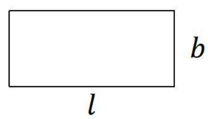
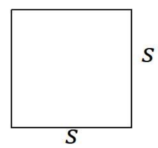
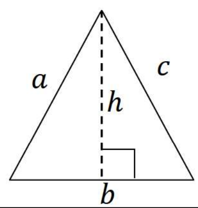
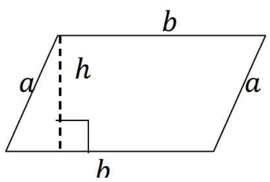
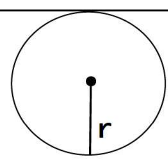
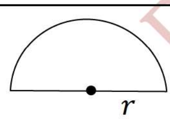
CHAPTER 9

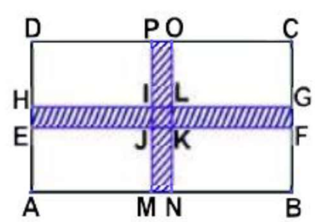
VIII CLASS-NCERT (2024-25)
MENSURATION (Notes)

PREPARED BY : BALABHADRA SURESH-9866845885
www.sureshmathsmaterial.com/

Diagram	Shape	Area	Perimeter
	**RECTANGLE** Length=l Breadth=b	$l \times b$	$2(l+b)$
	**SQUARE** Side=s	$a \times a = a^2$	$4a$
	**TRIANGLE** Base=b , sides=a , c Height=h	$\frac{1}{2}bh$	$a+b+c$
	**PARALLELOGRAM** Base=b Corresponding height=h	$b \times h$	$2(a+b)$
	**CIRCLE** Radius=r $\pi = \frac{22}{7}$ or 3.14	πr^2	$2\pi r$
	**SEMI-CIRCLE** Radius=r	$\frac{1}{2}\pi r^2$	$\pi r + 2r = \frac{36}{7}r$

2. **Area of shaded path**

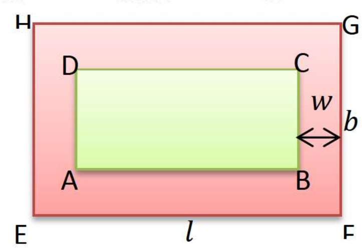
=Area of EFGH + Area of MNOP – (Area of IJKL)



3. **Area of rectangular path**

= Area of outer rectangle EFGH – Area of inner rectangle ABCD

$= l \times b - (l-2w)(b-2w)$



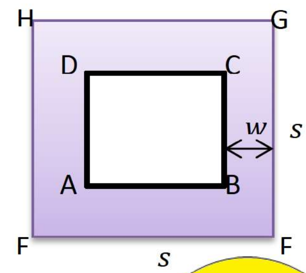
4. **Area of square path**= Area of outer square EFGH – Area of

inner square ABCD

$= s^2 - (s - 2w)^2$

$= (2s - 2w) \times 2w$

$= 4(s - w) \times w$

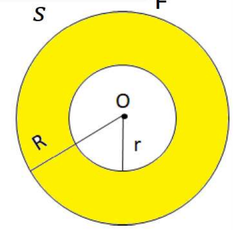


5. **The area of circular pathway** = Area of outer circle – Area of inner circle

$= \pi R^2 - \pi r^2$

$= \pi(R^2 - r^2)$

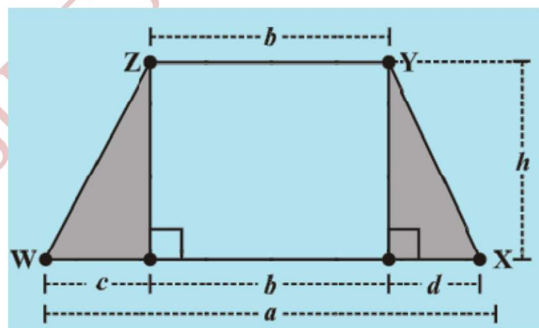
$= \pi(R + r)(R + r)\ sq.units$



AREA OF TRAPEZIUM:

TRY THESE

1. **the area of trapezium WXYZ $= h\frac{(a+b)}{2}$**



Sol: $Area\ of\ \Delta PZW = \frac{1}{2} \times c \times h$

$Area\ of\ \Delta QXY = \frac{1}{2} \times d \times h$

$Area\ of\ rectangle\ PQYZ = b \times h$

$The\ area\ of\ trapezium\ WXY$

$= Area\ of\ \Delta PZW + Area\ of\ \Delta QXY + Area\ of\ rectangle\ PQYZ$

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

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

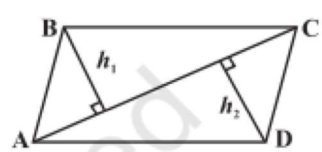
$= h\left(\frac{c + d + 2b}{2}\right)$

$= h\left(\frac{c + d + b + b}{2}\right)$

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

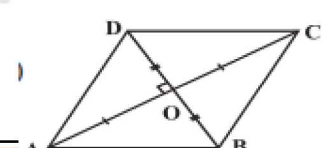
Area of a General Quadrilateral

Area of quadrilateral ABCD $= \frac{1}{2}d(h_1 + h_2)$



Rhombus

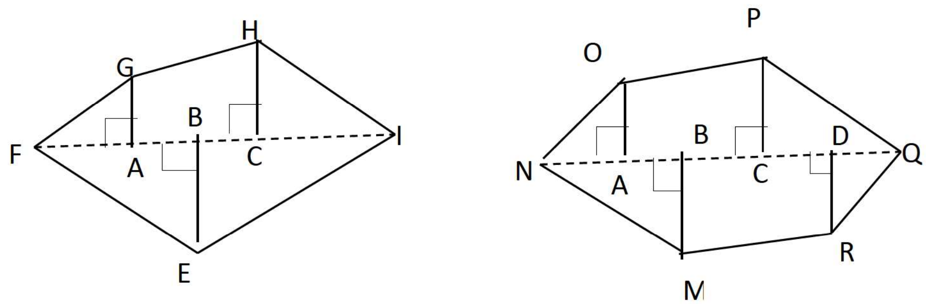
$Area\ of\ rhombus = \frac{1}{2} \times d_1 \times d_2$



