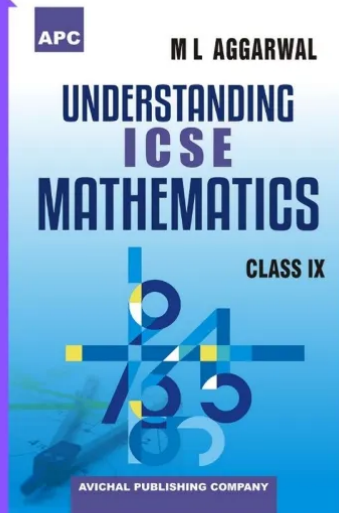


ML Aggarwal Solutions for Class 9 Maths

Chapter 16- Mensuration



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ML Agrawal Solutions

CLASS 9 MATHS

Chapter 16: Mensuration

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Chapter 16- Mensuration

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ML Aggarwal Solutions for Class 9 Maths Chapter 16- Mensuration

ML Aggarwal 9th Maths Chapter 16, Class 9 Maths Chapter 16 solutions

Exercise 16.1

1. Find the area of a triangle whose base is 6 cm and corresponding height is 4 cm.

Solution:

It is given that

Base of triangle = 6 cm

Height of triangle = 4 cm

We know that

Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$

Substituting the values

$$= \frac{1}{2} \times 6 \times 4$$

By further calculation

$$= 6 \times 2$$

$$= 12 \text{ cm}^2$$

2. Find the area of a triangle whose sides are

(i) 3 cm, 4 cm and 5 cm

(ii) 29 cm, 20 cm and 21 cm

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(iii) 12 cm, 9.6 cm and 7.2 cm

Solution:

(i) Consider $a = 3$ cm, $b = 4$ cm and $c = 5$ cm

We know that

$$S = \text{Semi perimeter} = (a + b + c) / 2$$

Substituting the values

$$= (3 + 4 + 5) / 2$$

$$= 12/2$$

$$= 6 \text{ cm}$$

Here

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{6(6-3)(6-4)(6-5)}$$

By further calculation

$$= \sqrt{6 \times 3 \times 2 \times 1}$$

$$= \sqrt{6 \times 6}$$

$$= 6 \text{ cm}^2$$

(ii) Consider $a = 29$ cm, $b = 20$ cm and $c = 21$ cm

We know that

$$S = \text{Semi perimeter} = (a + b + c) / 2$$

Substituting the values

$$= (29 + 20 + 21) / 2$$

$$= 70/2$$

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$$= 35 \text{ cm}$$

Here

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{35(35-29)(35-20)(35-21)}$$

By further calculation

$$= \sqrt{35 \times 6 \times 15 \times 14}$$

$$= \sqrt{7 \times 5 \times 3 \times 2 \times 5 \times 3 \times 7 \times 2}$$

We can write it as

$$= \sqrt{7 \times 7 \times 5 \times 5 \times 3 \times 3 \times 2 \times 2}$$

So we get

$$= 7 \times 5 \times 3 \times 2$$

$$= 210 \text{ cm}^2$$

(iii) Consider $a = 12 \text{ cm}$, $b = 9.6 \text{ cm}$ and $c = 7.2 \text{ cm}$

We know that

$$S = \text{Semi perimeter} = (a + b + c) / 2$$

Substituting the values

$$= (12 + 9.6 + 7.2) / 2$$

$$= 28.8 / 2$$

$$= 14.4 \text{ cm}$$

Here

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$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{14.4(14.4 - 12)(14.4 - 9.6)(14.4 - 7.2)}$$

By further calculation

$$= \sqrt{14.4 \times 2.4 \times 4.8 \times 7.2}$$

$$= \sqrt{6 \times 2.4 \times 2.4 \times 2 \times 2.4 \times 3 \times 2.4}$$

We can write it as

$$= 2.4 \times 2.4 \times \sqrt{6 \times 6}$$

So we get

$$= 2.4 \times 2.4 \times 6$$

$$= 34.56 \text{ cm}^2$$

3. Find the area of a triangle whose sides are 34 cm, 20 cm and 42 cm. hence, find the length of the altitude corresponding to the shortest side.

Solution:

Consider 34 cm, 20 cm and 42 cm as the sides of triangle

$$a = 34 \text{ cm, } b = 20 \text{ cm and } c = 42 \text{ cm}$$

We know that

$$S = \text{Semi perimeter} = (a + b + c) / 2$$

Substituting the values

$$= (34 + 20 + 42) / 2$$

$$= 96 / 2$$

$$= 48 \text{ cm}$$

Here

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$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{48(48-34)(48-20)(48-42)}$$

By further calculation

$$= \sqrt{48 \times 14 \times 28 \times 6}$$

$$= \sqrt{8 \times 6 \times 14 \times 14 \times 2 \times 6}$$

We can write it as

$$= 14 \times 6 \times \sqrt{8 \times 2}$$

$$= 14 \times 6 \times \sqrt{16}$$

So we get

$$= 14 \times 6 \times 4$$

$$= 336 \text{ cm}^2$$

Here the shortest side of the triangle is 20 cm

Consider h cm as the corresponding altitude

Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$

Substituting the values

$$336 = \frac{1}{2} \times 20 \times h$$

By further calculation

$$h = (336 \times 2) / 20$$

So we get

$$h = 336/10$$

$$h = 33.6 \text{ cm}$$

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Hence, the required altitude of the triangle is 33.6 cm.

4. The sides of a triangular field are 975 m, 1050 m and 1125 m. If this field is sold at the rate of Rs 1000 per hectare, find its selling price. (1 hectare = 10000 m²)

Solution:

It is given that

a = 975 m, b = 1050 m and c = 1125 m

We know that

S = Semi perimeter = (a + b + c)/ 2

Substituting the values

$$= (975 + 1050 + 1125)/ 2$$

$$= 3150/2$$

$$= 1575 \text{ cm}$$

Here

$$\text{Area of triangular field} = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{1575(1575 - 975)(1575 - 1050)(1575 - 1125)}$$

By further calculation

$$= \sqrt{1575 \times 600 \times 525 \times 450}$$

$$= \sqrt{525 \times 3 \times 150 \times 4 \times 525 \times 150 \times 3}$$

We can write it as

$$= 525 \times 3 \times 150 \times \sqrt{4}$$

So we get

$$= 525 \times 450 \times 2$$

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It is given that

$$1 \text{ hectare} = 10000 \text{ m}^2$$

$$= (525 \times 900) / 10000$$

By further calculation

$$= (525 \times 9) / 100$$

$$= 4725 / 100$$

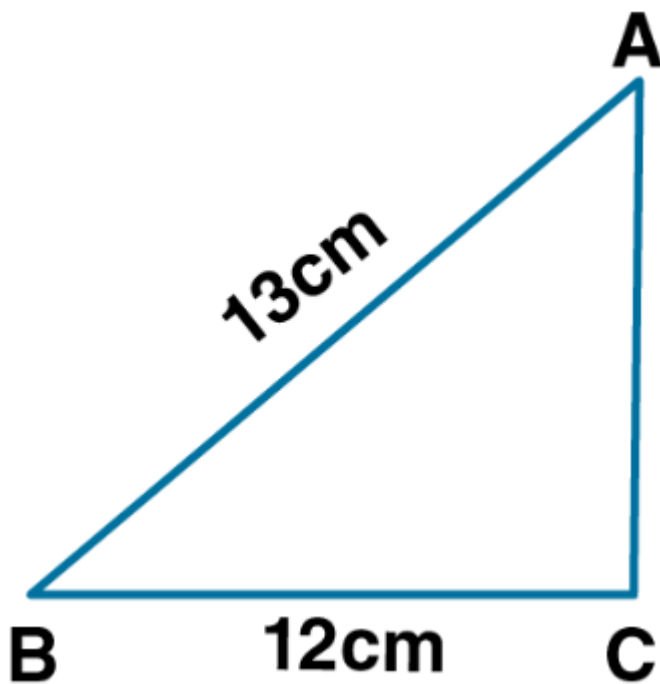
$$= 47.25 \text{ hectares}$$

We know that

Selling price of 1 hectare field = Rs 1000

Selling price of 47.25 hectare field = $1000 \times 47.25 = \text{Rs } 47250$

5. The base of a right angled triangle is 12 cm and its hypotenuse is 13 cm long. Find its area and the perimeter.



Solution:

It is given that

ABC is a right angled triangle

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BC = 12 cm and AB = 13 cm

Using the Pythagoras theorem

$$AB^2 = AC^2 + BC^2$$

Substituting the values

$$13^2 = AC^2 + 12^2$$

By further calculation

$$AC^2 = 13^2 - 12^2$$

So we get

$$AC^2 = 169 - 144 = 25$$

$$AC = \sqrt{25} = 5 \text{ cm}$$

We know that

Area of triangle ABC = $\frac{1}{2} \times \text{base} \times \text{height}$

Substituting the values

$$= \frac{1}{2} \times 12 \times 5$$

$$= 30 \text{ cm}^2$$

Similarly

Perimeter of triangle ABC = AB + BC + CA

Substituting the values

$$= 13 + 12 + 5$$

$$= 30 \text{ cm}$$

6. Find the area of an equilateral triangle whose side is 8 m. Give your answer correct to two decimal places.

Solution:

It is given that

Side of equilateral triangle = 8 m

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We know that

$$\text{Area of equilateral triangle} = \frac{\sqrt{3}}{4} (\text{side})^2$$

Substituting the values

$$= \frac{\sqrt{3}}{4} \times 8 \times 8$$

By further calculation

$$= \sqrt{3} \times 2 \times 8$$

$$= 1.73 \times 16$$

$$= 27.71 \text{ m}^2$$

7. If the area of an equilateral triangle is $81\sqrt{3} \text{ cm}^2$ find its perimeter.

Solution:

We know that

$$\text{Area of equilateral triangle} = \frac{\sqrt{3}}{4} (\text{side})^2$$

Substituting the values

$$81\sqrt{3} = \frac{\sqrt{3}}{4} (\text{side})^2$$

By further calculation

$$\text{Side}^2 = (81\sqrt{3} \times 4) / \sqrt{3}$$

So we get

$$(\text{side})^2 = 81 \times 4$$

$$\text{side} = \sqrt{(81 \times 4)}$$

$$\text{side} = 9 \times 2 = 18 \text{ cm}$$

So the perimeter of equilateral triangle = $3 \times \text{side}$

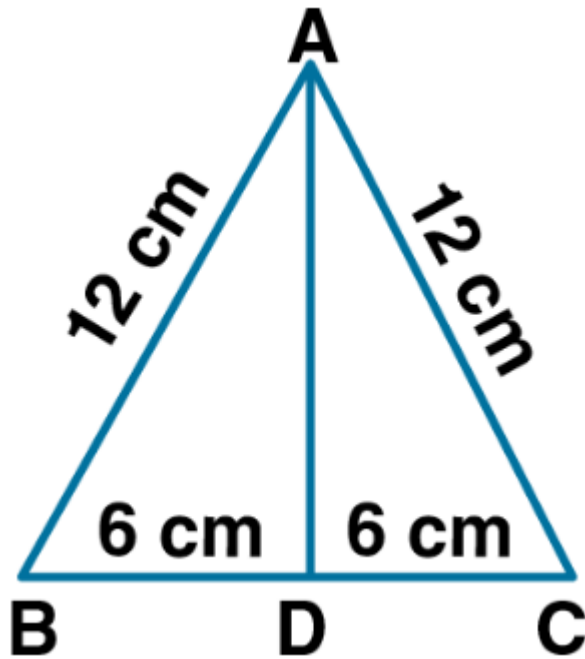
$$= 3 \times 18$$

$$= 54 \text{ cm}$$

8. If the perimeter of an equilateral triangle is 36 cm, calculate its area and height.

Solution:

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We know that

Perimeter of an equilateral triangle = $3 \times \text{side}$

Substituting the values

$$36 = 3 \times \text{side}$$

By further calculation

$$\text{side} = 36/3 = 12 \text{ cm}$$

$$\text{So } AB = BC = CA = 12 \text{ cm}$$

Here

$$\text{Area of equilateral triangle} = \frac{\sqrt{3}}{4} (\text{side})^2$$

Substituting the values

$$= \frac{\sqrt{3}}{4} (12)^2$$

By further calculation

$$= \frac{\sqrt{3}}{4} \times 12 \times 12$$

So we get

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$$= \sqrt{3} \times 3 \times 12$$

$$= 1.73 \times 36$$

$$= 62.4 \text{ cm}^2$$

In triangle ABD

Using Pythagoras Theorem

$$AB^2 = AD^2 + BD^2$$

$$\text{Here } BD = 12/2 = 6 \text{ cm}$$

Substituting the values

$$12^2 = AD^2 + 6^2$$

By further calculation

$$144 = AD^2 + 36$$

$$AD^2 = 144 - 36 = 108$$

So we get

$$AD = \sqrt{108} = 10.4$$

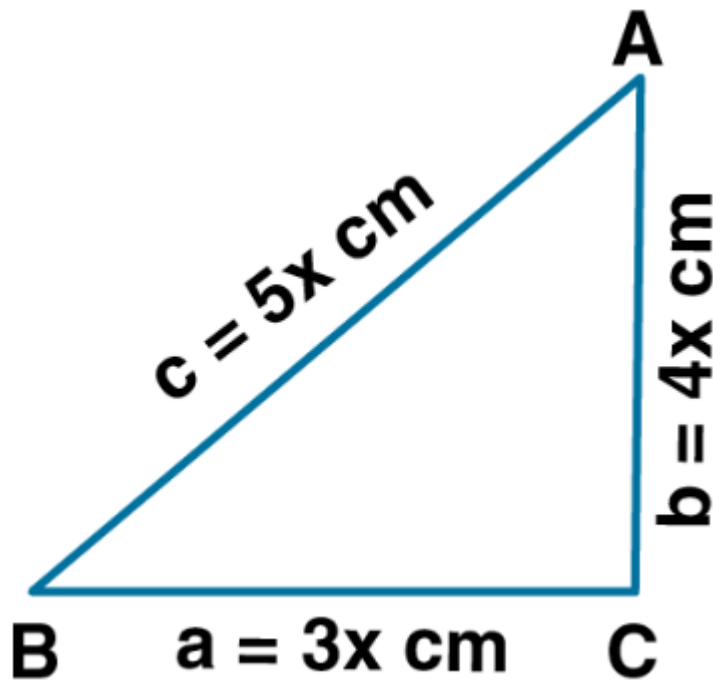
Therefore, the required height is 10.4 cm.

9. (i) If the length of the sides of a triangle are in the ratio 3: 4: 5 and its perimeter is 48 cm, find its area.

(ii) The sides of a triangular plot are in the ratio 3: 5: 7 and its perimeter is 300 m. Find its area.

Solution:

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(i) Consider ABC as the triangle

Ratio of the sides are $3x$, $4x$ and $5x$

Take $a = 3x$ cm, $b = 4x$ cm and $c = 5x$ cm

We know that

$$a + b + c = 48$$

Substituting the values

$$3x + 4x + 5x = 48$$

$$12x = 48$$

So we get

$$x = 48/12 = 4$$

Here

$$a = 3x = 3 \times 4 = 12 \text{ cm}$$

$$b = 4x = 4 \times 4 = 16 \text{ cm}$$

$$c = 5x = 5 \times 4 = 20 \text{ cm}$$

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We know that

$$S = \text{Semi perimeter} = (a + b + c) / 2$$

Substituting the values

$$= (12 + 16 + 20) / 2$$

$$= 48 / 2$$

$$= 24 \text{ cm}$$

Here

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{24(24-12)(24-16)(24-20)} \qquad = \sqrt{24 \times 12 \times 8 \times 4}$$

$$\text{By further calculation} \qquad = \sqrt{12 \times 2 \times 12 \times 4 \times 2 \times 4}$$

So we get

$$= 12 \times 4 \times 2$$

$$= 96 \text{ cm}^2$$

(ii) It is given that

Sides of a triangle are in the ratio = 3: 5: 7

Perimeter = 300 m

We know that

First side = $(300 \times 3) / \text{sum of ration}$

Substituting the values

$$= (300 \times 3) / (3 + 5 + 7)$$

By further calculation

$$= (300 \times 3) / 15$$

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$$= 60 \text{ m}$$

$$\text{Second side} = (300 \times 5) / 15 = 100 \text{ m}$$

$$\text{Third side} = (300 \times 7) / 15 = 140 \text{ m}$$

Here

$$S = \text{perimeter}/2 = 300/2 = 150 \text{ m}$$

So we get

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{150(150-60)(150-100)(150-140)}$$

By further calculation

$$= \sqrt{150 \times 90 \times 50 \times 10}$$

$$= \sqrt{6750000}$$

We can write it as

$$= \sqrt{225 \times 10000 \times 3}$$

$$= 15 \times 100 \times \sqrt{3} \qquad \qquad \qquad = 1500 \times \sqrt{3}$$

We get

$$= 1500 \times 1.732$$

$$= 2598 \text{ m}^2$$

10. ABC is a triangle in which $AB = AC = 4 \text{ cm}$ and $\angle A = 90^\circ$. Calculate the area of $\triangle ABC$. Also find the length of perpendicular from A to BC.

Solution:

It is given that

$$AB = AC = 4 \text{ cm}$$

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Using the Pythagoras theorem

$$BC^2 = AB^2 + AC^2$$

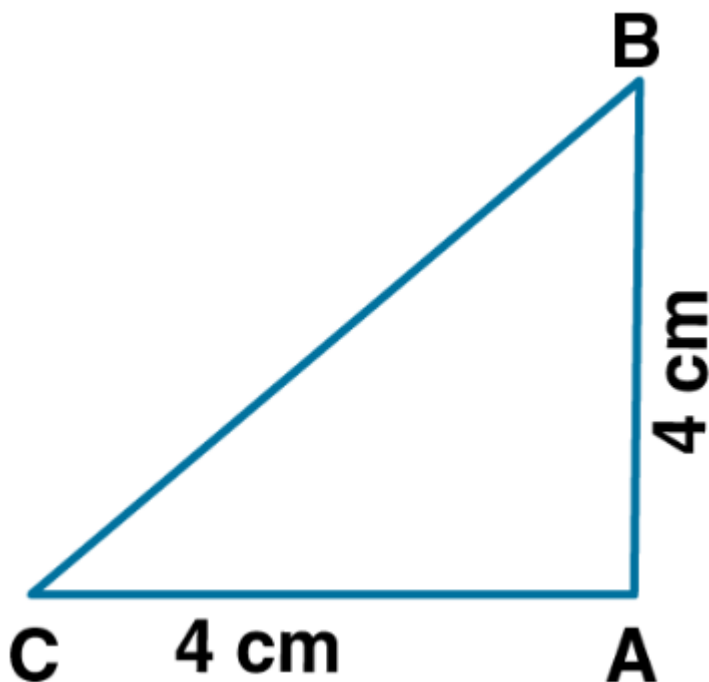
Substituting the values

$$BC^2 = 4^2 + 4^2$$

By further calculation

$$BC^2 = 16 + 16 = 32$$

$$BC = \sqrt{32} = 4\sqrt{2} \text{ cm}$$



We know that

$$\text{Area of } \triangle ABC = \frac{1}{2} \times BC \times h$$

Substituting the values

$$8 = \frac{1}{2} \times 4\sqrt{2} \times h$$

By further calculation

$$h = (8 \times 2) / 4\sqrt{2}$$

We can write it as

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$$h = (2 \times 2) / \sqrt{2} \times \sqrt{2}/\sqrt{2}$$

So we get

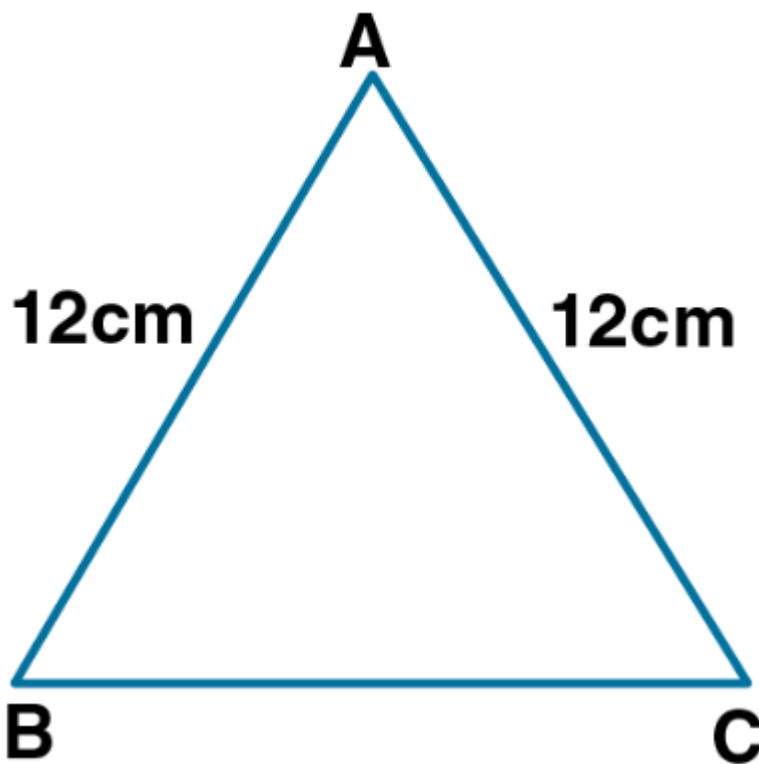
$$h = 4\sqrt{2}/2 = 2 \times \sqrt{2}$$

$$h = 2 \times 1.41 = 2.82 \text{ cm}$$

11. Find the area of an isosceles triangle whose equal sides are 12 cm each and the perimeter is 30 cm.

Solution:

Consider ABC as the isosceles triangles



Here $AB = AC = 12\text{cm}$

Perimeter = 30 cm

$$\text{So } BC = 30 - (12 + 12) = 30 - 24 = 6 \text{ cm}$$

We know that

$$S = \text{Semi perimeter} = (a + b + c) / 2$$

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Substituting the values

$$= 30/2$$

$$= 15 \text{ cm}$$

Here

$$\text{Area of triangle } ABC = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{15(15-12)(15-12)(15-6)}$$

By further calculation

$$= \sqrt{15 \times 3 \times 3 \times 9}$$

$$= \sqrt{81 \times 15}$$

$$= 9\sqrt{15}$$

We can write it as

$$= 9 \times 3.873$$

$$= 34.857$$

$$= 34.86 \text{ cm}^2$$

12. Find the area of an isosceles triangle whose base is 6 cm and perimeter is 16 cm.

Solution:

It is given that

$$\text{Base} = 6 \text{ cm}$$

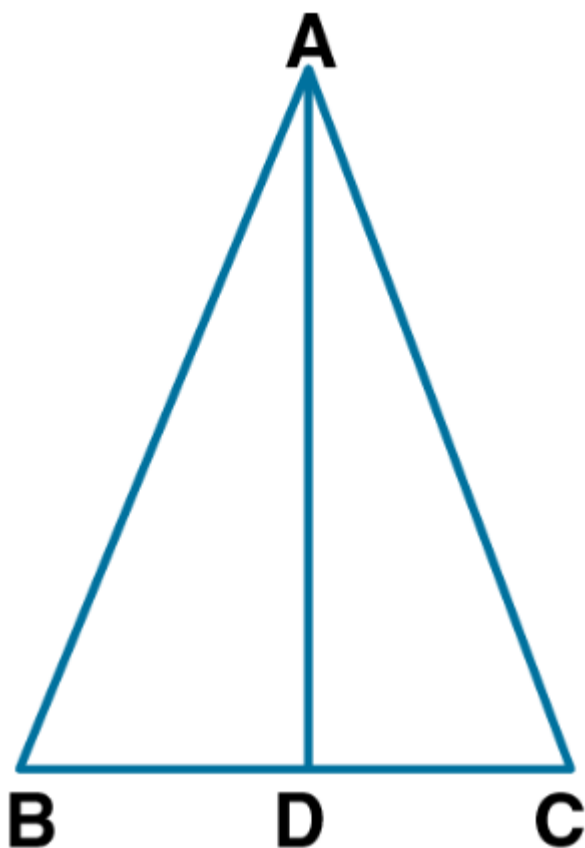
$$\text{Perimeter} = 16 \text{ cm}$$

Consider ABC as an isosceles triangle in which

$$AB = AC = x$$

$$\text{So } BC = 6 \text{ cm}$$

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We know that

Perimeter of $\triangle ABC = AB + BC + AC$

Substituting the values

$$16 = x + 6 + x$$

By further calculation

$$16 = 2x + 6$$

$$16 - 6 = 2x$$

$$10 = 2x$$

So we get

$$x = 10/2 = 5$$

Here $AB = AC = 5$ cm

$$BC = \frac{1}{2} \times 6 = 3 \text{ cm}$$

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In $\triangle ABD$

$$AB^2 = AD^2 + BD^2$$

Substituting the values

$$5^2 = AD^2 + 3^2$$

$$25 = AD^2 + 9$$

By further calculation

$$AD^2 = 25 - 9 = 16$$

So we get

$$AD = 4 \text{ cm}$$

Here

$$\text{Area of } \triangle ABC = \frac{1}{2} \times \text{base} \times \text{height}$$

Substituting the values

$$= \frac{1}{2} \times 6 \times 4$$

$$= 3 \times 4$$

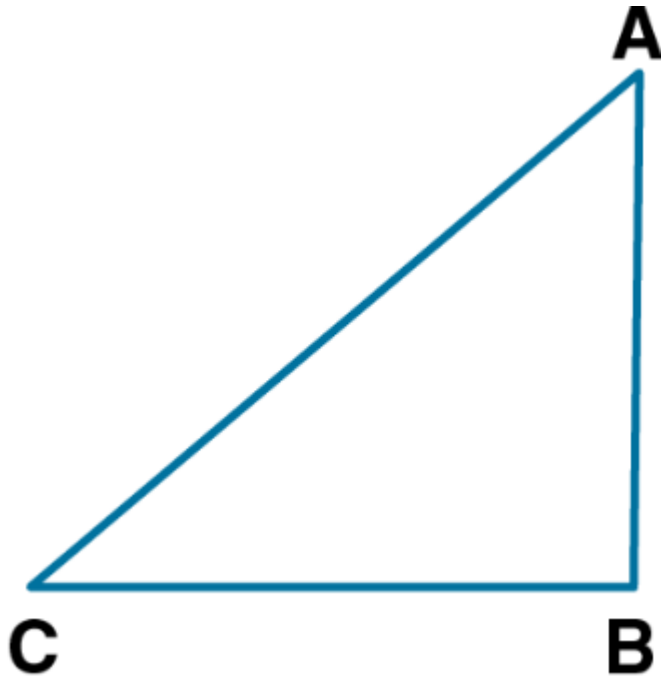
$$= 12 \text{ cm}^2$$

13. The sides of a right angled triangle containing the right angle are $5x$ cm and $(3x - 1)$ cm. Calculate the length of the hypotenuse of the triangle if its area is 60 cm^2 .

Solution:

Consider ABC as a right angled triangle

$$AB = 5x \text{ cm and } BC = (3x - 1) \text{ cm}$$



We know that

$$\text{Area of } \triangle ABC = \frac{1}{2} \times AB \times BC$$

Substituting the values

$$60 = \frac{1}{2} \times 5x (3x - 1)$$

By further calculation

$$120 = 5x (3x - 1)$$

$$120 = 15x^2 - 5x$$

It can be written as

$$15x^2 - 5x - 120 = 0$$

Taking out the common terms

$$5 (3x^2 - x - 24) = 0$$

$$3x^2 - x - 24 = 0$$

$$3x^2 - 9x + 8x - 24 = 0$$

Taking out the common terms

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$$3x(x - 3) + 8(x - 3) = 0$$

$$(3x + 8)(x - 3) = 0$$

Here

$$3x + 8 = 0 \text{ or } x - 3 = 0$$

We can write it as

$$3x = -8 \text{ or } x = 3$$

$$x = -8/3 \text{ or } x = 3$$

$x = -8/3$ is not possible

$$\text{So } x = 3$$

$$AB = 5 \times 3 = 15 \text{ cm}$$

$$BC = (3 \times 3 - 1) = 9 - 1 = 8 \text{ cm}$$

In right angled $\triangle ABC$

Using Pythagoras theorem

$$AC^2 = AB^2 + BC^2$$

Substituting the values

$$AC^2 = 15^2 + 8^2$$

By further calculation

$$AC^2 = 225 + 64 = 289$$

$$AC^2 = 17^2$$

$$\text{So } AC = 17 \text{ cm}$$

Therefore, the hypotenuse of the right angled triangle is 17 cm.

14. In $\triangle ABC$, $\angle B = 90^\circ$, $AB = (2A + 1)$ cm and $BC = (A + 1)$ cm. If the area of the $\triangle ABC$ is 60 cm^2 , find its perimeter.

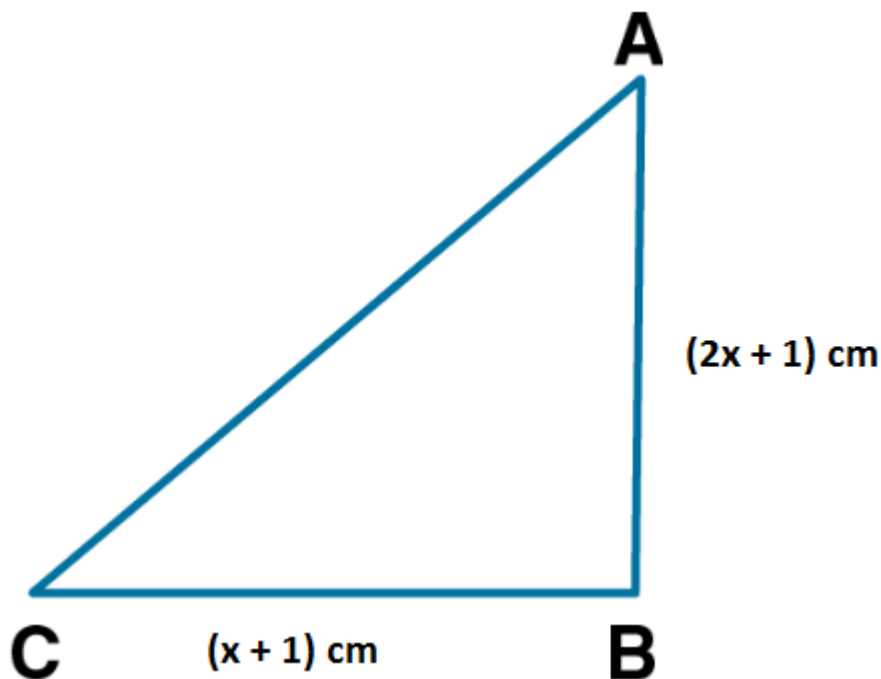
Solution:

It is given that

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$$AB = (2x + 1) \text{ cm}$$

$$BC = (x + 1) \text{ cm}$$



We know that

$$\text{Area of } \triangle ABC = \frac{1}{2} \times AB \times BC$$

Substituting the values

$$60 = \frac{1}{2} \times (2x + 1) (x + 1)$$

By cross multiplication

$$60 \times 2 = (2x + 1) (x + 1)$$

By further calculation

$$120 = 2x^2 + 3x + 1$$

We can write it as

$$0 = 2x^2 + 3x + 1 - 120$$

$$0 = 2x^2 + 3x - 119$$

So we get

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$$2x^2 + 3x - 119 = 0$$

$$2x^2 + 17x - 14x - 119 = 0$$

Taking out the common terms

$$x(2x + 17) - 7(2x + 17) = 0$$

$$(x - 7)(2x + 17) = 0$$

Here

$$x - 7 = 0 \text{ or } 2x + 17 = 0$$

$$x = 7 \text{ or } 2x = -17$$

$$x = 7 \text{ or } x = -17/2$$

$$AB = (2x + 1) = 2 \times 7 + 1$$

$$AB = 14 + 1 = 15 \text{ cm}$$

$$BC = (x + 1) = 7 + 1 = 8 \text{ cm}$$

In right angled $\triangle ABC$

Using Pythagoras Theorem

$$AC^2 = AB^2 + BC^2$$

Substituting the values

$$AC^2 = 15^2 + 8^2$$

$$AC^2 = 225 + 64$$

$$AC^2 = 289$$

So we get

$$AC = 17 \text{ cm}$$

So the perimeter = $AB + BC + AC$

Substituting the values

$$= 15 + 8 + 17$$

$$= 40 \text{ cm}$$

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15. If the perimeter of a right angled triangle is 60 cm and its hypotenuse is 25 cm, find its area.

Solution:

We know that

Perimeter of a right angled triangle = 60 cm

Hypotenuse = 25 cm

Here the sum of two sides = $60 - 25 = 35$ cm

Consider base = x cm

Altitude = $(35 - x)$ cm

Using the Pythagoras theorem

$$x^2 + (35 - x)^2 = 25^2$$

By further calculation

$$x^2 + 1225 + x^2 - 70x = 625$$

$$2x^2 - 70x + 1225 - 625 = 0$$

$$2x^2 - 70x + 600 = 0$$

Dividing by 2

$$x^2 - 35x + 300 = 0$$

$$x^2 - 15x - 20x + 300 = 0$$

Taking out the common terms

$$x(x - 15) - 20(x - 15) = 0$$

$$(x - 15)(x - 20) = 0$$

Here

$$x - 15 = 0$$

So we get

$$x = 15$$

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Similarly

$$x - 20 = 0$$

So we get

$$x = 20 \text{ cm}$$

So 15 cm and 20 cm are the sides of the triangle

$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{altitude}$$

Substituting the values

$$= \frac{1}{2} \times 15 \times 20$$

$$= 150 \text{ cm}^2$$

16. The perimeter of an isosceles triangle is 40 cm. The base is two third of the sum of equal sides. Find the length of each side.

Solution:

It is given that

Perimeter of an isosceles triangle = 40 cm

Consider x cm as each equal side

We know that

$$\text{Base} = \frac{2}{3} (2x) = \frac{4}{3} x$$

So according to the sum

$$2x + \frac{4}{3} x = 40$$

By further calculation

$$6x + 4x = 120$$

$$10x = 120$$

By division

$$x = 120/10 = 12$$

Therefore, the length of each equal side is 12 cm.

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17. If the area of an isosceles triangle is 60 cm^2 and the length of each of its equal sides is 13 cm , find its base.

Solution:

It is given that

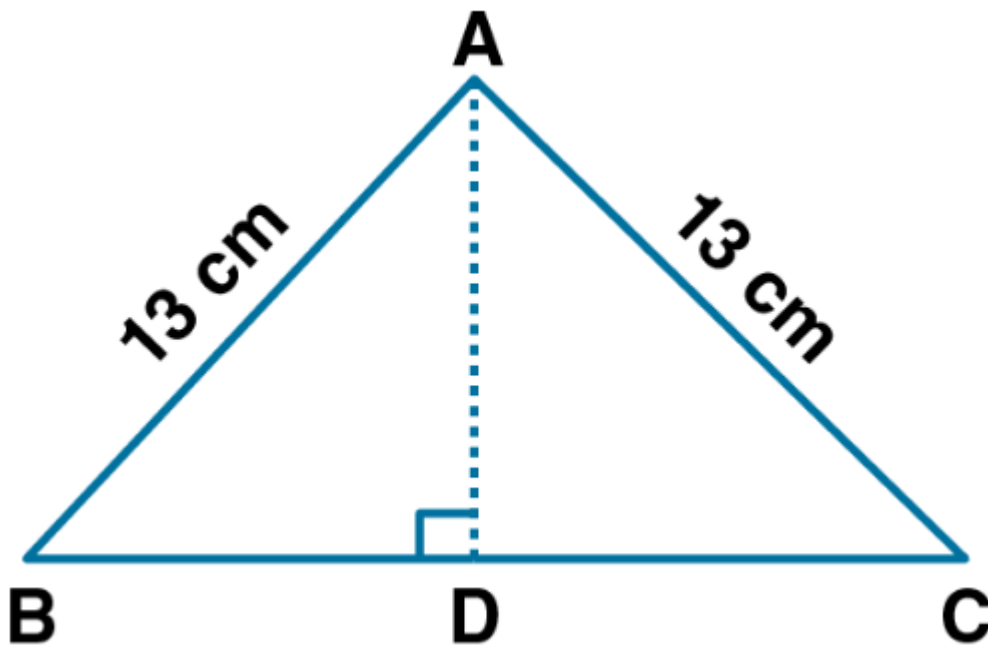
Area of isosceles triangle = 60 cm^2

Length of each equal side = 13 cm

Consider base $BC = x \text{ cm}$

Construct AD perpendicular to BC which bisects BC at D

So $BD = DC = x/2 \text{ cm}$



In right $\triangle ABD$

$$AB^2 = BD^2 + AD^2$$

Substituting the values

$$13^2 = (x/2)^2 + AD^2$$

By further calculation

$$169 = x^2/4 + AD^2$$

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$$AD^2 = 169 - x^2/4 \dots\dots (1)$$

We know that

$$\text{Area} = 60 \text{ cm}^2$$

$$AD = (\text{area} \times 2) / \text{base}$$

Substituting the values

$$AD = (60 \times 2) / x = 120/x \dots\dots (2)$$

Using both the equations

$$169 - x^2 / 4 = (120/x)^2$$

By further calculation

$$(676 - x^2) / 4 = 14400/x^2$$

By cross multiplication

$$676x^2 - x^4 = 57600$$

We can write it as

$$x^4 - 676x^2 + 57600 = 0$$

$$x^4 - 576x^2 - 100x^2 + 57600 = 0$$

Taking out the common terms

$$x^2 (x^2 - 576) - 100 (x^2 - 576) = 0$$

$$(x^2 - 576) (x^2 - 100) = 0$$

Here

$$x^2 - 576 = 0 \text{ where } x^2 = 576$$

$$\text{So } x = 24$$

Similarly

$$x^2 - 100 = 0 \text{ where } x^2 = 100$$

$$\text{So } x = 10$$

Hence, the base is 10 cm or 24 cm.

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18. The base of a triangular field is 3 times its height if the cost of cultivating the field at the rate of Rs 25 per 100 m² is Rs 60000; find its base and height.

Solution:

It is given that

Cost of cultivating the field at the rate of Rs 25 per 100 m² = Rs 60000

Here the cost of cultivating the field of Rs 25 for 100 m²

So the cost of cultivating the field of Rs 1 = $100/25$ m²

Cost of cultivating the field of Rs 60000 = $100/25 \times 60000$

$$= 4 \times 60000$$

$$= 240000 \text{ m}^2$$

So the area of field = 240000 m²

$$\frac{1}{2} \times \text{base} \times \text{height} = 240000 \dots\dots (1)$$

Consider

Height of triangular field = h m²

Base of triangular field = 3h m²

Substituting the values in equation (1)

$$\frac{1}{2} \times 3h \times h = 240000$$

By further calculation

$$\frac{1}{2} \times 3h^2 = 240000$$

$$h^2 = (240000 \times 2) / 3$$

$$h^2 = 80000 \times 2$$

$$h^2 = 160000$$

So we get

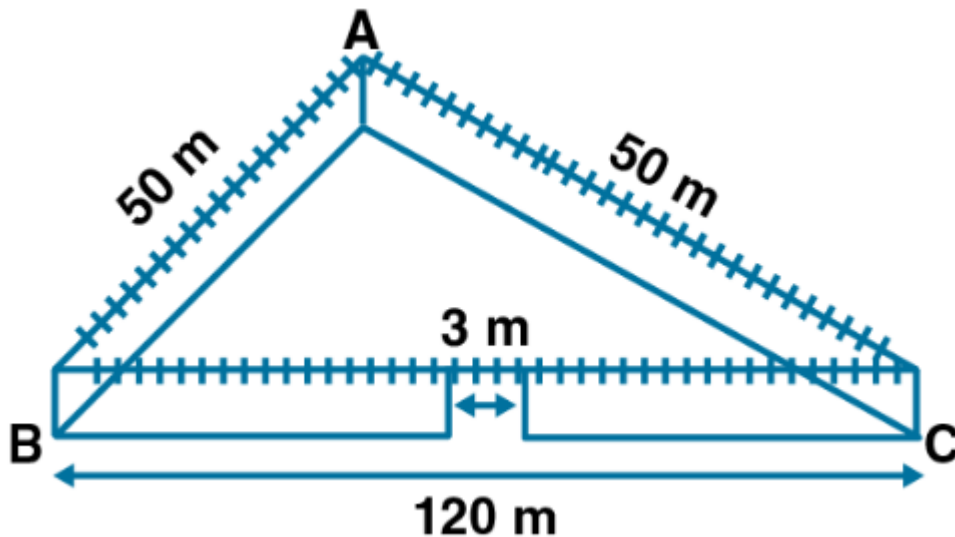
$$h = \sqrt{160000} = 400$$

Here the height of triangular field = 400 m

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Base of triangular field = $3 \times 400 = 1200 \text{ m}^2$

19. A triangular park ABC has sides 120 m, 80 m and 50 m (as shown in the given figure). A gardener Dhanika has to put a fence around it and also plant grass inside. How much area does she need to plant? Find the cost of fencing it with barbed wire at the rate of Rs 20 per metre leaving a space 3 m wide for a gate on one side.

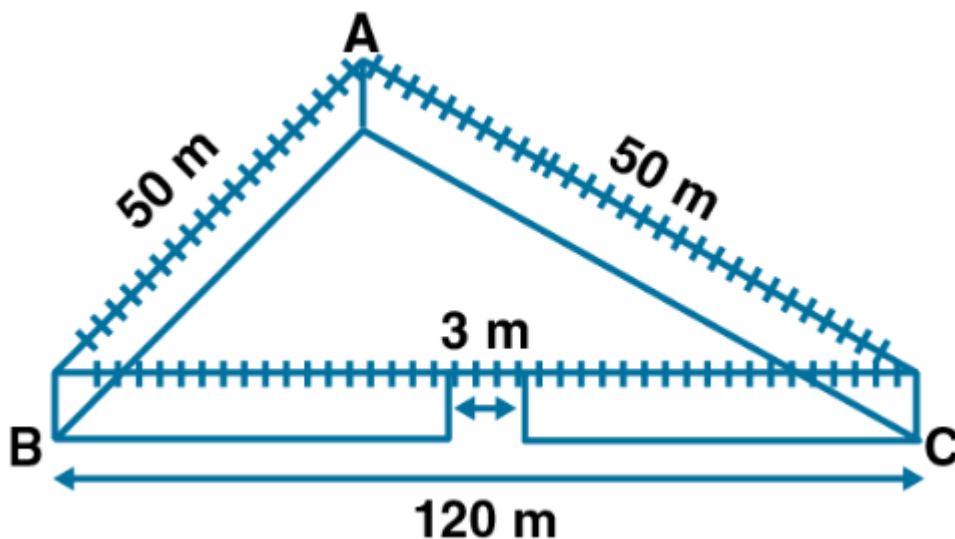


Solution:

It is given that

ABC is a triangular park with sides 120 m, 80 m and 50 m.

Here the perimeter of triangle ABC = $120 + 80 + 50 = 250 \text{ m}$



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We know that

Portion at which a gate is build = 3m

Remaining perimeter = $250 - 3 = 247$ m

So the length of fence around it = 247 m

Rate of fencing = Rs 20 per m

Total cost of fencing = $20 \times 247 = \text{Rs } 4940$

We know that

$S = \text{Semi perimeter} = (a + b + c) / 2$

Substituting the values

$$= 250/2$$

$$= 125 \text{ cm}$$

Here

$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{125(125 - 50)(125 - 80)(125 - 120)}$$

By further calculation

$$= \sqrt{125 \times 75 \times 45 \times 5}$$

$$= \sqrt{5 \times 5 \times 5 \times 5 \times 5 \times 3 \times 3 \times 3 \times 5 \times 5}$$

$$= 5 \times 5 \times 3 \times 5\sqrt{15}$$

So we get

$$= 375\sqrt{15}m^2$$

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20. An umbrella is made by stitching 10 triangular pieces of cloth of two different colors (shown in the given figure), each piece measuring 20 cm, 50 cm and 50 cm. How much cloth of each color is required for the umbrella?



Solution:

It is given that

An umbrella is made by stitching 10 triangular pieces of cloth of two different colors

20 cm, 50 cm, 50 cm are the measurement of each triangle

So we get

$$s/2 = (20 + 50 + 50)/2$$

$$s/2 = 120/2 = 60$$

We know that

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$$\text{Area of triangle} = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{60(60-20)(60-50)(60-50)}$$

By further calculation

$$= \sqrt{60 \times 40 \times 10 \times 10}$$

So we get

$$= \sqrt{240000}$$

$$= 100\sqrt{24}$$

$$= 100 \times 2\sqrt{6}$$

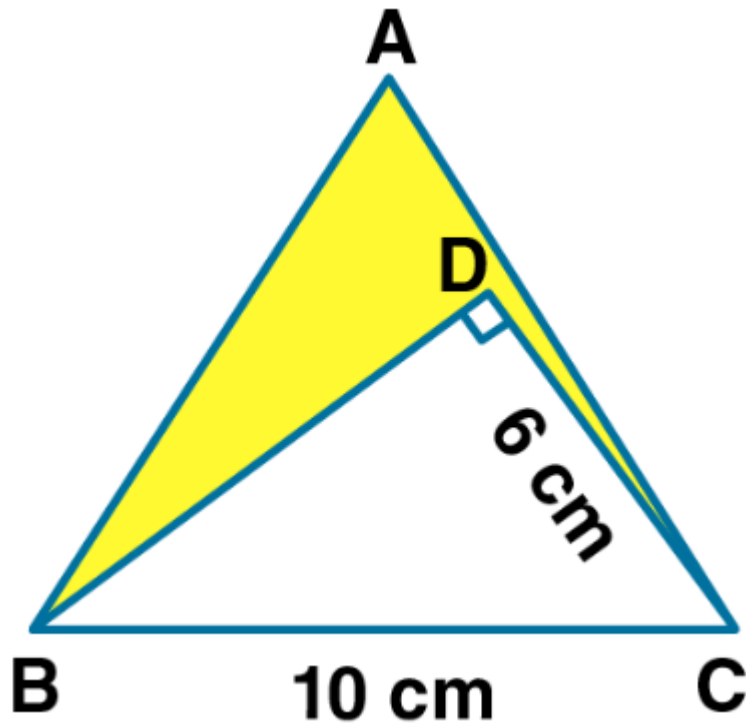
$$= 200\sqrt{6}\text{cm}^2$$

Here the area of 5 triangular piece of first color = $5 \times 200\sqrt{6} = 1000\sqrt{6}\text{ cm}^2$

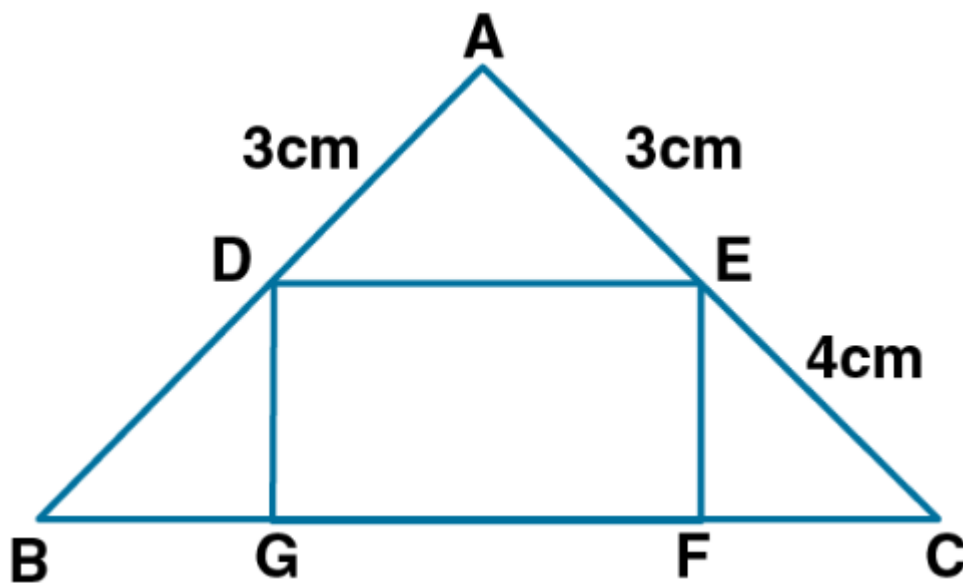
Area of triangular piece of second color = $1000\sqrt{6}\text{ cm}^2$

21. (a) In the figure (1) given below, ABC is an equilateral triangle with each side of length 10 cm. In $\triangle BCD$, $\angle D = 90^\circ$ and $CD = 6\text{ cm}$.

Find the area of the shaded region. Give your answer correct to one decimal place.



