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Chapter-11: Mensuration

Exercise 11.1 (Page 171 of NCERT Grade 8)

Q1. A square and a rectangular field with measurements as given in the figure have the same perimeter. Which field has a larger area?

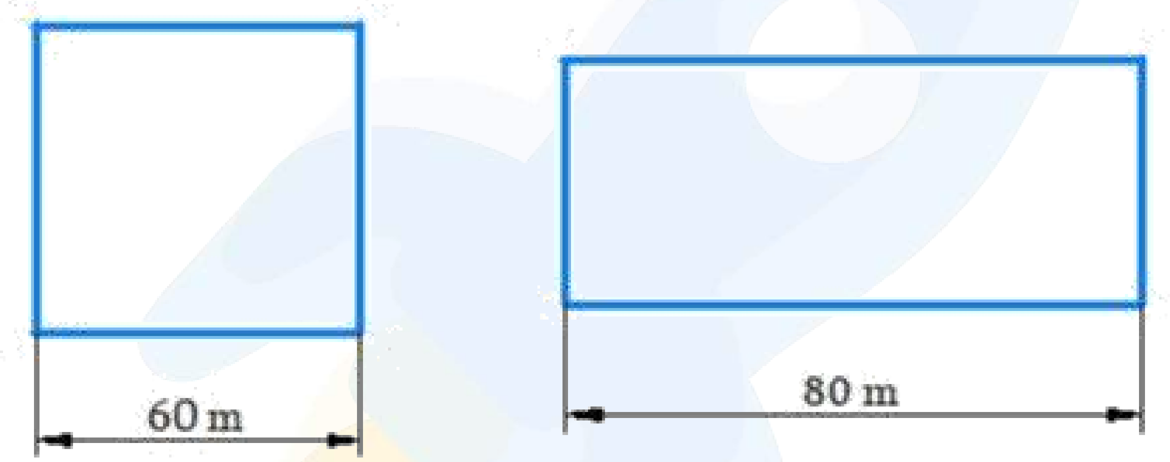
Known:

Perimeter of rectangular field and square are same and also one side of square and rectangular field are known.

Unknown:

Breadth of rectangular field.

Area of square and rectangular field.



(a) Square (b) Rectangular

Reasoning:

It is given that perimeter of the square and the rectangular field are same, so we can find breadth of the rectangular field and also the area of the rectangular field.

Solution:

Side of the square = 60m

Length of the rectangle = 80m

$$\text{Perimeter of the square } = 4 \times (\text{side of square})$$
$$= 4 \times 60\text{m} = 240\text{m}$$

$$\text{Perimeter of rectangle } = 2 \times (\text{length} + \text{breadth})$$

Perimeter of square = perimeter of rectangle

$$240 = 2 \times (\text{length} + \text{breadth})$$

$$240 = 2 \times (80 + \text{breadth})$$

$$240 = 160 + 2 \times \text{breadth}$$

$$240 - 160 = 2 \times \text{breadth}$$

$$80 = 2 \times \text{breadth}$$

$$\text{breadth} = \frac{80}{2} = 40m$$

$$\text{Area of the square} = \text{side} \times \text{side}$$

$$= 60 \times 60$$

$$= 3600\text{m}^2$$

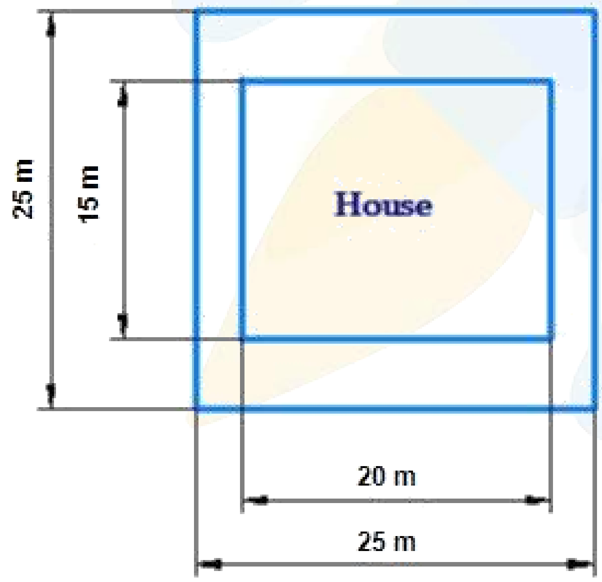
$$\text{Area of the rectangular field} = \text{length} \times \text{breadth}$$

$$= 80 \times 40$$

$$= 3200\ \text{m}^2$$

Thus, area of square is larger than the area of rectangular field.

Q2. Mrs. Kaushik has a square plot with the measurement as shown in the figure. She wants to construct a house in the middle of the plot. A garden is developed around the house. Find the total cost of developing a garden around the house at the rate of 55 per m^2.



Known:

The cost of developing a garden around the house at the rate of per m^2 and also dimensions of the house and square plot.

Unknown:

Total cost of developing of garden around the house.

Reasoning:

The plot is square from outside while the area of the house to be constructed is rectangular in the middle of the plot. From the diagram, we can see that the area of the garden is the difference between area of the square plot and the area of the house.

Solution:

$$\text{Area of the square plot} = \text{side} \times \text{side} = 25\text{m} \times 25\text{m} = 625\text{m}^2$$

$$\begin{aligned}\text{Area of the house} &= \text{length} \times \text{breadth}\\ &= 15\text{m} \times 20\text{ m}\\ &= 300\text{ m}^2\end{aligned}$$

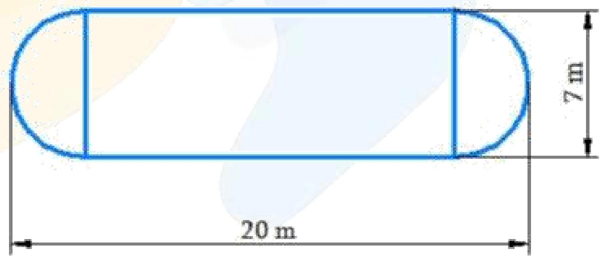
$$\begin{aligned}\text{Area of the garden to be developed} &= (\text{Area of the square plot}) - (\text{Area of the house})\\ &= 625\text{m}^2 - 300\text{m}^2\\ &= 325\text{m}^2\end{aligned}$$

Hence Area of the garden to be developed $= 325\text{m}^2$

The cost of developing garden around the house $= \text{Rs.}55 \; per\, m^2$

$$\begin{aligned}\therefore \text{Total cost of developing a garden of area } 325\text{ m}^2 &= \text{Rs.}325 \times 55\\ &= \text{Rs.}17{,}875\end{aligned}$$

Q3. The shape of a garden is rectangular in the middle and semicircular at the ends as shown in the diagram. Find the area and the perimeter of this garden [Length of rectangle is 20 – (3.5 + 3.5) meters].



Known:

Shape of a garden is rectangular in the middle and semicircular at the ends.

Unknown:

Area and perimeter of the garden

Reasoning:

The garden is rectangular in the middle and semicircular at the ends. From the diagram, we can see that the area of the garden is the sum of the rectangular middle portion and two semicircles at the end.

Solution:

$$\text{Length of the rectangular part} = 20-(3.5+3.5) \text{ meters}$$
$$=(20-7) \text{ meters}$$
$$=13 \text{ meters}$$

Breadth of the rectangular part = 7 meter

$$\text{Area of the rectangular part} = \text{length} \times \text{breadth}$$
$$=13\text{meter} \times 7\text{meter}$$
$$=91 \text{ m. sq.}$$

Diameter of the semicircle = 7 m

Radius of the semicircle = $\frac{7}{2}$ m= 3.5 m

Area of the semicircle $=\frac{1}{2}\times\pi\times r^2$

$$\text{Area of two semicircles} = 2\times\frac{1}{2}\times\frac{22}{7}\times(3.5)^2$$
$$=\frac{22}{7}\times 12.25$$
$$=38.5 \text{ m}^2$$

Total area of the garden = (Area of rectangle) + (Area of two semicircle regions)

$$=91 \text{ m}^2 + 38.5 \text{ m}^2$$
$$=129.5 \text{ m}^2$$

Perimeter of the garden = length of rectangle + perimeter of two semicircle + length of rectangle

$$=13+2(\pi\times 3.5)+13$$
$$=26+7\pi$$
$$=26+\cancel{7}\times\frac{22}{\cancel{7}} \text{ m}$$
$$=26+24 \text{ m}$$
$$=48 \text{ m}$$

Q4. A flooring tile has the shape of a parallelogram whose base is 24 cm and the corresponding height is 10 cm. How many such tiles are required to cover a floor of area 1080 m^2? (If required you can split the tiles in whatever way you want to fill up the corners).

Known:

Shape of the tile and its dimensions.

Unknown:

Number of tiles that are required to cover a floor of area $= 1080\ \text{m}^2$

Reasoning:

Shape of the tile is parallelogram and its area can be found easily.