Area of a rhombus is half the product of its diagonals

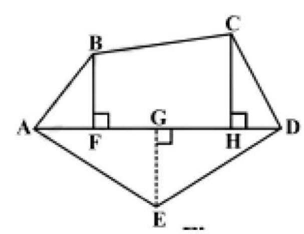
Area of a Polygon

(i) Divide the following polygons (Fig 11.17) into parts (triangles and trapezium) to find out its area



(ii) Polygon ABCDE is divided into parts as shown below (Fig 11.18). 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: $FH = AH - AF = 6 - 3 = 3\ cm, HD = AD - AH = 8 - 6 = 2\ cm$



$Area\ of\ \Delta AFB = \frac{1}{2} \times AF \times BF = \frac{1}{2} \times 3 \times 2 = 3\ cm^2$

$$\text{Area of trapezium} FBCH = FH \times \frac{(BF + CH)}{2}$$

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

$$= \frac{15}{2} = 7.5\ cm^2$$

$FH = AH - AF = 6 - 3 = 3\ cm$

$Area\ of\ \Delta CHD = \frac{1}{2} \times HD \times CH = \frac{1}{2} \times 2 \times 3 = 3\ cm^2$

$Area\ of\ \Delta ADE = \frac{1}{2} \times AD \times GE = \frac{1}{2} \times 8 \times 2.5 = 10\ cm^2$

The area of polygon $ABCDE$

$= Area\ of\ \Delta AFB +$ Area of trapezium FBCH + Area of ΔCHD + Area of ΔADE

$= 3 + 7.5 + 3 + 10$

$= 23.5\ cm^2$

(iii) Find the area of polygon MNOPQR (Fig 11.19) 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.

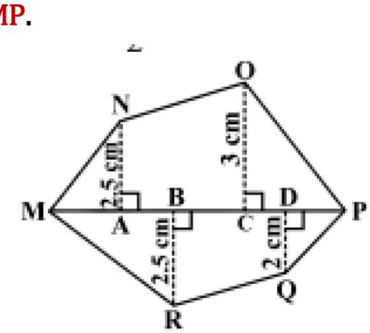
Sol: $AC = MC - MA = 6 - 2 = 4\ cm$

$CP = MP - MC = 9 - 6 = 3\ CM$

$DP = MP - MD = 9 - 7 = 2cm$

$BD = MD - MB = 7 - 4 = 3\ cm$

$Area\ of\ \Delta MAN = \frac{1}{2} \times MA \times NA = \frac{1}{2} \times 2 \times 2.5 = 2.5\ cm^2$



$$Area\ of\ trapezium\ \text{ACON} = \text{AC} \times \frac{(\text{AN}+\text{CO})}{2}$$

$$= 4 \times \frac{(2.5+3)}{2} = 2 \times 5.5 = 11cm^2$$

Area of ΔOCP $= \frac{1}{2} \times CP \times CO = \frac{1}{2} \times 3 \times 3 = 4.5\ cm^2$

Area of ΔPDQ $= \frac{1}{2} \times PD \times DQ = \frac{1}{2} \times 2 \times 2 = 2\ cm^2$

Area of trapezium BDQR $= BD \times \frac{(BR+DQ)}{2}$

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

$$= 3 \times 2.25$$

$$= 6.75cm^2$$

Area of ΔMBR $= \frac{1}{2} \times MB \times BR = \frac{1}{2} \times 4 \times 2.5 = 5\ cm^2$

The area of polygon MNOPQR$=2.5+11+4.5+2+6.75+5$

$$= 31.75\ cm^2$$

Example 1: The area of a trapezium shaped field is 480 m^2 , the distance between two parallel sides is 15 m and one of the parallel side is 20 m. Find the other parallel side.

Sol: $h = 15m\ ,\ a = 20\ m,\ b = ?$

The given area of trapezium = 480 m^2 .

$$\frac{1}{2} \times h \times (a+b) = 480$$

$$\frac{1}{2} \times 15 \times (20+b) = 480$$

$$20 + b = \frac{480 \times 2}{15} = 32 \times 2 = 64$$

$$20 + b = 64$$

$$b = 64 - 20 = 44\ m$$

Hence the other parallel side of the trapezium is 44 m

Example 2: The area of a rhombus is 240 cm^2 and one of the diagonals is 16 cm. Find the other diagonal.

Sol: The area of a rhombus = 240 cm^2, $d_1 = 16cm, d_2 = ?$

$$\frac{1}{2} \times d_1 \times d_2 = 240$$

$$\frac{1}{2} \times 16 \times d_2 = 240$$

$$d_2 = \frac{240 \times 2}{16} = 30\ cm$$

Hence the length of the second diagonal is 30 cm.

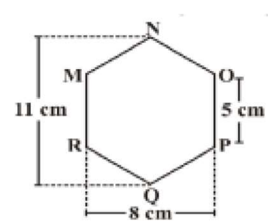
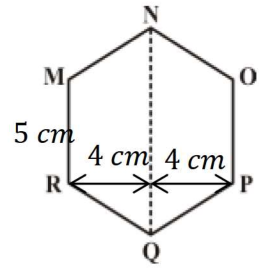


Fig 11.20

Example 3: There is a hexagon MNOPQR of side 5 cm (Fig 11.20). Aman and Ridhima divided it in two

different ways (Fig 11.21). Find the area of this hexagon using both ways

Solution: Aman's method:



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

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

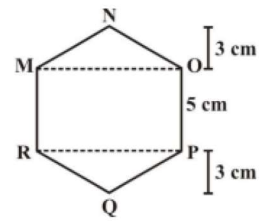
$$= 2 \times 16$$

$$= 32\ cm^2$$

Similarly Area of trapezium NQRO= $32\ cm^2$

So, the area of hexagon MNOPQR = $2 \times 32 = 64$ cm^2 .

Ridhima's method:



Δ MNO and Δ RPQ are congruent triangles with altitude 3 cm and base 8cm

$$Area\ of\ \Delta MNO = \frac{1}{2} \times b \times h$$

$$= \frac{1}{2} \times 8 \times 3$$

$$= 12\ cm^2$$

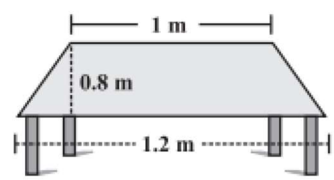
Also area of ΔMNO =12 cm^2

Area of rectangle MOPR = $8 \times 5 = 40$ cm^2 .

