CHAPTER 11

Mensuration

Understanding the Lesson

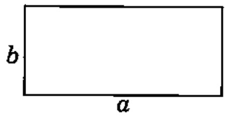
- Area of rectangle, square, triangle, parallelogram, circle and trapezium.
- Area of a general quadrilateral.
- Area of special quadrilaterals.
- Area of polygon.
- Surface area of cube, cuboid and cylinder.
- Volume of cube, cuboid and cylinder.
- Conversion of units.

Conceptual Facts

- Area of rectangle

  A = Length × Breadth

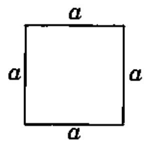
  $= a \times b$ sq. units



- Area of square

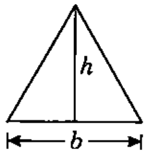
  $A = (\text{side})^2$

  $= a^2$ sq. units



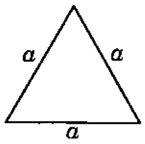
- Area of triangle

  $A = \frac{1}{2} \times b \times h$ sq. units



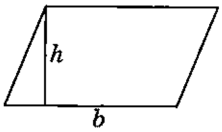
- Area of equilateral triangle

  $A = \frac{\sqrt{3}}{4} a^2$ sq. units



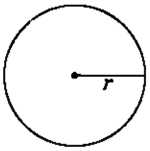
- Area of parallelogram

  $A = b \times h$ sq. units



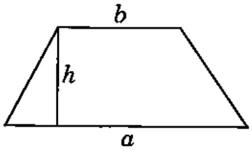
- Area of circle

  $A = \pi r^2$ sq. units



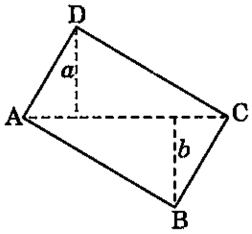
- Area of trapezium

  $A = \frac{1}{2}(a+b) \times h$ sq. units



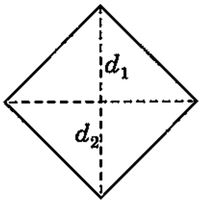
- Area of general quadrilateral

$$A = \text{Area of } \Delta ABC + \text{area of } \Delta ACD$$
$$= \frac{1}{2}(a + b) \times AC \text{ sq. units}$$



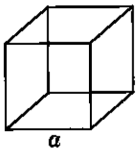
- Area of rhombus

$$A = \frac{1}{2}(d_1 \times d_2) \text{ sq. units}$$



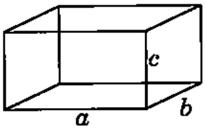
- Surface area of cube

$$A = 6a^2 \text{ sq. units}$$



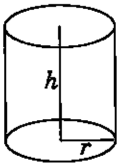
- Surface area of cuboid

$$A = 2[ab + bc + ca] \text{ sq. units}$$



- Surface area of cylinder

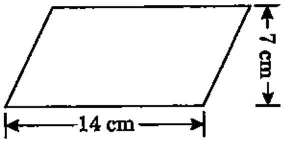
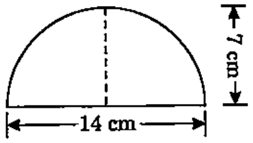
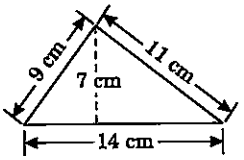
$$A = 2\pi rh \text{ sq. units}$$



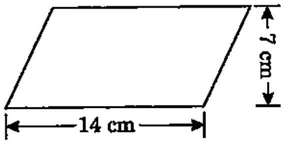
- Volume of cube $V = a^3$ cu. units
- Volume of cuboid $V = a \times b \times c$ cu. units
- Volume of cylinder $V = \pi r^2 h$

TRY THESE (*PAGE 170*)

(*a*) Match the following figures with their respective areas in the box.

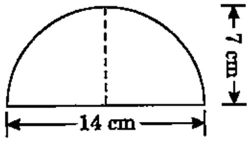
(*i*) 	(*a*) 49 cm^2
(*ii*) 	(*b*) 77 cm^2
(*iii*) 	(*c*) 98 cm^2

Sol. (*i*)



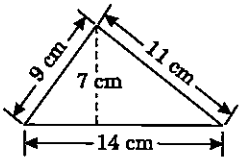
$$\text{Area} = b \times h$$
$$= 14 \times 7$$
$$= 98 \text{ cm}^2$$

(*ii*)



$$\text{Area} = \frac{1}{2} \times \pi \times r^2$$
$$= \frac{1}{\cancel{2}} \times \frac{\overset{11}{\cancel{22}}}{\cancel{7}} \times \cancel{7} \times 7$$
$$= 77 \text{ cm}^2$$

(*iii*)



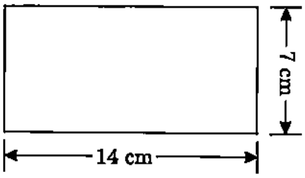
$$A = \frac{1}{2} \times b \times h = \frac{1}{\cancel{2}} \times \cancel{14}^{7} \times 7$$

$= 49\ \text{cm}^2$

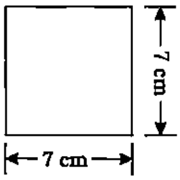
Hence, (*i*)↔(*c*), (*ii*)↔(*b*), (*iii*)↔(*a*)

(*b*) Write the perimeter of each shape.

(*i*)



(*ii*)



Sol. Perimeter of shape (*i*)

$= 2(l + b)$

$= 2(14 + 7)$

$= 2 \times 21 = 42$ cm

Perimeter of shape (*ii*)

$= 4 \times \text{side} = 4 \times 7 = 28$ cm

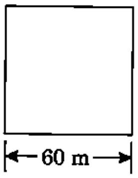
EXERCISE 11.1

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

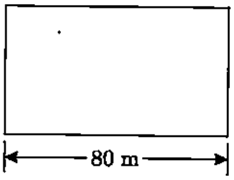
Sol. Perimeter of figure (*a*)

$= 4 \times \text{side}$

$= 4 \times 60 = 240$ m



(*a*)



(*b*)

Perimeter of figure (*b*)

$= 2[l + b]$

Perimeter of figure (*b*)

= Perimeter of figure (*a*)

$2[l + b] = 240$

$\Rightarrow \quad 2[80 + b] = 240$

$\Rightarrow \quad 80 + b = 240 \div 2$

$\Rightarrow \quad 80 + b = 120$

$\therefore \quad b = 120 - 80 = 40$ m

Area of figure (*a*)

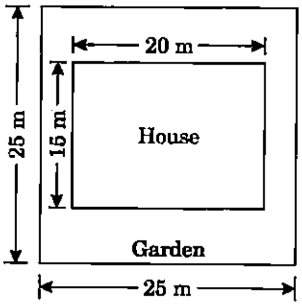
$= (\text{side})^2 = 60 \times 60 = 3600\ \text{m}^2$

Area of figure (*b*)

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

So, area of figure (*a*) is longer than the area of figure (*b*).

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.



Sol. Area of the plot

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

$= 25\ \text{m} \times 25\ \text{m} = 625\ \text{m}^2$

Area of the house

$= l \times b$

$= 20\ \text{m} \times 15\ \text{m}$

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

∴ Area of the garden to be developed

= Area of the plot – Area of the house

$= 625\ \text{m}^2 - 300\ \text{m}^2 = 325\ \text{m}^2$

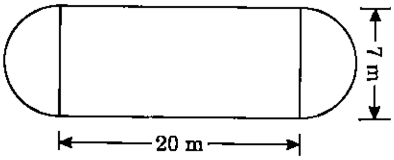
∴ Cost of developing the garden

= ₹ 325 × 55

= ₹ 17875

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) metres]



Sol. Length of the rectangle

$= 20 - (3.5 + 3.5)$

$= 20 - 7 = 13$ m

Area of the rectangle $= l \times b$

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

Area of two circular ends

$$= 2\left(\frac{1}{2}\pi r^2\right)$$

$$= \pi r^2 = \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2}$$

$$= \frac{77}{2} \text{ m}^2 = 38.5 \text{ m}^2$$

∴ Total area = Area of the rectangle + Area of two ends

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

$= 129.5 \text{ m}^2$

Total perimeter

= Perimeter of the rectangle + Perimeter of two ends

$= 2\,(l + b) + 2 \times (\pi r) - 2(2r)$

$$= 2\,(13 + 7) + 2\left(\frac{22}{7} \times \frac{7}{2}\right) - 4 \times \frac{7}{2}$$

$= 2 \times 20 + 22 - 14$

$= 40 + 22 - 14$

$= 48$ 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. Area of the floor $= 1080 \text{ m}^2$

$= 1080 \times 10000 \text{ cm}^2$

$= 10800000 \text{ cm}^2$ [$\because$ 1 m^2 = 10000 cm^2]

Area of 1 tile

= 1 × base × height

$= 1 \times 24 \times 10$

$= 240 \text{ cm}^2$

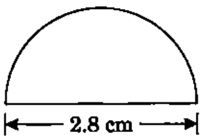
∴ Number of tiles required

$$= \frac{\text{Area of the floor}}{\text{Area of 1 tile}}$$

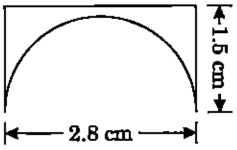
$$= \frac{10800000}{240}$$

= 45000 tiles

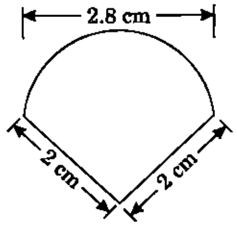
Q5. An ant is moving around a few food pieces of different shapes scattered on the floor. For which food-piece would the ant have to take a longer round? Remember, circumference of a circle can be obtained by using the expression $C = 2\pi r$, where r is the radius of the circle.



