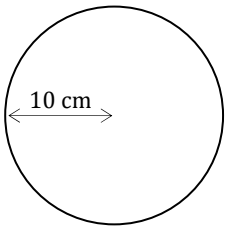
5 Circles

1. The circle below has a radius of 10 cm. What is the circumference of the circle? Take $\pi = 3.14$.



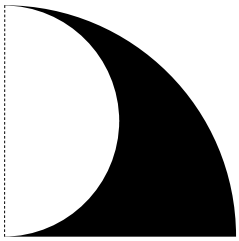
(1) 31.4 cm

(2) 62.8 cm

(3) 314 cm

(4) 1256 cm ( )

2. The figure below is made up of a quarter circle and a semicircle. What is the perimeter of the figure? Leave your answer in terms of π.



(1) 7.5π cm

(2) 10π cm

(3) $(10\pi + 10)$ cm

(4) $(15\pi + 10)$ cm ( )

3. Which one of the following statements is false?

(1) The radius of a circle is half the length of its diameter.

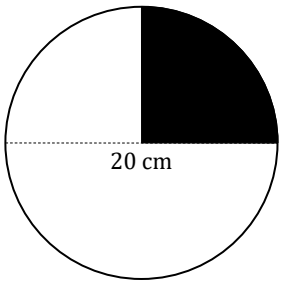
(2) The diameter of a circle passes through the centre of a circle.

(3) The circumference of a circle is slightly more than three times its diameter.

(4) The diameter is slightly more than three times the circumference of a circle.

( )

4. The figure shows a circle with a diameter of 20 cm.



Taking $\pi = 3.14$, find the area of the shaded quadrant.

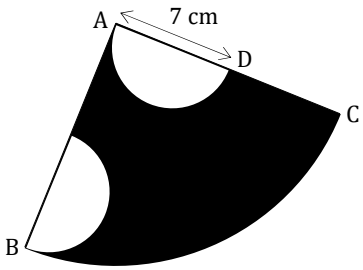
(1) $78.5\,\text{cm}^2$

(2) $157\,\text{cm}^2$

(3) $235.5\,\text{cm}^2$

(4) $314\,\text{cm}^2$ **( )**

5. The figure below is made up of a quadrant and 2 identical semicircles. AC is twice of AD.



Taking $\pi = \frac{22}{7}$, what is the perimeter of the shaded figure?

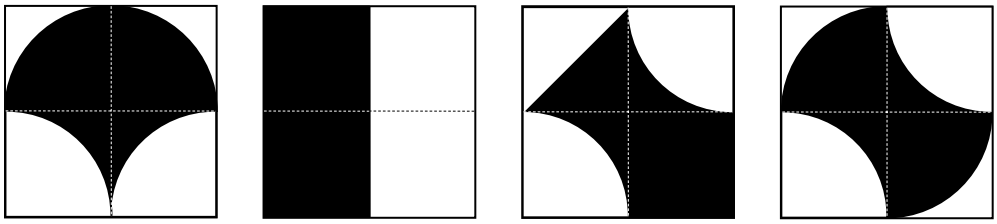
(1) 44 cm

(2) 47 cm

(3) 51 cm

(4) 58 cm **( )**

6. In the 4 figures labelled A, B, C and D, which 3 of them have the same shaded area?



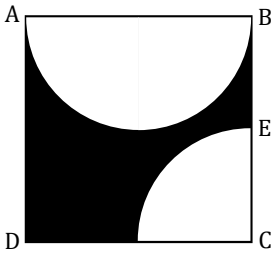
(1) A, B, C

(2) A, B, D

(3) B, C, D

(4) A, C, D ( )

7. ABCD is a square of area $64\,\text{cm}^2$. A semicircle and a quadrant lie within the square. BE = EC.



What is the area of the shaded part?

(1) $52\pi\ \text{cm}^2$

(2) $(64-6\pi)\,\text{cm}^2$

(3) $(64-12\pi)\,\text{cm}^2$

(4) $(64-16\pi)\,\text{cm}^2$ ( )

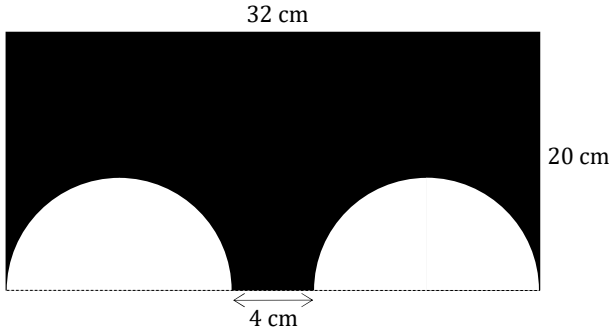
8. Circle A has a radius of 30 cm.
Circle B has a diameter of 40 cm.
Circle C has a circumference of 50π cm.

Which circle has the longest circumference and which circle has the shortest circumference?

	Longest	Shortest
(1)	A	B
(2)	A	C
(3)	B	A
(4)	C	A

( )

9. The figure below shows a rectangular piece of paper with two cut-out identical semicircles.



Taking $\pi = \frac{22}{7}$, calculate the area of the shaded part.

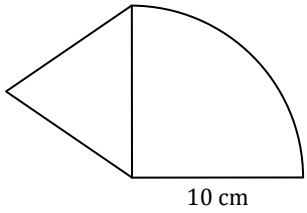
(1) $120\,\text{cm}^2$

(2) $332\,\text{cm}^2$

(3) $486\,\text{cm}^2$

(4) $596\,\text{cm}^2$ **( )**

10. The figure below is made up of an equilateral triangle and a quadrant. The radius of the quadrant is 10 cm. Find the perimeter of the figure, leaving your answer in terms of π.



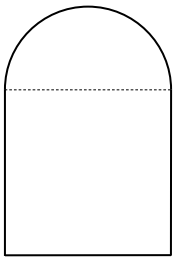
(1) $(2.5\pi + 30)\,\text{cm}$

(2) $(5\pi + 30)\,\text{cm}$

(3) $(20\pi + 30)\,\text{cm}$

(4) $(25\pi + 30)\,\text{cm}$ **( )**

11. The figure is made up of a square of perimeter 28 cm and a semicircle.



Taking $\pi = \frac{22}{7}$, find the perimeter of the figure.

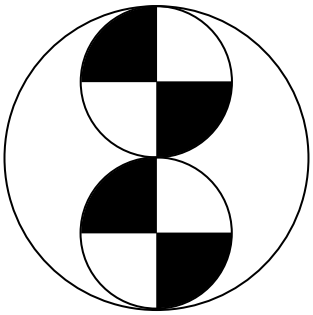
(1) 32 cm

(2) 39 cm

(3) 43 cm

(4) 50 cm ( )

12. The figure below is made up of 2 small identical circles and a big circle. The radius of the big circle is twice the radius of one small circle. Each small circle is divided into 4 quadrants.



What fraction of the big circle is shaded?

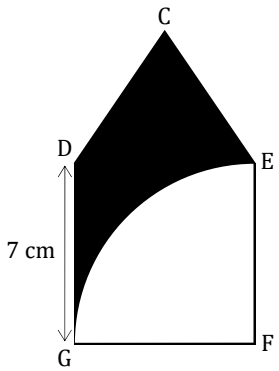
(1) $\frac{1}{16}$

(2) $\frac{1}{8}$

(3) $\frac{1}{4}$

(4) $\frac{1}{2}$ ( )

13. The figure below is made up of an equilateral triangle CDE and a square DEFG of length 7 cm with a quadrant in it.



Taking $\pi = \frac{22}{7}$, find the perimeter of the shaded region.

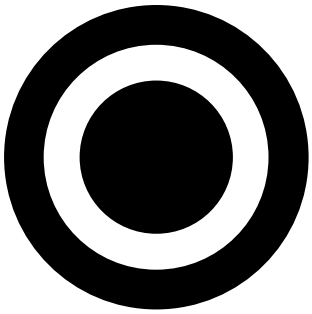
(1) 11 cm

(2) 32 cm

(3) 39 cm

(4) 65 cm **( )**

14. The figure below is formed by 3 circles with the same centre. Their radii are in the ratio 2 : 3 : 4. The diameter of the smallest circle is 4 cm.



Find the area of the shaded parts, leaving your answer in terms of π.

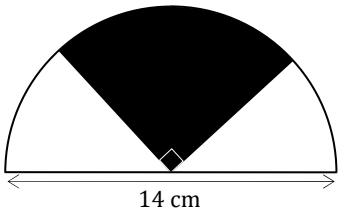
(1) 3π cm^2

(2) 7π cm^2

(3) 11π cm^2

(4) 14π cm^2 **( )**

15. The figure shows a quarter circle in a semicircle. The diameter of the semicircle is 14 cm.



Taking $\pi = \frac{22}{7}$, find the area of the unshaded parts.

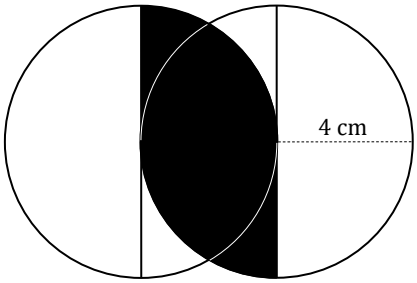
(1) $38.5\,\text{cm}^2$

(2) $77\,\text{cm}^2$

(3) $154\,\text{cm}^2$

(4) $308\,\text{cm}^2$ **( )**

16. The figure is made up of 2 identical circles of diameter 8 cm.



Find the area of the shaded parts, expressing your answer in terms of π.