(b) In the figure (ii) given, ABC is an isosceles right angled triangle and DEFG is a rectangle. If $AD = AE = 3$ cm and $DB = EC = 4$ cm, find the area of the shaded region.



Solution:

(a) It is given that

ABC is an equilateral triangle of side = 10 cm

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We know that

$$\text{Area of equilateral triangle ABC} = \frac{\sqrt{3}}{4} \times (\text{side})^2$$

Substituting the values

$$= \frac{\sqrt{3}}{4} \times 10^2$$

$$= \frac{\sqrt{3}}{4} \times 100$$

So we get

$$= \sqrt{3} \times 25$$

$$= 1.73 \times 25$$

$$= 43.3 \text{ cm}^2$$

In right angled triangle BDC

$$\angle D = 90^\circ$$

$$BC = 10 \text{ cm}$$

$$CD = 6 \text{ cm}$$

Using Pythagoras Theorem

$$BD^2 + DC^2 = BC^2$$

Substituting the values

$$BD^2 + 6^2 = 10^2$$

$$BD^2 + 36 = 100$$

So we get

$$BD^2 = 100 - 36 = 64$$

$$BD = \sqrt{64} = 8 \text{ cm}$$

We know that

$$\text{Area of triangle BDC} = \frac{1}{2} \times \text{base} \times \text{height}$$

So we get

$$= \frac{1}{2} \times BD \times DC$$

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Substituting the values

$$= \frac{1}{2} \times 8 \times 6$$

$$= 4 \times 6$$

$$= 24 \text{ cm}^2$$

Here the area of shaded portion = Area of triangle ABC – Area of triangle BDC

Substituting the values

$$= 43.3 - 24$$

$$= 19.3 \text{ cm}^2$$

(b) It is given that

$$AD = AE = 3 \text{ cm}$$

$$DB = EC = 4 \text{ cm}$$

By addition we get

$$AD + DB = AE + EC = (3 + 4) \text{ cm}$$

$$AB = AC = 7 \text{ cm}$$

$$\angle A = 90^\circ$$

We know that

$$\text{Area of right triangle ADE} = \frac{1}{2} \times AD \times AE$$

Substituting the values

$$= \frac{1}{2} \times 3 \times 3$$

$$= \frac{9}{2} \text{ cm}^2$$

So triangle BDG is an isosceles right triangle

Similarly

$$DG^2 + BG^2 = BD^2$$

$$DG^2 + DG^2 = 4^2$$

By further calculation

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$$2DG^2 = 16$$

$$DG^2 = 16/2 = 8$$

$$DG = \sqrt{8} \text{ cm}$$

$$\text{Area of triangle BDG} = \frac{1}{2} \times BG \times DG$$

We can write it as

$$= \frac{1}{2} \times DG \times DG$$

Substituting the values

$$= \frac{1}{2} (\sqrt{8})^2$$

$$= \frac{1}{2} \times 8$$

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

$$\text{Area of isosceles right triangle EFC} = 4 \text{ cm}^2$$

$$\text{So the area of shaded portion} = 9/2 + 4 + 4$$

Taking LCM

$$= (9 + 8 + 8)/2$$

$$= 25/2$$

$$= 12.5 \text{ cm}^2$$

Exercise 16.2

1. (i) Find the area of quadrilateral whose one diagonal is 20 cm long and the perpendiculars to this diagonal from other vertices are of length 9 cm and 15 cm.

(ii) Find the area of a quadrilateral whose diagonals are of length 18 cm and 12 cm and they intersect each other at right angles.

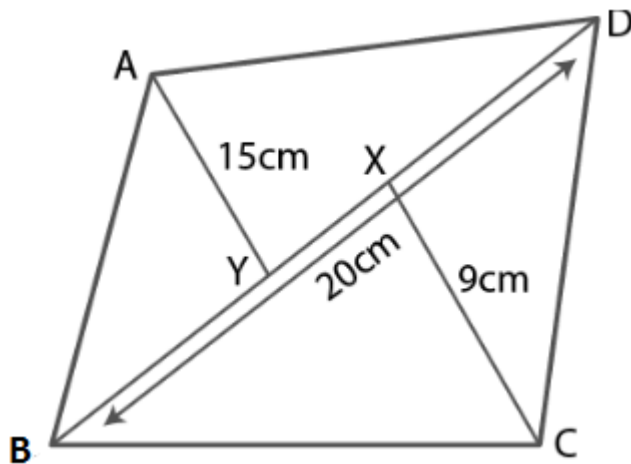
Solution:

(i) Consider ABCD as a quadrilateral in which AC = 20 cm

We know that

$$BY = 9 \text{ cm and } DY = 15 \text{ cm}$$

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Here

Area of quadrilateral ABCD = Area of triangle ABC + Area of triangle ACD

We can write it as

$$= \frac{1}{2} \times \text{base} \times \text{height} + \frac{1}{2} \times \text{base} \times \text{height}$$

So we get

$$= \frac{1}{2} \times AC \times BX + \frac{1}{2} \times AC \times DX$$

Substituting the values

$$= (\frac{1}{2} \times 20 \times 9) + (\frac{1}{2} \times 20 \times 15)$$

By further calculation

$$= (10 \times 9 + 10 \times 15)$$

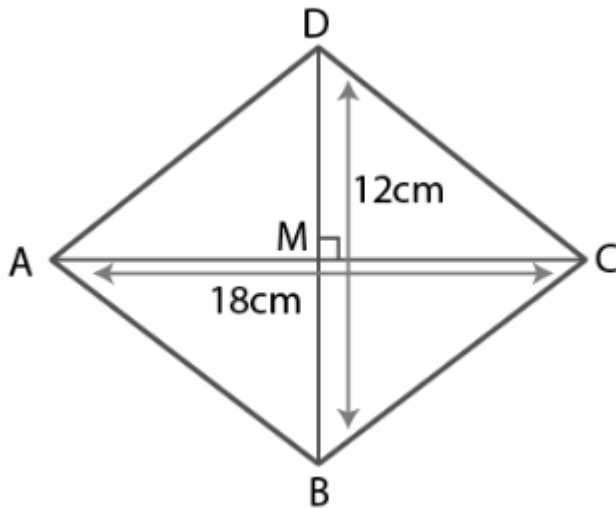
$$= 90 + 150$$

$$= 240 \text{ cm}^2$$

(ii) Consider ABCD as a quadrilateral in which the diagonals AC and BD intersect each other at M at right angles

AC = 18 cm and BD = 12 cm

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We know that

Area of quadrilateral ABCD = $\frac{1}{2} \times \text{diagonal AC} \times \text{diagonal BD}$

Substituting the values

$$= \frac{1}{2} \times 18 \times 12$$

By further calculation

$$= 9 \times 12$$

$$= 108 \text{ cm}^2$$

2. Find the area of the quadrilateral field ABCD whose sides AB = 40 m, BC = 28 m, CD = 15 m, AD = 9 m and $\angle A = 90^\circ$.

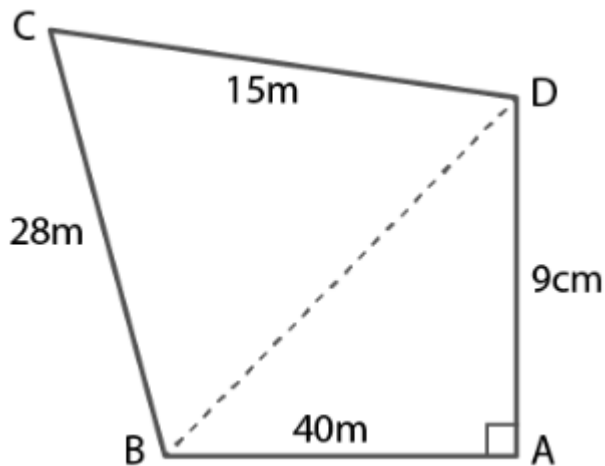
Solution:

It is given that

ABCD is a quadrilateral field

AB = 40 m, BC = 28 m, CD = 15 m, AD = 9 m and $\angle A = 90^\circ$

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In triangle BAD

$$\angle A = 90^\circ$$

Using the Pythagoras Theorem

$$BD^2 = BA^2 + AD^2$$

Substituting the values

$$BD^2 = 40^2 + 9^2$$

By further calculation

$$BD^2 = 1600 + 81 = 1681$$

So we get

$$BD = 41$$

We know that

$$\text{Area of quadrilateral ABCD} = \text{Area of } \triangle BAD + \text{Area of } \triangle BDC$$

It can be written as

$$= \frac{1}{2} \times \text{base} \times \text{height} + \text{Area of } \triangle BDC$$

Substituting the values

$$= \frac{1}{2} \times 40 \times 9 + \text{Area of } \triangle BDC$$

By further calculation

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$$= 180 \text{ m}^2 + \text{Area of } \triangle BDC$$

Determining the area of $\triangle BDC$

Consider $a = BD = 41 \text{ m}$, $b = CD = 15 \text{ m}$, $c = BC = 28 \text{ m}$

We know that

$$S = \text{Semi perimeter} = (a + b + c) / 2$$

Substituting the values

$$= (41 + 15 + 28) / 2$$

$$= 42 \text{ cm}$$

Here

$$\text{Area of } \triangle BDC = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{42(42-41)(42-15)(42-28)}$$

By further calculation

$$= \sqrt{42 \times 1 \times 27 \times 14}$$

We can write it as

$$= \sqrt{2 \times 3 \times 7 \times 3 \times 3 \times 3 \times 2 \times 7}$$

So we get

$$= 2 \times 7 \times 3 \times 3$$

$$= 126 \text{ m}^2$$

So the area of quadrilateral ABCD = $180 \text{ m}^2 + \text{Area of } \triangle BDC$

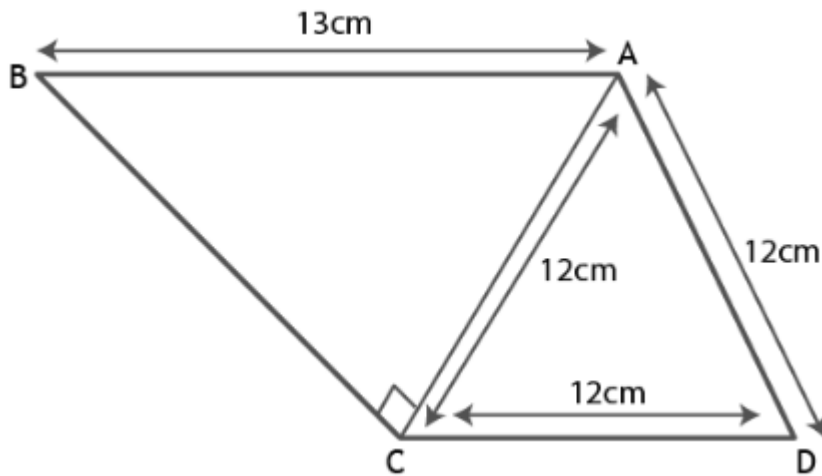
Substituting the values

$$= 180 + 126$$

$$= 306 \text{ m}^2$$

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3. Find the area of the quadrilateral ABCD in which $\angle BCA = 90^\circ$, $AB = 13$ cm and ACD is an equilateral triangle of side 12 cm.



Solution:

It is given that

ABCD is a quadrilateral in which $\angle BCA = 90^\circ$ and $AB = 13$ cm

ABCD is an equilateral triangle in which $AC = CD = AD = 12$ cm

In right angled $\triangle ABC$

Using Pythagoras theorem,

$$AB^2 = AC^2 + BC^2$$

Substituting the values

$$13^2 = 12^2 + BC^2$$

By further calculation

$$BC^2 = 13^2 - 12^2$$

$$BC^2 = 169 - 144 = 25$$

So we get

$$BC = \sqrt{25} = 5 \text{ cm}$$

We know that

Area of quadrilateral ABCD = Area of $\triangle ABC$ + Area of $\triangle ACD$

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It can be written as

$$= \frac{1}{2} \times \text{base} \times \text{height} + \frac{\sqrt{3}}{4} \times \text{side}^2$$

$$= \frac{1}{2} \times AC \times BC + \frac{\sqrt{3}}{4} \times 12^2$$

Substituting the values

$$= \frac{1}{2} \times 12 \times 5 + \frac{\sqrt{3}}{4} \times 12 \times 12$$

So we get

$$= 6 \times 5 + \sqrt{3} \times 3 \times 12$$

$$= 30 + 36\sqrt{3}$$

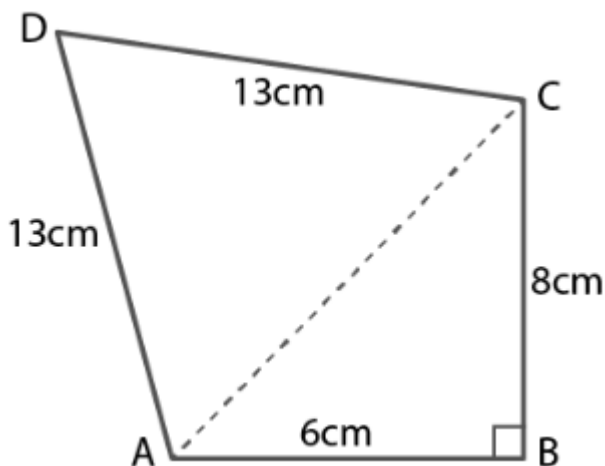
Substituting the value of $\sqrt{3}$

$$= 30 + 36 \times 1.732$$

$$= 30 + 62.28$$

$$= 92.28 \text{ cm}^2$$

4. Find the area of quadrilateral ABCD in which $\angle B = 90^\circ$, $AB = 6 \text{ cm}$, $BC = 8 \text{ cm}$ and $CD = AD = 13 \text{ cm}$.



Solution:

It is given that

ABCD is a quadrilateral in which $\angle B = 90^\circ$, $AB = 6 \text{ cm}$, $BC = 8 \text{ cm}$ and $CD = AD = 13 \text{ cm}$

In $\triangle ABC$

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Using Pythagoras theorem

$$AC^2 = AB^2 + BC^2$$

Substituting the values

$$AC^2 = 6^2 + 8^2$$

By further calculation

$$AC^2 = 36 + 64 = 100$$

So we get

$$AC^2 = 10^2$$

$$AC = 10 \text{ cm}$$

We know that

$$\text{Area of quadrilateral ABCD} = \text{Area of } \triangle ABC + \text{Area of } \triangle ACD$$

It can be written as

$$= \frac{1}{2} \times \text{base} \times \text{height} + \text{Area of } \triangle ACD$$

$$= \frac{1}{2} \times AB \times BC + \text{Area of } \triangle ACD$$

Substituting the values

$$= \frac{1}{2} \times 6 \times 8 + \text{Area of } \triangle ACD$$

By further calculation

$$= 24 \text{ cm}^2 + \text{Area of } \triangle ACD \dots\dots (1)$$

Finding the area of $\triangle ACD$

$$\text{Consider } a = AC = 10 \text{ cm, } b = CD = 13 \text{ cm, } c = AD = 13 \text{ cm}$$

We know that

$$S = \text{Semi perimeter} = (a + b + c) / 2$$

Substituting the values

$$= (10 + 13 + 13) / 2$$

$$= (10 + 26) / 2$$

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$$= 36/2$$

$$= 18 \text{ cm}$$

Here

$$\text{Area of } \triangle ACD = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{18(18-10)(18-13)(18-13)}$$

By further calculation

$$= \sqrt{18 \times 8 \times 5 \times 5}$$

We can write it as

$$= \sqrt{6 \times 3 \times 8 \times 5 \times 5}$$

$$= \sqrt{3 \times 2 \times 3 \times 2 \times 2 \times 2 \times 5 \times 5}$$

So we get

$$= 3 \times 2 \times 2 \times 5$$

$$= 60 \text{ cm}^2$$

Using equation (1)

$$\text{Area of quadrilateral ABCD} = 24 \text{ cm}^2 + \text{Area of } \triangle ACD$$

Substituting the values

$$= 24 + 60$$

$$= 84 \text{ cm}^2$$

5. The perimeter of a rectangular cardboard is 96 cm; if its breadth is 18 cm, find the length and the area of the cardboard.

Solution:

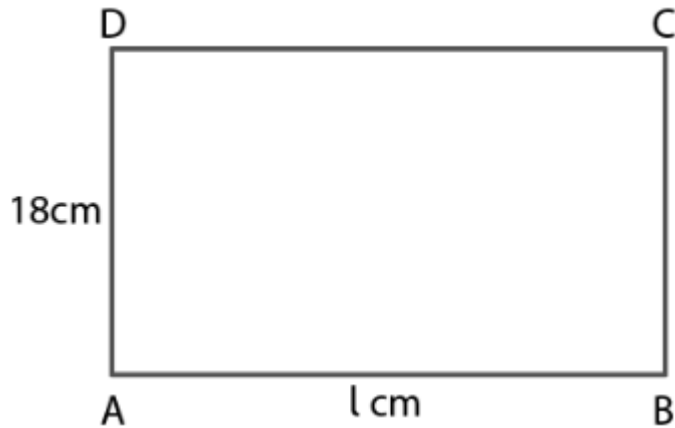
Consider ABCD as a rectangle

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Take length = l cm

Breadth = 18 cm

Perimeter = 96 cm



We know that

$$2 \times (l + b) = 96 \text{ cm}$$

Substituting the values

$$2 \times (l + 18) = 96 \text{ cm}$$

By further calculation

$$(l + 18) = 96/2$$

$$l + 18 = 48$$

So we get

$$l = 48 - 18 = 30 \text{ cm}$$

Here

Area of rectangular cardboard = $l \times b$

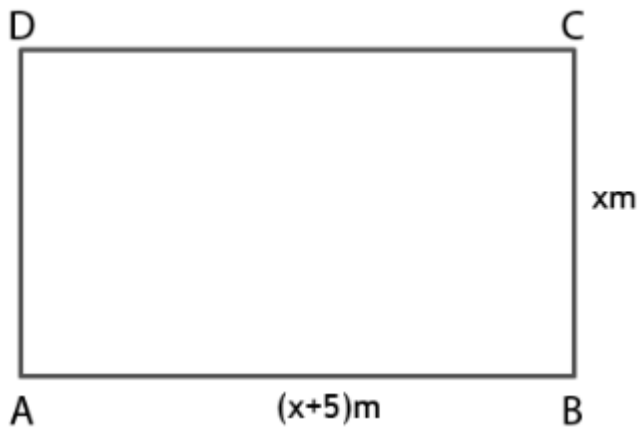
Substituting the values

$$= 30 \times 18$$

$$= 540 \text{ cm}^2$$

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6. The length of a rectangular hall is 5 cm more than its breadth, if the area of the hall is 594 m^2 , find its perimeter.



Solution:

Consider ABCD is a rectangular hall

Take Breadth = $x \text{ m}$

Length = $(x + 5) \text{ m}$

We know that

Area of rectangular field = $l \times b$

Substituting the values

$$594 = x(x + 5)$$

By further calculation

$$594 = x^2 + 5x$$

$$0 = x^2 + 5x - 594$$

$$x^2 + 5x - 594 = 0$$

It can be written as

$$x^2 + 27x - 22x - 594 = 0$$

Taking out the common terms

$$x(x + 27) - 22(x + 27) = 0$$

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So we get

$$(x - 22)(x + 27) = 0$$

Here

$$x - 22 = 0 \text{ or } x + 27 = 0$$

We get

$$x = 22 \text{ m or } x = -27 \text{ which is not possible}$$

We know that

$$\text{Breadth} = 22 \text{ m}$$

$$\text{Length} = (x + 5) = 22 + 5 = 27 \text{ m}$$

$$\text{Perimeter} = 2(l + b)$$

Substituting the values

$$= 2(27 + 22)$$

By further calculation

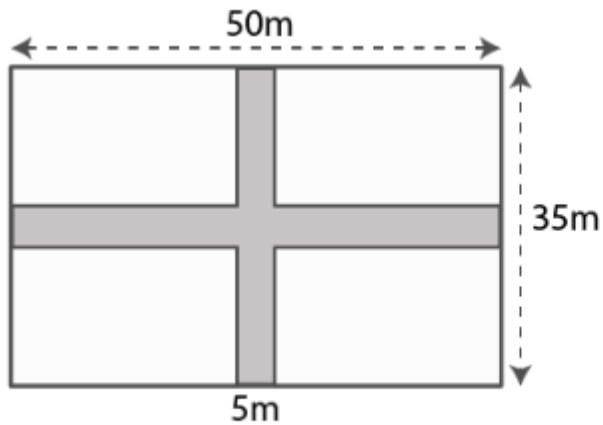
$$= 2 \times 49$$

$$= 98 \text{ m}$$

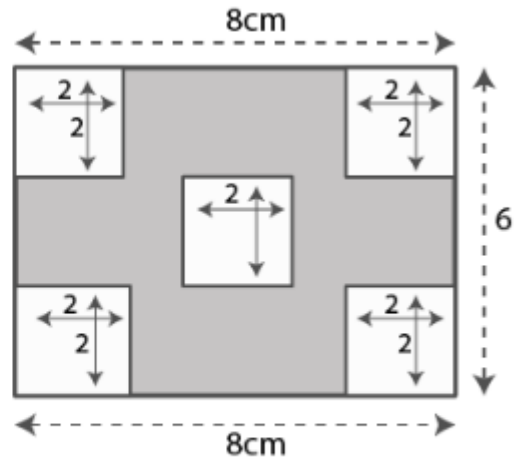
7. (a) The diagram (i) given below shows two paths drawn inside a rectangular field 50 m long and 35 m wide. The width of each path is 5 metres. Find the area of the shaded portion.

(b) In the diagram (ii) given below, calculate the area of the shaded portion. All measurements are in centimetres.

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(i)

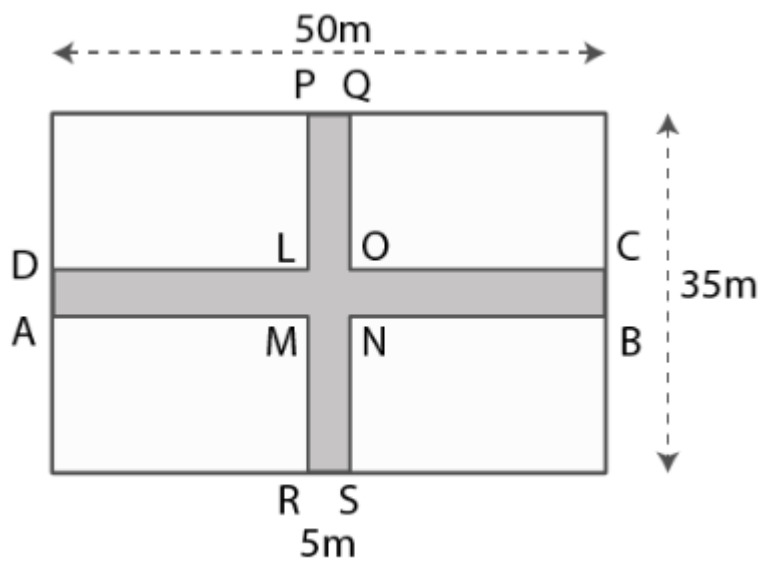


(ii)

Solution:

(a) We know that

Area of shaded portion = Area of rectangle ABCD + Area of rectangle PQRS – Area of square LMNO



(i)

Substituting the values

$$= 50 \times 5 + 5 \times 35 - 5 \times 5$$

By further calculation

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$$= 250 + 175 - 25$$

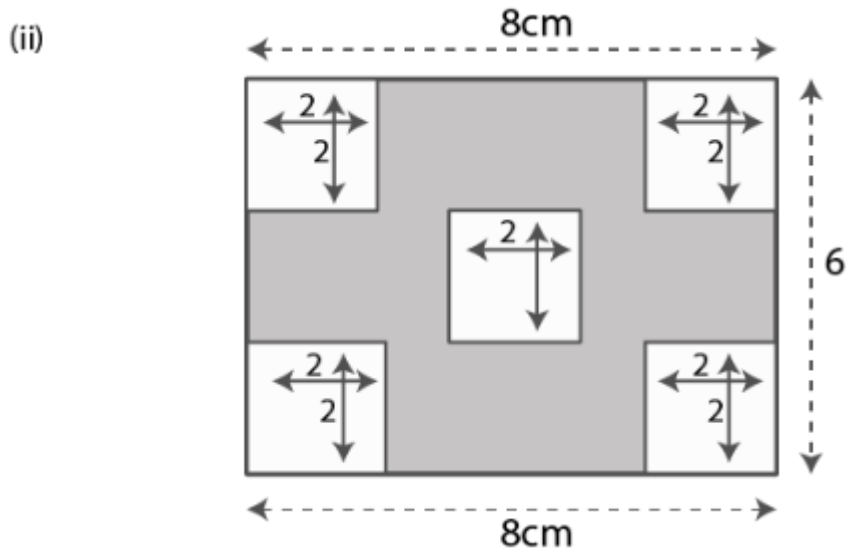
So we get

$$= 250 + 150$$

$$= 400 \text{ m}^2$$

(b) We know that

Area of shaded portion = Area of ABCD – 5 × Area of any small square



It can be written as

$$= l \times b - 5 \times \text{side} \times \text{side}$$

Substituting the values

$$= 8 \times 6 - 5 \times 2 \times 2$$

By further calculation

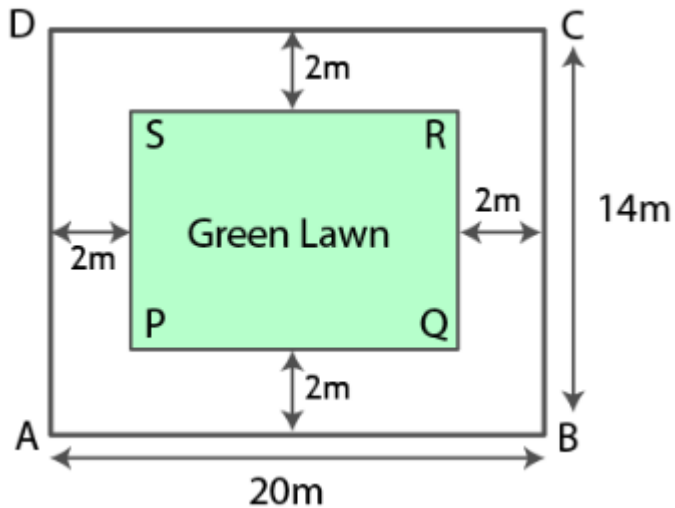
$$= 48 - 20$$

$$= 28 \text{ cm}^2$$

8. A rectangular plot 20 m long and 14 m wide is to be covered with grass leaving 2 m all around. Find the area to be laid with grass.

Solution:

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Consider ABCD as a plot

Length of plot = 20 m

Breadth of plot = 14 m

Take PQRS as the grassy plot

Here

Length of grassy lawn = $20 - 2 \times 2$

By further calculation

$$= 20 - 4$$

$$= 16 \text{ m}$$

Breadth of grassy lawn = $14 - 2 \times 2$

By further calculation

$$= 14 - 4$$

$$= 10 \text{ m}$$

Area of grassy lawn = length $\times$ breadth

Substituting the values

$$= 16 \times 10$$

$$= 160 \text{ m}^2$$

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9. The shaded region of the given diagram represents the lawn in front of a house. On three sides of the lawn there are flower beds of width 2 m.

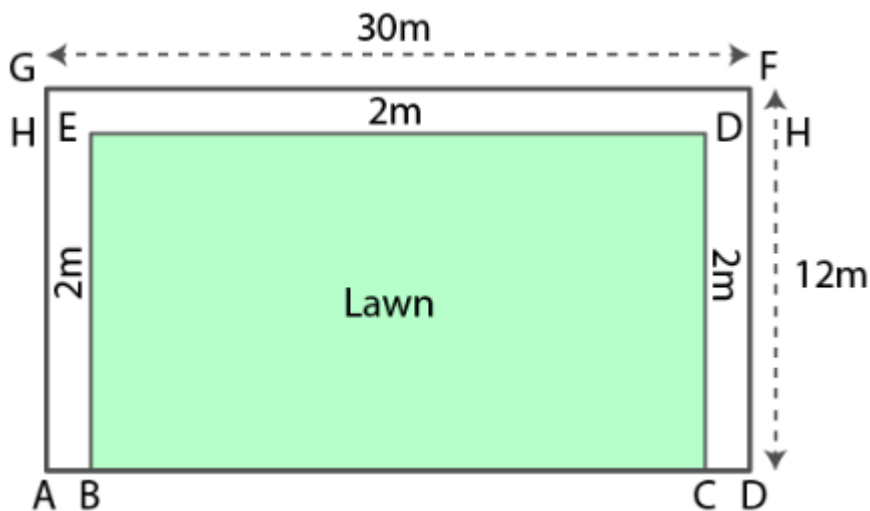
(i) Find the length and the breadth of the lawn.

(ii) Hence, or otherwise, find the area of the flower – beds.



Solution:

Consider BCDE as the lawn



(i) We know that

Length of lawn BCDE = BC

It can be written as

= AD – AB – CD

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Substituting the values

$$= 30 - 2 - 2$$

By further calculation

$$= 30 - 4$$

$$= 26 \text{ m}$$

Breadth of lawn BDCE = BE

It can be written as

$$= AG - GH$$

Substituting the values

$$= 12 - 2$$

$$= 10 \text{ m}$$

(ii) We know that

Area of flower beds = Area of rectangle ADFG – Area of lawn BCDE

It can be written as

$$= AD \times AG - BC \times BE$$

Substituting the values

$$= 30 \times 12 - 26 \times 10$$

By further calculation

$$= 360 - 260$$

$$= 100 \text{ m}^2$$

10. A foot path of uniform width runs all around the inside of a rectangular field 50 m long and 38 m wide. If the area of the path is 492 m^2 , find its width.

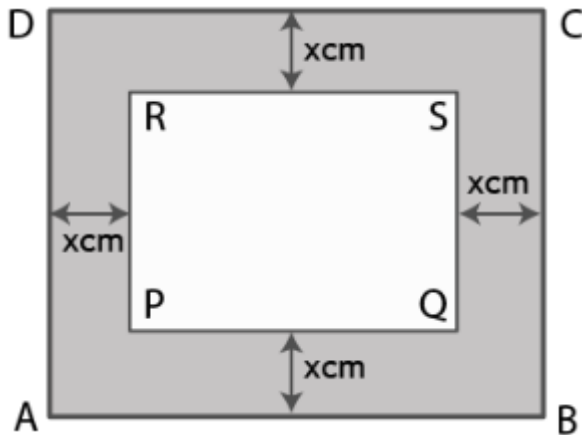
Solution:

Consider ABCD as a rectangular field having

Length = 50 m

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Breadth = 38 m



We know that

Area of rectangular field ABCD = $l \times b$

Substituting the values

$$= 50 \times 38$$

$$= 1900 \text{ m}^2$$

Let x m as the width of foot path all around the inside of a rectangular field

Length of rectangular field PQRS = $(50 - x - x) = (50 - 2x)$ m

Breadth of rectangular field PQRS = $(38 - x - x) = (38 - 2x)$ m

Here

Area of foot path = Area of rectangular field ABCD – Area of rectangular field PQRS

Substituting the values

$$492 = 1900 - (50 - 2x)(38 - 2x)$$

It can be written as

$$492 = 1900 - [50(38 - 2x) - 2x(38 - 2x)]$$

By further calculation

$$492 = 1900 - (1900 - 100x - 76x + 4x^2)$$

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$$492 = 1900 - 1900 + 100x + 76x - 4x^2$$

On further simplification

$$492 = 176x - 4x^2$$

Taking out 4 as common

$$492 = 4 (44x - x^2)$$

$$44x - x^2 = 492/4 = 123$$

We get

$$x^2 - 44x + 123 = 0$$

It can be written as

$$x^2 - 41x - 3x + 123 = 0$$

Taking out the common terms

$$x(x - 41) - 3(x - 41) = 0$$

$$(x - 3)(x - 41) = 0$$

Here

$$x - 3 = 0 \text{ or } x - 41 = 0$$

So $x = 3$ m or $x = 41$ m which is not possible

Therefore, width is 3 m.

11. The cost of enclosing a rectangular garden with a fence all around at the rate of Rs 15 per metre is Rs 5400. If the length of the garden is 100 m, find the area of the garden.

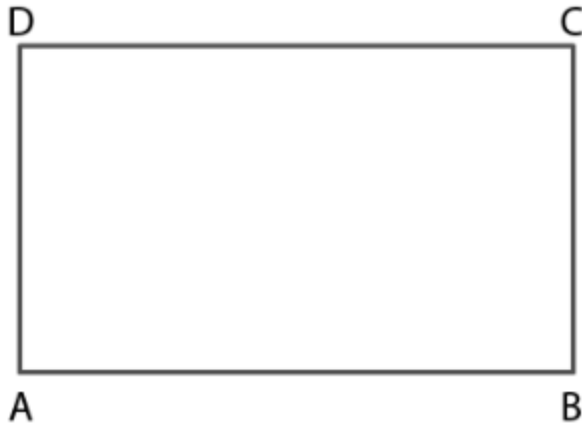
Solution:

Consider ABCD as a rectangular garden

Length = 100 m

Take breadth = x m

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We know that

Perimeter of the garden = $2(l + b)$

Substituting the values

$$= 2(100 + x)$$

$$= (200 + 2x) \text{ m}$$

We know that

Cost of 1 m to enclosing a rectangular garden = Rs 15

So the cost of $(200 + 2x)$ m to enclosing a rectangular garden = $15(200 + 2x)$

$$= 3000 + 30x$$

Given cost = Rs 5400

We get

$$3000 + 30x = 5400$$

It can be written as

$$30x = 5400 - 3000$$

$$x = 2400/30 = 80 \text{ m}$$

Breadth of garden = 80 m

So the area of rectangular field = $l \times b$

Substituting the values

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$$= 100 \times 80$$

$$= 8000 \text{ m}^2$$

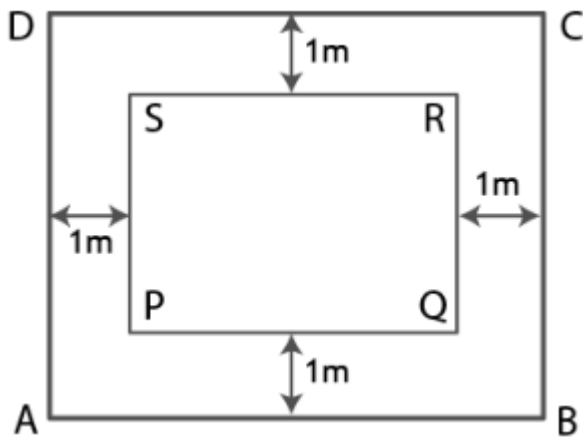
12. A rectangular floor which measures $15 \text{ m} \times 8 \text{ m}$ is to be laid with tiles measuring $50 \text{ cm} \times 25 \text{ cm}$ find the number of tiles required further, if a carpet is laid on the floor so that a space of 1 m exists between its edges and the edges of the floor, what fraction of the floor is uncovered?

Solution:

Consider ABCD as a rectangular field of measurement $15 \text{ m} \times 8 \text{ m}$

Length = 15 m

Breadth = 8 m



Here the area = $l \times b = 15 \times 8 = 120 \text{ m}^2$

Measurement of tiles = $50 \text{ cm} \times 25 \text{ cm}$

Length = $50 \text{ cm} = 50/100 = \frac{1}{2} \text{ m}$

Breadth = $25 \text{ cm} = 25/100 = \frac{1}{4} \text{ m}$

So the area of one tile = $\frac{1}{2} \times \frac{1}{4} = \frac{1}{8} \text{ m}^2$

No. of required tiles = Area of rectangular field/Area of one tile

Substituting the values

$$= 120 / (\frac{1}{8})$$

By further calculation

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$$= (120 \times 8) / 1$$

$$= 960 \text{ tiles}$$

$$\text{Length of carpet} = 15 - 1 - 1$$

$$= 15 - 2$$

$$= 13 \text{ m}$$

$$\text{Breadth of carpet} = 8 - 1 - 1$$

$$= 8 - 2$$

$$= 6 \text{ m}$$

$$\text{Area of carpet} = l \times b$$

$$= 13 \times 6$$

$$= 78 \text{ m}^2$$

We know that

$$\text{Area of floor which is uncovered by carpet} = \text{Area of floor} - \text{Area of carpet}$$

Substituting the values

$$= 120 - 78$$

$$= 42 \text{ m}^2$$

$$\text{Fraction} = \text{Area of floor which is uncovered by carpet} / \text{Area of floor}$$

Substituting the values

$$= 42/120$$

$$= 7/20$$

13. The width of a rectangular room is $\frac{3}{5}$ of its length x metres. If its perimeter is y metres, write an equation connecting x and y . Find the floor area of the room if its perimeter is 32 m.

Solution:

It is given that

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Length of rectangular room = x m

Width of rectangular room = $\frac{3}{5}$ of its length

$$= \frac{3x}{5} \text{ m}$$

Perimeter = y m

We know that

$$\text{Perimeter} = 2(l + b)$$

Substituting the values

$$y = 2 \left[\frac{(5x + 3x)}{5} \right]$$

By further calculation

$$y = 2 \times \frac{8x}{5}$$

$$y = \frac{16x}{5}$$

We get

$$5y = 16x$$

$$16x = 5y \dots\dots (1)$$

Equation (1) is the required relation between x and y

Given perimeter = 32 m

$$\text{So } y = 32 \text{ m}$$

Now substituting the value of y in equation (1)

$$16x = 5 \times 32$$

By further calculation

$$x = \frac{(5 \times 32)}{16}$$

$$x = \frac{(5 \times 2)}{1}$$

$$x = 10 \text{ m}$$

$$\text{Breadth} = \frac{3}{5} \times x$$

Substituting the value of x

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$$= \frac{3}{5} \times 10$$

$$= 3 \times 2$$

$$= 6 \text{ m}$$

Here the floor area of the room = $l \times b$

Substituting the values

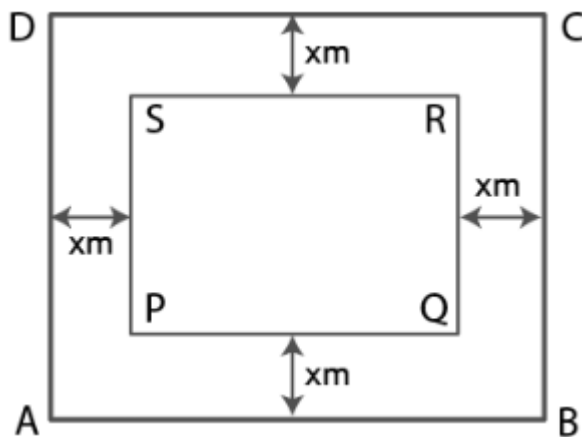
$$= 10 \times 6$$

$$= 60 \text{ m}^2$$

14. A rectangular garden 10 m by 16 m is to be surrounded by a concrete walk of uniform width. Given that the area of the walk is 120 square metres, assuming the width of the walk to be x , form an equation in x and solve it to find the value of x .

Solution:

Consider ABCD as a rectangular garden



Length = 10 m

Breadth = 16 m

So the area of ABCD = $l \times b$

Substituting the values

$$= 10 \times 16$$

$$= 160 \text{ m}^2$$

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Consider x m as the width of the walk

Length of rectangular garden PQRS = $10 - x - x = (10 - 2x)$ m

Breadth of rectangular garden PQRS = $16 - x - x = (16 - 2x)$ m

15. A rectangular room is 6 m long, 4.8 m wide and 3.5 m high. Find the inner surface of the four walls.

Solution:

It is given that

Length of rectangular room = 6 m

Breadth of rectangular room = 4.8 m

Height of rectangular room = 3.5 m

Here

Inner surface area of four wall = $2(l + b) \times h$

Substituting the values

$$= 2(6 + 4.8) \times 3.5$$

By further calculation

$$= 2 \times 10.8 \times 3.5$$

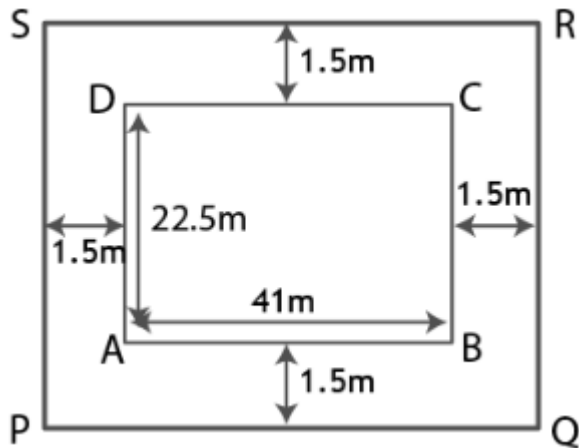
$$= 21.6 \times 3.5$$

$$= 75.6 \text{ m}^2$$

16. A rectangular plot of land measures 41 metres in length and 22.5 metres in width. A boundary wall 2 metres high is built all around the plot at a distance of 1.5 m from the plot. Find the inner surface area of the boundary wall.

Solution:

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It is given that

Length of rectangular plot = 41 metres

Breadth of rectangular plot = 22.5 metres

Height of boundary wall = 2 metre

Here

Boundary wall is built at a distance of 1.5 m

New length = $41 + 1.5 + 1.5$

$= 41 + 3$

$= 44 \text{ m}$

New breadth = $22.5 + 1.5 + 1.5$

$= 22.5 + 3$

$= 25.5 \text{ m}$

We know that

Inner surface area of the boundary wall = $2(l + b) \times h$

Substituting the values

$= 2(44 + 25.5) \times 2$

By further calculation

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$$= 2 \times 69.5 \times 2$$

$$= 2 \times 139$$

$$= 278 \text{ m}^2$$

17. (a) Find the perimeter and area of the figure

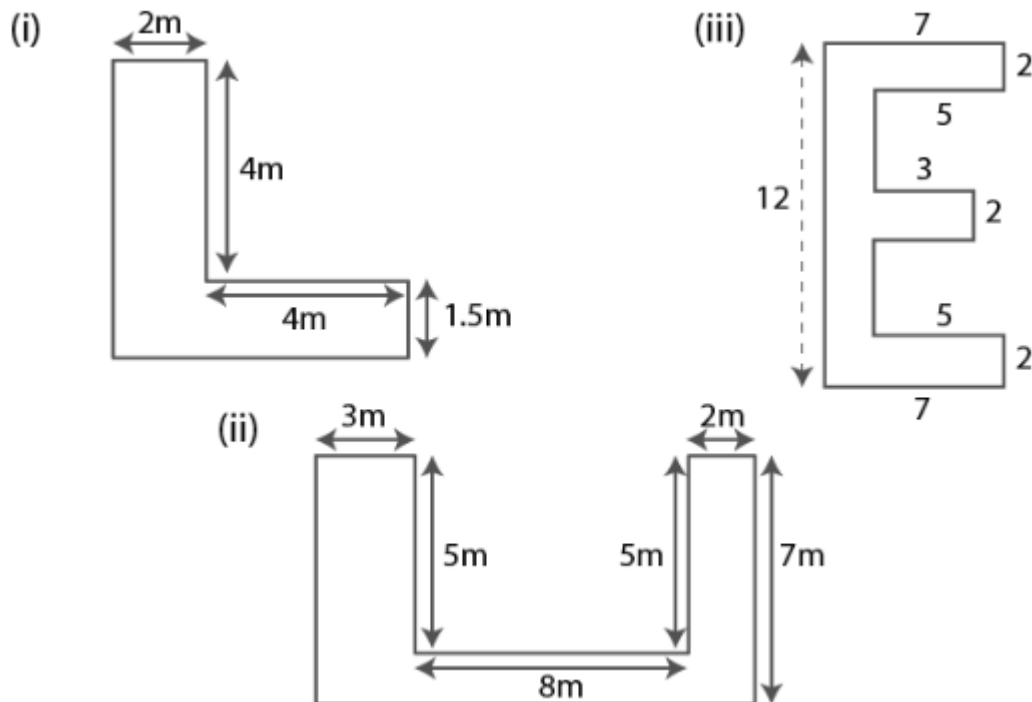
(i) given below in which all corners are right angled.

(b) Find the perimeter and area of the figure

(ii) given below in which all corners are right angles.

(c) Find the area and perimeter of the figure

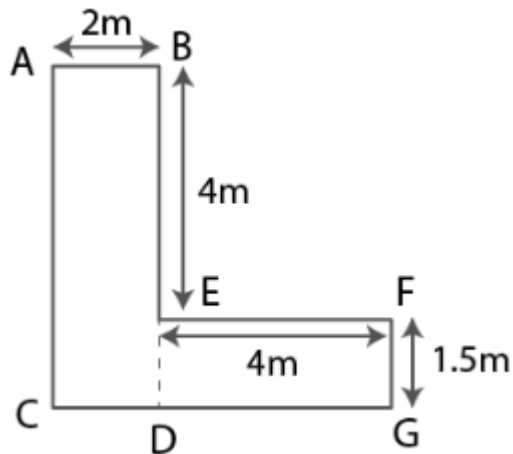
(iii) given below in which all corners are right angled and all measurement in centimetres.



Solution:

(a) It is given that

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$AB = 2\text{m}$, $BE = 4\text{m}$, $FE = 4\text{m}$ and $FG = 1.5\text{m}$

So $BD = 4 + 1.5 = 5.5\text{m}$

$AC = BD = 5.5\text{m}$

$CG = (4 + 2) = 6\text{m}$

We know that

Perimeter of figure (i) = $AC + CG + GF + FE + EB + BA$

Substituting the values

$$= 5.5 + 6 + 1.5 + 4 + 4 + 2$$

$$= 23\text{m}$$

Here

Area of given figure = Area of ABEDC + Area of FEDG

It can be written as

$$= \text{length} \times \text{breadth} + \text{length} \times \text{breadth}$$

Substituting the values

$$= 2 \times 5.5 + 4 \times 1.5$$

$$= 11 + 6$$

$$= 17\text{m}^2$$

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(b) It is given that

$$AB = CD = 3\text{m}$$

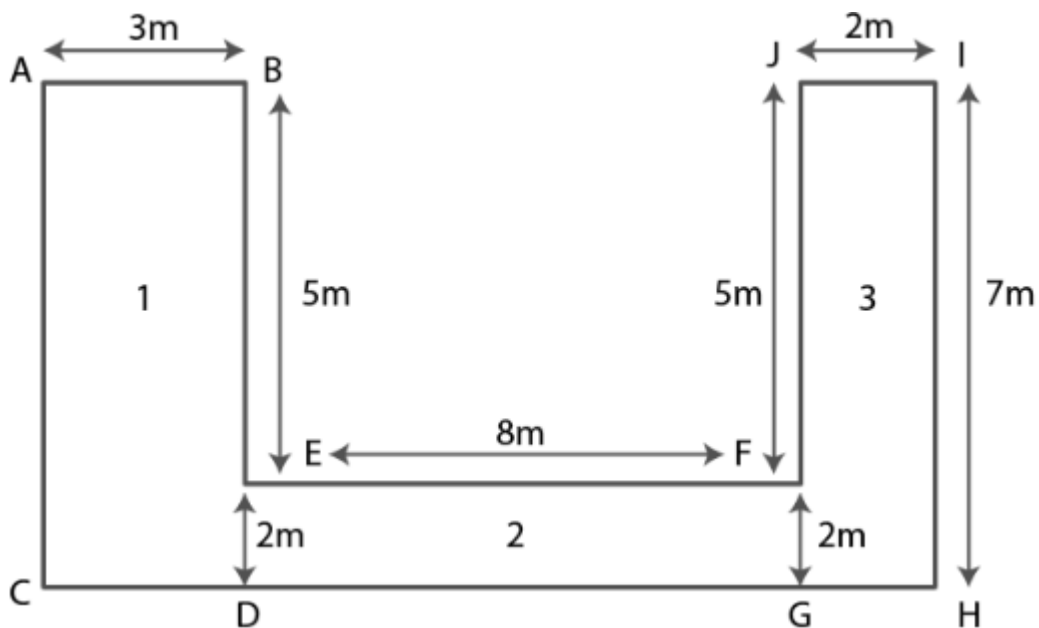
$$HI = AC = 7\text{m}$$

$$JE = BE = 5\text{m}$$

$$GF = DE = 2\text{m}$$

$$DG = EF = 8\text{m}$$

$$GH = JI = 2\text{m}$$



We know that

$$CH = CD + DG + GH$$

Substituting the values

$$= 3 + 8 + 2$$

$$= 13\text{ m}$$

$$\text{Perimeter of the given figure} = AB + AC + CH + HI + IJ + JF + FE + BE$$

Substituting the values

$$= 3 + 7 + 13 + 7 + 2 + 5 + 8 + 5$$

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$$= 50 \text{ m}$$

Here

Area of given figure = Area of first figure + Area of second figure + Area of third figure

Substituting the values

$$= 7 \times 3 + 8 \times 2 + 7 \times 2$$

By further calculation

$$= 21 + 16 + 14$$

$$= 51 \text{ m}^2$$

(c) It is given that

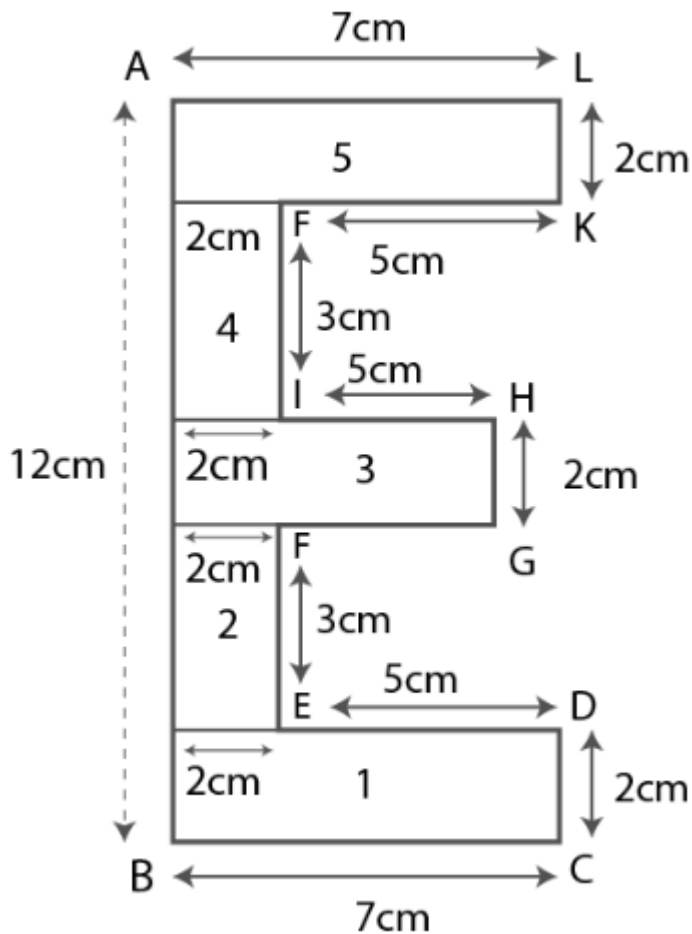
$$AB = 12 \text{ cm}$$

$$AL = BC = 7 \text{ cm}$$

$$JK = DE = 5 \text{ cm}$$

$$HJ = GF = 3 \text{ cm}$$

$$LK = HG = CD = 2 \text{ cm}$$



We know that

Perimeter of given figure = $AB + BC + CD + DE + EF + FG + GH + HI + IJ + JK + KL + LA$

Substituting the values

$$= 12 + 7 + 2 + 5 + 3 + 3 + 2 + 3 + 3 + 5 + 2 + 7$$

$$= 54 \text{ cm}$$

Here

Area of given figure = Area of first part + Area of second part + Area of third part + Area of fourth part + Area of fifth part

Substituting the values

$$= 7 \times 2 + 2 \times 3 + (2 + 3) \times 2 + 2 \times 3 + 7 \times 2$$

By further calculation

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$$= 14 + 6 + 10 + 6 + 14$$

$$= 50 \text{ cm}^2$$

18. The length and the breadth of a rectangle are 12 cm and 9 cm respectively. Find the height of a triangle whose base is 9 cm and whose area is one third that of rectangle.