(*a*)



(*b*)



(*c*)

Sol. (*a*) Distance covered to take a round by the ant

$$= \frac{1}{2} \times 2\pi r + 2r$$

$= \pi r + 2r$

$$= \frac{22}{7} \times 1.4 + 2 \times 1.4$$

$= 22 \times 0.2 + 2.8$

$= 4.4 + 2.8 = 7.2$ cm

(*b*) Distance travelled to take a round by the ant

$$= 1.5 + 1.5 + 2.8 + \frac{1}{2} \times 2\pi r$$

$= 5.8 + \pi r$

$$= 5.8 + \frac{22}{7} \times 1.4$$

$= 5.8 + 22 \times 0.2$

$= 5.8 + 4.4$

$= 10.2$ cm

(*c*) Distance travelled to take a round by the ant

$$= \frac{1}{2} \times 2\pi r + 2 + 2$$

$= \pi r + 4$

$$= \frac{22}{7} \times 1.4 + 4$$

$= 22 \times 0.2 + 4$

$= 4.4 + 4 = 8.4$ cm

Hence, the ant has to take longer round for the food-piece, i.e., 10.2 cm (*b*).

TRY THESE (*PAGE 172*)

Q1. Nazma's sister also has a trapezium shaped plot. Divide it into three parts as shown in Figure. Show that the area of trapezium WXYZ $= h\dfrac{(a + b)}{2}$.

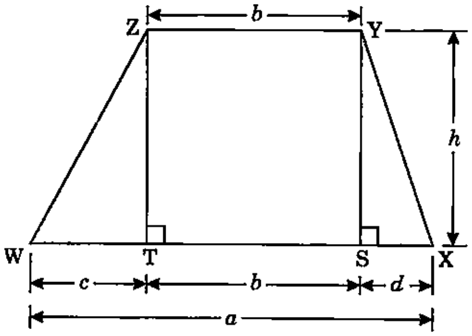


Fig. 1

Sol. Area of trapezium WXYZ

$$= \text{ar.}(\Delta ZTW) + \text{ar.}(\square ZTSY) + \text{ar.}(\Delta YSX)$$

$$= \left(\frac{1}{2} \times \text{base} \times \text{height}\right) + (\text{length} \times \text{breadth}) + \left(\frac{1}{2} \times \text{base} \times \text{height}\right)$$

$$= \frac{1}{2} \times c \times h + b \times h + \frac{1}{2} \times d \times h$$

$$= \frac{1}{2} h \times (c + 2b + d)$$

$$= \frac{1}{2} h \times (c + b + d + b)$$

$$= \frac{1}{2} h\ (a + b)$$

Hence, area of trapezium WXYZ

$$= \frac{1}{2} h\ (a + b) \text{ or } h \frac{(a + b)}{2}.$$

Q2. If $h = 10$ cm, $c = 6$ cm, $b = 12$ cm, $d = 4$ cm, find the values of each of its parts separately and add to find the area WXYZ (Fig. 1). Verify it by putting the values of h, a and b in the expression $h\frac{(a + b)}{2}$.

Sol. Given that: $h = 10$ cm, $c = 6$ cm, $b = 12$ cm, and $d = 4$ cm

Area of ΔZWT

$$= \frac{1}{2} \times \text{WT} \times \text{ZT}$$

$$= \frac{1}{2} \times c \times h$$

$$= \frac{1}{\cancel{2}} \times \cancel{6}^3 \times 10$$

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

Area of $\square$ZTSY

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

$$= b \times h$$

$$= 12 \times 10 = 120 \text{ cm}^2$$

Area of ΔYSX

$$= \frac{1}{2} \times \text{SX} \times \text{YS}$$

$$= \frac{1}{2} \times d \times h$$

$$= \frac{1}{\cancel{2}} \times \cancel{4}^2 \times 10$$

$$= 20 \text{ cm}^2$$

$\therefore$ Total area of trapezium WXYZ

$$= 30 \text{ cm}^2 + 120 \text{ cm}^2 + 20 \text{ cm}^2$$

$$= 170 \text{ cm}^2$$

Area of the same trapezium

$$= \frac{h(a + b)}{2}$$

$$= \frac{10(22 + 12)}{2} \qquad [\because a = c + b + d]$$

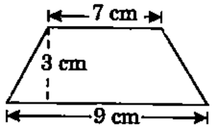
$$= \frac{10 \times 34}{2} = 170 \text{ cm}^2$$

Hence, verified.

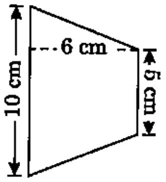
TRY THESE (*PAGE 173*)

Q1. Find the area of the following trapeziums:

(*i*)



(*ii*)



Sol. (*i*) Area of trapezium

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

$$= \frac{1}{2}(9 + 7) \times 3$$

$$= \frac{1}{\cancel{2}} \times \cancel{16}^8 \times 3$$

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

(*ii*) Area of trapezium

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

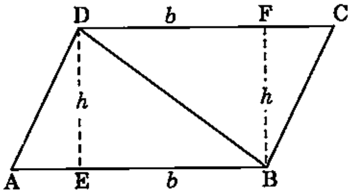
$$= \frac{1}{2}(10 + 5) \times 6$$

$$= \frac{1}{\cancel{2}} \times 15 \times \cancel{6}^3$$

$$= 45 \text{ cm}^2$$

TRY THESE (PAGE 174)

Q1. We know that parallelogram is also a quadrilateral. Let us also split such a quadrilateral into two triangles, find their areas and hence that of the parallelogram. Does this agree with the formula that you know already?



Sol. Area of ΔADB

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

$$= \frac{1}{2} \times b \times h$$

Area of ΔDBC

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

$$= \frac{1}{2} \times b \times h$$

$\therefore$ Area of parallelogram

$= \text{area of } \Delta ADB + \text{area of } \Delta DBC$

$$= \frac{1}{2} \times b \times h + \frac{1}{2} \times b \times h$$

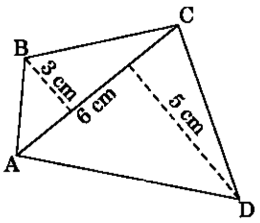
$= b \times h$

$= \text{base} \times \text{height}$

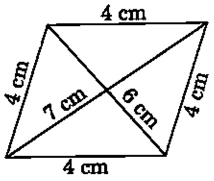
Yes, this gives the formula of area of parallelogram, i.e., base × height.

TRY THESE (PAGE 175)

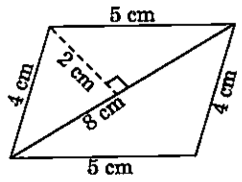
Q1. Find the area of given quadrilaterals.



(i)



(ii)



(iii)

Sol. (i) Area of $\square ABCD$

$= \text{Area of } \Delta ABC + \text{area of } \Delta ADC$

$$= \frac{1}{2} \times 6 \times 3 + \frac{1}{2} \times 6 \times 5$$

$= 3 \times 3 + 3 \times 5$

$= 9 + 15$

$= 24 \text{ cm}^2$

(ii) Area of rhombus

$$= \frac{1}{2} \times d_1 \times d_2$$

$$= \frac{1}{2} \times 7 \times 6$$

$= 21 \text{ cm}^2$

(iii) Area of the parallelogram

$= 2 \times$ area of one of the equal triangles

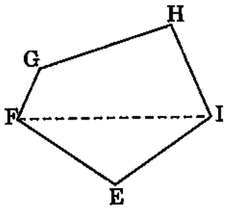
$$= 2 \times \frac{1}{2} \times b \times h$$

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

$= 16 \text{ cm}^2$

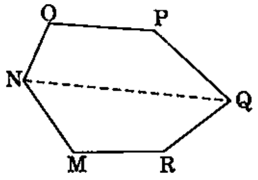
TRY THESE (PAGE 176)

Q1. (i) Divide the following polygons into parts (triangles and trapezium) and find their area.



FI is a diagonal of polygon EFGHI

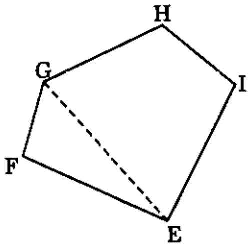
(i)



NQ is a diagonal of polygon MNOPQR

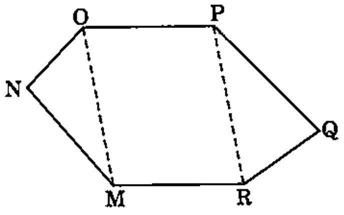
(ii)

Sol. (i)



Here polygon EFGHI has been divided into ΔEFG and a trapezium EGHI.

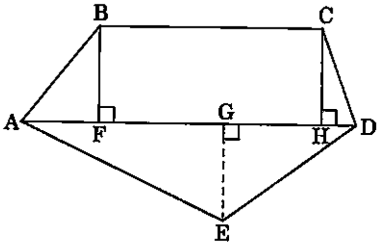
(ii)



Here the polygon MNOPQR has been divided into two triangles MNO, ΔPQR and a trapezium MRPO.

Q2. Polygon ABCDE is divided into parts as shown below in figure.

Find its area if AD = 8 cm, AH = 6 cm, AG = 4 cm, AF = 3 cm and perpendiculars BF = 2 cm, CH = 3 cm, EG = 2.5 cm.