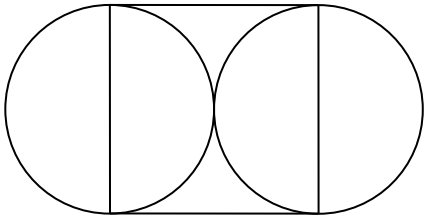
(1) $(8\pi)\,\text{cm}^2$

(2) $(8\pi + 8)\,\text{cm}^2$

(3) $(16\pi)\,\text{cm}^2$

(4) $(16\pi + 8)\,\text{cm}^2$ **( )**

17. The figure below is made up of four identical semicircles of diameters 10 cm and a square.



Find the perimeter of the figure in terms of π.

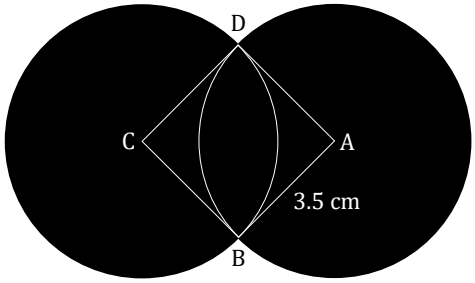
(1) $(100+50\pi)$ cm

(2) $(40+20\pi)$ cm

(3) $(20+20\pi)$ cm

(4) $(20+10\pi)$ cm ( )

18. The shaded figure is formed by two identical circles with centres at A and C. ABCD is a square and length AB is 3.5 cm.



Taking $\pi = \frac{22}{7}$, find the perimeter of the shaded figure.

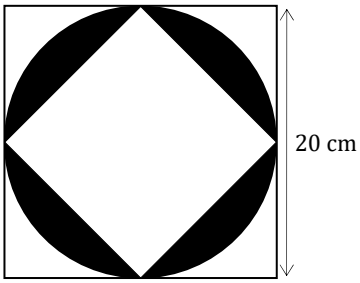
(1) 23.5 cm

(2) 30.5 cm

(3) 33 cm

(4) 47 cm ( )

19. In the figure below, a circle is touching two squares at exactly four points.



Given that the side of the bigger square is 20 cm, find the area of the shaded parts. Leave your answer in terms of π.

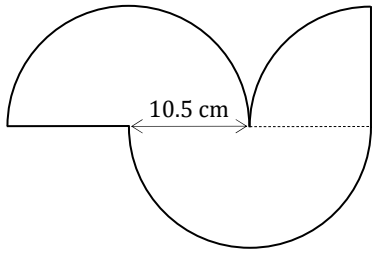
(1) $(100\pi - 100)\,\text{cm}^2$

(2) $(100\pi - 200)\,\text{cm}^2$

(3) $(400 - 100\pi)\,\text{cm}^2$

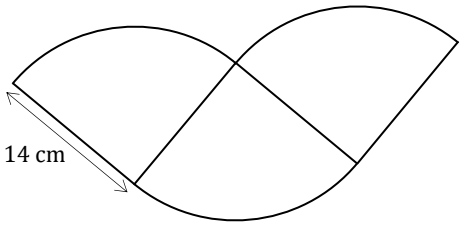
(4) $(600 - 100\pi)\,\text{cm}^2$ **( )**

20. The figure below is made up of a quadrant and 2 identical semicircles of radius 10.5 cm. Find the perimeter of the figure. Take $\pi = \frac{22}{7}$.



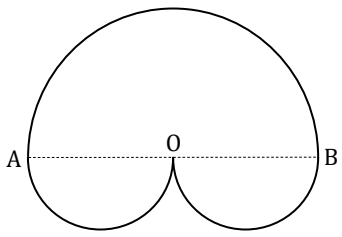
Ans: _____ cm

21. The figure below is made up of 3 identical quadrants with radius of 14 cm. Find the area of the figure. Take $\pi = \frac{22}{7}$.



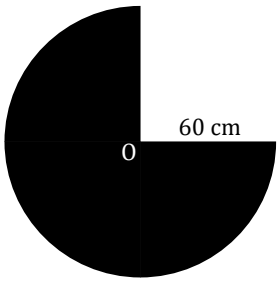
Ans: _____ cm^2

22. The figure below is made up of 2 identical smaller semicircles and a bigger semicircle. O is the centre of the bigger semicircle of radius 7 cm. Find the perimeter of the whole figure. Take $\pi = \frac{22}{7}$.



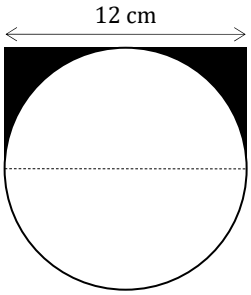
Ans: _____ cm

23. The figure below shows a three-quarter circle with centre O and radius 60 cm. Using the calculator value of π, find the perimeter of the figure. Give your answer correct to 1 decimal place.



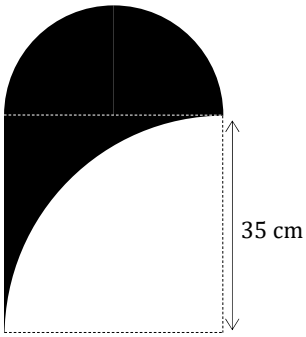
Ans: _____ cm

24. The figure below is made up of a rectangle and a circle. Taking $\pi = 3.14$, find the area of the shaded parts.



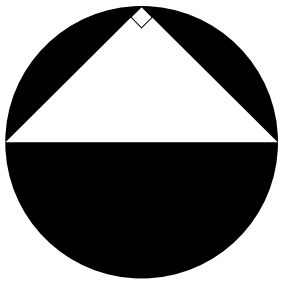
Ans: _____ cm^2

25. The shaded figure below is formed by a semicircle, a quadrant and a square. The radius of the quadrant is 35 cm. Find the perimeter of the shaded part. Take $\pi = \frac{22}{7}$.



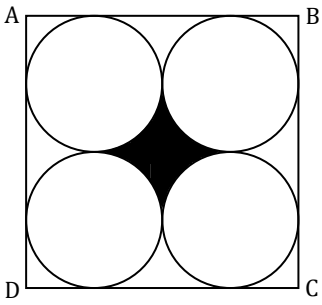
Ans: _____ cm

26. The figure below shows a right-angled triangle inside a circle. The longest side of the triangle is the diameter of the circle. Given that the diameter of the circle is 10 cm, find the area of the shaded portion. Take $\pi = 3.14$.



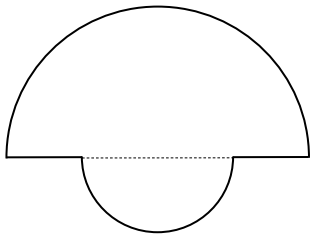
Ans: _____ cm^2

27. The figure below shows 4 identical circles in a square, ABCD. The area of the square is $64\ cm^2$. Find the area of the shaded part. Take $\pi = 3.14$.



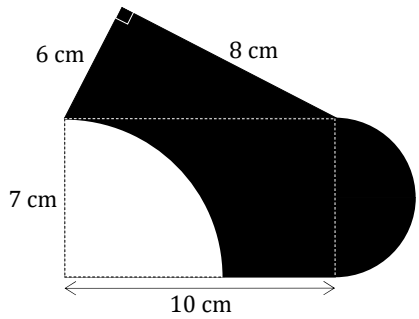
Ans: _____ cm^2

28. The figure below is made up of 2 semicircles with diameters 7 cm and 14 cm respectively. What is the perimeter of the figure? Take $\pi = \frac{22}{7}$.



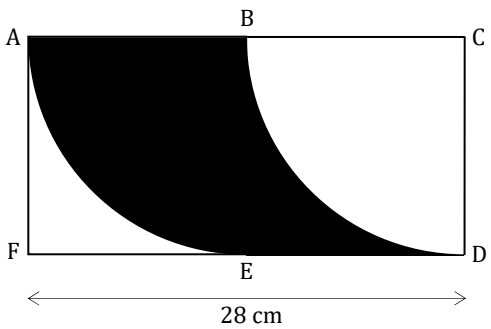
Ans: _____ cm

29. The figure below is made up of a right-angled triangle, a semicircle and a rectangle with a quadrant cut out from it. Find the area of the shaded figure, rounding off your answer to 2 decimal places. Take $\pi = 3.14$.



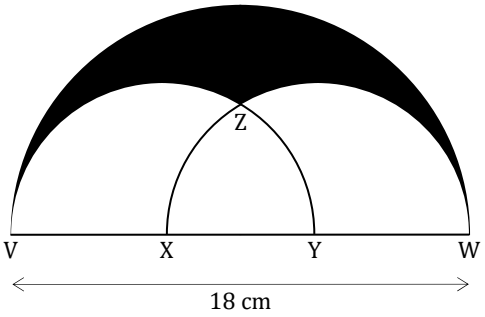
Ans: _____ cm^2

30. In the figure below, ACDF is a rectangle of length 28 cm made up of two identical squares. A quarter circle is drawn in each square. What is the perimeter of the shaded part? Take $\pi = \frac{22}{7}$.



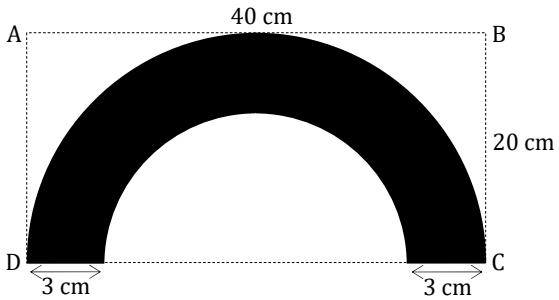
Ans: _____ cm

31. The figure below is made up of a big semicircle and 2 identical smaller semicircles. The length of VW is 18 cm and VX = XY = YW. The overlapping part of the 2 smaller semicircles, Part XYZ, has a perimeter of 18.56 cm. Find the perimeter of the shaded part. Take $\pi = 3.14$.



