CHAPTER 19

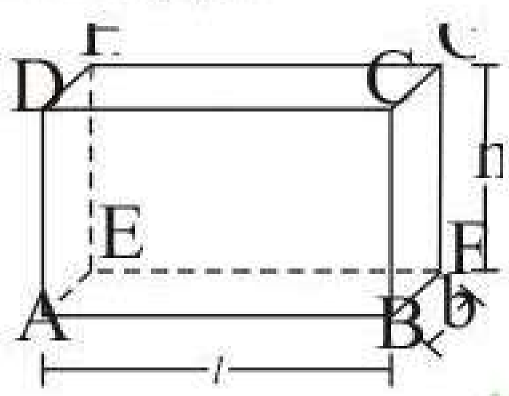
# VOLUME AND SURFACE AREA

## SOLID

A solid body has three dimensions namely length, breadth (or width) and height (or thickness). The surfaces that bind it are called faces and the lines where faces meet are called edges.
The area of the surface that binds the solid is called its surface area.
The size of a solid body is measured in terms of its volume.
The amount of space that any solid body occupies is called its volume.
Surface areas are measured in square units and volumes are measured in cubic units.

### Cuboid

A cuboid is like a three dimensional box. It is defined by its length ($l$), breadth ($b$) and height ($h$). It has six rectangular faces. It is also called rectangular parallelopiped.

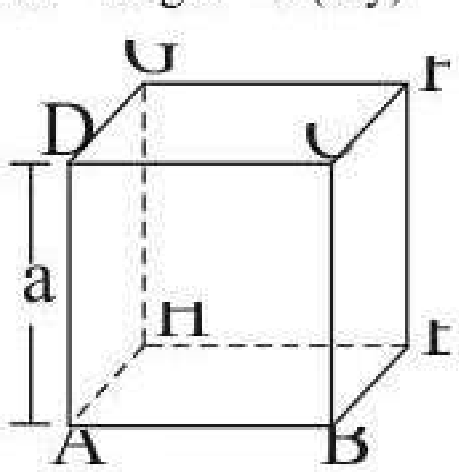



- Total surface area of a cuboid = $2(lb + bh + hl)$
- Lateral surface area (i.e., total area excluding area of the base and top) = $2h(l + b)$
- Length of a diagonal of a cuboid = $\sqrt{l^2 + b^2 + h^2}$

  Volume of a cuboid = Space occupied by cuboid
  = Area of base × height
  = $(l \times b) \times h = lbh$

### Cube

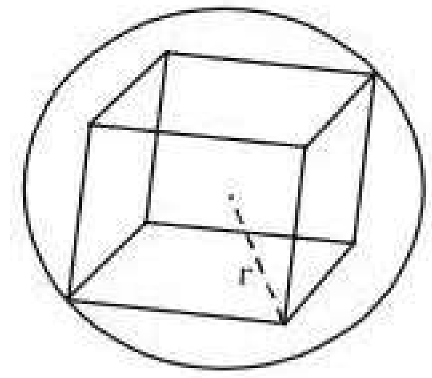
A cube is a cuboid whose all edges are equal i.e.,
length=breadth = height = $a$ (say)




- Area of each face of the cube is $a^2$ square units.
- Total surface area of the cuboid = Area of 6 square faces of the cube
  $= 6 \times a^2 = 6a^2$
- Lateral surface area of cube i.e., total surface area excluding top and bottom faces = $4a^2$
- Length of diagonal ($d$) of the cube
  $= \sqrt{a^2 + a^2 + a^2}$
  $= \sqrt{3a^2} = \sqrt{3}a$
- Volume of the cube ($V$) = Base area × Height
  $= a^2 \times a = a^3$