Now, area of hexagon MNOPQR = $40 + 12 + 12 = 64$ cm^2 .

EXERCISE 9.1

1. **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: Given $a = 1m$, $b = 1.2\ m$ and $h = 0.8\ m$

The area of table $= h \times \frac{(a+b)}{2}$

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

$$= 0.4 \times 2.2$$

$$= 0.88\ m^2$$

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

Sol: Given $a = 10cm, h = 4cm, b = ?$

The area of a trapezium = 34 cm^2

$$h \times \frac{(a+b)}{2} = 34$$

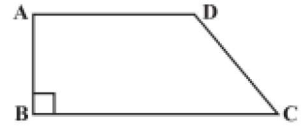
$$4 \times \frac{(10+b)}{2} = 34$$

$10 + b = \frac{34}{2} = 17$

$b = 17 - 10 = 7$

Length of the other parallel side=7 cm

3. 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: Length of the fence of a trapezium shaped field ABCD = 120 m

AB+BC+CD+DA=120 m

AB+48+17+40=120

AB+105=120

AB=120-105

AB=15 m

Here $a = BC = 48\ m, b = AD = 40m\ \ and\ \ h = AB = 15m$

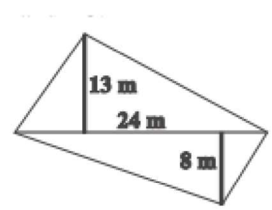
$The\ area\ of\ the\ field = h \times \frac{(a+b)}{2}$

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

$= 15 \times 44$

$= 660\ m^2$

4. 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 $d = 24m,\ h_1 = 13\ m,\ h_2 = 8\ m$

$The\ area\ of\ the\ field = \frac{1}{2}d(h_1 + h_2)$

$= \frac{1}{2} \times 24 \times (13 + 8) = 12 \times 21 = 252\ m^2$

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

Sol: Here $d_1 = 7.5\ cm,\ d_2 = 12\ cm$

The area of rhombus $= \frac{1}{2} \times d_1 \times d_2$

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

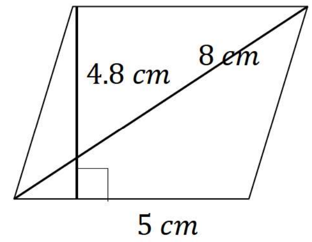
$= 7.5 \times 6$

$= 45\ cm^2$

6. 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: Side of rhombus(S)=5 cm

Altitude (h)=4.8 cm



We know that rhombus is also a parallelogram.

Area of rhombus(parallelogram) $= \text{Base} \times \text{Height}$

$= 5 \times 4.8$

$= 24\ cm^2$

One of its diagonal$(d_1) = 8\ cm$

Area of rhombus $= 24\ cm^2$

$\frac{1}{2} \times d_1 \times d_2 = 24 \Rightarrow \frac{1}{\cancel{2}_1} \times \cancel{8}^4 \times d_2 = 24$

$d_2 = \frac{24}{4} = 6\ cm$

The length of the other diagonal=6 cm

7. 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: Diagonals of each tile $d_1 = 45\ cm,\ d_2 = 30\ cm$

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

$= \frac{1}{2} \times 45 \times 30$

$= 45 \times 15$

$= 675\ cm^2$

$Area\ of\ 3000\ tiles = 3000 \times 675\ cm^2$

$= 2025000\ cm^2$

$= \frac{2025000}{10000}\ m^2 = 202.5\ m^2$

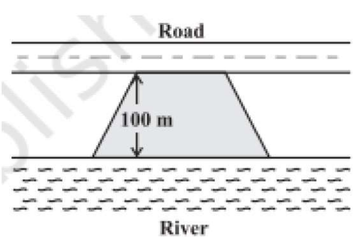
Cost of polishing the floor per 1 m^2=4

Cost of polishing 202.5 $m^2 = 4 \times 202.5 = 810$

Total cost of polishing the floor=₹810.

8. 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: Let side along the road(a)=$x\ m$



Side along the river(b)=$2x\ m$

Distance between two sides(h)=100 m

Area of trapezium=10500 m²

$h \times \frac{(a+b)}{2} = 10500$

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

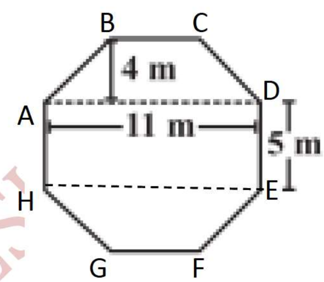
$$\frac{3x}{2} = \frac{10500}{100}$$

$$x = \frac{105 \times 2}{3} = 35 \times 2 = 70$$

Side along the road=x=70 m

The length of the side along the river$=2 \times 70 = 140\ m$

9. **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: Given is a regular octagon . So, all sides are equal.

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

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

$$= 2 \times 16$$

$$= 32\ m^2$$

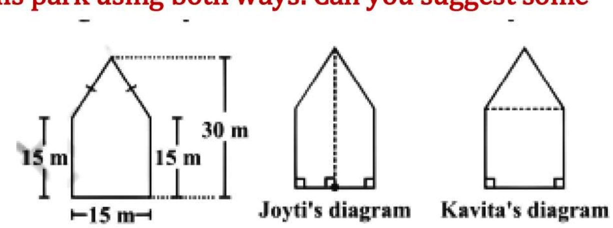
Area of rectangle ADEH$=AD \times DE = 11 \times 5 = 55\ m^2$

Area of octagonal surface $= 2 \times$ Area of trapezium $+$ Area of rectangle

$$= 2 \times 32 + 55$$

$$= 64 + 55 = 119 m^2$$

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



Sol: Finding area by Jyothi's diagram:

Area of trapezium ABFE $= \text{EF} \times \frac{(\text{AE}+\text{BF})}{2}$

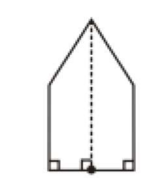
$= \frac{15}{2} \times \frac{(15+30)}{2} = \frac{15 \times 45}{4} m^2$