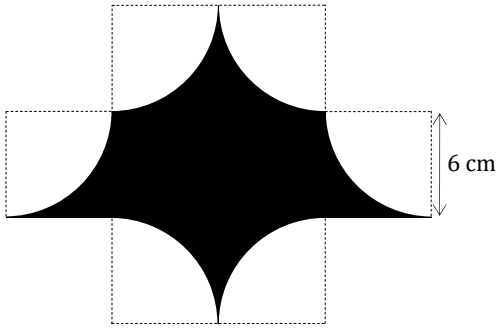
Ans: _____ cm

32. ABCD is a rectangular cardboard measuring 40 cm by 20 cm. Samuel cut out a semicircle and 2 corners from it. Find the perimeter of the remaining cardboard which is shaded below. Leave your answer in terms of π.



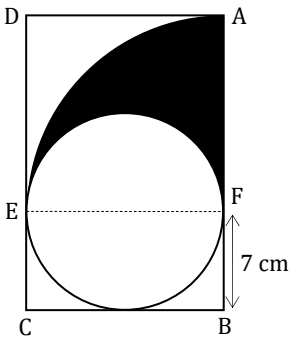
Ans: _____ cm

33. The figure below is made up of 6 identical quadrants. The radius of the quadrant is 6 cm. Find the area of the shaded part. Take $\pi = 3.14$.



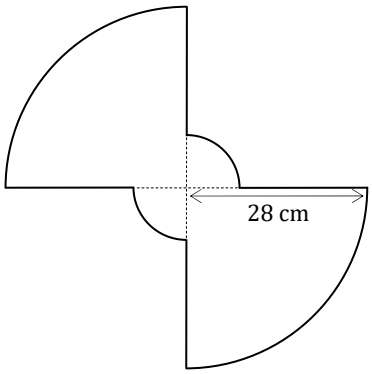
Ans: _____ cm^2

34. The shaded part in the figure below is made up of a quadrant and a semicircle which are drawn within Rectangle ABCD. FB = 7 cm. What fraction of Rectangle ABCD is shaded? Take $\pi = \frac{22}{7}$.



Ans: _____

35. The figure below is made up of two identical big quadrants and two identical small quadrants. The ratio of the radius of the small quadrant to the radius of the big quadrant is 1 : 4. The radius of the big quadrant is 28 cm. Find the perimeter of the figure. Take $\pi = \frac{22}{7}$.

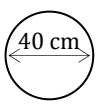


Ans: _____ cm

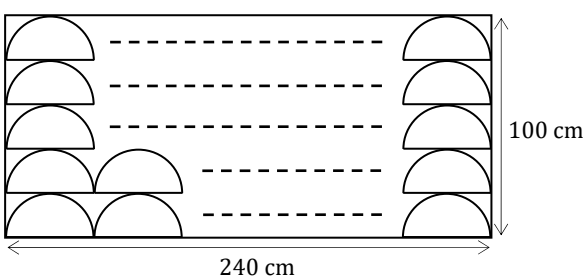
36. Lynette has a rectangular board and some circular pieces of paper of diameter 40 cm. She cuts all the circular pieces of paper into semicircles before decorating the entire board using all the semicircles, following the pattern shown in the figure below. Each piece of semicircular paper is in contact with those next to it.

(a) How many pieces of circular paper does Lynette have at first?

(b) Find the area of the board covered by the semicircular pieces of paper. Take $\pi = 3.14$.



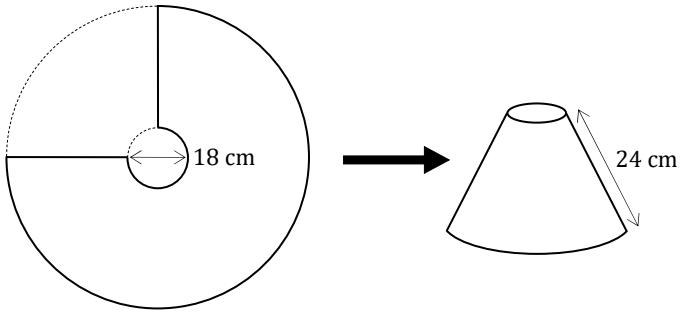
Circular paper



Ans: (a) _____

(b) _____ cm^2

37. A quarter of a piece of circular paper with a hole in the middle had been cut as shown in the figure below. The remaining piece of paper was then folded to form a lamp shade. What is the area of the piece of paper used to make the lamp shade? Take $\pi = 3.14$.

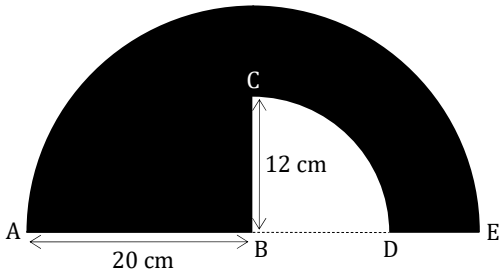


Ans: _____ cm^2

38. The figure below shows a quarter circle in a semicircle with centre B. It is given that AB = 20 cm and BC = 12 cm. Taking $\pi = 3.14$, find

(a) the area of the shaded part

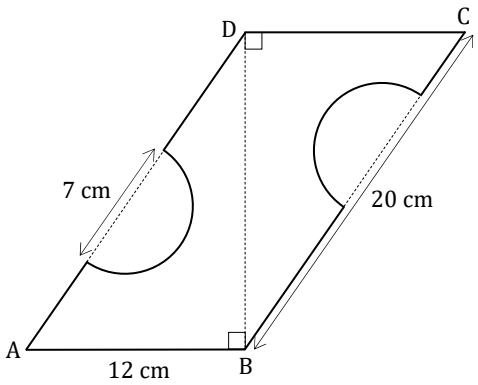
(b) the perimeter of the shaded part



Ans: (a) _____ cm^2

(b) _____ cm

39. The figure below shows a piece of paper made up of two identical right-angled triangles. Two identical semicircles with diameter 7 cm are cut from it. Find the perimeter of the remaining piece of paper. Take $\pi = \frac{22}{7}$.

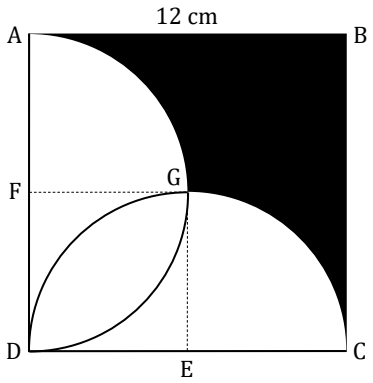


Ans: _____ cm

40. The figure below is formed by a square with 2 identical semicircles in it. ABCD is a square of sides 12 cm. AGD and DGC are semicircles with centres F and E respectively. Taking $\pi = 3.14$, find

(a) the area of the shaded part

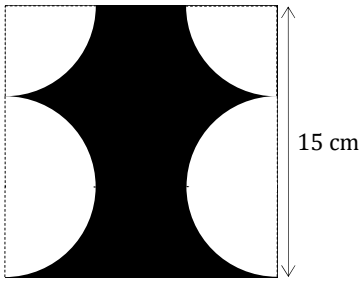
(b) the perimeter of the shaded part



Ans: (a) _____ cm^2

(b) _____ cm

41. Two quarter circles and two semicircles of the same radius are cut out from a square piece of paper of length 15 cm. What is the perimeter of the remaining piece of paper? Express your answer in terms of π.

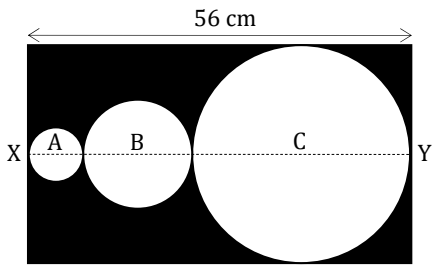


Ans: _____ cm

42. The figure below is formed by a rectangle and three circles, A, B and C. The diameter of Circle A is half that of Circle B and the diameter of Circle B is half that of Circle C. Line XY is the line of symmetry of the figure.

(a) What is the diameter of Circle A?

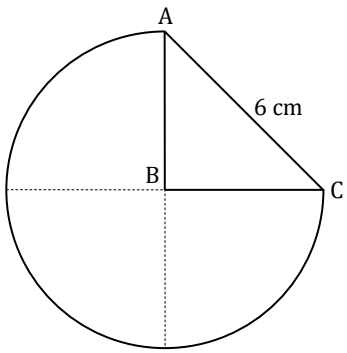
(b) Taking $\pi = 3.14$, find the shaded area.



Ans: (a) _____ cm

(b) _____ cm^2

43. The figure below is made up of 3 identical quarter circles and a right-angled isosceles triangle. $\angle ABC = 90°$ and $AB = BC$. The length of AC is 6 cm. Find the area of the figure. Take $\pi = 3.14$.