Solution:

It is given that

Length of a rectangle = 12 cm

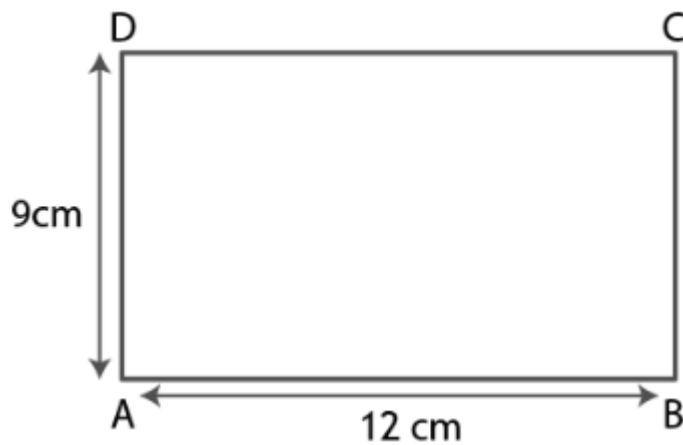
Breadth of a rectangle = 9 cm

So the area = $l \times b$

Substituting the values

$$= 12 \times 9$$

$$= 108 \text{ cm}^2$$



Using the condition

Area of triangle ABC = $\frac{1}{3} \times$ area of rectangle

Substituting the values

$$= \frac{1}{3} \times 108$$

$$= 36 \text{ cm}^2$$

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Consider h cm as the height of triangle ABC

Area of triangle ABC = $\frac{1}{2} \times \text{base} \times \text{height}$

Substituting the values

$$36 = \frac{1}{2} \times 9 \times h$$

By further calculation

$$36 \times 2 = 9 \times h$$

$$h = (36 \times 2) / 9$$

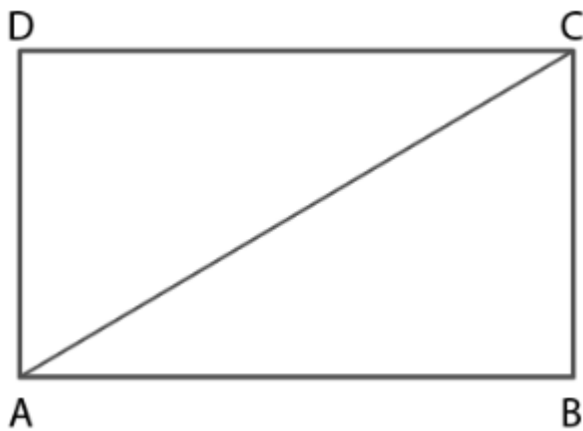
So we get

$$h = 4 \times 2$$

$$h = 8 \text{ cm}$$

Therefore, height of triangle ABC is 8 cm.

19. The area of a square plot is 484 m^2 . Find the length of its one side and the length of its one diagonal.



Solution:

It is given that

ABCD is a square plot having area = 484 m^2

Sides of square are AB, BC, CD and AD

We know that

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Area of square = side $\times$ side

Substituting the values

$$484 = (\text{side})^2$$

So we get

$$\text{Side} = \sqrt{484} = 22 \text{ m}$$

$$AB = BC = 22 \text{ m}$$

In triangle ABC

Using Pythagoras Theorem

$$AC^2 = AB^2 + BC^2$$

Substituting the values

$$AC^2 = 22^2 + 22^2$$

$$AC^2 = 484 + 484 = 968$$

By further calculation

$$AC = \sqrt{968} = \sqrt{(484 \times 2)}$$

$$AC = 22 \times \sqrt{2}$$

So we get

$$AC = 22 \times 1.414 = 31.11 \text{ m}$$

Therefore, length of side is 22 m and length of diagonal is 31.11 m.

20. A square has the perimeter 56 m. Find its area and the length of one diagonal correct up to two decimal places.

Solution:

Consider ABCD as a square with side x m

Perimeter of square = 4 $\times$ side

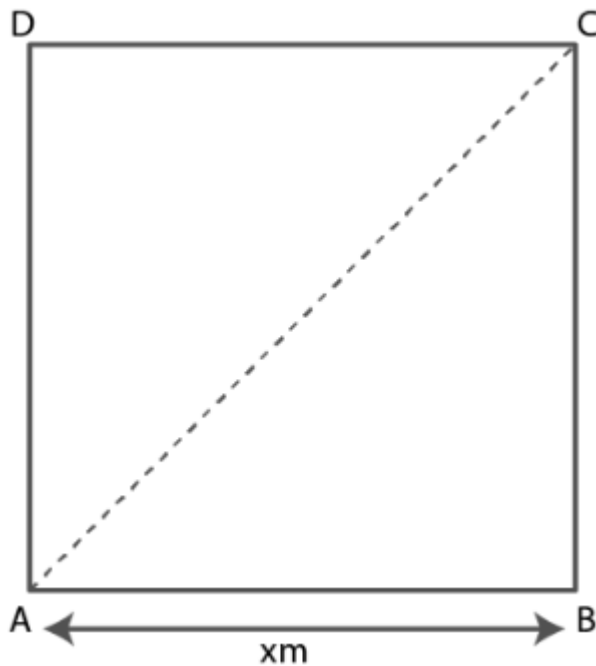
Substituting the values

$$56 = 4x$$

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By further calculation

$$x = 56/4 = 14 \text{ m}$$



In triangle ABC

Using Pythagoras theorem

$$AC^2 = AB^2 + BC^2$$

Substituting the values

$$AC^2 = 14^2 + 14^2$$

By further calculation

$$AC^2 = 196 + 196 = 392$$

So we get

$$AC = \sqrt{392}$$

$$AC = \sqrt{(196 \times 2)}$$

$$AC = 14\sqrt{2}$$

Substituting the value of $\sqrt{2}$

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$$AC = 14 \times 1.414$$

$$AC = 19.80 \text{ m}$$

Therefore, the side of square is 14 m and diagonal is 19.80 m.

21. A wire when bent in the form of an equilateral triangle encloses an area of $36\sqrt{3}$ cm². Find the area enclosed by the same wire when bent to form:

(i) a square, and

(ii) a rectangle whose length is 2 cm more than its width.

Solution:

It is given that

$$\text{Area of equilateral triangle} = 36\sqrt{3} \text{ cm}^2$$

Consider x cm as the side of equilateral triangle

We know that

$$\text{Area} = \frac{\sqrt{3}}{4} (\text{side})^2$$

Substituting the values

$$36\sqrt{3} = \frac{\sqrt{3}}{4} \times (x)^2$$

By further calculation

$$x^2 = (36\sqrt{3} \times 4) / \sqrt{3}$$

$$x^2 = 36 \times 4$$

So we get

$$x = \sqrt{36 \times 4}$$

$$x = 6 \times 2$$

$$x = 12 \text{ cm}$$

Here

$$\text{Perimeter of equilateral triangle} = 3 \times \text{side}$$

$$= 3 \times 12$$

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$$= 36 \text{ cm}$$

(i) We know that

Perimeter of equilateral triangle = Perimeter of square

It can be written as

$$36 = 4 \times \text{side}$$

So we get

$$\text{Side} = 36/4 = 9 \text{ cm}$$

Area of square = side $\times$ side

$$= 9 \times 9$$

$$= 81 \text{ cm}^2$$

(ii) We know that

Perimeter of triangle = Perimeter of rectangle (1)

According to the condition of rectangle

Length is 2 cm more than its width

Width of rectangle = x cm

Length of rectangle = $(x + 2)$ cm

Perimeter of rectangle = $2(l + b)$

Substituting the values

$$= 2 [(x + 2) + x]$$

By further calculation

$$= 2 (2x + 2)$$

$$= 4x + 4$$

Using equation (1)

$$4x + 4 = \text{Perimeter of triangle}$$

$$4x + 4 = 36$$

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By further calculation

$$4x = 36 - 4 = 32 \text{ cm}$$

So we get

$$x = 32/4 = 8 \text{ cm}$$

Here

$$\text{Length of rectangle} = 8 + 2 = 10 \text{ cm}$$

$$\text{Breadth of rectangle} = 8 \text{ cm}$$

$$\text{Area of rectangle} = \text{length} \times \text{breadth}$$

$$= 10 \times 8$$

$$= 80 \text{ cm}^2$$

22. Two adjacent sides of a parallelogram are 15 cm and 10 cm. If the distance between the longer sides is 8 cm, find the area of the parallelogram. Also find the distance between shorter sides.

Solution:

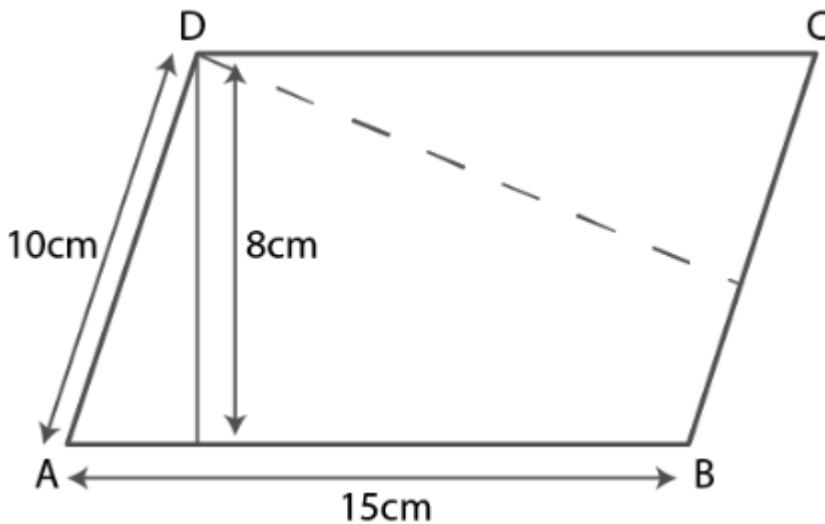
Consider ABCD as a parallelogram

$$\text{Longer side AB} = 15 \text{ cm}$$

$$\text{Shorter side} = 10 \text{ cm}$$

$$\text{Distance between longer side DM} = 8 \text{ cm}$$

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Consider DN as the distance between the shorter side

Area of parallelogram ABCD = base $\times$ height

We can write it as

$$= AB \times DM$$

Substituting the values

$$= 15 \times 8$$

$$= 120 \text{ cm}^2$$

If base is AD

Area of parallelogram = AD $\times$ DN

Substituting the values

$$120 = 10 \times DN$$

So we get

$$DN = 120/10 = 12 \text{ cm}$$

Therefore, the area of parallelogram is 120 cm^2 and the distance between shorter side is 12 cm.

23. ABCD is a parallelogram with sides AB = 12 cm, BC = 10 cm and diagonal AC = 16 cm. Find the area of the parallelogram. Also find the distance between its shorter sides.

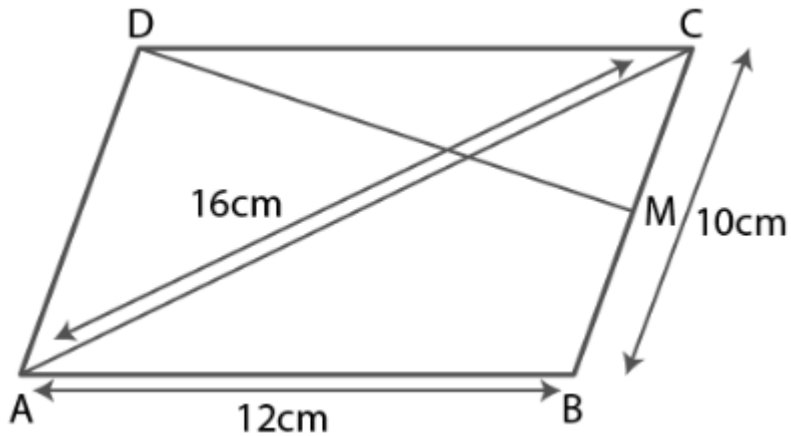
<https://www.indcareer.com/schools/ml-aggarwal-solutions-for-class-9-maths-chapter-16-men-suration/>

Solution:

It is given that

ABCD is a parallelogram

AB = 12 cm, BC = 10 cm and AC = 16 cm



Area of triangle ABC

BC = a = 10 cm

AC = b = 16 cm

AB = c = 12 cm

We know that

$$s = (a + b + c) / 2$$

Substituting the values

$$s = (10 + 16 + 12) / 2$$

By further calculation

$$s = 38 / 2 = 19 \text{ cm}$$

Here

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$$\text{Area of } \triangle ABC = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{19(19-10)(19-16)(19-12)}$$

By further calculation

$$= \sqrt{19 \times 9 \times 3 \times 7}$$

We can write it as

$$= \sqrt{19 \times 3 \times 3 \times 3 \times 7}$$

$$= 3\sqrt{19 \times 3 \times 7}$$

$$= 3\sqrt{19 \times 21}$$

So we get

$$= 3\sqrt{399} \text{ cm}^2$$

We know that

$$\text{Area of parallelogram} = 2 \times \text{Area of triangle ABC}$$

Substituting the values

$$= 2 \times 3\sqrt{399}$$

$$= 6\sqrt{399}$$

So we get

$$= 6 \times 19.96$$

$$= 119.8 \text{ cm}^2$$

Consider DM as the distance between the shorter lines

$$\text{Base} = AD = BC = 10 \text{ cm}$$

$$\text{Area of parallelogram} = AD \times DM$$

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Substituting the values

$$119.8 = 10 \times DM$$

By further calculation

$$DM = 119.8 / 10$$

$$DM = 11.98 \text{ cm}$$

Therefore, the distance between shorter lines is 11.98 cm.

24. Diagonals AC and BD of a parallelogram ABCD intersect at O. Given that AB = 12 cm and perpendicular distance between AB and DC is 6 cm. Calculate the area of the triangle AOD.

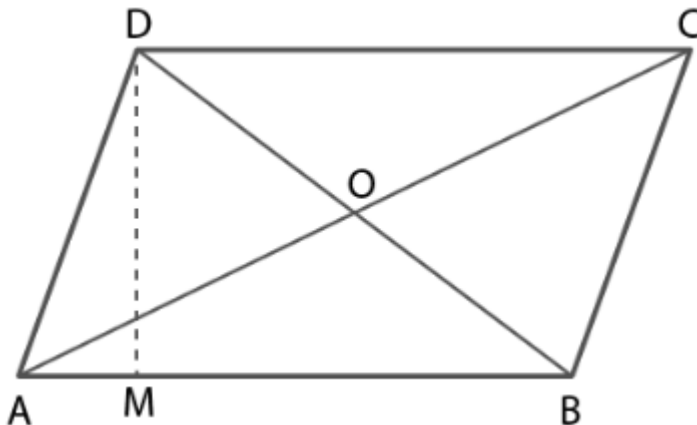
Solution:

It is given that

ABCD is a parallelogram

AC and BD are the diagonal which intersect at O

AB = 12 cm and DM = 6 cm



We know that

$$\text{Area of parallelogram ABCD} = AB \times DM$$

Substituting the values

$$= 12 \times 6$$

$$= 72 \text{ cm}^2$$

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Similarly

Area of triangle AOD = $\frac{1}{4} \times$ Area of parallelogram

Substituting the values

$$= \frac{1}{4} \times 72$$

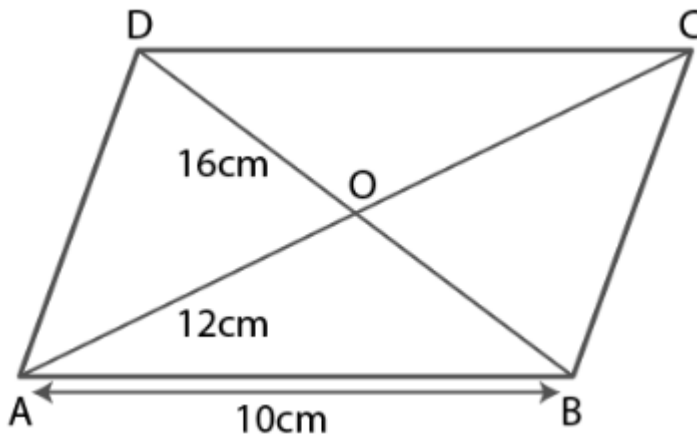
$$= 18 \text{ cm}^2$$

25. ABCD is a parallelogram with side AB = 10 cm. Its diagonals AC and BD are of length 12 cm and 16 cm respectively. Find the area of the parallelogram ABCD.

Solution:

It is given that

ABCD is a parallelogram



AB = 10 cm, AC = 12 cm

$$AO = CO = 12/2 = 6 \text{ cm}$$

BD = 16 cm

$$BO = OD = 16/2 = 8 \text{ cm}$$

In triangle AOB

$$a = 10 \text{ cm}, b = AO = 6 \text{ cm}, c = BO = 8 \text{ cm}$$

We know that

$$s = (a + b + c)/2$$

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Substituting the values

$$s = (10 + 6 + 8) / 2$$

By further calculation

$$s = 24/2 = 12 \text{ cm}$$

$$\text{Area of } \triangle AOB = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{12(12-10)(12-6)(12-8)}$$

By further calculation

$$= \sqrt{12 \times 2 \times 6 \times 4}$$

$$= \sqrt{12 \times 2 \times 4}$$

So we get

$$= 12 \times 2$$

$$= 24 \text{ cm}^2$$

We know that

$$\text{Area of parallelogram ABCD} = 4 \times \text{Area of triangle AOB}$$

Substituting the values

$$= 4 \times 24$$

$$= 96 \text{ cm}^2$$

26. The area of a parallelogram is $p \text{ cm}^2$ and its height is $q \text{ cm}$. A second parallelogram has equal area but its base is $r \text{ cm}$ more than that of the first. Obtain an expression in terms of p , q and r for the height h of the second parallelogram.

Solution:

It is given that

$$\text{Area of a parallelogram} = p \text{ cm}^2$$

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Height of first parallelogram = q cm

We know that

Area of parallelogram = base $\times$ height

Substituting the values

$$p = \text{base} \times q$$

$$\text{Base} = p/q$$

Here

$$\text{Base of second parallelogram} = (p/q + r)$$

Taking LCM

$$= (p + qr)/q \text{ cm}$$

$$\text{Area of second parallelogram} = \text{Area of first parallelogram} = p \text{ cm}^2$$

It can be written as

$$\text{Base} \times \text{height} = p \text{ cm}^2$$

$$\text{Substituting the values} [(p + qr)/q] \times h = p$$

So we get

$$h = pq/(p + qr) \text{ cm}$$

Therefore, the height of second parallelogram is $h = pq/(p + qr)$ cm.

27. What is the area of a rhombus whose diagonals are 12 cm and 16 cm?

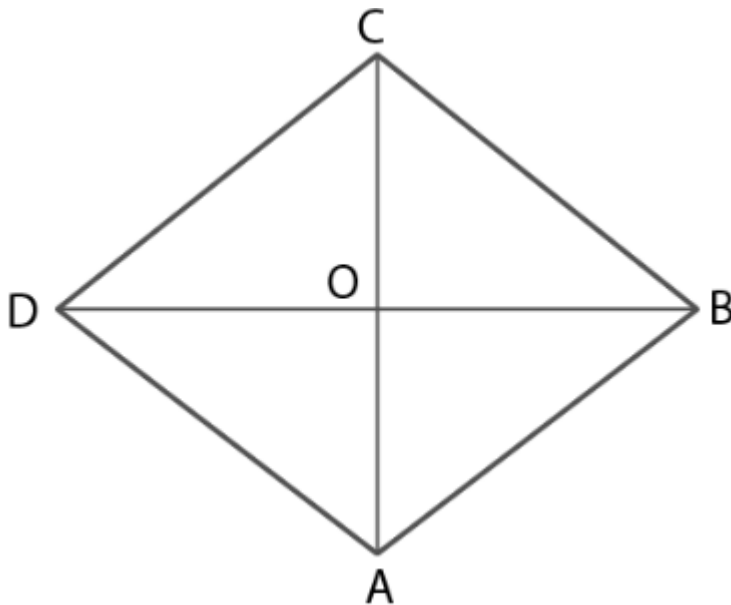
Solution:

It is given that

ABCD is a rhombus

BD = 12 cm and AC = 16 cm are diagonals

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We know that

$$\text{Area of rhombus ABCD} = \frac{1}{2} \times AC \times BD$$

Substituting the values

$$= \frac{1}{2} \times 16 \times 12$$

By further calculation

$$= 8 \times 12$$

$$= 96 \text{ cm}^2$$

28. The area of a rhombus is 98 cm^2 . If one of its diagonal is 14 cm, what is the length of the other diagonal?

Solution:

It is given that

$$\text{Area of rhombus} = 98 \text{ cm}^2$$

$$\text{One of its diagonal} = 14 \text{ cm}$$

We know that

$$\text{Area of rhombus} = \frac{1}{2} \times \text{product of diagonals}$$

Substituting the values

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$$98 = \frac{1}{2} \times \text{one diagonal} \times \text{other diagonal}$$

$$98 = \frac{1}{2} \times 14 \times \text{other diagonal}$$

By further calculation

$$\text{Other diagonal} = (98 \times 2) / 14$$

$$= 7 \times 2$$

$$= 14 \text{ cm}$$

Therefore, the other diagonal is 14 cm.

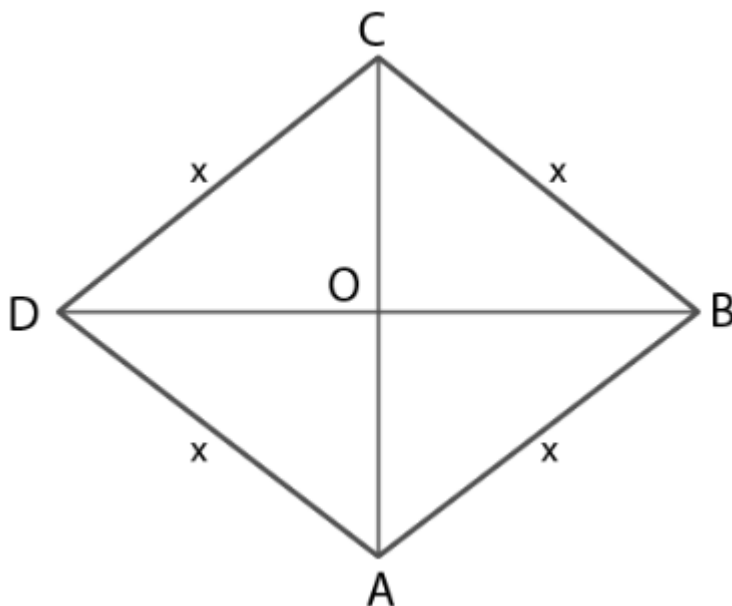
29. The perimeter of a rhombus is 45 cm. If its height is 8 cm, calculate its area.

Solution:

It is given that

ABCD is a rhombus

Consider x cm as each side



$$\text{Perimeter} = 45 \text{ cm}$$

$$AB + BC + CD + AD = 45 \text{ cm}$$

Substituting the values

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$$x + x + x + x = 45$$

$$4x = 45$$

By division

$$x = 45/4 \text{ cm}$$

We know that

$$\text{Height} = 8 \text{ cm}$$

$$\text{Area of rhombus} = \text{base} \times \text{height}$$

Substituting the values

$$= 45/4 \times 8$$

$$= 45 \times 2$$

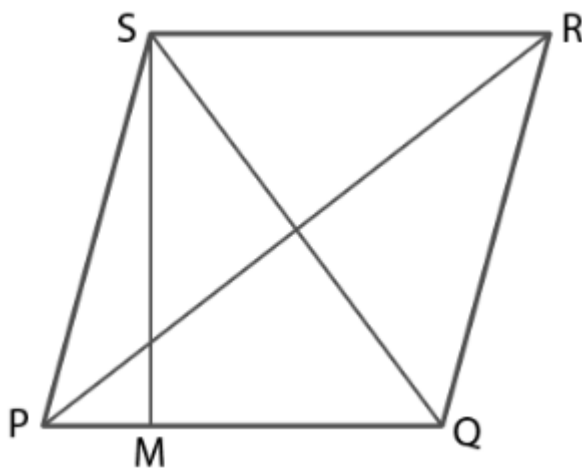
$$= 90 \text{ cm}^2$$

30. PQRS is a rhombus. If it is given that PQ = 3 cm and the height of the rhombus is 2.5 cm, calculate its area.

Solution:

It is given that

PQRS is a rhombus



$$PQ = 3 \text{ cm}$$

$$\text{Height} = 2.5 \text{ cm}$$

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Consider PQ as the base of rhombus PQRS.

SM = 2.5 cm is the height of rhombus

We know that

Area of rhombus PQRS = base $\times$ height

Substituting the values

$$= 3 \times 2.5$$

$$= 7.5 \text{ cm}^2$$

31. If the diagonals of a rhombus are 8 cm and 6 cm, find its perimeter.

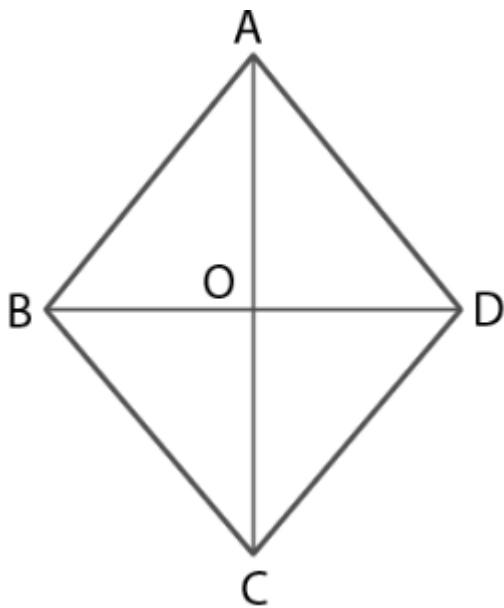
Solution:

Consider ABCD as a rhombus with AC and BD as two diagonals

Here

AC = 8 cm and BD = 6 cm

AO = 4 cm and BO = 3 cm



In triangle ABC

Using Pythagoras theorem

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$$AB^2 = AO^2 + BO^2$$

Substituting the values

$$AB^2 = 4^2 + 3^2$$

By further calculation

$$AB^2 = 16 + 9 = 25$$

So we get

$$AB = \sqrt{25} = 5 \text{ cm}$$

Side of rhombus ABCD = 5 cm

Here

Perimeter of rhombus = 4 × side

Substituting the values

$$= 4 \times 5$$

$$= 20 \text{ cm}$$

32. If the sides of a rhombus are 5 cm each and one diagonal is 8 cm, calculate

(i) the length of the other diagonal, and

(ii) the area of the rhombus.

Solution:

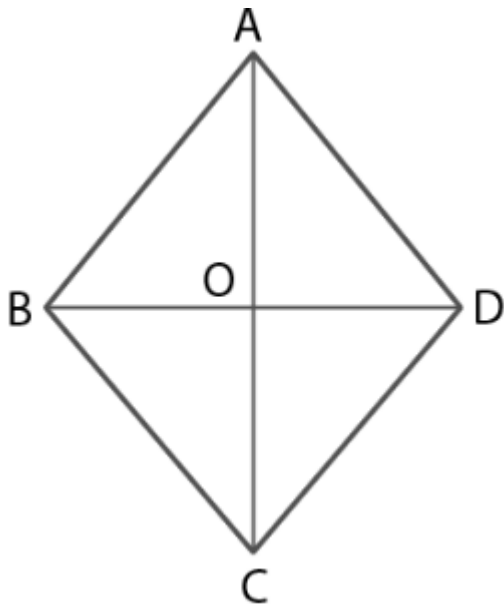
It is given that

ABCD is a rhombus with side AB, BC, CD and AD

$$AB = BC = CD = AD = 5 \text{ cm}$$

$$AC = 8 \text{ cm and } AO = 4 \text{ cm}$$

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In triangle AOB

Using Pythagoras theorem

$$AB^2 = AO^2 + BO^2$$

Substituting the values

$$5^2 = 4^2 + BO^2$$

By further calculation

$$25 = 16 + BO^2$$

$$BO^2 = 25 - 16 = 9$$

So we get

$$BO = \sqrt{9} = 3 \text{ cm}$$

$$BD = 2 \times BO = 2 \times 3 = 6 \text{ cm}$$

Length of other diagonal = 6 cm

Area of rhombus = $\frac{1}{2} \times$ product of diagonals

Substituting the values

$$= \frac{1}{2} \times 8 \times 6$$

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By further calculation

$$= 4 \times 6$$

$$= 24 \text{ cm}^2$$

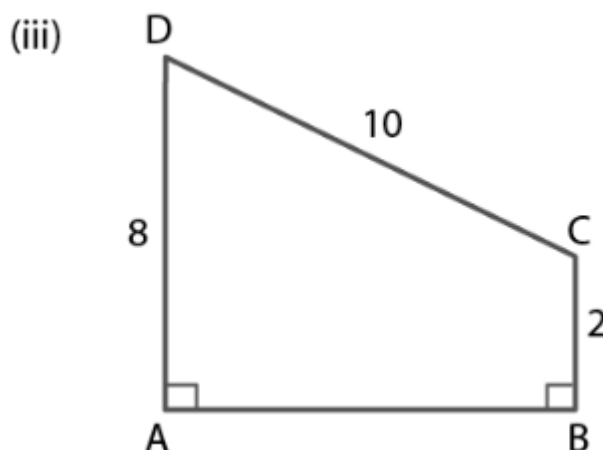
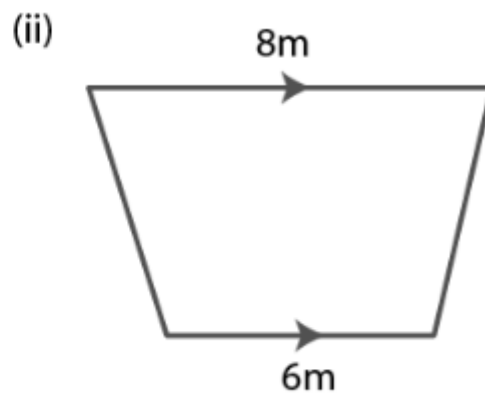
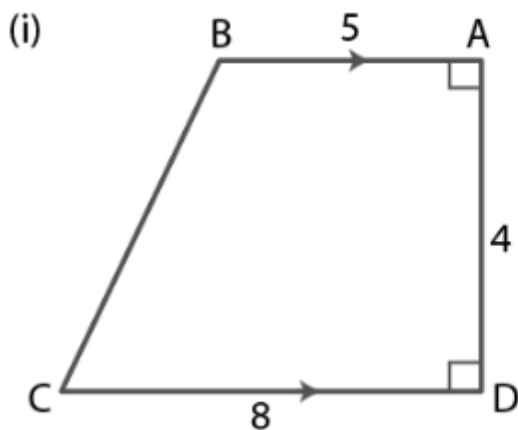
33. (a) The diagram (i) given below is a trapezium. Find the length of BC and the area of the trapezium. Assume $AB = 5 \text{ cm}$, $AD = 4 \text{ cm}$, $CD = 8 \text{ cm}$.

(b) The diagram (ii) given below is a trapezium. Find

(i) AB

(ii) area of trapezium ABCD

(c) The cross-section of a canal is shown in figure (iii) given below. If the canal is 8 m wide at the top and 6 m wide at the bottom and the area of the cross-section is 16.8 m^2 , calculate its depth.



Solution:

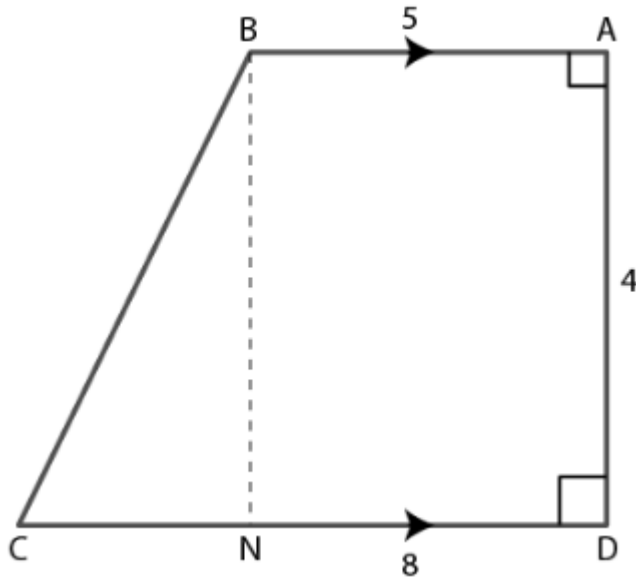
<https://www.indcareer.com/schools/ml-aggarwal-solutions-for-class-9-maths-chapter-16-measurement/>

(a) It is given that

ABCD is a trapezium

AB = 5 cm, AD = 4 cm and CD = 8 cm

Construct BN perpendicular to CD



Here

$$BN = 4 \text{ cm}$$

$$CN = CD - ND$$

$$CN = CD - AO$$

$$CN = 8 - 5 = 3 \text{ cm}$$

In triangle BCN

Using Pythagoras theorem

$$BC^2 = BN^2 + CN^2$$

Substituting the values

$$BC^2 = 4^2 + 3^2$$

By further calculation

$$BC^2 = 16 + 9 = 25$$

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$$BC = \sqrt{25} = 5 \text{ cm}$$

$$\text{Length of BC} = 5 \text{ cm}$$

$$\text{Area of trapezium} = \frac{1}{2} \times \text{sum of parallel sides} \times \text{height}$$

It can be written as

$$= \frac{1}{2} \times (AB + CD) \times AD$$

Substituting the values

$$= \frac{1}{2} \times (5 + 8) \times 4$$

By further calculation

$$= \frac{1}{2} \times 13 \times 4$$

So we get

$$= 13 \times 2$$

$$= 26 \text{ cm}^2$$

$$\text{Area of trapezium} = 26 \text{ cm}^2$$

(b) From the figure (ii)

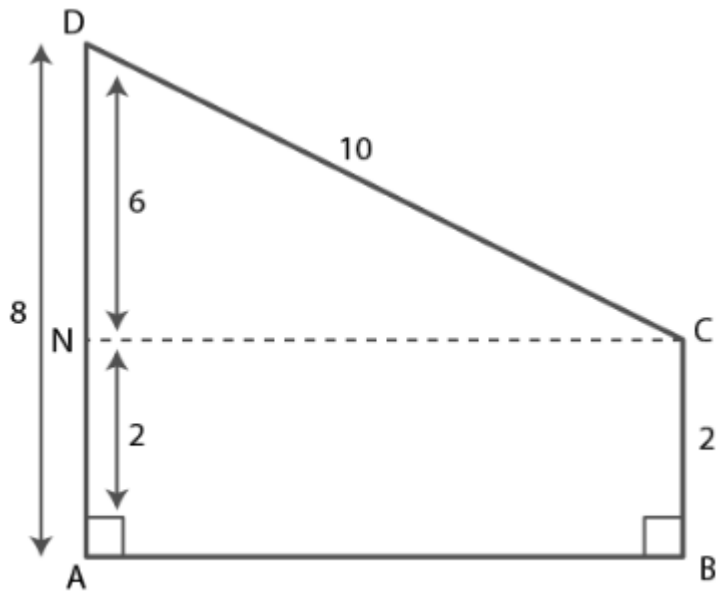
$$AD = 8 \text{ units}$$

$$BC = 2 \text{ units}$$

$$CD = 10 \text{ units}$$

Construct CN perpendicular to AD

$$AN = 2 \text{ units}$$



(ii)

We know that

$$DN = AD - AN$$

Substituting the values

$$= 8 - 6$$

$$= 2 \text{ units}$$

In triangle CDN

Using Pythagoras theorem

$$CD^2 = DN^2 + NC^2$$

Substituting the values

$$10^2 = 6^2 + NC^2$$

By further calculation

$$NC^2 = 10^2 - 6^2$$

$$NC^2 = 100 - 36 = 64$$

So we get

$$NC = \sqrt{64} = 8 \text{ units}$$

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From the figure $NC = AB = 8$ units

We know that

Area of trapezium = $\frac{1}{2} \times \text{sum of parallel sides} \times \text{height}$

It can be written as

$$= \frac{1}{2} \times (BC + AD) \times AB$$

Substituting the values

$$= \frac{1}{2} \times (2 + 8) \times 8$$

By further calculation

$$= \frac{1}{2} \times 10 \times 8$$

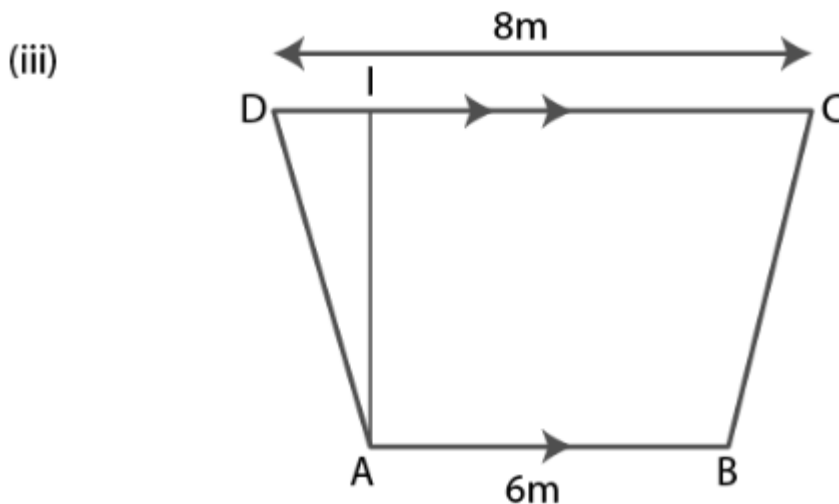
$$= 5 \times 8$$

$$= 40 \text{ sq. units}$$

(c) Consider ABCD as the cross section of canal in the shape of trapezium.

$AB = 6 \text{ m}$, $DC = 8 \text{ m}$

Take AL as the depth of canal



So the area of cross-section = 16.8 m^2

It can be written as

$$\frac{1}{2} \times \text{sum of parallel sides} \times \text{depth} = 16.8$$

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$$\frac{1}{2} \times (AB + DC) \times AL = 16.8$$

Substituting the values

$$\frac{1}{2} \times (6 + 8) \times AL = 16.8$$

By further calculation

$$\frac{1}{2} \times 14 \times AL = 16.8$$

$$AL = (16.8 \times 2) / 14$$

So we get

$$AL = (16.8 \times 1) / 7$$

$$AL = 2.4 \text{ m}$$

34. The distance between parallel sides of a trapezium is 12 cm and the distance between mid-points of other sides is 18 cm. Find the area of the trapezium.

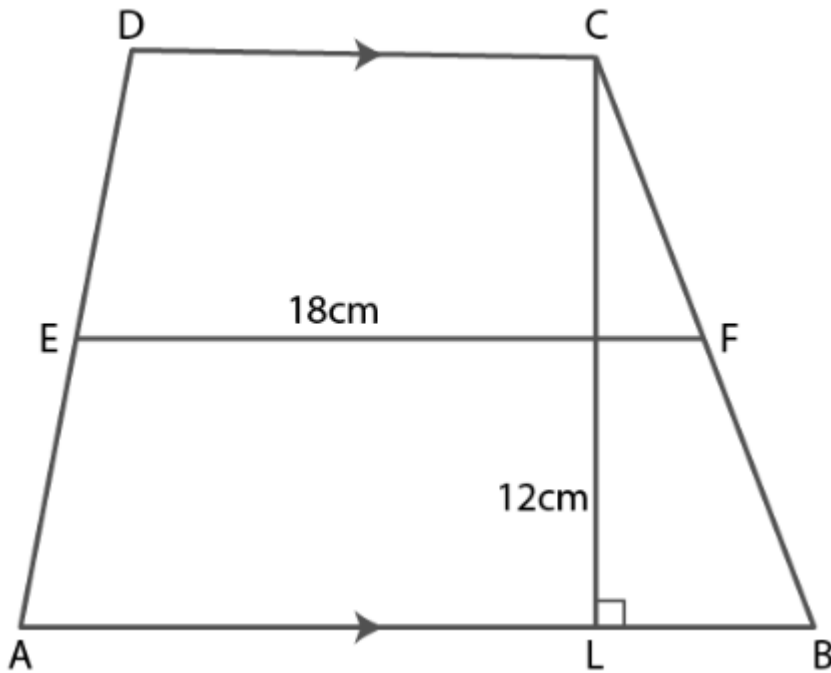
Solution:

Consider ABCD as a trapezium in which $AB \parallel DC$

Height $CL = 12 \text{ cm}$

E and F are the mid-points of sides AD and BC

$EF = 18 \text{ cm}$



We know that

$$EF = \frac{1}{2} (AB + DC) = 18 \text{ cm}$$

Here

$$\text{Area of trapezium } ABCD = \frac{1}{2} (AB + DC) \times \text{height}$$

Substituting the values

$$= 18 \times 12$$

$$= 216 \text{ cm}^2$$

35. The area of a trapezium is 540 cm^2 . If the ratio of parallel sides is 7: 5 and the distance between them is 18 cm, find the length of parallel sides.

Solution:

It is given that

$$\text{Area of trapezium} = 540 \text{ cm}^2$$

$$\text{Ratio of parallel sides} = 7: 5$$

Consider $7x \text{ cm}$ as one parallel side

$$\text{Other parallel side} = 5x \text{ cm}$$

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Distance between the parallel sides = height = 18 cm

We know that

Area of trapezium = $\frac{1}{2} \times \text{sum of parallel sides} \times \text{height}$

Substituting the values

$$540 = \frac{1}{2} \times (7x + 5x) \times 18$$

By further calculation

$$540 = \frac{1}{2} \times 12x \times 18$$

$$540 = 6x \times 18$$

$$540 = 108x$$

$$x = 540/108 = 5$$

Here

$$\text{First parallel side} = 7x = 7 \times 5 = 35 \text{ cm}$$

$$\text{Second parallel side} = 5x = 5 \times 5 = 25 \text{ cm}$$

36. The parallel sides of an isosceles trapezium are in the ratio 2: 3. If its height is 4 cm and area is 60 cm², find the perimeter.

Solution:

It is given that

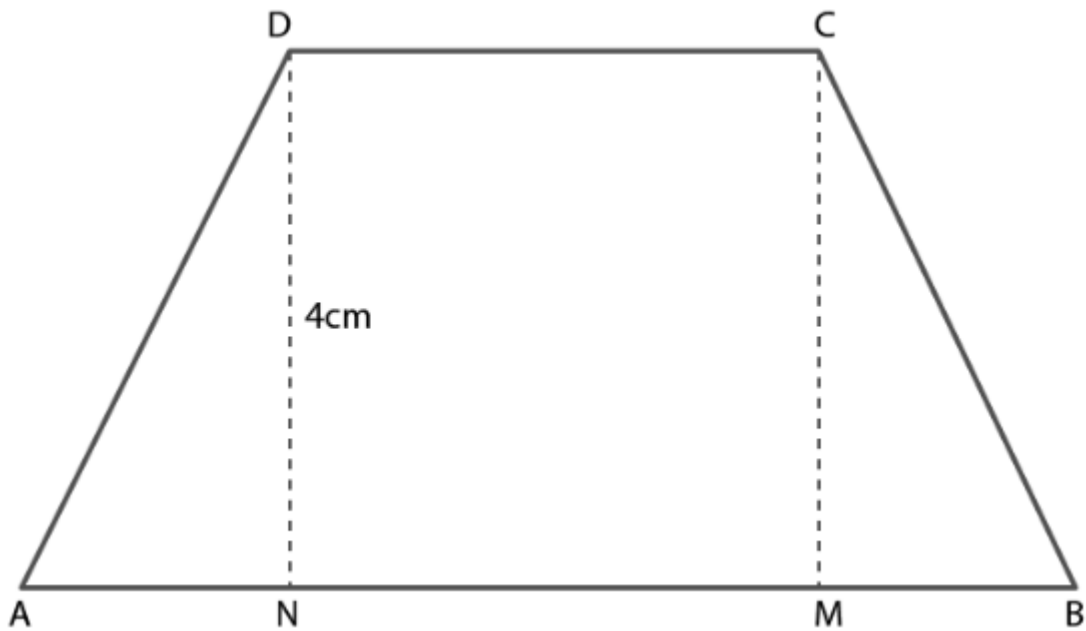
ABCD is an isosceles trapezium

$$BC = AD$$

$$\text{Height} = 4 \text{ cm}$$

$$\text{Consider } CD = 2x \text{ and } AB = 3x$$

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We know that

Area of trapezium = $\frac{1}{2}$ (sum of parallel sides) $\times$ height

Substituting the values

$$60 = \frac{1}{2} \times (2x + 3x) \times 4$$

By further calculation

$$60 = \frac{1}{2} \times 5x \times 4$$

$$60 = 5x \times 2$$

$$60 = 10x$$

So we get

$$x = 60/10 = 6$$

Here

$$CD = 2x = 2 \times 6 = 12 \text{ cm}$$

$$AB = 3x = 3 \times 6 = 18 \text{ cm}$$

$$AN = BM$$

We can write it as

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$$AN = AB - BN$$

$$AN = AB - (MN + BM)$$

We know that

$$MN = CD$$

$$AN = AB - (CD + BM)$$

$$\text{Similarly } BM = AN$$

$$AN = AB - (CD + AN)$$

Substituting the values

$$AN = 18 - (12 + AN)$$

$$AN = 18 - 12 - AN$$

$$AN + AN = 6$$

$$2AN = 6$$

By division

$$AN = 6/2 = 3$$

In triangle AND

Using Pythagoras theorem

$$AD^2 = DN^2 + AN^2$$

$$\text{Here } DN = 4 \text{ cm}$$

$$AD^2 = 4^2 + 3^2$$

By further calculation

$$AD^2 = 16 + 9 = 25$$

So we get

$$AD = \sqrt{25} = 5 \text{ cm}$$

$$\text{Here } AD = BC = 5 \text{ cm}$$

$$\text{Perimeter of trapezium} = AB + BC + CD + AD$$

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Substituting the values

$$= 18 + 5 + 12 + 5$$

$$= 40 \text{ cm}$$

37. The area of a parallelogram is 98 cm^2 . If one altitude is half the corresponding base, determine the base and the altitude of the parallelogram.