Sol. Area of polygon ABCDE

= area of ΔAFB

+ area of trapezium FBCH

+ area of ΔCHD + area of ΔADE

Area of ΔAFB

$$= \frac{1}{2} \times AF \times BF$$

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

Area of trapezium FBCH

$$= FH \times \frac{(BF + CH)}{2}$$

$$= 3 \times \frac{(2+3)}{2} \qquad [\because FH = AH - AF]$$

$$= \frac{3 \times 5}{2} = \frac{15}{2} = 7.5 \text{ cm}^2$$

Area of ΔCHD

$$= \frac{1}{2} \times HD \times CH$$

$$= \frac{1}{2} \times 2 \times 3 = 3 \text{ cm}^2 \; [\because HD = AD - AH]$$

Area of ΔADE

$$= \frac{1}{2} \times AD \times GE$$

$$= \frac{1}{2} \times 8 \times 2.5 = 10 \text{ cm}^2$$

∴ Area of polygon ABCDE

$= 3 \text{ cm}^2 + 7.5 \text{ cm}^2 + 3 \text{ cm}^2 + 10 \text{ cm}^2$

$= 23.5 \text{ cm}^2$.

Q3. Find the area of polygon MNOPQR if MP = 9 cm, MD = 7 cm, MC = 6 cm, MB = 4 cm, MA = 2 cm.

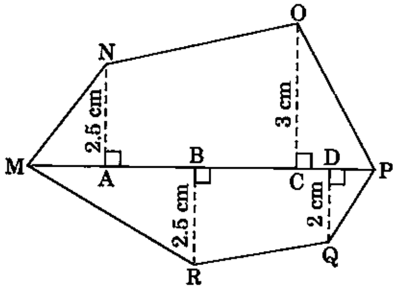
NA, OC, QD and RB are perpendiculars to diagonal MP.

Sol. Area of ΔMAN

$$= \frac{1}{2} \times MA \times AN$$

$$= \frac{1}{2} \times 2 \times 2.5$$

$$= 2.5 \text{ cm}^2$$



Area of trapezium NACO

$$= \frac{1}{2} \times AC \times (NA + OC)$$

$$= \frac{1}{2} (MC - MA) \times (NA + OC)$$

$$= \frac{1}{2} (6 - 2) \times (2.5 + 3)$$

$$= \frac{1}{2} \times 4 \times 5.5$$

$$= 11 \text{ cm}^2$$

Area of ΔOCP

$$= \frac{1}{2} \times CP \times OC$$

$$= \frac{1}{2} \times (MP - MC) \times OC$$

$$= \frac{1}{2} \times (9 - 6) \times 3$$

$$= \frac{1}{2} \times 3 \times 3 = \frac{9}{2} = 4.5 \text{ cm}^2$$

Area of ΔQDP

$$= \frac{1}{2} \times DP \times QD$$

$$= \frac{1}{2} \times (MP - MD) \times QD$$

$$= \frac{1}{2} \times (9 - 7) \times 2$$

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

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

Area of trapezium BRQD

$$= \frac{1}{2} \times BD \times (BR + DQ)$$

$$= \frac{1}{2} \times (MD - MB) \times (BR + DQ)$$

$= \frac{1}{2}(7-4) \times (2.5+2)$

$= \frac{1}{2} \times 3 \times 4.5$

$= 6.75 \text{ cm}^2$

Area of ΔMBR

$= \frac{1}{2} \times \text{MB} \times \text{BR}$

$= \frac{1}{2} \times 4 \times 2.5 = 5 \text{ cm}^2$

Area of the polygon MNOPQR

= Area of ΔMAN

+ Area of trapezium NACO

+ area of ΔOCP + area of ΔQDP

+ area of trapezium BRQD

+ Area of ΔMBR

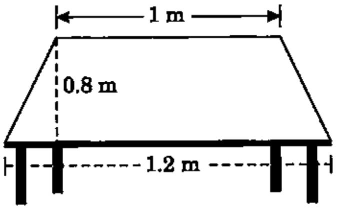
$= 2.5 \text{ cm}^2 + 11 \text{ cm}^2 + 4.5 \text{ cm}^2$

$+ 2 \text{ cm}^2 + 6.75 \text{ cm}^2 + 5 \text{ cm}^2$

$= 31.75 \text{ cm}^2$

EXERCISE 11.2

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. Area of the trapezium

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

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

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

$= 0.88 \text{ m}^2$

Hence, the required area = 0.88 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 sides.

Sol. Given: Area of trapezium = 34 cm^2

Length of one of the parallel sides a = 10 cm

height h = 4 cm

$\therefore$ Area of the trapezium

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

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

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

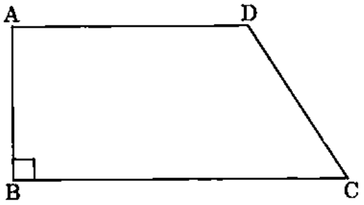
$\Rightarrow \quad \frac{34}{2} = 10 + b$

$\Rightarrow \quad 17 = 10 + b$

$\therefore \quad b = 17 - 10 = 7 \text{ cm}$

Hence, the required length = 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:

AB + BC + CD + DA = 120 m

BC = 48 m, CD = 17 m, AD = 40 m

$\therefore$ AB = 120 m − (48 m + 17 m + 40 m)

= 120 − 105 m

= 15 m

Area of the trapezium ABCD

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

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

$= \frac{1}{2} \times 88 \times 15$

$= 44 \times 15$

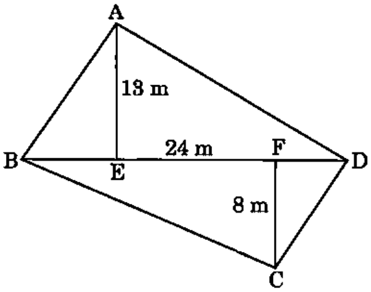
$= 660 \text{ m}^2$.

Hence, the required area = 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. Area of the field

= area of ΔABD + area of ΔBCD



$$= \frac{1}{2} \times b \times h + \frac{1}{2} \times b \times h$$

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

$$= 12 \times 13 + 12 \times 8$$

$$= 12 \times (13 + 8)$$

$$= 12 \times 21 = 252 \text{ m}^2$$

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

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

Sol. Here, d_1 = 7.5 cm, d_2 = 12 cm

$\therefore$ Area of the rhombus

$$= \frac{1}{2} \times d_1 \times d_2$$

$$= \frac{1}{\cancel{2}} \times 7.5 \times \cancel{12}^{6}$$

$$= 7.5 \times 6 = 45 \text{ cm}^2$$

Hence, area of the rhombus = 45 cm^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.

Sol. **Given:** Side = 5 cm

Altitude = 4.8 cm

Length of one diagonal = 8 cm

Area of the rhombus

= Side × Altitude

= 5 × 4.8

= 24 cm^2

Area of the rhombus

$$= \frac{1}{2} \times d_1 \times d_2$$

$$24 = \frac{1}{\cancel{2}} \times \cancel{8}^{4} \times d_2$$

$$24 = 4d_2$$

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

Hence, the length of other diagonal = 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 m^2 is ₹ 4.

Sol. **Given:** Number of tiles = 3000

Length of the two diagonals of a tile

= 45 cm and 30 cm

$\therefore$ Area of one tile

$$= \frac{1}{2} \times d_1 \times d_2$$

$$= \frac{1}{\cancel{2}} \times 45 \times \cancel{30}^{15}$$

$$= 45 \times 15 = 675 \text{ cm}^2$$

$\therefore$ Area covered by 3000 tiles

$$= 3000 \times 675 \text{ cm}^2$$

$$= 2025000 \text{ cm}^2$$

or $\dfrac{2025000}{100 \times 100} \text{ cm}^2$

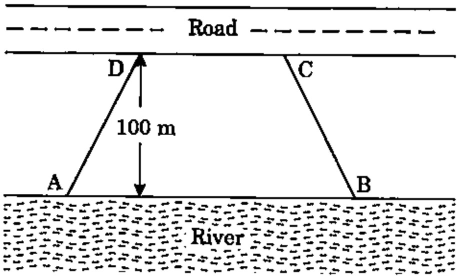
$$= 202.5 \text{ m}^2$$

Cost of polishing the floor

= 202.5 × 4 = ₹ 810

Hence, the required cost = ₹ 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.



Sol. Let the side of the trapezium (roadside) be x cm.

$\therefore$ The opposite parallel

side = $2x$ m

h = 100 m

Area = 10500 m^2

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

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

$$2 \times 10500 = 3x \times 100$$

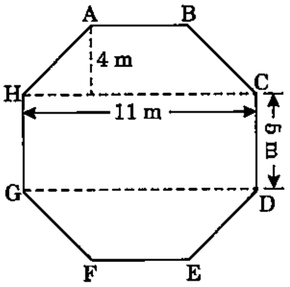
$$21000 = 300\,x$$

$$\therefore \quad x = \frac{21000}{300} = 70 \text{ m}$$

So, $\quad AB = 2x = 2 \times 70 = 140$ m

Hence, the required length = 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. Area of the octagonal surface

= area of trapezium ABCH

+ area of rectangle HCDG

+ area of trapezium GDEF

Area of trapezium ABCH

= Area of trapezium GDEF

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

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

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

Area of rectangle HCDG = $l \times b$

$= 11 \text{ m} \times 5 \text{ m} = 55 \text{ m}^2$

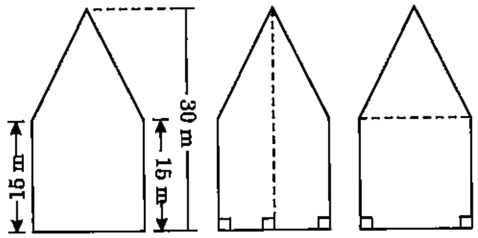
$\therefore$ Area of the octagonal surface

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

$= 119 \text{ m}^2$

Hence, the required area = 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.