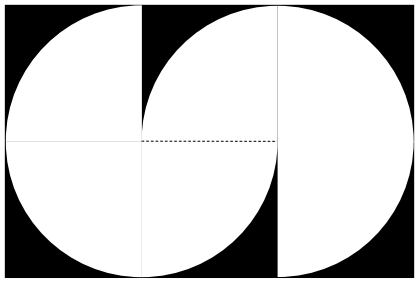


Ans: _____ cm^2

44. Mary placed 2 identical three-quarter circles onto a black rectangular mat without overlapping as shown in the figure below. The diameter of each of the three-quarter circles is 28 cm. Taking $\pi = \frac{22}{7}$, find

(a) the length of the rectangular mat

(b) the area of the rectangular mat not covered by the 2 identical three-quarter circles



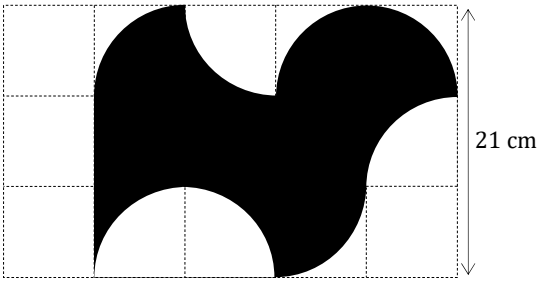
Ans: (a) _____ cm

(b) _____ cm^2

45. In the square grid below, the outline of the shaded figure is formed by 8 identical quarter circles and a straight line. Taking $\pi = \frac{22}{7}$, find

    (a) the area of the shaded figure

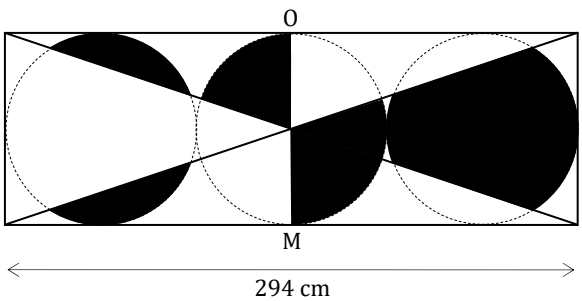
    (b) the perimeter of the shaded figure



Ans: (a) _____ cm^2

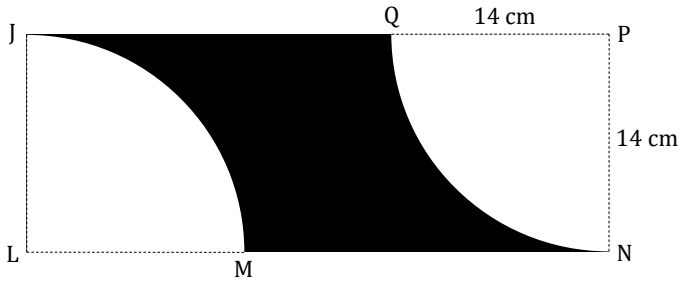
(b) _____ cm

46. The figure below shows 3 identical circles drawn within a rectangle. The two slanted lines are the diagonals of the rectangle and OM is a straight line. If the length of the rectangle is 294 cm, what is the total area of the unshaded parts? Take $\pi = \frac{22}{7}$.



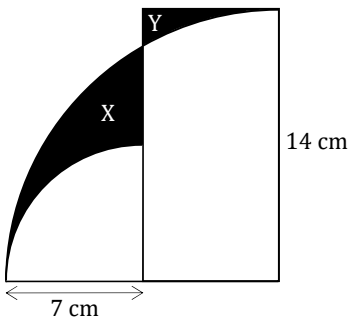
Ans: _____ cm^2

47. Two identical quarter circles of radius 14 cm are cut from the rectangular piece of wood, JLNP, as shown in the figure below. The remaining piece of wood, as shown by the shaded area, has an area of $266\,\text{cm}^2$. Taking $\pi = \frac{22}{7}$, find the length of MN.



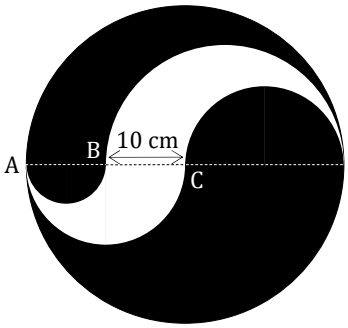
Ans: _____ cm

48. The figure shows two quarter circles and a rectangle. The radius of the big quarter circle is 14 cm. The radius of the small quarter circle is 7 cm. What is the difference in area between the two shaded parts X and Y? Take $\pi = \frac{22}{7}$.



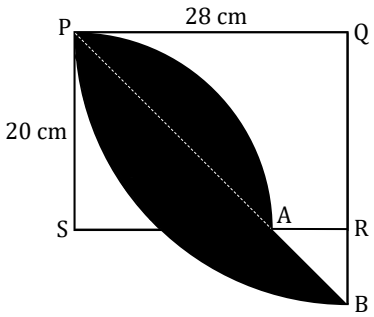
Ans: _____ cm^2

49. The figure below is made up of a circle and 4 semicircles. C is the centre of the circle and its radius is 20 cm. AB = BC. Find the area of the shaded part. Take $\pi = 3.14$.



Ans: _____ cm^2

50. The figure below is made up of a rectangle PQRS, and two quarter circles PAS and PBQ. Find the area of the shaded part. Take $\pi = 3.14$.

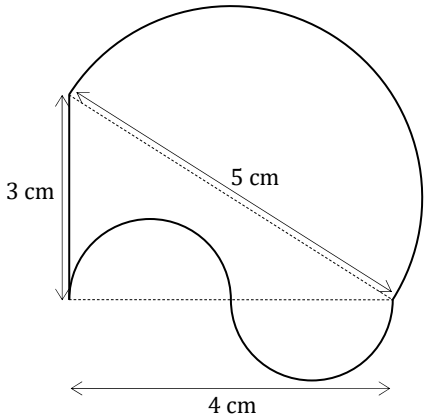


Ans: _____ cm^2

51. The figure below is formed by 1 large semicircle, 2 small identical semicircles and a straight line. The semicircles are formed along the edges of a right-angled triangle. The dimensions of the triangle are 3 cm, 4 cm and 5 cm. Taking $\pi = 3.14$, find, correct to 2 decimal places,

    (a) the perimeter of the figure

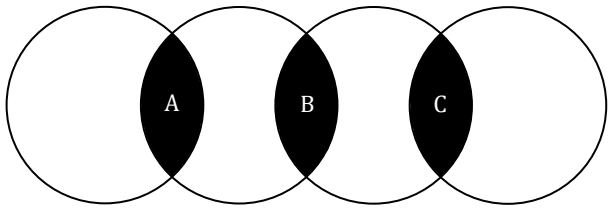
    (b) the area of the figure



Ans: (a) _____ cm

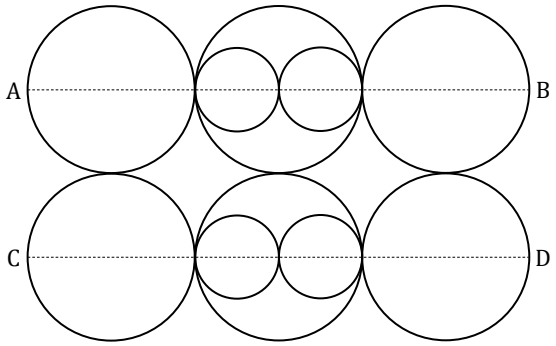
(b) _____ cm^2

52. The figure below is made up of 4 identical circles, each with a radius of 7 cm. The circles overlap at the shaded parts A, B and C. The area of each shaded part is $30\,cm^2$. Find the total area of the unshaded parts. Take $\pi = \frac{22}{7}$.



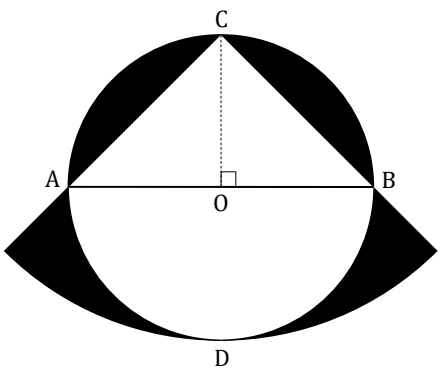
Ans: _____ cm^2

53. Jonathan had a roll of wire. He used the roll of wire to form the figure shown below. It is made up of 6 identical big circles and 4 identical small circles. The diameter of the big circle is twice the diameter of the small circle. The diameters of all the circles form two straight lines such that AB = CD = 84 cm. What was the length of the roll of wire that Jonathan had? Take $\pi = \frac{22}{7}$.



Ans: _____ cm

54. The figure below is made up of a quadrant, a circle and a triangle overlapping one another. The quadrant touches the circle at Point D. The circle, with centre O, has a diameter of 16 cm. Given that AB is perpendicular to OC, what is the area of the shaded region? Take $\pi = 3.14$.

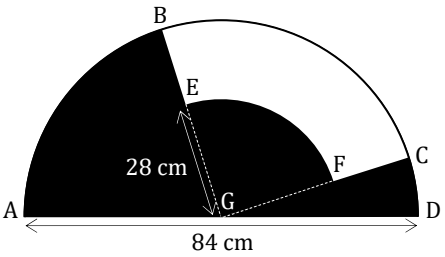


Ans: _____ cm^2

55. The figure below shows a semicircle with a diameter of 84 cm and a quarter circle EFG with a radius of 28 cm. G is the midpoint of AD. BEG and CFG are straight lines. Taking $\pi = \frac{22}{7}$, find

(a) the area of the shaded part

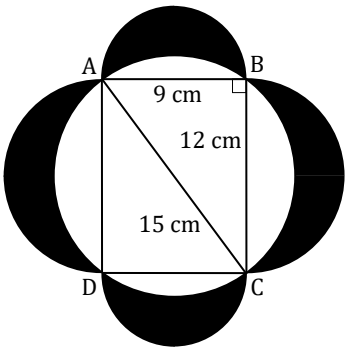
(b) the perimeter of the shaded part



Ans: (a) _____ cm^2

(b) _____ cm

56. The figure below is made up of four semicircles and a rectangle ABCD. AB = 9 cm, BC = 12 cm and AC = 15 cm. The lengths AB, BC, CD and DA are the diameters of the respective semicircles. Find the total area of the shaded parts. Take $\pi = 3.14$.

