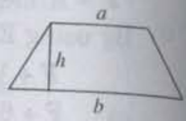
11 Mensuration

Learn and Remember

1. Area of a trapezium is equal to half of the product of the sum of the lengths of parallel sides and perpendicular distance between them.



Area of trapezium = $\frac{1}{2}(a+b)\times h$.

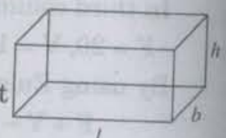
2. Area of rhombus is equal to half of the product of the diagonals of the rhombus.

Area = $\frac{1}{2}d_1d_2$, where d_1 and d_2 are diagonals of the rhombus.

3. Total surface area of a solid is the sum of the areas of its faces. Let a solid in form of cuboid be given below.

Total surface area = $2(lb + bh + hl)$

4. (*i*) Volume of cuboid = length × breadth × height $= l \times b \times h$

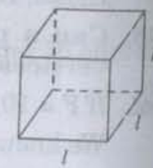


(*ii*) Length of diagonal of a cuboid = $\sqrt{l^2+b^2+h^2}$

5. (*i*) Surface area of a cube = $6l^2$.

(*ii*) Volume of cube = l^3

(*iii*) Length of a diagonal of cube = $l\sqrt{3}$.



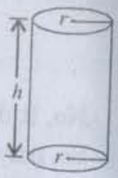
6. (*i*) Surface area of a cylinder = $2\pi rh$.

(*ii*) Base area = πr^2.

(*iii*) Total surface area = $2\pi rh + 2\pi r^2$
$= 2\pi r(h+r)$

(*iv*) Volume of cylinder = $\pi r^2 h$

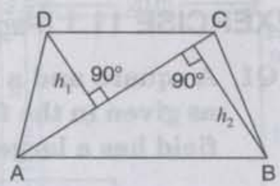
where, r = radius and h = height of the cylinder.



7. (*i*) $1\text{ cm}^3 = 1\text{ mL}$, (*ii*) $1\text{ L} = 1000\text{ cm}^3$,

(*iii*) $1\text{ m}^3 = 1000\text{ L}$.

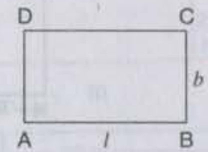
8. Area of a quadrilateral when its diagonal and heights are given, then



Area = $\frac{1}{2}\text{ AC }(h_1+h_2)$

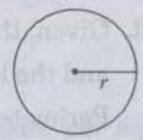
9. (*i*) Perimeter of rectangle = $2(l+b)$

(*ii*) Area of rectangle = $l \times b$.

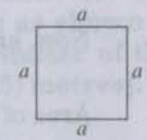


10. (*i*) Circumference of a circle = $2\pi r$

(*ii*) Area of a circle = πr^2.

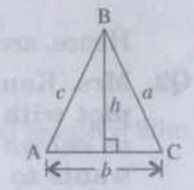


11. Volume refers to the amount of space occupied by an object.
12. Capacity refers to the quantity that a container holds.
13. Amount of space occupied by a three dimensional object, is called its volume.
14. Perimeter of edges of a cuboid = $4l + 4b + 4h = 4(l+b+h)$.
15. Total perimeter of edges of a cube = $4 \times 3l = 12l$.



16. Area of square = $a \times a = a^2$ (side)^2.

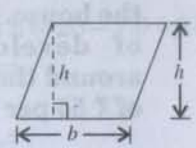
17. Area of triangle = $\frac{1}{2}\times b\times h$.



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

where, $s = \frac{a+b+c}{2}$ and a, b, c are sides of a triangle.

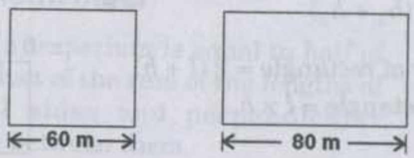
19. Area of parallelogram = $b \times h$.