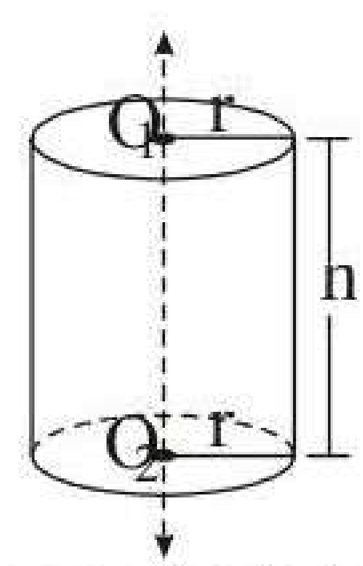
**Remember**

✧ If a cube of the maximum volume is inscribed in a sphere of radius '$r$', then the edge of the cube = $\frac{2r}{\sqrt{3}}$




### Cylinder

A cylinder with circular ends each of radius $r$ and height $h$ is shown.



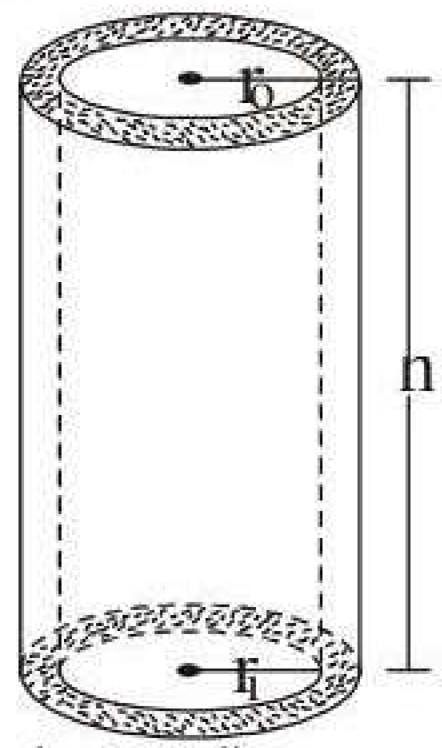

- Curved surface area of a cylinder
  = Circumference of base × height
  $= 2\pi r \times h = 2\pi rh$
- If cylinder is closed at both the ends then total surface area of the cylinder
  = Curved surface area + Area of circular ends
  $= 2\pi rh + 2 \times \pi r^2 = 2\pi r(h + r)$
- Volume of the cylinder ($V$) = Base area × Height
  $= \pi r^2 \times h = \pi r^2 h$

## Remember

✧ A cylinder can be generated by rotating a rectangle by fixing one of its sides.
✧ The curved surface of a cylinder is also called lateral surface.

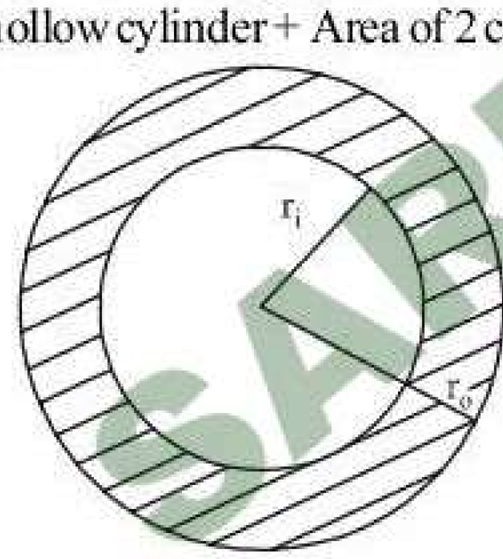
## Hollow Cylinder

A hollow cylinder is like a pipe.




Inner radius $= r_i$ and outer radius $= r_o$
Hence $r_o - r_i$ = thickness of material of the cylinder.
Length or height of the cylinder $= h$,

- Curved surface area (C.S.A) of the hollow cylinder
  = Outer curved surface area of the cylinder
  + Inner curved surface area of the cylinder
  $= 2\pi r_o h + 2\pi r_i h = 2\pi h(r_o + r_i)$
- Total surface area of hollow cylinder
  = C.S.A. of hollow cylinder + Area of 2 circular end rings.