Area of pentagon ABCDE $= 2 \times$ Area of trapezium ABFE

$$= 2 \times \frac{15 \times 45}{4}$$

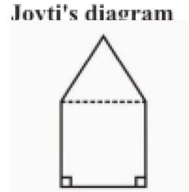
$$= \frac{675}{2}$$

$$= 337.5\ m^2$$



Joyti's diagram

Finding area by Kavita's diagram:



Kavita's diagram

Area of ΔABC $= \frac{1}{2} \times b \times h$

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

$$= \frac{225}{2} = 112.5\ m^2$$

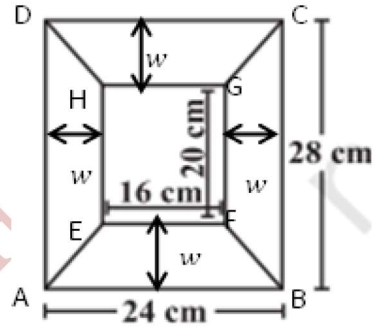
Area of square ACDE $= s \times s$

$$= 15 \times 15 = 225\ m^2$$

Area of pentagon ABCDE = Area of ΔABC + Area of square ACDE

$$= 112.5 + 225 = 337.5\ m^2$$

11. 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: Outer dimentions $L = 28cm\ \ and\ \ B = 24\ cm$

Inner dimentions $l = 20cm\ \ and\ \ b = 16\ cm$

The width of each section is same

Width $= w = \frac{L-l}{2} = \frac{28-20}{2} = \frac{8}{2} = 4\ cm \Rightarrow h = 4cm$

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

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

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

Similarly area of trapezium DCGH= 80 cm^2

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

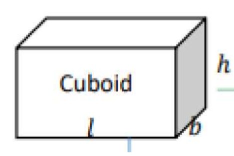
$$= 4 \times \frac{(28+20)}{2}$$

$$= 2 \times 48 = 96\ cm^2$$

Similarly area of trapezium ADHE= 96 cm^2

Solid Shapes

Cuboid :



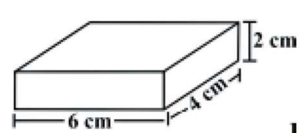
$Length = l\ ,Breadth = b,\ \ Height = h$

(i) **Lateral surface area(LSA)=**$2lh + 2bh = 2h(l+b)$

(ii) **Toatl surface area(TSA)=**$2(lb + bh + hl)$

TRY THESE

Find the total surface area of the following cuboids.



1

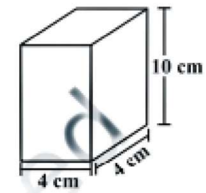
(i) $l = 6cm,\ \ b = 4cm,\ \ h = 2cm$

Toatl surface area (TSA) of cuboid$=2(lb+bh+hl)$

$=2(6\times4+4\times2+2\times6)$

$=2(24+8+12)$

$=2\times44=88\ cm^2$



(ii) $l=4cm,\ \ b=4cm,\ \ \ h=10cm$

Toatl surface area (TSA) of cuboid$=2(lb+bh+hl)$

$=2(4\times4+4\times10+10\times4)$

$=2(16+40+40)$

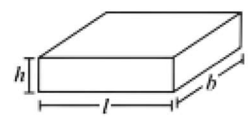
$=2\times96=88\ cm^2$

THINK, DISCUSS AND WRITE

1. Can we say that the total surface area of cuboid = lateral surface area + 2 × area of base?

Sol: Lateral surface area$=2lh+2bh=2h(l+b)$

Area of base$=lb$



lateral surface area + 2 × area of base

$=2lh+2bh+2\times lb$

$=2(lh+bh+lb)$

$=Total\ surface\ area\ of\ cuboid$

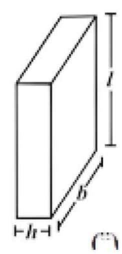
Yes, we can say that the total surface area of cuboid = lateral surface area + 2 × area of base.

2. If we interchange the lengths of the base and the height of a cuboid (Fig 11.33(i)) to get another cuboid (Fig 11.33(ii)), will its lateral surface area change?

Sol: LSA of cuboid (ii) $=2lb+2lh)=2l(b+h)$

But LSA of cuboid (i)$=2lh+2bh=2h(l+b)$

Hence the lateral surface area will change.

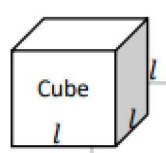


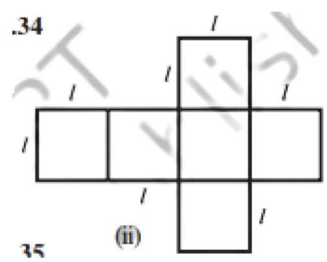
Cube,

Side of cube$=l$

(i) Larerl surface area of cube$=4l^2$

(ii) Total surface area of cube$=6l^2$





TRY THESE

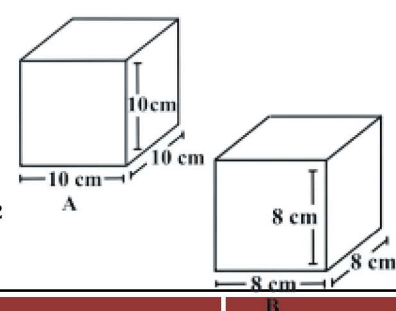
Find the surface area of cube A and lateral surface area of cube B .

Sol: For cube A : $l=10cm$

The surface area of cube A $=6l^2=6\times10^2=6\times100=600\ cm^2$

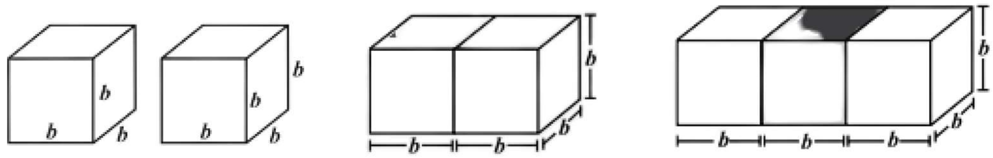
For cube B : $l=8\ cm$

The lateral surface area of cube B $=4l^2=4\times8^2=4\times64=256cm^2$



THINK, DISCUSS AND WRITE

(i) Two cubes each with side b are joined to form a cuboid (Fig 11.37). What is the surface area of this cuboid? Is it $12b^2$? Is the surface area of cuboid formed by joining three such cubes, $18b^2$? Why?