TEXTBOOK QUESTIONS SOLVED

EXERCISE 11.1 *(Page –171)*

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



(a) (b)

Sol. Given, the side of a square = 60 m.

and the length of a rectangular field = 80 m

Perimeter of a rectangular field = perimeter of a square field.

$$2(l + b) = 4 \times \text{side}$$
$$\Rightarrow 2(80 + b) = 4 \times 60$$
$$\Rightarrow 2 \times 80 + 2b = 240$$
$$\Rightarrow 160 + 2b = 240$$
$$\Rightarrow 2b = 240 - 160 = 80$$
$$\Rightarrow b = \frac{80}{2} = 40 \text{ m}$$

Now, area of square = $(\text{side})^2 = (60)^2$

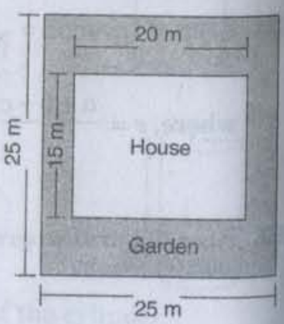
$= 3600 \text{ m}^2$

Area of rectangular field $=$ length $\times$ breadth

$= 80 \times 40 = 3200 \text{ m}^2$

Hence, area of a square field is larger.

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 m².



Sol. Side of a square plot = 25 m

Area of a square plot = $(\text{side})^2$

$= (25)^2$

$= 625 \text{ m}^2$

Length of the house = 20 m

Breadth of the house = 15 m

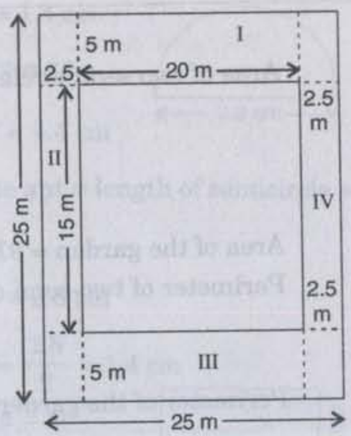
Area of house = length × breadth

$= 20 \times 15 = 300 \text{ m}^2$

Area of garden = area of square plot – area of house

$= 625 \text{ m}^2 - 300 \text{ m}^2$

$= 325 \text{ m}^2$



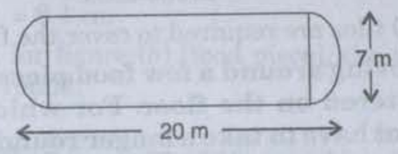
Cost of developing a garden around the house per square metre = ₹ 55

Cost of developing a garden around the house 325 square metre

$= 55 \times 325 =$ ₹ 17,875

Hence, total cost of developing a garden around the house is ₹ 17,875.

Q3. The shape of a garden is rectangular in the middle and semi-circular 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) metres].



Sol. It has been given in the question that total length = 20m

Given, diameter of semi-circle = 7 m.

Length of radius of semi circle $= \frac{7}{2}$ m $= 3.5$ m

Length of rectangular field $= 20 - (3.5 + 3.5) = 20 - 7.0 = 13$ m

and breadth of the rectangular field = 7 m.

Area of rectangular field $= l \times b$

$= 13 \times 7 = 91 \text{ m}^2$

Area of two semi-circles $= 2 \times \frac{1}{2}\pi r^2$

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

$= 38.5 \text{ m}^2$

Area of the garden $= 91 + 38.5 = 129.5 \text{ m}^2$.

Perimeter of two-semi circles $= 2 \times \pi r$

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

Perimeter of the garden $= 22 + 13 + 13$

$= 48$ 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.]

Sol. Given, base of a flooring tile = 24 cm = 0.24 m

Corresponding height of a flooring tile = 10 cm or 0.10 m

Now, area of flooring tile = base × altitude

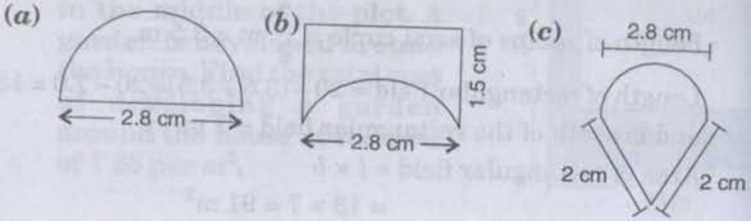
$= 0.24 \times 0.10 = 0.024 \text{ m}^2$

Number of tiles required to cover a floor $= \frac{1080}{0.024}$

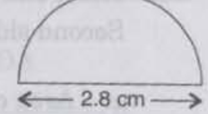
= 45000 tiles.

Hence, 45000 tiles are required to cover the floor.

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.



