 9 \times \pi = 18\pi$
Sum of circumference of 2 circle = $38\pi + 18\pi = 56\pi$ ................. (1)
Given that the have a circle whose circumference is equal to the sum given by (1)
Let $R$ be the radii of the circle . . . $2\pi R = 56\pi$ (given) $\Rightarrow R = 28 \text{ cm}$.
Question-2

The radii of two circles are 8 cm and 6 cm respectively. Find the radius of the circle having area equal to the sum of the areas of the two circles.

Solution:

Let \( r_1 = 8 \) cm be the radius of circle (1) and \( r_2 = 6 \) cm be the radius of circle (2).

Area of circle (1) \( \pi r_1^2 = \pi \times 8 \times 8 = 64\pi \)

Area of circle (2) \( \pi r_2^2 = \pi \times 6 \times 6 = 36\pi \)

Sum of area of circle (1) + that of circle (2) \( = 64\pi + 36\pi \)

\( = 100\pi \) ...........(i)

Given that we have a new circle, whose area is equal to the sum given by (i)

Let \( R \) be the radius of this circle.

Its area = \( \pi R^2 \)

\( \pi R^2 = 100\pi \)

\( R^2 = 100 \)

\( R = 10 \) cm.
Figure depicts an archery target marked with its five scoring areas from the centre outwards as Gold, Red, Blue, Black and White. The diameter of the region representing Gold score is 21 cm and each of the other bands is 10.5 cm wide. Find the area of each of the five scoring regions.

Solution:
Let \( r_1, r_2, r_3, r_4, r_5 \) be the radii of the 5 scoring areas namely Gold, Red, Blue, Black, white
\[
\begin{align*}
  r_1 &= \frac{21}{2} = 10.5 \text{ cm} \\
  r_2 &= 10.5 \text{ cm} + 10.5 = 21 \text{ cm} \\
  r_3 &= 21 \text{ cm} + 10.5 = 31.5 \text{ cm} \\
  r_4 &= 31.5 \text{ cm} + 10.5 = 42.0 \text{ cm} \\
  r_5 &= 42 \text{ cm} + 10.5 = 52.5 \text{ cm}
\end{align*}
\]
Area of Gold circle = \( \pi \times (10.5)^2 \)
\[
= 346.5 \text{ cm}^2 
\]  \hspace{1cm} (1)
Area of circle is \( \pi r_2^2 \) with radii = \( r_2 \)
\[
= \pi \times (21)^2 \\
= 441 \times \frac{22}{7} = 1386 \text{ cm}^2
\]
Area of red scoring area = Area with radius \( r_2 = 1386 \text{ cm}^2 \) ........... (2)
Hence area of red scoring area = Area given by (2) - Area given by (1)
\[
= 1386 \times 346.5 \\
= 1039.5 \text{ cm}^2
\]
Area of circle with radii $r_3 = \pi \times r_3^2$
\[ = \frac{22}{7} \times (31.5)^2 \]
\[ = 3118.5 \text{ sq. cm} \] .................. (3)

\[ \therefore \text{Area of blue scoring area} = \text{Area given by (3)} - \text{Area given by (2)} \]
\[ = 3118.5 - 1386 \]
\[ = 1732.5 \text{ sq. cm.} \]

Area of circle with radii $r_4 \pi r_4^2 = \pi \times (42)^2$
\[ \frac{22}{7} \times 42 \times 42 \text{ sq cm} \] .................. (4) \[ \therefore \text{Area of black scoring area} = \]
Area given by (4) - Area given by (3)
\[ = 5544 - 3118.5 \]
\[ = 2425.5 \text{ sq.cm} \]

Area of the circle with radii $r_5 = \pi \times (52.5)^2$
\[ = \frac{22}{7} \times 52.5 \times 52.5 \text{ sq cm} \]
\[ = 8662.5 \text{ sq.cm} \] .................. (5)

\[ \therefore \text{Area of white scoring region} = \text{Area of circle given by (5)} - \text{Area of circle given by (4)} \]
\[ = 8662.5 - 5544 \]
\[ = 3118.5 \text{ sq.cm} \]

\[ \therefore \text{The areas given by the required region} \]
Gold = 346.5 cm²
Red = 1039.5 cm²
Blue = 1732.5 cm²
Black = 2425.5 cm²
White = 3118.5 cm².
The wheels of a car are of diameter 80 cm each. How many complete revolutions does each wheel make in 10 minutes when the car is travelling at a speed of 66 km per hour?

Solution:
Radius of the wheel of the car = \( \frac{80}{2} = 40 \) cm
Distance travelled with one revolution = Its circumference
\( = 2\pi r \)
\( = 2 \times \frac{22}{7} \times 40 = \frac{1760}{7} \) cm
Let the no. of revolution made by each wheel be \( n \). Total distance travelled = Distance travelled with one revolution of the wheel \( \times \) No. of revolution
\( = \frac{1760}{7} n \) cm
Time taken = 10 min = \( \frac{10}{60} = \frac{1}{6} \) hr
Speed of the car = \( \frac{\text{Total distance travelled}}{\text{Time taken}} \)
\( = \frac{\frac{1760}{7} n}{\frac{1}{6}} \) cm/hr
\( = \frac{1760 \times 6 \times n}{7 \times 100 \times 1000} \) (Given speed = 66 km/hr)
\( = \frac{1760 \times 6 \times n}{1700 \times 6} \)
\( n = \frac{1760}{1700} \)
\( n = 4375 \)
Hence no. of revolutions \( n = 4375 \).