Solution:

It is given that

$$\text{Area of parallelogram} = 98 \text{ cm}^2$$

Condition – If one altitude is half the corresponding base

$$\text{Take base} = x \text{ cm}$$

$$\text{Corresponding altitude} = x/2 \text{ cm}$$

We know that

$$\text{Area of parallelogram} = \text{base} \times \text{altitude}$$

Substituting the values

$$98 = x \times x/2$$

$$98 = x^2/2$$

By cross multiplication

$$x^2 = 98 \times 2 = 196$$

So we get

$$x = \sqrt{196} = 14 \text{ cm}$$

$$\text{Base} = 14 \text{ cm}$$

$$\text{Here altitude} = 14/2 = 7 \text{ cm}$$

38. The length of a rectangular garden is 12 m more than its breadth. The numerical value of its area is equal to 4 times the numerical value of its perimeter. Find the dimensions of the garden.

Solution:

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The dimensions of rectangular garden are

$$\text{Breadth} = x \text{ m}$$

$$\text{Length} = (x + 12) \text{ m}$$

We know that

$$\text{Area} = l \times b$$

Substituting the values

$$\text{Area} = (x + 12) \times x$$

$$\text{Area} = (x^2 + 12x) \text{ m}^2$$

$$\text{Perimeter} = 2(l + b)$$

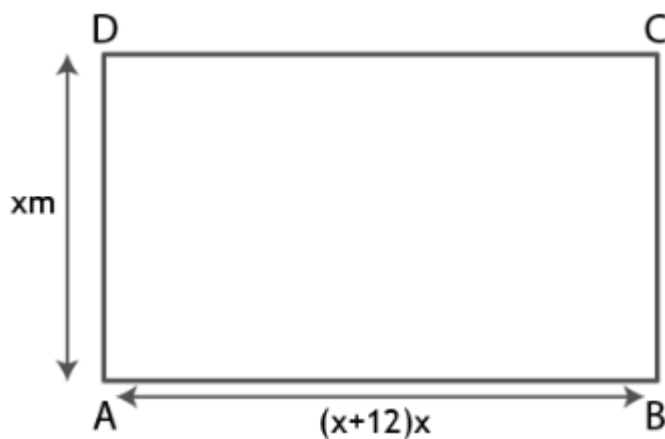
Substituting the values

$$= 2[(x + 12) + x]$$

$$= 2[x + 12 + x]$$

$$= 2[2x + 12]$$

$$= (4x + 24) \text{ m}$$



Based on the question

$$\text{Numerical value of area} = 4 \times \text{numerical value of perimeter}$$

$$x^2 + 12x = 4 \times (4x + 24)$$

By further calculation

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$$x^2 + 12x = 16x + 96$$

$$x^2 + 12x - 16x - 96 = 0$$

$$x^2 - 4x - 96 = 0$$

It can be written as

$$x^2 - 12x + 8x - 96 = 0$$

Taking out the common terms

$$x(x - 12) + 8(x - 12) = 0$$

$$(x + 8)(x - 12) = 0$$

Here

$$x + 8 = 0 \text{ or } x - 12 = 0$$

So we get

$$x = -8 \text{ (not possible) or } x = 12$$

Breadth of rectangular garden = 12 m

Length of rectangular garden = $12 + 12 = 24$ m

39. If the perimeter of a rectangular plot is 68 m and length of its diagonal is 26 m, find its area.

Solution:

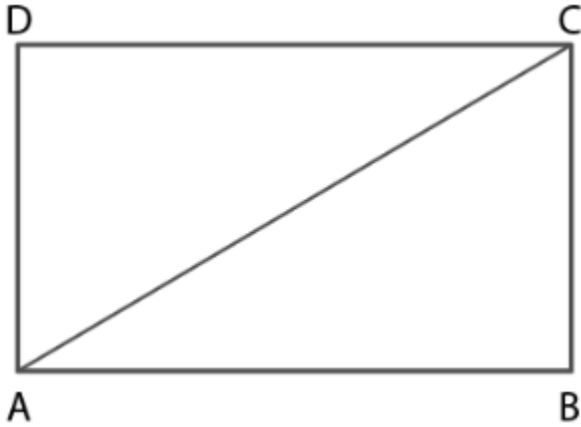
It is given that

Perimeter of a rectangular plot = 68 m

Length of its diagonal = 26 m

ABCD is a rectangular plot of length x m and breath y m

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Perimeter = 2 (length + breadth)

Substituting the values

$$68 = 2 (x + y)$$

By further calculation

$$68/2 = x + y$$

$$34 = x + y$$

So we get

$$x = 34 - y \dots\dots (1)$$

In triangle ABC

Using Pythagoras theorem

$$AC^2 = AB^2 + BC^2$$

Substituting the values

$$26^2 = x^2 + y^2$$

$$x^2 + y^2 = 676$$

Now substituting the value of x in equation (1)

$$(34 - y)^2 + y^2 = 676$$

$$1156 + y^2 - 68y + y^2 = 676$$

By further calculation

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$$2y^2 - 68y + 1156 - 676 = 0$$

$$2y^2 - 68y - 480 = 0$$

Taking 2 as common

$$2(y^2 - 34y - 240) = 0$$

$$y^2 - 34y - 240 = 0$$

It can be written as

$$y^2 - 24y - 10y - 240 = 0$$

Taking out the common terms

$$y(y - 24) - 10(y - 24) = 0$$

$$(y - 10)(y - 24) = 0$$

Here

$$y - 10 = 0 \text{ or } y - 24 = 0$$

$$y = 10 \text{ m or } y = 24 \text{ m}$$

Now substituting the value of y in equation (1)

$$y = 10 \text{ m, } x = 34 - 10 = 24 \text{ m}$$

$$y = 24 \text{ m, } x = 34 - 24 = 10 \text{ m}$$

Area in both cases = xy

$$= 24 \times 10 \text{ or } 10 \times 24$$

$$= 240 \text{ m}^2$$

Therefore, the area of the rectangular block is 240 m^2 .

40. A rectangle has twice the area of a square. The length of the rectangle is 12 cm greater and the width is 8 cm greater than 2 side of a square. Find the perimeter of the square.

Solution:

Consider

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Side of a square = x cm

Length of rectangle = $(x + 12)$ cm

Breadth of rectangle = $(x + 8)$ cm

We know that

Area of square = side $\times$ side = $x \times x = x^2$ cm²

Area of rectangle = $l \times b$

Substituting the values

$$= (x + 12)(x + 8) \text{ cm}^2$$

Based on the question

Area of rectangle = $2 \times$ area of square

Substituting the values

$$(x + 12)(x + 8) = 2 \times x^2$$

It can be written as

$$x(x + 8) + 12(x + 8) = 2x^2$$

$$x^2 + 8x + 12x + 96 = 2x^2$$

$$x^2 - 2x^2 + 8x + 12x + 96 = 0$$

By further calculation

$$-x^2 + 20x + 96 = 0$$

$$-(x^2 - 20x - 96) = 0$$

$$x^2 - 20x - 96 = 0$$

We can write it as

$$x^2 - 24x + 4x - 96 = 0$$

$$x(x - 24) + 4(x - 24) = 0$$

$$(x + 4)(x - 24) = 0$$

Here

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$$x + 4 = 0 \text{ or } x - 24 = 0$$

$$x = -4 \text{ or } x = 24 \text{ cm}$$

$$\text{Side of square} = 24 \text{ cm}$$

$$\text{Perimeter of square} = 4 \times \text{side}$$

Substituting the values

$$= 4 \times 24$$

$$= 96 \text{ cm}$$

41. The perimeter of a square is 48 cm. The area of a rectangle is 4 cm^2 less than the area of the square. If the length of the rectangle is 4 cm greater than its breadth, find the perimeter of the rectangle.

Solution:

It is given that

$$\text{Perimeter of a square} = 48 \text{ cm}$$

$$\text{Side} = \text{perimeter}/4 = 48/4 = 12 \text{ cm}$$

We know that

$$\text{Area} = \text{side}^2 = 12^2 = 144 \text{ cm}^2$$

$$\text{Area of rectangle} = 144 - 4 = 140 \text{ cm}^2$$

$$\text{Take breadth of rectangle} = x \text{ cm}$$

$$\text{Length of rectangle} = x + 4 \text{ cm}$$

$$\text{So the area} = (x + 4) \times x \text{ cm}^2$$

Substituting the values

$$(x + 4) \times x = 140$$

By further calculation

$$x^2 + 4x - 140 = 0$$

$$x^2 + 14x - 10x - 140 = 0$$

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Taking out the common terms

$$x(x + 14) - 10(x + 14) = 0$$

$$(x + 14)(x - 10) = 0$$

Here

$$x + 14 = 0 \text{ where } x = -14$$

$$x - 10 = 0 \text{ where } x = 10$$

$$\text{Breadth} = 10 \text{ cm}$$

$$\text{Length} = 10 + 4 = 14 \text{ cm}$$

$$\text{Perimeter} = 2(l + b)$$

Substituting the values

$$= 2(14 + 10)$$

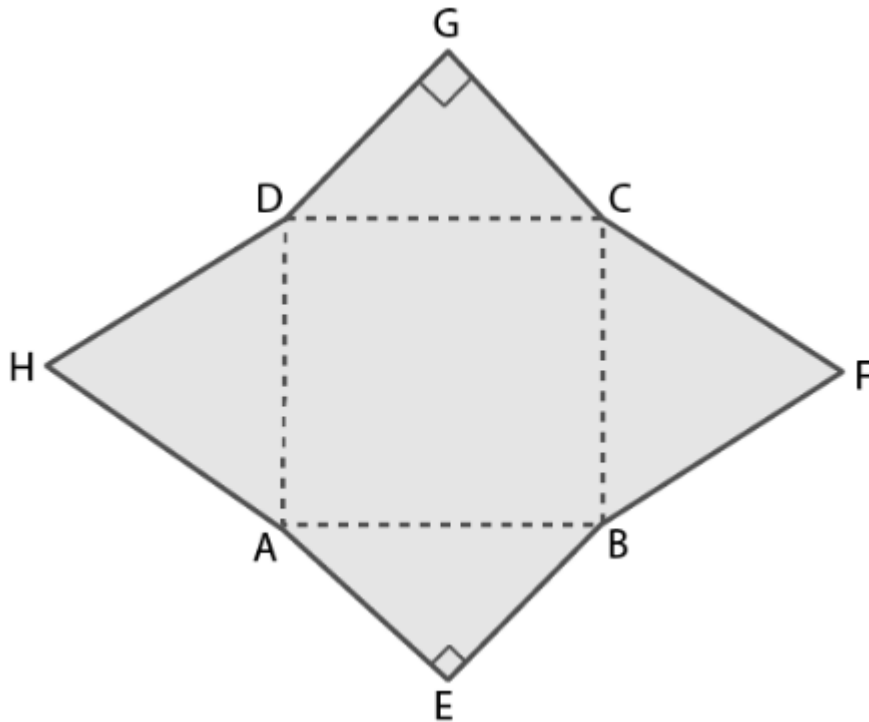
$$= 2 \times 24$$

$$= 48 \text{ cm}$$

42. In the adjoining figure, ABCD is a rectangle with sides AB = 10 cm and BC = 8 cm. HAD and BFC are equilateral triangle; AEB and DCG are right angled isosceles triangles. Find the area of the shaded region and the perimeter of the figure.

Solution:

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It is given that

ABCD is a rectangle with sides $AB = 10$ cm and $BC = 8$ cm

HAD and BFC are equilateral triangle with each side = 8 cm

AEB and DCG are right angled isosceles triangles with hypotenuse = 10 cm

Consider $AE = EB = x$ cm

In triangle ABE

$$AE^2 + EB^2 = AB^2$$

Substituting the values

$$x^2 + x^2 = 10^2$$

$$2x^2 = 100$$

By further calculation

$$x^2 = 100/2 = 50$$

$$x = \sqrt{50} = \sqrt{(25 \times 2)} = 5\sqrt{2} \text{ cm}$$

We know that

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Area of triangle AEB = Area of triangle GCD

It can be written as

$$= \frac{1}{2} \times x \times x$$

$$= \frac{1}{2} x^2 \text{ cm}^2$$

Substituting the value of x

$$= \frac{1}{2} \times 50$$

$$= 25 \text{ cm}^2$$

Area of triangle HAD = Area of BFC

It can be written as

$$= \frac{\sqrt{3}}{4} \times 8^2$$

$$= \frac{\sqrt{3}}{4} \times 64$$

$$= 16\sqrt{3} \text{ cm}^2$$

Area of shaded portion = Area of rectangle ABCD + 2 area of triangle AEB + 2 area of triangle BFC

Substituting the values

$$= (10 \times 8 + 2 \times 25 + 2 \times 16\sqrt{3})$$

By further calculation

$$= 80 + 50 + 32\sqrt{3}$$

So we get

$$= (130 + 32\sqrt{3}) \text{ cm}^2$$

Here

Perimeter of the figure = AE + EB + BF + FC + CD + GD + DH + HA

It can be written as

$$= 4AE + 4BF$$

Substituting the values

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$$= 4 \times 5\sqrt{2} + 4 \times 8$$

So we get

$$= 20\sqrt{2} + 32$$

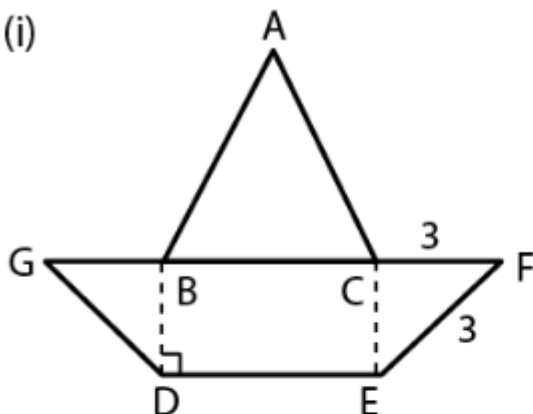
$$= (32 + 20\sqrt{2}) \text{ cm}$$

43. (a) Find the area enclosed by the figure (i) given below, where ABC is an equilateral triangle and DEFG is an isosceles trapezium. All measurements are in centimetres.

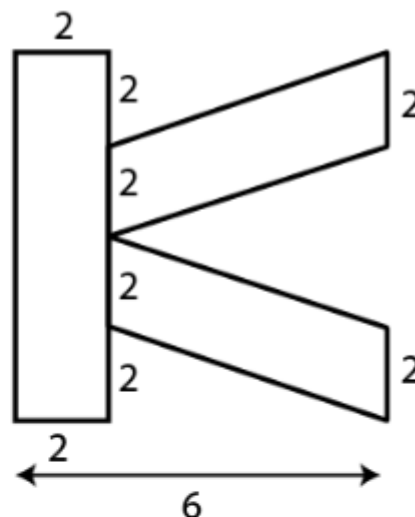
(b) Find the area enclosed by the figure (ii) given below. All measurements are in centimetres.

(c) In the figure (iii) given below, from a 24 cm × 24 cm piece of cardboard, a block in the shape of letter M is cut off. Find the area of the cardboard left over, all measurements are in centimetres.

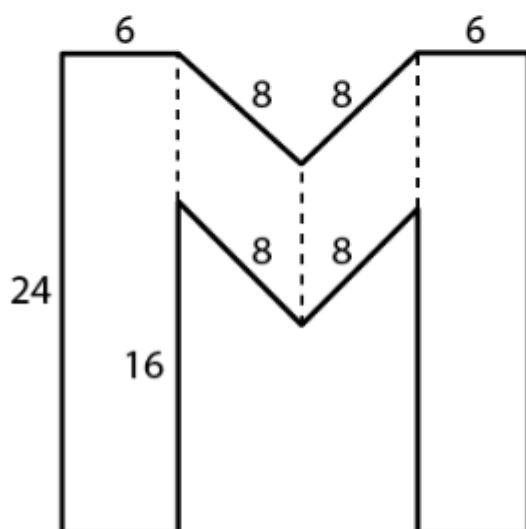
(i)



(ii)



(iii)



Solution:

(a) It is given that

ABC is an equilateral triangle and DEFG is an isosceles trapezium

$$EF = GD = 5 \text{ cm}$$

$$DE = 6 \text{ cm}$$

$$GF = GB + BC + CF$$

Substituting the values

$$= 3 + 6 + 3$$

$$= 12 \text{ cm}$$

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$$AB = AC = BC = 6 \text{ cm}$$

Join BD and CE

In right triangle CEF

$$CE^2 = EF^2 - CF^2$$

Substituting the values

$$= 5^2 - 3^2$$

$$= 25 - 9$$

$$= 16$$

So we get

$$CE = \sqrt{16} = 4 \text{ cm}$$

$$\text{Area of triangle ABC} = \frac{\sqrt{3}}{4} \times 6^2$$

By further calculation

$$= \frac{\sqrt{3}}{4} \times 36$$

$$= 9\sqrt{3} \text{ cm}^2$$

$$\text{Area of trapezium DEFG} = \frac{1}{2} (DE + GF) \times CE$$

Substituting the values

$$= \frac{1}{2} \times (6 + 12) \times 4$$

By further calculation

$$= \frac{1}{2} \times 18 \times 4$$

$$= 36 \text{ cm}^2$$

$$\text{So the area of figure} = 9\sqrt{3} + 36$$

Substituting the values

$$= 9 \times 1.732 + 36$$

$$= 15.59 + 36$$

$$= 51.59 \text{ cm}^2$$

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(b) We know that

Length of rectangle = $2 + 2 + 2 + 2 = 8$ cm

Width of rectangle = 2 cm

Area of rectangle = $l \times b$

Substituting the values

$$= 8 \times 2$$

$$= 16 \text{ cm}^2$$

Here

Area of each trap = $\frac{1}{2} (2 + 2) \times (6 - 2)$

By further calculation

$$= \frac{1}{2} \times 4 \times 4$$

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

So the total area = area of rectangle + area of 2 trapezium

Substituting the values

$$= 16 + 8 + 8$$

$$= 32 \text{ cm}^2$$

(c) We know that

Length of each rectangle = 24 cm

Width of each rectangle = 6 cm

Area of each rectangle = $l \times b$

Substituting the values

$$= 24 \times 6$$

$$= 144 \text{ cm}^2$$

Base of each parallelogram = 8 cm

Height of each parallelogram = 6 cm

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So the area of each parallelogram = $8 \times 6 = 48 \text{ cm}^2$

Here

Area of the M-shaped figure = $2 \times 144 + 2 \times 48$

So we get

$$= 288 + 96$$

$$= 384 \text{ cm}^2$$

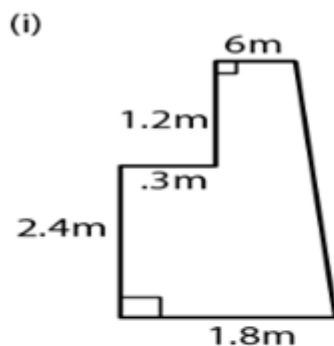
Area of the square cardboard = $24 \times 24 = 576 \text{ cm}^2$

Area of the removing cardboard = $576 - 384 = 192 \text{ cm}^2$

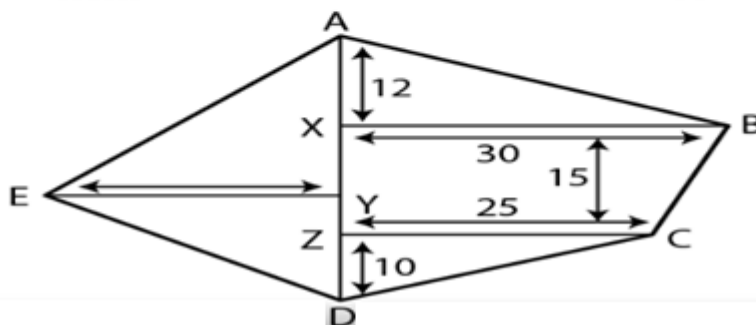
44. (a) The figure (i) given below shows the cross-section of the concrete structure with the measurements as given. Calculate the area of cross-section.

(b) The figure (ii) given below shows a field with the measurements given in metres. Find the area of the field.

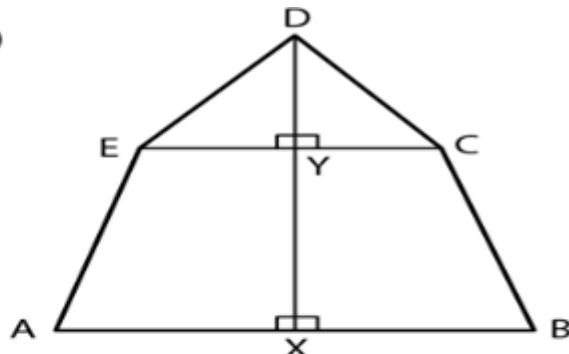
(c) Calculate the area of the pentagon ABCDE shown in fig (iii) below, given that $AX = BX = 6 \text{ cm}$, $EY = CY = 4 \text{ cm}$, $DE = DC = 5 \text{ cm}$, $DX = 9 \text{ cm}$ and DX is perpendicular to EC and AB .



(ii)



(iii)



Solution:

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(a) From the figure (i)

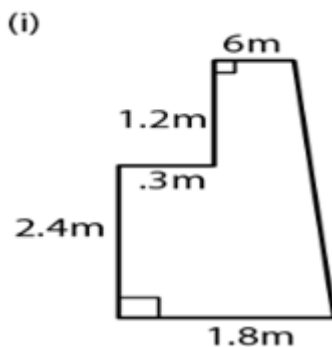
$AB = 1.8 \text{ m}$, $CD = 0.6 \text{ m}$, $DE = 1.2 \text{ m}$

$EF = 0.3 \text{ m}$, $AF = 2.4 \text{ m}$

Construct DE to meet AB in G

$\angle FEG = \angle GAF = 90^\circ$

So, $AGEF$ is a rectangle



We know that

Area of given figure = Area of rectangle $AGEF$ + Area of trapezium $GBCD$

It can be written as

$$= l \times b + \frac{1}{2} (\text{sum of parallel sides} \times \text{height})$$

$$= AF \times AG + \frac{1}{2} (GB + CD) \times DG$$

Substituting the values

$$= 2.4 \times 0.3 + \frac{1}{2} [(AB - AG) + CD] \times (DE + EG)$$

Here $AG = FE$ and using $EG = AF$

$$= 0.72 + \frac{1}{2} [(1.8 - 0.3) + 0.6] \times (1.2 + 2.4)$$

By further calculation

$$= 0.72 + \frac{1}{2} [1.5 + 0.6] \times 3.6$$

$$= 0.72 + \frac{1}{2} \times 2.1 \times 3.6$$

So we get

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$$= 0.72 + 2.1 \times 1.8$$

$$= 0.72 + 3.78$$

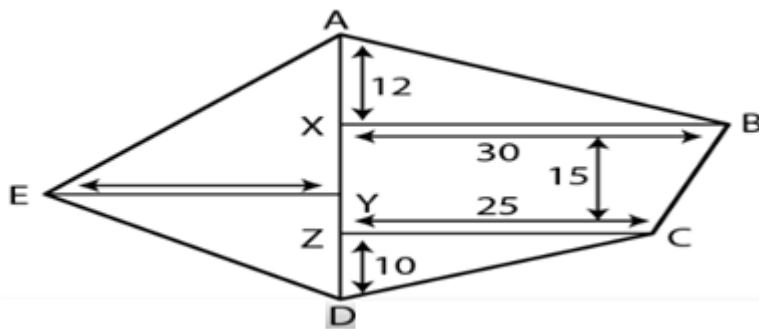
$$= 4.5 \text{ m}^2$$

(b) It is given that

ABCD is a pentagonal field

AX = 12 m, BX = 30 m, XZ = 15 m, CZ = 25 m,

DZ = 10 m, AD = 12 + 15 + 10 = 37 m, EY = 20 m



We know that

Area of pentagonal field ABCDE = Area of triangle ABX + Area of trapezium BCZY + Area of triangle CDZ + Area of triangle AED

It can be written as

$$= \frac{1}{2} \times \text{base} \times \text{height} + \frac{1}{2} (\text{sum of parallel sides}) \times \text{height} + \frac{1}{2} \times \text{base} \times \text{height} + \frac{1}{2} \times \text{base} \times \text{height}$$

$$= \frac{1}{2} \times BX \times AX + \frac{1}{2} (BX + CZ) \times XZ + \frac{1}{2} \times CZ \times DZ + \frac{1}{2} \times AD \times EY$$

Substituting the values

$$= \frac{1}{2} \times 30 \times 12 + \frac{1}{2} (30 + 25) \times 15 + \frac{1}{2} \times 25 \times 10 + \frac{1}{2} \times 37 \times 20$$

By further calculation

$$= 15 \times 12 + 7.5 \times 55 + 25 \times 5 + 37 \times 10$$

So we get

$$= 180 + 412.5 + 125 + 370$$

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$$= 1087.5 \text{ m}^2$$

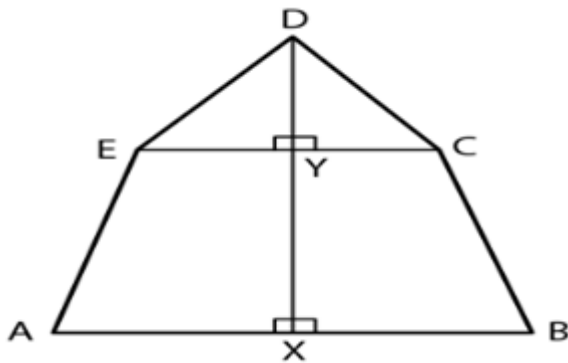
(c) It is given that

ABCDE is a pentagon

$$AX = BX = 6 \text{ cm}, EY = CY = 4 \text{ cm}$$

$$DE = DC = 5 \text{ cm}, DX = 9 \text{ cm}$$

Construct DX perpendicular to EC and AB



In triangle DEY

Using Pythagoras Theorem

$$DE^2 = DY^2 + EY^2$$

Substituting the values

$$5^2 = DY^2 + 4^2$$

$$25 = DY^2 + 16$$

$$DY^2 = 25 - 16 = 9$$

So we get

$$DY = \sqrt{9} = 3 \text{ cm}$$

Here

Area of pentagonal field ABCDE = Area of triangle DEY + Area of triangle DCY + Area of trapezium EYXA + Area of trapezium CYXB

It can be written as

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$$= \frac{1}{2} \times \text{base} \times \text{height} + \frac{1}{2} \times \text{base} \times \text{height} + \frac{1}{2} \times (\text{sum of parallel sides}) \times \text{height} + \frac{1}{2} \times (\text{sum of parallel sides}) \times \text{height}$$

$$= \frac{1}{2} \times EY \times DY + \frac{1}{2} \times CY \times DY + \frac{1}{2} \times (EY + AX) \times XY + \frac{1}{2} \times (CY + BX) \times XY$$

Substituting the values

$$= \frac{1}{2} \times 4 \times 3 + \frac{1}{2} \times 4 \times 3 + \frac{1}{2} \times (4 + 6) \times (DX - DY) + \frac{1}{2} \times (4 + 6) \times (DX - DY)$$

By further calculation

$$= 2 \times 3 + 2 \times 2 + \frac{1}{2} \times 10 \times (9 - 3) + \frac{1}{2} \times 10 \times (9 - 3)$$

So we get

$$= 6 + 6 + 5 \times 6 + 5 \times 6$$

$$= 6 + 6 + 30 + 30$$

$$= 72 \text{ cm}^2$$

45. If the length and the breadth of a room are increased by 1 metre the area is increased by 21 square metres. If the length is increased by 1 metre and breadth is decreased by 1 metre the area is decreased by 5 square metres. Find the perimeter of the room.

Solution:

Take length of room = x m

Breadth of room = y m

Here

Area of room = l × b = xy m²

We know that

Length is increased by 1 m then new length = (x + 1) m

Breadth is increased by 1 m then new breadth = (y + 1) m

So the new area = new length × new breadth

Substituting the values

$$= (x + 1)(y + 1) \text{ m}^2$$

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Based on the question

$$xy = (x + 1)(y + 1) - 21$$

By further calculation

$$xy = x(y + 1) + 1(y + 1) - 21$$

$$xy = xy + x + y + 1 - 21$$

So we get

$$0 = x + y + 1 - 21$$

$$0 = x + y - 20$$

$$x + y - 20 = 0$$

$$x + y = 20 \dots\dots (1)$$

Similarly

Length is increased by 1 metre then new length = $(x + 1)$ metre

Breadth is decreased by 1 metre then new breadth = $(y - 1)$ metre

So the new area = new length $\times$ new breadth

$$= (x + 1)(y - 1) \text{ m}^2$$

Based on the question

$$xy = (x + 1)(y - 1) + 5$$

By further calculation

$$xy = x(y - 1) + 1(y - 1) + 5$$

$$xy = xy - x + y - 1 + 5$$

$$0 = -x + y + 4$$

So we get

$$x - y = 4 \dots\dots (2)$$

By adding equations (1) and (2)

$$2x = 24$$

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$$x = 24/2 = 12 \text{ m}$$

Now substituting the value of x in equation (1)

$$12 + y = 20$$

$$y = 20 - 12 = 8 \text{ m}$$

Here

Length of room = 12 m

Breadth of room = 8 m

So the perimeter = $2(l + b)$

Substituting the values

$$= 2(12 + 8)$$

$$= 2 \times 20$$

$$= 40 \text{ m}$$

46. A triangle and a parallelogram have the same base and same area. If the sides of the triangle are 26 cm, 28 cm and 30 cm and the parallelogram stands on the base 28 cm, find the height of the parallelogram.

Solution:

It is given that

Sides of a triangle = 26 cm, 28 cm and 30 cm

We know that

$$s = (a + b + c)/2$$

Substituting the values

$$s = (26 + 28 + 30)/2$$

$$s = 84/2$$

$$s = 42 \text{ cm}$$

Here

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$$\text{Area of } \Delta = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{42(42-26)(42-28)(42-30)}$$

By further calculation

$$= \sqrt{42 \times 16 \times 14 \times 12}$$

$$= \sqrt{7 \times 6 \times 4 \times 4 \times 7 \times 2 \times 6 \times 2}$$

So we get

$$= 2 \times 4 \times 6 \times 7$$

$$= 336 \text{ cm}^2$$

We know that

$$\text{Base} = 28 \text{ cm}$$

$$\text{Height} = \text{Area}/\text{base}$$

Substituting the values

$$= 336/28$$

$$= 12 \text{ cm}$$

47. A rectangle of area 105 cm^2 has its length equal to $x \text{ cm}$. Write down its breadth in terms of x . Given that its perimeter is 44 cm , write down an equation in x and solve it to determine the dimensions of the rectangle.

Solution:

It is given that

$$\text{Area of rectangle} = 105 \text{ cm}^2$$

$$\text{Length of rectangle} = x \text{ cm}$$

We know that

$$\text{Area} = \text{length} \times \text{breadth}$$

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Substituting the values

$$105 = x \times \text{breadth}$$

$$x = 105 / x \text{ cm}$$

Perimeter of rectangle = 44 cm

So we get

$$2(l + b) = 44$$

$$2(x + 105/x) = 44$$

By further calculation

$$(x^2 + 105)/x = 22$$

By cross multiplication

$$x^2 + 105 = 22x$$

$$x^2 - 22x + 105 = 0$$

We can write it as

$$x^2 - 15x - 7x + 105 = 0$$

$$x(x - 15) - 7(x - 15) = 0$$

$$(x - 7)(x - 15) = 0$$

Here

$$x - 7 = 0 \text{ or } x - 15 = 0$$

$$x = 7 \text{ cm or } x = 15 \text{ cm}$$

If $x = 7$ cm,

$$\text{Breadth} = 105/7 = 15 \text{ cm}$$

If $x = 15$ cm,

$$\text{Breadth} = 105/15 = 7 \text{ cm}$$

Therefore, the required dimensions of rectangle are 15 cm and 7 cm.

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48. The perimeter of a rectangular plot is 180 m and its area is 1800 m^2 . Take the length of plot as x m. Use the perimeter 180 m to write the value of the breadth in terms of x . Use the value of the length, breadth and the area to write an equation in x . Solve the equation to calculate the length and breadth of the plot.

Solution:

It is given that

Perimeter of a rectangular plot = 180 m

Area of a rectangular plot = 1800 m^2

Take length of rectangle = x m

Here

Perimeter = 2 (length + breadth)

Substituting the values

$$180 = 2 (x + \text{breadth})$$

$$180/2 = x + \text{breadth}$$

$$x + \text{breadth} = 90$$

$$\text{Breadth} = 90 - x \text{ m}$$

We know that

Area of rectangle = $l \times b$

Substituting the values

$$1800 = x \times (90 - x)$$

$$90x - x^2 = 1800$$

It can be written as

$$-(x^2 - 90x) = 1800$$

$$x^2 - 90x = -1800$$

By further calculation

$$x^2 - 90x + 1800 = 0$$

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$$x^2 - 60x - 30x + 1800 = 0$$

$$x(x - 60) - 30(x - 60) = 0$$

$$(x - 30)(x - 60) = 0$$

Here

$$x - 30 = 0 \text{ or } x - 60 = 0$$

$$x = 30 \text{ or } x = 60$$

If $x = 30$ m

$$\text{Breadth} = 90 - 30 = 60 \text{ m}$$

If $x = 60$ m

$$\text{Breadth} = 90 - 60 = 30 \text{ m}$$

Therefore, the required length of rectangle is 60 m and the breadth of rectangle is 30 m.

Exercise 16.3

1. Find the length of the diameter of a circle whose circumference is 44 cm.

Solution:

Consider radius of the circle = r cm

$$\text{Circumference} = 2\pi r$$

We know that

$$2\pi r = 44$$

So we get

$$(2 \times 22) / 7 r = 44$$

By further calculation

$$r = (44 \times 7) / (2 \times 22) = 7 \text{ cm}$$

$$\text{Diameter} = 2r = 2 \times 7 = 14 \text{ cm}$$

2. Find the radius and area of a circle if its circumference is 18π cm.

Solution:

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Consider the radius of the circle = r

Circumference = $2 \pi r$

We know that

$$2 \pi r = 18\pi$$

So we get

$$2r = 18$$

$$r = 18/2 = 9 \text{ cm}$$

Here

$$\text{Area} = \pi r^2$$

Substituting the value of r

$$= \pi \times 9 \times 9$$

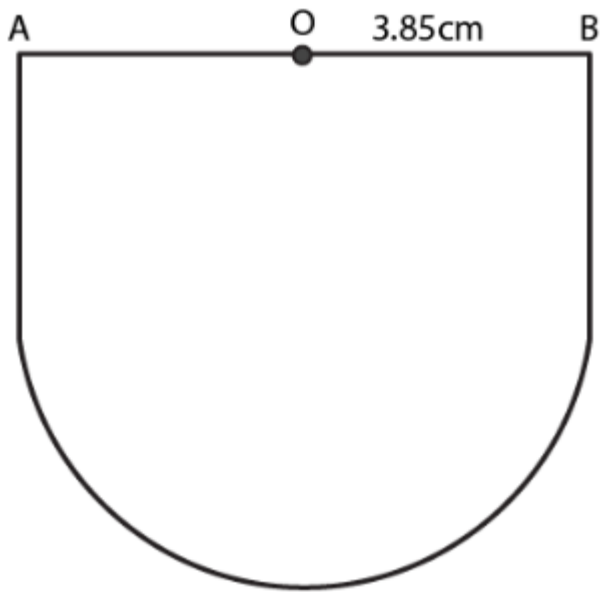
$$= 81\pi \text{ cm}^2$$

3. Find the perimeter of a semicircular plate of radius 3.85 cm.

Solution:

It is given that

Radius of semicircular plate = 3.85 cm



We know that

Length of semicircular plat = πr

Perimeter = $\pi r + 2r = r(\pi + 2)$

Substituting the values

$$= 3.85 (22/7 + 2)$$

By further calculation

$$= 3.85 \times 36/7$$

$$= 0.55 \times 36$$

$$= 19.8 \text{ cm}$$

4. Find the radius and circumference of a circle whose area is $144 \pi \text{ cm}^2$.

Solution:

It is given that

Area of a circle = $144 \pi \text{ cm}^2$

Consider radius = r

$$\pi r^2 = 144 \pi$$

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$$r^2 = 144$$

So we get

$$r = \sqrt{144} = 12 \text{ cm}$$

Here

$$\text{Circumference} = 2 \pi r$$

So we get

$$= 2 \times 12 \times \pi$$

$$= 24\pi \text{ cm}$$

5. A sheet is 11 cm long and 2 cm wide. Circular pieces 0.5 cm in diameter are cut from it to prepare discs. Calculate the number of discs that can be prepared.

Solution:

It is given that

Length of sheet = 11 cm

Width of sheet = 2 cm

We have to cut the sheet to a square of side 0.5 cm

Here

$$\text{Number of squares} = 11/0.5 \times 2/0.5$$

Multiply and divide by 10

$$= (11 \times 10)/5 \times (2 \times 10)/5$$

By further calculation

$$= 22 \times 4$$

$$= 88$$

Hence, the number of discs will be equal to number of squares cut out = 88.

6. If the area of a semicircular region is 77 cm^2 , find its perimeter.

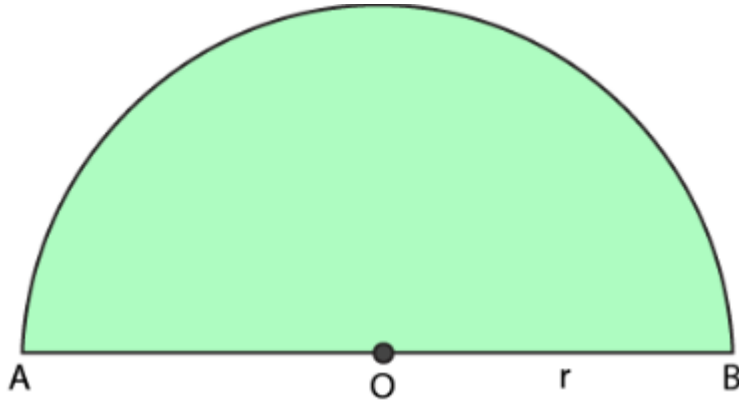
Solution:

<https://www.indcareer.com/schools/ml-aggarwal-solutions-for-class-9-maths-chapter-16-men-suration/>

It is given that

Area of a semicircular region = 77 cm^2

Consider r as the radius of the region



We know that

$$\text{Area} = \frac{1}{2} \pi r^2$$

$$\frac{1}{2} \pi r^2 = 77$$

By further calculation

$$\frac{1}{2} \times \frac{22}{7} r^2 = 77$$

So we get

$$r^2 = (77 \times 2 \times 7) / 22 = 49 = 7^2$$

$$r = 7 \text{ cm}$$

Here

$$\text{Perimeter of the region} = \pi r + 2r$$

By further calculation

$$= \frac{22}{7} \times 7 + 2 \times 7$$

So we get

$$= 22 + 14$$

$$= 36 \text{ cm}$$

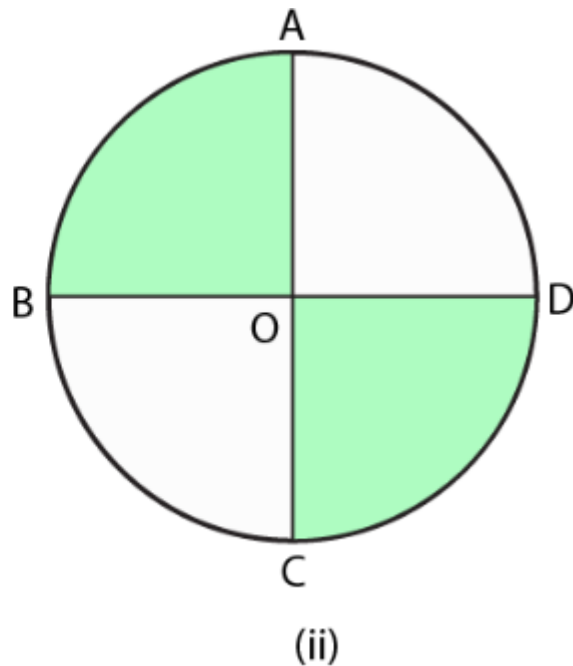
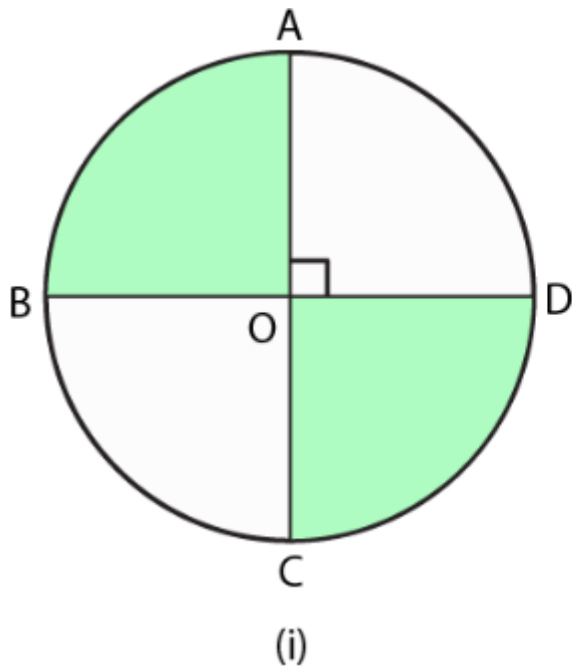
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7. (a) In the figure (i) given below, AC and BD are two perpendicular diameters of a circle ABCD. Given that the area of shaded portion is 308 cm^2 , calculate

(i) the length of AC and

(ii) the circumference of the circle

(b) In the figure (ii) given below, AC and BD are two perpendicular diameters of a circle with centre O. If AC = 16 cm, calculate the area and perimeter of the shaded part. (Take $\pi = 3.14$)



Solution:

(a) It is given that

Area of shaded portion = Area of semicircle = 308 cm^2

Consider r as the radius of circle

$$\frac{1}{2} \pi r^2 = 308$$

By further calculation

$$\frac{1}{2} \times \frac{22}{7} r^2 = 308$$

$$r^2 = (308 \times 2 \times 7) / 22$$

$$r^2 = 196 = 14^2$$

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So $r = 14$ cm

(i) $AC = 2r = 2 \times 14 = 28$ cm

(ii) We know that

Circumference of the circle $= 2\pi r$

Substituting the values

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

So we get

$$= 4 \times 22$$

$$= 88 \text{ cm}$$

(b) We know that

Diameter of circle $= 16$ cm

Radius of circle $= 16/2 = 8$ cm

Here

Area of shaded part $= 2 \times$ area of one quadrant

So we get

$$= \frac{1}{2} \pi r^2$$

Substituting the values

$$= \frac{1}{2} \times 3.14 \times 8 \times 8$$

$$= 100.48 \text{ cm}^2$$

We know that

Perimeter of shaded part $= \frac{1}{2}$ of circumference $+ 4r$

It can be written as

$$= \frac{1}{2} \times 2\pi r + 4r$$

$$= \pi r + 4r$$

Taking r as common

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$$= r (\pi + 4)$$

Substituting the values

$$= 8 (3.14 + 4)$$

$$= 8 \times 7.14$$

$$= 57.12 \text{ cm}$$

8. A bucket is raised from a well by means of a rope which is wound round a wheel of diameter 77 cm. Given that the bucket ascends in 1 minute 28 seconds with a uniform speed of 1.1 m/sec, calculate the number of complete revolutions the wheel makes in raising the bucket.

Solution:

It is given that

Diameter of wheel = 77 cm

So radius of wheel = $77/2$ cm

We know that

Circumference of wheel = $2\pi r$

Substituting the values

$$= 2 \times 22/7 \times 77/2$$

$$= 242 \text{ cm}$$

9. The wheel of a cart is making 5 revolutions per second. If the diameter of the wheel is 84 cm, find its speed in km/hr. Give your answer correct to the nearest km.

Solution:

It is given that

Diameter of wheel = 84 cm

Radius of wheel = $84/2 = 42$ cm

Here

Circumference of wheel = $2\pi r$

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Substituting the values

$$= 2 \times 22/7 \times 42$$

$$= 264 \text{ cm}$$

So the distance covered in 5 reductions = $264 \times 5 = 1320 \text{ cm}$

Time = 1 second

We know that

$$\text{Speed of wheel} = 1320/1 \times (60 \times 60) / (100 \times 1000)$$

$$= 47.25 \text{ km/hr}$$

$$= 48 \text{ km/hr}$$

10. The circumference of a circle is 123.2 cm. Calculate:

(i) the radius of the circle in cm.

(ii) the area of the circle in cm^2 , correct to the nearest cm^2 .

(iii) the effect on the area of the circle if the radius is doubled.

Solution:

It is given that

Circumference of a circle = 123.2 cm

Consider radius = $r \text{ cm}$

(i) We know that

$$2\pi r = 123.2$$

By further calculation

$$(2 \times 22) / 7 \times r = 1232/10$$

So we get

$$r = (1232 \times 7) / (10 \times 2 \times 22)$$

$$r = 19.6 \text{ cm}$$

Therefore, radius of the circle is 19.6 cm

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(ii) Here

$$\text{Area of the circle} = \pi r^2$$

Substituting the values

$$= 22/7 \times 19.6 \times 19.6$$

$$= 1207.36$$

$$= 1207 \text{ cm}^2$$

(iii) We know that

$$\text{If radius is doubled} = 19.6 \times 2 = 39.2 \text{ cm}$$

$$\text{So the area of circle} = \pi r^2$$

Substituting the values

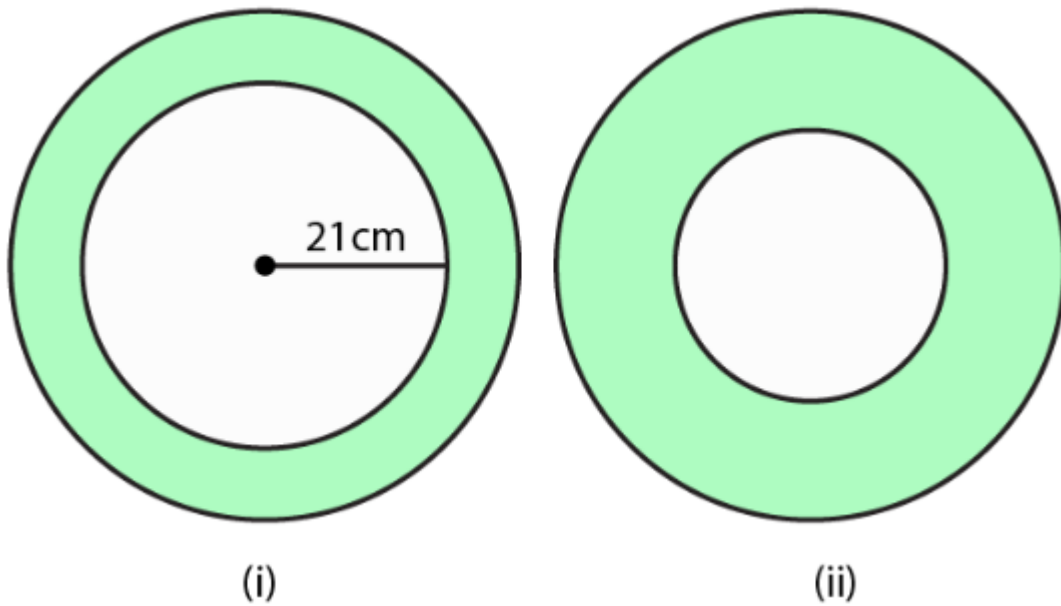
$$= 22/7 \times 39.2 \times 39.2$$

$$= 4829.44 \text{ cm}^2$$

$$\text{Effect on area} = 4829.44/1207 = 4 \text{ times}$$

11. (a) In the figure (i) given below, the area enclosed between the concentric circles is 770 cm^2 . Given that the radius of the outer circle is 21 cm, calculate the radius of the inner circle.

(b) In the figure (ii) given below, the area enclosed between the circumferences of two concentric circles is 346.5 cm^2 . The circumference of the inner circle is 88 cm. Calculate the radius of the outer circle.