Sol: Cube has six faces normally when two equal cubes are placed together, two side faces are not visible.

We left with $12 - 2 = 10$ squared faces

$\therefore Surface\ area = 10b^2$

When three equal cubes are placed together, four side faces are not visible.

We left with $18 - 4 = 14$ squared faces

$\therefore Surface\ area = 14b^2$

(ii) How will you arrange 12 cubes of equal length to form a cuboid of smallest surface area?

Sol: Case 1: $12 = 12 \times 1 \times 1$

$Surface\ area = 2(lb + bh + hl)$

$= 2(12 \times 1 + 1 \times 1 + 1 \times 12)$

$= 2 \times 25 = 50\ square\ units$

Case 2: $12 = 6 \times 2 \times 1$

Surface area $= 2(6 \times 2 + 2 \times 1 + 1 \times 6)$

$= 2(12 + 2 + 6)$

$= 2 \times 20 = 40$ square units

Case 3: $12 = 4 \times 3 \times 1$

$Surface\ area = 2(4 \times 3 + 3 \times 1 + 1 \times 4)$

$= 2(12 + 3 + 4)$

$= 2 \times 19 = 38\ square\ units$

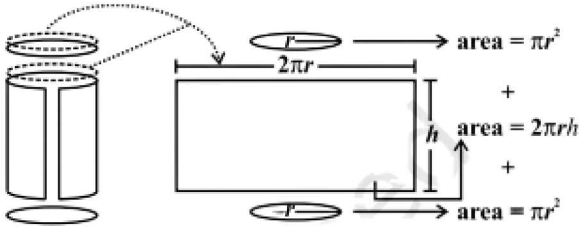
Case 4: $12 = 3 \times 2 \times 2$

Surface area $= 2(3 \times 2 + 2 \times 2 + 2 \times 3)$

$= 2(6 + 4 + 6)$

$= 2 \times 16 = 32$ square units

Cylinders



The lateral (or curved) surface area of a cylinder $= 2\pi rh$

The total surface area of a cylinder $= \pi r^2 + 2\pi rh + \pi r^2$

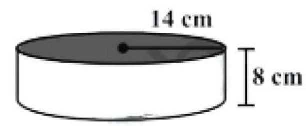
$$= 2\pi r^2 + 2\pi rh$$

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

TRY THESE

Find total surface area of the following cylinders

1) $\boldsymbol{r = 14\ cm, h = 8cm}$



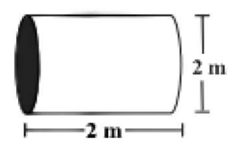
Total surface area of the cylinder$=2\pi r\,(r + h)$

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

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

$$= 2 \times 22 \times 2 \times 22 = 1936\ cm^2$$

2) $\boldsymbol{d = 2m \Rightarrow r = \frac{2}{2} = 1\ cm, h = 2cm}$



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

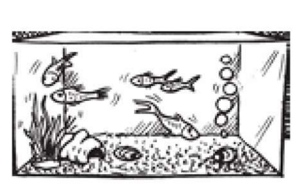
$$= 2 \times \frac{22}{7} \times 1 \times (1 + 2)\ cm^2$$

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

$$= \frac{132}{7} = 18.9\ cm^2$$

Example 4: An aquarium is in the form of a cuboid whose external measures are 80 cm × 30 cm × 40 cm. The base, side faces and back face are to be covered with a coloured paper. Find the area of the paper needed?

Sol: The length of the aquarium = l = 80 cm



Width of the aquarium = b = 30 cm

Height of the aquarium = h = 40 cm

Area of the base = l × b = 80 × 30 = 2400 cm^2

Area of the side face = b × h = 30 × 40 = 1200 cm^2

Area of the back face = l × h = 80 × 40 = 3200 cm^2

Required area = Area of the base + area of the back face + (2 × area of a side face)

= 2400 + 3200 + (2 × 1200) = 8000 cm^2

Hence the area of the coloured paper required is 8000 cm².

Example 5: The internal measures of a cuboidal room are 12 m × 8 m × 4 m. Find the total cost of whitewashing all four walls of a room, if the cost of white washing is ₹ 5 per m2 . What will be the cost of white washing if the ceiling of the room is also whitewashed.

Sol: $l = 12\ m, b = 8\ m, h = 4\ m$

Area of the four walls of the room (LSA)=$2h(l + b)$

$= 2 \times 4 \times (12 + 8)$

$= 8 \times 20$

$= 160\ m^2$

Cost of white washing per m^2 = ₹ 5

The total cost of white washing four walls of the room = ₹ (160 × 5) = ₹ 800

Area of ceiling= $l \times b = 12 \times 8 = 96\ m^2$

Cost of white washing the ceiling = ₹ (96 × 5) = ₹ 480

So the total cost of white washing = ₹ (800 + 480) = ₹ 1280

Example 6: 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 m^2 .

Sol : Radius of cylindrical pillar, r = 28 cm = 0.28 m

Height, h = 4 m

curved surface area of a cylinder $= 2\pi rh$

Curved surface area of a pillar $= 2 \times \frac{22}{\not{7}} \times \not{0.28}^{0.04} \times 4$

$= 2 \times 22 \times 0.04 \times 4$

$= 7.04\ m^2$

Curved surface area of 24 such pillar = 7.04 × 24

= 168.96 m^2

Cost of painting an area of 1 m^2 = ₹ 8

Therefore, cost of painting 1689.6 m^2 = 168.96 × 8

= ₹ 1351.68

Ex 7: Find the height of a cylinder whose radius is 7 cm and the total surface area is 968 cm^2.

Sol: Let height of the cylinder = h, radius = r = 7cm

Total surface area $= 968\ cm^2$

$2\pi r\ (h + r) = 968$

$2 \times \frac{22}{\not{7}} \times \not{7} \times (h + 7) = 968$

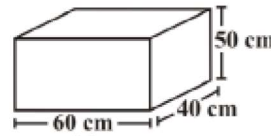
$h + 7 = \frac{968}{2 \times 22} = \frac{484}{22} = 22$

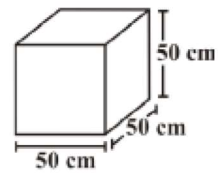
$h = 22 - 7 = 15\ cm$

Hence, the height of the cylinder is 15 cm.