(one end of the pipe)

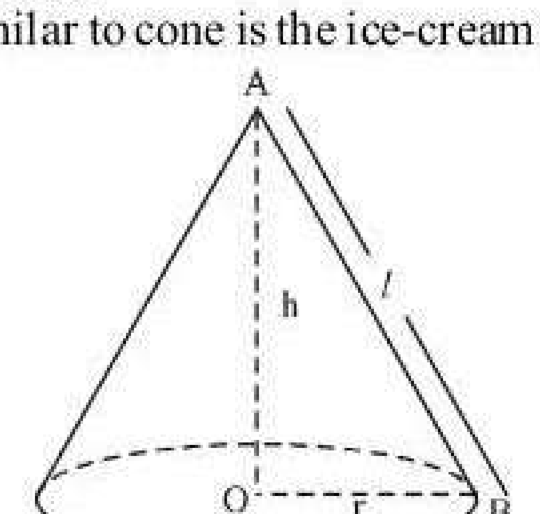
$= 2\pi h(r_o + r_i) + 2\pi(r_o^2 - r_i^2) = 2\pi(r_o + r_i)(h + r_o + r_i)$

- Volume of hollow cylinder = Volume of the material used in making the cylinder
  $= \pi(r_o^2 - r_i^2)\, h$

## Cone

Its dimensions are defined by the radius of the base ($r$), the height ($h$) and slant height ($l$).

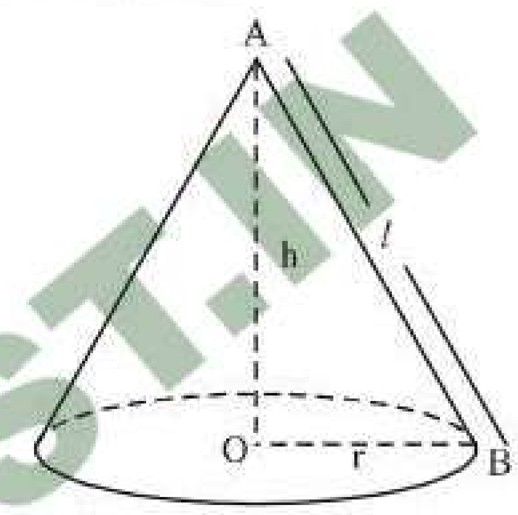
A structure similar to cone is the ice-cream cone.



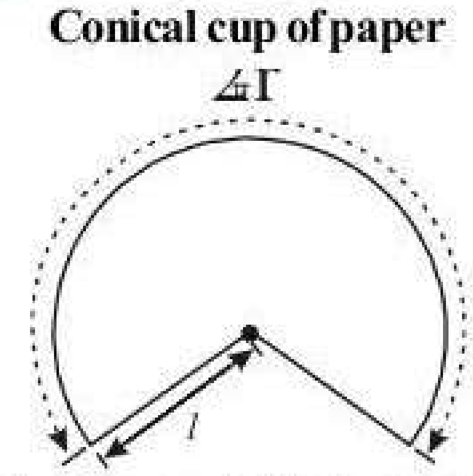

- Height ($AO$) of cone is always perpendicular to base radius ($OB$) of the cone.
- Slant height $(l) = \sqrt{h^2 + r^2}$
- Volume of cone $= \frac{1}{3} \times$ base area $\times$ height $= \frac{1}{3} \times \pi r^2 \times h$
- Curved surface area (C.S.A.) $= \pi rl$
- Total surface area (T.S.A.) = C.S.A. + Base area
  $= \pi rl + \pi r^2 = \pi r(l + r)$

## Remember

✧ When a conical cup of paper (hollow cylinder) is unrolled, it forms a sector of a circle




**Conical cup of paper**




**Unrolled conical cup, which is a sector of a circle.**

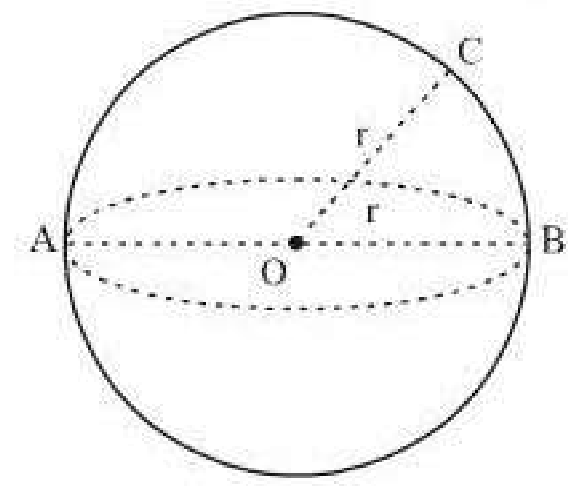
Radius of this sector is equal to slant height of the cone.