Sol. (*a*) Radius $= \frac{\text{diameter}}{2} = \frac{2.8}{2} = 1.4$ cm



Circumference of semi-circle $= \pi r$

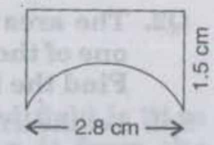
$= \frac{22}{7} \times 1.4 = 22 \times 2 = 4.4$ cm

Total distance covered by the ant = length of semicircle + diameter

$= 4.4 + 2.8 = 7.2$ cm

(*b*) Diameter of the semi-circle = 2.8 cm

So, radius $r = \frac{\text{diameter}}{2} = \frac{2.8}{2} = 1.4$ cm



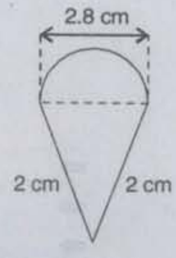
Circumference of semi-circle $= \pi r$

$= \frac{22}{7} \times 1.4 = 22 \times 2 = 4.4$ cm

Total distance covered by the ant $= 1.5 + 2.8 + 1.5 + 4.4$

$= 10.2$ cm

(*c*) Diameter of the semi-circle = 2.8 cm



So, radius $= \frac{\text{diameter}}{2} = \frac{2.8}{2} = 1.4$ cm

Circumference of semi-circle $= \pi r$

$= \frac{22}{7} \times 1.4 = 4.4$ cm

Total distance covered by the ant

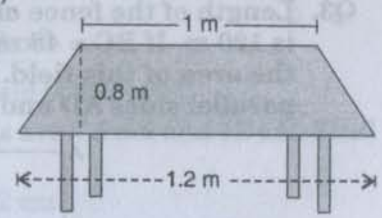
$= 2 + 2 + 4.4$

$= 8.4$ cm

Hence, for figure (*b*) [food piece], the ant would take a longer round.

EXERCISE 11.2 *(Page –177-178)*

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.



Sol. Here, one parallel side of the trapezium, $a = 1$ m

Second side $b = 1.2$ m and height $= 0.8$ m

$\therefore$ Area of top surface of the table $= \frac{1}{2} \times (a + b) \times h$

$= \frac{1}{2} \times (1 + 1.2) \times 0.8$

$= \frac{1}{2} \times 2.2 \times 0.8$

$= 0.88 \text{ m}^2.$

Hence, surface area of the table is 0.88 m^2.

Q2. The area of a trapezium is 34 cm² 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.

Sol. Let the length of other parallel side be b.

Length of one parallel side, $a = 10$ cm and height, $h = 4$ cm

Area of the trapezium $= 34 \text{ cm}^2$

Area of trapezium $= \frac{1}{2}(a + b) \times h$

$34 = \frac{1}{2}(10 + b) \times 4$

$\Rightarrow \quad 34 = (10 + b) \times 2$

$\Rightarrow \quad 34 = 20 + 2b$

$\Rightarrow \quad 20 + 2b = 34$

$\Rightarrow \quad 2b = 34 - 20$

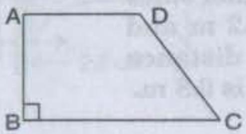
$\Rightarrow \quad 2b = 14$

$\Rightarrow \quad b = \frac{14}{2}$

$\Rightarrow \quad b = 7$ cm

Hence, another required parallel side is 7 cm.

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.



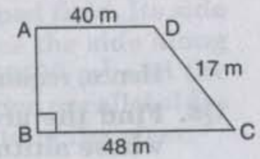
Sol. Given, BC = 48 m, CD = 17 m, AD = 40 m and Perimeter = 120 m.

Perimeter of trapezium = AB + BC + CD + DA

$\Rightarrow \quad 120 = AB + 48 + 17 + 40$

$\Rightarrow \quad 120 = AB + 105$

$\Rightarrow \quad AB = 120 - 105 = 15$ m



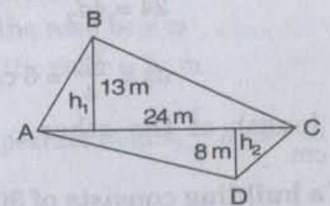
Area of the field $= \frac{1}{2}(BC + AD) \times AB$

$= \frac{1}{2} \times (48 + 40) \times 15 = \frac{1}{2} \times 88 \times 15$

$= 660 \text{ m}^2$

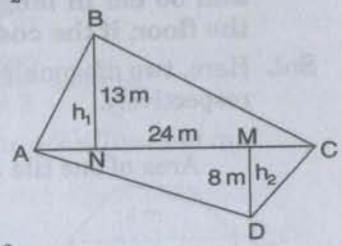
Hence, area of field ABCD is 660 m^2.