**Solution:**

(a) It is given that

Radius of outer circle (R) = 21 cm

Consider r cm as the radius of inner circle

We know that

$$\text{Area of the ring} = \pi (R^2 - r^2)$$

Substituting the values

$$= \frac{22}{7} (21^2 - r^2)$$

$$= \frac{22}{7} (441 - r^2)$$

$$\text{Area of the ring} = 770 \text{ cm}^2$$

So we get

$$\frac{22}{7} (441 - r^2) = 770$$

By further calculation

$$441 - r^2 = (770 \times 7) / 22 = 245$$

$$r^2 = 441 - 245 = 196$$

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$$r = \sqrt{196} = 14$$

Hence, the radius of inner circle is 14 cm.

(b) It is given that

$$\text{Area of ring} = 346.5 \text{ cm}^2$$

$$\text{Circumference of inner circle} = 88 \text{ cm}$$

We know that

$$\text{Radius} = (88 \times 7) / (2 \times 22) = 14 \text{ cm}$$

Consider R cm as the radius of outer circle

$$\text{Area of ring} = \pi (R^2 - r^2)$$

Substituting the values

$$= 22/7 (R^2 - 14^2)$$

$$= 22/7 (R^2 - 196) \text{ cm}^2$$

$$\text{Area of ring} = 346.5 \text{ cm}^2$$

By equating we get

$$22/7 (R^2 - 196) = 346.5$$

By further calculation

$$R^2 - 196 = (346.5 \times 7) / 22 = 110.25$$

$$R^2 = 110.25 + 196 = 306.25$$

So we get

$$R = \sqrt{306.25} = 17.5$$

Hence, the radius of outer circle is 17.5 cm.

12. A road 3.5 m wide surrounds a circular plot whose circumference is 44m. Find the cost of paving the road at Rs 50 per m².

Solution:

It is given that

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Circumference of circular plot = 44 m

Radius of circular plot = $(44 \times 7) / (22 \times 2) = 7$ m

Width of the road = 3.5 m

So the radius of outer circle = $7 + 3.5 = 10.5$ m

We know that

Area of road = $\pi (R^2 - r^2)$

Substituting the values

$$= 22/7 (10.5^2 - 7^2)$$

We can write it as

$$= 22/7 (10.5 + 7) (10.5 - 7)$$

$$= 22/7 \times 17.5 \times 3.5$$

$$= 192.5 \text{ m}^2$$

Here

Rate of paving the road = Rs 50 per m^2

Total cost = $192.5 \times 50 = \text{Rs } 9625$

13. The sum of diameters of two circles is 14 cm and the difference of their circumferences is 8 cm. Find the circumference of the two circles.

Solution:

It is given that

Sum of the diameters of two circles = 14 cm

Consider R and r as the radii of two circles

$$2R + 2r = 14$$

Dividing by 2

$$R + r = 7 \dots\dots (1)$$

We know that

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Difference of their circumferences = 8 cm

$$2\pi R - 2\pi r = 8$$

Taking out the common terms

$$2\pi (R - r) = 8$$

$$(2 \times 22)/7 (R - r) = 8$$

By further calculation

$$R - r = (8 \times 7)/(2 \times 22) = 14/11 \dots (2)$$

By adding both the equations

$$2R = 7 + 14/11$$

By taking LCM

$$2R = (77 + 14)/11 = 91/11$$

By further calculation

$$R = 91/(11 \times 2) = 91/22$$

From equation (1)

$$R + r = 7$$

Substituting the value of R

$$91/22 + r = 7$$

$$r = 7 - 91/22$$

Taking LCM

$$r = (154 - 91)/22 = 63/22$$

We know that

Circumference of first circle = $2\pi r$

Substituting the values

$$= 2 \times 22/7 \times 91/22$$

$$= 26 \text{ cm}$$

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Circumference of second circle = $2 \pi R$

Substituting the values

$$= 2 \times \frac{22}{7} \times \frac{63}{22}$$

$$= 18 \text{ cm}$$

14. Find the circumference of the circle whose area is equal to the sum of the areas of three circles with radius 2 cm, 3 cm and 6 cm.

Solution:

It is given that

Radius of first circle = 2 cm

Area of first circle = πr^2

$$= \pi (2)^2$$

$$= 4 \pi \text{ cm}^2$$

Radius of second circle = 3 cm

Area of first circle = πr^2

$$= \pi (3)^2$$

$$= 9 \pi \text{ cm}^2$$

Radius of second circle = 6 cm

Area of first circle = πr^2

$$= \pi (6)^2$$

$$= 36 \pi \text{ cm}^2$$

So the total area of the three circles = $4 \pi + 9 \pi + 36 \pi = 49 \pi \text{ cm}^2$

Area of the given circle = $49 \pi \text{ cm}^2$

We know that

$$\text{Radius} = \sqrt{(49 \pi / \pi)} = \sqrt{49} = 7 \text{ cm}$$

$$\text{Circumference} = 2 \pi r = 2 \times \frac{22}{7} \times 7 = 44 \text{ cm}$$

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15. A copper wire when bent in the form of a square encloses an area of 121 cm^2 . If the same wire is bent into the form of a circle, find the area of the circle.

Solution:

It is given that

$$\text{Area of square} = 121 \text{ cm}^2$$

$$\text{So side} = \sqrt{121} = 11 \text{ cm}$$

$$\text{Perimeter} = 4a = 4 \times 11 = 44 \text{ cm}$$

$$\text{Circumference of circle} = 44 \text{ cm}$$

$$\text{Radius of circle} = (44 \times 7) / (2 \times 22) = 7 \text{ cm}$$

We know that

$$\text{Area of the circle} = \pi r^2$$

Substituting the values

$$= 22/7 (7)^2$$

So we get

$$= 22/7 \times 7 \times 7$$

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

16. A copper wire when bent into an equilateral triangle has area $121 \sqrt{3} \text{ cm}^2$. If the same wire is bent into the form of a circle, find the area enclosed by the wire.

Solution:

It is given that

$$\text{Area of equilateral triangle} = 121 \sqrt{3} \text{ cm}^2$$

Consider a as the side of triangle

$$\text{Area} = \sqrt{3}/4 a^2$$

It can be written as

$$\sqrt{3}/4 a^2 = 121\sqrt{3}$$

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By further calculation

$$a^2 = (121 \times \sqrt{3} \times 4) / \sqrt{3}$$

$$a^2 = 484$$

So we get

$$a = \sqrt{484} = 22 \text{ cm}$$

Here

Length of the wire = 66 cm

Radius of the circle = $66/2\pi$

By further calculation

$$= (66 \times 7) / (2 \times 22)$$

$$= 21/2 \text{ cm}$$

We know that

Area of the circle = πr^2

By further calculation

$$= 22/7 \times (21/2)^2$$

$$= 22/7 \times 21/2 \times 21/2$$

So we get

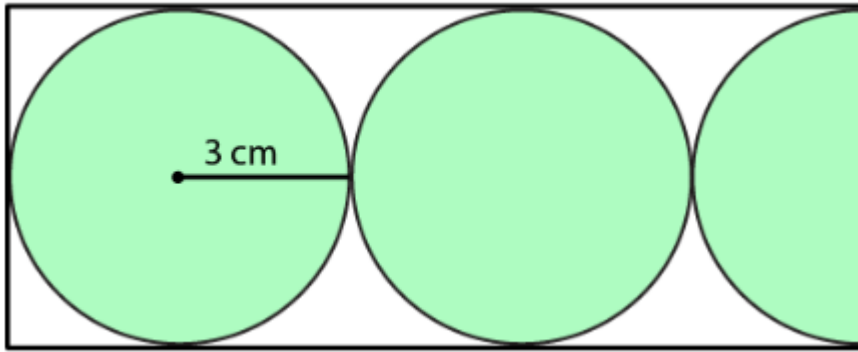
$$= 693/2$$

$$= 346.5 \text{ cm}^2$$

17. (a) Find the circumference of the circle whose area is 16 times the area of the circle with diameter 7 cm.

(b) In the given figure, find the area of the unshaded portion within the rectangle. (Take $\pi = 3.14$)

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**Solution:**

(a) It is given that

Diameter of the circle = 7 cm

Radius of the circle = $7/2$ cm

We know that

Area of the circle = πr^2

Substituting the values

$$= 22/7 \times 7/2 \times 7/2$$

$$= 77/2 \text{ cm}^2$$

Here

$$\text{Area of bigger circle} = 77/2 \times 16 = 616 \text{ cm}^2$$

Consider r as the radius

$$\pi r^2 = 616$$

We can write it as

$$22/7 r^2 = 616$$

By further calculation

$$r^2 = (616 \times 7) / 22$$

$$r^2 = 196 \text{ cm}^2$$

So we get

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$$r = \sqrt{196} = 14 \text{ cm}$$

$$\text{Circumference} = 2\pi r$$

Substituting the values

$$= 2 \times \frac{22}{7} \times 14$$

$$= 88 \text{ cm}$$

(b) It is given that

$$\text{Radius of each circle} = 3 \text{ cm}$$

$$\text{Diameter of each circle} = 2 \times 3 = 6 \text{ cm}$$

Here

$$\text{Length of rectangle (l)} = 6 + 6 + 3 = 15 \text{ cm}$$

$$\text{Breadth of rectangle (b)} = 6 \text{ cm}$$

$$\text{So the area of rectangle} = l \times b$$

Substituting the values

$$= 15 \times 6$$

$$= 90 \text{ cm}^2$$

We know that

$$\text{Area of } 2 \frac{1}{2} \text{ circles} = \frac{5}{2} \pi r^2$$

Substituting the values

$$= \frac{5}{2} \times 3.14 \times 3 \times 3$$

By further calculation

$$= 5 \times 1.57 \times 9$$

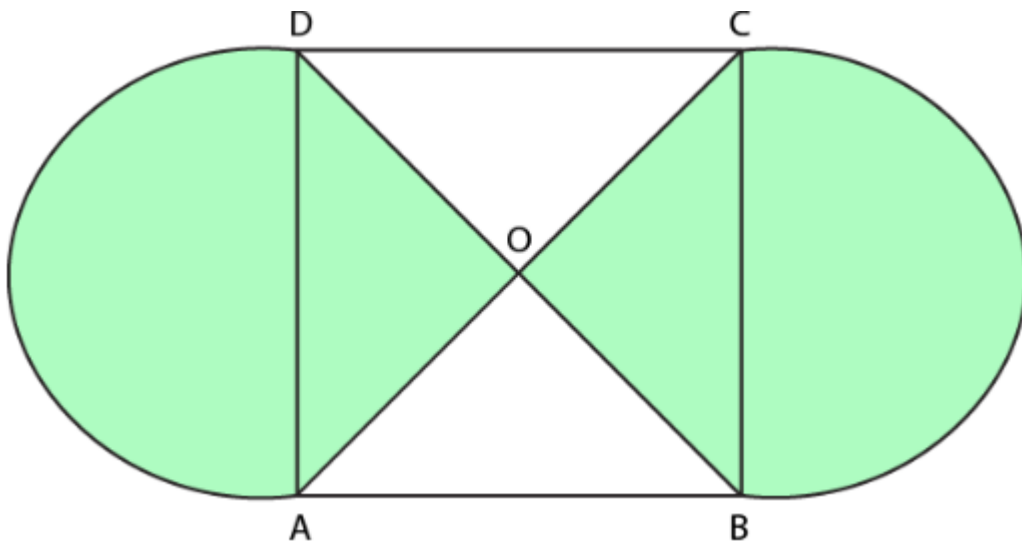
$$= 70.65 \text{ cm}^2$$

$$\text{So the area of unshaded portion} = 90 - 70.65$$

$$= 19.35 \text{ cm}^2$$

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18. In the adjoining figure, ABCD is a square of side 21 cm. AC and BD are two diagonals of the square. Two semi-circles are drawn with AD and BC as diameters. Find the area of the shaded region. Take $\pi = 22/7$.



Solution:

It is given that

Side of square = 21 cm

So the area of square = $\text{side}^2 = 21^2 = 441 \text{ cm}^2$

We know that

$$\angle AOD + \angle COD + \angle AOB + \angle BOC = 441$$

Substituting the values

$$x + x + x + x = 441$$

$$4x = 441$$

So we get

$$x = 441/4 = 110.25 \text{ cm}^2$$

Based on the question

We should find the area of shaded portion in square ABCD which is $\angle AOD$ and $\angle BOC$

$$\angle AOD + \angle BOC = 110.25 + 110.25 = 220.5 \text{ cm}^2$$

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Here

$$\text{Area of two semicircle} = \pi r^2$$

Substituting the values

$$= 22/7 \times 10.5 \times 10.5$$

$$= 346.50 \text{ cm}^2$$

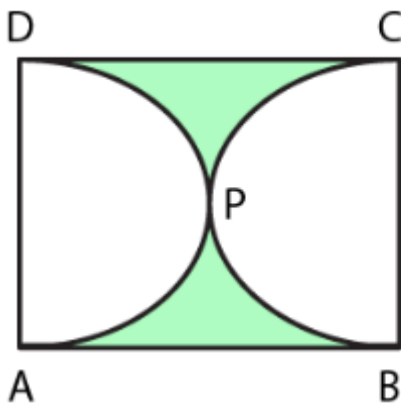
$$\text{So the area of shaded portion} = 220.5 + 346.5 = 567 \text{ cm}^2$$

19. (a) In the figure (i) given below, ABCD is a square of side 14 cm and APD and BPC are semicircles. Find the area and the perimeter of the shaded region.

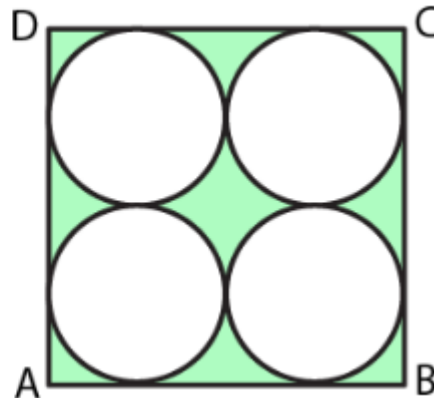
(b) In the figure (ii) given below, ABCD is a square of side 14 cm. Find the area of the shaded region.

(c) In the figure (iii) given below, the diameter of the semicircle is equal to 14 cm. Calculate the area of the shaded region. Take $\pi = 22/7$.

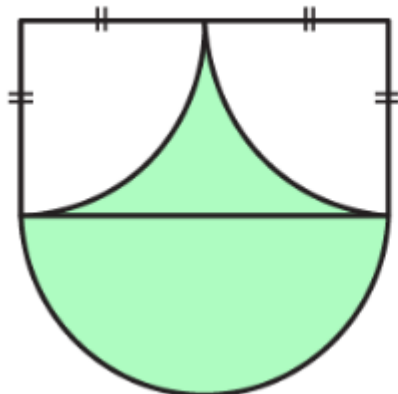
(i)



(ii)



(iii)



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Solution:

(a) It is given that

ABCD is a square of each side (a) = 14 cm

APD and BPC are semi-circle with diameter = 14 cm

Radius of each semi-circle (a) = $14/2 = 7$ cm

(i) We know that

$$\text{Area of square} = a^2 = 14^2 = 196 \text{ cm}^2$$

$$\text{Area of two semicircles} = 2 \times \frac{1}{2} \pi r^2$$

$$= \pi r^2$$

Substituting the values

$$= \frac{22}{7} \times 7 \times 7$$

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

$$\text{So the area of shaded portion} = 196 - 154 = 42 \text{ cm}^2$$

(ii) Here

$$\text{Length of arcs of two semicircles} = 2\pi r$$

Substituting the values

$$= 2 \times \frac{22}{7} \times 7$$

$$= 44 \text{ cm}$$

$$\text{So the perimeter of shaded portion} = 44 + 14 + 14 = 72 \text{ cm}$$

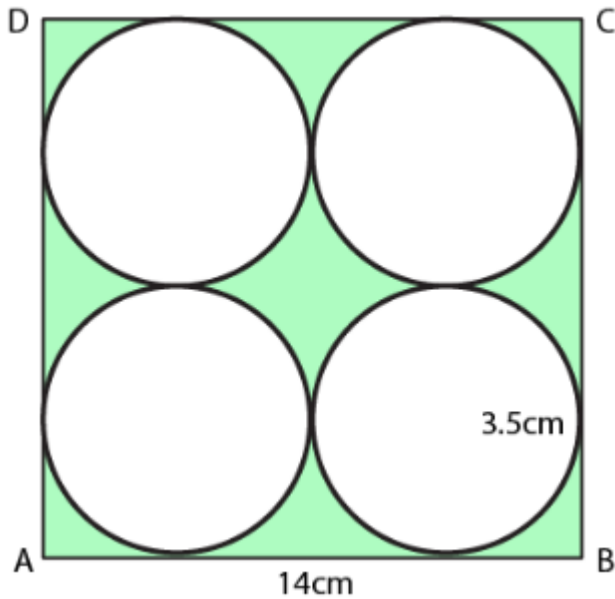
(b) It is given that

ABCD is a square whose each side (a) = 14 cm

4 circles are drawn which touch each other and the sides of squares

$$\text{Radius of each circle (r)} = \frac{7}{2} = 3.5 \text{ cm}$$

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(i) We know that

$$\text{Area of square ABCD} = a^2 = 14^2 = 196 \text{ cm}^2$$

$$\text{Area of 4 circles} = 4 \times \pi r^2$$

Substituting the values

$$= 4 \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}$$

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

$$\text{So the area of shaded portion} = 196 - 154 = 42 \text{ cm}^2$$

(ii) Here

$$\text{Perimeter of 4 circles} = 4 \times 2 \pi r$$

Substituting the values

$$= 4 \times 2 \times \frac{22}{7} \times \frac{7}{2}$$

$$= 88 \text{ cm}$$

$$\text{So the perimeter of shaded portion} = \text{perimeter of 4 circles} + \text{perimeter of square}$$

Substituting the values

$$= 88 + 4 \times 14$$

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So we get

$$= 88 + 56$$

$$= 144 \text{ cm}$$

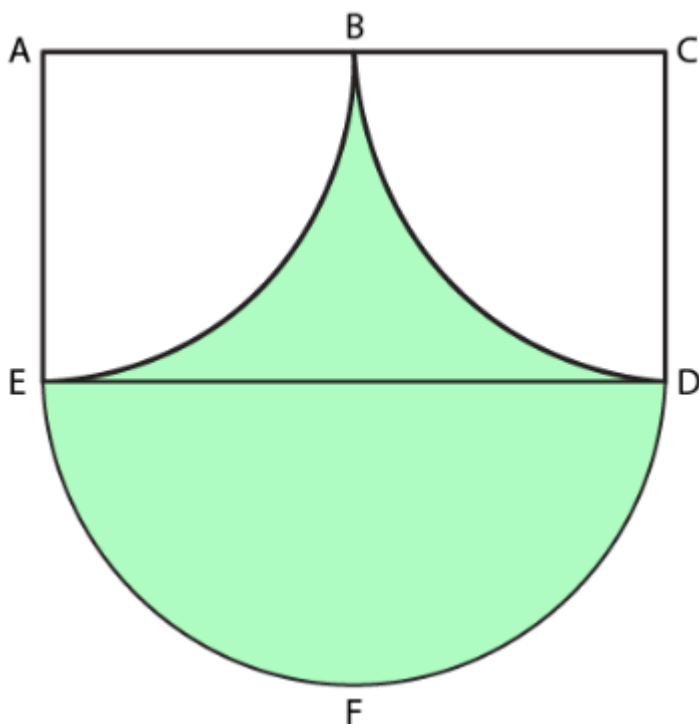
(c) We know that

$$\text{Area of rectangle ACDE} = ED \times AE$$

Substituting the values

$$= 14 \times 7$$

$$= 98 \text{ cm}^2$$



Here

$$\text{Area of semicircle DEF} = \frac{\pi r^2}{2}$$

Substituting the values

$$= \frac{(22 \times 7 \times 7)}{(7 \times 2)}$$

$$= 77 \text{ cm}^2$$

$$\text{So the area of shaded region} = 77 + (98 - 2 \times \frac{1}{4} \times 22/7 \times 7 \times 7)$$

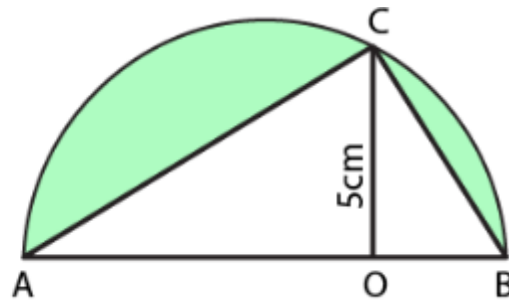
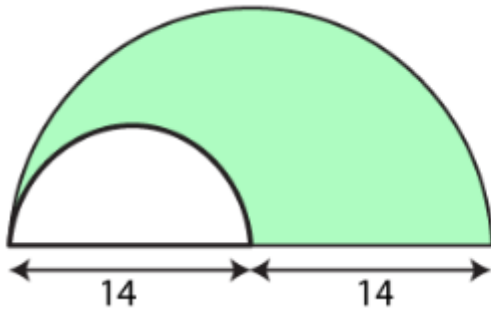
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$$= 77 + 21$$

$$= 98 \text{ cm}^2$$

20. (a) Find the area and the perimeter of the shaded region in figure (i) given below. The dimensions are in centimetres.

(b) In the figure (ii) given below, area of $\triangle ABC = 35 \text{ cm}^2$. Find the area of the shaded region.



Solution:

(a) It is given that

There are 2 semicircles where the smaller is inside the larger

Radius of larger semicircles (R) = 14 cm

Radius of smaller circle (r) = $14/2 = 7 \text{ cm}$

(i) We know that

Area of shaded portion = Area of larger semicircle – Area of smaller circle

$$= \frac{1}{2} \pi R^2 - \frac{1}{2} \pi r^2$$

We can write it as

$$= \frac{1}{2} \pi (R^2 - r^2)$$

Substituting the values

$$= \frac{1}{2} \times \frac{22}{7} (14^2 - 7^2)$$

By further calculation

$$= \frac{11}{7} (14 + 7) (14 - 7)$$

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So we get

$$= 11/7 \times 21 \times 7$$

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

(ii) Here

Perimeter of shaded portion = circumference of larger semicircle + circumference of smaller semicircle + radius of larger semicircle

$$= \pi R + \pi r + R$$

Substituting the values

$$= 22/7 \times 14 + 22/7 \times 7 + 14$$

By further calculation

$$= 44 + 22 + 14$$

$$= 80 \text{ cm}$$

(b) We know that

Area of $\triangle ABC$ formed in a semicircle = 3.5 cm

Altitude CD = 5 cm

So the base AB = (area $\times$ 2)/ altitude

Substituting the values

$$= (35 \times 2)/ 5$$

$$= 14 \text{ cm}$$

Here

Diameter of semicircle = 14 cm

Radius of semicircle (R) = $14/2 = 7 \text{ cm}$

So the area of semicircle = $\frac{1}{2} \pi R^2$

Substituting the values

$$= \frac{1}{2} \times 22/7 \times 7 \times 7$$

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$$= 77 \text{ cm}^2$$

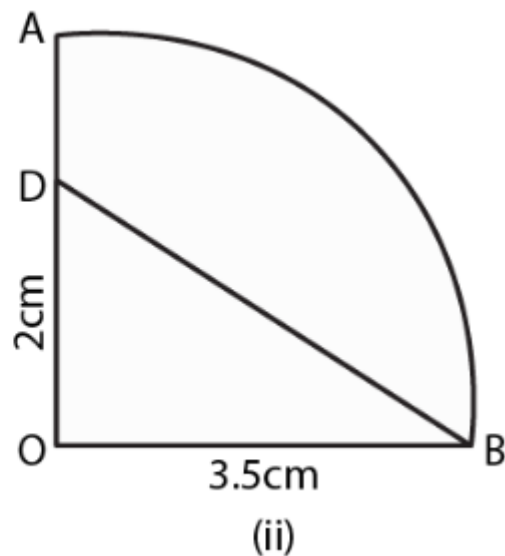
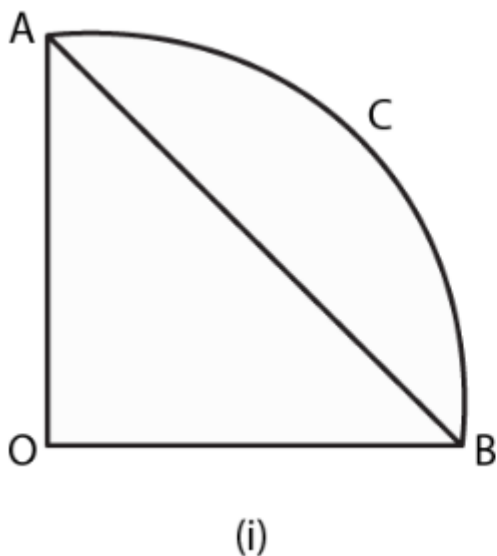
Area of shaded portion = Area of semicircle – Area of triangle

$$= 77 - 35$$

$$= 42 \text{ cm}^2$$

21. (a) In the figure (i) given below, AOB is a quadrant of a circle of radius 10m. Calculate the area of the shaded portion. Take $\pi = 3.14$ and give your answer correct to two significant figures.

(b) In the figure (ii) given below, OAB is a quadrant of a circle. The radius OA = 3.5 cm and OD = 2 cm. Calculate the area of the shaded portion.



Solution:

(a) In the figure

Shaded portion = Quadrant – $\triangle AOB$

Radius of the quadrant = 10 m

Here

Area of quadrant = $\frac{1}{4} \pi r^2$

Substituting the values

$$= \frac{1}{4} \times 3.14 \times 10 \times 10$$

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By further calculation

$$= (3.14 \times 100) / 4$$

$$= 314 / 4$$

$$= 78.5 \text{ m}^2$$

We know that

$$\text{Area of } \triangle AOB = \frac{1}{2} \times AO \times OB$$

Substituting the values

$$= \frac{1}{2} \times 10 \times 10$$

$$= 50 \text{ m}^2$$

$$\text{So the area of shaded portion} = 78.5 - 50 = 28.5 \text{ m}^2$$

(b) In the figure

$$\text{Radius of quadrant} = 3.5 \text{ cm}$$

(i) We know that

$$\text{Area of quadrant} = \frac{1}{4} \pi r^2$$

Substituting the values

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

$$= 9.625 \text{ cm}^2$$

(ii) Here

$$\text{Area of } \triangle AOD = \frac{1}{2} \times AO \times OD$$

Substituting the values

$$= \frac{1}{2} \times 3.5 \times 2$$

$$= 3.5 \text{ cm}^2$$

$$\text{So the area of shaded portion} = \text{Area of quadrant} - \text{Area of } \triangle AOD$$

Substituting the values

$$= 9.625 - 3.6$$

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$$= 6.125 \text{ cm}^2$$

22. A student takes a rectangular piece of paper 30 cm long and 21 cm wide. Find the area of the biggest circle that can be cut out from the paper. Also find the area of the paper left after cutting out the circle. (Take $\pi = 22/7$)

Solution:

It is given that

Length of rectangle = 30 cm

Width of rectangle = 21 cm

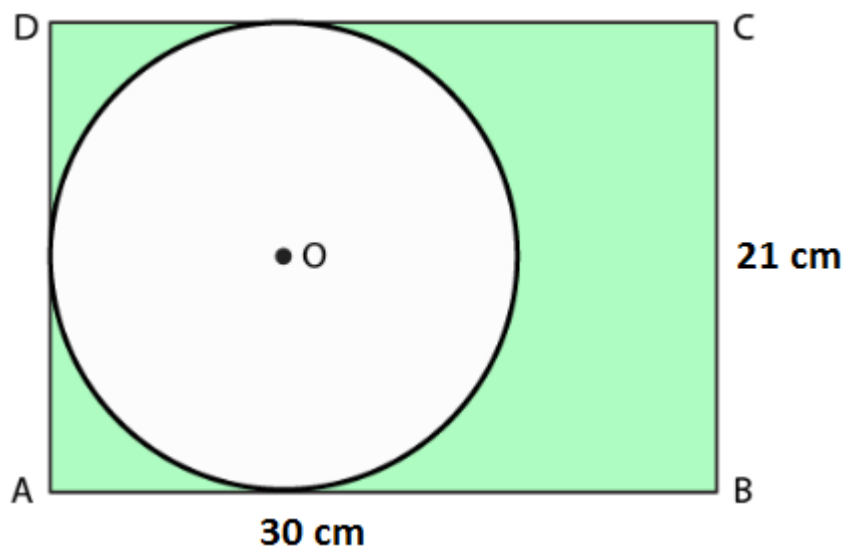
We know that

Area of rectangle = $l \times b$

$$= 30 \times 21$$

$$= 630 \text{ cm}^2$$

So the radius of the biggest circle = $21/2$ cm



Here

Area of the circle = πr^2

Substituting the values

$$= 22/7 \times 21/2 \times 21/2$$

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So we get

$$= 693/2$$

$$= 346.5 \text{ cm}^2$$

So the area of remaining part = $630 - 346.5 = 283.5 \text{ cm}^2$

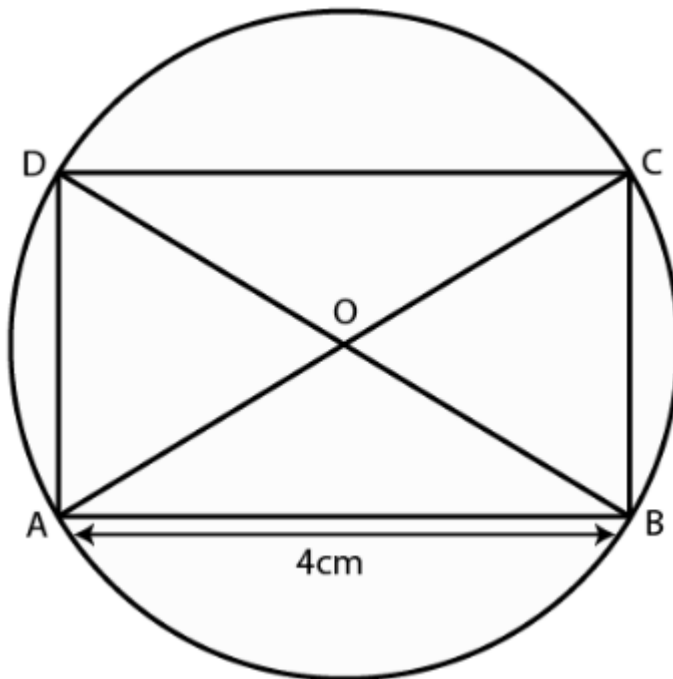
23. A rectangle with one side 4 cm is inscribed in a circle of radius 2.5 cm. Find the area of the rectangle.

Solution:

Consider ABCD as a rectangle

$$AB = 4 \text{ cm}$$

$$\text{Diameter of circle } AC = 2.5 \times 2 = 5 \text{ cm}$$



Here

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$$BC = \sqrt{AC^2 - AB^2}$$

Substituting the values

$$= \sqrt{5^2 - 4^2}$$

$$= \sqrt{25 - 16}$$

$$= \sqrt{9}$$

So we get

$$= 3 \text{ cm}$$

We know that

$$\text{Area of rectangle} = AB \times BC$$

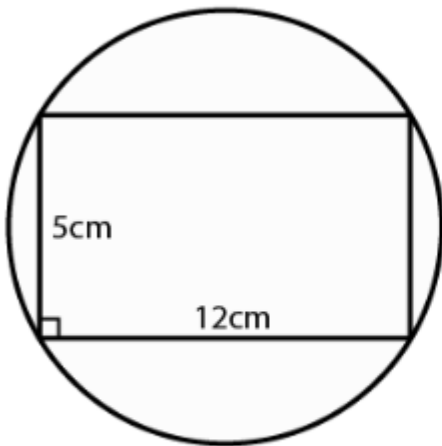
Substituting the values

$$= 4 \times 3$$

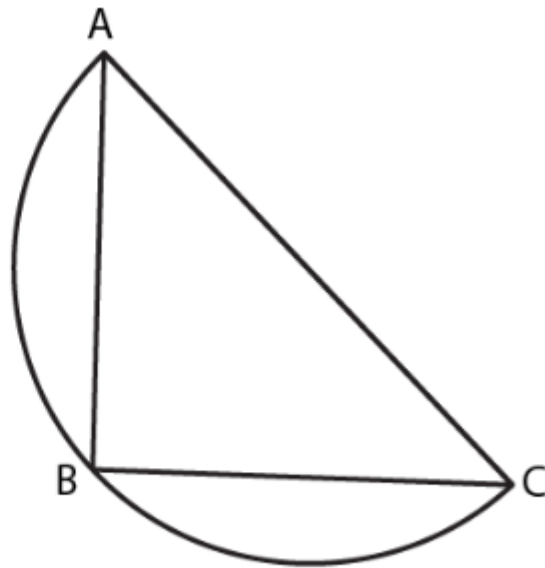
$$= 12 \text{ cm}^2$$

24. (a) In the figure (i) given below, calculate the area of the shaded region correct to two decimal places. (Take $\pi = 3.142$)

(b) In the figure (ii) given below, ABC is an isosceles right angled triangle with $\angle ABC = 90^\circ$. A semicircle is drawn with AC as diameter. If $AB = BC = 7 \text{ cm}$, find the area of the shaded region. Take $\pi = 22/7$.



(i)



(ii)

Solution:

(a) We know that

ABCD is a rectangle which is inscribed in a circle of length = 12 cm

Width = 5 cm

$$AC = \sqrt{AB^2 + BC^2}$$

Substituting the values

$$= \sqrt{12^2 + 5^2}$$

$$= \sqrt{144 + 25}$$

$$= \sqrt{169}$$

$$= 13 \text{ cm}$$

Diameter of circle = AC = 13 cm

Radius of circle = $13/2 = 6.5$ cm

Here

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$$\text{Area of circle} = \pi r^2$$

Substituting the values

$$= 3.142 \times (6.5)^2$$

By further calculation

$$= 3.142 \times 42.25$$

$$= 132.75 \text{ cm}^2$$

$$\text{Area of rectangle} = l \times b$$

Substituting the values

$$= 12 \times 5$$

$$= 60 \text{ cm}^2$$

$$\text{So the area of the shaded portion} = 132.75 - 60 = 72.75 \text{ cm}^2$$

(b) We know that

$$\text{Area of } \triangle ABC = \frac{1}{2} \times AB \times BC$$

Substituting the values

$$= \frac{1}{2} \times 7 \times 7$$

$$= 49/2 \text{ cm}^2$$

Here

$$AC^2 = AB^2 + BC^2$$

Substituting

$$= 49 + 49$$

So we get

$$AC = 7\sqrt{2}$$

$$\text{Radius of semi-circle} = 7\sqrt{2}/2 \text{ cm}$$

$$\text{Area of semi-circle} = \pi/2 \times (7\sqrt{2}/2)^2$$

By further calculation

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$$= \frac{1}{2} \times \frac{22}{7} \times \frac{98}{4}$$

$$= \frac{77}{2} \text{ cm}^2$$

Area of the shaded region = Area of the semi-circle – Area of $\triangle ABC$

Substituting the values

$$= \frac{77}{2} - \frac{49}{2}$$

$$= \frac{28}{2}$$

$$= 14 \text{ cm}^2$$

25. A circular field has perimeter 660 m. A plot in the shape of a square having its vertices on the circumference is marked in the field. Calculate the area of the square field.

Solution:

It is given that

Perimeter of circular field = 660 m

Radius of the field = $\frac{660}{2\pi}$

Substituting the values

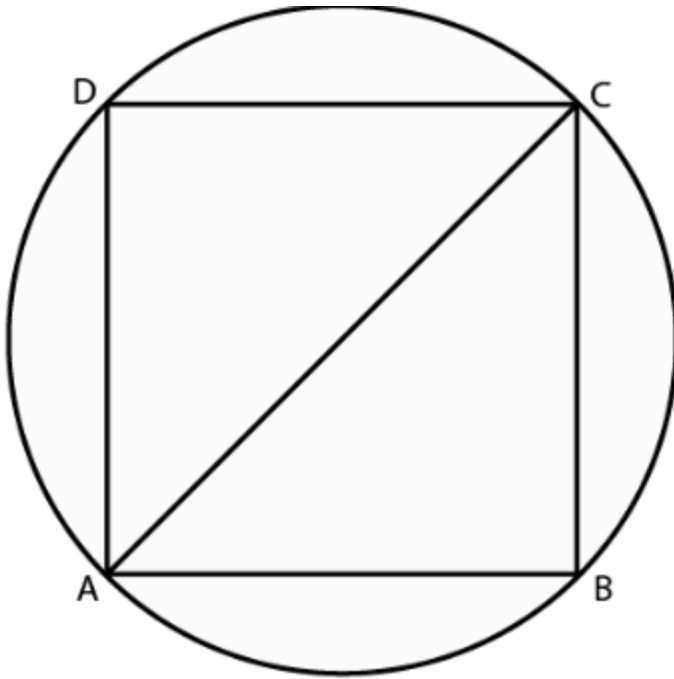
$$= \frac{(660 \times 7)}{(2 \times 22)}$$

$$= 105 \text{ m}$$

Here

ABCD is a square which is inscribed in the circle where AC is the diagonal which is the diameter of the circular field

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Consider a as the side of the square

$$AC = \sqrt{2} a$$

$$a = AC/\sqrt{2}$$

Substituting the values

$$a = (105 \times 2)/\sqrt{2}$$

Multiply and divide by $\sqrt{2}$

$$a = (105 \times 2 \times \sqrt{2})/(\sqrt{2} \times \sqrt{2})$$

By further calculation

$$a = (105 \times 2 \times \sqrt{2})/2$$

$$a = 105\sqrt{2} \text{ m}$$

We know that

$$\text{Area of the square} = a^2$$

It can be written as

$$= (105\sqrt{2})^2$$

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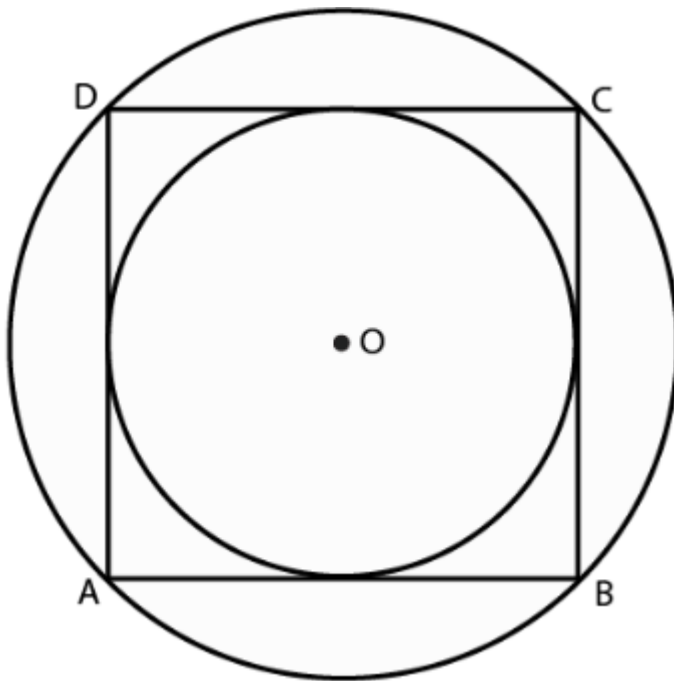
$$= 105\sqrt{2} \times 105\sqrt{2}$$

$$= 22050 \text{ m}^2$$

26. In the adjoining figure, ABCD is a square. Find the ratio between

(i) the circumferences

(ii) the areas of the incircle and the circumcircle of the square.



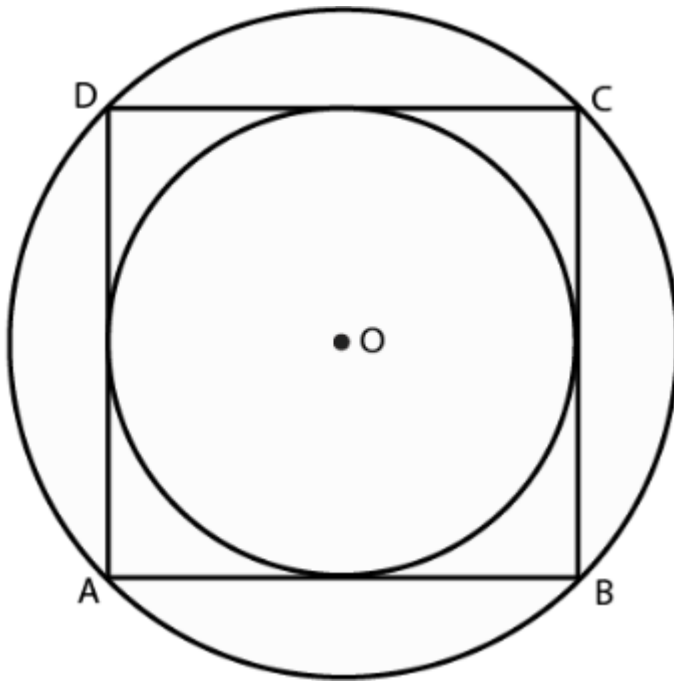
Solution:

Consider side of the square = $2a$

$$\text{Area} = (2a)^2 = 4a^2$$

$$\text{Diagonal of AC} = \sqrt{2}AB$$

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(i) We know that

Radius of the circumcircle = $\frac{1}{2} AC$

It can be written as

$$= \frac{1}{2} (\sqrt{2} \times AB)$$

Substituting the values

$$= \frac{\sqrt{2}}{2} \times 2a$$

$$= \sqrt{2}a$$

$$\text{Circumference} = 2 \pi r = 2 \times \pi \times \sqrt{2}a = 2\sqrt{2} \pi a$$

$$\text{Radius of incircle} = AB = \frac{1}{2} \times 2a = a$$

$$\text{Circumference} = 2 \pi r = 2 \pi a$$

Here

$$\text{Ratio between the circumference incircle and circumcircle} = 2 \pi a : 2\sqrt{2} \pi a$$

$$= 1 : \sqrt{2}$$

(ii) We know that

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$$\text{Area of incircle} = \pi r^2 = \pi a^2$$

$$\text{Area of circumcircle} = \pi R^2$$

$$= \pi (\sqrt{2}a)^2$$

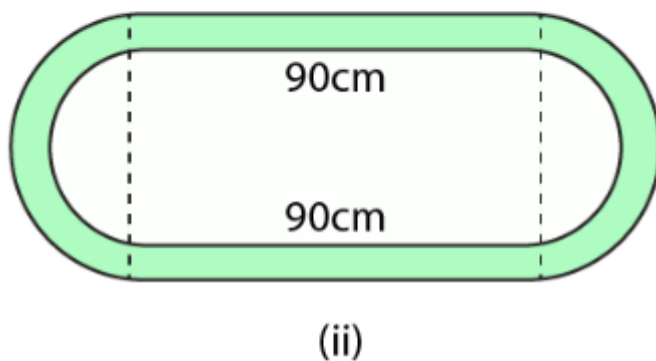
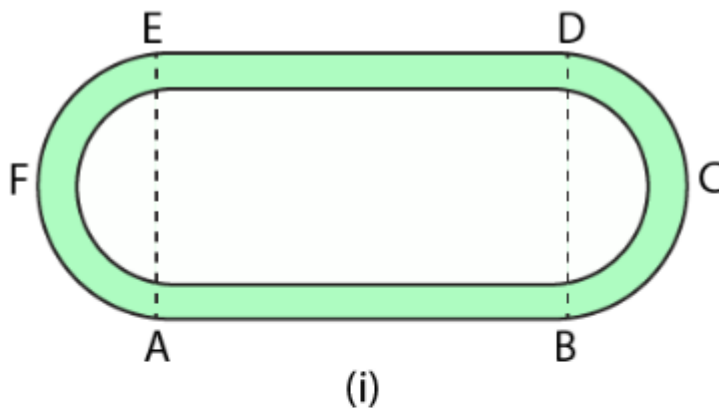
$$= \pi 2a^2$$

$$= 2 \pi a^2$$

$$\text{So the ratio} = \pi a^2 : 2 \pi a^2 = 1 : 2$$

27. (a) The figure (i) given below shows a running track surrounding a grassed enclosure PQRTU. The enclosure consists of a rectangle PQST with a semicircular region at each end.

PQ = 200 m, PT = 70 m



(i) Calculate the area of the grassed enclosure in m².

(ii) Given that the track is of constant width 7 m, calculate the outer perimeter ABCDEF of the track.

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(b) In the figure (ii) given below, the inside perimeter of a practice running track with semi-circular ends and straight parallel sides is 312 m. The length of the straight portion of the track is 90 m. If the track has a uniform width of 2m throughout, find its area.

Solution:

(a) It is given that

Length of PQ = 200 m

Width PT = 70 m

(i) We know that

Area of rectangle PQST = $l \times b$

$$= 200 \times 70$$

$$= 14000 \text{ m}^2$$

Radius of each semi-circular part on either side of rectangle = $70/2 = 35 \text{ m}$

Area of both semi-circular parts = $2 \times \frac{1}{2} \pi r^2$

Substituting the values

$$= \frac{22}{7} \times 35 \times 35$$

$$= 3850 \text{ m}^2$$

So the total area of grassed enclosure = $1400 + 3850 = 17850 \text{ m}^2$

(ii) We know that

Width of track around the enclosure = 7 m

Outer length = 200 m

So the width = $70 + 7 \times 2$

$$= 70 + 14$$

$$= 84 \text{ m}$$

Outer radius = $84/2 = 42 \text{ m}$

Here

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Circumference of both semi-circular part = $2\pi r$

Substituting the values

$$= 2 \times 22/7 \times 42$$

$$= 264 \text{ m}$$

$$\text{Outer perimeter} = 264 + 200 \times 2$$

$$= 264 + 400$$

$$= 664 \text{ m}$$

(b) It is given that

$$\text{Inside perimeter} = 312 \text{ m}$$

$$\text{Total length of the parallel sides} = 90 + 90 = 180 \text{ m}$$

$$\text{Circumference of two semi-circles} = 312 - 180 = 132 \text{ m}$$

Here

$$\text{Radius of each semi-circle} = 132/2\pi$$

So we get

$$= 66/3.14$$

$$= 21.02 \text{ m}$$

$$\text{Diameter of each semi-circle} = 66/\pi \times 2$$

So we get

$$= 132/\pi$$

$$= 132/3.14$$

Multiply and divide by 100

$$= (132 \times 100)/314$$

$$= 42.04 \text{ m}$$

$$\text{Width of track} = 2 \text{ m}$$

$$\text{Outer diameter} = 42.04 + 4 = 46.04 \text{ m}$$

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$$\text{Radius} = 46.04/2 = 23.02 \text{ m}$$

We know that

$$\text{Area of two semi-circles} = 2 \times \frac{1}{2} \times \pi R^2$$

$$= \pi R^2$$

Substituting the values

$$= 3.14 \times (23.02)^2$$

$$= 3.14 \times 23.02 \times 23.02$$

$$= 1663.95 \text{ m}^2$$

$$\text{Area of rectangle} = 90 \times 46.04$$

$$= 4143.6 \text{ m}^2$$

$$\text{Total area} = 1663.95 + 4143.60 = 5807.55 \text{ m}^2$$

$$\text{Area of two inner circles} = 2 \times \frac{1}{2} \pi r^2$$

Substituting the values

$$= 3.14 \times 21.02 \times 21.02$$

$$= 1387.38 \text{ m}^2$$

$$\text{Area of inner rectangle} = 90 \times 42.04$$

$$= 3783.6 \text{ m}^2$$

$$\text{Total inner area} = 3783.60 + 1387.38$$

$$= 5170.98 \text{ m}^2$$

Here

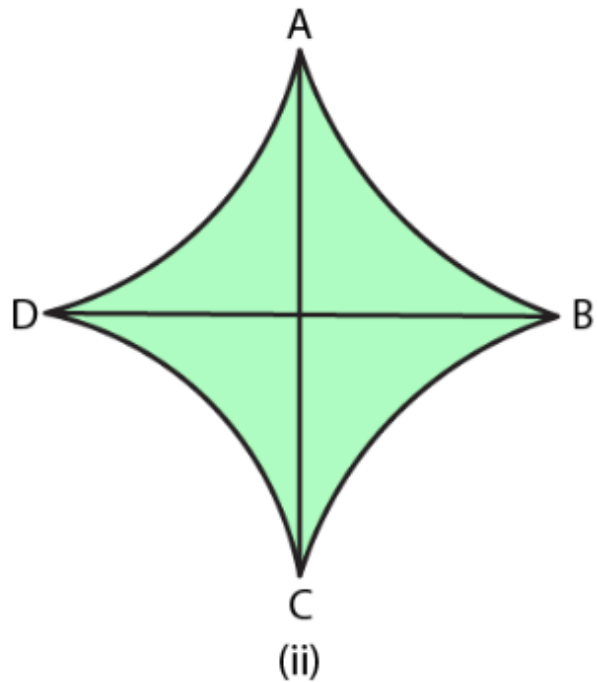
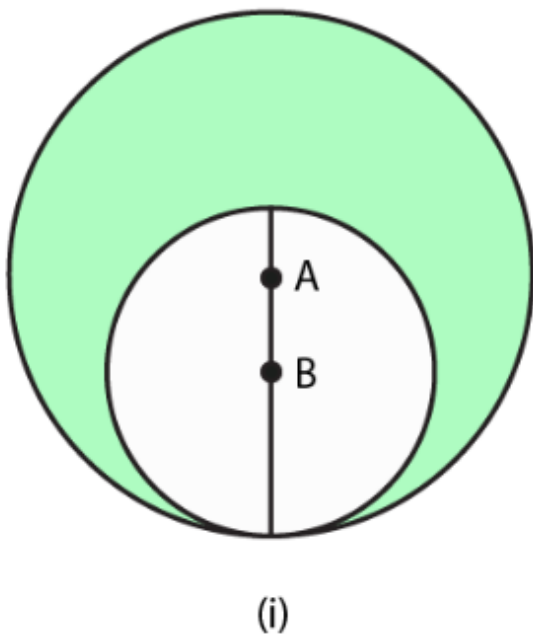
$$\text{Area of path} = 5807.55 - 5170.98$$

$$= 636.57 \text{ m}^2$$

28. (a) In the figure (i) given below, two circles with centres A and B touch each other at the point C. If AC = 8 cm and AB = 3 cm, find the area of the shaded region.