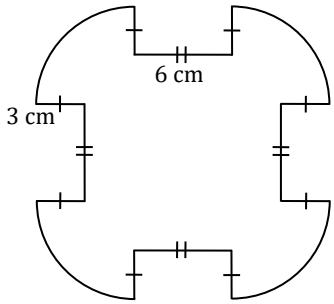


Ans: _____ cm^2

57. The figure below is made up of four quarter circles and straight lines. All corner angles are at right angles. The radius of each quarter circle is 6 cm.

    (a) What is the area of the figure? Leave your answer in terms of π.

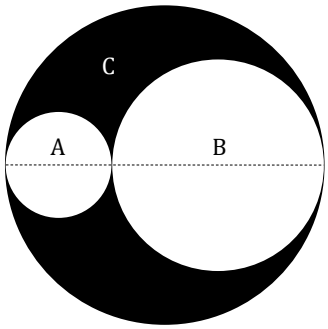
    (b) What is the perimeter of the figure? Leave your answer in terms of π.



Ans: (a) _____ cm^2

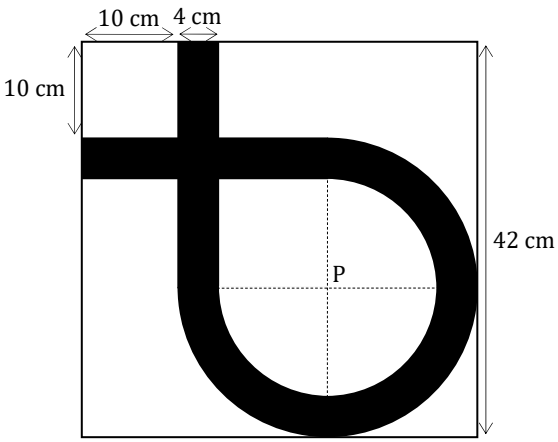
(b) _____ cm

58. The figure below is made up of 3 circles. The ratio of the area of Circle A to the area of Circle B is 1 : 4. If the diameter of Circle A is 14 cm, find the perimeter of the shaded region in the figure. Give your answer in terms of π.



Ans: _____ cm

59. A square poster of side 42 cm has a design formed by a 4 cm wide black strip. The outline of the design is made up of quarter circles with centre P and straight lines. All the straight lines meet at right angles. Find the area of the shaded part. Take $\pi = 3.14$.



Ans: _____ cm^2

5 Circles

Solution 1

2

Circumference of the circle $= 2 \times \pi \times 10$
$= 20 \times 3.14 = 62.8$ cm

Solution 2

3

Radius of the semicircle $= 10 \div 2 = 5$ cm

Perimeter of the figure
$= \left(\frac{1}{4} \times 2 \times \pi \times 10\right) + \left(\frac{1}{2} \times 2 \times \pi \times 5\right) + 10$
$= 5\pi + 5\pi + 10 = (10\pi + 10)$ cm

Solution 3

4

Option 1: True.
Option 2: True.

Option 3: True
Circumference of a circle $= \pi \times d = 3.14d$

Option 4: False

Solution 4

1

Radius of the circle $= 20 \div 2 = 10$ cm

Area of the shaded quadrant
$= \frac{1}{4} \times \pi \times 10 \times 10 = \frac{1}{4} \times 3.14 \times 10 \times 10$
$= \frac{1}{4} \times 314 = 78.5\,\text{cm}^2$

Solution 5

4

Radius of the quadrant $= 2 \times 7 = 14$ cm

Radius of the semicircle $= 7 \div 2 = 3.5$ cm

Perimeter of the shaded figure
$= (2 \times 7) + \left(\frac{1}{4} \times 2 \times \pi \times 14\right) + (2 \times \pi \times 3.5)$
$= 14 + 7\pi + 7\pi = 14 + 14\pi$
$= 14 + \left(14 \times \frac{22}{7}\right) = 14 + 44 = 58$ cm

---

Solution 6

2

Figures A, B and D have the same shaded area of two squares.

Solution 7

3

Length of a side of Square ABCD $= \sqrt{64}$
$= 8$ cm

Radius of the semicircle $= 8 \div 2 = 4$ cm

Area of the shaded part $= 64 - \left(\frac{3}{4} \times \pi \times 4 \times 4\right)$

$= (64 - 12\pi)\,\text{cm}^2$

Solution 8

1

Circumference of Circle A $= 2 \times \pi \times 30$
$= 60\pi$ cm

Circumference of Circle B $= \pi \times 40$
$= 40\pi$ cm

Solution 9

3

Radius of the semicircle $= (32 - 4) \div 4 = 7$ cm

Area of the shaded part
$= (32 \times 20) - (\pi \times 7 \times 7) = 640 - \left(\frac{22}{7} \times 7 \times 7\right)$
$= 640 - 154 = 486\ \text{cm}^2$

Solution 10

2

Perimeter of the figure
$= \left(\frac{1}{4} \times 2 \times \pi \times 10\right) + (3 \times 10) = (5\pi + 30)$ cm

---

Solution 11

1

Length of a side of the square $= 28 \div 4 = 7$ cm

Radius of the semicircle $= 7 \div 2 = 3.5$ cm

Perimeter of the figure
$= (3 \times 7) + \left(\frac{1}{2} \times 2 \times \pi \times 3.5\right) = 21 + \left(\frac{22}{7} \times 3.5\right)$
$= 21 + \frac{22}{2} = 21 + 11 = 32$ cm

Solution 12

3

All the shaded regions make up the area of one small circle.

Let the radius of the small circle be r cm.

Area of the small circle $= \pi \times r \times r$

Area of the big circle $= \pi \times 2r \times 2r$
$= 4\pi \times r \times r$

Fraction of the big circle which is shaded
$= \frac{\pi \times r \times r}{4\pi \times r \times r} = \frac{1}{4}$

Solution 13

2

Perimeter of the shaded region
$= \left(\frac{1}{4} \times 2 \times \pi \times 7\right) + (3 \times 7) = \left(\frac{1}{2} \times \frac{22}{7} \times 7\right) + 21$
$= 11 + 21 = 32$ cm

Solution 14

3

Radius of the smallest circle $= 4 \div 2 = 2$ cm
Radius of the medium circle $= 3$ cm
Radius of the biggest circle $= 4$ cm

Area of the shaded parts
$= (\pi \times 4 \times 4) - (\pi \times 3 \times 3) + (\pi \times 2 \times 2)$
$= 16\pi - 9\pi + 4\pi = 11\pi\ \text{cm}^2$

Solution 15

1

Radius of the semicircle $= 14 \div 2 = 7$ cm

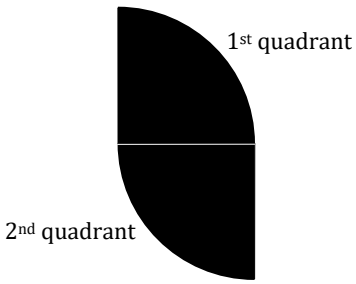
Area of the unshaded parts

$= \frac{1}{4} \times \pi \times 7 \times 7 = \frac{1}{4} \times \frac{22}{7} \times 7 \times 7$

$= \frac{1}{4} \times 22 \times 7 = 38.5 \text{ cm}^2$

Solution 16

1



The shaded parts are made up of two quadrants.

Area of the shaded parts $= 2 \times \frac{1}{4} \times \pi \times 4 \times 4$

$= 8\pi \text{ cm}^2$

Solution 17

4

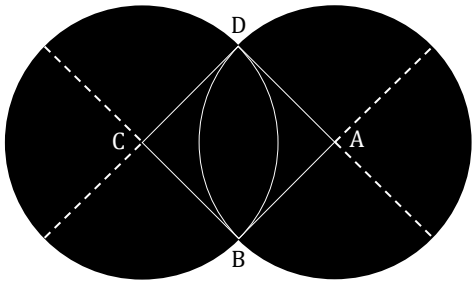
Perimeter of the figure $= 10 + 10 + (\pi \times 10)$

$= (20 + 10\pi) \text{ cm}$

Solution 18

3

Since ABCD is a square with $\angle DCB = 90°$, CBD and ABD are quadrants.



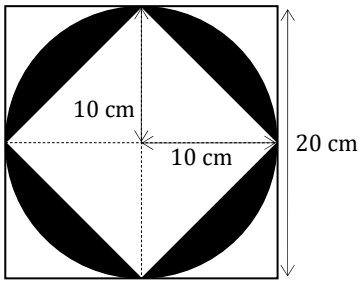
Perimeter of the shaded figure

$= 6 \times \frac{1}{4} \times 2 \times \pi \times 3.5 = 6 \times \frac{1}{4} \times 2 \times \frac{22}{7} \times \frac{7}{2}$

$= 6 \times \frac{1}{4} \times 22 = 33 \text{ cm}$

Solution 19

2



Area of the circle $= \pi \times 10 \times 10 = 100\pi \text{ cm}^2$

Area of the smaller square $= 4 \times \frac{1}{2} \times 10 \times 10$

$= 200 \text{ cm}^2$

Area of the shaded parts $= (100\pi - 200) \text{ cm}^2$

Solution 20

The figure is made up of 5 quadrants.