Area of parallelogram $=$ base $\times$ height

Solution:

$$\begin{aligned}\text{Area of parallelogram} &= \text{base} \times \text{height}\\ &= 24\,\text{cm} \times 10\,\text{cm}\\ &= 240\,\text{cm}^2\end{aligned}$$

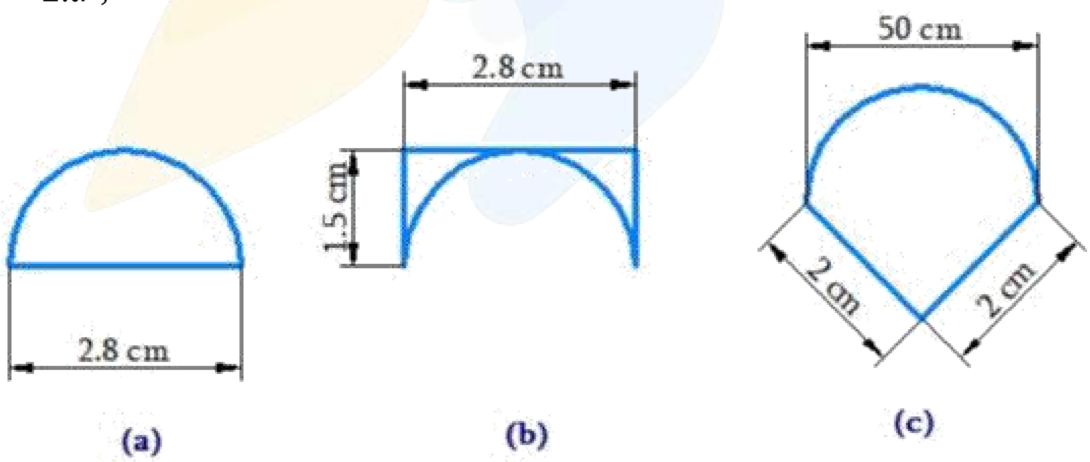
Hence the area of one tile $= 240\,\text{cm}^2$

Area of the floor $= 1080\text{m}^2$ (given)

$$\begin{aligned}\therefore \text{ Required number of tiles} &= \frac{\text{Area of the floor}}{\text{Area of one tile}}\\ &= \frac{1080\,\text{m}^2}{240\ \text{cm}^2}\\ &= \frac{(1080 \times 10000)\,\text{cm}^2}{240\text{cm}^2} \qquad (\because 1\text{m} = 100\,\text{cm})\\ &= 45000 \text{ tiles}\end{aligned}$$

Thus, 45000 tiles are required to cover a floor of area $1080m^2$

Q5. An ant is moving around a few food pieces of different shapes scattered on the floor. For which food-piece would the ant have to take a longer round? Remember, circumference of a circle can be obtained by using the expression $c = 2\pi r$, where r is the radius of the circle.



Known:

Shape and dimensions of various food pieces.

Unknown:

Perimeter of different shaped food pieces.

Reasoning:

Hence, we will calculate perimeter of different shaped food piece. Larger the perimeter, longer will be the path to take round.

Solution:

(a) Radius of the semicircle part $= \left(\frac{2.8}{2}\right) \text{cm} = 1.4 \text{cm}$

Perimeter of the circle $= 2\pi r$

$\therefore$ Perimeter of the semicircle $= \pi r$

The perimeter of the food piece $= 2.8\text{cm} + \pi r$

$$= 2.8\text{cm} + \left(\frac{22}{\not 7} \times 1.\not 4^{0.2}\right) \text{cm}$$

$$= 2.8\text{cm} + 4.4\text{cm}$$

$$= 7.2\text{cm}$$

(b). Radius of semicircle part $= \frac{2.8}{2} = 1.4$ cm

Perimeter of the food piece $= 1.5\text{cm} + 2.8\text{cm} + 1.5\text{cm} + \pi r$

$$= 5.8 \text{ cm} + \left(\frac{22}{\not 7} \times 1.\not 4^{0.2}\right) \text{cm}$$

$$= 5.8 \text{ cm} + 4.4 \text{ cm}$$

$$= 10.2 \text{ cm}$$

(c). Radius of the food piece $= \frac{2.8}{2} = 1.4$ cm

Perimeter of the food piece $= 2\text{cm} + \pi r + 2\text{cm}$

$$= 4\text{cm} + \left(\frac{22}{\not 7} \times 1.\not 4^{0.2}\right) \text{cm}$$

$$= 4 \text{ cm} + 4.4 \text{ cm}$$

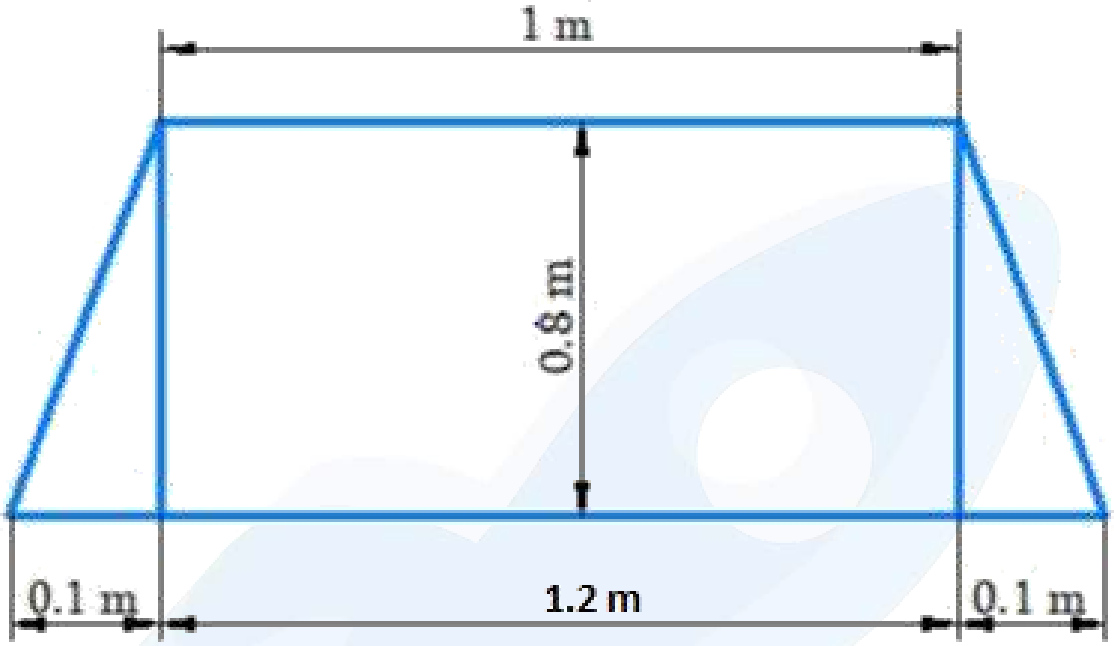
$$= 8.4 \text{ cm}$$

Thus, the ant will have to take a longer round for food piece (b) because the perimeter of the figure given in (b) is the greatest among all.

Chapter-11: Mensuration

Exercise 11.2 (Page 177 of NCERT Grade 8)

Q1. The shape of the top surface of a table is a trapezium. Find its area if its parallel sides are 1 m and 1.2 m and perpendicular distance between them is 0.8 m.



Known:
Shape of the table is trapezium and dimensions of the table.

Unknown:
Area of the table.

Reasoning:
The table is rectangular in the middle and triangle at the end. Usually the area of the problem is sum of areas of two right angle triangle and rectangle.

Solution:
Base of the triangles (CE+FD) = (CD-EF)
= 1.2cm – 1m = 0.2m

Base of one triangle $= CE = FD = \dfrac{0.2}{2} = 0.1\text{m}$

Height of the triangle= AE = BF = 0.3m
Area of the triangle ΔACE = Area of the triangle ΔBDF

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

$$= \frac{1}{2} \times 0.1\,\text{m} \times 0.8\,\text{m} = 0.04\,\text{m}^2$$

$$\text{Area of the rectangle ABEF} = 1\,\text{m} \times 0.8\,\text{m}$$
$$= 0.8\,\text{m}^2$$

$$\therefore \text{ Area of the table} = \text{Area of the triangle } \Delta ACE + \text{Area of the rectangle ABEF} + \text{Area of the triangle } \Delta BFD$$
$$= 0.04\,\text{m}^2 \times 0.8\,\text{m}^2 + 0.04\,\text{m}^2$$
$$= 0.88\,\text{m}^2$$

Q2. The area of a trapezium is 34 cm^2 and the length of one of the parallel sides is 10 cm and its height is 4 cm. Find the length of the other parallel side.

Known:

Area, length of the one of the parallel sides of the trapezium and its height.

Unknown:

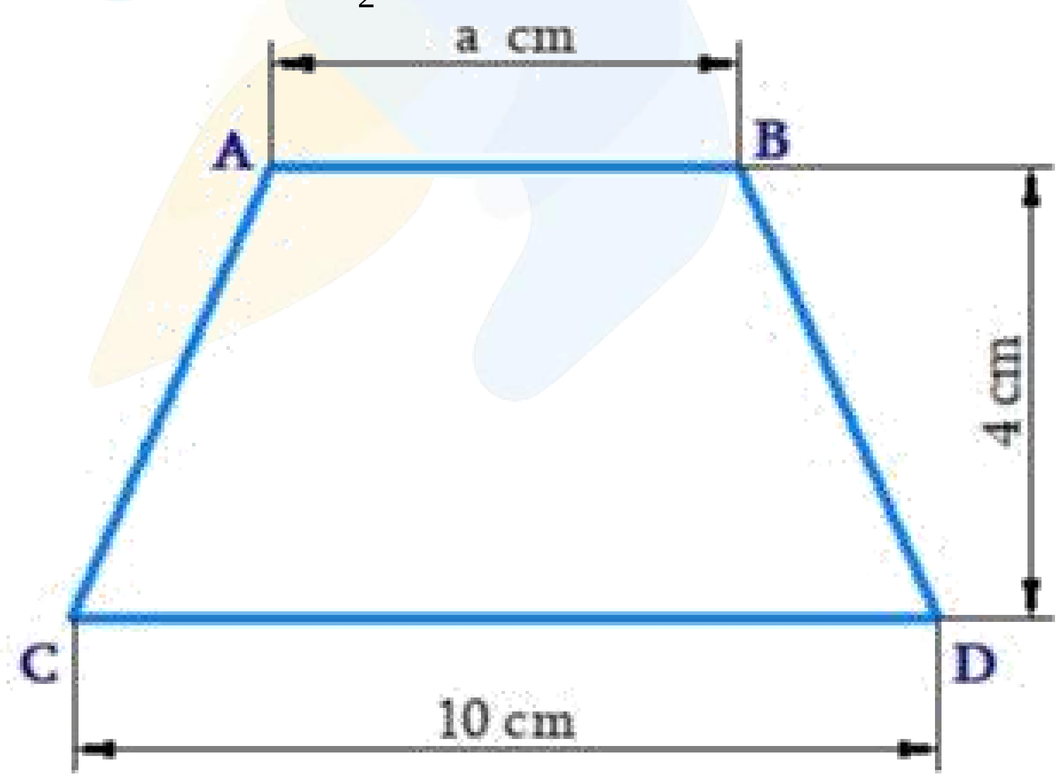
Length of the other parallel side

Reasoning:

Since area of the trapezium is known. So is easy to find another parallel side by using given information.