✧ Length of curved edge of this sector is equal to the circumference of the base of the cone.

## Sphere

A sphere is formed by revolving a semi-circle about its diameter. It has one curved surface which is such that all points on it are equidistant from a fixed point within it, called the centre.

- Length of a line segment joining the centre to any point of the curved surface is called the radius ($r$) of the sphere.

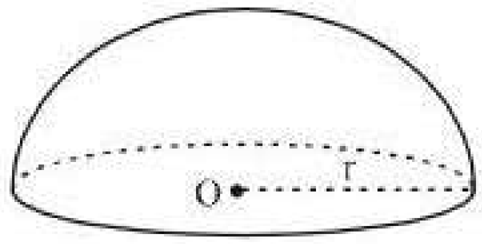



- Any line segment passing through the centre and joining two points on the curved surface is called the diameter ($d$) of the sphere.
  Centre $= O$
  Radius $= OC = OA = OB = r$,
  Diameter $= AB$
  $= d = 2r$

- Surface area of a sphere = $4\pi r^2$
- Volume of a sphere (V) $= \frac{4}{3}\pi r^3$

## Hemisphere

A plane through the centre of the sphere cuts the sphere into two equal parts. Each part is called a hemisphere.



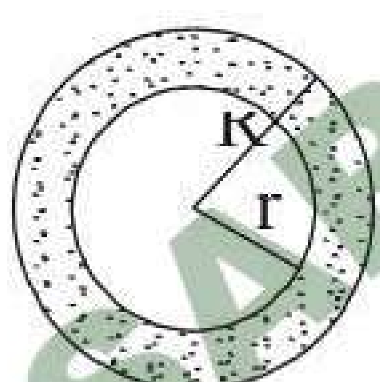

- Volume of a hemisphere = $\frac{2}{3}\pi r^3$
- Curved surface area (C.S.A.) of a hemisphere = $2\pi r^2$
- Total surface area (T.S.A.) of a hemisphere
  = C.S.A. + Base area
  = $2\pi r^2 + \pi r^2 = 3\pi r^2$

### Remember

✧ If a sphere is inscribed in a cylinder then the volume of the sphere is $\frac{2}{3}$rd of the volume of the cylinder.

## Hollow Sphere or Spherical Shell

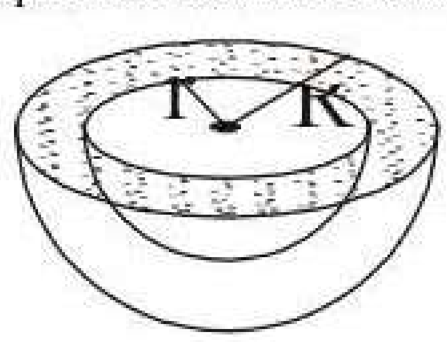
A rubber ball is an example of hollow sphere. If outer and inner radii are $R$ and $r$, then thickness of rubber or material used in hollow sphere = $R - r$.




- Volume of the rubber or material used in hollow sphere
  = External volume – Internal volume
  $= \frac{4}{3}\pi R^3 - \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(R^3 - r^3)$
- External surface area = $4\pi R^2$.

## Hemispherical Bowl

When a spherical shell is cut off in two equal parts, then each part is called a hemispherical bowl as shown in the figure.