Tick the correct answer in the following and justify your choice:
If the perimeter and the area of a circle are numerically equal, then the radius of the circle is
(A) 2 units
(B) \( \pi \) units
(C) 4 units
(D) 7 units.

Solution:
Perimeter of a circle = \( 2\pi r \)
Area of a circle = \( \pi r^2 \)
Given \( 2\pi r = \pi r^2 \)
Hence radius = 2 units
Answer is (A).

https://www.youtube.com/watch?v=DUoYX1v1IU&list=PLXX3lyEZ5Op5wHNguA_6OrTmJ8E1KFlt
NCERT Solutions For Class 10 Chapter 12 Maths Areas Related to Circles Exercise 12.2

Find the area of a sector of a circle with radius 5 cm if angle of the sector is 60°.

Solution:

\[ r = 6 \text{ cm} \quad \theta = 60° \]

Area of the sector of the circle = \( \frac{\theta}{360} \times \pi r^2 \)

\[ = \frac{60}{360} \times \frac{22}{7} \times 6 \times 6 \]

\[ = \frac{132}{7} \text{ cm}^2 \]

\[ = 18.8 \text{ cm}^2 \]

Question-7

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

Solution:

Circumference of circle is 22 cm \( \Rightarrow 2\pi r = 22 \) (If \( r \) = radius of circle) \( \Rightarrow 2 \times \frac{22}{7} \times r = 22 \)

\[ r = \frac{7}{2} \text{ cm} \]

Area of a quadrant of a circle

\[ = \frac{\theta}{360} \times \pi r^2 \]

\[ = \frac{90}{360} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \]

\[ = \frac{77}{8} \text{ cm}^2 \]
Question-8

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

Solution:
Length of the minute hand = 14 cm
Radius the circle covered = length of minute hand
∴ r = 14 cm.
The minute hand makes an angle of 360° in 60 minutes.
so. angle made by it in 5 mins = 30°
Area = \( \frac{\theta}{360} \times \pi r^2 \)
where \( \theta \) is the angle of the sector
Area covered = \( \frac{30}{360} \times \frac{22}{7} \times 14 \times 14 \)
= 51.33 cm²

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. (Use \( \pi = 3.14 \))

Solution:

(i) Let AB be the chord of the circle with centre O
∴ Radius AO = OB = 10 cm
Area of minor sector = \( \frac{\theta}{360} \times \pi r^2 \)
= \( \frac{90}{360} \times \frac{22}{7} \times 10 \times 10 \)
= \( \frac{550}{7} \) cm²
= 78.57 cm²

In \( \triangle OAB \), \( \sin 90° = \frac{AB}{OA} \)
∴ \( AB = 10 \) cm, Area of \( \triangle OAB = \frac{1}{2} \times 10 \times 10 = 50 \) cm²
Area of minor segment = 78.5 - 50 = 28.5 cm²

(ii) For the major sector \( \theta = (360° - 90°) = 270° \)
Area of major sector = \( \frac{270}{360} \times \frac{22}{7} \times 10 \times 10 \)
= \( \frac{550}{7} \times 3 \)
= 78.57 \times 3
= 235.713 cm².
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. (Use \( \pi = 3.14 \))

**Solution:**

(i) Let \( AB \) be the chord of the circle with centre \( O \)  
\[ \therefore \text{Radius } AO = OB = 10 \text{ cm} \]

Area of minor sector = \[ \frac{90}{360} \times \pi r^2 \]
\[ = \frac{90}{360} \times 3.14 \times 10 \times 10 \]
\[ = \frac{550}{7} \text{ cm}^2 \]
\[ = 78.571 \text{ cm}^2 \]

In \( \triangle OAB \), \( \sin 90^\circ = \frac{AB}{OA} \)
\[ \therefore AB = 10 \text{ cm}, \text{Area of } \triangle OAB = \frac{1}{2} \times 10 \times 10 = 50 \text{ cm}^2 \]

Area of minor segment = 78.5 - 50 = 28.5 cm²

(ii) For the major sector \( \theta = (360^\circ - 90^\circ) = 270^\circ \)

Area of major sector = \[ \frac{270}{360} \times \frac{22}{7} \times 10 \times 10 \]
\[ = \frac{550}{7} \times \frac{3}{1} \]
\[ = 78.571 \times 3 \]
\[ = 235.713 \text{ cm}^2 \].
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  
(iii) area of the segment formed by the corresponding chord

Solution:

(i) length of the arc = \( \frac{2\pi r}{360} \times 60 \times 2 = \frac{11}{7} \times 21 \times 2 \)

\( = 22 \text{ cm} \)

(ii) Area of the sector formed by the arc

\( = \frac{\theta}{360} \times \pi r^2 \)

\( = \frac{60}{360} \times \frac{22}{7} \times 21 \times 21 \)

\( = 231 \text{ cm}^2 \)

(iii) Area of segment formed by corresponding chord.