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(b) The quadrants shown in the figure (ii) given below are each of radius 7 cm. Calculate the area of the shaded portion.



Solution:

(a) It is given that

$$AC = 8 \text{ cm}$$

$$BC = AC - AB = 8 - 3 = 5 \text{ cm}$$

We know that

$$\text{Area of big circle of radius } AC = \pi R^2$$

Substituting the values

$$= \frac{22}{7} \times 8 \times 8$$

By further calculation

$$= 64 \times \frac{22}{7} \text{ cm}^2$$

$$\text{Area of smaller circle} = \pi r^2$$

Substituting the values

$$= \frac{22}{7} \times 5 \times 5$$

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By further calculation

$$= (25 \times 22) / 7 \text{ cm}^2$$

Here

$$\text{Area of shaded portion} = (64 \times 22) / 7 - (25 \times 22) / 7$$

Taking out the common terms

$$= 22/7 (64 - 25)$$

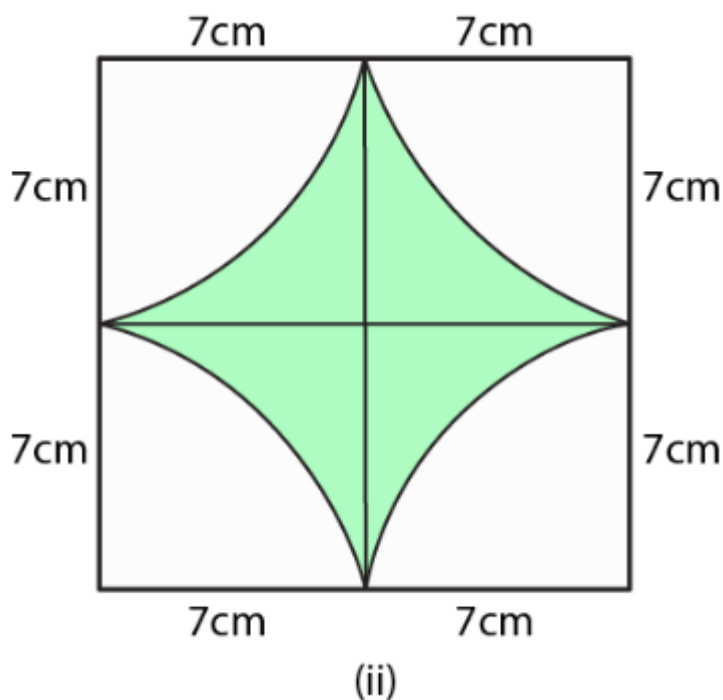
By further calculation

$$= 22/7 \times 39$$

$$= 122.57 \text{ cm}^2$$

(b) We know that

Radius of each quadrant = 7 cm



Here

Area of shaded region = Area of square – 4 area of the quadrant

It can be written as

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$$= (\text{side})^2 - 4 \times \frac{1}{4} \pi r^2$$

Substituting the values

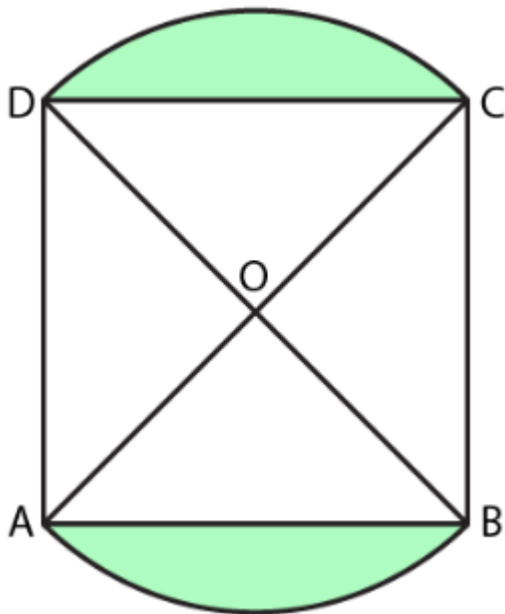
$$= 14^2 - 22/7 \times 7 \times 7$$

By further calculation

$$= 196 - 154$$

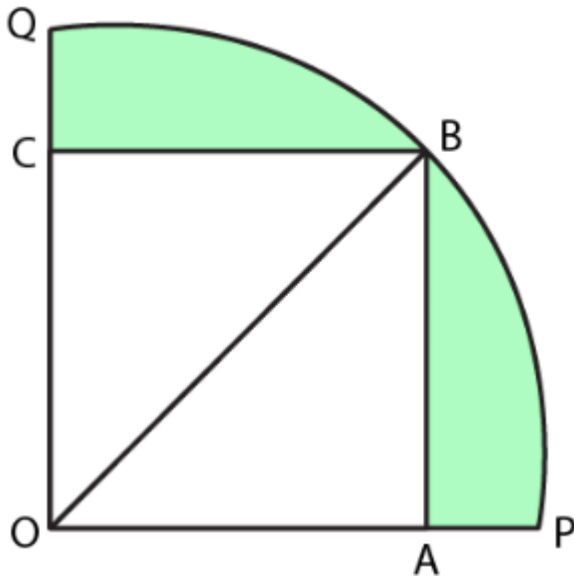
$$= 42 \text{ cm}^2$$

29. (a) In the figure (i) given below, two circular flower beds have been shown on the two sides of a square lawn ABCD of side 56 m. If the centre of each circular flower bed is the point of intersection O of the diagonals of the square lawn, find the sum of the areas of the lawn and the flower beds.



(b) In the figure (ii) given below, a square OABC is inscribed in a quadrant OPBQ of a circle. If OA = 20 cm, find the area of the shaded region. ($\pi = 3.14$)

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**Solution:**

(a) It is given that

Side of square lawn ABCD (a) = 56 cm

$$\text{Area} = a^2 = 56^2 = 3136 \text{ cm}^2$$

We know that

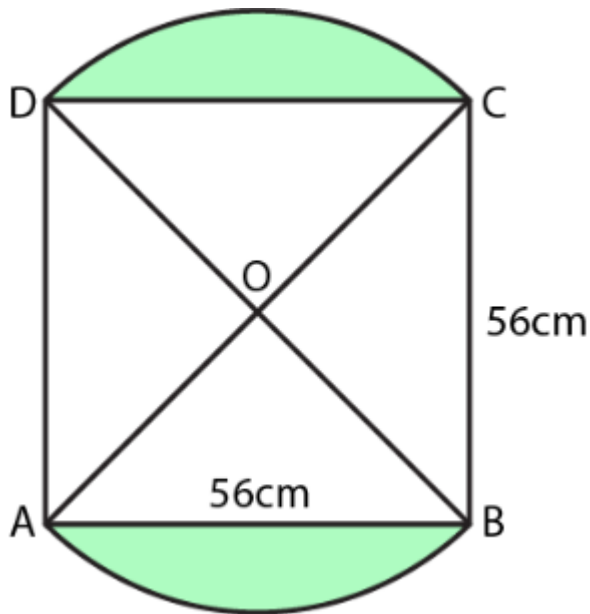
Length of the diagonal of the square = $\sqrt{2} a$

$$= \sqrt{2} \times 56 \text{ cm}$$

Radius of each quadrant = $(\sqrt{2} \times 56) / 2$

$$= 28 \sqrt{2} \text{ cm}$$

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So the area of each segment = $\frac{1}{4} \pi r^2$ – area of $\triangle OBC$

Substituting the values

$$= \frac{1}{4} \times 22/7 \times 28\sqrt{2} \times 28\sqrt{2} - \frac{1}{2} \times 28\sqrt{2} \times 28\sqrt{2}$$

Taking out the common terms

$$= 28\sqrt{2} \times 28\sqrt{2} \left(\frac{1}{4} \times \frac{22}{7} - \frac{1}{2} \right)$$

By further calculation

$$= 784 \times 2 \left(\frac{11}{14} - \frac{1}{2} \right)$$

So we get

$$= 784 \times 2 \times \frac{4}{14}$$

$$= 448 \text{ cm}^2$$

Here

$$\text{Area of two segments} = 448 \times 2 = 896 \text{ cm}^2$$

$$\text{So the total area of the lawn and beds} = 3136 + 896 = 4032 \text{ cm}^2$$

(b) In the figure

OPBQ is a quadrant and OABC is a square which is inscribed in a side of square = 20 cm

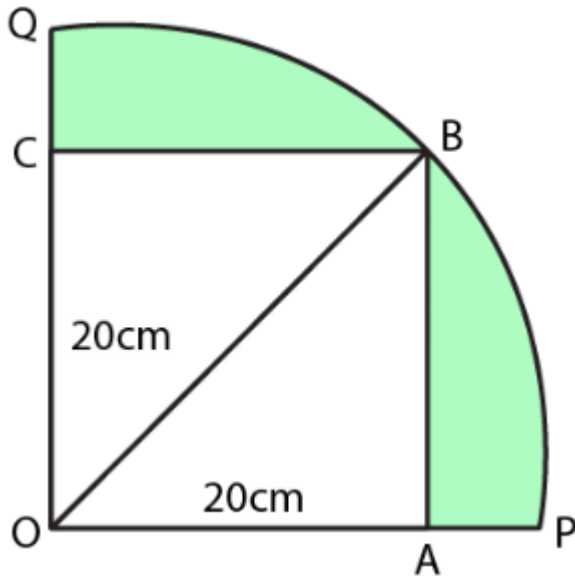
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OB is joined

Here

$$OB = \sqrt{2} a = \sqrt{2} \times 20 \text{ cm}$$

$$\text{Radius of quadrant} = OB = 20\sqrt{2} \text{ cm}$$



We know that

$$\text{Area of quadrant} = \frac{1}{4} \pi r^2$$

Substituting the values

$$= \frac{1}{4} \times 3.14 \times (20\sqrt{2})^2$$

By further calculation

$$= \frac{1}{4} \times 3.14 \times 800$$

So we get

$$= 314 \times 2$$

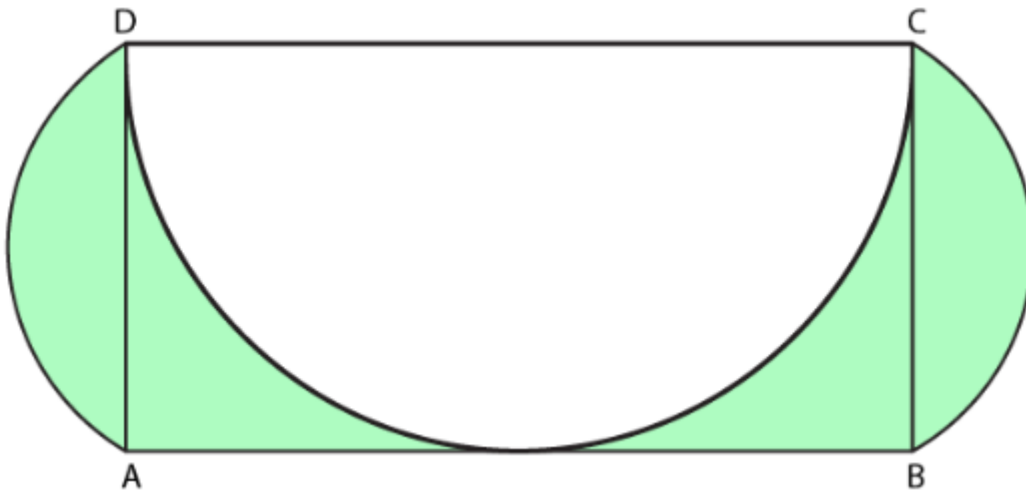
$$= 628 \text{ cm}^2$$

$$\text{Area of square} = a^2 = 20^2 = 400 \text{ cm}^2$$

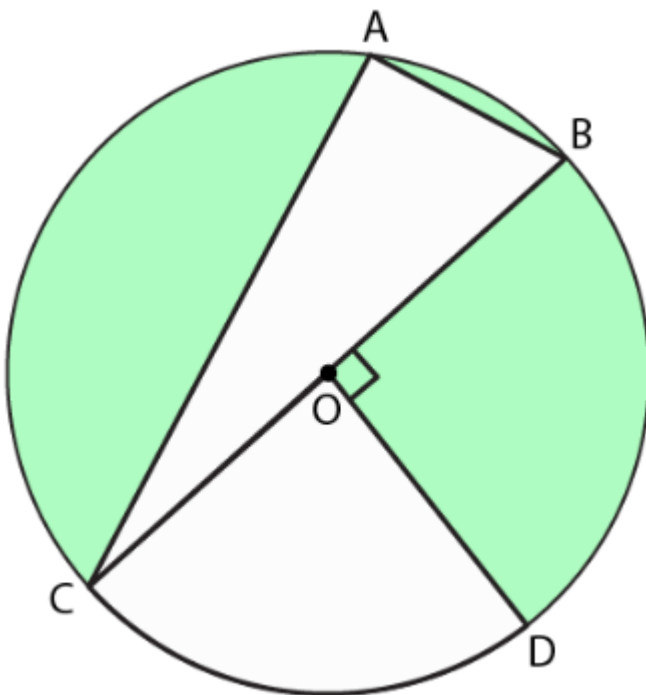
$$\text{So the area of shaded portion} = 628 - 400 = 228 \text{ cm}^2$$

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30. (a) In the figure (i) given below, ABCD is a rectangle, $AB = 14$ cm and $BC = 7$ cm. Taking DC, BC and AD as diameters, three semicircles are drawn as shown in the figure. Find the area of the shaded portion.



(b) In the figure (ii) given below, O is the centre of a circle with $AC = 24$ cm, $AB = 7$ cm and $\angle BOD = 90^\circ$. Find the area of the shaded region. (Use $\pi = 3.14$)



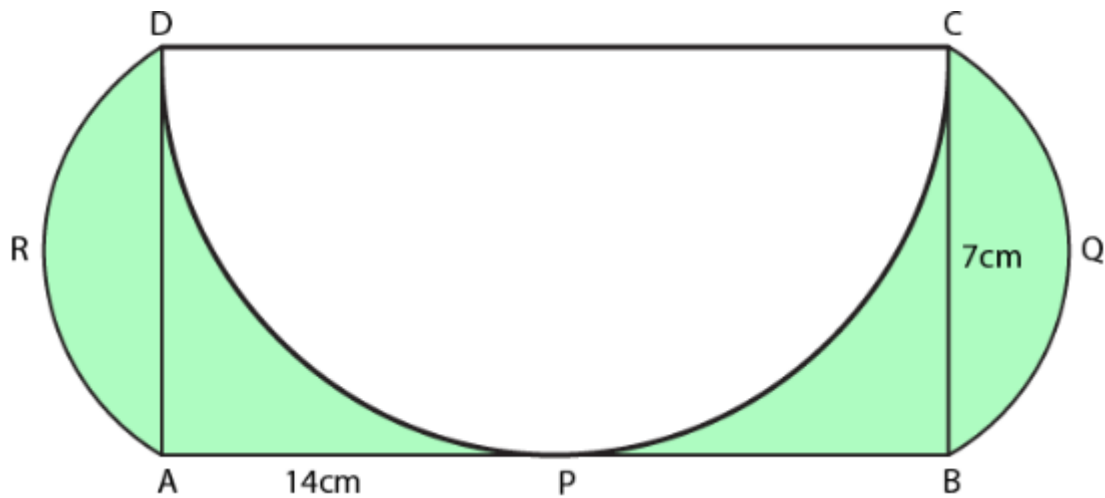
Solution:

(a) It is given that

ABCD is a rectangle

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Three semicircles are drawn with $AB = 14$ cm and $BC = 7$ cm



We know that

Area of rectangle ABCD = $l \times b$

Substituting the values

$$= 14 \times 7$$

$$= 98 \text{ cm}^2$$

Radius of each outer semicircles = $7/2$ cm

So the area = $2 \times \frac{1}{2} \pi r^2$

Substituting the values

$$= 22/7 \times 7/2 \times 7/2$$

$$= 77/2$$

$$= 38.5 \text{ cm}^2$$

Here

Area of semicircle drawn on CD as diameter = $\frac{1}{2} \pi R^2$

Substituting the values

$$= \frac{1}{2} \times 22/7 \times 7^2$$

By further calculation

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$$= 11/7 \times 7 \times 7$$

$$= 77 \text{ cm}^2$$

So the area of shaded region = $98 + 38.5 - 77$

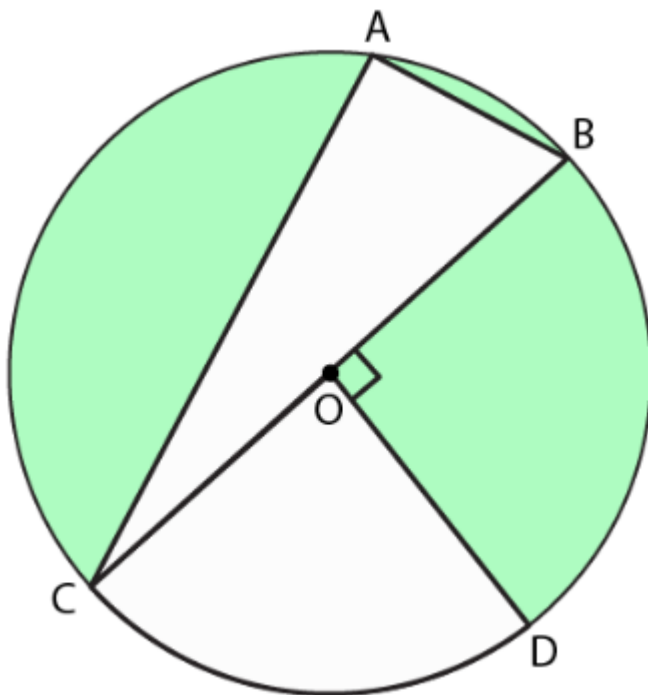
$$= 59.5 \text{ cm}^2$$

(b) In the figure

$$AC = 24 \text{ cm}$$

$$AB = 7 \text{ cm}$$

$$\angle BOD = 90^\circ$$



In $\triangle ABC$

Using Pythagoras theorem

$$BC^2 = AC^2 + AB^2$$

Substituting the values

$$BC^2 = 24^2 + 7^2$$

By further calculation

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$$BC = \sqrt{(576 + 49)} = \sqrt{625} = 25 \text{ cm}$$

So the radius of circle = $25/2$ cm

We know that

$$\text{Area of } \triangle ABC = \frac{1}{2} \times AB \times AC$$

Substituting the values

$$= \frac{1}{2} \times 7 \times 24$$

$$= 84 \text{ cm}^2$$

$$\text{Area of quadrant COD} = \frac{1}{4} \pi r^2$$

Substituting the values

$$= \frac{1}{4} \times 3.14 \times 25/2 \times 25/2$$

By further calculation

$$= 1962.5/16$$

$$= 122.66 \text{ cm}^2$$

$$\text{Area of circle} = \pi r^2$$

Substituting the values

$$= 3.14 \times 25/2 \times 25/2$$

By further calculation

$$= 1962.5/4$$

$$= 490.63 \text{ cm}^2$$

$$\text{Area of shaded portion} = \text{Area of circle} - (\text{Area of } \triangle ABC + \text{Area of quadrilateral COD})$$

Substituting the values

$$= 490.63 - (84 + 122.66)$$

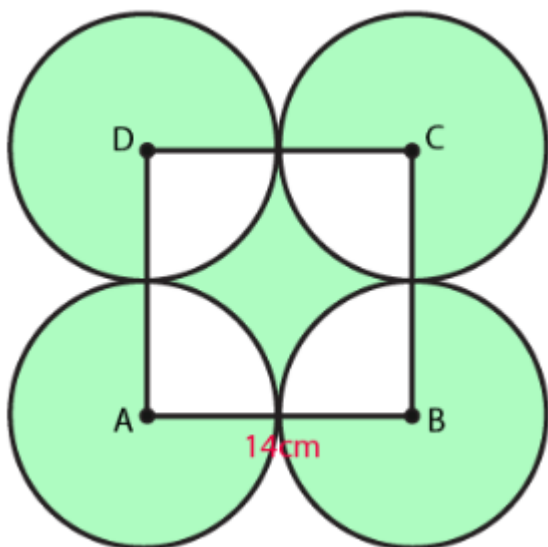
By further calculation

$$= 490.63 - 206.66$$

$$= 283.97 \text{ cm}^2$$

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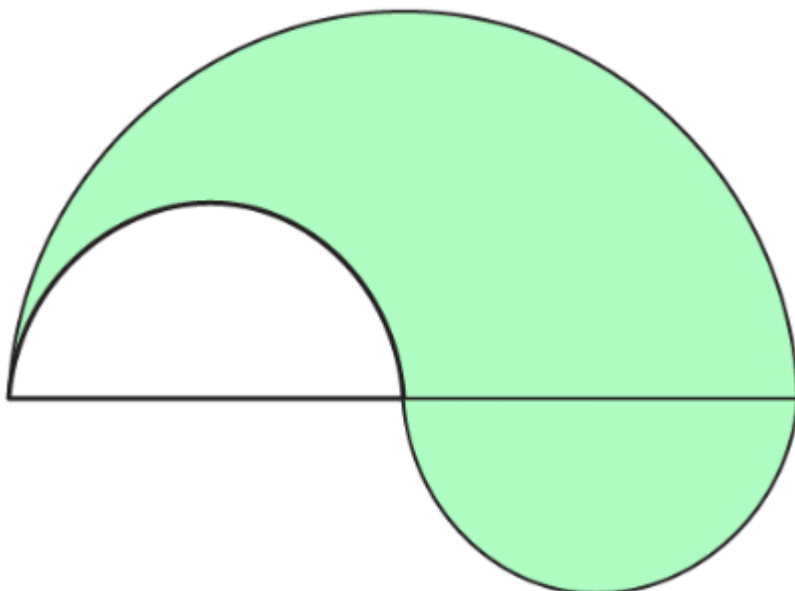
31. (a) In the figure given below ABCD is a square of side 14 cm. A, B, C and D are centres of the equal circle which touch externally in pairs. Find the area of the shaded region.



(b) In the figure (ii) given below, the boundary of the shaded region in the given diagram consists of three semicircular arcs, the smaller being equal. If the diameter of the larger one is 10 cm, calculate.

(i) the length of the boundary.

(ii) the area of the shaded region. (Take π to be 3.14)



Solution:

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(a) It is given that

Side of square ABCD = 14 cm

Radius of each circle drawn from A, B, C and D and touching externally in pairs = $14/2 = 7$ cm

We know that

Area of square = a^2

Substituting the values

$$= 14 \times 14$$

$$= 196 \text{ cm}^2$$

Area of 4 sectors of 90° each = $4 \times \pi \times r^2$

Substituting the values

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

$$= 154 \text{ cm}$$

Area of each sector of 270° angle = $\frac{3}{4} \pi r^2$

Substituting the values

$$= \frac{3}{4} \times \frac{22}{7} \times 7 \times 7$$

$$= 231/2$$

$$= 115.5 \text{ cm}^2$$

Here

$$\text{Area of 4 sectors} = 115.5 \times 4 = 462 \text{ cm}^2$$

So the area of shaded portion = area of square + area of 4 bigger sector – area of 4 smaller sector

Substituting the values

$$= 196 + 462 - 154$$

$$= 658 - 154$$

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$$= 504 \text{ cm}^2$$

(b) We know that

$$\text{Radius of big semi-circle} = 10/2 = 5 \text{ cm}$$

$$\text{Radius of each smaller circle} = 5/2 \text{ cm}$$

(i) Length of boundary = circumference of bigger semi-circle + 2 circumference of smaller semi-circles

It can be written as

$$= \pi R + \pi r + \pi r$$

$$= 3.14 (R + 2r)$$

Substituting the values

$$= 3.14 (5 + 2 \times 5/2)$$

By further calculation

$$= 3.14 \times 10$$

$$= 31.4 \text{ cm}$$

(ii) Here

Area of shaded region = area of bigger semi-circle + area of one smaller semi-circle – area of other smaller semi-circle

We know that

$$\text{Area of bigger semi-circle} = \frac{1}{2} \pi R^2$$

Substituting the values

$$= 3.14/2 \times 5 \times 5$$

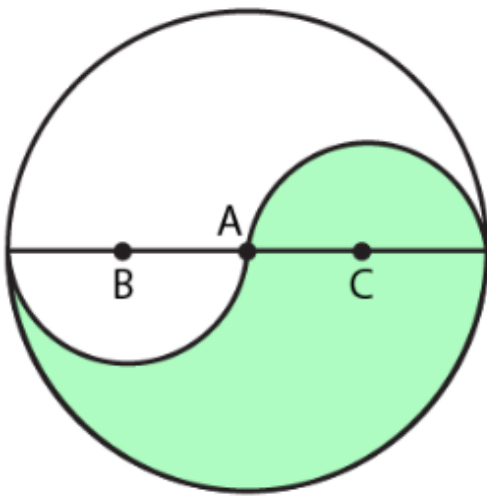
$$= 1.57 \times 25$$

$$= 39.25 \text{ cm}$$

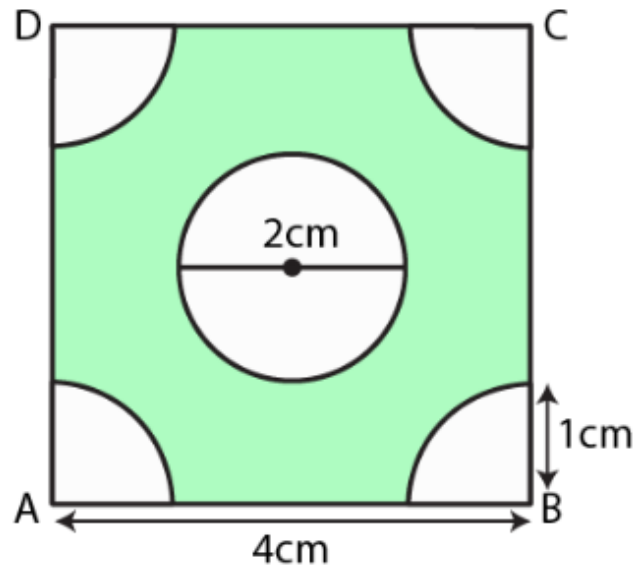
32. (a) In the figure (i) given below, the points A, B and C are centres of arcs of circles of radii 5 cm, 3 cm and 2 cm respectively. Find the perimeter and the area of the shaded region. (Take $\pi = 3.14$)

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(b) In the figure (ii) given below, ABCD is a square of side 4 cm. At each corner of the square a quarter circle of radius 1 cm, and at the centre a circle of diameter 2 cm are drawn. Find the perimeter and the area of the shaded region. Take $\pi = 3.14$



(i)



(ii)

Solution:

(a) It is given that

Radius of bigger circle = 5 cm

Radius of small circle (r_1) = 3 cm

Radius of smaller circle (r_2) = 2 cm

(i) We know that

Perimeter of shaded region = circumference of bigger semi-circle + circumference of small semi-circle + circumference of smaller semi-circle

It can be written as

$$= \pi R + \pi r_1 + \pi r_2$$

$$= \pi (R + r_1 + r_2)$$

Substituting the values

$$= \pi (5 + 3 + 2)$$

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$$= 3.14 \times 10$$

$$= 31.4 \text{ cm}^2$$

(ii) We know that

Area of shaded region = area of bigger semi-circle + area of smaller semi-circle – area of small semicircle

It can be written as

$$= \frac{1}{2} \pi R^2 + \frac{1}{2} \pi r_2^2 - \frac{1}{2} \pi r_1^2$$

$$= \frac{1}{2} \pi (R^2 + r_2^2 - r_1^2)$$

Substituting the values

$$= \frac{1}{2} \pi (5^2 + 2^2 - 3^2)$$

By further calculation

$$= \frac{1}{2} \pi (25 + 4 - 9)$$

$$= \frac{1}{2} \pi \times 20$$

So we get

$$= 10 \times 3.14$$

$$= 31.4 \text{ cm}^2$$

(b) We know that

Side of square ABCD = 4 cm

Radius of each quadrant circle = 1 cm

Radius of circle in the square = $\frac{2}{2} = 1$ cm

(i) Here

Perimeter of shaded region = circumference of 4 quadrants + circumference of circle + $4 \times \frac{1}{2}$ side of square

It can be written as

$$= 4 \times \frac{1}{4} (2 \pi r) + 2 \pi r + 4 \times 2$$

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By further calculation

$$= 2 \pi r + 2 \pi r + 8$$

$$= 4 \pi r + 8$$

So we get

$$= 4 \times 3.14 \times 1 + 8$$

$$= 12.56 + 8$$

$$= 20.56 \text{ cm}$$

(ii) Area of shaded region = area of square – area of 4 quadrants – area of circle

It can be written as

$$= \text{side}^2 - 4 \times \frac{1}{4} \pi r^2 - \pi r^2$$

$$= 4^2 - \pi r^2 - \pi r^2$$

By further calculation

$$= 16 - 2\pi r^2$$

So we get

$$= 16 - 2 \times 3.14 \times 1^2$$

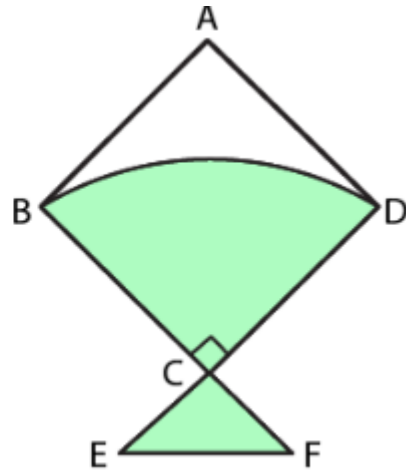
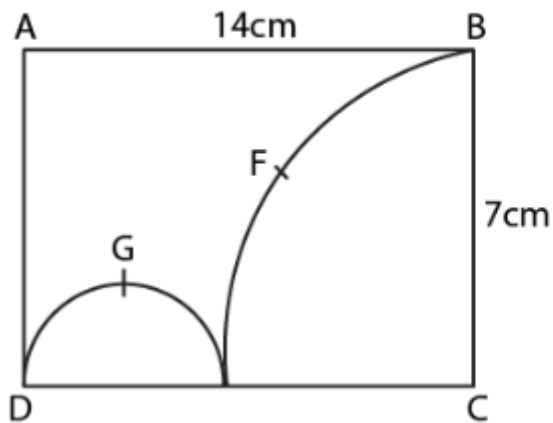
$$= 16 - 6.28$$

$$= 9.72 \text{ cm}^2$$

33. (a) In the figure given below, ABCD is a rectangle. AB = 14 cm, BC = 7 cm. From the rectangle, a quarter circle BFEC and a semicircle DGE are removed. Calculate the area of the remaining piece of the rectangle. (Take $\pi = 22/7$)

(b) The figure (ii) given below shows a kite, in which BCD is in the shape of a quadrant of circle of radius 42 cm. ABCD is a square and $\triangle CEF$ is an isosceles right angled triangle whose equal sides are 6 cm long. Find the area of the shaded region.

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Solution:

(a) Here

Area of remaining piece = area of rectangle ABCD – area of semicircle DGE – area of quarter BFEC

Substituting the values

$$= 14 \times 7 - \frac{1}{2} \times \pi (7/2)^2 - \frac{1}{4} \pi \times 7^2$$

By further calculation

$$= 14 \times 7 - \frac{1}{2} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} - \frac{1}{4} \times \frac{22}{7} \times 7 \times 7$$

So we get

$$= 98 - \frac{77}{4} - \frac{154}{4}$$

$$= 98 - 19.25 - 38.5$$

$$= 98 - 57.75$$

$$= 40.25 \text{ cm}^2$$

(b) In the given figure

ABCD is a square of side = radius of quadrant = 42 cm

$\triangle CEF$ is an isosceles right triangle with each side = 6 cm

Area of shaded portion = area of quadrant + area of isosceles right triangle

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It can be written as

$$= \frac{1}{4} \pi r^2 + \frac{1}{2} EC \times FC$$

Substituting the values

$$= \frac{1}{4} \times \frac{22}{7} \times 42 \times 42 + \frac{1}{2} \times 6 \times 6$$

By further calculation

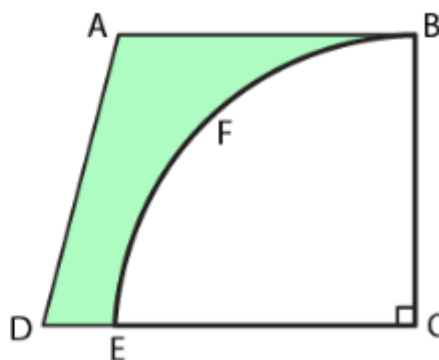
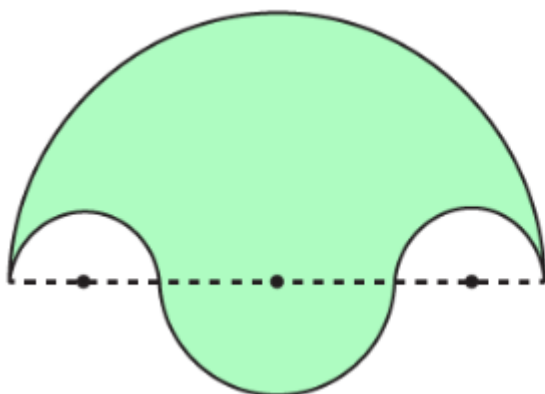
$$= 1386 + 18$$

$$= 1404 \text{ cm}^2$$

34. (a) In the figure (i) given below, the boundary of the shaded region in the given diagram consists of four semicircular arcs, the smallest two being equal. If the diameter of the largest is 14 cm and of the smallest is 3.5 cm, calculate

(i) the length of the boundary.

(ii) the area of the shaded region.



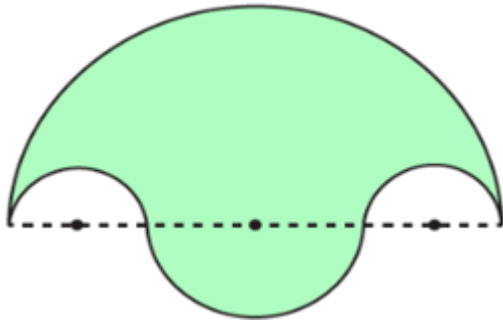
(b) In the figure (ii) given below, a piece of cardboard, in the shape of a trapezium ABCD, AB || CD and $\angle BOD = 90^\circ$, quarter circle BFEC is removed. Given AB = BC = 3.5 cm and DE = 2 cm. Calculate the area of the remaining piece of the cardboard.

Solution:

(a) (i) We know that

Length of boundary = Circumference of bigger semi-circle + Circumference of small semi-circle + 2 × circumference of the smaller semi-circles

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It can be written as

$$= \pi R + \pi r_1 + 2 \times \pi r_2$$

$$= \pi (R + r_1) + 2\pi r_2$$

Substituting the values

$$= \frac{22}{7} (7 + 3.5) + 2 \times \frac{22}{7} \times \frac{3.5}{2}$$

By further calculation

$$= \frac{22}{7} \times 10.5 + 11$$

So we get

$$= 33 + 11$$

$$= 44 \text{ cm}$$

(ii) We know that

Area of shaded region = Area of bigger semicircle + area of small semicircle – 2 × area of smaller semicircles

It can be written as

$$= \frac{1}{2} \pi (7)^2 + \frac{1}{2} \pi (3.5)^2 - 2 \times \frac{1}{2} \pi (1.75)^2$$

By further calculation

$$= \frac{1}{2} \times \frac{22}{7} \times 7 \times 7 + \frac{1}{2} \times \frac{22}{7} \times 3.5 \times 3.5 - \frac{22}{7} \times 1.75 \times 1.75$$

So we get

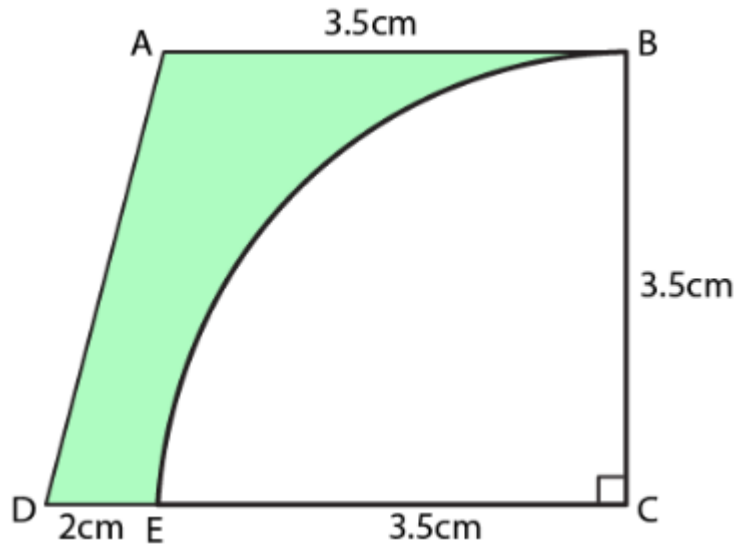
$$= 77 + 19.25 - 9.625$$

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$$= 86.625 \text{ cm}^2$$

(b) Here

ABCD is a trapezium in which $AB \parallel DC$ and $\angle C = 90^\circ$



$AB = BC = 3.5 \text{ cm}$ and $DE = 2 \text{ cm}$

Radius of quadrant = 3.5 cm

We know that

Area of trapezium = $\frac{1}{2} (AB + DC) \times BC$

Substituting the values

$$= \frac{1}{2} (3.5 + 3.5 + 2) \times 3.5$$

By further calculation

$$= \frac{1}{2} (9 \times 3.5)$$

$$= 4.5 \times 3.5$$

$$= 15.75 \text{ cm}^2$$

So the area of quadrant = $\frac{1}{4} \pi r^2$

Substituting the values

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

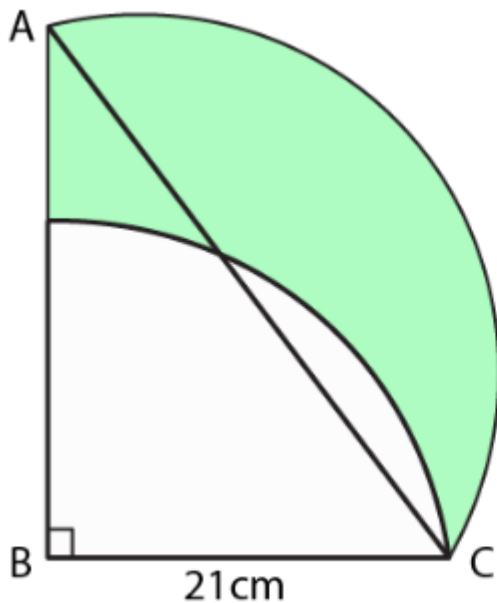
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$$= 9.625 \text{ cm}^2$$

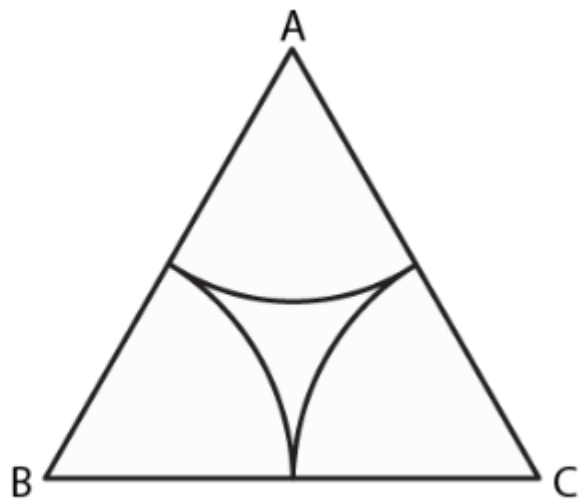
$$\text{Area of shaded portions} = 15.75 - 9.625 = 6.125 \text{ cm}^2$$

35. (a) In the figure (i) given below, ABC is a right angled triangle, $\angle B = 90^\circ$, AB = 28 cm and BC = 21 cm. With AC as diameter a semi-circle is drawn and with BC as radius a quarter circle is drawn. Find the area of the shaded region correct to two decimal places.

(b) In the figure (ii) given below, ABC is an equilateral triangle of side 8 c. A, B and C are the centers of circular arcs of equal radius. Find the area of the shaded region correct upto 2 decimal places. (Take $\pi = 3.142$ and $\sqrt{3} = 1.732$)



(i)



(ii)

Solution:

(a) In right $\triangle ABC$

$$\angle B = 90^\circ$$

Using Pythagoras theorem

$$AC^2 = AB^2 + BC^2$$

Substituting the values

$$= 28^2 + 21^2$$

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$$= 784 + 441$$

$$= 1225$$

So we get

$$AC = \sqrt{1225} = 35 \text{ cm}$$

Here

$$\text{Radius of semi-circle (R)} = 35/2$$

$$\text{Radius of quadrant (r)} = 21 \text{ cm}$$

So the area of shaded region = area of $\triangle ABC$ + area of semi-circle – area of quadrant

$$= \frac{1}{2} \times 28 \times 21 + \frac{1}{2} \pi R^2 - \frac{1}{4} r^2$$

Substituting the values

$$= 294 + \frac{1}{2} \times \frac{22}{7} \times \frac{35}{2} \times \frac{35}{2} - \frac{1}{4} \times \frac{22}{7} \times 21 \times 21$$

By further calculation

$$= 294 + 1925/4 - 693/2$$

$$= 294 + 481.25 - 346.5$$

So we get

$$= 775.25 - 346.50$$

$$= 428.75 \text{ cm}^2$$

(b) We know that

$\triangle ABC$ is an equilateral triangle of side 8 cm

A, B, C are the centres of three circular arcs of equal radius

$$\text{Radius} = 8/2 = 4 \text{ cm}$$

Here

$$\text{Area of } \triangle ABC = \frac{\sqrt{3}}{4} a^2$$

Substituting the values

$$= \frac{\sqrt{3}}{4} \times 8 \times 8$$

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$$= \sqrt{3}/4 \times 64$$

So we get

$$= 16\sqrt{3}\text{cm}^2$$

Substituting the value of $\sqrt{3}$

$$= 16 \times 1.732$$

$$= 27.712 \text{ cm}^2$$

So the area of 3 equal sectors of 60° whose radius is 4 cm $= 3 \times \pi r^2 \times 60/360$

By further calculation

$$= 3 \times 3.142 \times 4 \times 4 \times 1/6$$

So we get

$$= 3.142 \times 8$$

$$= 25.136 \text{ cm}^2$$

$$\text{Area of shaded region} = 27.712 - 25.136 = 2.576 = 2.58 \text{ cm}^2$$

36. A circle is inscribed in a regular hexagon of side $2\sqrt{3}$ cm. Find

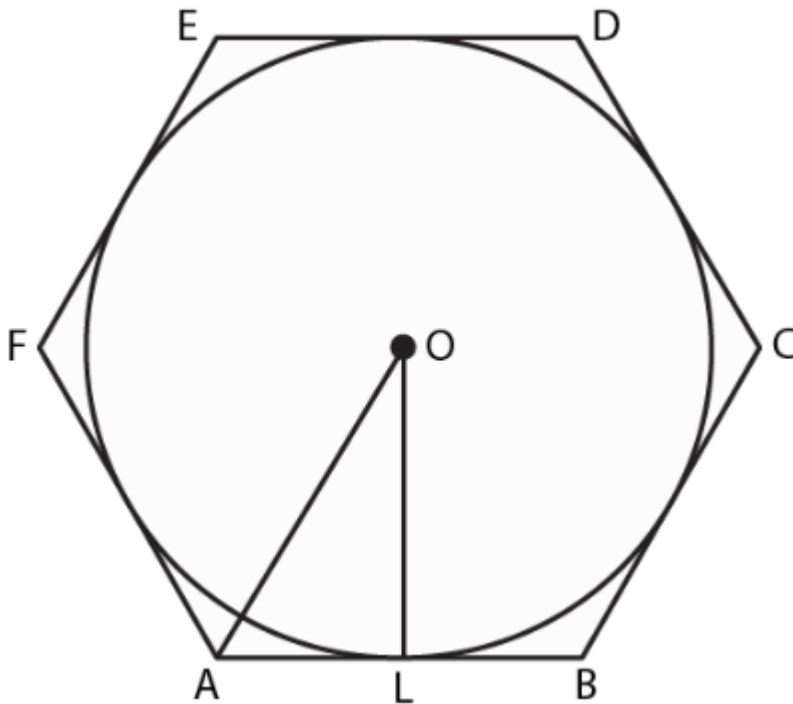
(i) the circumference of the inscribed circle

(ii) the area of the inscribed circle

Solution:

It is given that

ABCDEF is a regular hexagon of side $2\sqrt{3}$ cm and a circle is inscribed in it with O as the centre



Radius of inscribed circle = $\frac{\sqrt{3}}{2} \times \text{side of regular hexagon}$

Substituting the values

$$= \frac{\sqrt{3}}{2} \times 2\sqrt{3}$$

$$= 3 \text{ cm}$$

(i) We know that

Circumference of the circle = $2\pi r$

Substituting the values

$$= 2\pi \times 3$$

By further calculation

$$= (6 \times 22) / 7$$

$$= 132/7 \text{ cm}$$

(ii) Area of the circle = πr^2

Substituting the values

$$= \pi \times 3 \times 3$$

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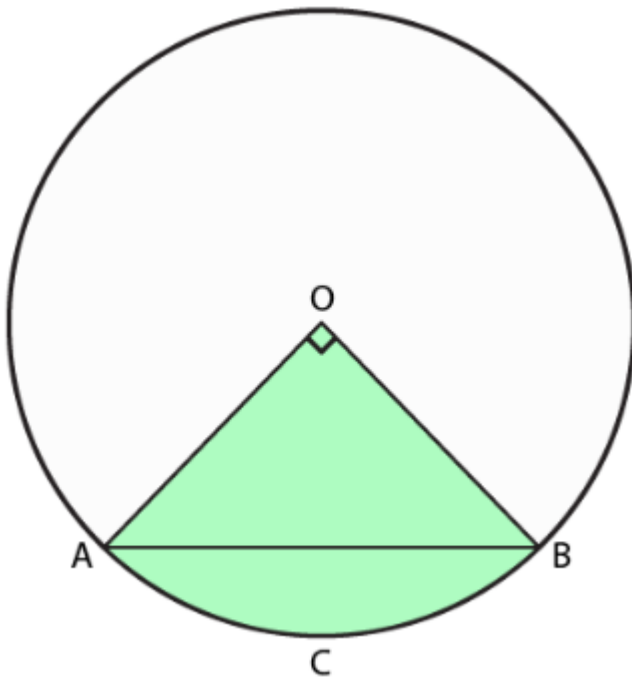
By further calculation

$$= (9 \times 22) / 7$$

$$= 198/7 \text{ cm}^2$$

37. In the figure (i) given below, a chord AB of a circle of radius 10 cm subtends a right angle at the centre O. Find the area of the sector OACB and of the major segment. Take $\pi = 3.14$.