Solution:

$$\text{Area of the trapezium ABCD} = \frac{1}{2} \times (\text{sum of parallel side}) \times \text{distance between its parallel sides}$$



$$34 = \frac{1}{2} \times (AB + CD) \times 4 \text{ cm}$$

$$34 = \frac{1}{\not{2}} \times (10 \text{ cm} + a) \times \not{4}^{2} \text{ cm}$$

$$34 = 2(10 \text{ cm} + a)$$

$$\frac{34}{2} = 10 \text{ cm} + a$$

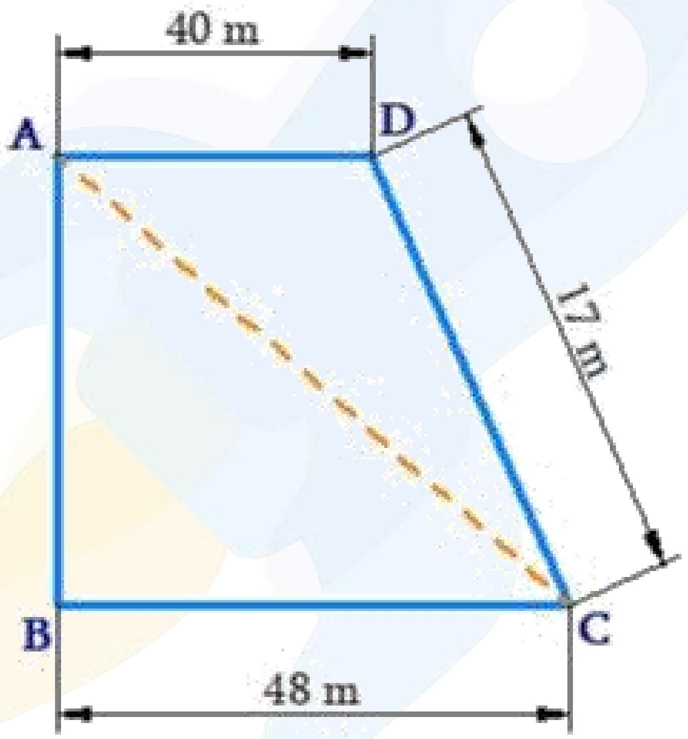
$$17 = 10 \text{ cm} + a$$

$$a = 17 \text{ cm} - 10 \text{ cm}$$

$$= 7 \text{ cm}$$

Thus, the length of the parallel side is 7cm.

Q3. Length of the fence of a trapezium shaped field ABCD is 120 m. If BC = 48 m, CD = 17 m and AD = 40 m, find the area of this field. Side AB is perpendicular to the parallel sides AD and BC.



Known:

Length of the trapezium shaped field and side AB, DC, and BC

Unknown:

Area of the field and side AB.

Reasoning:

Visually area of given figure (trapezium) is sum of the area of two triangles.

Solution:

Length of the hence of a trapezium shaped field ABCD = AB + BC + CD + AD

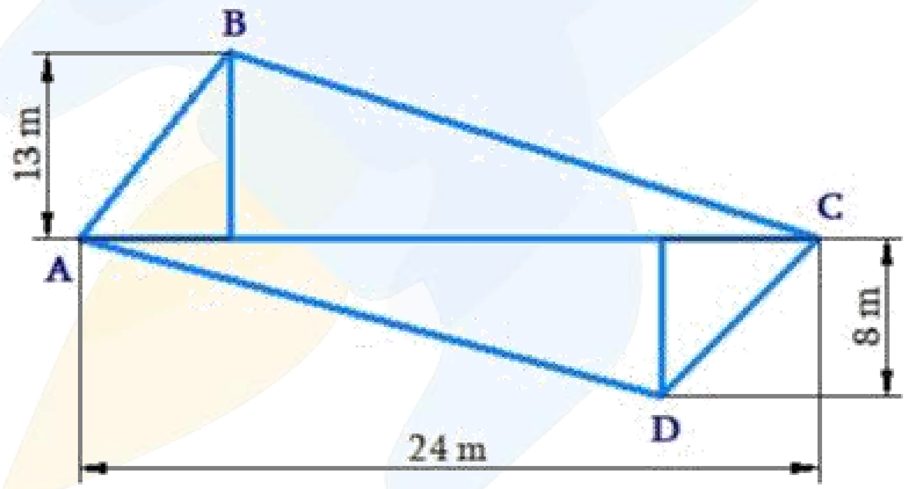
$$120\text{ m} = AB + 48\text{m} + 17\text{ m} + 40\text{ m}$$
$$120\text{ m} = AB + 105\text{ m}$$
$$AB = 120\text{ m} - 105\text{ m}$$
$$AB = 15\text{ m}$$

Area of the field ABCD $= \frac{1}{2} \times$ (length of the parallel side) $\times$ distance between two parallel sides

$$= \frac{1}{2} \times (AD + BC) \times AB$$
$$= \frac{1}{2} \times (40 + 48) \times 15\text{ m}$$
$$= \frac{1}{2} \times (88\text{ m}) \times 15\text{ m}$$
$$= 44\text{ m} \times 15\text{ m}$$
$$= 660\text{ m}^2$$

Thus, Area of the field ABCD is 660m^2.

Q4. The diagonal of a quadrilateral shaped field is 24 m and the perpendiculars dropped on it from the remaining opposite vertices are 8 m and 13 m. Find the area of the field.



Known:

The shape of the field is quadrilateral, and length of the diagonal and length of the perpendicular drop is given.

Unknown:

Area of the field ABCD.

Reasoning:

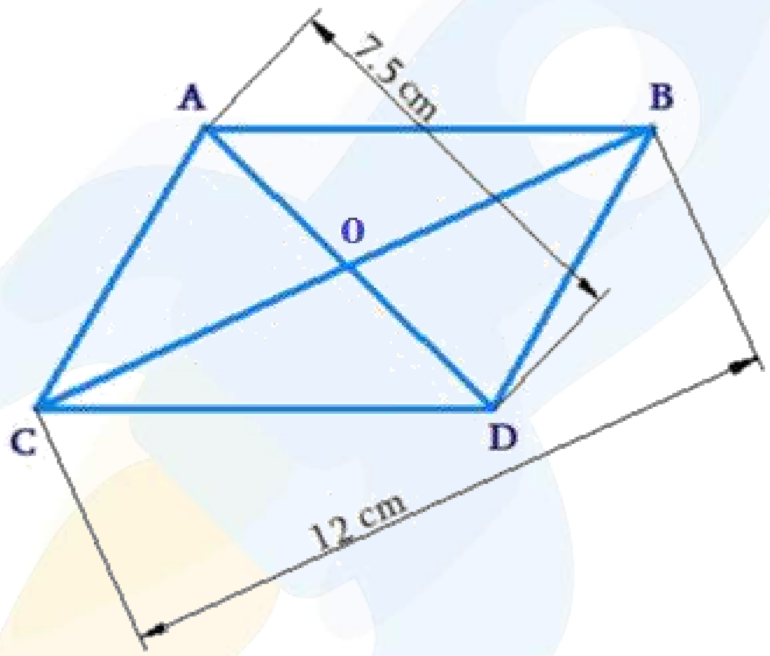
A general quadrilateral can be split into two triangles by drawing one of its diagrams. Area of quadrilateral will be the sum of area of two triangles.

Solution:

$$\begin{aligned}\text{Area of quadrilateral ABCD} &= \text{Area of } \Delta\,\text{ABC} + \text{Area of } \Delta\,\text{ADC} \\ &= \frac{1}{2}\times(\text{AC}\times\text{BE}) + \frac{1}{2}\times(\text{AC}\times\text{FD}) \\ &= \frac{1}{2}\times\text{AC}\,(\text{BE}+\text{FD}) \\ &= \frac{1}{2}\times 24\ \text{m}\,(13\,\text{m}+8\,\text{m}) \\ &= \frac{1}{2}\times 24\ \text{m}\times 21\,\text{m} \\ &= 252\ \text{m}^2\end{aligned}$$

Thus, area of the field is 252m^2

Q5. The diagonals of a rhombus are 7.5 cm and 12 cm. Find its area.



Known:
Diagonals of the rhombus are given.

Unknown:
Area of rhombus.

Reasoning:
By using the method of splitting into triangles (triangulation method) we can find area of the rhombus visually diagonals AD and BC are perpendicular bisectors of each other. Hence area of rhombus ABCD will be the sum of area of triangle ACB and area of the triangle DBC.

Solution:

Area of rhombus ABCD = Area of ΔABC + Area of ΔDCB

$$= \frac{1}{2} \times (CB \times AO) + \frac{1}{2} \times (CB \times OD)$$
$$= \frac{1}{2} \times CB \times (AO + OD)$$
$$= \frac{1}{2} \times CB \times AD$$
$$= \frac{1}{2} \times 12\ m \times 7.5\ m$$
$$= 45.0\ m^2$$

The, area of the rhombus is $45.0\,m^2$

Q6. Find the area of a rhombus whose side is 5 cm and whose altitude is 4.8 cm. If one of its diagonals is 8 cm long, find the length of the other diagonal.

Known:

One of the diagonals, side and attitude of the rhombus.

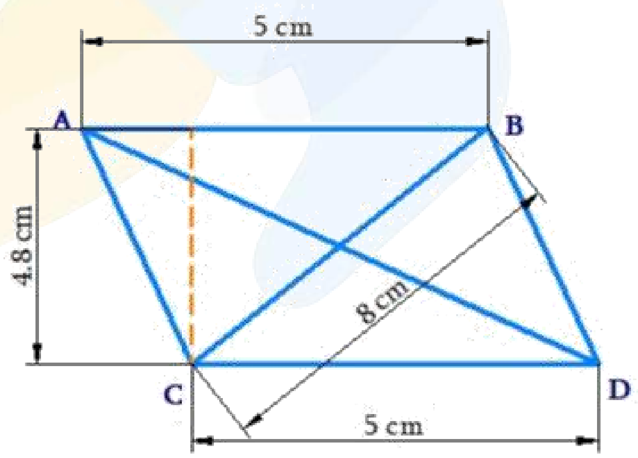
Unknown:

Area of the rhombus and length of the diagonal.

Reasoning:

Rhombus is a special case of parallelogram and the area of parallelogram is product of its base and height.