\( = \text{Area of sector} - \text{Area of triangle} \)

\( = 231 - \text{Area of } \triangle OAB \) ........................ (1)

Let OM be the \( \perp \) r bisector to the chord AB.

\( \Rightarrow \angle AOM = \angle BOM \) (: AM = BM)

Let OM = x cm

\( \text{In } \triangle OMA, \ \frac{OM}{OA} = \cos 30^\circ \)

\( \frac{x}{21} = \frac{\sqrt{3}}{2} \) (\( \cos 30^\circ = \frac{\sqrt{3}}{2} \))

\( x = 18.2 \text{ cm} \)

\( \text{In } \triangle OMA, \ \frac{AM}{OA} = \sin 30^\circ = \frac{1}{2} \) (\( \sin 30^\circ = \frac{1}{2} \))

AM = 21 \times \frac{1}{2} = 11.5 \text{ cm}

AB = 2 AM

\( = 2 \times 11.5 = 21 \text{ cm} \)

\( \text{In } \triangle OAB, \ \text{area of } \triangle OAB = \frac{1}{2} \cdot OM \times AB \)

\( = \frac{1}{2} \times 18.2 \times 21 \)

\( = 191 \text{ cm}^2 \)

from (1), Area of segment formed by corresponding chord \( (231 - 191) = 40 \text{ cm}^2. \)
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:

Area of sector formed by the arc = \( \frac{\theta}{360} \times \pi r^2 \)

= \( \frac{60}{360} \times \frac{22}{7} \times 15 \times 15 \)

= \( \frac{625}{7} \) = 117.82 cm²

In \( \triangle OAB \), let OM be \( \perp \) bisector of \( AB \)
\( \angle AOM = \angle BOM \)
Let OM be = x cm

In \( \triangle OMA \), \( \frac{OM}{CA} = \cos 30° \)

\( \frac{x}{15} = \frac{\sqrt{3}}{2} \) (\( \cos 30° = \frac{\sqrt{3}}{2} \))

\( x = 15 \times \frac{\sqrt{3}}{2} \) \( cm = \frac{15 \times 1.73}{2} \)

= \( \frac{25.95}{2} \)

OM = 12.975 cm
In $\triangle OMA$
\[
\sin 30^\circ = \frac{AM}{OA}
\]
\[
\frac{1}{2} = \frac{AM}{15}
\]
AM = 15/2 cm
AB = 2AM = 15 cm
Area of $\triangle OAB = \frac{1}{2} \times CM \times AB$
\[
= \frac{1}{2} \times 12.975 \times 15
\]
\[
= \frac{194.625}{2}
\]
\[
= 97.3125 \text{ Sq.cm}
\]
Area of minor segment = Area of sector formed by the arc – Area of $\triangle OAB$
\[
= 117.82 - 97.31
\]
\[
= 20.51 \text{ sq.cm}
\]
Area of major segment = $\pi r^2 - 20.51$
\[
= 3.14 \times 15 \times 15
\]
\[
= 706.5 - 20.51
\]
\[
= 686.0 \text{ sq.cm}
\]
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:**

\[ OA = OB = r = 12 \text{ cm} \quad \theta = 120^\circ \]

Area of sector formed by the arc \( \theta \) is

\[
\text{Area} = \frac{\theta}{360} \times \pi r^2 = \frac{120}{360} \times 3.14 \times 12 \times 12 = 150.72 \text{ sq.cm.}
\]

In \( \triangle OAB \), \( \angle AOB = 120^\circ \)

Let \( OM = x, \) be \( \perp \) bisector to chord \( AB \)

In \( \triangle OMA, \)

\[
\frac{OM}{OA} = \cos 60^\circ = \frac{1}{2} \]

OM = OA \times \frac{1}{2} = 12 \times \frac{1}{2} = 6 \text{ cm}

\[
\sin 60^\circ = \frac{AM}{AO} \Rightarrow AM = 12 \times \frac{\sqrt{3}}{2} = 6 \sqrt{3} = 6 \times 1.73 = 10.38 \text{ cm}
\]

AB = 2AM = 20.76 cm

Area of \( \triangle OAB = \frac{1}{2} \times OM \times AB = \frac{1}{2} \times 6 \times 20.76 = 62.28 \text{ sq.cm.} \)

Area of segment of the circle

150.72 - 62.28 = 88.44 sq.cm.
A horse is tied to a peg at one corner of a square shaped grass field of side 15 m by means of a 5 m long rope (see Figure). Find
(i) the area of that part of the field in which the horse can graze.
(ii) the increase in the grazing area if the rope were 10 m long instead of 5 m. (Use \( \pi = 3.14 \))

**Solution:**

(i) Area of the part that the horse can graze: 
\[
= \frac{90}{360} \times \pi \times r^2 \\
= \frac{90}{360} \times \frac{22}{7} \times 5 \times 5 \\
= 19.642 \text{ sq m}
\]

(ii) If the rope were 10 m Long instead of 5 m Area = \( \frac{90}{360} \times \pi \times (10)^2 \)
\[
= \frac{90}{360} \times \frac{22}{7} \times 100 \\
= 3.14 \times 25 \\
= 78.57 \text{ sq m}
\]

\[\therefore \text{ Increase in grazing area } = 78.570 - 19.642 = 58.92 \text{ sq m.}\]
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 as shown in Figure Find:
(i) the total length of the silver wire required.
(ii) the area of each sector of the brooch.