EXERCISE 9.2

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





Sol: (a) $\boldsymbol{l = 60\ cm, b = 40\ cm, h = 50\ cm}$.

TSA of box$(a) = 2(lb + bh + lh)$

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

$= 2(2400 + 2000 + 3000)$

$= 2 \times 7400$

$= 14800\ cm^2$

(b) $\boldsymbol{l = 50\ cm, b = 50\ cm, h = 50\ cm}$.

TSA of box$(b) = 6a^2$

$= 6 \times 50^2$

$= 6 \times 2500$

$= 15000\ cm^2$

TSA of box$(a)$is lesser than The TSA of box(b)

So, box $(\boldsymbol{a})$requires the lesser amount of material to make .

2. 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: $l = 80\ cm, b = 48\ cm, h = 24\ cm.$

$Total\ surface\ area\ of\ suitcase = 2(lb + bh + lh)$

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

$= 2(3840 + 1152 + 1920)$

$= 2 \times 6912$

$= 13824\ cm^2$

Tarpaulin required for 1 suitcase=13824 cm^2

Area of Tarpaulin required for 100 suitcase=100 × 13824 cm^2

$= 1382400\ \ cm^2$

Width of given tarpaulin=96 cm.

$$\text{Length of required tarpaulin} = \frac{\text{Area of tarpaulin required}}{\text{width of tarpaulin}}$$

$$= \frac{1382400\ \ cm^2}{96\ cm}$$

$= 14400\ cm$

$$= 144 \times 100\ cm = 144\ m$$

3. Find the side of a cube whose surface area is 600 cm.

Sol: surface area of cube= 600 cm

$6l^2 = 600$

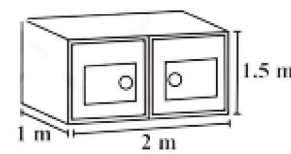
$l^2 = \frac{600}{6} = 100$

$l = \sqrt{100} = 10$

$\therefore side\ of\ cube = 10\ cm.$

4. 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: $l = 1\ m, b = 2\ m, h = 1.5\ m$



Total surface area of cabinet $= 2(lb + bh + lh)$

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

$= 2(2 + 3 + 1.5)$

$= 2 \times 6.5$

$= 13\ m^2$

The bottom area of the cabinet $= l \times b = 1 \times 2 = 2\ m^2$

Painted area = Total surface area of cabinet − The bottom area of the cabinet

$= 13 - 2 = 11m^2$

5. 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: $l = 15\ m, b = 10\ m, h = 7\ m$

Total surface area of hall $= 2(lb + bh + lh)$

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

$= 2(150 + 70 + 105)$

$= 2 \times 325$

$= 650\ m^2.$

The bottom area of hall $= l \times b$

$= 15 \times 10$

$= 150\ m^2$

Painted area = Total surface area of hall − The bottom area of hall

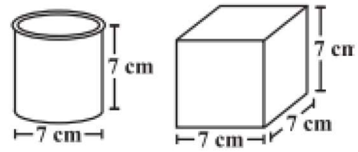
$= 650 - 150$

$= 500\ m^2.$

Area painted by 1 can $= 100\ m^2.$

$$\text{Number of cans required} = \frac{\text{Painted area}}{\text{Area painted by 1 can}} = \frac{500}{100} = 5$$

6. 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 are like prisms with same height 7 cm.

First figure is cylinder it has curved surface area.

Second figure is cube it has only plan surfaces.

Cylinder:

Diameter=d=7 cm

$Radius = r = \frac{7}{2}\ cm$

Height=h=7 cm.

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

$= 2 \times \frac{22}{7} \times \frac{7}{2} \times 7 = 22 \times 7 = 154\ cm^2$

Cube:

Side of cube $= l = 7\ cm$

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

So, cube has larger surface area.

7. 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: Radius of cylinder=r=7 m

Height of cylinder=h=3 m.

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

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

$= 44 \times 10$

$= 440\ m^2$

Required sheet of metal=440 m^2

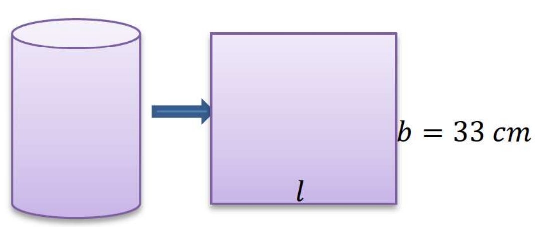
8. The lateral surface area of a hollow cylinder is 4224 cm^2. It is cut along its height and formed a rectangular sheet of width 33 cm. Find the perimeter of rectangular sheet?

Sol: Area of rectangular sheet=curved surface area of cylinder

$l \times b = 4224$

$l \times 33 = 4224$

$l = \frac{4224}{33} = 128\ cm$



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

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

9. 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: Diameter of a road roller = 84 cm

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

Length $= h = 1\ m = 100\ cm$

Curved surface area of roller $= 2\pi rh.$

$= 2 \times \frac{22}{7} \times 42^{6} \times 100$

$= 44 \times 600$

$= 26400\ cm^2$

The area of road covered in 750 complete revolutions

$= 750 \times$ Curved surface area of roller

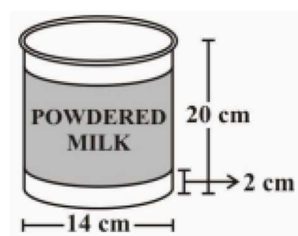
$= 750 \times 26400$

$= 19800000\ cm^2$

$= 1980 \times 10000\ cm^2$

$= 1980\ m^2$

10. 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: Label is in cylinder shape