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.



Sol. Here, it is given that $h_1 = 13$ m, $h_2 = 8$ m and AC = 24 m

Therefore, area of quadrilateral



$= \frac{1}{2} AC \times (h_1 + h_2)$

$= \frac{1}{2} \times 24 \times (13 + 8)$

$= \frac{1}{2} \times 24 \times 21 = 252 \text{ m}^2$

Hence, required area of the field is 252 m^2.

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

Sol. Given, $d_1 = 7.5$ cm and $d_2 = 12$ cm

Area of the rhombus $= \frac{1}{2} d_1 \times d_2$

$= \frac{1}{2} \times 7.5 \times 12$

$= 45 \text{ cm}^2$

Hence, required area of the rhombus is 45 cm^2.

Q6. Find the area of a rhombus whose side is 6 cm and whose altitude is 4 cm. If one of the diagonals is 8 cm long, find the length of the other diagonal.

Sol. Since, we know that rhombus is also a kind of parallelogram.

So, area of rhombus = base × altitude

$= 6 \times 4 = 24 \text{ cm}^2$

Again, we know that area of rhombus $= \frac{1}{2} d_1 \times d_2$

$$24 = \frac{1}{2} \times 8 \times d_2$$

$$24 = 4d_2$$

$$\Rightarrow \quad d_2 = \frac{24}{4} = 6 \text{ cm}$$

Hence, the length of the other diagonal is 6 cm.

Q7. The floor of a building consists of 3000 tiles which are rhombus shaped and each of its diagonals are 45 cm and 30 cm in length. Find the total cost of polishing the floor, if the cost per m² is ₹ 4.

Sol. Here, two diagonals of a tile d_1 and d_2 are 45 cm and 30 cm respectively.

Area of one tile $= \frac{1}{2} d_1 \times d_2$

$= \frac{1}{2} \times 45 \times 30 = 675 \text{ cm}^2$

Area of 3000 tiles $= 675 \times 3000 = 2025000 \text{ cm}^2$

$= \frac{2025000}{10000} \text{ m}^2 \quad [\because \ 1 \text{ m}^2 = 10000 \text{ cm}^2]$

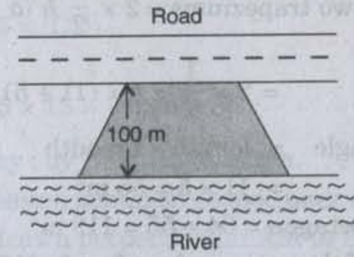
$= 202.50 \text{ m}^2$

Cost of polishing the floor per metre square = ₹ 4

Cost of polishing the floor $202.50 \text{ m}^2 = 4 \times 202.5 =$ ₹ 810

Hence, the total cost of polishing the floor is ₹ 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 m² and the perpendicular distance between the two parallel sides is 100 m, find the length of the side along the river.



Sol. Given, perpendicular distance, $h = 100$ m

Area of the trapezium sized field $= 10500 \text{ m}^2$

Let side along the road be x m

and side along the river $= 2x$ m

Area of the trapezium field $= \frac{1}{2} h(a + b)$

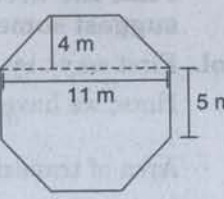
$$10500 = \frac{1}{2} \times 100 \times (x + 2x)$$

$$\Rightarrow \quad 10{,}500 = 50 \times 3x$$

$$\Rightarrow \quad x = \frac{10{,}500}{50 \times 3} = 70 \text{ m}$$

Hence, the side along the river $= 2x = 2 \times 70 = 140$ 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.



Sol. Here, Octagon having eight equal sides, each 5 m has been given.

First, we have divided the octagon in three different figures. Two of them are trapeziums, whose parallel and perpendicular sides are 11 m and 4 m respectively.

And third middle figure is a rectangle having length and breadth 11 m and 5 m respectively.