Perimeter of the figure

$$=\left(5\times\frac{1}{4}\times2\times\pi\times10.5\right)+(2\times10.5)$$

$$=\left(5\times\frac{1}{4}\times2\times\frac{22}{7}\times\frac{21}{2}\right)+(2\times10.5)$$

$$=\left(5\times\frac{1}{4}\times22\times3\right)+21=103.5\,\text{cm}$$

Ans: 103.5 cm

Solution 21

Area of the figure $=3\times\frac{1}{4}\times\pi\times14\times14$

$$=3\times\frac{1}{4}\times\frac{22}{7}\times14\times14=462\,\text{cm}^2$$

Ans: $462\,\text{cm}^2$

Solution 22

Perimeter of the whole figure

$$=\left(\frac{1}{2}\times2\times\pi\times7\right)+(\pi\times7)=14\pi$$

$$=14\times\frac{22}{7}=44\,\text{cm}$$

Ans: 44 cm

Solution 23

Perimeter of the figure

$$=\left(\frac{3}{4}\times2\times\pi\times60\right)+60+60=90\pi+120$$

$=402.7\,\text{cm}$ (correct to 1 decimal place)

Ans: 402.7 cm

Solution 24

Breadth of the rectangle $=12\div2=6\,\text{cm}$

Radius of the circle $=6\,\text{cm}$

Area of the shaded parts

$$=(12\times6)-\left(\frac{1}{2}\times\pi\times6\times6\right)=72-(18\times3.14)$$

$=15.48\,\text{cm}^2$

Ans: $15.48\,\text{cm}^2$

Solution 25

Radius of the semicircle $=35\div2=17.5\,\text{cm}$

Perimeter of the shaded part

$$=\left(\frac{1}{4}\times2\times\pi\times35\right)+\left(\frac{1}{2}\times2\times\pi\times17.5\right)+35$$

$$=17.5\pi+17.5\pi+35=35\pi+35$$

$$=\left(35\times\frac{22}{7}\right)+35=110+35=145\,\text{cm}$$

Ans: 145 cm

Solution 26

Radius of the circle $=10\div2=5\,\text{cm}$

Area of the circle $=\pi\times5\times5=3.14\times25$

$=78.5\,\text{cm}^2$

Height of the triangle = Radius of the circle

$=5\,\text{cm}$

Area of the triangle $=\frac{1}{2}\times10\times5=25\,\text{cm}^2$

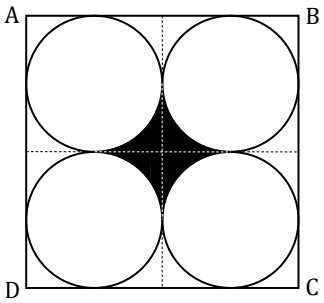
Area of the shaded portion $=78.5-25$

$=53.5\,\text{cm}^2$

Ans: $53.5\,\text{cm}^2$

Solution 27

The figure can be divided into 4 equal portions.



Area of the square in each portion
$= 64 \div 4 = 16\ \text{cm}^2$

Length of a side of the square in each portion
$= \sqrt{16} = 4\ \text{cm}$

Radius of a circle $= 4 \div 2 = 2\ \text{cm}$

Area of a circle $= \pi \times 2 \times 2 = 4\pi = 4 \times 3.14$
$= 12.56\ \text{cm}^2$

Area of the shaded part in each portion
$= \frac{1}{4}(16 - 12.56) = 0.86\ \text{cm}^2$

Area of shaded part in the whole figure
$= 4 \times 0.86 = 3.44\ \text{cm}^2$

Ans: $3.44\ \text{cm}^2$

Solution 28

Perimeter of the figure
$= \left(\frac{1}{2} \times \pi \times 14\right) + \left(\frac{1}{2} \times \pi \times 7\right) + (14 - 7)$
$= 7\pi + \frac{7}{2}\pi + 7 = \left(7 \times \frac{22}{7}\right) + \left(\frac{7}{2} \times \frac{22}{7}\right) + 7$
$= 22 + 11 + 7 = 40\ \text{cm}$

Ans: 40 cm

Solution 29

Radius of the semicircle $= 7 \div 2 = 3.5\ \text{cm}$

Area of the shaded figure
$= \left(\frac{1}{2} \times 6 \times 8\right) + (10 \times 7) + \left(\frac{1}{2} \times \pi \times 3.5 \times 3.5\right)$
$\quad - \left(\frac{1}{4} \times \pi \times 7 \times 7\right)$
$= 24 + 70 + 6.125\pi - 12.25\pi = 94 - 6.125\pi$
$= 94 - (6.125 \times 3.14)$
$= 74.77\ \text{cm}^2$ (correct to 2 decimal places)

Ans: $74.77\ \text{cm}^2$

Solution 30

Perimeter of the shaded part
$= \left(\frac{1}{2} \times \pi \times 28\right) + 28 = 14\pi + 28$
$= \left(14 \times \frac{22}{7}\right) + 28 = 44 + 28 = 72\ \text{cm}$

Ans: 72 cm

Solution 31

$VX = XY = YW = 18 \div 3 = 6\ \text{cm}$

Length of curved sections XZ and ZY
$= 18.56 - 6 = 12.56\ \text{cm}$

Diameter of the smaller semicircle
$= 2 \times 6 = 12\ \text{cm}$

Perimeter of the shaded part
$= \left(\frac{1}{2} \times \pi \times 18\right) + (\pi \times 12) - 12.56$
$= 9\pi + 12\pi - 12.56 = 21\pi - 12.5$
$= (21 \times 3.14) - 12.56 = 53.38\ \text{cm}$

Ans: 53.38 cm

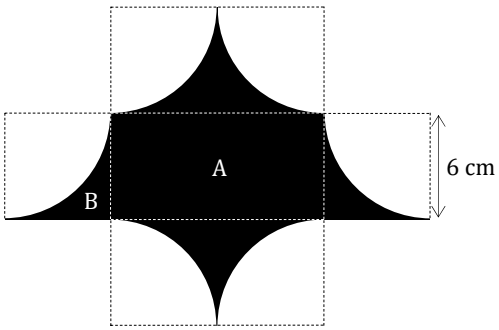
Solution 32

Diameter of the smaller semicircle
$= 40 - 3 - 3 = 34\text{ cm}$

Perimeter of the remaining cardboard
$= \left(\frac{1}{2} \times \pi \times 40\right) + \left(\frac{1}{2} \times \pi \times 34\right) + 3 + 3$
$= 20\pi + 17\pi + 3 + 3 = (37\pi + 6)\text{ cm}$

Ans: $(37\pi + 6)\text{ cm}$

Solution 33



Area of shaded part A $= 12 \times 6 = 72\text{ cm}^2$

Area of shaded part B
$= (6 \times 6) - \left(\frac{1}{4} \times \pi \times 6 \times 6\right) = 36 - 9\pi$
$= 36 - (9 \times 3.14) = 7.74\text{ cm}^2$

Total area of shaded part $= (6 \times 7.74) + 72$
$= 118.44\text{ cm}^2$

Ans: 118.44 cm^2

Solution 34

Length of AF = Length of EF $= 2 \times 7 = 14\text{ cm}$

Length of AB $= 14 + 7 = 21\text{ cm}$

Area of Rectangle ABCD $= 21 \times 14 = 294\text{ cm}^2$

Area of shaded part
$= \left(\frac{1}{4} \times \pi \times 14 \times 14\right) - \left(\frac{1}{2} \times \pi \times 7 \times 7\right)$
$= 49\pi - 24.5\pi = 24.5\pi = 24.5 \times \frac{22}{7} = 77\text{ cm}^2$

Fraction of Rectangle ABCD which is shaded
$= \frac{77}{294} = \frac{11}{42}$

Ans: $\frac{11}{42}$

Solution 35

Radius of the small quadrant $= 28 \div 4 = 7\text{ cm}$

Perimeter of the figure
$= \left(\frac{1}{2} \times 2 \times \pi \times 28\right) + \left(\frac{1}{2} \times 2 \times \pi \times 7\right)$
$\quad + [4 \times (28 - 7)]$
$= 28\pi + 7\pi + 84 = 35\pi + 84 = \left(35 \times \frac{22}{7}\right) + 84$
$= 194\text{ cm}$

Ans: 194 cm

Solution 36

(a) Radius of the circular paper $= 40 \div 2 = 20\text{ cm}$

Number of semicircular pieces of paper
$= \frac{100}{20} \times \frac{240}{40} = 5 \times 6 = 30$

Number of pieces of circular paper
$= 30 \div 2 = 15$

Ans: 15

(b) Area covered $= 15 \times \pi \times 20 \times 20 = 6000\pi$
$= 6000 \times 3.14 = 18840\text{ cm}^2$

Ans: 18840 cm^2

Solution 37

Radius of the hole $= 18 \div 2 = 9$ cm

Radius of the full piece of circular paper
$= 24 + 9 = 33$ cm

Area of the piece of paper
$= \frac{3}{4}[(\pi \times 33 \times 33) - (\pi \times 9 \times 9)]$
$= \frac{3}{4}(1089\pi - 81\pi) = \frac{3}{4} \times 1008 \times 3.14$
$= 2373.84 \text{ cm}^2$