Diameter=d=14 cm

$Radius = r = \frac{14}{2} = 7\ cm$

$Height = h = 20 - 2 \times 2 = 20 - 4 = 16\ cm.$

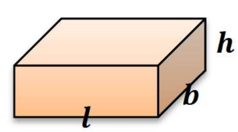
Area of label=CSA of cylinder

$= 2\pi rh$

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

$= 44 \times 16$

$= 704\ cm^2$

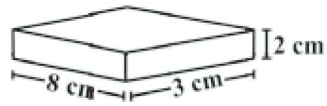


Volume of cuboid:

$\boldsymbol{Volume\ of\ cuboid =}$ **area of the base × height** $= (l \times b) \times h = lbh$

TRY THESE

(i) Volume of cuboid $= lbh$



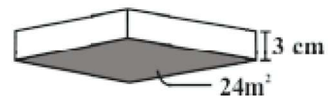
$= 8\ cm \times 3 cm \times 2\ cm$

$= 48\ cm^3$

Volume of cuboid = area of the base × height

$= 24\ m^2 \times 3\ cm$

$= 24\ m^2 \times \frac{3}{100}\ m$



$= \frac{24 \times 3}{100}\ m^3$

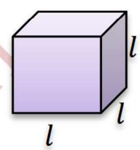
$= \frac{92}{100}\ m^3$

$= 0.92\ m^3$

Volume of cube:

***Volume of cube* = area of the base × height**

$= (l \times l) \times l = l^2 \times l = l^3$



TRY THESE

Find the volume of the following cubes.

(a) **With a side 4 cm.**

Sol: side (l)=4 cm

Volume of cube = $l^3 = l \times l \times l$

$= 4 \times 4 \times 4$

$= 64\ cm^3$

(b) **With a side 1.5 m**

Sol: side (l)=1.5 m

Volume of cube = $l^3 = l \times l \times l$

$= 1.5 \times 1.5 \times 1.5$

$= 3.375\ m^3$

DO THIS

Arrange 64 cubes of equal size in as many ways as you can to form a cuboid. Find the surface area of each arrangement. Can solid shapes of same volume have same surface area?

Arrangement	$Volume = l \times b \times h$	$Surface\ area = 2(lb + bh + lh)$
$1 \times 1 \times 64$	64	$2(1 \times 1 + 1 \times 64 + 1 \times 64) = 2(1 + 64 + 64) = 258$
$1 \times 2 \times 32$	64	$2(1 \times 2 + 2 \times 32 + 1 \times 32) = 2(2 + 64 + 32) = 196$
$1 \times 4 \times 16$	64	$2(1 \times 4 + 4 \times 16 + 1 \times 16) = 2(4 + 64 + 16) = 168$
$1 \times 8 \times 8$	64	$2(1 \times 1 + 1 \times 64 + 1 \times 64) = 2(1 + 64 + 64) = 258$
$2 \times 2 \times 16$	64	$2(2 \times 2 + 2 \times 16 + 2 \times 16) = 2(4 + 32 + 32) = 136$

$2 \times 4 \times 8$	64	$2(2 \times 4 + 4 \times 8 + 2 \times 8) = 2(8 + 32 + 16) = 112$
$4 \times 4 \times 4$	64	$2(4 \times 4 + 4 \times 4 + 4 \times 4) = 2(16 + 16 + 16) = 96$

Here volume is same but surface area is different.

From above , we conclude that solid shapes of same volume does not have same surface area.

THINK, DISCUSS AND WRITE

A company sells biscuits. For packing purpose they are using cuboidal boxes: box A →3 cm × 8 cm × 20 cm, box B → 4 cm × 12 cm × 10 cm. What size of the box will be economical for the company? Why? Can you suggest any other size (dimensions) which has the same volume but is more economical than these?

Sol: Box A:

$l = 3\ cm\ , b = 8\ cm, h = 20\ cm$

Total surface area of box A $= 2(lb + bh + lh)$

$= 2(3 \times 8 + 8 \times 20 + 3 \times 20)$

$= 2(24 + 160 + 60)$

$= 2 \times 244$

$= 488\ cm^2$

Box B:

$l = 4\ cm\ , b = 12cm, h = 10\ cm$

Total surface area of box A $= 2(lb + bh + lh)$

$= 2(4 \times 12 + 12 \times 10 + 4 \times 10)$

$= 2(48 + 120 + 40)$

$= 2 \times 208$

$= 416\ cm^2$

Box B will be economical for the company.

Suggested Box:

$l = 6\ cm\ , b = 8\ cm, h = 10\ cm$

Total surface area of box A $= 2(lb + bh + lh)$

$= 2(6 \times 8 + 8 \times 10 + 6 \times 10)$

$= 2(48 + 80 + 60)$

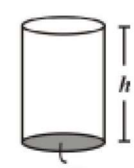
$= 2 \times 188$

$= 376\ cm^2$

Cylinder

Volume of cylinder = area of base × height

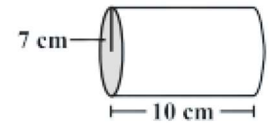
$$= \pi r^2 \times h = \pi r^2 h$$



TRY THESE

Find the volume of the following cylinders.

(i) Radius$(r) = 7\ cm.$



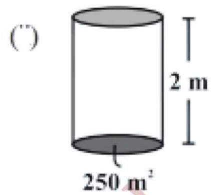
Height $(h) = 10\ cm.$

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

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

$$= 440\ cm^3$$

(ii) Height $(h) = 2\ m.$



Area of base $(A) = 250\ m^2$

Volume of cylinder = Area of base × height

$$= 250\ m^2 \times 2\ m$$

$$= 500\ m^3$$

Volume and Capacity

(a) Volume refers to the amount of space occupied by an object.

(b) Capacity refers to the quantity that a container holds.

$1\text{mL} = 1\ cm^3$

$1\ \text{L} = 1000\ cm^3$

$1m^3 = 1000000\ cm^3 = 1000\text{L}$

Ex 8: **Find the height of a cuboid whose volume is 275 cm³ and ba**

Sol: Volume of a cuboid = 275 cm³

Base area × Height=275 cm³

$25 \times \text{Height} = 275$

$\text{Height} = \frac{275}{25} = 11\ cm$

Height of the cuboid is 11 cm.