Solution:
Diameter = 35 mm
The wire is used to form the circumference of the circle + 5 diameter of the circle.
Circumference of circle = \(2\pi r\)
\[
= 2 \times \frac{22}{7} \times \frac{35}{2} \\
= 110 \text{ mm}
\]
The total length of silver wire required
\[
= 110 + 5 \times 35 \\
= 110 + 175 \\
= 285 \text{ mm}
\]
The brooch is divided into 10 equal sectors.
But angle at the centre = 360°
Area made by each sector = \(\frac{360}{10}\)
\[
= 36°
\]
Area of each sector = \(\frac{\theta}{360} \times \pi r^2\)
\[
= \frac{36}{360} \times \frac{22}{7} \times \left(\frac{35}{2}\right)^2 \\
= \frac{1925}{20} = 96.25 \text{ sq m}
\]
An umbrella has 8 ribs which are equally spaced (see Fig.). Assuming umbrella to be a flat circle of radius 45 cm, find the area between the two consecutive ribs of the umbrella.

Solution:
The umbrella is divided into 8 ribs.
If we consider one sector the angle \( \theta \) at the centre is \( \frac{360^\circ}{9} = 45^\circ \)
Area between two consecutive ribs = Area of sector = \( \frac{\theta}{360^\circ} \times \pi \times r^2 \)
\[
= \frac{90}{360} \times \frac{22}{7} \times 45 \times 45
= \frac{22275}{14}
= 1591 \text{ cm}^2.
\]

A car has two wipers which do not overlap. Each wiper has a blade of length 25 cm sweeping through an angle of 115\(^\circ\). Find the total area cleaned at each sweep of the blades.

Solution:
The area of the region wiped by both the wipers of the car which do not overlap each other

= 2(Area of the region wiped by one wiper)

Sector angle \( \theta = 115^\circ \). Radius of the sector = Length of the wiper = 25 cm

Area of the region wiped by both the wiper

\[
= 2 \left( \frac{115}{360} \times \frac{22}{7} \times 25 \times 25 \right) = 1254.96 \text{ cm}^2.
\]
To warn ships for underwater rocks, a lighthouse spreads a red coloured light over a sector of angle $80^\circ$ to a distance of 16.5 km. Find the area of the sea over which the ships are warned. (Use $\pi = 3.14$).

**Solution:**

$\theta = 80^\circ$

$r = 16.5 \text{ km} \therefore \text{Area of the sector of the circle} = \frac{\theta}{360} \times \pi r^2$

$$= \frac{80}{360} \times \frac{22}{7} \times 16.5 \times 16.5$$

$$= \frac{2}{9} \times 3.14 \times 16.5 \times 16.5$$

$$= 189.97 \text{ sq. km.}$$

Area of the sea over which the ships are warned = Area of the sector of the circle.

A round table cover has six equal designs as shown in Figure. If the radius of the cover is 28 cm, find the cost of making the designs at the rate of Rs. 0.35 per cm². (Use $\sqrt{3} = 1.7$)

**Solution:**

$R = 28 \text{ cm}$

The no. of sides = 6

Hence the angle $\theta$

Made by an segment of the circle $= \frac{360}{6} = 60^\circ$

Area of the sector of angle $60^\circ = \frac{60}{360} \times \pi r^2$

$$= \frac{1}{6} \times \frac{22}{7} \times 28 \times 28$$

$$= \frac{1}{6} \times 3.14 \times 28 \times 28$$

$$= 410.29 \text{ sq. cm.}$$

To find the area of $\triangle OAB$
Set 0 be the circle
0A = OB = 28 cm
Let OM be ⊥ r to AB then In Δ OAM,
\[
\sin 30^\circ = \frac{AM}{OA}
\]
∴ AM = OA sin 30°
= 28 × 1/2 = 14 cm
AB = 28 cm
OM = OA cos 30° = 28 × \frac{\sqrt{3}}{2}
= 24.248 cm
Hence, Area of Δ OAB = \frac{1}{2} × OM × AB
= \frac{1}{2} × 24.248 × 28
= 339.472 sq.cm.

Area of segment made by AB
410.29
339.47
70.82
= 70.82 × 6
= 424.92 sq.cm.

Cost of making the designs = 424.92 × 0.35
= Rs. 148.72

Similarly the area of segment made by 6 chords.

**Question-19**

Tick the correct answer in the following:
Area of a sector of angle \(p\) (in degrees) of a circle with radius \(R\) is
(A) \(\frac{p}{180} \times 2\pi R^2\)
(B) \(\frac{p}{180} \times \pi R^2\)
(C) \(\frac{p}{360} \times 2\pi R^2\)
(d) \(\frac{p}{720} \times 2\pi R^2\)

**Solution:**
Ans. \(\frac{p}{360} \times \pi R^2\)
\[= \frac{p}{720} \times 2\pi R^2\]
-----Answer: d
In Fig., ABC is a quadrant of a circle of radius 14 cm and a semicircle is drawn with BC as diameter. Find the area of the shaded region.