Ans: 2373.84 cm^2

Solution 38

(a) Area of the shaded part
$= \left(\frac{1}{2} \times \pi \times 20 \times 20\right) - \left(\frac{1}{4} \times \pi \times 12 \times 12\right)$
$= 200\pi - 36\pi = 164\pi = 164 \times 3.14$
$= 514.96 \text{ cm}^2$

Ans: 514.96 cm^2

(b) Perimeter of the shaded part
$= \left(\frac{1}{2} \times 2 \times \pi \times 20\right) + \left(\frac{1}{4} \times 2 \times \pi \times 12\right)$
$+ 20 + 12 + (20 - 12)$
$= 20\pi + 6\pi + 40 = 26\pi + 40$
$= (26 \times 3.14) + 40 = 121.64$ cm

Ans: 121.64 cm

Solution 39

Perimeter of the remaining piece of paper
$= (\pi \times 7) + [2 \times (20 - 7)] + (2 \times 12)$
$= \left(7 \times \frac{22}{7}\right) + 26 + 24 = 72$ cm

Ans: 72 cm

Solution 40

(a) Length of FD = Length of DE $= 12 \div 2 = 6$ cm

Area of the shaded part
$= (12 \times 12) - (6 \times 6) - \left(\frac{1}{2} \times \pi \times 6 \times 6\right)$
$= 144 - 36 - 18\pi = 108 - (18 \times 3.14)$
$= 51.48 \text{ cm}^2$

Ans: 51.48 cm^2

(b) Perimeter of the shaded part
$= \left(\frac{1}{2} \times 2 \times \pi \times 6\right) + 12 + 12 = 6\pi + 24$
$= (6 \times 3.14) + 24 = 42.84$ cm

Ans: 42.84 cm

Solution 41

Radius of the quarter circle $= 15 \div 3 = 5$ cm

Diameter of the semicircle $= 5 \times 2 = 10$ cm

Perimeter of the remaining piece of paper
$= (\pi \times 10) + \left(\frac{1}{2} \times 2 \times \pi \times 5\right) + (15 - 5 - 5) + 15$
$= 10\pi + 5\pi + 5 + 15 = (15\pi + 20)$ cm

Ans: $(15\pi + 20)$ cm

Solution 42

(a) For the diameters,

Circle A : Circle B : Circle C $= 1 : 2 : 4$

Total number of units $= 1 + 2 + 4 = 7$

7 units $= 56$ cm
1 unit $= 56 \div 7 = 8$ cm

Diameter of Circle A $= 8$ cm

Ans: 8 cm

(b) Radius of Circle A $= 8 \div 2 = 4$ cm

Diameter of Circle B $= 2 \times 8 = 16$ cm
Radius of Circle B $= 16 \div 2 = 8$ cm

Diameter of Circle C $= 4 \times 8 = 32$ cm
Radius of Circle C $= 32 \div 2 = 16$ cm

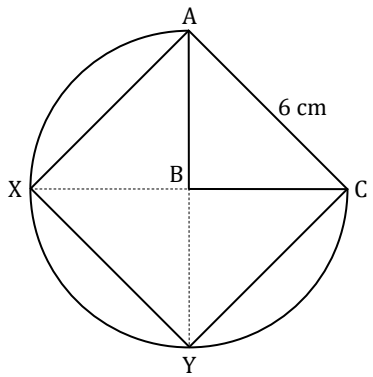
Breadth of the rectangle $= 32$ cm

Area of the shaded parts
$= (56 \times 32) - (\pi \times 4 \times 4) - (\pi \times 8 \times 8)$
$\quad -(\pi \times 16 \times 16)$
$= 1792 - 16\pi - 64\pi - 256\pi$
$= 1792 - (336 \times 3.14) = 736.96 \text{ cm}^2$

Ans: 736.96 cm^2

Solution 43

Draw a square within the figure.



Area of Square AXYC $= 6 \times 6 = 36 \text{ cm}^2$

Area of Rectangle AXC $= \frac{1}{2} \times 36 = 18 \text{ cm}^2$

Area of Rectangle AXC $= \frac{1}{2} \times \text{XC} \times \text{AB}$

$18 = \frac{1}{2} \times 2r \times r$
$r^2 = 18$
$r = \sqrt{18}$ cm

Area of the figure
$= \left(\frac{3}{4} \times \pi \times \sqrt{18} \times \sqrt{18}\right) + \left(\frac{1}{2} \times \sqrt{18} \times \sqrt{18}\right)$
$= \left(\frac{3}{4} \times \pi \times 18\right) + \left(\frac{1}{2} \times 18\right)$
$= (13.5 \times 3.14) + 9 = 51.39 \text{ cm}^2$

Ans: 51.39 cm^2

Solution 44

(a) Radius of the three-quarter circle
$= 28 \div 2 = 14$ cm

Length of the rectangular mat $= 3 \times 14$
$= 42$ cm

Ans: 42 cm

(b) Uncovered area of the rectangular mat
$= (42 \times 28) - 2 \times \left(\frac{3}{4} \times \pi \times 14 \times 14\right)$
$= 1176 - 294\pi = 1176 - \left(294 \times \frac{22}{7}\right)$
$= 1176 - 924 = 252 \text{ cm}^2$

Ans: 252 cm^2

Solution 45

(a) The shaded figure makes up the area of 7 small squares.

Length of a side of a small square
$= 21 \div 3 = 7$ cm

Area of the shaded figure $= 7 \times 7 \times 7$
$= 343 \text{ cm}^2$

Ans: 343 cm^2

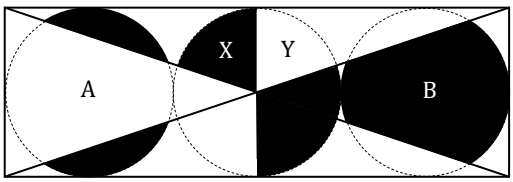
(b) Perimeter of the shaded figure

$$=\left(8\times\frac{1}{4}\times2\times\pi\times7\right)+7+7=28\pi+14$$

$$=\left(28\times\frac{22}{7}\right)+14=102\,\text{cm}$$

Ans: 102 cm

Solution 46



Area of Region A = Area of Region B
Area of Region X = Area of Region Y

Diameter of a circle $=294\div3=98\,\text{cm}$

Radius of a circle $=98\div2=49\,\text{cm}$

Total area of the unshaded parts

$$=(294\times98)-(1.5\times\pi\times49\times49)$$

$$=28812-\left(1.5\times\frac{22}{7}\times49\times49\right)$$

$$=28812-11319=17493\,\text{cm}^2$$

Ans: $17493\,\text{cm}^2$

Solution 47

Area of the two quarter circles

$$=\frac{1}{2}\times\pi\times14\times14=\frac{1}{2}\times\frac{22}{7}\times14\times14$$

$$=11\times2\times14=308\,\text{cm}^2$$

Area of Rectangle JLNP $=308+266$

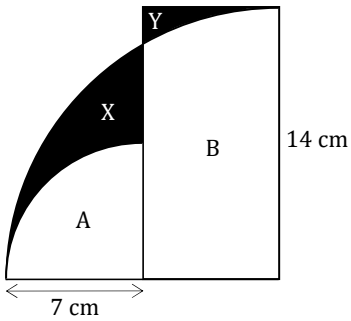
$$=574\,\text{cm}^2$$

Length of LN $=574\div14=41\,\text{cm}$

Length of MN $=41-14=27\,\text{cm}$

Ans: 27 cm

Solution 48



Area of Part Y + Area of Part B

$$=14\times(14-7)=98\,\text{cm}^2$$

Area of Part X + Area of Part B

$$=\left(\frac{1}{4}\times\pi\times14\times14\right)-\left(\frac{1}{4}\times\pi\times7\times7\right)$$

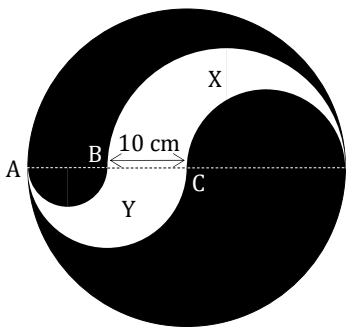
$$=49\pi-12.25\pi=36.75\times\frac{22}{7}=115.5\,\text{cm}^2$$