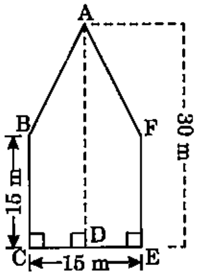


Jyoti's diagram

Kavita's diagram

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

Sol. (*i*) From Jyoti's diagram:



Area of the pentagonal shape

= Area of trapezium ABCD

+ Area of trapezium ADEF

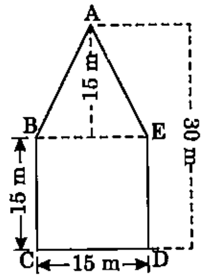
= 2 × Area of trapezium ABCD

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

$= (15 + 30) \times 7.5$

$= 45 \times 7.5 = 337.5 \text{ m}^2$

(*ii*) From Kavita's diagram:



Area of the pentagonal shape

= Area of ΔABE

+ Area of square BCDE

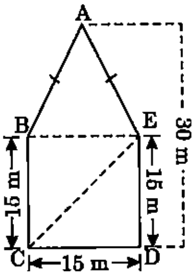
$$= \frac{1}{2} \times b \times h + 15 \times 15$$

$$= \frac{1}{2} \times 15 \times 15 + 225$$

$$= \frac{1}{2} \times 225 + 225$$

$= 112.5 + 225$

$= 337.5 \text{ m}^2$



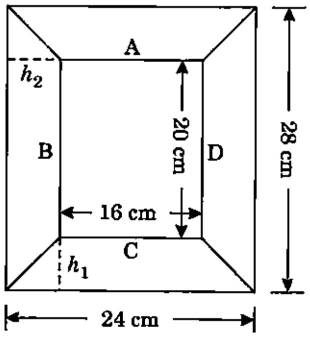
Yes, we can also find the other way to calculate the area of the given pentagonal shape.

Join CE to divide the figure into two parts, i.e., trapezium ABCE and right triangle EDC.

$\therefore$ Area of ABCDE

= area of ABCE + area of ΔEDC

Q11. Diagram of the 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. $h_1 = \frac{1}{2}(28 - 20) = \frac{1}{2} \times 8 = 4$ cm

$h_2 = \frac{1}{2}(24 - 16) = \frac{1}{2} \times 8 = 4$ cm

Area of the trapezium A

$= \frac{1}{2} \times (a + b) \times h_1$

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

$= \frac{1}{\cancel{2}} \times 40 \times \cancel{4}^2$

$= 80$ cm^2

Area of trapezium A = Area of trapezium C = 80 cm^2

Area of trapezium B = Area of trapezium D

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

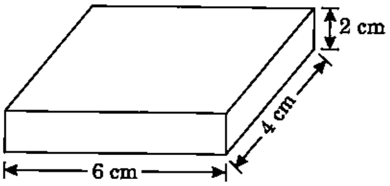
$= \frac{1}{\cancel{2}} \times 48 \times \cancel{4}^2$

$= 96$ cm^2

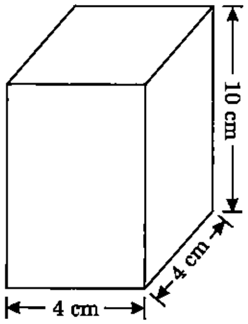
Hence, the areas of the four parts A, B, C and D are 80 cm^2, 96 cm^2, 80 cm^2 and 96 cm^2 respectively.

TRY THESE (*PAGE 181*)

Q1. Find the total surface area of the following cuboids.



(*i*)



(*ii*)

Sol. (*i*) Total surface area of the cuboid

$= 2[lb + bh + lh]$

$= 2[6 \times 4 + 4 \times 2 + 6 \times 2]$

$= 2[24 + 8 + 12]$

$= 2 \times 44$

$= 88$ cm^2

Hence, the required area = 88 cm^2

(*ii*) Total surface area of the cuboid

$= 2[lb + bh + lh]$

$= 2[4 \times 4 + 4 \times 10 + 10 \times 4]$

$= 2[16 + 40 + 40]$

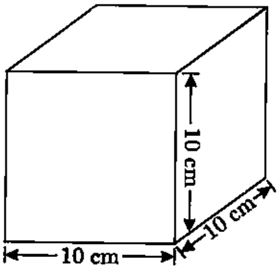
$= 2 \times 96$

$= 192$ cm^2

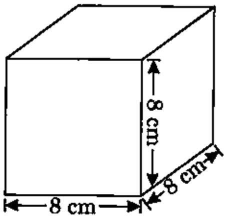
Hence, the required area = 192 cm^2.

TRY THESE (*PAGE 182*)

Q1. Find the surface area of cube A and lateral surface area of cube B.



(A)



(B)

Sol. (A) Side = 10 cm

∴ Surface area of cube A

$= 6(\text{side})^2$

$= 6(10)^2$

$= 6 \times 100$

$= 600$ cm^2

Hence, the required area = 600 cm^2

(B) Side = 8 cm

Lateral surface area of cube B

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

$= 4(8)^2$

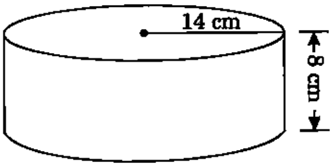
$= 4 \times 64$

$= 256 \text{ cm}^2$

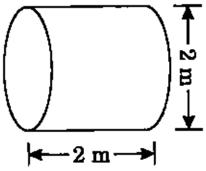
Hence, the required area = 256 cm^2.

TRY THESE (*PAGE 184*)

Q1. Find total surface area of the following cylinders.



(*i*)



(*ii*)

Sol. (*i*) Here $h = 8$ cm

$r = 14$ cm

$\therefore$ Total surface area of the cylinder

$= 2\pi r(h + r)$

$= 2 \times \frac{22}{7} \times 14(14 + 8)$

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

$= 4 \times 484$

$= 1936 \text{ cm}^2$

Hence, the required area = 1936 cm^2

(*ii*) Here, $h = 2$ m

$r = \frac{1}{2} \times 2 = 1$ m

$\therefore$ Total surface area of the cylinder

$= 2\pi r(h + r)$

$= 2 \times \frac{22}{7} \times 1(1 + 2)$

$= 2 \times \frac{22}{7} \times 3$

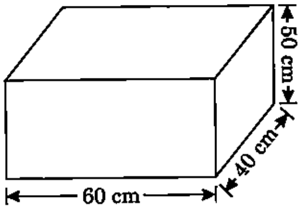
$= \frac{132}{7} \text{ m}^2$

$= 18\frac{6}{7} \text{ m}^2$

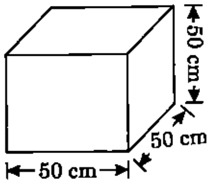
Hence, the required area = $18\frac{6}{7} \text{ m}^2$.

EXERCISE 11.3

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



(*a*)



(*b*)

Sol. (*a*) Volume of the cuboid

$= l \times b \times h$

$= 60 \times 40 \times 50$

$= 120000 \text{ cm}^3$

(*b*) Volume of cube

$= (\text{Side})^3 = (50)^3$

$= 50 \times 50 \times 50$

$= 125000 \text{ cm}^3$

Cuboidal 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 metres of tarpaulin of width 96 cm is required to cover 100 such suitcases?

Sol. Measurement of the suitcase

$= 80 \text{ cm} \times 48 \text{ cm} \times 24 \text{ cm}$

$l = 80$ cm, $b = 48$ cm and $h = 24$ cm

$\therefore$ Total surface area of the 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

$=$ length × breadth

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

Area of tarpaulin

= Area of 100 suitcase

$96l = 100 \times 13824$

$$\therefore \quad l = \frac{100 \times 13824}{96}$$

$$= 100 \times 144 = 14400 \text{ cm}$$

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

Hence, the required length of the cloth = 144 m.

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

Sol. Total surface area of a cube = $6l^2$

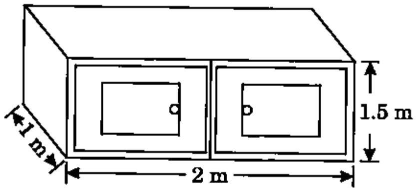
$$\therefore \quad 6l^2 = 600$$

$$l^2 = \frac{600}{6} = 100$$

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

Hence, the required length of side = 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. $l = 2$ m, $b = 1.5$ m, $h = 1$ m

Area of the surface to be painted

= Total surface area of box – Area of base of box

$$= 2[lb + bh + hl] - lb$$

$$= 2[2 \times 1.5 + 1.5 \times 1 + 1 \times 2] - 2 \times 1$$

$$= 2[3 + 1.5 + 2] - 2$$

$$= 2[6.5] - 2$$

$$= 13 - 2 = 11 \text{ m}^2$$

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?

Sol. Surface area of a cuboidal hall without bottom

= Total surface area – Area of base

$$= 2[lb + bh + hl] - lb$$

$$= 2[15 \times 10 + 10 \times 7 + 7 \times 15] - 15 \times 10$$

$$= 2[150 + 70 + 105] - 150$$

$$= 2[325] - 150$$

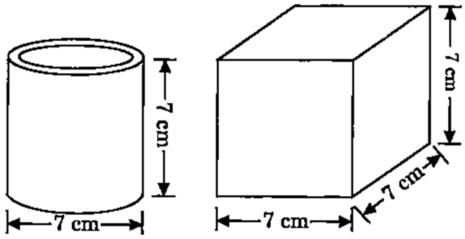
$$= 650 - 150 = 500 \text{ m}^2$$

Area of the paint in one can = 100 m^2

$$\therefore \text{ Number of cans required} = \frac{500}{100}$$

$$= 5 \text{ cans.}$$

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



Sol. The two figures given are cylinder and cube. Both figures are alike in respect of their same height.

Cylinder: $d = 7$ cm, $h = 7$ cm

Cube: Length of each side $a = 7$ cm

Both of the figures are different in respect of their shapes.

Lateral surface of cylinder = $2\pi rh$

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

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

Lateral surface of the cube = $4l^2$

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

$$= 4 \times 49$$

$$= 196$$

So, cube has the larger lateral surface = 196 cm^2.