Solution:
In figure, ABC is a quadrant of a circle of radius 14 cm and a semicircular is drawn with BC as diameter.
The area of the above shaded region can be got by first finding the area of the semicircle with BC of diameter and then subtract the segment of the sector BAC.
ABC is a right angled Δ by applying Pythagoras theorem
\[
BC = \sqrt{AB^2 + AC^2} = \sqrt{(14)^2 + (14)^2} = \sqrt{392} = 14\sqrt{2} \text{ cm}
\]
Radius = \(\frac{14\sqrt{2}}{2}\) = 7\(\sqrt{2}\)
Area of the semicircle with BC as diameter
\[
= \frac{1}{2} \times \frac{22}{7} \times 7\sqrt{2} \times 7\sqrt{2} = \frac{1}{2} \times 22 \times 2 \times 7 = 154 \text{ cm}^2 \text{ ........ (i)}
\]
Area of the segment of sector BAC = Area of quadrant of a circle - Area of Δ ABC
\[
= \frac{90}{360} \times \frac{22}{7} \times 14^2 \times \frac{1}{2} - \frac{1}{2} \times 14 \times 14 \]
\[
= 154 - 98 = 56 \text{ cm}^2 \text{ ........ (ii)} \quad \text{Area of the shaded sector = Area of the semi circle with BC as diameter - Area of the segment of sector BAC}
\]
\[
= (i) - (ii) = 154 - 56 = 98 \text{ cm}^2.
\]
Find the area of the shaded region in Fig., if PQ = 24 cm, PR = 7 cm and O is the centre of the circle

Solution:
In the figure, PQ = 24 cm, PR = 7 cm \( \angle QPR = 90^\circ \) (Angle in a semi-circle)
Thus, 
\[
QR = \sqrt{(RP)^2 + (CP)^2} = \sqrt{(7)^2 + (24)^2} = \sqrt{49 + 576} = \sqrt{625} = 25 \text{ cm}
\]
Radius of the circle (OR) = \( \frac{25}{2} \) = 12.5 cm
Area of semicircle = \( \frac{1}{2} \pi r^2 \)
\[
= \frac{1}{2} \times \frac{22}{7} \times 12.5 \times 12.5 = 245.54 \text{ cm}^2
\]
Area of triangle = \( \frac{1}{2} \times \text{base} \times \text{height} \)
\[
= \frac{1}{2} \times 7 \times 24 = 84 \text{ cm}^2
\]
Area of shaded region = Area of semicircle - Area of triangle
\[
= 245.54 - 84 = 161.54 \text{ cm}^2.
\]
Find the area of the shaded region in Fig. if radii of the two concentric circles with centre O are 7 cm and 14 cm respectively and ∠ AOC = 40°.

Solution:
Radius of bigger circle = 14 cm
Radius of smaller circle = 7 cm

Area of bigger sector = \( \frac{\theta}{360} \times \pi r^2 \)
= \( \frac{40}{360} \times \frac{22}{7} \times 14 \times 14 = 68.44 \text{ cm}^2 \)

Area of smaller sector = \( \frac{\theta}{360} \times \pi r^2 \)
= \( \frac{40}{360} \times \frac{22}{7} \times 7 \times 7 = 17.11 \text{ cm}^2 \)

Area of shaded portion = Area of bigger sector - Area of smaller sector
= 68.44 - 17.11 = 51.33 \text{ cm}^2
Find the area of the shaded region in the figure, if ABCD is a square of side 14 cm and APD and BPC are semicircles.

Solution:
To find the area of the shaded region,
It can be found out by subtracting the two semicircle area from the area of the square.
Area of the square = $a^2 = 14 \times 14 = 196 \text{ cm}^2$
[Diameter of the semicircle = Side of the square = 14 cm
and hence the radius of the semicircle = $\frac{1}{2} \times 14 = 7 \text{ cm}$]
Area of a semicircle = $\frac{1}{2} \pi r^2 = \frac{1}{2} \times \frac{22}{7} \times 7 \times 7 = 77 \text{ cm}^2$ ............(1)

As the diameter of both the semicircle is the side of the same square, the combined area of both the semicircle
= $2 \times $ Area of a each semicircle
= $2 \times 77 = 154 \text{ cm}^2$ (from 1)

Area of the shaded region
$196 - 154 = 42 \text{ cm}^2$.  

Find the area of the shaded region in Fig., where a circular arc of radius 6 cm has been drawn with vertex O of an equilateral triangle OAB of side 12 cm as centre.

\[ \text{Solution:} \]

In the above figure what students should absence is that there is a common area in the form of a sector of a circle shown in the figure. Therefore in order to get the shaded area, we have to remove the common area in the combined areas of the area of the equilateral and the area of the circle.