Area of Part X − Area of Part Y
= (Area of Part X + Area of Part B)
− (Area of Part Y + Area of Part B)

$$=115.5-98=17.5\,\text{cm}^2$$

Ans: $17.5\,\text{cm}^2$

Solution 49



Area of Part X

$$=\left(\frac{1}{2}\times\pi\times15\times15\right)-\left(\frac{1}{2}\times\pi\times10\times10\right).$$

$$=112.5\pi-50\pi=62.5\pi\,\text{cm}^2$$

Area of Part Y

$$=\left(\frac{1}{2}\times\pi\times10\times10\right)-\left(\frac{1}{2}\times\pi\times5\times5\right).$$

$$=50\pi-12.5\pi=37.5\pi\text{ cm}^2$$

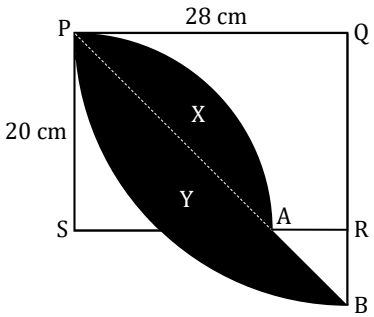
Area of the shaded part

$$=(\pi\times20\times20)-62.5\pi-37.5\pi=300\pi$$

$$=300\times3.14=942\text{ cm}^2$$

Ans: 942 cm^2

Solution 50



Area of Part X

$$=\left(\frac{1}{4}\times\pi\times20\times20\right)-\left(\frac{1}{2}\times20\times20\right)$$

$$=100\pi-200=(100\times3.14)-200$$

$$=314-200=114\text{ cm}^2$$

Area of Part Y

$$=\left(\frac{1}{4}\times\pi\times28\times28\right)-\left(\frac{1}{2}\times28\times28\right)$$

$$=196\pi-392=(196\times3.14)-392$$

$$=615.44-392=223.44\text{ cm}^2$$

Area of the shaded part $=114+223.44$

$$=337.44\text{ cm}^2$$

Ans: 337.44 cm^2

Solution 51

(a) Diameter of the smaller semicircle

$$=4\div2=2\text{ cm}$$

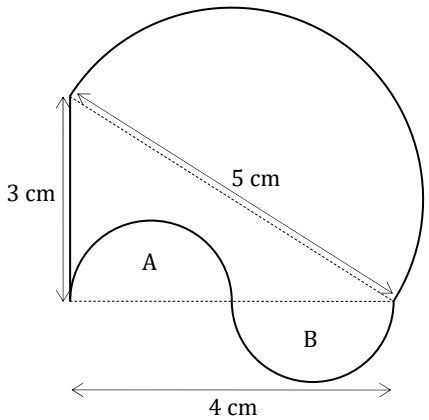
Perimeter of the figure

$$=\left(\frac{1}{2}\times\pi\times5\right)+(\pi\times2)+3=4.5\pi+3$$

$$=(4.5\times3.14)+3=17.13\text{ cm}$$

Ans: 17.13 cm

(b)



Area of Part A = Area of Part B

Radius of the larger semicircle $=5\div2$

$$=2.5\text{ cm}$$

Area of the figure

$$=\left(\frac{1}{2}\times\pi\times2.5\times2.5\right)+\left(\frac{1}{2}\times3\times4\right)$$

$$=3.125\pi+6=(3.125\times3.14)+6$$

$$=15.81\text{ cm}\ \text{(correct to 2 decimal places)}$$

Ans: 15.81 cm

Solution 52

Area of a full circle $= \pi \times 7 \times 7 = \frac{22}{7} \times 7 \times 7$

$= 154\,\text{cm}^2$

Total area of the unshaded parts
$= [2 \times (154 - 30)] + [2 \times (154 - 30 - 30)]$
$= 248 + 188 = 436\,\text{cm}^2$

Ans: $436\,\text{cm}^2$

Solution 53

Diameter of a big circle $= 84 \div 3 = 28\,\text{cm}$

Diameter of a small circle $= 28 \div 2 = 14\,\text{cm}$

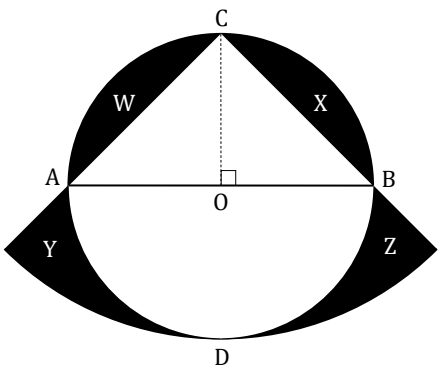
Total length of wire
$= (6 \times \pi \times 28) + (4 \times \pi \times 14) = 168\pi + 56\pi$
$= 224\pi = 224 \times \frac{22}{7} = 704\,\text{cm}$

Ans: 704 cm

Solution 54

Length of AB $= 16\,\text{cm}$

Length of OC $= 16 \div 2 = 8\,\text{cm}$



Total area of Part W and Part X
$= \left(\frac{1}{2} \times \pi \times 8 \times 8\right) - \left(\frac{1}{2} \times 16 \times 8\right)$
$= (32\pi - 64)\,\text{cm}^2$

Total area of Part Y and Part Z
$= \left(\frac{1}{4} \times \pi \times 16 \times 16\right) - \left(\frac{1}{2} \times 16 \times 8\right)$
$\quad - \left(\frac{1}{2} \times \pi \times 8 \times 8\right)$
$= 64\pi - 64 - 32\pi = (32\pi - 64)\,\text{cm}^2$

Total area of shaded region
$= 32\pi - 64 + 32\pi - 64 = 64\pi - 128$
$= (64 \times 3.14) - 128 = 72.96\,\text{cm}^2$

Ans: $72.96\,\text{cm}^2$

Solution 55

(a) Radius of the semicircle $= 84 \div 2 = 42\,\text{cm}$

Area of the shaded part
$= \left(\frac{1}{4} \times \pi \times 42 \times 42\right) + \left(\frac{1}{4} \times \pi \times 28 \times 28\right)$
$= 441\pi + 196\pi = 637\pi = 637 \times \frac{22}{7}$
$= 2002\,\text{cm}^2$

Ans: $2002\,\text{cm}^2$

(b) Perimeter of the shaded part
$= \left(\frac{1}{4} \times 2 \times \pi \times 42\right) + \left(\frac{1}{4} \times 2 \times \pi \times 28\right)$
$\quad + 84 + [2 \times (42 - 28)]$
$= 21\pi + 14\pi + 84 + 28 = 35\pi + 112$
$= \left(35 \times \frac{22}{7}\right) + 112 = 110 + 112 = 222\,\text{cm}$

Ans: 222 cm

Solution 56

Radius of the smaller semicircle $= 9 \div 2$
$= 4.5\,\text{cm}$

Radius of the bigger semicircle $= 12 \div 2$
$= 6\,\text{cm}$

Total area of the four semicircles
$= (\pi \times 4.5 \times 4.5) + (\pi \times 6 \times 6)$
$= 20.25\pi + 36\pi = 56.25\pi\ \text{cm}^2$

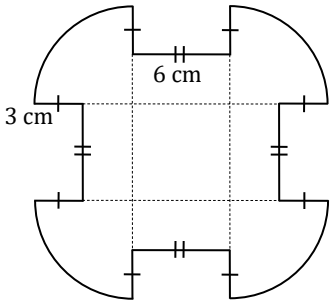
Radius of the circle $= 15 \div 2 = 7.5\,\text{cm}$

Total area of the shaded parts
$= 56.25\pi + (9 \times 12) - (\pi \times 7.5 \times 7.5)$
$= 56.25\pi + 108 - 56.25\pi = 108\,\text{cm}^2$

Ans: $108\,\text{cm}^2$

Solution 57

(a) The figure can be divided as shown below.



Total area of the four quarter circles
$= \pi \times 6 \times 6 = 36\pi\ \text{cm}^2$

Total area of the figure
$= 36\pi + (6 \times 6) + (4 \times 6 \times 3) = (36\pi + 108)\,\text{cm}^2$

Ans: $(36\pi + 108)\,\text{cm}^2$

(b) Perimeter of the figure
$= (2 \times \pi \times 6) + (8 \times 3) + (4 \times 6)$
$= 12\pi + 24 + 24 = (12\pi + 48)\,\text{cm}$

Ans: $(12\pi + 48)\,\text{cm}$

Solution 58

Radius of Circle A $= 14 \div 2 = 7\,\text{cm}$

Area of Circle A $= \pi \times 7 \times 7 = 49\pi\ \text{cm}^2$

Area of Circle B $= 4 \times 49\pi = 196\pi\ \text{cm}^2$

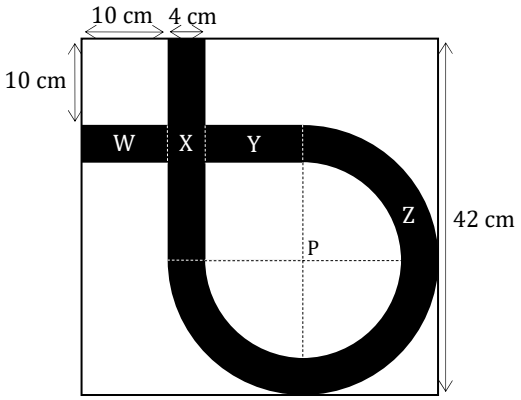
Radius of Circle B $= \sqrt{\dfrac{196\pi}{\pi}} = \sqrt{196} = 14\,\text{cm}$

Diameter of Circle C $= 14 + (2 \times 14) = 42\,\text{cm}$

Perimeter of the shaded region
$= (\pi \times 14) + (\pi \times 28) + (\pi \times 42) = 84\pi\ \text{cm}$

Ans: $84\pi\ \text{cm}$

Solution 59



Radius of the inner circle forming Part Z
$= \dfrac{42 - 10 - 4 - 4}{2} = 12\,\text{cm}$

Radius of the outer circle forming Part Z
$= 12 + 4 = 16\,\text{cm}$

Area of Part Z
$= \dfrac{3}{4} \times \left[(\pi \times 16 \times 16) - (\pi \times 12 \times 12)\right]$
$= \dfrac{3}{4} \times 112\pi = 84\pi\ \text{cm}^2$

Area of Part W $= 10 \times 4 = 40\,\text{cm}^2$

Area of Part X $= 4 \times (42 - 16) = 104\,\text{cm}^2$

Area of Part Y $= 12 \times 4 = 48\,\text{cm}^2$

Total area of the shaded part
$= 84\pi + 40 + 104 + 48 = 84\pi + 192$
$= (84 \times 3.14) + 192 = 455.76\,\text{cm}^2$

Ans: $455.76\,\text{cm}^2$