Solution:



Let the length of the other diagonal of rhombus is x.

Area of the rhombus ABCD = base × length

$$= 5cm \times 4.8cm$$
$$= 24.0cm^2$$

Also,

$$\text{Area of rhombus} = \frac{1}{2} \times (\text{Product of its diagonals})$$

$$24\text{cm}^2 = \frac{1}{2}(AD \times CB)$$

$$24\text{cm}^2 = \frac{1}{2}(x \times 8\text{cm})$$

$$x \times 4\text{cm} = 24\text{cm}^2$$

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

Thus, area of the rhombus is 24.0m^2 and length of the diagonals is 6cm.

Q7. The floor of a building consists of 3000 tiles which are rhombus shaped and each of its diagonals is 45 cm and 30 cm in length. Find the total cost of polishing the floor, if the cost per m^2 is 4.

Known:

The tiles used are rhombus shaped. Dimensions of single tile used and cost per m^2 of polishing the floor.

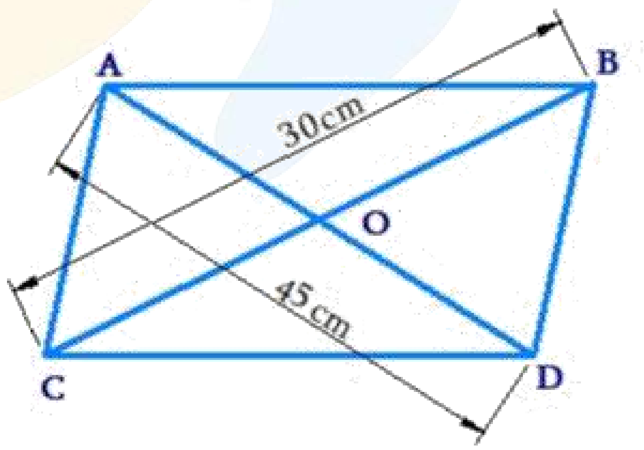
Unknown:

Total cost of polishing the floor.

Reasoning:

By using the method of splitting into triangles (triangulation method) we can find area of the rhombus visually diagonals AD and BC are perpendicular bisectors of each other. Hence, area of rhombus ABCD will be the sum of area of triangle ACB and area of the triangle DBC.

Solution:



$$\text{Area of rhombus} = \text{Area of } \Delta ABC + \text{Area of } \Delta DCB$$
$$= \frac{1}{2}\times(BC\times AO) + \frac{1}{2}\times(BC\times OD)$$
$$= \frac{1}{2}\times BC\times(AO+OD)$$
$$= \frac{1}{2}\times BC\times AD$$
$$= \frac{1}{2}\times 45\text{cm}\times 30\text{cm}$$
$$= 675\text{cm}^2$$

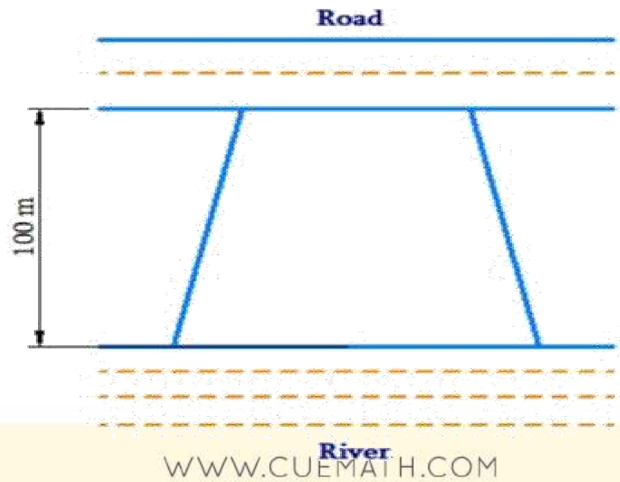
$$\text{Area of rhombus ABCD} = \text{Area of } \Delta ABC + \text{Area of } \Delta DCB$$
$$= \frac{1}{2}\times(BC\times AO) + \frac{1}{2}\times(BC\times OD)$$
$$= \frac{1}{2}\times BC\times(AO+OD)$$
$$= \frac{1}{2}\times BC\times AD$$
$$= \frac{1}{2}\times 45\text{cm}\times 30\text{cm}$$
$$= 675\text{cm}^2$$

Area of each tile $= 675m^2$

$$\text{Area covered by 3000 tiles} = (675\times 3000)\text{cm}^2$$
$$= 2025000\text{cm}^2$$
$$= 202.5\text{m}^2$$

The cost of polishing is Rs. 4 per m^2.
$\therefore$ Cost of polishing for $202.5m^2$ area $= Rs.(4\times 202.5) = Rs.810.0$
Thus, the cost of polishing the floor is Rs 810.

Q8. Mohan wants to buy a trapezium shaped field. Its side along the river is parallel to and twice the side along the road. If the area of this field is 10500 m^2 and the perpendicular distance between the two parallel sides is 100 m, find the length of the side along the river.



Known:
The field is trapezium shaped. The area of this field and perpendicular distance between the two parallel sides are known.

Unknown:
Length of the field side along the river.

Reasoning:
Since area of the trapezium is known. So is easy to find another parallel side by using given information.

Solution:
Let the length of the field along the road be l meter
Hence the length of the of the field along the river will be $2l$ meter

$$\text{Area of the trapezium} = \frac{1}{2} \times (\text{sum of parallel side}) \times (\text{distance between the parallel sides})$$

$$10500 \text{ m}^2 = \frac{1}{2} \times (l + 2l) \times 100 \text{ m}$$

$$10500 \text{ m}^2 = \frac{1}{2} \times 3l \times 100 \text{ m}$$

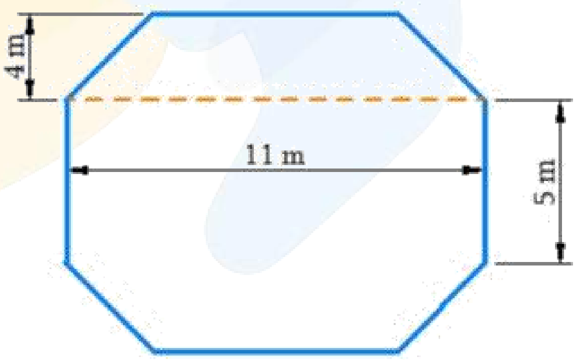
$$10500 \text{m}^2 = 3l \times 50m$$

$$150 \times l = 10500 \text{m}$$

$$l = 70 \text{ m}$$

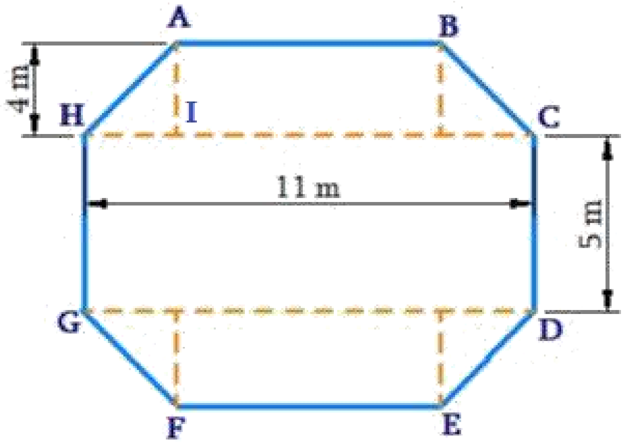
Thus, length of the field along the river $= 2 \times l = 2 \times 70 \text{m} = 140 \text{m}$.

Q9. Top surface of a raised platform is in the shape of a regular octagon as shown in the figure. Find the area of the octagonal surface.



Known:
Top surface of a raised platform is octagonal shaped.

Unknown:
Area of the octagonal surface



Reasoning:

Visually, the area of the octagonal surface will be the sum of the area of two trapezium and area of rectangular.

Solution:

Area of octagon ABCDEFGH =area of trapezium ABCH + area of rectangular HCDG + area of trapezium EFGD

Side of the regular octagon = 5cm

Area of trapezium ABCH = Area of trapezium EFGD

Area of trapezium $ABCH = \frac{1}{2} \times (AB + CH) \times AI$

$$= \frac{1}{2} \times (5m + 11m) \times 4m$$

$$= \frac{1}{2} \times 16m \times 4m$$
$$= 32m^2$$

$\therefore$ Area of trapezium ABCH = Area of trapezium EFGD $= 32m^2$

Area of rectangle HCDG $= HC \times CD = 11\text{m} \times 5\text{m} = 55\text{m}^2$

Area of ABCDEFGH = area of trapezium ABCH +area of rectangle HCDG area of trapezium EFGD

$$= 32\text{m}^2 + 55\text{m}^2 + 32\text{m}^2$$

$$= 119m^2$$

Thus, the area of the octagonal surface is 119m^2

Q10. There is a pentagonal shaped park as shown in the figure. For finding its area Jyoti and Kavita divided it in two different ways. Find the area of this park using both ways. Can you suggest some other way of finding its area?

Known:

The park is pentagonal shape and dimension of the park is given.