Solution:



It is given that

Radius of the circle = 10 cm

Angle at the centre subtended by a chord AB = 90°

We know that

$$\text{Area of sector OACB} = \pi r^2 \times 90/360$$

Substituting the values

$$= 3.14 \times 10 \times 10 \times 90/360$$

So we get

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$$= 314 \times \frac{1}{4}$$

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

Here

$$\text{Area of } \triangle OAB = \frac{1}{2} \times 10 \times 10 = 50 \text{ cm}^2$$

$$\text{Area of minor segment} = \text{Area of sector } \triangle ACB - \text{Area of } \triangle OAB$$

Substituting the values

$$= 78.5 - 50$$

$$= 28.5 \text{ cm}^2$$

$$\text{Area of circle} = \pi r^2$$

Substituting the values

$$= 3.14 \times 10 \times 10$$

$$= 314 \text{ cm}^2$$

$$\text{Area of major segment} = \text{area of circle} - \text{area of minor segment}$$

Substituting the values

$$= 314 - 28.5$$

$$= 285.5 \text{ cm}^2$$

Exercise 16.4

1. Find the surface area and volume of a cube whose one edge is 7 cm.

Solution:

It is given that

One edge of cube $a = 7 \text{ cm}$

We know that

$$\text{Surface area of cube} = 6a^2$$

Substituting the values

$$= 6 (7)^2$$

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$$= 6 \times 7 \times 7$$

$$= 294 \text{ cm}^2$$

Volume of cube = a^3

Substituting the values

$$= 7^3$$

$$= 7 \times 7 \times 7$$

$$= 343 \text{ cm}^3$$

2. Find the surface area and the volume of a rectangular solid measuring 5 m by 4 m by 3 m. Also find the length of a diagonal.

Solution:

In a rectangular solid

$$l = 5 \text{ m, } b = 4 \text{ m and } h = 3 \text{ m}$$

Here

$$\text{Surface area of rectangular solid} = 2 (lb + bh + lh)$$

Substituting the values

$$= 2 (5 \times 4 + 4 \times 3 + 5 \times 3)$$

By further calculation

$$= 2 (20 + 12 + 15)$$

$$= 2 \times 47$$

$$= 94 \text{ sq. m}$$

$$\text{Volume of rectangular solid} = l \times b \times h$$

Substituting the values

$$= 5 \times 4 \times 3$$

$$= 60 \text{ m}^3$$

We know that

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$$\text{Length of diagonal} = \sqrt{l^2 + b^2 + h^2}$$

Substituting the values

$$= \sqrt{5^2 + 4^2 + 3^2}$$

So we get

$$= \sqrt{25 + 16 + 9}$$

$$= \sqrt{50}$$

$$= \sqrt{25 \times 2}$$

It can be written as

$$= 5 \sqrt{2} \text{ m}$$

Substituting the value of $\sqrt{2}$

$$= 5 \times 1.414$$

$$= 7.07 \text{ m}$$

Therefore, the length of diagonal is 7.07 m.

3. The length and breadth of a rectangular solid are respectively 25 cm and 20 cm. If the volume is 7000 cm³, find its height.

Solution:

It is given that

Length of rectangular solid = 25 cm

Breadth of rectangular solid = 20 cm

Volume of rectangular solid = 7000 cm³

Consider height of rectangular solid = h cm

Here

$$\text{Volume} = l \times b \times h$$

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Substituting the values

$$7000 = 25 \times 20 \times h$$

By further calculation

$$25 \times 20 \times h = 7000$$

$$h = 7000 / (25 \times 20)$$

So we get

$$h = 700 / (25 \times 2)$$

$$h = 350 / 25$$

By division

$$h = 70 / 5$$

$$h = 14 \text{ cm}$$

Therefore, height of rectangular solid is 14 cm.

4. A class room is 10 m long, 6 m broad and 4 m high. How many students can it accommodate if one student needs 1.5 m^2 of floor area? How many cubic metres of air will each student have?

Solution:

The given dimensions of class room are

$$\text{Length (l)} = 10 \text{ m}$$

$$\text{Breadth (b)} = 6 \text{ m}$$

$$\text{Height (h)} = 4 \text{ m}$$

We know that

$$\text{Floor area of class room} = l \times b$$

Substituting the values

$$= 10 \times 6$$

$$= 60 \text{ m}^2$$

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Here

One student needs 1.5 m^2 floor area

So the number of students = $60/1.5$

Multiply and divide by 10

$$= (60 \times 10)/15$$

$$= 600/15$$

$$= 40 \text{ students}$$

Volume of class room = $l \times b \times h$

Substituting the values

$$= 10 \times 6 \times 4$$

$$= 240 \text{ m}^3$$

So the cubic metres of air for each student = volume of classroom/ number of students

Substituting the values

$$= 240/40$$

$$= 6 \text{ m}^3$$

5. (a) The volume of a cuboid is 1440 cm^3 . Its height is 10 cm and the cross-section is a square. Find the side of the square.

(b) The perimeter of one face of a cube is 20 cm. Find the surface area and the volume of the cube.

Solution:

(a) It is given that

Volume of cuboid = 1440 cm^3

Height of cuboid = 10 cm

We know that

Volume of cuboid = area of square $\times$ height

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Substituting the values

$$1440 = \text{area of square} \times 10$$

By further calculation

$$\text{Area of square} = 1440/10 = 144 \text{ cm}^2$$

Here

$$\text{Side} \times \text{side} = 144$$

So we get

$$\text{Side} = \sqrt{144} = 12 \text{ cm}$$

Therefore, the side of square is 12 cm.

(b) It is given that

$$\text{Perimeter of one face of a cube} = 20 \text{ cm}$$

$$\text{Perimeter of one face of a cube} = 4 \times \text{side}$$

We can write it as

$$20 = 4 \times \text{side}$$

By further calculation

$$\text{Side} = 20/4 = 5 \text{ cm}$$

Here

$$\text{Area of one face} = \text{side} \times \text{side}$$

Substituting the values

$$= 5 \times 5$$

$$= 25 \text{ cm}^2$$

$$\text{Area of 6 faces} = 6 \times 25 = 150 \text{ cm}^2$$

$$\text{So the volume of cube} = \text{side} \times \text{side} \times \text{side}$$

Substituting the values

$$= 5 \times 5 \times 5$$

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$$= 125 \text{ cm}^3$$

6. Mary wants to decorate her Christmas tree. She wants to place the tree on a wooden box covered with coloured papers with pictures of Santa Claus. She must know the exact quantity of paper to buy for this purpose. If the box has length 80 cm, breadth 40 cm and height 20 cm respectively, then how many square sheets of paper of side 40 cm would she require?

Solution:

It is given that

Length of box (l) = 80 cm

Breadth (b) = 40 cm

Height (h) = 20 cm

We know that

Surface area of the box = $2 (lh + bh + hl)$

Substituting the values

$$= 2 (80 \times 40 + 40 \times 20 + 20 \times 80)$$

By further calculation

$$= 2 (320 + 800 + 1600)$$

$$= 2 \times 5600$$

$$= 11200 \text{ cm}^2$$

So the area of square sheet = side^2

$$= 40^2$$

$$= 1600 \text{ cm}^2$$

Here

Number of sheets = area of box / area of one sheet

Substituting the values

$$= 11200/1600$$

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= 7

7. The volume of a cuboid is 3600 cm^3 and its height is 12 cm. The cross-section is a rectangle whose length and breadth are in the ratio 4: 3. Find the perimeter of the cross-section.

Solution:

It is given that

Volume of a cuboid = 3600 cm^3

Height of cuboid = 12 cm

We know that

Volume of cuboid = Area of rectangle $\times$ height

Substituting the values

$3600 = \text{area of rectangle} \times 12$

By further calculation

Area of rectangle = $3600 / 12$

Area of rectangle = 300 cm^2 (1)

Here

Ratio of length and breadth of rectangle = 4: 3

Consider

Length of rectangle = $4x$

Breadth of rectangle = $3x$

Area of rectangle = length $\times$ breadth

Substituting the values

Area of rectangle = $4x \times 3x$

So we get

Area of rectangle = $12x^2 \text{ cm}^2$ (2)

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Using equations (1) and (2)

$$12x^2 = 300$$

$$x^2 = 300/12$$

So we get

$$x^2 = 25$$

$$x = \sqrt{25} = 5$$

Here

$$\text{Length of rectangle} = 4 \times 5 = 20 \text{ cm}$$

$$\text{Breadth of rectangle} = 3 \times 5 = 15 \text{ cm}$$

$$\text{Perimeter of the cross section} = 2(l + b)$$

Substituting the values

$$= 2(20 + 15)$$

$$= 2 \times 35$$

$$= 70 \text{ cm}$$

8. The volume of a cube is 729 cm^3 . Find its surface area and the length of a diagonal.

Solution:

It is given that

$$\text{Volume of a cube} = 729 \text{ cm}^3$$

We can write it as

$$\text{side} \times \text{side} \times \text{side} = 729$$

$$(\text{side})^3 = 729$$

So we get

$$\text{side} = \sqrt[3]{729} = \sqrt[3]{9 \times 9 \times 9}$$

$$\text{Side} = 9 \text{ cm}$$

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We know that

$$\text{Surface area of cube} = 6 (\text{side})^2$$

Substituting the values

$$= 6 \times (9)^2$$

$$= 6 \times 9 \times 9$$

$$= 486 \text{ cm}^2$$

$$\text{So the length of a diagonal} = \sqrt{3} \times \text{side}$$

Substituting the value

$$= \sqrt{3} \times 9$$

$$= 1.73 \times 9$$

$$= 15.57 \text{ cm}$$

9. The length of the longest rod which can be kept inside a rectangular box is 17 cm. If the inner length and breadth of the box are 12 cm and 8 cm respectively, find its inner height.

Solution:

Consider h m as the inner height

It is given that

Length of longest rod inside a rectangular box = 17 cm which is same as diagonal of rectangular box

$$17 = \sqrt{l^2 + b^2 + h^2}$$

Substituting the values

$$17 = \sqrt{12^2 + 8^2 + h^2}$$

By squaring on both sides

$$17^2 = 12^2 + 8^2 + h^2$$

By further calculation

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$$289 = 144 + 64 + h^2$$

$$289 = 208 + h^2$$

So we get

$$h^2 + 208 = 289$$

$$h^2 = 289 - 208 = 81$$

$$h = \sqrt{81} = 9 \text{ cm}$$

Therefore, the inner height of rectangular box is 9 cm.

10. A closed rectangular box has inner dimensions 90 cm by 80 cm by 70 cm. Calculate its capacity and the area of tin-foil needed to line its inner surface.

Solution:

It is given that

Inner length of rectangular box = 90 cm

Inner breadth of rectangular box = 80 cm

Inner height of rectangular box = 70 cm

We know that

Capacity of rectangular box = volume of rectangular box = $l \times b \times h$

Substituting the values

$$= 90 \times 80 \times 70$$

$$= 504000 \text{ cm}^3$$

Here

Required area of tin foil = $2 (lb + bh + lh)$

Substituting the values

$$= 2 (90 \times 80 + 80 \times 70 + 90 \times 70)$$

By further calculation

$$= 2 (7200 + 5600 + 6300)$$

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So we get

$$= 2 \times 19100$$

$$= 38200 \text{ cm}^2$$

11. The internal measurements of a box are 20 cm long, 16 cm wide and 24 cm high. How many 4 cm cubes could be put into the box?

Solution:

It is given that

$$\text{Volume of box} = 20 \text{ cm} \times 16 \text{ cm} \times 14 \text{ cm}$$

$$\text{Volume of cubes} = 4 \text{ cm} \times 4 \text{ cm} \times 4 \text{ cm}$$

We know that

$$\text{Number of cubes put into the box} = \text{volume of box} / \text{volume of cubes}$$

Substituting the values

$$= (20 \times 16 \times 24) / (4 \times 4 \times 4)$$

$$= 5 \times 4 \times 6$$

$$= 120$$

Therefore, 120 cubes can be put into the box.

12. The internal measurements of a box are 10 cm long, 8 cm wide and 7 cm high. How many cubes of side 2 cm can be put into the box?

Solution:

It is given that

$$\text{Length of box} = 10 \text{ cm}$$

$$\text{Breadth of box} = 8 \text{ cm}$$

$$\text{Height of box} = 7 \text{ cm}$$

We know that

3 number of cubes of side 2 cm can be put in box

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i.e. height of box is 7 cm so only 3 cubes can be put height wise

13. A certain quantity of wood costs Rs 250 per m^3 . A solid cubical block of such wood is bought for Rs 182.25. Calculate the volume of the block and use the method of factors to find the length of one edge of the block.

Solution:

It is given that

Cost of Rs 250 for 1 m^3 wood

Cost of Rs 1 for $1/250 \text{ m}^3$ wood

Cost of Rs 182.25 for $182.25/250 \text{ m}^3$ wood

Here

Quantity of wood = $182.25/250 \text{ m}^3$

Multiply and divide by 100

$$= 18225 / (250 \times 100)$$

So we get

$$= 18225 / (25 \times 1000)$$

$$= 729 / 1000$$

$$= 0.729 \text{ m}^3$$

We know that

Volume of given block = 0.729 m^3

Consider the length of one edge of block = $x \text{ m}$

So we get

$$x^3 = 0.729 \text{ m}^3$$

Now taking cube root on both sides

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$$x = \sqrt[3]{0.729} = \sqrt[3]{\frac{729}{1000}}$$

It can be written as

$$= \sqrt[3]{\frac{3 \times 3 \times 3 \times 3 \times 3 \times 3}{2 \times 2 \times 2 \times 5 \times 5 \times 5}}$$

$$\begin{array}{r|l} 3 & 729 \\ \hline 3 & 243 \\ \hline 3 & 81 \\ \hline 3 & 27 \\ \hline 3 & 9 \\ \hline 3 & 3 \\ \hline 1 & \end{array}$$

$$\begin{array}{r|l} 2 & 1000 \\ \hline 2 & 500 \\ \hline 2 & 250 \\ \hline 5 & 125 \\ \hline 5 & 25 \\ \hline 5 & 5 \\ \hline 1 & \end{array}$$

So we get

$$= (3 \times 3) / (2 \times 5)$$

$$= 9/10$$

$$= 0.9 \text{ m}$$

Therefore, the length of one edge of the block is 0.9 m.

14. A cube of 11 cm edge is immersed completely in a rectangular vessel containing water. If the dimensions of the base of the vessel are 15 cm × 12 cm, find the rise in the water level in centimetres correct to 2 decimal places, assuming that no water over flows.

Solution:

It is given that

Edge of cube = 11 cm

Volume of cube = edge³

Substituting the values

$$= 11^3$$

$$= 11 \times 11 \times 11$$

$$= 1331 \text{ cm}^3$$

We know that

The dimensions of the base of the vessel are 15 cm × 12 cm

Consider the rise in the water level = h cm

So the volume of cube = volume of vessel

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Substituting the values

$$1331 = 15 \times 12 \times h$$

By further calculation

$$h = 1331 / (15 \times 12)$$

So we get

$$h = 1331 / 180 = 7.39 \text{ cm}$$

Therefore, the rise in the water level is 7.39 cm.

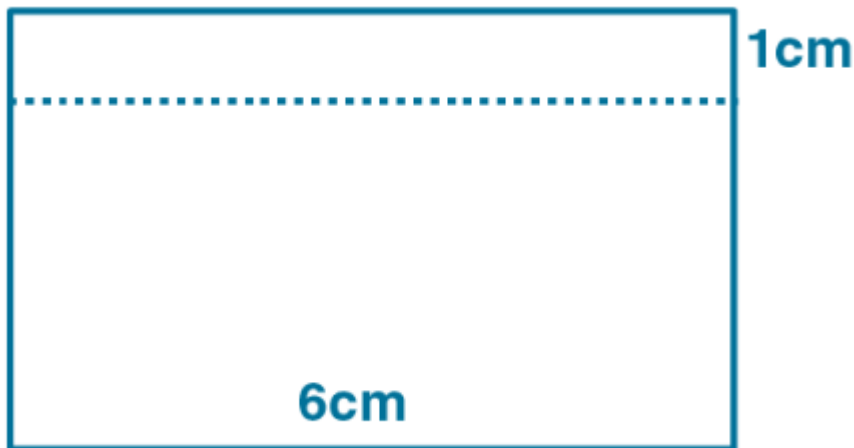
15. A rectangular container, whose base is a square of side 6 cm, stands on a horizontal table and holds water upto 1 cm from the top. When a cube is placed in the water and is completely submerged, the water rises to the top and 2 cm³ of water overflows, calculate the volume of the cube.

Solution:

If the base of rectangular container is a square

$$l = 6 \text{ cm and } b = 6 \text{ cm}$$

When a cube is placed in it, water rises to top i.e. through height 1 cm and 2 cm³ of water overflows



We know that

$$\text{Volume of cube} = \text{Volume of water displaced}$$

Substituting the values

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$$= 6 \times 6 \times 1 + 2$$

$$= 36 + 2$$

$$= 38 \text{ cm}^3$$

16. (a) Two cubes, each with 12 cm edge, are joined end to end. Find the surface area of the resulting cuboid.

(b) A solid cube of side 12 cm is cut into eight cubes of equal volume. What will be the side of the new cube? Also, find the ratio between the surface area of the original cube and the sum of the surface areas of the new cubes.

Solution:

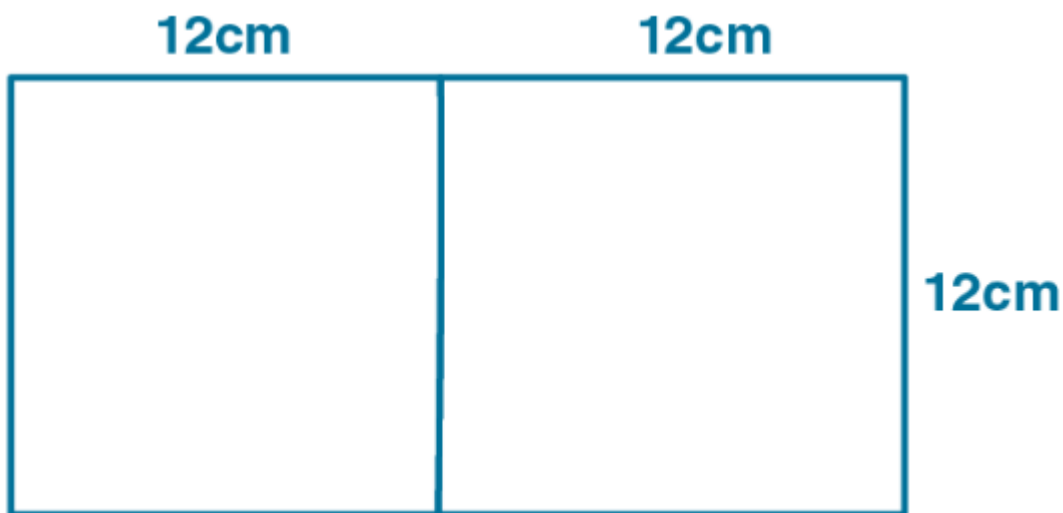
(a) We know that

By joining two cubes end to end a cuboid is formed whose dimensions are

$$l = 12 + 12 = 24 \text{ cm}$$

$$b = 12 \text{ cm}$$

$$h = 12 \text{ cm}$$



Here

$$\text{Total surface area of cuboid} = 2 (lb + bh + hl)$$

Substituting the values

$$= 2 (24 \times 12 + 12 \times 12 + 12 \times 24)$$

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By further calculation

$$= 2 (288 + 144 + 288)$$

So we get

$$= 2 \times 720$$

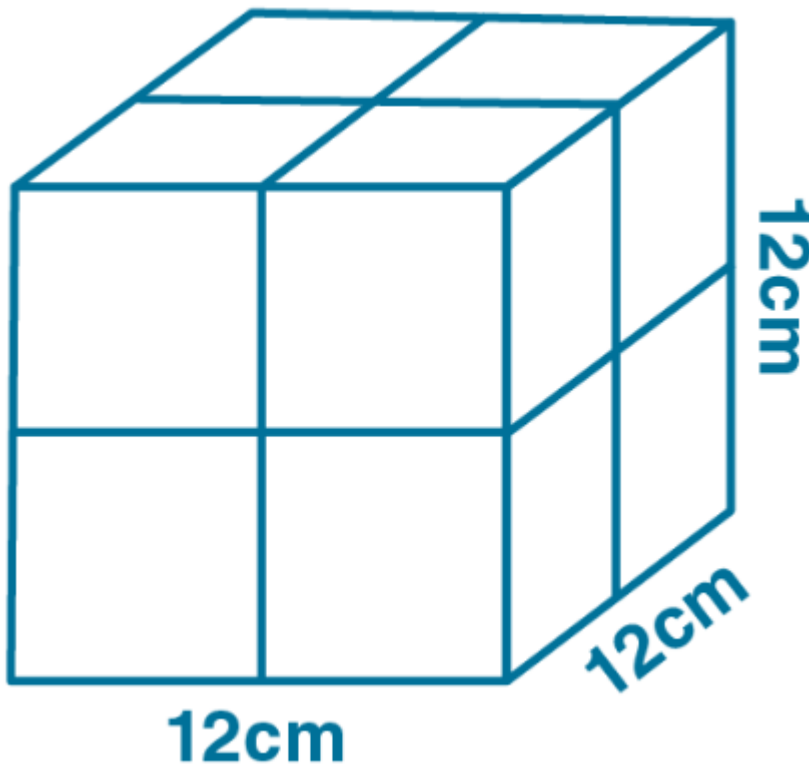
$$= 1440 \text{ cm}^2$$

(b) We know that

Side of a cube = 12 cm

Here

$$\text{Volume} = \text{side}^3 = 12^3 = 1728 \text{ cm}^3$$



If cut into 8 equal cubes

$$\text{Volume of each cube} = 1728/8 = 216 \text{ cm}^3$$

$$\text{side} = \sqrt[3]{216} = \sqrt[3]{6 \times 6 \times 6} = 6 \text{ cm}$$

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Surface area of original cube = $6 \times \text{side}^2$

Substituting the values

$$= 6 \times 12^2$$

$$= 6 \times 144$$

$$= 864 \text{ cm}^2$$

Surface area of one smaller cube = 6×6^2

So we get

$$= 6 \times 36$$

$$= 216 \text{ cm}^2$$

Surface area of 8 cube = 216×8

$$= 1728 \text{ cm}^2$$

So the ratio between their areas = $864: 1728 = 1: 2$

17. A cube of a metal of 6 cm edge is melted and cast into a cuboid whose base is 9 cm × 8 cm. Find the height of the cuboid.

Solution:

It is given that

Edge of melted cube = 6 cm

Volume of melted cube = $6 \text{ cm} \times 6 \text{ cm} \times 6 \text{ cm} = 216 \text{ cm}^3$

Dimensions of cuboid are

Length = 9 cm

Breadth = 8 cm

h cm is the height

We know that

Volume of cuboid = $l \times b \times h$

Substituting the values

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$$= 9 \times 8 \times h$$

$$= 72 h \text{ cm}^3$$

Here

Volume of cuboid = Volume of melted metal cube

Substituting the values

$$72h = 216$$

$$h = 216/72 = 3 \text{ cm}$$

Therefore, the height of cuboid is 3 cm.

18. The area of a playground is 4800 m^2 . Find the cost of covering it with gravel 1 cm deep, if the gravel costs Rs 260 per cubic metre.

Solution:

It is given that

$$\text{Area of playground} = 4800 \text{ m}^2$$

We can write it as

$$l \times b = 4800$$

We know that

$$\text{Depth of level} = 1 \text{ cm}$$

$$h = 1 \text{ cm} = 1/100 \text{ m}$$

Here

$$\text{Volume of gravel} = l \times b \times h$$

Substituting the values

$$= 4800 \times 1/100$$

$$= 48 \text{ m}^3$$

$$\text{Cost of gravel} = \text{Rs } 260 \text{ per cubic metre}$$

$$\text{So the total cost} = 260 \times 48 = \text{Rs } 12480$$

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19. A field is 30 m long and 18 m broad. A pit 6 m long, 4 m wide and 3 m deep is dug out from the middle of the field and the earth removed is evenly spread over the remaining area of the field. Find the rise in the level of the remaining part of the field in centimetres correct to two decimal places.

Solution:

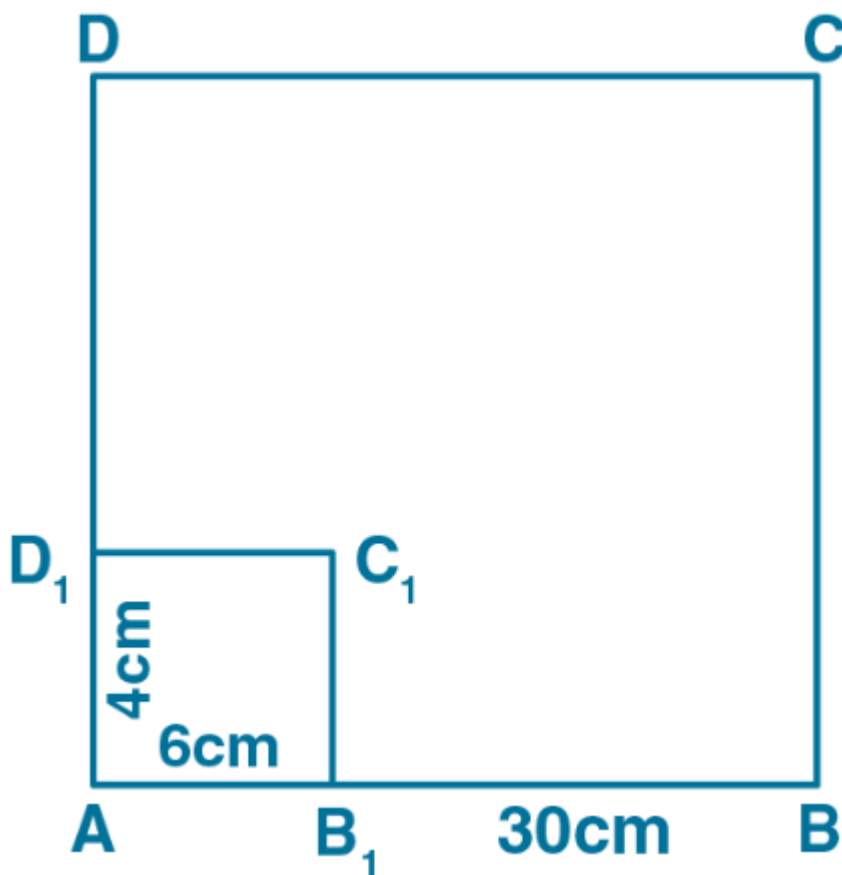
Consider ABCD is a field

Let ABCD be a part of the field where a pit is dug

Here

Volume of the earth dug out = $6 \times 4 \times 3 = 72 \text{ m}^3$

h m is the level raised over the field uniformly



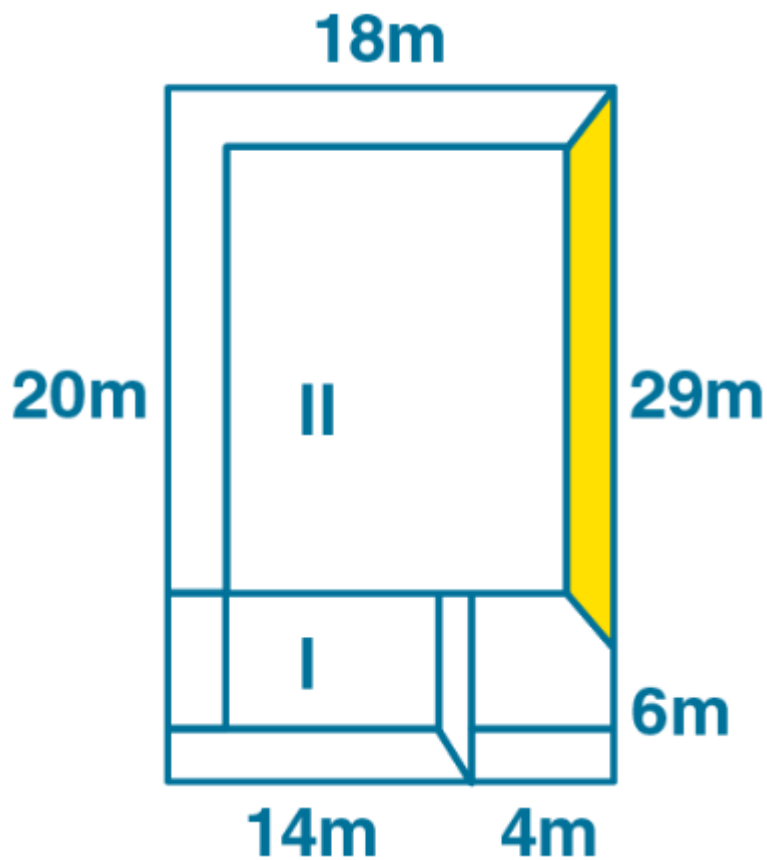
Now divide the raised level of the field into parts I and II

Volume of part I = $14 \times 6 \times h = 84h \text{ m}^3$

Volume of part II = $24 \times 18 \times h = 432h \text{ m}^3$

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Total volume of part I and II = $[84h + 432h] = 516h \text{ m}^3$



We know that

516 = volume of earth dug out

Substituting the values

$$516 = 72$$

So we get

$$h = 72/516 = 0.1395 \text{ m}$$

Multiply by 100

$$h = 0.1395 \times 100$$

$$h = 13.95 \text{ cm}$$

Therefore, the level has been raised by 13.95 cm.

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20. A rectangular plot is 24 m long and 20 m wide. A cubical pit of edge 4 m is dug at each of the four corners of the field and the soil removed is evenly spread over the remaining part of the plot. By what height does the remaining plot get raised?

Solution:

It is given that

Length of plot (l) = 24 m

Width of plot (b) = 20 m

So the area of plot = $l \times b = 24 \times 20 = 480 \text{ m}^2$

We know that

Side of cubical pit = 4 m

Volume of each pit = $4^3 = 64 \text{ m}^3$

Here

Volume of 4 pits at the corners = $4 \times 64 = 256 \text{ m}^3$

Area of surface of 4 pits = $4a^2$

= 4×4^2

= 64 m^2

So the area of remaining plot = $480 - 64 = 416 \text{ m}^2$

Height of the soil spread over the remaining plot = $256/416 = 8/13 \text{ m}$

21. The inner dimensions of a closed wooden box are 2 m, 1.2 m and 0.75 m. The thickness of the wood is 2.5 cm. Find the cost of wood required to make the box if 1 m^3 of wood costs Rs 5400.

Solution:

It is given that

Inner dimensions of wooden box are 2 m, 1.2 m and 0.75 m

Thickness of the wood = 2.5 cm

So we get

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$$= 25/10 \text{ cm}$$

It can be written as

$$= 25/10 \times 1/100$$

$$= 1/10 \times \frac{1}{4}$$

So we get

$$= 1/40$$

$$= 0.025 \text{ m}$$

So the external dimensions of wooden box are

$$(2 + 2 \times 0.025), (1.2 + 2 \times 0.025), (0.75 + 2 \times 0.025)$$

By further calculation

$$= (2 + 0.05), (1.2 + 0.05), (0.75 + 0.05)$$

$$= 2.05, 1.25, 0.80$$

Here

Volume of solid = External volume of box – Internal volume of box

Substituting the values

$$= 2.05 \times 1.25 \times 0.80 - 2 \times 1.2 \times 0.75$$

By further calculation

$$= 2.05 - 1.80$$

$$= 0.25 \text{ m}^3$$

Cost = Rs 5400 for 1 m^3

So the total cost = 5400×0.25

Multiply and divide by 100

$$= 5400 \times 25/100$$

$$= 54 \times 25$$

$$= \text{Rs } 1350$$

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22. A cubical wooden box of internal edge 1 m is made of 5 cm thick wood. The box is open at the top. If the wood costs Rs 9600 per cubic metre, find the cost of the wood required to make the box.

Solution:

It is given that

Internal edge of cubical wooden box = 1 m

Thickness of wood = 5 cm

We know that

External length = 1 m + 10 cm = 1.1 m

Breadth = 1 m + 10 cm = 1.1 m

Height = 1 m + 5 cm = 1.05 m

Here

Volume of the wood used = Outer volume – Inner volume

Substituting the values

$$= 1.1 \times 1.1 \times 1.05 - 1 \times 1 \times 1$$

By further calculation

$$= 1.205 - 1$$

$$= 0.2705 \text{ m}^3$$

Cost of 1 m^3 = Rs 9600

So the cost of 0.2705 m^3 = 9600×0.2705

$$= \text{Rs } 2596.80$$

23. A square brass plate of side x cm is 1 mm thick and weighs 4725 g. If one cc of brass weighs 8.4 gm, find the value of x.

Solution:

It is given that

Side of square brass plate = x cm

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Here $l = x$ cm and $b = x$ cm

Thickness of plate = 1 mm = $1/10$ cm

We know that

Volume of the plate = $l \times b \times h$

Substituting the values

$$= x \times x \times 1/10$$

$$= x^2/10 \text{ cm}^3 \dots (1)$$

Here

8.4 gm weight brass having volume = 1 cc

1 gm weight brass having volume = $1/8.4$ cc

So the 4725 gm weight brass having volume = $4725 \times 1/8.4 = 562.5$ cc

Volume of plate = 562.5 cc = $562.5 \text{ cm}^3 \dots (2)$

Using both the equations

$$x^2/10 = 562.5$$

By cross multiplication

$$x^2 = 562.5 \times 10 = 5625$$

Here

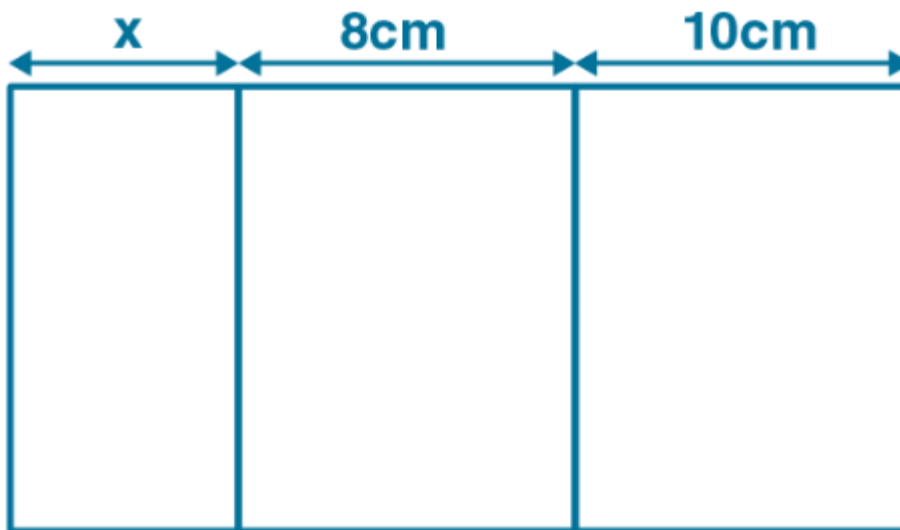
$$x = \sqrt{5625} = 75 \text{ cm}$$

Therefore, the value of x is 75 cm.

24. Three cubes whose edges are x cm, 8 cm and 10 cm respectively are melted and recast into a single cube of edge 12 cm. Find x .

Solution:

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It is given that

Edges of three cubes are x cm, 8 cm and 10 cm

So the volumes of these cubes are x^3 , 8^3 and 10^3 i.e. x^3 , 512 cm^3 and 1000 cm^3

We know that

Edges of new cube formed = 12 cm

Volume of new cube = $12^3 = 1728 \text{ cm}^3$

Based on the question

$$x^3 + 512 + 1000 = 1728$$

By further calculation

$$x^3 + 1512 = 1728$$

$$x^3 = 216$$

It can be written as

$$x^3 = 6 \times 6 \times 6$$

So we get

$$x = 6 \text{ cm}$$

25. The area of cross-section of a pipe is 3.5 cm^2 and water is flowing out of pipe at the rate of 40 cm/s. How much water is delivered by the pipe in one minute?

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Solution:

It is given that

Area of cross-section of pipe = 3.5 cm^2

Speed of water = 40 cm/sec

Length of water column in 1 sec = 40 cm

We know that

Volume of water flowing in 1 second = Area of cross section $\times$ length

Substituting the values

$$= 3.5 \times 40$$

$$= 35 \times 4$$

$$= 140 \text{ cm}^3$$

So the volume of water flowing in 1 minute i.e. 60 sec = $140 \times 60 \text{ cm}^3$

Here

$$1 \text{ litre} = 1000 \text{ cm}^3$$

So we get

$$\text{Volume} = (140 \times 60) / 100$$

$$= (14 \times 6) / 10$$

$$= 84 / 10$$

$$= 8.4 \text{ litres}$$

26. (a) The figure (i) given below shows a solid of uniform cross-section. Find the volume of the solid. All measurements are in cm and all angles in the figure are right angles.

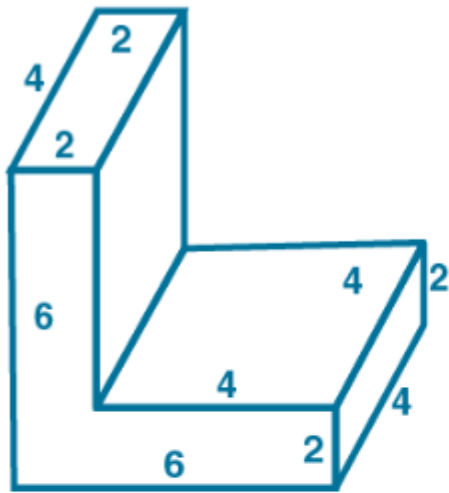
(b) The figure (ii) given below shows the cross section of a concrete wall to be constructed. It is 2 m wide at the top, 3.5 m wide at the bottom and its height is 6 m and its length is 400 m. Calculate

(i) the cross sectional area and

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(ii) volume of concrete in the wall.

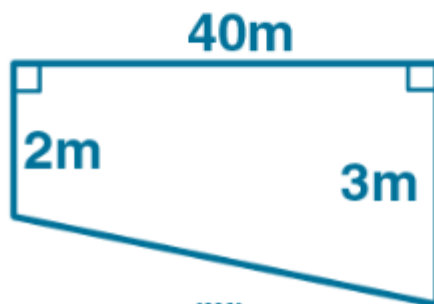
(c) The figure (iii) given below show the cross section of a swimming pool 10 m broad, 2 m deep at one end and 3 m deep at the other end. Calculate the volume of water it will hold when full, given that its length is 40 m.



(i)



(ii)



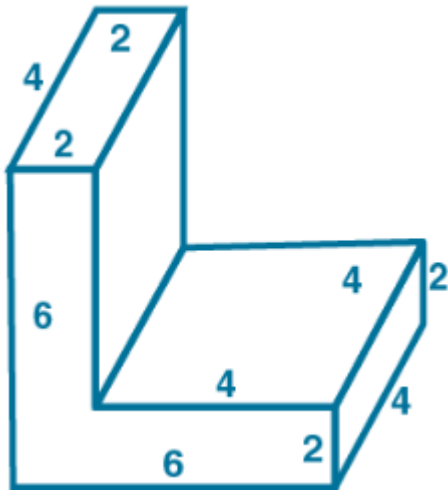
(iii)

Solution:

(a) We know that

The given figure can be divided into two cuboids of dimensions 4 cm, 4 cm, 2 cm, 4 cm, 2 cm and 6 cm

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Volume of solid = $4 \times 4 \times 2 + 4 \times 2 \times 6$

$$= 32 + 48$$

$$= 80 \text{ cm}^3$$

(b) We know that

Figure (ii) is a trapezium with parallel sides 2 m and 3.5 m

(i) Area of cross section = $\frac{1}{2}$ (sum of parallel sides) $\times$ height

Substituting the values

$$= \frac{1}{2} (2 + 3.5) \times 6$$

By further calculation

$$= \frac{1}{2} \times 5.5 \times 6$$

So we get

$$= 5.5 \times 3$$

$$= 16.5 \text{ m}^2$$

(ii) Volume of concrete in the wall = Area of cross section $\times$ length

Substituting the values

$$= 16.5 \times 400$$

$$= 165 \times 40$$

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$$= 6600 \text{ m}^3$$

(c) We know that

From figure (iii) we know that it is trapezium with parallel sides 2 m and 3m

Here

Area of cross section = $\frac{1}{2}$ (sum of parallel sides) $\times$ height

Substituting the values

$$= \frac{1}{2} (2 + 3) \times 10$$

By further calculation

$$= \frac{1}{2} \times 5 \times 10$$

$$= 5 \times 5$$

$$= 25 \text{ m}^2$$

So the volume of water it will hold when full = area of cross section $\times$ height

$$= 25 \times 40$$

$$= 1000 \text{ m}^3$$

27. A swimming pool is 50 metres long and 15 metres wide. Its shallow and deep ends are $1\frac{1}{2}$ metres and $14\frac{1}{2}$ metres deep respectively. If the bottom of the pool slopes uniformly, find the amount of water required to fill the pool.

Solution:

It is given that

Length of swimming pool = 50 m

Width of swimming pool = 15 m

Its shallow and deep ends are $1\frac{1}{2}$ m and $5\frac{1}{2}$ m deep

We know that

Area of cross section of swimming pool = $\frac{1}{2}$ (sum of parallel sides) $\times$ width

Substituting the values

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$$= \frac{1}{2} (1 \frac{1}{2} + 4 \frac{1}{2}) \times 15$$

By further calculation

$$= \frac{1}{2} (3/2 + 9/2) \times 15$$

So we get

$$= \frac{1}{2} [(3 + 9)/ 2] \times 15$$

$$= \frac{1}{2} \times 12/2 \times 15$$

$$= \frac{1}{2} \times 6 \times 15$$

$$= 3 \times 15$$

$$= 45 \text{ m}^2$$

Here

Amount of water required to fill pool = Area of cross section $\times$ length

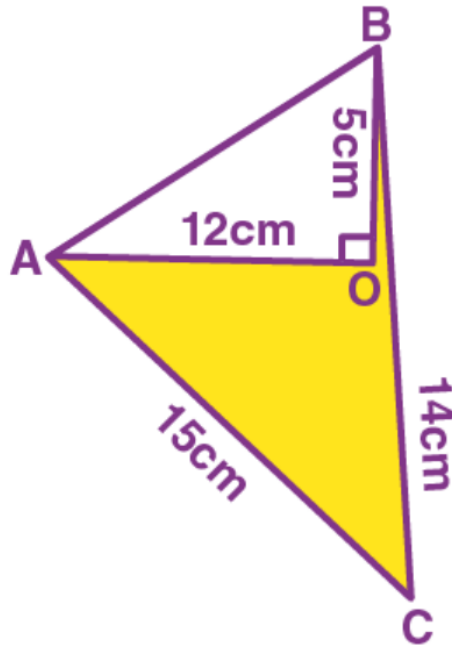
$$= 45 \times 50$$

$$= 2250 \text{ m}^3$$

Chapter Test

Take $\pi = 22/7$, unless stated otherwise.

1. (a) Calculate the area of the shaded region.



(b) If the sides of a square are lengthened by 3 cm, the area becomes 121 cm^2 . Find the perimeter of the original square.

Solution:

(a) From the figure,

OA is perpendicular to BC

It is given that

$AC = 15 \text{ cm}$, $AO = 12 \text{ cm}$, $BO = 5 \text{ cm}$, $BC = 14 \text{ cm}$

$OC = BC - BO = 14 - 5 = 9 \text{ cm}$

Here

Area of right $\triangle AOC = \frac{1}{2} \times \text{base} \times \text{altitude}$

Substituting the values

$$= \frac{1}{2} \times 9 \times 12$$

$$= 54 \text{ cm}^2$$

(b) Consider the side of original square = $x \text{ cm}$

So the length of given square = $(x + 3) \text{ cm}$

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We know that

Area = side $\times$ side

Substituting the values

$$121 = (x + 3)(x + 3)$$

It can be written as

$$11^2 = (x + 3)^2$$

By further calculation

$$11 = x + 3$$

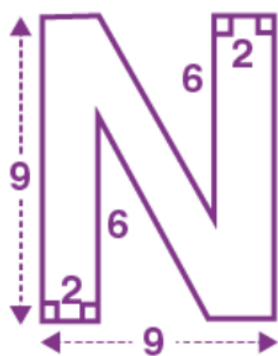
$$x = 11 - 3$$

$$x = 8 \text{ cm}$$

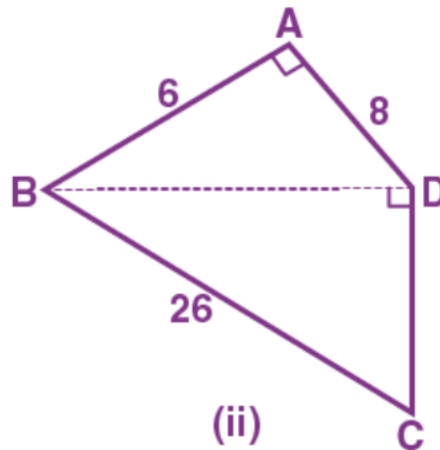
2. (a) Find the area enclosed by the figure (i) given below. All measurements are in centimetres.

(b) Find the area of the quadrilateral ABCD shown in figure (ii) given below. All measurements are in centimetres.

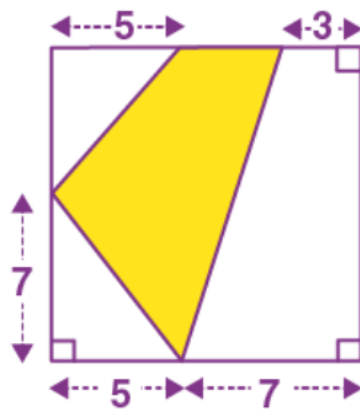
(c) Calculate the area of the shaded region shown in figure (iii) given below. All measurements are in metres.