- If $R$ and $r$ are external and internal radii of the hemisphere respectively, then
- Volume of the material used in the hemispherical bowl
  = External volume – Internal volume
  $= \frac{2}{3}\pi R^3 - \frac{2}{3}\pi r^3 = \frac{2}{3}\pi(R^3 - r^3)$
- External curved surface area $= 2\pi R^2$
- Internal surface area = $2\pi r^2$
- Area of the cross-sectional ring = $\pi R^2 - \pi r^2 = \pi(R^2 - r^2)$
- Total surface area
  = (External curved surface area) + (Internal curved surface area) + (Area of cross-sectional ring)
  $= 2\pi R^2 + 2\pi r^2 + \pi(R^2 - r^2)$
  $= \pi(3R^2 + r^2)$

**Example 1: If the radius of a sphere is increased by 2 cm, then its surface area increases by 352 cm². The radius of the sphere before the increase was:**

***Solution:***

$4\pi(r+2)^2 - 4\pi r^2 = 352$

$\Rightarrow (r+2)^2 - r^2 = \left(352 \times \frac{7}{22} \times \frac{1}{4}\right) = 28.$

$\Rightarrow (r+2+r)(r+2-r) = 28$

$\Rightarrow 2r + 2 = \frac{28}{2} \Rightarrow 2r + 2 = 14 \Rightarrow r = 6$ cm

**Example 2: A cylindrical bucket of height 36 cm and radius 21 cm is filled with sand. The bucket is emptied on the ground and a conical heap of sand is formed, the height of the heap being 12 cm. The radius of the heap at the base is :**

***Solution:***

Volume of the bucket = volume of the sand emptied

Volume of sand = $\pi(21)^2 \times 36$

Let $r$ be the radius of the conical heap.

Then, $\frac{1}{3}\pi r^2 \times 12 = \pi(21)^2 \times 36$

or $r^2 = (21)^2 \times 9$ or $r = 21 \times 3 = 63$ cm

**Example 3: The length of the longest rod that can be placed in a room which is 12 m long, 9 m broad and 8 m high is**

***Solution:***

Required length = length of the diagonal

$= \sqrt{12^2 + 9^2 + 8^2} = \sqrt{144 + 81 + 64} = \sqrt{289} = 17$ m

**Example 4: The internal measurements of a box with lid are 115 × 75 × 35 cm³ and the wood of which it is made is 2.5 cm thick. Find the volume of wood.**

***Solution:***

Internal volume = $115 \times 75 \times 35 = 3{,}01{,}875$ cm³

External volume = $(115 + 2 \times 2.5) \times (75 + 2 \times 2.5) \times (35 + 2 \times 2.5)$

$= 120 \times 80 \times 40 = 3{,}84{,}000$ cm³

$\therefore$ Volume of wood = External volume – Internal volume

$= 3{,}84{,}000 - 3{,}01{,}875 = 82{,}125$ cm³

**Example 5: A rectangular tank is 225 m by 162 m at the base. With what speed must water flow into it through an aperture 60 cm by 45 cm that the level may be raised 20 cm in 5 hours ?**

***Solution:***

Required speed of flow of water

$$= \frac{225 \times 162 \times 20}{5 \times 100} = \frac{60}{100} \times \frac{45}{100} \times h$$