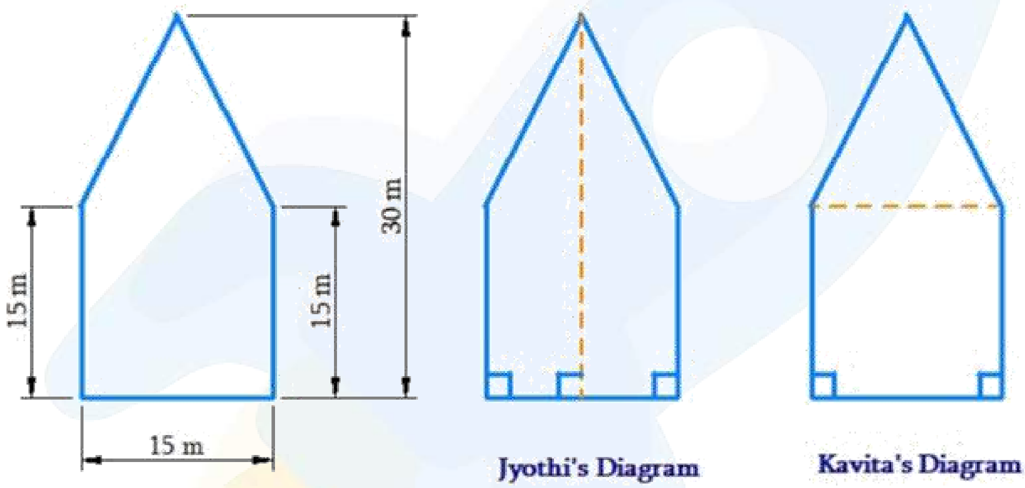
Unknown:

Area of the park

Reasoning:

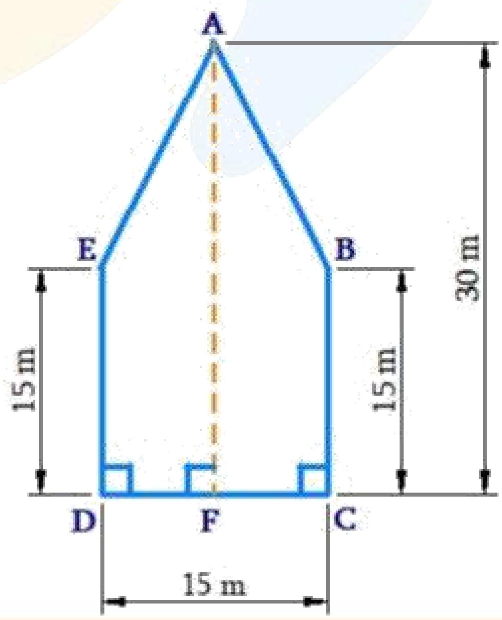
Visually the pentagon is divided into two equal trapeziums or into one triangle and one square. So, the area of the pentagon will be sum of the area of triangle and area of the square.

Solution:



(i) Jyoti's way of triangle area is as follows

Area of pentagon ABCDE=Area of trapezium ABCD+ Area of trapezium AEDF



$$= \frac{1}{2} \times (AF + BC) \times FC + \frac{1}{2} \times (AF \times BC) \times DF$$

$$= \frac{1}{2} \times (13\text{m} + 15\text{m}) \times \frac{15}{2}\text{m} + \frac{1}{2} \times (30 + 15\text{m}) \times \frac{15}{2}\text{m}$$

$$= 2 \times \frac{1}{2}(30\text{m} + 15\text{m}) \times \frac{15}{2}$$

$$= 45\text{ m} \times 7.5\text{ m}$$

$$= 337.5\text{ m}^2$$

Thus, area of the pentagonal shaped park according to Jyoti's way is $337.5m^2$

(ii) Kavitha's way of finding area is as follows.

Area of pentagon ABCDE=Area of triangle ABE + Area of square EBDC

$$= \frac{1}{2} \times BE \times (AF - OF) + FC \times BC$$

$$= \frac{1}{2} \times 15 \times (30 - 15) + (15 \times 15\text{ m})$$

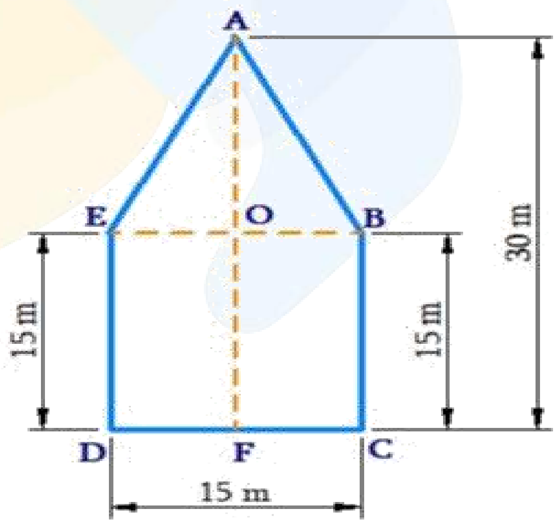
$$= \left(\frac{1}{2} \times 15 \times 15\right)\text{m}^2 + 225\text{ m}^2$$

$$= 112.5\text{ m}^2 + 225\text{ m}^2$$

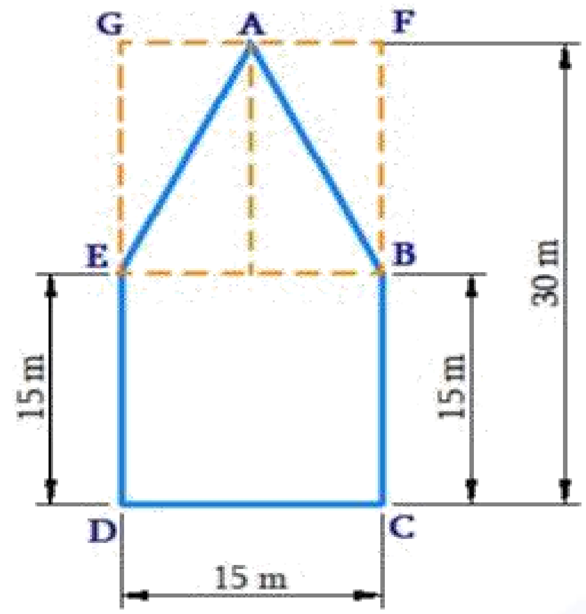
$$= 337.5\text{ m}^2$$

Thus, the area of the pentagonal shaped park according to Kavitha's way is $337.5m^2$

Another way of finding its area is follows.



Area of pentagon ABCDE = Area of rectangle GFCD – 2(Area of ΔAGE)

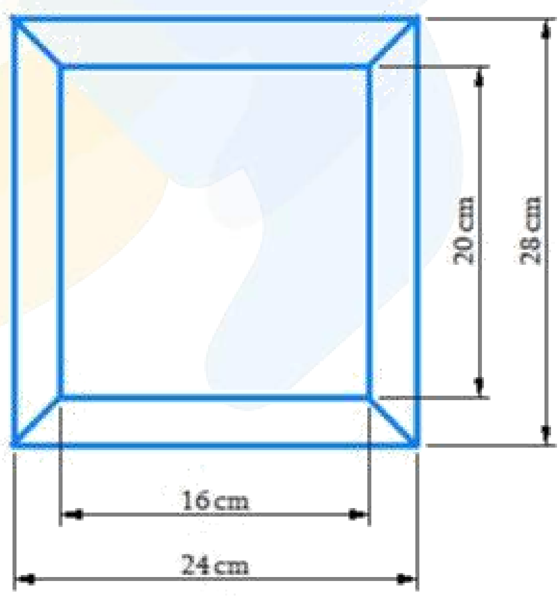


$$= 30\text{ m} \times 15\text{ m} - 2 \times \left(\frac{1}{2} \times 7.5 \times 1.5\right)$$

$$= 450\text{ m}^2 + 112.5\text{ m}^2$$

$$= 337.5\text{ cm}^2$$

Q11. Diagram of the adjacent picture frame has outer dimensions = 24 cm × 28 cm and inner dimensions 16 cm × 20 cm. Find the area of each section of the frame, if the width of each section is same.



Known:

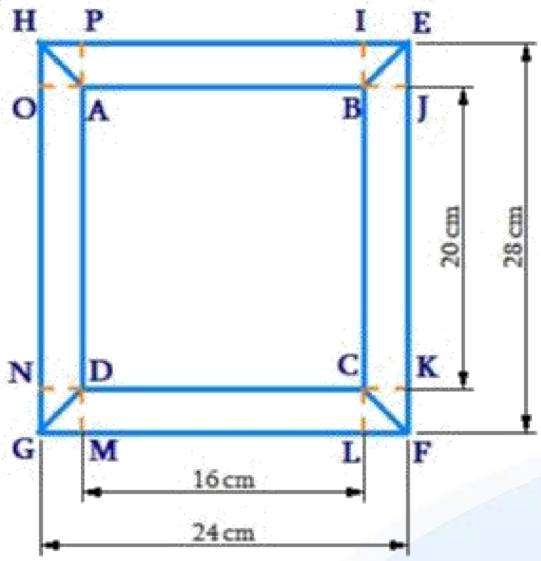
Inner and outer dimensions of the frame.

Unknown:

Area of each section of the frame

Reasoning:

Visually, there are four trapezium and one rectangle in the given figure.



Solution:

Given that the width of each section is same, therefore.

$$IB = BJ = CK = CL = DM = DN = AP = AO$$

$$IL = IB + BC + CL$$

$$28 = IB + 20\text{cm} + CL$$

$$28\text{cm} - 20\text{cm} = IB + CL$$

$$8cm = IB + CL$$

$$IB = CL$$

$$2IB = 8\text{cm}$$

$$IB = 4\text{m}$$

Hence IB = BJ=CK=CL=DN=AP=AO=4cm

$$\text{Area of section } ABEH = \text{ Area of section } CDFG$$

$$= \frac{1}{2} \times (AB + HE) + IB$$

$$= \frac{1}{2}(16 + 24) \times 4\text{cm}$$

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

$$\text{Area of section } BEFC = \text{ Area of section } ADGH$$

$$= \frac{1}{2} \times (BC + EF) + BJ$$

$$= \frac{1}{2} \times (20 + 28)\text{cm} \times 4\text{cm}$$

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

$$\text{Area of section ABCD} = BC \times DC$$

$$= 20\text{cm} \times 16\text{cm}$$

$$= 320\text{m}^2$$

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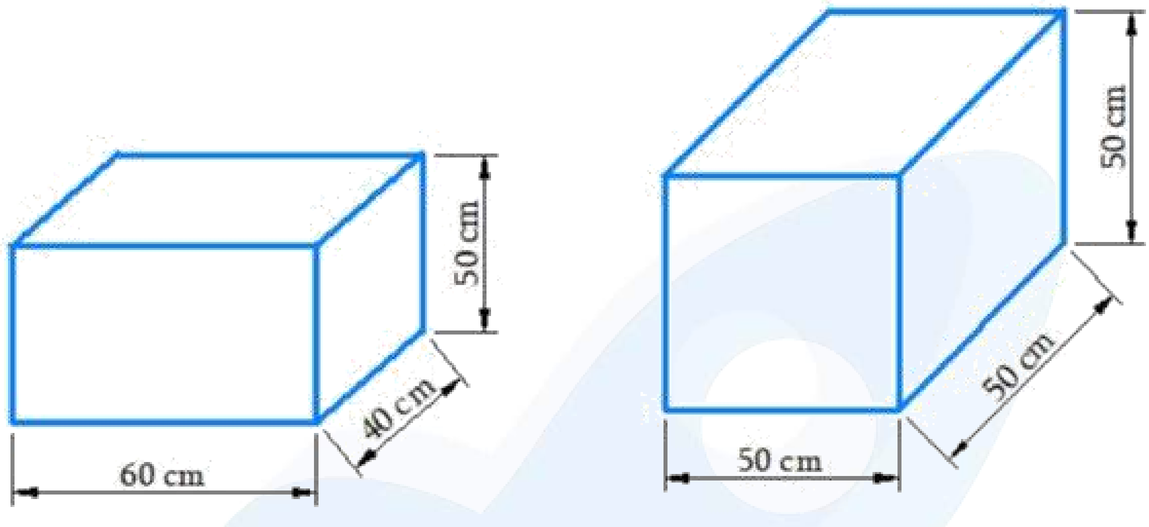
THE MATH EXPERT

Chapter-11: Mensuration

Exercise 11.3 (Page 186 of NCERT Grade 8)

Q1. There are two cuboidal boxes as shown in the adjoining figure. Which box requires the lesser amount of material to make?