Now, area of two trapeziums $= 2 \times \frac{1}{2}\ h\ (a + b)$

$$= 2 \times \frac{1}{2} \times 4 \times (11 + 5) = 4 \times 16 = 64\ m^2$$

Area of rectangle $=$ length $\times$ breadth

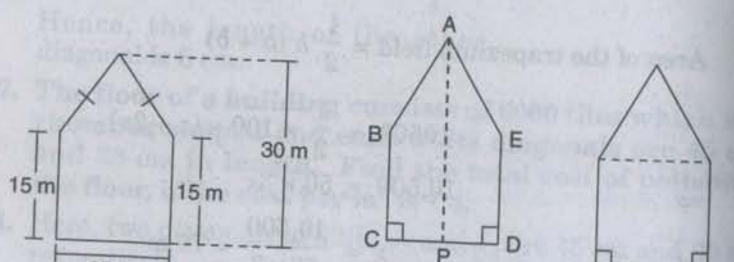
$$= 11 \times 5 = 55\ m^2$$

Total area of octagon $= 64 + 55 = 119\ m^2$

Hence, area of the octagonal surface is $119\ m^2$.

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.



Jyoti's diagram Kavita's diagram

Find the area of this park using both ways. Can you suggest some other way of finding its area?

Sol. First way : by Jyoti's diagram.

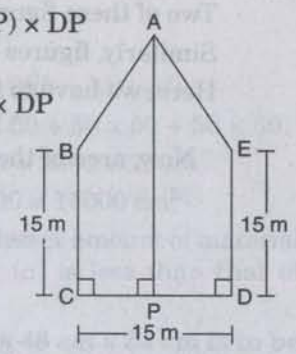
Here, we have a pentagon shaped parts shown in figure.

Area of trapezium ABCP $= \frac{1}{2}$ (AP + BC) $\times$ CP

Area of trapezium AEDP $= \frac{1}{2} \times$ (ED + AP) $\times$ DP

Total area of pentagon

$$= \frac{1}{2}\ (AP + BC) \times CP + \frac{1}{2}\ (ED + AP) \times DP$$



$$= \frac{1}{2}\ (30 + 15) \times CP + \frac{1}{2}\ (15 + 30) \times DP$$

$$= \frac{1}{2}\ (15 + 30)\ [CP + DP]$$

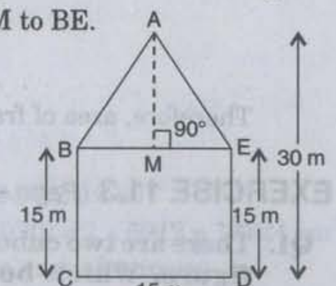
$$= \frac{1}{2} \times 45 \times (CD)$$

$$= \frac{1}{2} \times 45 \times 15 = = 337.5\ m^2.$$

Second way : by Kavita's diagram.

Here, we have a pentagon shaped park as shown in the figure.

We have drawn perpendicular AM to BE.



AM = 30 – 15 = 15 m

Since BE = CD = 15 m

Now the area of triangle ABE

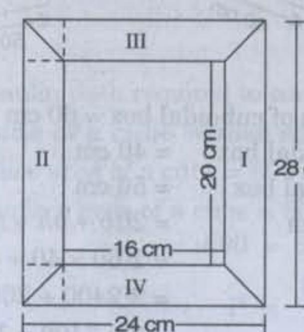
$$= \frac{1}{2} \times 15 \times 15 = 112.5\ m^2$$

Now, area of square

BCDE $= 15 \times 15 = 225.0\ m^2$

Total area of pentagon shape park $= 112.5 + 225 = 337.5\ m^2$

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.



Sol. Here, given figure contains five smaller figures.

Two of these figures (I) and (II) are similar in dimensions.

Similarly, figures (III) and (IV) are similar in dimensions.

Here, we have to find area of these figures.

Now, area of the frame I $= \frac{1}{2}(a+b)\times h$

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

$= \frac{1}{2}\times 48\times 4 = 96\text{ cm}^2$

Area of frame (II) is also equal to 96 cm^2.

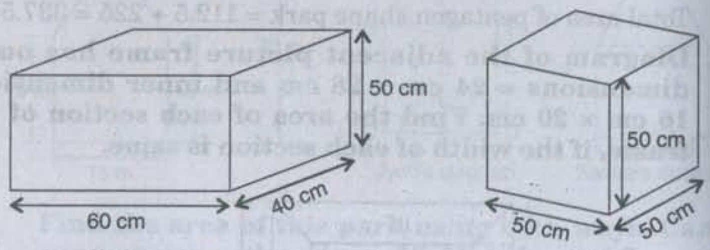
Now, area of frame (III) $= \frac{1}{2}(a+b)\times h = \frac{1}{2}(24+16)\times 4$

$= \frac{1}{2}\times 40\times 4 = 80\text{ cm}^2$

Therefore, area of frame (IV) is also equal to 80 cm^2.