(i)



(ii)

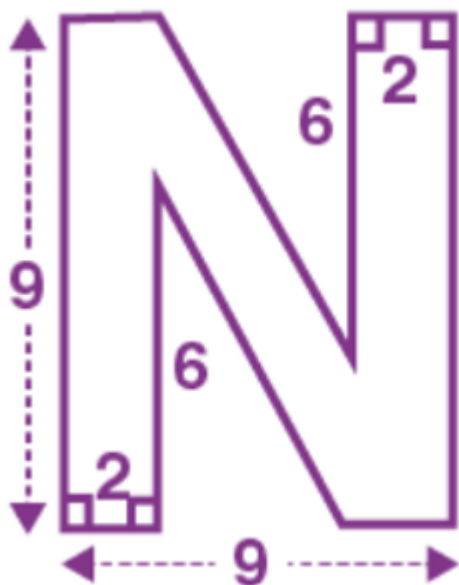


(iii)

Solution:

(a) We know that

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Area of figure (i) = Area of ABCD – Area of both triangles

Substituting the values

$$= (9 \times 9) - \left(\frac{1}{2} \times 5 \times 6 \right) \times 2$$

By further calculation

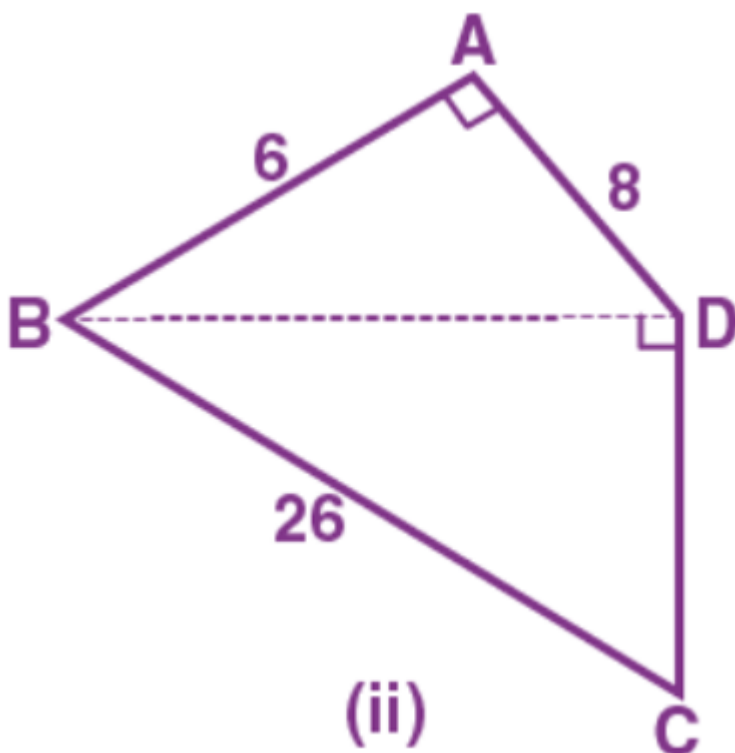
$$= 81 - (15 \times 2)$$

So we get

$$= 81 - 30$$

$$= 51 \text{ cm}^2$$

(b) In $\triangle ABD$



Using Pythagoras theorem

$$BD^2 = AB^2 + AD^2$$

Substituting the values

$$BD^2 = 6^2 + 8^2$$

$$BD^2 = 36 + 64$$

So we get

$$BD^2 = 100$$

$$BD = 10 \text{ cm}$$

In $\triangle BCD$

Using Pythagoras theorem

$$BC^2 = BD^2 + CD^2$$

Substituting the values

$$26^2 = 10^2 + CD^2$$

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$$676 = 100 + CD^2$$

By further calculation

$$CD^2 = 676 - 100 = 576$$

$$CD = \sqrt{576}$$

$$CD = 24 \text{ cm}$$

Here

Area of the given figure = Area of $\triangle ABD$ + Area of $\triangle BCD$

We can write it as

Area of the given figure = $\frac{1}{2} \times \text{base} \times \text{height} + \frac{1}{2} \times \text{base} \times \text{height}$

Area of the given figure = $\frac{1}{2} \times AB \times AD + \frac{1}{2} \times CD \times BD$

Substituting the values

$$\text{Area of the given figure} = \frac{1}{2} \times 6 \times 8 + \frac{1}{2} \times 24 \times 10$$

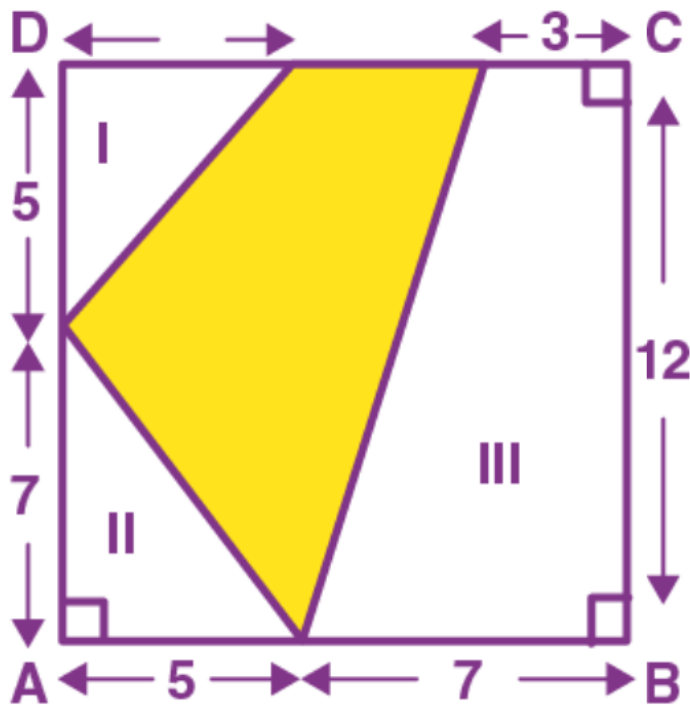
So we get

$$\text{Area of the given figure} = 3 \times 8 + 12 \times 10$$

$$= 24 + 120$$

$$= 144 \text{ cm}^2$$

(c) We know that



Area of the figure (iii) = Area of ABCD – (Area of 1st part + Area of 2nd part + Area of 3rd part)

It can be written as

$$= (AB \times BC) - \left[\left(\frac{1}{2} \times \text{base} \times \text{height} \right) + \left(\frac{1}{2} \times \text{base} \times \text{height} \right) + \frac{1}{2} (\text{sum of parallel side} \times \text{height}) \right]$$

Substituting the values

$$= (12 \times 12) - \left[\frac{1}{2} \times 5 \times 5 + \frac{1}{2} \times 5 \times 7 + \frac{1}{2} (7 + 3) \times 12 \right]$$

By further calculation

$$= 144 - \left[\frac{25}{2} + \frac{35}{2} + 10 \times 6 \right]$$

$$= 144 - \left(\frac{60}{2} + 60 \right)$$

$$= 144 - (30 + 60)$$

So we get

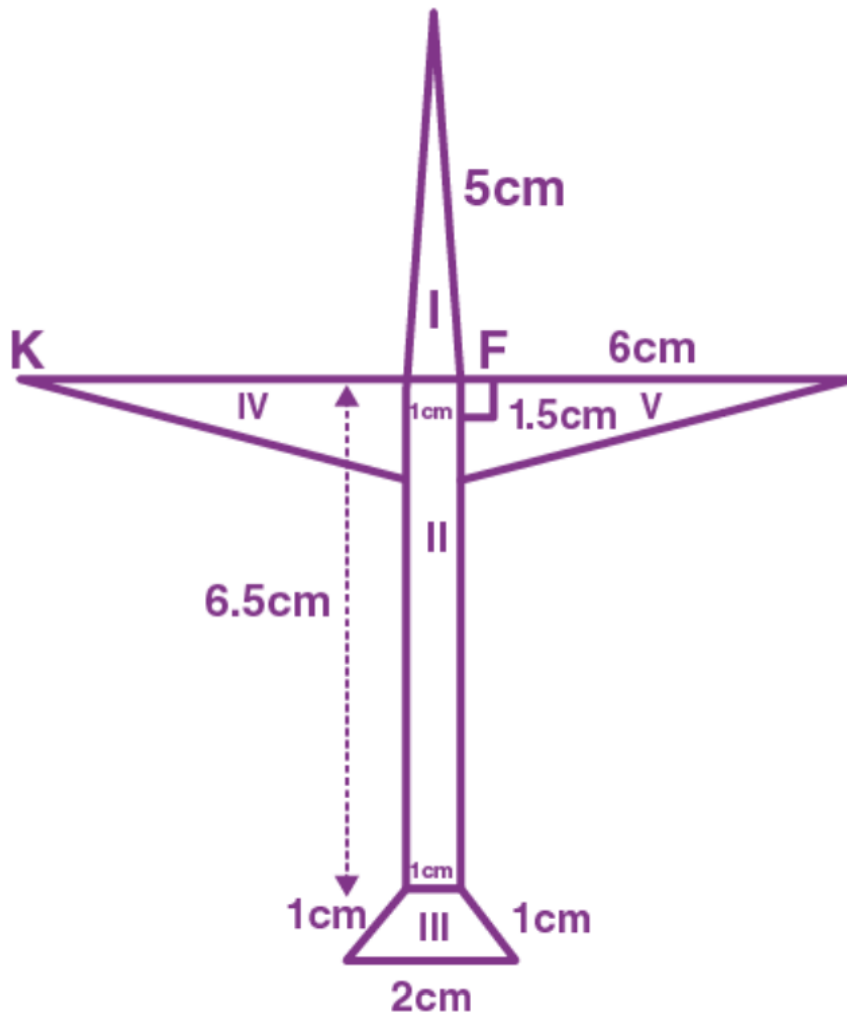
$$= 144 - 90$$

$$= 54 \text{ m}^2$$

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Therefore, the required area of given figure = 54 m^2 .

3. Asifa cut an aeroplane from a coloured chart paper (as shown in the adjoining figure). Find the total area of the chart paper used, correct to 1 decimal place.



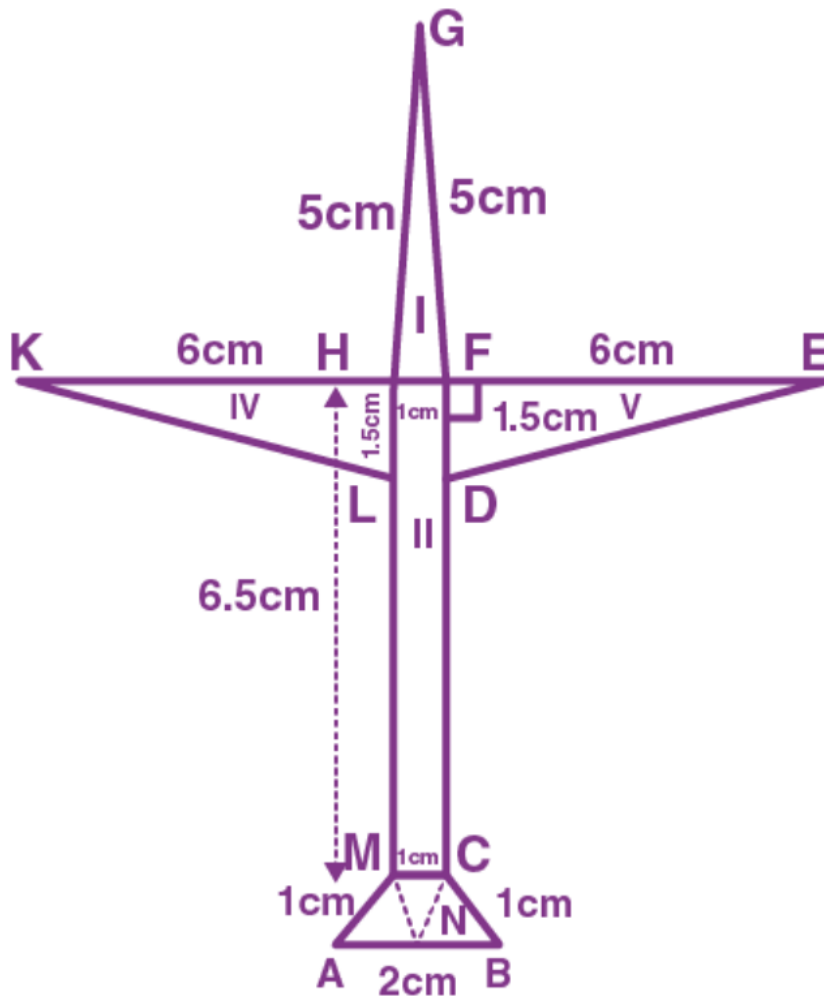
Solution:

Here the whole figure of an aeroplane has 5 figures i.e. three triangles, one rectangle and one trapezium

Consider M as the midpoint of AB

$$AM = MB = 1 \text{ cm}$$

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Now join MN and CN

$\triangle AMN$, $\triangle NCB$ and $\triangle MNC$ are equilateral triangles having 1 cm side each

Area of $\triangle GHF$

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$$s = \frac{a+b}{c}$$

$$s = \frac{5+5+1}{2}$$

$$s = \frac{11}{2}$$

We know that

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

Substituting the values

$$= \sqrt{\frac{11}{2}(\frac{11}{2}-5)(\frac{11}{2}-5)(\frac{11}{2}-1)}$$

By further calculation

$$= \sqrt{\frac{11}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{9}{2}}$$

So we get

$$\begin{aligned} &= \sqrt{\frac{11 \times 9}{16}} \\ &= \frac{3}{4}\sqrt{11} \end{aligned}$$

Here

$$= \frac{3}{4} \times 3.316$$

$$= 3 \times 0.829$$

$$= 2.487$$

$$= 2.48 \text{ cm}^2$$

Area of rectangle II (MCFH) = l × b

Substituting the values

$$= 6.5 \times 1$$

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$$= 6.5 \text{ cm}^2$$

$$\text{Area of } \triangle \text{ III} + \text{IV} = 2 \times \frac{1}{2} \times 6 \times 1.5 = 9 \text{ cm}^2$$

$$\text{Area of three equilateral triangles formed trapezium III} = 3 \times \frac{\sqrt{3}}{4} \times 1^2$$

$$= \frac{3}{4} \times 1.732$$

$$= 3 \times 0.433$$

$$= 1.299$$

$$= 1.3 \text{ cm}^2$$

So we get

$$\text{Total area} = 2.48 + 6.50 + 9 + 1.30$$

$$= 19.28$$

$$= 19.3 \text{ cm}^2$$

4. If the area of a circle is 78.5 cm^2 , find its circumference. (Take $\pi = 3.14$)

Solution:

It is given that

$$\text{Area of a circle} = 78.5 \text{ cm}^2$$

Consider r as the radius

$$r^2 = \text{Area}/\pi$$

Substituting the values

$$r^2 = 78.50/3.14$$

$$r^2 = 25 = 5^2$$

So we get

$$r = 5 \text{ cm}$$

Here

$$\text{Circumference} = 2 \pi r$$

Substituting the values

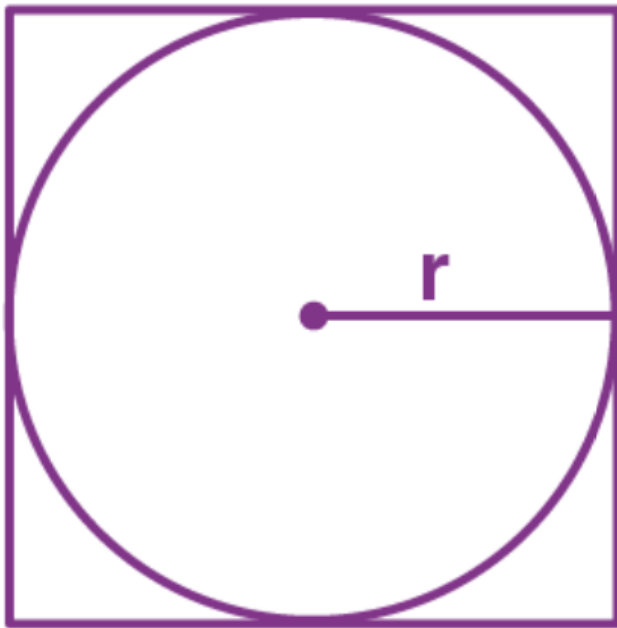
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$$= 2 \times 3.14 \times 5$$

$$= 31.4 \text{ cm}$$

5. From a square cardboard, a circle of biggest area was cut out. If the area of the circle is 154 cm^2 , calculate the original area of the cardboard.

Solution:



It is given that

Area of circle cut out from the square board = 154 cm^2

Consider r as the radius

$$\pi r^2 = 154$$

$$\frac{22}{7} r^2 = 154$$

By further calculation

$$r^2 = (154 \times 7) / 22 = 49 = 7^2$$

$$r = 7 \text{ cm}$$

We know that

$$\text{Side of square} = 7 \times 2 = 14 \text{ cm}$$

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So the area of the original cardboard = a^2

$$= 14^2$$

$$= 196 \text{ cm}^2$$

6. (a) From a sheet of paper of dimensions $2 \text{ m} \times 1.5 \text{ m}$, how many circles of radius 5 cm can be cut? Also find the area of the paper wasted. Take $\pi = 3.14$.

(b) If the diameter of a semi-circular protractor is 14 cm, then find its perimeter.

Solution:

(a) It is given that

Length of sheet of paper = $2 \text{ m} = 200 \text{ cm}$

Breadth of sheet = $1.5 \text{ m} = 150 \text{ cm}$



$$\text{Area} = l \times b$$

Substituting the values

$$= 200 \times 150$$

$$= 30000 \text{ cm}^2$$

We know that

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Radius of circle = 5 cm

Number of circles in lengthwise = $200 / (5 \times 2) = 20$

Number of circles in widthwise = $150 / 10 = 15$

So the number of circles = $20 \times 15 = 300$

Here

Area of one circle = πr^2

Substituting the values

$$= 3.14 \times 5 \times 5 \text{ cm}^2$$

$$\text{Area of 300 circles} = 300 \times 314 / 100 \times 25 = 23550 \text{ cm}^2$$

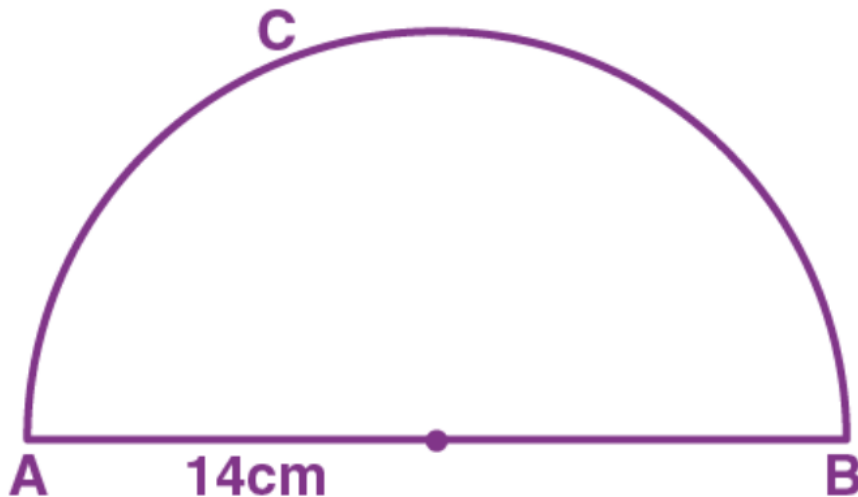
So the area of remaining portion = area of square – area of 300 circles

$$= 30000 - 23550$$

$$= 6450 \text{ cm}^2$$

(b) It is given that

Diameter of semicircular protractor = 14 cm



We know that

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$$\text{Perimeter} = \frac{1}{2} \pi d + d$$

Substituting the values

$$= \frac{1}{2} \times \frac{22}{7} \times 14 + 14$$

$$= 22 + 14$$

$$= 36 \text{ cm}$$

7. A road 3.5 m wide surrounds a circular park whose circumference is 88 m. Find the cost of paving the road at the rate of ₹ 60 per square metre.

Solution:

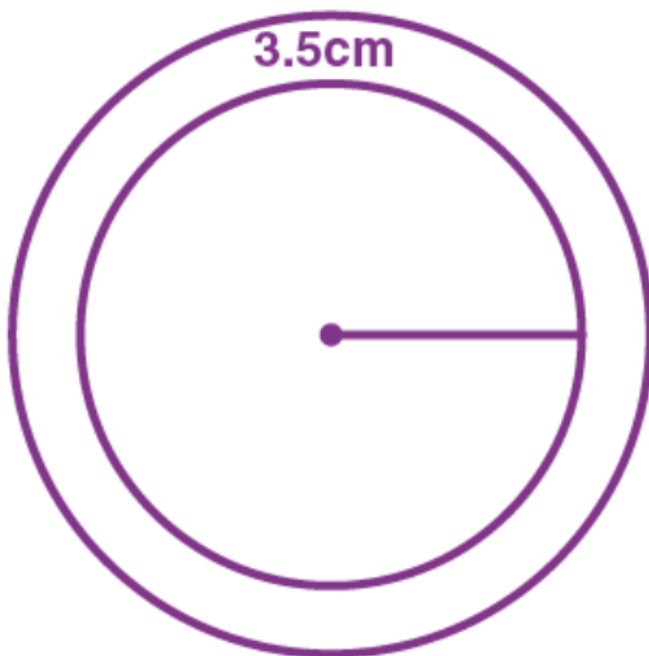
It is given that

Width of the road = 3.5 m

Circumference of the circular park = 88 m

Consider r as the radius of the park

$$2 \pi r = 88$$



Substituting the values

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$$2 \times \frac{22}{7} r = 88$$

By further calculation

$$r = (88 \times 7) / (2 \times 22) = 14 \text{ m}$$

Here

$$\text{Outer radius (R)} = 14 + 3.5 = 17.5 \text{ m}$$

$$\text{Area of the path} = \frac{22}{7} \times (17.5 + 14) (17.5 - 14)$$

We know that

$$\pi (R^2 - r^2) = \frac{22}{7} [(17.5)^2 - (14)^2]$$

By further calculation

$$= \frac{22}{7} (17.5 + 14) (17.5 - 14)$$

$$= \frac{22}{7} \times 31.5 \times 3.5$$

$$= 246.5 \text{ m}^2$$

It is given that

$$\text{Rate of paving the road} = ₹ 60 \text{ per m}^2$$

$$\text{So the total cost} = 60 \times 346.5 = ₹ 20790$$

8. The adjoining sketch shows a running track 3.5 m wide all around which consists of two straight paths and two semicircular rings. Find the area of the track.



Solution:

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It is given that

Width of track = 3.5 m

Inner length of rectangular base = 140 m

Width = 42 m

Outer length of rectangular base = $140 + 2 \times 3.5$

= $140 + 7$

= 147 m

Width = $42 + 2 \times 3.5$

= $42 + 7$

= 49 m

We know that

Radius of inner semicircle (r) = $42/2 = 21$ m

Outer radius (R) = $21 + 3.5 = 24.5$ m

Here

Area of track = $2 (140 \times 3.5) + 2 \times \frac{1}{2} \pi (R^2 - r^2)$

Substituting the values

= $2 (490) + 22/7 [(24.5)^2 - (21)^2]$

By further calculation

= $980 + 22/7 (24.5 + 21) (24.5 - 21)$

= $980 + 22/7 \times 45.5 \times 3.5$

So we get

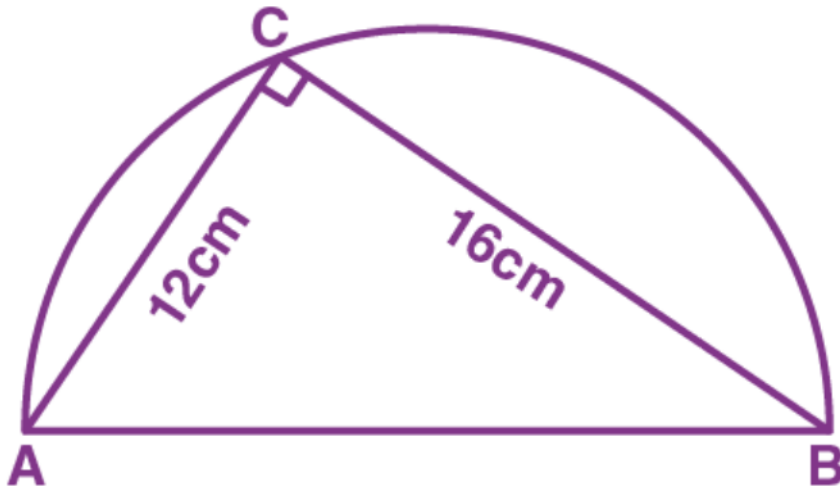
= $980 + 500.5$

= 1480.5 m^2

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9. In the adjoining figure, O is the centre of a circular arc and AOB is a line segment. Find the perimeter and the area of the shaded region correct to one decimal place. (Take $\pi = 3.142$)

Hint. Angle in a semicircle is a right angle.



Solution:

We know that

In a semicircle $\angle ACB = 90^\circ$

$\triangle ABC$ is a right-angled triangle

Using Pythagoras theorem

$$AB^2 = AC^2 + BC^2$$

Substituting the values

$$= 12^2 + 16^2$$

$$= 144 + 256$$

$$= 400$$

$$AB^2 = (20)^2$$

$$AB = 20 \text{ cm}$$

Radius of semicircle $= 20/2 = 10 \text{ cm}$

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(i) We know that

Area of shaded portion = Area of semicircle – Area of $\triangle ABC$

It can be written as

$$= \frac{1}{2} \pi r^2 - (AC \times BC) / 2$$

Substituting the values

$$= \frac{1}{2} \times 3.142 (10)^2 - (12 \times 16) / 2$$

By further calculation

$$= 314.2 / 2 - 96$$

$$= 157.1 - 96$$

$$= 61.1 \text{ cm}^2$$

(ii) Here

Perimeter of shaded portion = circumference of semicircle + AC + BC

It can be written as

$$= \pi r + 12 + 16$$

$$= 3.142 \times 10 + 28$$

So we get

$$= 31.42 + 28$$

$$= 59.42 \text{ cm}$$

$$= 59.4 \text{ cm}$$

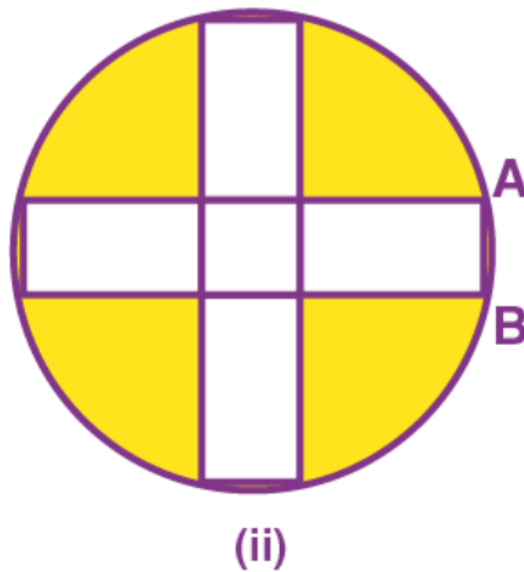
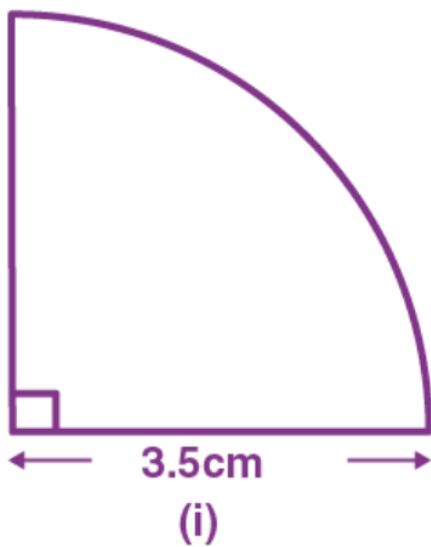
10. (a) In the figure (i) given below, the radius is 3.5 cm. Find the perimeter of the quarter of the circle.

(b) In the figure (ii) given below, there are five squares each of side 2 cm.

(i) Find the radius of the circle.

(ii) Find the area of the shaded region. (Take $\pi = 3.14$).

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Solution:

(a) It is given that

Radius of quadrant = 3.5 cm

Perimeter = $2r + \frac{1}{4} \times 2\pi r$

= $2r + \frac{1}{2} \times \pi r$

Substituting the values

= $2 \times 3.5 + \frac{1}{2} \times \frac{22}{7} \times 3.5$

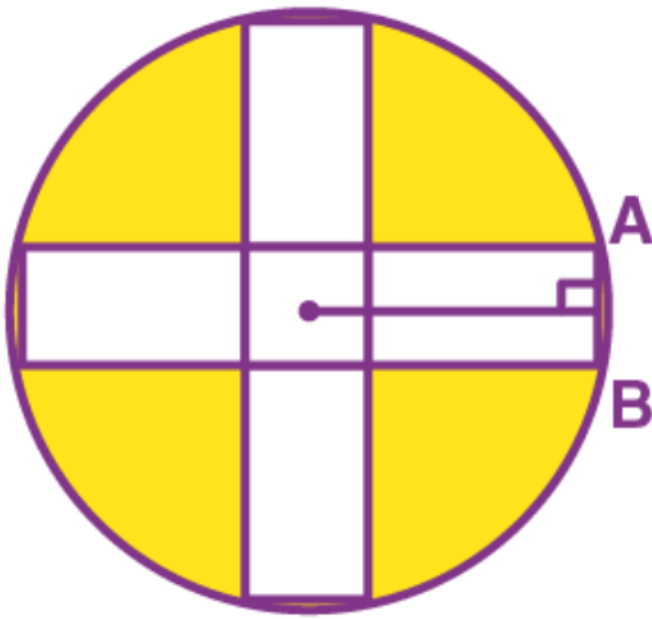
So we get

= $7 + 5.5$

= 12.5 cm

(b) From the figure

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$$OB = 2 + 1 = 3 \text{ cm}$$

$$AB = 1 \text{ cm}$$

Using Pythagoras theorem

$$OA = \sqrt{OB^2 + AB^2}$$

Substituting the values

$$OA = \sqrt{(3)^2 + (1)^2}$$

$$= \sqrt{9 + 1}$$

$$= \sqrt{10}$$

So the radius of the circle = $\sqrt{10}$ cm

We know that

$$\text{Area of the circle} = \pi r^2$$

Substituting the values

$$= 3.14 \times (\sqrt{10})^2$$

$$= 3.14 \times 10$$

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$$= 31.4 \text{ cm}^2$$

$$\text{Area of 5 square of side 2 cm each} = 2^2 \times 5$$

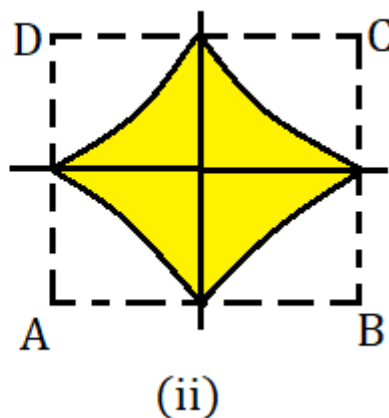
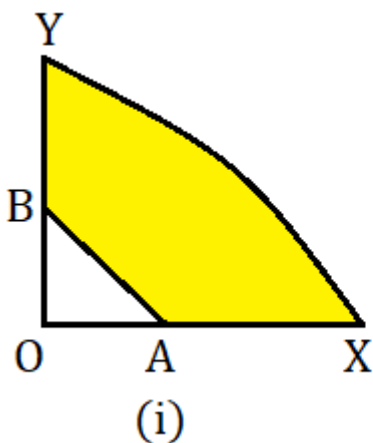
$$= 4 \times 5$$

$$= 20 \text{ cm}^2$$

$$\text{So the area of shaded portion} = 31.4 - 20 = 11.4 \text{ cm}^2$$

11. (a) In the figure (i) given below, a piece of cardboard in the shape of a quadrant of a circle of radius 7 cm is bounded by the perpendicular radii OX and OY. Points A and B lie on OX and OY respectively such that OA = 3 cm and OB = 4 cm. The triangular part OAB is removed. Calculate the area and the perimeter of the remaining piece.

(b) In the figure (ii) given below, ABCD is a square. Points A, B, C and D are centres of quadrants of circles of the same radius. If the area of the shaded portion is $21 \frac{3}{7} \text{ cm}^2$, find the radius of the quadrants.



Solution:

(a) It is given that

Radius of quadrant = 7 cm

OA = 3 cm, OB = 4 cm

AX = 7 - 3 = 4 cm

BY = 7 - 4 = 3 cm

We know that

$$AB^2 = OA^2 + OB^2$$

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Substituting the values

$$= 3^2 + 4^2$$

$$= 9 + 16$$

$$= 25$$

So we get

$$AB = \sqrt{25} = 5 \text{ cm}$$

$$(i) \text{ Area of shaded portion} = \frac{1}{4} \pi r^2 - \frac{1}{2} OA \times OB$$

Substituting the values

$$= \frac{1}{4} \times \frac{22}{7} \times 7^2 - \frac{1}{2} \times 3 \times 4$$

$$= \frac{1}{4} \times \frac{22}{7} \times 49 - 6$$

By further calculation

$$= \frac{77}{2} - 6$$

$$= \frac{65}{2}$$

$$= 32.5 \text{ cm}^2$$

$$(ii) \text{ Perimeter of shaded portion} = \frac{1}{4} \times 2 \pi r + AX + BY + AB$$

Substituting the values

$$= \frac{1}{2} \times \frac{22}{7} \times 7 + 4 + 3 + 5$$

$$= 11 + 12$$

$$= 23 \text{ cm}$$

(b) We know that

ABCD is a square with centres A, B, C and D quadrants drawn.

Consider a as the side of the square

Radius of each quadrant = $a/2$

Here

$$\text{Area of shaded portion} = a^2 - 4 \times \left[\frac{1}{4} \pi (a/2)^2 \right]$$

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We can write it as

$$= a^2 - 4 \times \frac{1}{4} \pi a^2/4$$

Substituting the values

$$= a^2 - 22/7 \times a^2/4$$

So we get

$$= a^2 - 11a^2/14$$

$$= 3a^2/14$$

Here

$$\text{Area of shaded portion} = 21 \frac{3}{7} = 150/7 \text{ cm}^2$$

By equating both we get

$$3a^2/14 = 150/7$$

On further calculation

$$a^2 = 150/7 \times 14/3$$

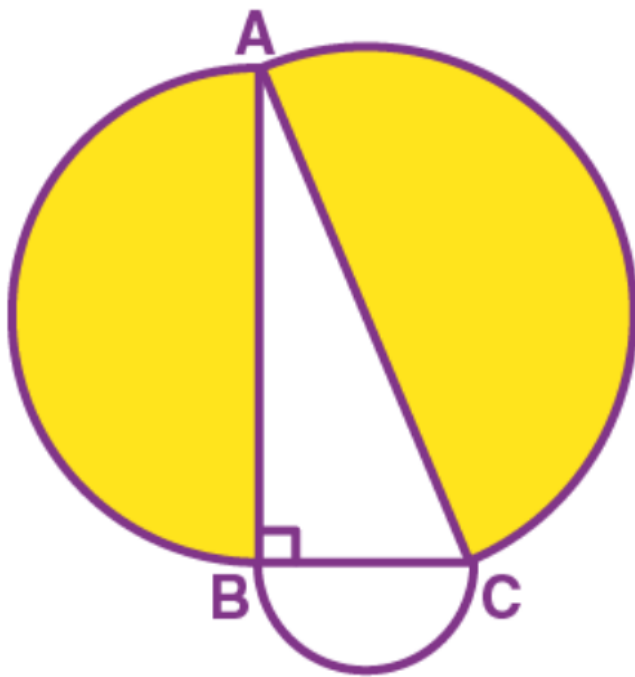
$$a^2 = 100 = 10^2$$

$$a = 10 \text{ cm}$$

$$\text{So the radius of each quadrant} = a/2 = 10/2 = 5 \text{ cm}$$

12. In the adjoining figure, ABC is a right angled triangle right angled at B. Semicircles are drawn on AB, BC and CA as diameter. Show that the sum of areas of semicircles drawn on AB and BC as diameter is equal to the area of the semicircle drawn on CA as diameter.

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**Solution:**

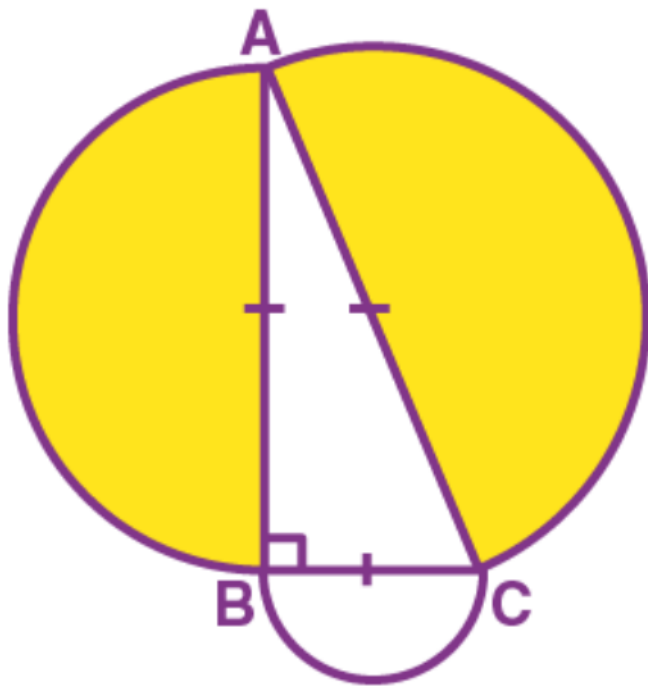
It is given that

ABC is a right angled triangle right angled at B

Using Pythagoras theorem

$$AC^2 = AB^2 + BC^2 \dots\dots(i)$$

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Area of semicircle on AC as diameter = $\frac{1}{2} \pi (AC/2)^2$

So we get

$$= \frac{1}{2} \pi \times AC^2/4$$

$$= \pi AC^2/8$$

Area of semicircle on AB as diameter = $\frac{1}{2} \pi (AB/2)^2$

So we get

$$= \frac{1}{2} \pi \times AB^2/4$$

$$= \pi AB^2/8$$

Area of semicircle on BC as diameter = $\frac{1}{2} \pi (BC/2)^2$

So we get

$$= \frac{1}{2} \pi \times BC^2/4$$

$$= \pi BC^2/8$$

We know that

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$$\pi AB^2/8 + \pi BC^2/8 = \pi/8 (AB^2 + BC^2)$$

From equation (i)

$$= \pi/8 (AC^2)$$

$$= \pi AC^2/8$$

Therefore, it is proved.

13. The length of minute hand of a clock is 14 cm. Find the area swept by the minute hand in 15 minutes.

Solution:

It is given that

Radius of hand = 14 cm

So the area swept in 15 minutes = $\pi r^2 \times 15/60$

By further calculation

$$= 22/7 \times 14 \times 14 \times \frac{1}{4}$$

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

14. Find the radius of a circle if a 90° arc has a length of 3.5π cm. Hence, find the area of the sector formed by this arc.

Solution:

It is given that

Length of arc of the sector of a circle = 3.5π cm

Angle at the centre = 90°

We know that

Radius of the arc = $3.5\pi/2 \times 360/90$

So we get

$$= (3.5 \times 4)/2$$

$$= 7 \text{ cm}$$

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$$\text{Area of the sector} = \pi r^2 \times 90^\circ/360^\circ$$

By further calculation

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

$$= \frac{77}{2}$$

$$= 38.5 \text{ cm}^2$$

15. A cube whose each edge is 28 cm long has a circle of maximum radius on each of its face painted red. Find the total area of the unpainted surface of the cube.

Solution:

It is given that

Edge of cube = 28 cm

Surface area = $6a^2$

Substituting the value

$$= 6 \times (28)^2$$

$$= 6 \times 28 \times 28$$

$$= 4704 \text{ cm}^2$$

Diameter of each circle = 28 cm

So the radius = $28/2 = 14$ cm

We know that

Area of each circle = πr^2

Substituting the values

$$= \frac{22}{7} \times 14 \times 14$$

$$= 616 \text{ cm}^2$$

Area of such 6 circles drawn on 6 faces of cube = $616 \times 6 = 3696 \text{ cm}^2$

Here

Area of remaining portion of the cube = $4704 - 3696 = 1008 \text{ cm}^2$

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16. Can a pole 6.5 m long fit into the body of a truck with internal dimensions of 3.5 m, 3 m and 4 m?

Solution:

No, a pole 6.5 m long cannot fit into the body of a truck with internal dimensions of 3.5 m, 3 m and 4 m

Length of pole = 6.5 m

Internal dimensions of truck are 3.5 m, 3 m and 4 m

The internal dimensions are less than the length of pole. So the pole cannot fit into the body of truck with given dimensions.

17. A car has a petrol tank 40 cm long, 28 cm wide and 25 cm deep. If the fuel consumption of the car averages 13.5 km per litre, how far can the car travel with a full tank of petrol?

Solution:

It is given that

Capacity of car tank = $40 \text{ cm} \times 28 \text{ cm} \times 25 \text{ cm} = (40 \times 28 \times 25) \text{ cm}^3$

Here $1000 \text{ cm}^3 = 1 \text{ litre}$

So we get

$= (40 \times 28 \times 25) / 1000 \text{ litre}$

Average of car = 13.5 km per litre

We know that

Distance travelled by car = $(40 \times 28 \times 25) / 1000 \times 13.5$

Multiply and divide by 10

$= (40 \times 25) \times 28 / 1000 \times 135 / 10$

So we get

$= (1 \times 28) / 1 \times 135 / 10$

$= (14 \times 135) / 5$

$= 14 \times 27$

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$$= 378 \text{ km}$$

Therefore, the car can travel 378 km with a full tank of petrol.

18. An aquarium took 96 minutes to completely fill with water. Water was filling the aquarium at a rate of 25 litres every 2 minutes. Given that the aquarium was 2 m long and 80 cm wide, compute the height of the aquarium.

Solution:

We know that

Water filled in 2 minutes = 25 litres

Water filled in 1 minute = $25/2$ litres

Water filled in 96 minutes = $25/2 \times 96$

$$= 25 \times 48$$

$$= 1200 \text{ litres}$$

So the capacity of aquarium = 1200 litres (1)

Here

Length of aquarium = 2m = $2 \times 100 = 200$ cm

Breadth of aquarium = 80 cm

Consider h cm as the height of aquarium

So the capacity of aquarium = $200 \times 80 \times h \text{ cm}^3$

We can write it as

$$= (200 \times 80 \times h) / 1000 \text{ litre}$$

$$= 1/5 \times 80 \times h \text{ litre}$$

$$= 16 h \text{ litre (2)}$$

Using equation (1) and (2)

$$16h = 1200$$

So we get

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$$h = 1200 / 16$$

$$h = 75 \text{ cm}$$

Therefore, height of aquarium = 75 cm.

19. The lateral surface area of a cuboid is 224 cm^2 . Its height is 7 cm and the base is a square. Find

(i) a side of the square, and

(ii) the volume of the cuboid.

Solution:

It is given that

$$\text{Lateral surface area of a cuboid} = 224 \text{ cm}^2$$

$$\text{Height of cuboid} = 7 \text{ cm}$$

Base is square

Consider x cm as the length of cuboid

x cm as the breadth of cuboid (Since the base is square both length and breadth are same)

Here

$$\text{Lateral surface area} = 2 (l + b) \times h$$

Substituting the values

$$224 = 2 (x + x) \times 7$$

By further calculation

$$224 = 2 \times 2x \times 7$$

$$224 = 28x$$

So we get

$$28x = 224$$

$$x = 224/28 = 8 \text{ cm}$$

(i) Side of the square = 8 cm

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(ii) We know that

Volume of the cuboid = $l \times b \times h$

Substituting the values

$$= 8 \times 8 \times 7$$

$$= 448 \text{ cm}^3$$

20. If the volume of a cube is $V \text{ m}^3$, its surface area is $S \text{ m}^2$ and the length of a diagonal is d metres, prove that $6\sqrt{3} V = Sd$.

Solution:

We know that

Volume of cube = $(V) = (\text{Side})^3$

Consider a as the side of cube

$$V = a^3 \text{ and } S = 6a^2$$

$$\text{Diagonal } (d) = \sqrt{3} \cdot a$$

$$Sd = 6a^2 \times \sqrt{3}a = 6\sqrt{3}a^3$$

$$\text{Here } V = a^3$$

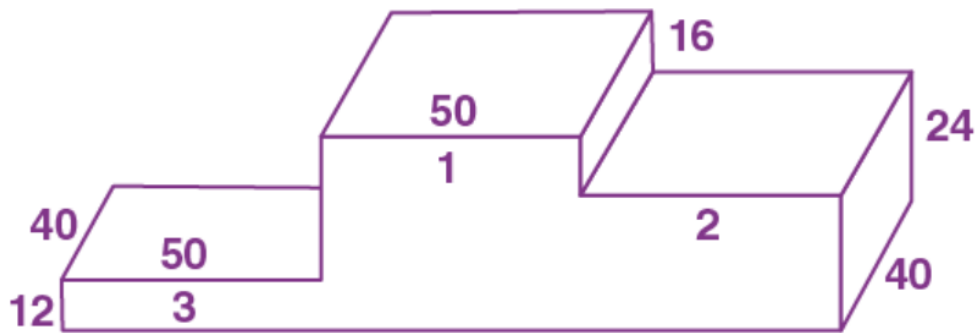
So we get

$$Sd = 6\sqrt{3}V$$

Therefore, $6\sqrt{3}V = Sd$.

21. The adjoining figure shows a victory stand, each face is rectangular. All measurements are in centimetres. Find its volume and surface area (the bottom of the stand is open).

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**Solution:**

Three parts are indicated as 3, 1 and 2 in the figure

We know that

$$\text{Volume of part (3)} = 50 \times 40 \times 12 = 24000 \text{ cm}^3$$

$$\text{Volume of part (1)} = 50 \times 40 \times (16 + 24)$$

By further calculation

$$= 50 \times 40 \times 40$$

$$= 80000 \text{ cm}^3$$

$$\text{Volume of part (2)} = 50 \times 40 \times 24 = 48000 \text{ cm}^3$$

$$\text{So the total volume} = 24000 + 80000 + 48000 = 153000 \text{ cm}^3$$

We know that

Total surface area = Area of front and back + Area of vertical faces + Area of top faces

Substituting the values

$$= 2 (50 \times 12 + 50 \times 40 + 50 \times 24) \text{ cm}^2 + (12 \times 40 + 28 \times 40 + 16 \times 40 + 24 \times 40) \text{ cm}^2 + 3 (50 \times 40) \text{ cm}^2$$

By further calculation

$$= 2 (600 + 2000 + 1200) \text{ cm}^2 + (480 + 1120 + 640 + 960) \text{ cm}^2 + (3 \times 2000) \text{ cm}^2$$

$$= 2 (3800) + 3200 + 6000 \text{ cm}^2$$

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So we get

$$= 7600 + 3200 + 6000$$

$$= 16800 \text{ cm}^2$$

22. The external dimensions of an open rectangular wooden box are 98 cm by 84 cm by 77 cm. If the wood is 2 cm thick all around, find

(i) the capacity of the box

(ii) the volume of the wood used in making the box, and

(iii) the weight of the box in kilograms correct to one decimal place, given that 1 cm^3 of wood weighs 0.8 g.

Solution:

It is given that

External dimensions of open rectangular wooden box = 98 cm, 84 cm and 77 cm

Thickness = 2 cm

So the internal dimensions of open rectangular wooden box = $(98 - 2 \times 2)$ cm, $(84 - 2 \times 2)$ cm and $(77 - 2)$ cm

$$= (98 - 4) \text{ cm}, (84 - 4) \text{ cm}, 75 \text{ cm}$$

$$= 94 \text{ cm}, 80 \text{ cm}, 75 \text{ cm}$$

(i) We know that

$$\text{Capacity of the box} = 94 \text{ cm} \times 80 \text{ cm} \times 75 \text{ cm}$$

$$= 564000 \text{ cm}^3$$

$$(ii) \text{ Internal volume of box} = 564000 \text{ cm}^3$$

$$\text{External volume of box} = 98 \text{ cm} \times 84 \text{ cm} \times 77 \text{ cm} = 633864 \text{ cm}^3$$

$$\text{So the volume of wood used in making the box} = 633864 - 564000 = 69864 \text{ cm}^3$$

$$(iii) \text{ Weight of } 1 \text{ cm}^3 \text{ wood} = 0.8 \text{ gm}$$

$$\text{So the weight of } 69864 \text{ cm}^3 \text{ wood} = 0.8 \times 69864 \text{ gm}$$

By further calculation

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$$= (0.8 \times 69864) / 1000 \text{ kg}$$

$$= 55891.2 / 1000 \text{ kg}$$

$$= 55.9 \text{ kg (correct to one decimal place)}$$

23. A cuboidal block of metal has dimensions 36 cm by 32 cm by 0.25 m. It is melted and recast into cubes with an edge of 4 cm.

(i) How many such cubes can be made?

(ii) What is the cost of silver coating the surfaces of the cubes at the rate of ₹ 1.25 per square centimetre?

Solution:

It is given that

Dimensions of cuboidal block = 36 cm, 32 cm and 0.25 m

We can write it as

$$= 36 \text{ cm} \times 32 \text{ cm} \times (0.25 \times 100) \text{ cm}$$

$$= (36 \times 32 \times 25) \text{ cm}^3$$

$$\text{Volume of cube having edge 4 cm} = 4 \times 4 \times 4 = 64 \text{ cm}^3$$

(i) We know that

Number of cubes = Volume of cuboidal block / Volume of one cube

Substituting the values

$$= (36 \times 32 \times 25) / 64$$

$$= (36 \times 25) / 2$$

So we get

$$= 18 \times 25$$

$$= 250$$

(ii) Here

$$\text{Total surface area of one cube} = 6(a)^2$$

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Substituting the values

$$= 6 (4)^2$$

$$= 6 \times 4 \times 4$$

$$= 96 \text{ cm}^2$$

So the total surface area of 450 cubes = $450 \times 96 = 43200 \text{ cm}^2$

Given

Cost of silver coating the surface for $1 \text{ cm}^2 = ₹ 1.25$

Cost of silver coating the surface for $43200 \text{ cm}^2 = 43200 \times 1.25 = ₹ 54000$

24. Three cubes of silver with edges 3 cm, 4 cm and 5 cm are melted and recast into a single cube. Find the cost of coating the surface of the new cube with gold at the rate of ₹ 3.50 per square centimetre.

Solution:

We know that

Volume of first cube = edge^3

Substituting the values

$$= (3 \text{ cm})^3$$

$$= 3 \times 3 \times 3$$

$$= 27 \text{ cm}^3$$

Volume of second cube = edge^3

Substituting the values

$$= (4 \text{ cm})^3$$

$$= 4 \times 4 \times 4$$

$$= 64 \text{ cm}^3$$

Volume of third cube = edge^3

Substituting the values

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$$= (5 \text{ cm})^3$$

$$= 5 \times 5 \times 5$$

$$= 125 \text{ cm}^3$$

$$\text{So the total volume} = 27 + 64 + 125 = 216 \text{ cm}^3$$

Make new cube whose volume = 216 cm^3

So we get

$$\text{Edge}^3 = 216 \text{ cm}^3$$

$$\text{Edge}^3 = (6 \text{ cm})^3$$

$$\text{Edge} = 6 \text{ cm}$$

$$\text{Surface area of new cube} = 6 (\text{edge})^2$$

Substituting the values

$$= 6 (6)^2$$

$$= 6 \times 6 \times 6$$

$$= 216 \text{ cm}^2$$

Given

$$\text{Cost of coating the surface for } 1 \text{ cm}^2 = ₹ 3.50$$

$$\text{So the cost of coating the surface for } 216 \text{ cm}^2 = 3.50 \times 216 = ₹ 756$$



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