(a) (b)

Known:
Dimensions of the cuboidal boxes.

Unknown:
Surface area of the given figure

Reasoning:
The amount of material requires to make boxes will be equal to their respective surface area.

Solution:
Total surface area of the cuboid lateral surface $=$ area of curved surface $+ 2 \times$ area of base

Total surface area of the cub $= 6(l)^2$

Total surface area of cuboid in figure

$$\begin{aligned}
&= (hl + hb + hl + hb) + 2(lb) \\
&= 2(hl + lb + hb) \\
&= 2(60 \times 50 \times + 40 \times 50 + 60 \times 40)cm^2 \\
&= 2(3000 + 2000 + 2400)cm^2 \\
&= 14800m^2
\end{aligned}$$

Total surface area of cube in figure (b)

$$= 6 \times (l)^2$$
$$= 6 \times (50)^2$$
$$= 6 \times 2500$$
$$= 15000 cm^2$$

Thus, the cuboid box (a) requires lesser amount of material.

Q2. A suitcase with measures 80 cm × 48 cm × 24 cm is to be covered with a tarpaulin cloth. How many meters of tarpaulin of width 96 cm is required to cover 100 such suitcases?

Known:
Number of suitcases to be covered and dimensions of each suitcase.

Unknown:
Required length of tarpaulin cloth cover suitcase

Reasoning:
Find the surface area of a suitcase.

Solution:
Let the length of the tarpaulin cloth = *l* cm

Total surface of the suitcase

$$= 2[(80 \times 48) + (48 \times 24) + (24 \times 80)]\ \text{cm}^2$$
$$= 2[3840 + 1152 + 1920]\text{cm}^2$$
$$= 13824\,\text{m}^2$$

Total surface area of 100 suitcases
$$= 100 \times 13824\,\text{m}^2$$
$$= 1382400\ \text{cm}^2$$

Required Tarpaulin cloth $= \text{length} \times \text{breadth}$

$$1382400\,\text{cm}^2 = l \times 96\,\text{cm}$$
$$l = \frac{1382400}{96}\ \text{cm}$$
$$= 14400\ \text{cm}$$
$$l = 144m$$

Thus, 144m of tarpaulin cloth is required to cover 100 suitcases.

Q3. Find the side of a cube whose surface area is $600\,cm^2$.

Known:
Surface area of cube.

Unknown:
Length of the cube.

Reasoning:
Surface area of cube $= 6 \times (side)^2$

Solution:
Let the length of each side of cube be *l*.

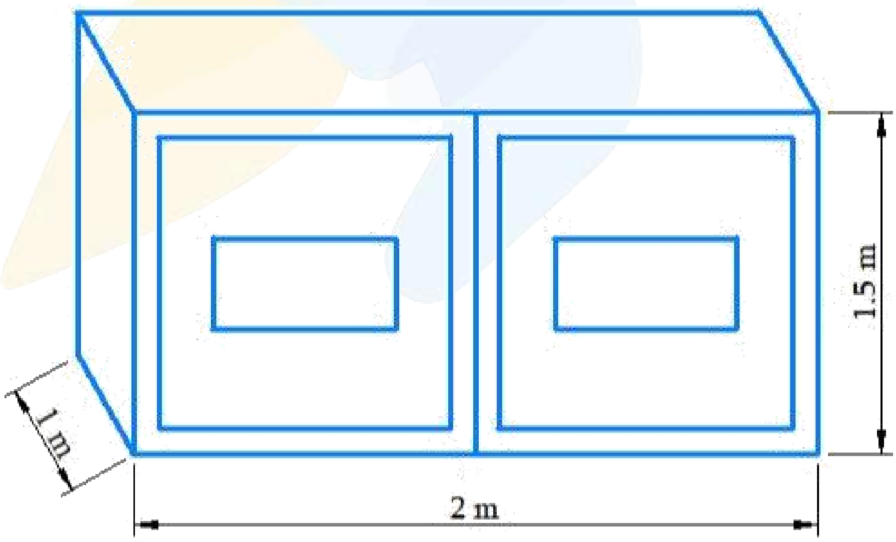
Given that, surface area of cube = $60\,\text{cm}^2$

Surface area of cube $= 6 \times (side)^2$

$$600\text{ cm}^2 = 6 \times (l)^2$$
$$l^2 = 100\text{ cm}^2$$
$$l = 10\,\text{cm}$$

Thus, the side of the cube is 10cm.

Q4. Rukhsar painted the outside of the cabinet of measure 1 m × 2 m × 1.5 m. How much surface area did she cover if she painted all except the bottom of the cabinet?



Known:
Dimensions of the cuboid.

Unknown:
Surface area of cuboid that was palindrome.

Reasoning:

Surface area of bottom of the cuboid will be subtracted from the total surface area of the cabinet.

Solution:

Length (l) of the cabinet $= 2\,\text{m}$

Breadth (b) of the cabinet $= 1\,\text{m}$

Height (n) of the cabinet $= 1.5\,\text{m}$

Area of the bottom of cabinet $= (l \times b)$

Total Surface area of the cabinet $= 2(l \times b + b \times h + n \times l)$

Area of the cabinet that was painted= (total surface area of the cabinet) **-** (area of bottom of the cabinet)

$$= 2(l \times b + b \times h + h \times l) - l \times b$$
$$= 2(b \times h + h \times l) + l \times b$$
$$= [2 \times (1 \times 1.5 + 1.5 \times 2) + 2 \times 1]\,\text{m}^2$$
$$= [2 \times 4.5 + 2]\,\text{m}^2$$
$$= 11\,\text{m}^2$$

Hence, the required area= 11 m^2

Q5. Daniel is painting the walls and ceiling of a cuboidal hall with length, breadth and height of 15 m, 10 m and 7 m respectively. From each can of paint 100 m^2 of area is painted. How many cans of paint will she need to paint the room?

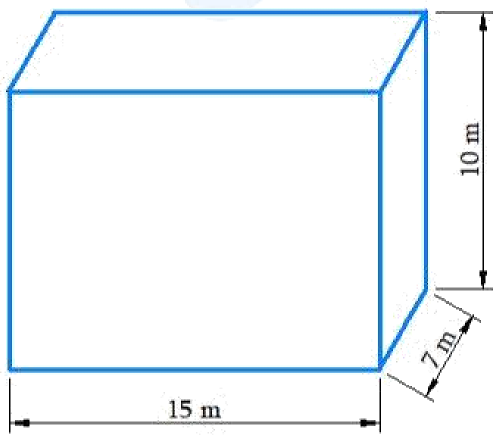
Known:

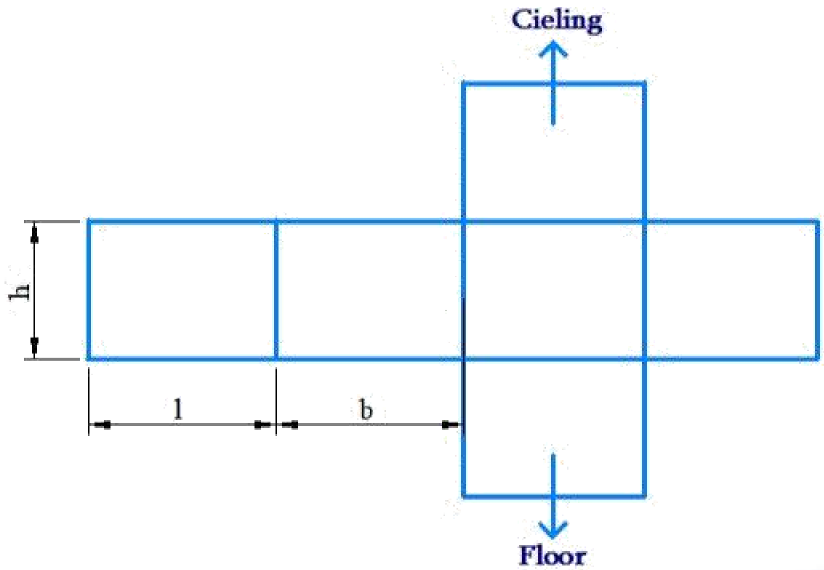
Shape of the hall and its length, breadth and height.

Unknown:

Number of cans of paint required to paint the room.

Reasoning:





The side of the hall makes the lateral surface area of cuboid. The total surface area of the cuboid will be the sum of lateral surface area of four walls and sum of the area of the ceiling and area of the floor.

Solution:

Length of the hall $l = 15\,\text{m}$

Breadth of the hall $b = 10\,\text{m}$

Height of the hall $n = 7\,\text{m}$

Lateral surface area of four walls $= (h \times l + h \times b + h \times l + h \times b)$

$$= 2(h \times l + h \times b)$$
$$= 2(7 \times 15 + 7 \times 10)\,\text{m}^2$$
$$= 2(105 + 70)\,\text{m}^2$$
$$= 350\,\text{m}^2$$

Area of the ceiling $= l \times b$

$$= 15 \times 10 = 150\,\text{m}^2$$

Area of the hall to be painted = Lateral surface area of walls + area of the ceiling.