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. Area of metal sheet required

= Total surface area of the cylindrical tank

$$= 2\pi r(h + r)$$

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

$$= 2 \times \frac{22}{\cancel{7}} \times \cancel{7} \times 10$$

$$= 440 \text{ m}^2$$

Hence, the required area of sheet = 440 m^2.

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. Width of the rectangular sheet

= Circumference of the cylinder

$$33 = 2\pi r$$

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

$$\Rightarrow \quad r = \frac{\cancel{33}^{3} \times 7}{2 \times \cancel{22}_{2}} = \frac{21}{4} \text{ cm}$$

Now lateral surface area of the cylinder = $2\pi rh$

$$4224 = 2 \times \frac{22}{7} \times \frac{21}{4} \times h$$

$$\therefore \quad h = \frac{\overset{128}{\cancel{\overset{1408}{\cancel{4224}}}} \times \cancel{7} \times \cancel{4}^{\cancel{2}}}{\cancel{2} \times \underset{\cancel{11}}{\cancel{22}} \times \underset{\cancel{3}}{\cancel{21}}}$$

$$h = 128 \text{ cm}$$

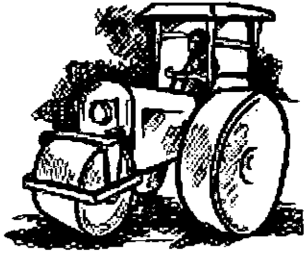
$$\therefore \quad l = 128 \text{ cm}, b = 33 \text{ cm}$$

$\therefore$ Perimeter of the sheet = $2(l + b)$

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

Hence, the required perimeter = 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. Lateral surface area of the road roller

$$= 2\pi rh$$

$$= 2 \times \frac{22}{\cancel{7}} \times \overset{6}{\cancel{42}} \times 100 \qquad \left[\because \; r = \frac{84}{2} = 42 \text{ cm}\right]$$

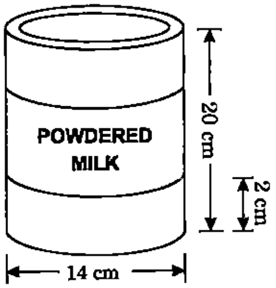
$$= 26400 \text{ cm}^2$$

Area covered by the roller in 750 complete revolutions

$$= 26400 \times 750 \text{ cm}^2$$
$$= 19800000 \text{ cm}^2$$
$$\frac{19800000}{10000} \text{ m}^2$$
$$= 1980 \text{ m}^2$$

Hence, the area of road = 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. Here, $r = \frac{14}{2} = 7$ cm

Height of the cylindrical label

$$= 20 - (2 + 2) = 16 \text{ cm}$$

$\therefore$ Surface area of the cylindrical shaped label

$$= 2\pi rh$$

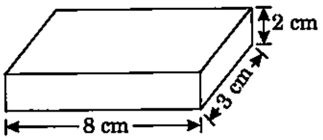
$$= 2 \times \frac{22}{\cancel{7}} \times \cancel{7} \times 16$$

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

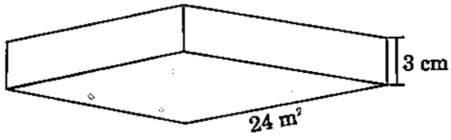
Hence, the required area of label = 704 cm^2.

TRY THESE (*PAGE 188*)

Q1. Find the volume of the following cuboids.



(*i*)



(*ii*)

Sol. (*i*) Here, $l = 8$ cm, $b = 3$ cm, $h = 2$ cm

Volume of the cuboid

$$= l \times b \times h$$
$$= 8 \times 3 \times 2 = 48 \text{ cm}^3$$

(*ii*) Here, area of base surface = 24 cm^2

Height = 3 cm

$\therefore$ Volume of the cuboid

$$= \text{Area of base} \times \text{height}$$
$$= 24 \times 3$$
$$= 72 \text{ cm}^3.$$

TRY THESE (*PAGE 189*)

Q1. Find the volume of the following cubes

(*a*) with a side 4 cm

(*b*) with a side 1.5 m

Sol. (*a*) Side = 4 cm

Volume = $(\text{Side})^3 = (4)^3 = 64 \text{ cm}^3$

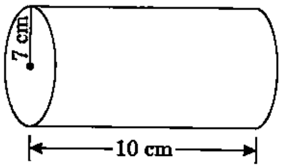
(*b*) Side = 1.5 m

Volume of the cube = $(\text{Side})^3$

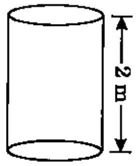
$= (1.5)^3 = 3.375 \text{ m}^3$

TRY THESE (*PAGE 189*)

Q1. Find the volume of the following cylinders.



(*i*)



(*ii*)

Sol. (*i*) Given $r = 7$ cm, $h = 10$ cm

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

$$= \frac{22}{\cancel{7}} \times \cancel{7} \times 7 \times 10$$

$= 1540 \text{ cm}^3$

Hence, required volume = 1540 cm^3

(*ii*) Given: Area of base = 250 m^2

$h = 2$ m

$\therefore$ Volume of the cylinder

= Area of the base × height

= 250 × 2

= 500 m^3

Hence, the required volume = 500 m^3.

EXERCISE 11.4

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.

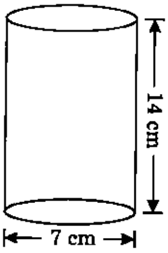
(*c*) To find the number of smaller tanks that can be filled with water from it.

Sol. (*a*) In this situation, we can find the volume.

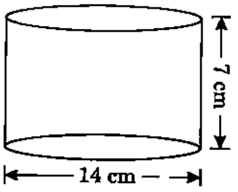
(*b*) In this situation, we can find the surface area.

(*c*) In this situation, we can find the 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. Cylinder B has the greater volume.

Verification:

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

$$= \frac{\cancel{22}^{11}}{\cancel{7}} \times \frac{\cancel{7}}{\cancel{2}} \times \frac{7}{\cancel{2}} \times \cancel{14}^{7}$$

$= 539 \text{ cm}^3$

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

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

$= 22 \times 49 = 1078 \text{ cm}^3$

Hence, volume of cylinder B is double to that of cylinder A. Hence verified.

Total surface area of cylinder A

$= 2\pi r(h + r)$

$$= 2 \times \frac{22}{7} \times \frac{7}{2}\left(\frac{7}{2} + 14\right)$$

$$= \cancel{2} \times \frac{\cancel{22}^{11}}{\cancel{7}} \times \frac{\cancel{7}}{\cancel{2}} \times \frac{35}{\cancel{2}}$$

$= 385 \text{ cm}^2$

Total surface area of cylinder B

$= 2\pi r(h + r)$

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

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

$= 616 \text{ cm}^2$

Hence, cylinder B has greater surface area.

Q3. Find the height of a cuboid whose base area is 180 cm^2 and volume is 900 cm^3.

Sol. Given: Area of base = lb = 180 cm^2

$$V = 900 \text{ cm}^3$$

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

$$900 = 180 \times h$$

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

Hence, the required height = 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. Volume of the cuboid = $l \times b \times h$

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

$$= 97200 \text{ cm}^3$$

Volume of the cube = $(\text{Side})^3 = (6)^3 = 216 \text{ cm}^3$

Number of the cubes from the cuboid

$$= \frac{\text{Volume of the cuboid}}{\text{Volume of cube}}$$

$$= \frac{97200}{216}$$

$$= 450$$

Hence, the required number of cubes = 450.

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

Sol. $V = 1.54 \text{ m}^3$, d= 140 cm = 1.40 m

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

$$1.54 = \frac{22}{7} \times \frac{1.4}{2} \times \frac{1.4}{2} \times h$$

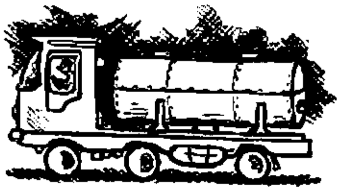
$$\Rightarrow \quad h = \frac{1.54 \times 7 \times 2 \times 2}{22 \times 1.4 \times 1.4}$$

$$= \frac{\cancel{154}^{\cancel{14}^{7}} \times \cancel{7} \times \cancel{2} \times \cancel{2}}{\cancel{22}_{2} \times \cancel{14}_{2} \times \cancel{14}_{2}}$$

$$= 1 \text{ m}$$

Hence, the height of cylinder = 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. Here, r = 1.5 m

h = 7 m

$\therefore$ Volume of the milk tank = $\pi r^2 h$

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

$$= 22 \times 2.25$$

$$= 49.50 \text{ m}^3$$

Volume of milk in litres

$$= 49.50 \times 1000 \text{ L}$$

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

$$= 49500 \text{ L}$$

Hence, the required volume = 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. Let the edge of the cube = x cm

If the edge is doubled, then the new edge = $2x$ cm

(*i*) Original surface area = $6x^2 \text{ cm}^2$

New surface area = $6(2x)^2$

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

$$= 24x^2$$

$\therefore$ Ratio = $6x^2 : 24x^2 = 1 : 4$

Hence, the new surface area will be four times the original surface area.

(*ii*) Original volume of the cube = $x^3 \text{ cm}^3$

New volume of the cube = $(2x)^3 = 8x^3 \text{ cm}^3$

$\therefore$ Ratio = $x^3 : 8x^3 = 1 : 8$

Hence, the new volume will be eight times the original volume.

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. Volume of the reservoir = 108 m^3

$$= 108000 \text{ L} \qquad [\because 1 \text{ m}^3 = 1000 \text{ L}]$$

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

$\therefore$ Time taken to fill the reservoir

$$= \frac{\text{Volume of the reservoir}}{\text{Rate of flowing the water}}$$

$$= \frac{108000}{60} \text{ minutes}$$

$$= 1800 \text{ minutes or } \frac{1800}{60} \text{ hours}$$

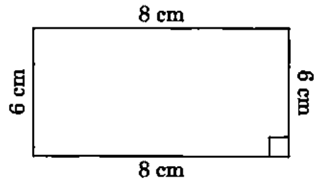
$$= 30 \text{ hours}$$

Hence, the required hour to fill the reservoir = 30 hours.