Area of the sector = \( \frac{60}{360} \times \pi \times 6 \times 6 \)

\[ = \frac{1}{6} \times \pi \times 6 \times 6 \]
\[ = 6 \pi = \frac{22}{7} \times 6 \]
\[ = \frac{132}{7} = 18.86 \text{ cm}^2 \] \[ \text{...(1)} \]

Combined area of the circle + Area of the equilateral triangle
\[ = \pi r^2 + (\frac{\sqrt{3}}{4} \times a^2) \ \text{[The relevant formula for area of a circle]} \]
\[ = \frac{22}{7} \times 6 \times 6 \times \frac{\sqrt{3}}{4} - 12 \times 12 \]
\[ = 113.14 + 62.352 \]
\[ = 175.50 \text{ cm}^2 \] \[ \text{...(2)} \]

Area of the shaded region
\[ = 175.50 - 18.86 [\text{...(2) - (1)}] \]
\[ = 156.64 \text{ cm}^2. \]
From each corner of a square of side 4 cm a quadrant of a circle of radius 1 cm is cut and also a circle of diameter 2 cm is cut as shown in Fig. Find the area of the remaining portion of the square.

Solution:
The area of the square excluding the four sectors and the area of the circle of the centre of square can be obtained by subtracting the combined area of the four sectors and the central and for the area of the square.

Area of 1 sector = \( \frac{90}{360} \times \pi \times 1 \times 1 \)

= \( \frac{\pi}{4} \)

= \( \frac{22}{7} \times \frac{1}{4} = \frac{11}{14} \)

\( = 0.785 \text{ cm}^2 \)

\( \therefore \) Area of the 4 sectors = \( 0.785 \times 4 = 3.14 \text{ cm}^2 \)

Area of the circle at the centre = \( \pi \times 1 \times 1 = \frac{22}{7} \times 3.14 \text{ cm}^2 \)

\( \therefore \) Combined area of the four sectors and area of the circle = \( 3.14 + 3.14 = 6.28 \text{ cm}^2 \)

Area of the square = \( a^2 = 4^2 = 16 \text{ cm}^2 \)

\( \therefore \) Shaded region area = \( 16 - 6.28 = 9.72 \text{ cm}^2 \).
In figure, ABCD is a square of side 14 cm. With centres A, B, C and D, four circles are drawn such that each circle touch externally two of the remaining three circles. Find the area of the shaded region.

Solution:
Side of a square ABCD = 14 cm. \( \therefore \) Area of square ABCD = 14 \( \times \) 14 = 196 cm\(^2\)
Radius of each circle = \( \frac{14}{2} \) = 7 cm

Area of four quadrants at the four corners = Area of circle
\[ = \pi r^2 \]
\[ = \frac{22}{7} \times 7 \times 7 = 154 \text{ cm}^2 \]

Required area = Area of square ABCD \(-\) 4(\(\frac{1}{4}\) of area of each circle)
\[ = \text{Area of square} - \text{Area of one circle} \]
\[ = 196 - 154 = 42 \text{ cm}^2 \]
Figure depicts a racing track whose left and right ends are semicircular. The distance between the two inner parallel line segments is 60 m and they are each 106 m long. If the track is 10 m wide, find:
(i) the distance around the track along its inner edge
(ii) the area of the track.

Solution:
(i) The distance around the track along its inner edge = Perimeter of the inner track

\[= 106 + 106 + 2 \times \frac{22}{7} \times 30\]

\[= 400.60 \text{ m.}\]

(ii) Area of the two rectangles = \(2 \times 106 \times 10\)

\[= 2120\]

Area of the 2 semicircular region

\[= \pi (R^2 - r^2) = \pi (R + r) (R - r)\]

\[= \frac{22}{7} (40 \times 30)(40 - 30)\]

\[= \frac{22}{7} (70)(10)\]

\[= 2200\]

Total area of the track = 2120 + 2200 = 4320 \text{ m}^2
In figure, AB and CD are two diameters of a circle (with centre O) perpendicular to each other and OD is the diameter of the smaller circle. If OA = 7 cm, find the area of the shaded region.

**Solution:**
Consider semicircle BCA. By subtracting the area of the triangle ABC from this semicircular area, we will be able to get the combined segmented area.

\[
\text{Area of the bigger semicircular with radius 7m} - \text{area of the } \Delta \text{ABC.}
\]

\[
= \frac{1}{2} \times \frac{22}{7} \times 7 \times 7 - \frac{1}{2} \times 14 \times 7
\]

\[
= 77 - 49 = 28 \text{ cm}^2
\]

Area of smaller circle = \(\pi \times \frac{7}{2} \times \frac{7}{2}\)

\[
= \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}
\]

\[
= \frac{22}{2} = 38.5 \text{ cm}^2
\]

Total Area of the shaded Region = 28 + 38.5 = 66.5 cm².
The area of an equilateral triangle ABC is 17320.5 cm². With each vertex of the triangle as centre, a circle is drawn with radius equal to half the length of the side of the triangle (see Fig. 12.28). Find the area of the shaded region.

(Use \( \pi = 3.14 \) and \( \sqrt{3} = 1.73205 \)).