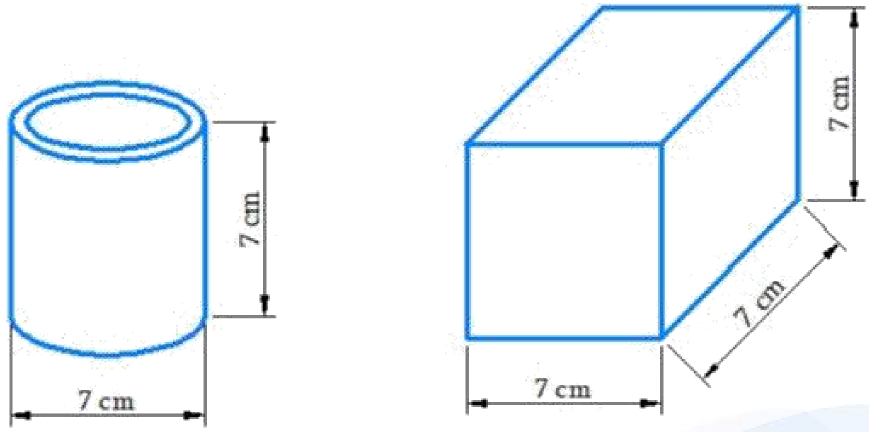
$$= 350m^2 + 150m^2$$
$$= 500m^2$$

It is given that from each can $100m^2$ area can be painted .

$\therefore$ Number of cans required to paint an area of $500m^2 = \dfrac{500}{100} = 5cans$

Thus, 5 cans are required to paint the walls and the ceiling of the cuboidal hall.

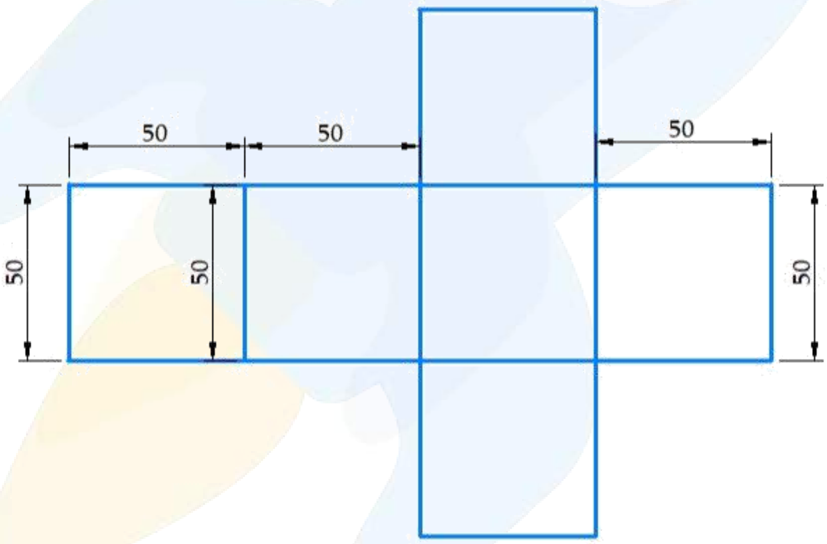
Q6. Describe how the two figures at the right are alike and how they are different. Which box has larger lateral surface area?

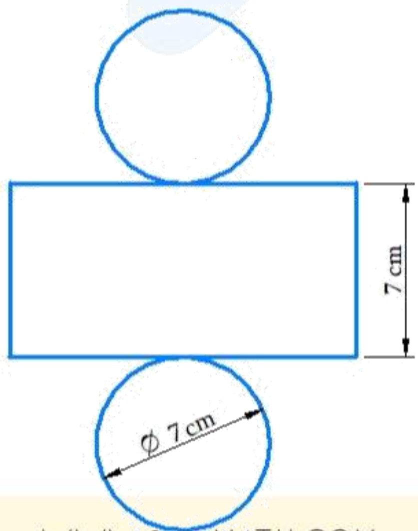


Known:
Shape and their respective dimension.

Unknown:
Lateral surface area.

Reasoning:





Length of rectangular strip will be equal to the circumference of the circle. Visually, all the faces of a cube and square are equal in shape. This makes length, height and width of a cube equal, so area of each of the face will be equal.

Solution:

Similarly, both the figures are alike in respect of their same height.

The difference between the two figures is that one is cylinder and other is a cube.

Length of one side of cube $(l) = 1cm$

Height of one side of cube $(h) = 7cm$

Width of one side of cube $(b) = 7cm$

Lateral surface area of the cube $= (h \times l + h \times b + h \times l + h \times b)$

$$= (l \times l + l \times l + l \times l + l \times l) \quad \{l = h = b\}$$

$$= 4l^2$$

$$= 4 \times (7)^2$$

$$= 196 \text{m}^2$$

Height of the cylinder h = 7cm

Radius of the cylinder $r = \frac{7}{2} cm = 3.5cm$

Lateral surface area of the cylinder = $2\pi rh$

$$= 2 \times \frac{22}{7} \times 3.5 \times 7$$

$$= 154m^2$$

Hence, the cube has larger lateral surface area.

Q7. A closed cylindrical tank of radius 7 m and height 3 m is made from a sheet of metal. How much sheet of metal is required?

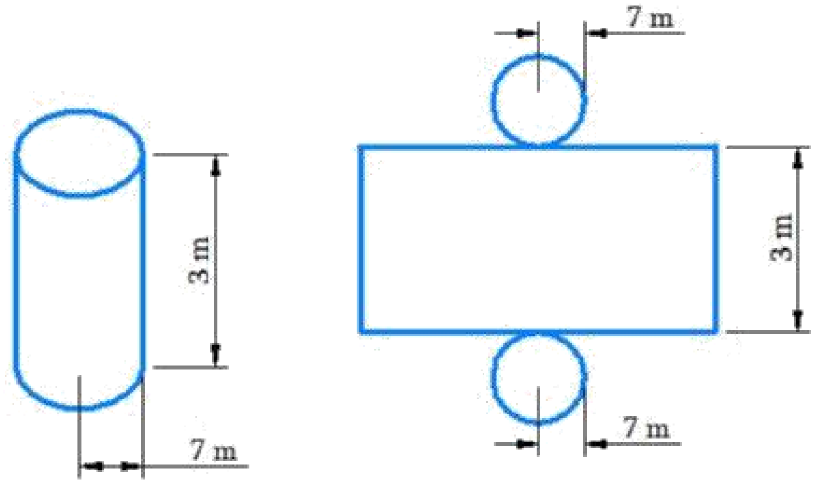
Known:

Radius and height of cylindrical tank.

Unknown:

Metal sheet required for cylindrical tank.

Reasoning:



The length of rectangular sheet will be equal to the circumference of the circle. Visually total surface of the cylinder will be equal to sum of lateral surface area and area of two circles.

Solution:

Height of the cylindrical tank (h) = 3cm

Radius of the cylindrical (r) = 7cm

Lateral surface area of the cylinder $= 2\pi rh = 2 \times \frac{22}{7} \times 7 \times 3 = 132m^2$ …… (1)

Area of circle $= \pi r^2 = 2 \times \frac{22}{7} \times 7\text{m} \times 7\text{m} = 154\,\text{m}^2$ ……(II)

Total surface area of cylinder = lateral surface area of the cylinder + area of two circles

$= 2\pi rh + 2\pi r^2$

$= 132m^2 + 308m^2$ (put the values from (I) and (II))

$= 440m^2$

Thus, $440m^2$ sheet is required.

Q8. The lateral surface area of a hollow cylinder is 4224 cm^2 .It is cut along its height and formed a rectangular sheet of width 33 cm. Find the perimeter of rectangular sheet?

Known:

A hollow cylinder is cut along its height to from a rectangular sheet. The lateral surface of the cylinder is given.

Unknown:

Perimeter of the rectangular sheet.

Reasoning:

The length of rectangular sheet will be equal to the circumference of the circle.
Lateral surface area of the cylinder will be equal to the area of rectangular sheet.

Solution:

Lateral surface area of a hollow cylinder $= 4224 cm^2$

Width of rectangular sheet = 33 *cm*

Let length of the rectangular sheet $= l$

Area of cylinder = Area of rectangular sheet

$$4224 cm^2 = 33 cm \times l$$

$$l = \frac{4224}{33} cm$$

$$l = 128 cm$$

Thus, the length of the rectangular sheet is 128 cm.

$$\text{Perimeter of the rectangular sheet} = 2 \times (\text{length} \times \text{width})$$
$$= 2 \times (128\,\text{cm} \times 33\,\text{cm})$$
$$= 2 \times 161\,\text{cm}$$
$$= 322\,\text{cm}$$

Thus, the perimeter of rectangular sheet is 322 cm.

Q9. A road roller takes 750 complete revolutions to move once over to level a road. Find the area of the road if the diameter of a road roller is 84 cm and length is 1 m.

Known:

Diameter of the road roller and length is given.

Unknown:

Area of the road.

Reasoning:

In one revolution, the roller will cover an area equal to its lateral surface area.

Solution:

Radius of the road roller $r = \frac{84}{2} cm$ = 42 cm

Length of the road roller, h = 1 m = 100 cm

In 1 revolution, area of the road covered $= 2\pi rh = 2 \times \frac{22}{7} \times 42 \times 100$

$$= 26400\,\text{cm}^2 = 2.64\,\text{m}^2$$

In 750 revolutions area of the road covered $= 750 \times 2.64 m^2$
$= 1980 m^2$

Thus, the area of the road is $1980 m^2$ $1980\ m^2$.

Q10. A company packages its milk powder in cylindrical container whose base has a diameter of 14 cm and height 20 cm. Company places a label around the surface of the container (as shown in the figure). If the label is placed 2 cm from top and bottom, what is the area of the label.

Known:
Label placed on container is in the form of a cylinder.

Unknown:
Area of the label placed on container.

Reasoning:
The length of rectangular sheet will be equal to the circumference of the circle. Visually, area of the label on the cylinder will be equal to lateral surface area of the cylinder.