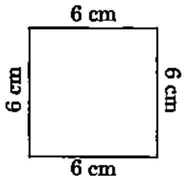
Learning More Q & A

I. VERY SHORT ANSWER (VSA) QUESTIONS

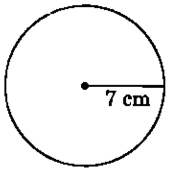
Q1. Find the perimeter of the following figures:



(*i*) Rectangle



(*ii*) Square



(*iii*) Circle

Sol. (*i*) Perimeter of the rectangle

$= 2(l + b)$

$= 2(8 + 6)$

$= 2 \times 14 = 28$ cm

(*ii*) Perimeter of the square

$= 4 \times$ side

$= 4 \times 6 = 24$ cm

(*iii*) Perimeter of the circle $= 2\pi r$

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

$= 44$ cm.

Q2. The length and breadth of a rectangle are 10 cm and 8 cm respectively. Find its perimeter if the length and breadth are

(*i*) doubled (*ii*) halved.

Sol. Length of the rectangle = 10 cm

Breadtb of the rectangle = 8 cm

(*i*) When they are doubled,

$l = 10 \times 2 = 20$ cm

and $b = 8 \times 2 = 16$ cm

$\therefore$ Perimeter $= 2(l + b)$

$= 2(20 + 16)$

$= 2 \times 36 = 72$ cm

(*ii*) When they are halved,

$$l = \frac{10}{2} = 5 \text{ cm}$$

and $$b = \frac{8}{2} = 4 \text{ cm}$$

$\therefore$ Perimeter $= 2(l + b)$

$= 2(5 + 4)$

$= 2 \times 9 = 18$ cm

Q3. A copper wire of length 44 cm is to be bent into a square and a circle. Which will have larger area?

Sol. (*i*) When the wire is bent into a square.

$$\therefore \quad \text{Side} = \frac{44}{4} = 11 \text{ cm}$$

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

$= (11)^2 = 121 \text{ cm}^2$

(*ii*) When the wire is bent into a circle.

Circumference $= 2\pi r$

$44 = 2\pi r$

$$44 = 2 \times \frac{22}{7} \times r$$

$$\therefore \quad r = \frac{44 \times 7}{2 \times 22} = 7 \text{ cm}$$

$\therefore$ Area of the circle $= \pi r^2$

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

$= 154 \text{ cm}^2$

So, the circle will have larger area.

Q4. The length and breadth of a rectangle are in the ratio 4 : 3. If its perimeter is 154 cm, find its length and breadth.

Sol. Let the length of the rectangle be $4x$ cm and that of breadth $= 3x$ cm

$\therefore$ Perimeter $= 2(l + b)$

$= 2(4x + 3x)$

$= 2 \times 7x = 14x$ cm

$14x = 154$

$$\therefore \quad x = \frac{154}{14} = 11$$

$\therefore$ Length $= 4 \times 11 = 44$ cm

and breadth $= 3 \times 11 = 33$ cm

Q5. The area of a rectangle is 544 cm². If its length is 32 cm, find its breadth.

Sol. Area $= 544 \text{ cm}^2$

Length $= 32$ cm

$$\therefore \text{ Breadth of the rectangle} = \frac{\text{Area}}{\text{Length}}$$

$$= \frac{\cancel{544}\ \cancel{34}^{17}}{\cancel{32}\ \cancel{2}} = 17 \text{ cm}$$

Hence, the required breadth = 17 cm

Q6. If the side of a square is doubled then how much time its area becomes?

Sol. Let the side of the square be x cm.

$\therefore$ Area = $(\text{side})^2 = x^2$ sq. cm

If its side becomes $2x$ cm then area

$= (2x)^2 = 4x^2$ sq. cm

$\therefore$ Ratio is $x^2 : 4x^2 = 1 : 4$

Hence, the area would become four times.

Q7. The areas of a rectangle and a square are equal. If the length of the rectangle is 16 cm and breadth is 9 cm, find the side of the square.

Sol. Area of the square

= Area of the rectangle

$= 16 \times 9 = 144 \text{ cm}^2$

$\therefore$ Side of the square

$= \sqrt{\text{Area of the square}}$

$= \sqrt{144} = 12$ cm

Hence, the side of square = 12 cm.

Q8. If the lengths of the diagonals of a rhombus are 16 cm and 12 cm, find its area.

Sol. **Given:**

First diagonal $d_1 = 16$ cm

Second diagonal $d_2 = 12$ cm

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

$$= \frac{1}{\cancel{2}} \times \cancel{16}^{8} \times 12$$

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

Hence, the required area = 96 cm^2.

Q9. The area of a rhombus is 16 cm^2. If the length of one diagonal is 4 cm, find the length of the other diagonal.

Sol. **Given:** Area of the rhombus = 16 cm^2

Length of one diagonal = 4 cm

$$\therefore \quad \text{Area} = \frac{1}{2} \times d_1 \times d_2$$

$$16 = \frac{1}{2} \times 4 \times d_2$$

$$\Rightarrow \quad 16 \times 2 = 4 \times d_2$$

$$\Rightarrow \quad 32 = 4 \times d_2$$

$$\therefore \quad d_2 = \frac{\cancel{32}^{8}}{\cancel{4}} = 8 \text{ cm}$$

Hence, the required length = 8 cm.

Q10. If the diagonals of a rhombus are 12 cm and 5 cm, find the perimeter of the rhombus.

Sol. **Given:** $d_1 = 12$ cm

$d_2 = 5$ cm

$\therefore$ Side of the rhombus

$$= \frac{1}{2}\sqrt{d_1^2 + d_2^2}$$

$$= \frac{1}{2}\sqrt{(12)^2 + (5)^2}$$

$$= \frac{1}{2}\sqrt{144 + 25}$$

$$= \frac{1}{2}\sqrt{169}$$

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

$$= \frac{13}{2} \text{ cm} = 6.5 \text{ cm}$$

The perimeter = 4 × side

= 4 × 6.5 = 26 cm

Hence, the perimeter = 26 cm.

II. SHORT ANSWER (SA) QUESTIONS

Q11. The volume of a box is 13400 cm^3. The area of its base is 670 cm^2. Find the height of the box.

Sol. Volume of the box = 13400 cm^3

Area of the box = 670 cm^2

$$\therefore \quad \text{Height} = \frac{\text{Volume}}{\text{Base area}}$$

$$= \frac{13400}{670} = 20 \text{ cm}$$

Hence, the required height = 20 cm.

Q12. Complete the following table; measurement in centimetres.

	(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)
Length	4	12	7	16	60	40
Breadth	5	8	6	—	—	24
Height	6	6	—	8	5	—
Volume	—	—	84	1536	5400	2400

Sol. (*a*) $V = l \times b \times h$

$= 4 \times 5 \times 6 = 120 \text{ cm}^3$

(*b*) $V = l \times b \times h$

$= 12 \times 8 \times 6 = 576 \text{ cm}^3$

(*c*) $V = l \times b \times h$

$84 = 7 \times 6 \times h$

$$\therefore \quad h = \frac{84}{7 \times 6} = 2 \text{ cm}$$

(*d*) $V = l \times b \times h$

$1536 = 16 \times b \times 8$

$$\therefore \quad b = \frac{1536}{16 \times 8} = 12 \text{ cm}$$

(*e*) $V = l \times b \times h$

$5400 = 60 \times b \times 5$

$$\Rightarrow b = \frac{5400}{60 \times 5} = 18 \text{ cm}$$

(*f*) $V = l \times b \times h$

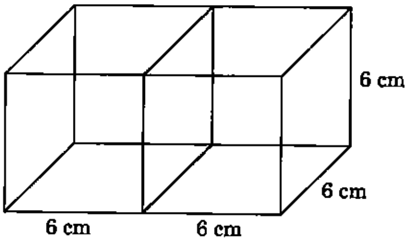
$$2400 = 40 \times 24 \times h$$

$$\therefore h = \frac{2400}{40 \times 24} = 2.5 \text{ cm}$$

Hence $(a) \leftrightarrow 120 \text{ cm}^3$, $(b) \leftrightarrow 576 \text{ cm}^3$, $(c) \leftrightarrow 2$ cm, $(d) \leftrightarrow 12$ cm, $(e) \leftrightarrow 18$ cm, $(f) \leftrightarrow 2.5$ cm

Q13. Two cubes are joined end to end. Find the volume of the resulting cuboid, if each side of the cubes is 6 cm.

Sol.



Length of the resulting cuboid

$= 6 + 6 = 12$ cm

Breadth = 6 cm

Height = 6 cm

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

$= 12 \times 6 \times 6$

$= 432 \text{ cm}^3$

Q14. How many bricks each 25 cm by 15 cm by 8 cm, are required for a wall 32 m long, 3 m high and 40 cm thick?

Sol. Converting into same units, we have,

Length of the wall = 32 m

$= 32 \times 100$

$= 3200$ cm

Breadth of the wall = 3 m

$= 3 \times 100$

$= 300$ cm

and the height = 40 cm

Now, length of the brick = 25 cm

breadth = 15 cm

and height = 8 cm

$\therefore$ Number of bricks required

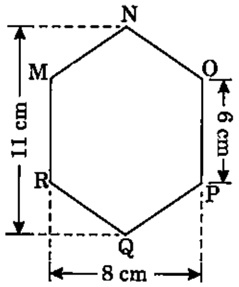
$$= \frac{\text{Volume of the wall}}{\text{Volume of one brick}}$$

$$= \frac{3200 \times 300 \times 40}{25 \times 15 \times 8}$$

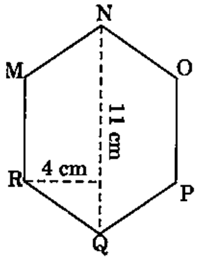
$$= 128 \times 20 \times 5 = 12800$$

Hence, the required number of bricks = 12800.