![Diagram of an equilateral triangle with circles drawn at each vertex]

**Solution:**

Area of equilateral \( \triangle ABC \) with \( \frac{\sqrt{3}}{4} \times a^2 \), where \( a \) is the side of a triangle

\[ 17320.5 = \frac{\sqrt{3}}{4} \times a^2 \]

\[ a^2 = \frac{17320.5 \times 4}{\sqrt{3}} \]

\[ a^2 = 40000 \text{ cm}^2 \]

\[ a = 200 \]

Radius of each circle = \( \frac{200}{2} = 100 \) cm

Area of sector = \( \frac{60}{360} \times \pi r^2 \)

\[ = \frac{60}{360} \times 3.14 \times 100 \times 100 \]

\[ = 5233.33 \text{ cm}^2 \]

Area of three sectors formed = \( 5233.33 \times 3 = 15699.99 \text{ cm}^2 \)

Area of shaded portion = Area of triangle – Area of three sectors

\[ = 17320.5 - 15699.99 \]

\[ = 1620.51 \text{ cm}^2 \].
On a square handkerchief, nine circular designs each of radius 7 cm are made. Find the area of the remaining portion of the handkerchief.

Solution:
Area of remaining portion of the handkerchief = Area of the square kerchief - 9(Area of circle)
Radius of a circle = 7 cm
Length of a side of square = 3(diameter of the circle) = 3 × 14 = 42 cm
Area of a square = Side × Side = (42)² = 1764
Area of one circle = \(\pi r^2 = \frac{22}{7} \times (7)^2 = 154\)

\[\therefore\text{Area of remaining portion of the handkerchief} = 1764 - 9(154)\]
\[= 1764 - 1386\]
\[= 378 \text{ cm}^2.\]
In Fig., OACB is a quadrant of a circle with centre O and radius 3.5 cm. If OD = 2 cm, find the area of the
(i) quadrant OACB,
(ii) shaded region.

![Diagram of quadrant OACB]

**Solution:**

(i) Area of the Quadrant OACB = \( \frac{1}{4} \pi r^2 \)

\[ = \frac{1}{4} \times \frac{22}{7} \times 3.5 \times 3.5 = 9.625 \text{ cm}^2 \]

(ii) Area of \( \triangle OBD = \frac{1}{2} \times \text{base} \times \text{height} \)

\[ = \frac{1}{2} \times AB \times AE = \frac{1}{2} \times 3.5 \times 2 = 3.5 \text{ cm}^2 \]

Hence the area of shaded portion = Area of the Quadrant - Area of \( \triangle OBD \)

\[ = 9.625 - 3.5 \]

\[ = 6.125 \text{ cm}^2. \]
In Fig., a square OABC is inscribed in a quadrant OBPQ. If OA = 20 cm, find the area of the shaded region. (Use \( \pi = 3.14 \))

![Diagram of a square inscribed in a quadrant]

**Solution:**

Area of square = Side \( \times \) Side = 20 \( \times \) 20

= 400 cm\(^2\)

Diagonal of square = Radius of the quadrant \( \therefore \) Diagonal of square = \( \sqrt{(20)^2 + (20)^2} \)

= 28.28 cm

Thus radius of a circle = 20.42 cm

Area of the Quadrant OBPQ = \( \frac{1}{4} \pi r^2 \)

= \( \frac{1}{4} \times \frac{22}{7} \times 20.42 \times 20.42 \)

= 628.58 cm\(^2\)

Hence the area of shaded portion = Area of the Quadrant - Area of square

= 628.58 - 400 = 228.58 cm\(^2\).
AB and CD are respectively arcs of two concentric circles of radii 21 cm and 7 cm and centre O. If \( \angle AOB = 30^\circ \), find the area of the shaded region.

**Solution:**
Radius of bigger sector = 21 cm
Radius of smaller sector = 7 cm
Area of bigger sector = \( \frac{\theta}{360} \times \pi r^2 \)
\[
= \frac{30^\circ}{360^\circ} \times \frac{22}{7} \times 21 \times 21 = 115.5 \text{ cm}^2
\]
Area of smaller sector = \( \frac{\theta}{360} \times \pi r^2 \)
\[
= \frac{30^\circ}{360^\circ} \times \frac{22}{7} \times 7 \times 7 = 12.83 \text{ cm}^2
\]
Area of shaded portion = Area of bigger sector - Area of smaller sector
\[
= 115.5 - 12.83 = 102.67 \text{ cm}^2.
\]
Question 1.
The radii of two circles are 19 cm and 9 cm respectively. Find the radius of the circle which has circumference equal to the sum of the circumferences of the two circles.

Question 2.
The radii of two circles are 8 cm and 6 cm respectively. Find the radius of the circle having area equal to the sum of the areas of the two circles.

Question 3.
Fig. 12.3 depicts an archery target marked with its five scoring regions from the centre outwards as Gold, Red, Blue, Black and White. The diameter of the region representing Gold score is 21 cm and each of the other bands is 10.5 cm wide. Find the area of each of the five
scoring regions.

**Question 4.**
The wheels of a car are of diameter 80 cm each. How many complete revolutions does each wheel make in 10 minutes when the car is travelling at a speed of 66 km per hour?

**Question 5.**
Tick the correct answer in the following and justify your choice : If the perimeter and the area of a circle are numerically equal, then the radius of the circle is
(A) 2 units  (B) π units  (C) 4 units  (D) 7 units

**NCERT Solutions for Class 10 Maths Chapter 12 Areas Related to Circles Exercise 12.2**

Unless stated otherwise, use π = 22/7.