Solution:

Height of the label $(h) = 20\,\text{cm} - 2 \times 2\,\text{cm}$
$= 16\,\text{cm}$

Radius of the label $= \frac{14}{2}\,\text{cm} = 7\,\text{cm}$

Label in the form of a cylinder having its Radius and height as 7cm and 16cm.

Area of the label = Lateral surface area of the cylinder

$$= 2\pi rh$$
$$= 2 \times \frac{22}{7} \times 7\,\text{cm} \times 16\text{cm}$$
$$= 704\,\text{cm}^2$$

Thus, the required area of the label is $704\,\text{cm}^2$.

Chapter-11: Mensuration

Exercise 11.4 (Page of 191 of NCERT Graded 8)

Q1. Given a cylindrical tank, in which situation will you find surface area and in which situation volume.

(a) To find how much it can hold.
(b) Number of cement bags required to plaster it.
(c) To find the number of smaller tanks that can be filled with water from it.

Known:
Various situations to find surface area and volume.

Unknown:
Surface area and volume of a cylinder.

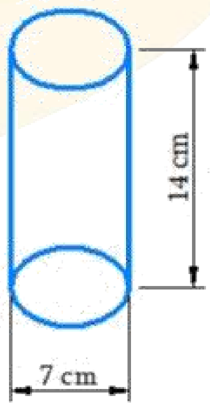
Solution:

a) We have to find out the volume of the object.

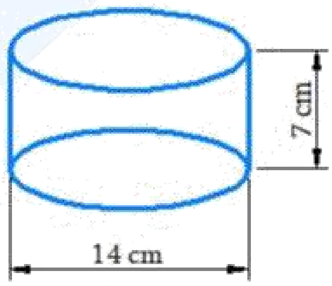
b) We find area of region covered by a boundary, wall or floor.

c) Volume

Q2. Diameter of cylinder A is 7 cm, and the height is 14 cm. Diameter of cylinder B is 14 cm and height is 7 cm. Without doing any calculations can you suggest whose volume is greater? Verify it by finding the volume of both the cylinders. Check whether the cylinder with greater volume also has greater surface area?



A



B

Known:
Dimensions of both cylinder A and B is given.

Unknown:
Volume of both the cylinders.

Reasoning:
Total surface area of cylinder = $2\pi r(r+h)$

Solution:
From the digram, radius of cylinder A is half of cylinder B. so its volume will be lesser than that of cylinder B.

The curved surface area of both cylinders will be same, but the total surface area will be greater in the cylinder with greater radius.

$$\text{Radius of cylinder } A(r) = \frac{7}{2} cm = 3.5 cm$$

$$\text{Height of cylinder } A(h) = 14 cm$$

$$\begin{aligned}\text{Volume of cylinder A} &= \pi r^2 h \\ &= \frac{22}{7} \times (3.5)^2 \times 14 cm^2 \\ &= 539 cm^2\end{aligned}$$

$$\begin{aligned}\text{Curved surface areaof cylinder A} &= 2\pi rh \\ &= 2 \times \frac{22}{7} \times 3.5 \times 14 \\ &= 308\ cm^2\end{aligned}$$

$$\begin{aligned}\text{Total surface area of cylinder A} &= 2\pi r(r+h) \\ &= 2\pi r^2 + 2\pi rh \\ &= \left(2 \times \frac{22}{7} \times 3.5 \times 3.5\right) cm^2 + 308 cm^2 \\ &= 385 cm^2\end{aligned}$$

$$\text{Radius of cylinder } B(r) = \frac{14}{2} cm = 7 cm$$

$$\text{Height of cylinder } \mathbf{B}(h) = 7 cm$$

$$\begin{aligned}\text{Volume of cylinder B} &= \pi r^2 h \\ &= \frac{22}{7} \times 7 \times 7 \times 7 \\ &= 1078 cm^2\end{aligned}$$

Surface area of cylinder B $= 2\pi rh$

$$= 2 \times \frac{22}{7} \times 7 \times 7$$

$$= 308\ cm^2$$

Total surface area of cylinder B $= 2\pi r(r+h)$

$$= 2\pi r^2 h + 2\pi rh$$

$$= (2 \times \frac{22}{7} \times 7 \times 7) cm^2 + 308 cm$$

$$= 308 cm^2 + 308 cm^2$$

$$= 616 cm$$

Thus, volume and surface area of cylinder B is greater than cylinder A.

Q3. Find the height of a cuboid whose base area is $180\ \text{cm}^2$ and volume is $900\ \text{cm}^3$?

Known:
Base area and volume of the cuboid is given.

Unknown:
Height of the cuboid.

Reasoning:
Volume of cuboid $= l \times b \times h$

Solution:
Base area of cuboid $=$ length $\times$ breadth

$$= 180 cm^2$$

Volume of cuboid $=$ length $\times$ breadth $\times$ height

$$900 cm^3 = 180 cm^2 \times \text{height}$$

$$\text{height} = \frac{900}{180} cm$$

$$= 5 cm$$

Thus, the height of the cuboid is 5cm.

Q4. A cuboid is of dimensions 60 cm × 54 cm × 30 cm. How many small cubes with side 6 cm can be placed in the given cuboid?

Known:
Side of the cube and dimensions of the cuboid.

Unknown:
Number of cubes that to be placed in the given cuboid.

Reasoning:
Volume of cuboid $= l \times b \times h$

Solution:

$$\begin{aligned} \text{Volume of cuboid} &= l \times b \times h \\ &= 60\,cm \times 54\,cm \times 30\,cm \\ &= 97200\,cm^2 \end{aligned}$$

$$\text{Side of the cube} = 6\,cm$$

$$\begin{aligned} \text{Volume of the cube} &= (6)^3\,cm^3 \\ &= 216\,cm \end{aligned}$$

$$\begin{aligned} \text{Required number of cubes} &= \frac{\text{volume of cuboid}}{\text{volume of the cube}} \\ &= \frac{97200}{216} \\ &= 450 \end{aligned}$$

Thus, 450 cubes can be placed in the given cuboid.

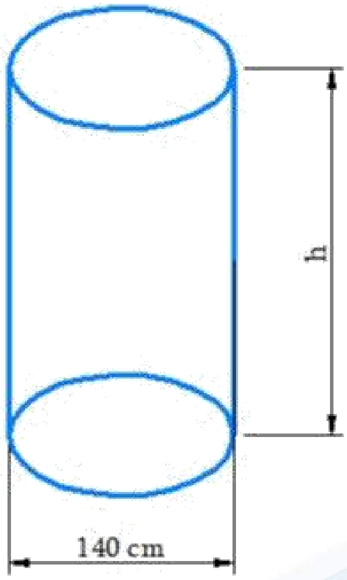
Q5. Find the height of the cylinder whose volume is $1.54\,\text{m}^3$ and diameter of the base is 140 cm?

Known:
Volume of the cylinder and diameter of the base of the cylinder is given.

Unknown:
Height of the cylinder.

Reasoning:
Volume of the cylinder $= \pi r^2 h$

Solution:



It the height of the cylinder = h

$$\text{Radius of the base } (r) = \frac{140}{2} cm$$
$$= 70 cm$$
$$= 0.7 m$$

$$\text{Volume of the cylinder} = \pi r^2 h$$
$$1.54 m^3 = \pi \times (0.7 m)^2 \times h$$
$$h = \frac{1.54}{\pi \times 49}$$
$$= \frac{^{0.07}\cancel{1.54} \times \cancel{7}}{\cancel{22} \times \cancel{0.49}_{0.07}}$$
$$= \frac{\cancel{0.07}}{\cancel{0.07}}$$
$$h = 1m$$

Thus, height of the cylinder is $1m$.

Q6. A milk tank is in the form of cylinder whose radius is 1.5 m and length is 7m. Find the quantity of milk in liters that can be stored in the tank?

Known:
Shaped of the milk tank is cylinder and its radius and length is known.

Unknown:
Quantity milk in liter that can be stored in the tank.

Reasoning:

Volume of the cylinder $= \pi r^2 h$

Solution:

Radius of cylinder = 1.5m

Length of cylinder (h) = 7m

Volume of the cylinder
$$= \pi r^2 h$$
$$= \frac{22}{7} \times (1.5)^2 \times 7\,\text{m}^3$$
$$= 49.5\ \text{m}^3$$

1 cubic meter = 1000 liters
So, 49.5 cubic meter = 49.5 x 1000 = 44500 liters

Therefore ,49500 liters of milk can be stored in the tank.

Q7. If each edge of a cube is doubled,

(i) How many times will its surface area increase?

(ii) How many times will its volume increase?

Known:

Initial surface area and volume of a cube.

Unknown:

Increased surface area and volume of a cube.

Reasoning:

Whenever sides are doubled in any structure then area becomes four times the original structure and the volume becomes eight times the original structure.

Solution:

It the initial edge of the cube is *l cm*.

If each edge of the cube is doubled, then it becomes 2l cm.

(i) Initial surface area= $6l^2$

New surface area $= 6(2l)^2 = 6 \times 4l^2 = 24l^2$

Ratio= $6l^2 : 24l^2$=1:4

(ii) Initial volume of the cube = l^3

New volume $= (2l)^3 = 8 \times l^3$

Ratio = $l^3 : 8\,l^3 = 1:8$

Thus, the surface area will be increased by four times and volume of the cube will be increased by eight times.

Q8. Water is pouring into a cuboidal reservoir at the rate of 60 liters per minute. If the volume of reservoir is $108\ \text{m}^3$, find the number of hours it will take to fill the reservoir.

Known:

Shape of the reservoir is cuboidal. The rate of pouring water into reservoir is given.

Unknown:

(i) Increased surface area and volume of a cube.
(ii) How much time it will take to fill the reservoir?

Solution:

$$\text{Volume of the reservoir} = 108m^3$$
$$= 108 \times 1000 \text{ litres}$$
$$= 108000 \text{ litres}$$

Volume of water flowing into the reservoir in 1 minute = 60L.

$$\text{In 1 hour} = (60 \times 60) \text{ Litres per hour}$$
$$= 3600 \text{ litres / hour}$$

$$\text{Required number of hours} = \frac{108000}{3600} \text{ hours}$$
$$= 30 \text{ hours}$$

Thus, it will take 30 hours to fill the reservoir.