Q15. MNOPQR is a hexagon of side 6 cm each. Find the area of the given hexagon in two different methods.



Sol. **Method I:** Divide the given hexagon into two similar trapezium by joining QN.



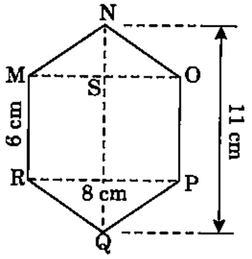
Area of the hexagon MNOPQR

= 2 area of trapezium MNQR

$$= 2 \times \frac{1}{2}(6 + 11) \times 4$$

$$= 17 \times 4 = 68 \text{ cm}^2$$

Method II: The hexagon MNOPQR is divided into three parts, 2 similar triangles and 1 rectangle by joining MO, RP.



$$NS = \frac{11 \text{ cm} - 6 \text{ cm}}{2}$$

$$= \frac{5}{2} \text{ cm} = 2.5 \text{ cm}$$

$\therefore$ Area of hexagon MNOPQR

$= 2 \times$ area of ΔMNO

+ area of rectangle MRPO

$$= 2 \times \left(\frac{1}{2} \times MO \times NS\right) + (RP \times MR)$$

$$= MO \times NS + RP \times MR$$

$$= 8 \times 2.5 + 8 \times 6$$

$$= 20 + 48$$

$$= 68 \text{ cm}^2.$$

Q16. The area of a trapezium is 400 cm^2, the distance between the parallel sides is 16 cm. If one of the parallel sides is 20 cm, find the length of the other side.

Sol. **Given:** Area of trapezium = 400 cm^2

Height = 16 cm

One of the parallel side = 20 cm

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

$$400 = \frac{1}{2}(20+b)\times 16$$

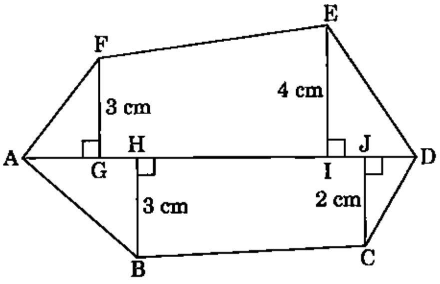
$$\Rightarrow \quad \frac{400\times 2}{16} = 20 + b$$

$$\Rightarrow \quad 50 = 20 + b$$

$$\therefore \quad b = 50 - 20 = 30 \text{ cm}$$

Hence, the required length = 30 cm.

Q17. Find the area of the hexagon ABCDEF given below. Given that: AD = 8 cm, AJ = 6 cm, AI = 5 cm, AH = 3 cm, AG = 2.5 cm and FG, BH, EI and CJ are perpendiculars on diagonal AD from the vertices F, B, E and C respectively.



Sol. **Given:**

AD = 8 cm　FG = 3 cm

AJ = 6 cm　EI = 4 cm

AI = 5 cm　BH = 3 cm

AH = 3 cm　CJ = 2 cm

AG = 2.5 cm

$$\text{Area of } \Delta AGF = \frac{1}{2}\times AG\times FG$$

$$= \frac{1}{2}\times 2.5\times 3$$

$$= 2.5 \times 1.5$$

$$= 3.75 \text{ cm}^2$$

Area of trapezium FGIE

$$= \frac{1}{2}\times(GF + IE)\times GI$$

$$= \frac{1}{2}\times(3+4)\times 2.5 \qquad [\because \; GI = AI - AG]$$

$$[\because \; GI = 5 - 2.5 = 2.5 \text{ cm}]$$

$$= \frac{1}{2}\times 7\times 2.5$$

$$= 3.5 \times 2.5 = 8.75 \text{ cm}^2$$

$$\text{Area of } \Delta EID = \frac{1}{2}\times ID\times EI$$

$$= \frac{1}{2}\times(AD - AI)\times EI$$

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

$$= \frac{1}{2}\times 3\times 4 = 6 \text{ cm}^2$$

$$\text{Area of } \Delta CJD = \frac{1}{2}\times JD\times JC$$

$$= \frac{1}{2}\times(AD - AJ)\times JC$$

$$= \frac{1}{2}\times(8-6)\times 2$$

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

Area of trapezium HBCJ

$$= \frac{1}{2}\times(HB + JC)\times HJ$$

$$= \frac{1}{2}\times(3+2)\times(AJ - AH)$$

$$= \frac{1}{2}\times 5\times(6-3)$$

$$= \frac{1}{2}\times 5\times 3 = 7.5 \text{ cm}^2$$

$$\text{Area of } \Delta AHB = \frac{1}{2}\times AH\times HB$$

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

$$= \frac{9}{2} = 4.5 \text{ cm}^2$$

Area of hexagon ABCDEF

= Area of ΔAGF + Area of trapezium FGIE + Area of ΔEID + Area of ΔCJD + Area of trapezium HBCJ + Area of ΔAHB

= 3.75 cm^2 + 8.75 cm^2 + 6 cm^2 + 2 cm^2 + 7.5 cm^2 + 4.5 cm^2

= 32.50 cm^2.

Q18. Three metal cubes of sides 6 cm, 8 cm and 10 cm are melted and recast into a big cube. Find its total surface area.

Sol. Volume of the cube with side 6 cm

= (side)^3

= (6)^3 = 216 cm^3

Volume of the cube with side 8 cm

= (side)^3

= (8)^3 = 512 cm^3

Volume of the cube with side 10 cm

$= (\text{side})^3$

$= (10)^3 = 1000 \text{ cm}^3$

Volume of the big cube

$= 216 \text{ cm}^3 + 512 \text{ cm}^3 + 1000 \text{ cm}^3$

$= 1728 \text{ cm}^3$

Side of the resulting cube $= \sqrt[3]{1728} = 12$ cm

Total surface area $= 6\,(\text{side})^2$

$= 6(12)^2$

$= 6 \times 144 \text{ cm}^2$

$= 864 \text{ cm}^2$.

Q19. The diameter of a roller is 84 cm and its length is 120 cm. It takes 500 complete revolutions to move once over to level a playground. Find the area of the playground in m^2.

Sol. **Given:** Diameter of the roller = 84 cm

Radius $= \frac{84}{2} = 42$ cm

Height = 120 cm

Curved surface area of the roller

$= 2\pi rh$

$= 2 \times \frac{22}{7} \times 42 \times 120$

$= 22 \times 1440$

$= 31680 \text{ cm}^2$

$= \frac{31680}{100 \times 100} \text{ m}^2 \qquad [1 \text{ m}^2 = 1000 \text{ cm}^2]$

$= 3.168 \text{ m}^2$

Area covered by the roller in one complete revolution $= 3.168 \text{ m}^2$

$\therefore$ Area covered in 500 complete revolutions

$= 500 \times 3.168$

$= 1584 \text{ m}^2$

Hence, the required area $= 1584 \text{ m}^2$.

Q20. A rectangular metal sheet of length 44 cm and breadth 11 cm is folded along its length to form a cylinder. Find its volume.

Sol. Circumference of the base $= 2\pi r$

$$11 = 2 \times \frac{22}{7} \times r$$

$$\therefore \quad r = \frac{11 \times 7}{22 \times 2}$$

$$= \frac{7}{4} \text{ cm}$$

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

$$= \frac{\overset{11}{\cancel{22}}}{\cancel{7}} \times \frac{\cancel{7}}{\cancel{4}_2} \times \frac{7}{\cancel{4}} \times \cancel{44}^{11}$$

$$= \frac{847}{2} \text{ cm}^3$$

$$= 423.5 \text{ cm}^3$$

Hence, the required volume $= 423.5 \text{ cm}^3$.

Q21. 160 m^3 of water is to be used to irrigate a rectangular field whose area is 800 m^2. What will be the height of the water level in the field? (*NCERT Exemplar*)

Sol. Volume of water $= 160 \text{ m}^3$

Area of rectangular field $= 800 \text{ m}^2$

Let h be the height of water level in the field.

Now, volume of water = volume of cuboid formed on the field by water.

$$160 = \text{Area of base} \times \text{height}$$

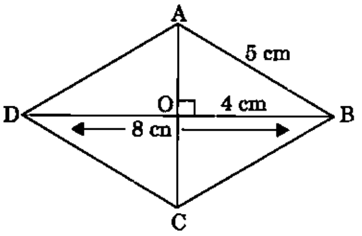
$$= 800 \times h$$

$$h = \frac{160}{800} = 0.2$$

So, required height = 0.2 m

Q22. Find the area of a rhombus whose one side measures 5 cm and one diagonal as 8 cm. (*NCERT Exemplar*)

Sol. Let ABCD be the rhombus as shown below.



DO = OB = 4 cm, since diagonals of a rhombus are perpendicular bisectors of each other. Therefore, using Pythagoras theorem in ΔAOB,

$$AO^2 + OB^2 = AB^2$$

$$AO = \sqrt{AB^2 - OB^2} = \sqrt{52 - 42} = 3 \text{ cm}$$

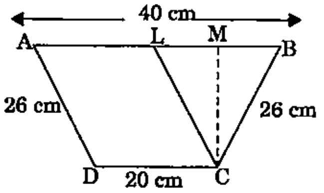
So, $\quad AC = 2 \times 3 = 6$ cm

Thus, the area of the rhombus $= \frac{1}{2} \times d_1 \times d_2$

$$= \frac{1}{2} \times 8 \times 6 = 24 \text{ cm}^2.$$

Q23. The parallel sides of a trapezium are 40 cm and 20 cm. If its nou-parallel sides are both equal, each being 26 cm, find the area of the trapezium.