EXERCISE 11.3 *(Page –186)*

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



Sol. (*a*) Given, length of cuboidal box = 60 cm

Breadth of cuboidal box = 40 cm

Height of cuboidal box = 50 cm

Total surface area $= 2(lb + bh + hl)$

$= 2(60\times 40 + 40\times 50 + 50\times 60)$

$= 2(2400 + 2000 + 3000)$

$= 2\times 7400 = 14800\text{ cm}^2$.

(*b*) Given, length of cuboidal box = 50 cm

Breadth of cuboidal box = 50 cm

Height of cuboidal box = 50 cm

Total surface area of cuboidal box $= 2(lb + bh + hl)$

$= 2(50\times 50 + 50\times 50 + 50\times 50)$

$= 2(2500 + 2500 + 2500)$

$= 2\times 7500 = 15000\text{ cm}^2$

Hence, cuboidal box (*a*) requires the lesser amount of material to make, since surface area of box (*a*) is less than that of box (*b*).

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

Sol. Length of suitcase = 80 cm,

Breadth of suitcase = 48 cm,

Height of suitcase = 24 cm.

Total surface area of suitcase

$= 2(lb + bh + hl)$

$= 2(80\times 48 + 48\times 24 + 24\times 80)$

$= 2(3840 + 1152 + 1920) = 2\times 6912 = 13824\text{ cm}^2$

Area of Tarpaulin cloth = surface area of suitcase

$l\times b = 13824$

$l\times 96\text{ cm} = 13824$

$l = \frac{13824}{96} = 144\text{ cm}$

Required tarpaulin for 100 suitcases $= 144\times 100$

$= 14400\text{ cm}$

or $= \frac{14400}{100}\text{ m} = 144\text{ m}$

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

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

Sol. Given, surface area of a cube = 600 cm^2.

$\because$ Total surface area of a cube $= 6l^2$

$600 = 6\times l^2$

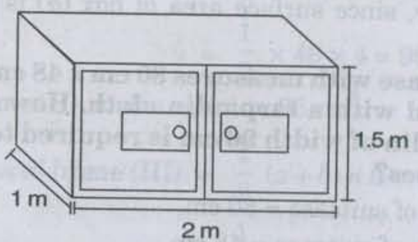
$l^2 = \frac{600}{6}$

$$l^2 = 100$$

$$l = \sqrt{100} = 10 \text{ cm}$$

Hence, the side of the cube is 10 cm.

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.



Sol. Length of cabinet $= 2\text{m}$,

Breadth of cabinet $= 1 \text{ m}$,

Height of cabinet $= 1.5 \text{ m}$.

So, required surface area $= lb + 2(bh + hl)$

$= 2 \times 1 + 2(1 \times 1.5 + 1.5 \times 2)$

$= 2 + 2(1.5 + 3.0) = 2 + 2(4.5)$

$= 2 + 9.0 = 11 \text{ m}^2$

Hence, required surface area is 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 m² of area is painted. How many cans of paint will she need to paint the room?

Sol. Length of wall $= 15 \text{ m}$,

Breadth of wall $= 10 \text{ m}$,

Height of wall $= 7 \text{ m}$.

where $l = 15$ m, $b = 10$ m and $h = 7$ m.

Total surface area of class room $= lb + 2(bh + hl)$

$= 15 \times 10 + 2(10 \times 7 + 7 \times 15)$

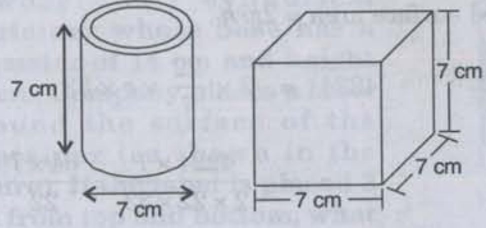
$= 150 + 2(70 + 105)$

$= 150 + 350 = 500 \text{ m}^2$.

Required number of cans $= \dfrac{\text{Area of hall}}{\text{Area of one can}} = \dfrac{500}{100} = 5$ cans

Hence, five cans are required to paint the room.

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



Sol. Both of these figures have same heights.

Difference between these figures is that one is a cylinder and other a cube.

Given, diameter of cylinder $= 7$ cm,

Radius of cylinder $= \dfrac{7}{2}$ cm,

Height of cylinder $= 7$ cm.