Ex 9: **A godown is in the form of a cuboid of measures 60 m × 40 m × 30 m. How many cuboidal boxes can be stored in it if the volume of one box is 0.8 m³ ?**

Sol: $Volume\ of\ one\ box\ = 0.8 = \frac{8}{10}\ m^3$

$Volume\ of\ godown = 60 \times 40 \times 30\ m^3$

$$\text{Required number of boxes} = \frac{\text{Volume of godown}}{\text{Volume of one box}}$$

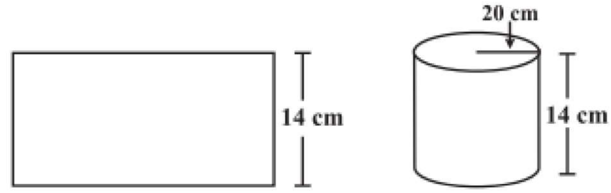
$$= \frac{60 \times 40 \times 30}{\frac{8}{10}}$$

$$= \frac{60 \times \cancel{40}^5 \times 30 \times 10}{\cancel{8}}$$

$$= 60 \times 5 \times 30 \times 10$$

$$= 90{,}000$$

Ex 10: A rectangular paper of width 14 cm is rolled along its width and a cylinder of radius 20 cm is formed. Find the volume of the cylinder (Take $\pi=\frac{22}{7}$)



Sol: $\text{Height}(h) = 14\ cm$

$\text{Radius}(r) = 20\ cm$

$\text{Volume of cylinder} = \pi r^2 h$

$$= \frac{22}{\cancel{7}} \times 20 \times 20 \times \cancel{14}^{2}$$

$$= 22 \times 20 \times 20 \times 2$$

$$= 17600\ cm^3$$

Ex11: A rectangular piece of paper 11 cm × 4 cm is folded without overlapping to make a cylinder of height 4 cm. Find the volume of the cylinder.

Sol: Let radius of the cylinder $= r$ and height $= h = 4\ cm$

Perimeter of the base of the cylinder=Length of paper

$$2\pi r = 11$$

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

$$r = \frac{11 \times 7}{2 \times 22} = \frac{7}{4}\ cm$$

$\text{Volume of cylinder} = \pi r^2 h$

$$= \frac{22}{\cancel{7}} \times \frac{\cancel{7}}{4} \times \frac{7}{4} \times 4$$

$$= \frac{\cancel{22}^{11} \times 7}{\cancel{4}_{2}}$$

$$= \frac{77}{2}$$

$$= 38.5\ cm^3$$

EXERCISE 9.3

1. **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.**

Sol: Volume

(b) **Number of cement bags required to plaster it.**

Sol: Surface area.

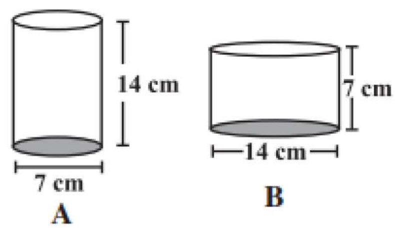
(c) **To find the number of smaller tanks that can be filled with water from it.**

Sol: Volume.

2. **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?

Sol: The diameter of cylinder B is double to cylinder A. So, The cylinder B volume is greater.



Cylinder A:

$\text{Diamter(d)} = 7\text{cm}; \text{Radius}(r) = \frac{7}{2}\ cm.$

$\text{Height(h)} = 14\ cm.$

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

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

$= 539\ cm^3$

Surface area(TSA)$of\ A = 2\pi r(h + r)$

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

$= 22 \times \frac{35}{2}$

$= 11 \times 35$

$= 385\ cm^2$

Cylinder B:

$\text{Diamter(d)} = 14\text{cm}; \text{Radius(r)} = \frac{14}{2} = 7\ cm.$

$\text{Height}(h) = 7\ cm.$

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

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

$= 1078\ cm^3$

Surface area$(TSA) of\ B = 2\pi r(h + r)$

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

$= 44 \times 14$

$= 616\ cm^2$

From above cylinder B has greater volume and also greater surface area.

Conclusion: The cylinder with greater volume has also greater surface area.

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

Sol: Base area of cuboid (A)=180 cm^2

Volume of cuboid=900 cm^3

Base area ×Height=900 cm^3

180×h=900

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

∴ Height of cuboid=5 cm.

4. 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 cuboid= 60 cm × 54 cm × 30 cm=60×54×30 cm^3

Volume of cube=6 cm×6 cm×6 cm=6×6×6 cm^3

$$\text{No. of cubes that can be placed in cuboid} = \frac{\text{Volume of cuboid}}{\text{Volume of cube}}$$

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

$$= 10 \times 9 \times 5 = 450$$

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

Sol: Diameter of the base of cylinder (d)= 140 cm

$\text{Radius}(r) = \frac{d}{2} = \frac{140}{2} = 70\ cm = \frac{70}{100} m = \frac{7}{10}\ m.$

Volume of cylinder=1.54 m^3

$\pi r^2 h = 1.54$

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

$h = \frac{154 \times 10 \times 10}{100 \times 22 \times 7} = \frac{154}{154} = 1m$

∴ The height of the cylinder=1 m.

6. 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?

$1\ m^3 = 1000\ L$

Sol: Milk tank (Cylinder)radius $= 1.5\ m = \frac{15}{10} = \frac{3}{2}\ m$

Length (h)=7 m.

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

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

$$= \frac{11 \times 9}{2}$$

$$= \frac{99}{2}$$

$$= 49.5\ m^3$$

The quantity of milk in litres that can be stored in the tank=49.5 × 1000 L = 48500 L

7. 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 side of cube=l

Surface area=$6\,l^2,\ Volume = l^3$

If each edge of cube is doubled then side=$2l$

Surface area of new cube $=6\,(2l)^2$

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

$$= 24l^2$$

$$= 4 \times (6\,l^2)$$

$\therefore$ Surface area of cube increased 4 times

Volume of new cube $= (2l)^3 = 8 \times l^3$

$\therefore$ Volume of cube increased 8 times.

8. 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 cuboidal reservoir=108 m^3 =108×1000 L=108000 L

Rate of pouring the water per 1minute= 60 litres.

Number of minutes take to fill the reservoir $= \frac{\text{Volume of reservoir}}{\text{60 L}}$

$$= \frac{108000}{60} = 1800\ minutes$$

It will take 1800 minutes = 30 hours to fill the reservoir.