Sol. Let ABCD be the trapezium such that AB = 40 cm and CD = 20 cm and AD = BC = 26 cm.



Now, draw CL || AD

Then ALCD is a parallelogram.

So AL = CD = 20 cm

and CL = AD = 26 cm.

In ΔCLB, we have

CL = CB = 26 cm

Therefore, ΔCLB is an isosceles triangle.

Draw altitude CM of ΔCLB.

Since ΔCLB is an isosceles triangle. So, CM is also the median.

Then LM = MB = $\frac{1}{2}$ BL = $\frac{1}{2}$ × 20 cm = 10 cm

[as BL = AB – AL = (40 – 20) cm = 20 cm].

Applying Pythagoras theorem in ΔCLM, we have

$$CL^2 = CM^2 + LM^2$$

$$26^2 = CM^2 + 10^2$$

$$CM^2 = 26^2 - 10^2 = (26 - 10)(26 + 10)$$

$$= 16 \times 36 = 576$$

$$CM = 576 = 24 \text{ cm}$$

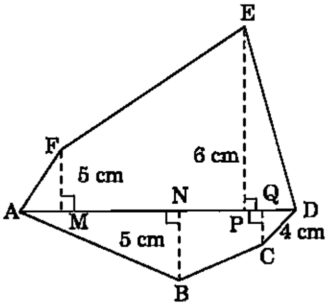
Hence, the area of the trapezium = $\frac{1}{2}$ (sum of parallel sides) × height

$$= \frac{1}{2}(20 + 40) \times 24 = 30 \times 24 = 720 \text{ cm}^2.$$

Q24. Find the area of polygon ABCDEF, if AD = 18 cm, AQ = 14 cm, AP = 12 cm, AN = 8 cm, AM = 4 cm, and FM, EP, QC and BN are perpendiculars to diagonal AD.

(NCERT Exemplar)

Sol.



In the figure

MP = AP – AM = (12 – 4) cm = 8 cm

PD = AD – AP = (18 – 12) cm = 6 cm

NQ = AQ – AN = (14 – 8) cm = 6 cm

QD = AD – AQ = (18 – 14) cm = 4 cm

Area of the polygon ABCDEF

= area of ΔAFM + area of trapezium FMPE + area of ΔEPD + area of ΔANB + area of trapezium NBCQ + area of ΔQCD.

$$= \frac{1}{2} \times AM \times FM + \frac{1}{2}(FM + EP) \times MP + \frac{1}{2} PD \times EP + \frac{1}{2} \times AN \times NB + \frac{1}{2}(NB + CQ) \times NQ + \frac{1}{2} QD \times CQ$$

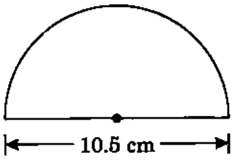
$$= \frac{1}{2} \times 4 \times 5 + \frac{1}{2}(5 + 6) \times 8 + \frac{1}{2} \times 6 \times 6 + \frac{1}{2} \times 8 \times 5 + \frac{1}{2}(5 + 4) \times 6 + \frac{1}{2} \times 4 \times 4.$$

$$= 10 + 44 + 18 + 20 + 27 + 8 = 127 \text{ cm}^2$$

Test Yourself

I. VERY SHORT ANSWER (VSA) QUESTIONS

Q1. Find the perimeter of the given semicircle.

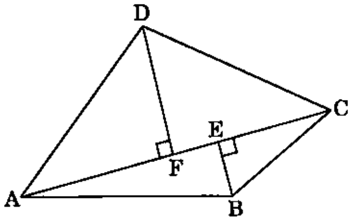


Q2. The area of a rectangle is equal to the area of a square. If length and breadth of the rectangle are 16 cm and 9 cm respectively. Find the side of the square.

Q3. The length of the diagonal of a square is 18 cm. Find the perimeter of the square.

Q4. The diagonals of a rhombus are 12 cm and 5 cm. Find the perimeter of the rhombus.

Q5. Find the area of the given quadrilateral ABCD if AC = 10 cm, BE = 3 cm and DF = 4 cm.



Q6. The side of a cube is 6 cm. Find its total surface area.

Q7. The volume of a cube is 1728 cm^3. Find its total surface area.

Q8. Find the area of a regular hexagon whose each side is 10 cm. (Take $\sqrt{3} = 1.73$)

Q9. Find the total surface area of a cylinder whose diameter is 14 cm and height 10 cm.

Q10. The surface area of a cuboid is 1372 cm². The dimensions of the cuboid are in the ratio of 4 : 2 : 1. Find its dimensions.

II. SHORT ANSWER (SA) QUESTIONS

Q11. The volume of a cuboid is 440 cm³. If its base area is 154 cm², find its height and lateral surface area.

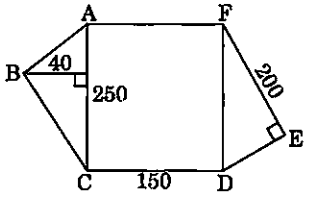
Q12. The volume of a circular cylinder is 3234 cm³. If its radius and height are in the ratio 1 : 3, find its total surface area.

Q13. A well of 10 m inside diameter is dug 14 m deep. The Earth taken out from it is spread evenly all around to a width of 5 metres to form as embankment. Find the height of the embankment.

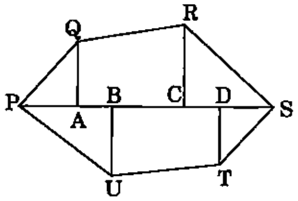
Q14. The area of the base of a right circular cylinder is 15400 cm² and its volume is 92400 cm³. Find the curved surface area of the cylinder.

Q15. Find the total surface area of a hollow cylinder open at both ends, if the length is 12 cm, the external diameter 10 cm and thickness 2 cm.

Q16. Find the area of the field ABCDEF whose measurements in metres are given alongsides. Here ∠E = 90° and ACDF is a rectangle.



Q17. Find the area of the given polygon PQRSTU with given measurements:



PS = 8 cm, PD = 6 cm,

PC = 5 cm, PB = 3 cm,

PA = 2 cm AQ = 2 cm,

RC = 3 cm UB = 3.5 cm

and TD = 2.5 cm

Q18. In a building there are 24 cylindrical pillars. The radius of each pillar is 28 cm and height is 4 m. Find the total cost of painting the curved surface area of all pillars at the rate of ₹ 8 per m².

ANSWERS

1. 27 cm
2. 12 cm
3. 50.91 cm
4. 26 cm
5. 35 cm
6. 216 cm²
7. 864 cm²
8. 259.5 cm²
9. 748 cm²
10. 28 cm, 14 cm, 7 cm
11. $2\frac{6}{7}$ cm, $125\frac{5}{7}$ cm²
12. 1232 cm²
13. $4\frac{2}{3}$ m
14. 2640 cm²
15. 704 cm²
16. 57500 m²
17. 30.75 cm²
18. ₹ 1351.68

Internal Assessment

Q1. Fill in the blanks:

(*a*) If d_1, d_2 be the diagonals of a rhombus then the area of the rhombus is ________

(*b*) 2 cm³ = ________ mm³

(*c*) 1 litre = ________ cm³

(*d*) Volume of a cube is 64 cm³, then its edge = ________

(*e*) Curved surface area of a cylinder is = ________

Q2. Answer True (T) or False (F):

(*a*) Total surface area of a cylinder = $2\pi rh + \pi r^2$ (....)

(*b*) Area of four walls of a room = Perimeter of floor × Height of wall. (....)

(*c*) Volume of cylinder = Area of base × height. (....)

(*d*) The surface area of a cube is 486 cm², then its edge is 9 cm. (....)

(*e*) Volume of a cuboid is = length × breadth (....)

III. MULTIPLE CHOICE QUESTIONS (MCQs)

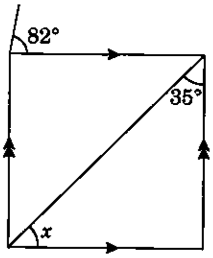
Q3. The measure of x in the given figure is

(*a*) 35°

(*b*) 82°

(*c*) 55°

(*d*) 63°



Q4. If volume of a cuboid is 154 cm^3 and the area of its base is 44 cm, then its height is

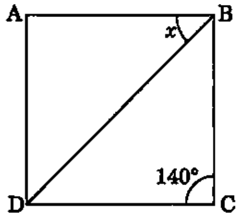
(*a*) 3.5 cm (*b*) 7 cm

(*c*) 2.5 cm (*d*) 3 cm

Q5. From the given rhombus ABCD, the value of x is

(*a*) 20° (*b*) 25°

(*c*) 15° (*d*) 25°



Q6. Area of an equilateral triangle with each sides 5 cm is

(*a*) $\frac{5\sqrt{3}}{2}$ (*b*) $\frac{25\sqrt{3}}{4}$

(*c*) $\frac{10\sqrt{3}}{2}$ (*d*) $\frac{8\sqrt{3}}{4}$

Q7. If a is the side of a regular hexagon, then its area is

(*a*) $\frac{2\sqrt{3}a^2}{3}$ sq. units (*b*) $\frac{3\sqrt{3}a^2}{2}$

(*c*) $\frac{3\sqrt{3}a^2}{4}$ (*d*) $\frac{2\sqrt{3}a^2}{4}$

Q8. The diagonals of a rhombus are 12 cm and 5 cm. Find its

(*a*) area (*b*) side

ANSWERS

1. (*a*) $\frac{1}{2} \times d_1 \times d_2$ (*b*) 2000
(*c*) 1000 (*d*) 4 cm
(*e*) $2\pi rh$

2. (*a*) False (*b*) True (*c*) True
(*d*) True (*e*) False

3. (*c*) 4. (*a*) 5. (*a*)

6. (*b*) 7. (*b*)

8. (*a*) 30 cm^2 (*b*) 6.5 cm.