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

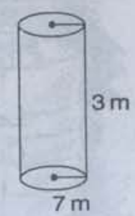
$= 2 \times \dfrac{22}{7} \times \dfrac{7}{2} \times 7$

$= 154 \text{ cm}^2$

Lateral surface area of cube $= 4l^2 = 4 \times 7^2 = 4 \times 49 = 196 \text{ cm}^2$

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?



Sol. Given, radius of cylindrical tank $= 7$ m

Height of cylindrical tank $= 3$ m

Total surface area of cylindrical tank $= 2\pi r(h + r)$

$= 2 \times \dfrac{22}{7} \times 7\,(3 + 7)$

$= 44(10) = 440 \text{ m}^2$

Hence, 440 m^2 metal 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?

Sol. Given, lateral surface area of hollow cylinder = 4224 cm^2 and height of hollow cylinder = 33 cm.

Curved surface area of hollow cylinder = $2\pi rh$

Curved surface area = $2\pi rh$

$$4224 = 2 \times \frac{22}{7} \times r \times 33$$

$$r = \frac{4224 \times 7}{2 \times 22 \times 33} = \frac{64 \times 7}{22} \text{ cm}$$

$\because$ Length of rectangular sheet = $2\pi r$

$$l = 2 \times \frac{22}{7} \times \frac{64 \times 7}{22} = 128 \text{ cm}$$

Perimeter of rectangular sheet

$$= 2(l + b)$$

$$= 2(128 + 33) = 2 \times 161 = 322 \text{ cm}$$

Hence, 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.

Sol. Given, diameter of road roller

$$= 84 \text{ cm}$$

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

Length of a road roller $h = 1$ m or 100 cm.

Curved surface area of a road roller = $2\pi rh$

$$= 2 \times \frac{22}{7} \times 42 \times 100$$

$$= 26400 \text{ cm}^2$$

Area covered by road roller in 750 revolutions

$$= 26400 \times 750 \text{ cm}^2 = \frac{1,98,00,000}{10,000} \text{ m}^2$$

$$= 1980 \text{ m}^2 \quad (\because\ 1 \text{ m}^2 = 10,000 \text{ cm}^2).$$

Hence, the area of the road is 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.

Sol. Given, diameter of cylindrical container = 14 cm

Radius of cylindrical container = $\frac{14}{2} = 7$ cm

Height of cylindrical container = 20 cm

Height of the label = 20 – 2 – 2 = 16 cm

Required area of the label = $2\pi rh$

$$= 2 \times \frac{22}{7} \times 7 \times 16$$

$$= 704 \text{ cm}^2$$

Hence, the area of the label is 704 cm^2.

EXERCISE 11.4 *(Page –191)*

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.

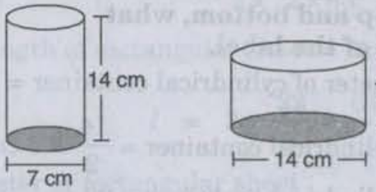
(*c*) To find the number of smaller tanks that can be filled with water from it.

Sol. We find area when a region covered by a boundary, such as outer and inner surface area of a cylinder, a cone, a sphere and surface of wall or floor.

When the amount of space occupied by an object such as water, milk, coffee, tea, etc., then we have to find out volume of the object.

(*a*) volume (*b*) surface area (*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?

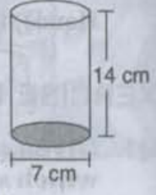


A **B**

Sol. Volume of cylinder B is greater. Since, radius of cylinder B is greater than cylinder A (and square of radius gives more value than previous).

Diameter of cylinder A = 7 cm

Radius of cylinder A $= \frac{7}{2}$ cm



Height of cylinder A = 14 cm

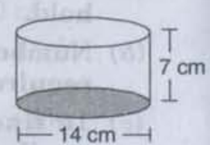
Volume of cylinder A $= \pi r^2 h$

$$= \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times 14$$

$$= 539 \text{ cm}^3$$

Diameter of cylinder B = 14 cm

Radius of cylinder B = 7 cm



Height of cylinder B = 7 cm

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

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

$$= 1078 \text{ cm}^3$$

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

$\because$ It is open from top

$$= \frac{22}{7} \times \frac{7}{2}\left(2\times14+\frac{7}{2}\right)$$

$$= 11\times\left(28+\frac{7}{2}\right) = 11\left(\frac{56+7}{2}\right)$$

$$= 11 \times \frac{63}{2} = \frac{693}{2} = 346.5 \text{ cm}^2$$

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

$$= \frac{22}{7} \times 7\,(2 \times 7 + 7)$$

$$= 22 \times (14 + 7)$$

$$= 22 \times 21 = 462 \text{ cm}^2$$

Yes, cylinder with greater volume also has greater surface area.