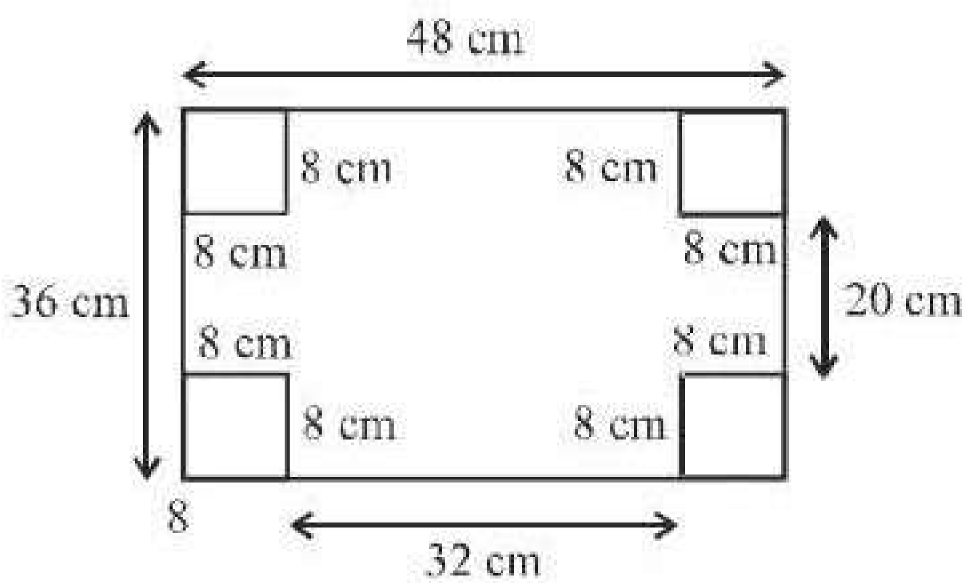
$\therefore \quad h = 5400$

**Example 6: A metallic sheets is of rectangular shape with dimensions 48 cm × 36 cm. From each one of its corners, a square of 8 cm is cut off. An open box is made of the remaining sheet. Find the volume of the box**

***Solution:***

Volume of the box made of the remaining sheet

$= 32 \times 20 \times 8 = 5120\,cm^3$




**Example 7: The capacity of a cylindrical tank is 246.4 litres. If the height is 4 metres, what is the diameter of the base?**

***Solution:***

Volume of the tank = 246.4 litres = 246400 $cm^3$.

Let the radius of the base be $r$ cm. Then,

$$\left(\frac{22}{7} \times r^2 \times 400\right) = 246400$$

$$\Rightarrow r^2 = \left(\frac{246400 \times 7}{22 \times 400}\right) = 196 \Rightarrow r = 14.$$

$\therefore$ Diameter of the base = $2r$ = 28 cm = .28 m

**Example 8: A cone, a hemisphere and a cylinder stand on equal bases and have the same height. What is the ratio of their volumes?**

***Solution:***

As they stand on the same base so their radius is also same.

Then; volume of cone = $\frac{\pi r^2 h}{3}$

Volume of hemisphere = $\frac{2\pi r^2}{3}$

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

Ratio = $\frac{\pi r^2 h}{3} : \frac{2\pi r^3}{3} : \pi r^2 h$

$\Rightarrow \quad \frac{h}{3} : \frac{2r}{3} : h$

$\Rightarrow \quad h : 2r : 3h$

Radius of a hemisphere = Its height

So $h : 2h : 3h \Rightarrow 1 : 2 : 3$

**Example 9: The sum of length, breadth and height of a room is 19 m. The length of the diagonal is 11 m. Find the cost of painting the total surface area of the room at the rate of ₹ 10 per m².:**

***Solution :***

Let length, breadth and height of the room be $\ell$, b and h, respectively. Then,

$\ell + b + h = 19$ ...(i)

and $\sqrt{\ell^2 + b^2 + h^2} = 11$

$\Rightarrow \ell^2 + b^2 + h^2 = 121$ ...(ii)

Area of the surface to be painted

$= 2(\ell b + bh + h\ell)$

$(\ell + b + h)^2 = \ell^2 + b^2 + h^2 + 2(\ell b + bh + h\ell)$

$\Rightarrow 2(\ell b + bh + h\ell) = (19)^2 - 121 = 361 - 121 = 240$

Surface area of the room = 240 $m^2$.