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

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

**Question 3.**
The length of the minute hand of a clock is 14 cm. Find the area swept by the minute hand in 5 minutes.

**Question 4.**
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. (Use π = 3.14)

**Question 5.**
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
(iii) area of the segment formed by the corresponding chord

**Question 6.**
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 π = 3.14 and √3 = 1.73)
Question 7.
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 \( \sqrt{3} = 1.73 \))

Question 8.
A horse is tied to a peg at one corner of a square shaped grass field of side 15 m by means of a 5 m long rope (see Fig. 12.11). Find
(i) the area of that part of the field in which the horse can graze.
(ii) the increase in the grazing area if the rope were 10 m long instead of 5 m. (Use \( \pi = 3.14 \))

Question 9.
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 as shown in Fig. 12.12. Find:
(i) the total length of the silver wire required.
(ii) the area of each sector of the brooch.

Question 10.
An umbrella has 8 ribs which are equally spaced (see Fig. 12.13). Assuming umbrella to be a flat circle of radius 45 cm, find the area between the two consecutive ribs of the umbrella.

Question 11.
A car has two wipers which do not overlap. Each wiper has a blade of length 25 cm sweeping through an angle of 115°. Find the total area cleaned at each sweep of the blades.

Question 12.
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 \( \pi = 3.14 \))

Question 13.
A round table cover has six equal designs as shown in Fig. 12.14. If the radius of the cover is 28 cm, find the cost of making the designs at the rate of ₹ 0.35 per cm². (Use \( \sqrt{3} = 1.7 \))

Question 14.
Tick the correct answer in the following:
Area of a sector of angle \( p \) (in degrees) of a circle with radius \( R \) is
(A) \( p/180 \times 2\pi R \) \hspace{1cm} (B) \( p/180 \times \pi R^2 \) \hspace{1cm} (C) \( p/360 \times 2\pi R \) \hspace{1cm} (D) \( p/720 \times 2\pi R^2 \)

NCERT Solutions for Class 10 Maths Chapter 12 Areas Related to Circles Exercise 12.3

Unless stated otherwise, use \( \pi = \frac{22}{7} \)

Question 1.
Find the area of the shaded region in Fig. 12.19, if \( PQ = 24 \) cm, \( PR = 7 \) cm and \( O \) is the centre of the circle.
Question 2.
Find the area of the shaded region in Fig. 12.20, if radii of the two concentric circles with
centre O are 7 cm and 14 cm respectively and \( \angle AOC = 40^\circ \).

Question 3.
Find the area of the shaded region in Fig. 12.21, if ABCD is a square of side 14 cm and APD
and BPC are semicircles.

Question 4.
Find the area of the shaded region in Fig. 12.22, where a circular arc of radius 6 cm has been
drawn with vertex O of an equilateral triangle OAB of side 12 cm as centre.

Question 5.
From each corner of a square of side 4 cm a quadrant of a circle of radius 1 cm is cut and also
a circle of diameter 2 cm is cut as shown in Fig. 12.23. Find the area of the remaining portion
of the square.

Question 6.
In a circular table cover of radius 32 cm, a design is formed leaving an equilateral triangle
ABC in the middle as shown in Fig. 12.24. Find the area of the design.

Question 7.
In Fig. 12.25, ABCD is a square of side 14 cm. With centres A, B, C and D, four circles are
drawn such that each circle touch externally two of the remaining three circles. Find the area
of the shaded region.

Question 8.
Fig. 12.26 depicts a racing track whose left and right ends are semicircular.
The distance between the two inner parallel line segments is 60 m and they are each 106 m
long. If
the track is 10 m wide, find :
(i) the distance around the track along its inner edge
(ii) the area of the track.

Question 9.
In Fig. 12.27, AB and CD are two diameters of a circle (with centre O) perpendicular to each
other
and OD is the diameter of the smaller circle. If OA = 7 cm, find the area of the shaded region.

Question 10.
The area of an equilateral triangle ABC is 17320.5 cm\(^2\). With each vertex of the triangle as
centre, a circle is drawn with radius equal to half the length of the side of the triangle (see
Fig. 12.28). Find the area of the shaded region. (Use \( \pi = 3.14 \) and \( \sqrt{3} = 1.73205 \))

Question 11.
On a square handkerchief, nine circular designs each of radius 7 cm are made (see Fig.
12.29). Find the area of the remaining portion of the handkerchief.

Question 12.
In Fig. 12.30, OACB is a quadrant of a circle with centre O and radius 3.5 cm. If OD = 2 cm,
find the area of the
(i) quadrant OACB,  (ii) shaded region.

**Question 13.**
In Fig. 12.31, a square OABC is inscribed in a quadrant OPBQ. If OA = 20 cm, find the area of the shaded region. (Use \( \pi = 3.14 \))

**Question 14.**
AB and CD are respectively arcs of two concentric circles of radii 21 cm and 7 cm and centre O (see Fig. 12.32). If \( \angle AOB = 30^\circ \), find the area of the shaded region.

**Question 15.**
In Fig. 12.33, ABC is a quadrant of a circle of radius 14 cm and a semicircle is drawn with BC as diameter. Find the area of the shaded region.

**Question 16.**
Calculate the area of the designed region in Fig. 12.34 common between the two quadrants of circles of radius 8 cm each.