Q3. Find the height of a cuboid whose base area is 180 cm² and volume is 900 cm³?

Sol. Given, Base area of cuboid = 180 cm²

and volume of the cuboid = 900 cm³

Volume of cuboid $= l \times b \times h$ = base area × height

($\because$ $l \times b$ = base area)

$$900 = 180 \times h$$

$$h = \frac{900}{180} = 5 \text{ cm}$$

Hence, the height of the cuboid is 5 cm.

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?

Sol. Given, length of cuboid = 60 cm, Breadth of cuboid = 54 cm,

Height of cuboid = 30 cm.

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

$= 60 \times 54 \times 30 \text{ cm}^3$

Volume of cube $= (\text{side})^3 = 6 \times 6 \times 6 \text{ cm}^3$

Number of small cubes can be placed in the cuboid

$$= \frac{60 \times 54 \times 30}{6 \times 6 \times 6} = 450$$

Hence, required cubes are 450.

Q5. Find the height of the cylinder whose volume is 1.54 m^3 and diameter of the base is 140 cm?

Sol. Given, volume of cylinder $= 1.54 \text{ m}^3$

and diameter of cylinder $= 140$ cm

radius $= \frac{140}{2}$ cm $= 70$ cm $= 0.7$ m

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

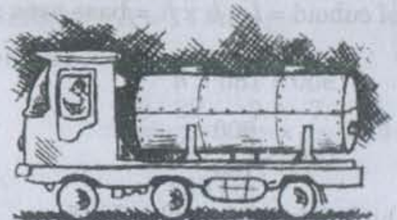
$$1.54 = \frac{22}{7} \times 0.7 \times 0.7 \times h$$

$$h = \frac{1.54 \times 7}{22 \times 0.7 \times 0.7} = \frac{154 \times 7 \times 10 \times 10}{22 \times 7 \times 7 \times 100}$$

$= 1$ m

Hence, height of the cylinder is 1 m.

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



Sol. Radius of cylindrical tank $= 1.5$ m

and height of cylindrical tank $= 7$ m.

Volume of cylindrical tank $= \pi r^2 h$

$= \frac{22}{7} \times 1.5 \times 1.5 \times 7$

$= 49.5 \text{ m}^3$

$= 49.5 \times 1000$ litres

$(\because 1 \text{ m}^3 = 1000 \text{ litres})$

$= 49500$ litres.

Hence, the required quantity of milk is 49500 l.

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?

Sol. (*i*) Let the edge of cube be l.

Surface area of cube (A) $= 6l^2$

When edge of cube is doubled, then

Surface area of cube (A) $= 6(2l)^2$

$= 6 \times 4l^2 = 4 \times 6l^2$

$\therefore \quad A_2 = 4 \times A_1$

Hence, surface area will increase four times.

(*ii*) Volume of cube $(V_1) = l^3$

When edge of cube is doubled then,

Volume of cube $(V_2) = (2l)^3 = 8l^3$

$\therefore \quad V_2 = 8V_1$

Hence, volume will increase 8 times.

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

Sol. Given, volume of reservoir $= 108 \text{ m}^3$

Rate of pouring water into cuboidal reservoir

$= 60$ litres/minute

$= \frac{60 \text{ m}^3}{1000}$ /minute $\quad \left(\because 1\,l = \frac{1}{1000} \text{ m}^3\right)$

$= \frac{60 \times 60 \text{ m}^3}{1000}$ /hour

Time taken to fill the reservoir $= \dfrac{108 \times 1000}{60 \times 60}$ hours

$= 30$ hours.

It will take 30 hours to fill the reservoir.

Or

$\dfrac{60 \times 60\ m^3}{1000}$ water filled in reservoir will take = 1 hour

$1\ m^3$ water filled in reservoir will take $= \dfrac{1000}{60 \times 60}$ hrs

$108\ m^3$ water filled in reservoir will take $= \dfrac{108 \times 1000}{60 \times 60}$

$= 30$ hours.

□□