Cost of painting the required area = 10 × 240 = ₹ 2400

**Example 10 : A road roller of diameter 1.75 m and length 1 m has to press a ground of area 1100 sqm. How many revolutions does it make ?**

***Solution :***

Area covered in one revolution = curved surface area

$\therefore$ Number of revolutions = $\frac{\text{Total area to be pressed}}{\text{Curved surface area}}$

$$= \frac{1100}{2\pi rh} = \frac{1100}{2 \times \frac{22}{7} \times \frac{1.75}{2} \times 1} = 200$$

**Example 11 : The annual rainfall at a place is 43 cm. Find the weight in metric tonnes of the annual rain falling there on a hectare of land, taking the weight of water to be 1 metric tonne to the cubic metre.**

***Solution :***

Area of land = 10000 sqm

Volume of rainfall $= \frac{10000 \times 43}{100} = 4300\,m^3$

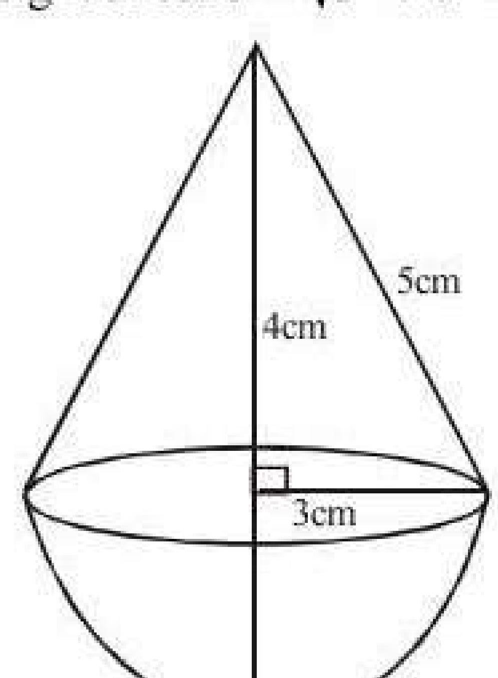
Weight of water = 4300 × 1 m tonnes = 4300 m tonnes

**Example 12 : A toy is in the form of a cone mounted on a hemisphere with the same radius. The diameter of the base of the conical portion is 6 cm and its height is 4 cm. Determine the surface area of the toy. (Use π = 3.14).**

***Solution :***

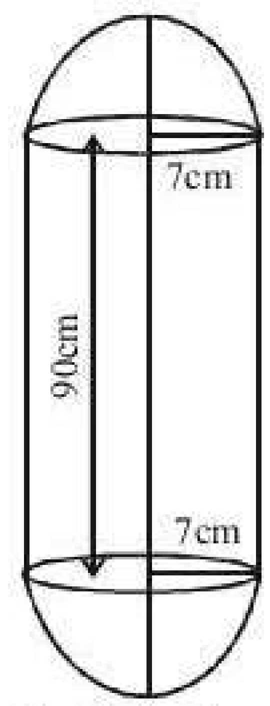
The radius of the hemisphere $= \frac{1}{2} \times 6 = 3$ cm

Now, slant height of cone $= \sqrt{3^2 + 4^2} = 5$ cm



The surface area of the toy
= Curved surface of the conical portion
+ Curved surface of the hemisphere
$= (\pi \times 3 \times 5 + 2\pi \times 3^2)\ \text{cm}^2$
$= 3.14 \times 3\ (5 + 6)\ \text{cm}^2 = 103.62\ \text{cm}^2.$

**Example** ***13:*** **A solid is composed of a cylinder with hemispherical ends. If the whole length of the solid is 104 cm and the radius of each of the hemispherical ends is 7 cm, find the cost of polishing its surface at the rate of Re. 1 per dm$^2$.**
***Solution :***




Let the height of the cylinder be h cm.
Then $h + 7 + 7 = 104$
$\Rightarrow h = 90$
Surface area of the solid
= 2 × curved surface area of hemisphere
+ curved surface area of the cylinder

$$= \left(2 \times 2 \times \frac{22}{7} \times 7 \times 7 + 2 \times \frac{22}{7} \times 7 \times 90\right) \text{cm}^2$$

$= 616 + 3960\ \text{cm}^2 = 4576\ \text{cm}^2$
Cost of polishing the surface of the solid

$$= ₹\ \frac{4576 \times 1}{100} = ₹\ 45.76$$

**Example** ***14 :*** **A regular hexagonal prism has perimeter of its base as 600 cm and height equal to 200 cm. How many litres of petrol can it hold ? Find the weight of petrol if density is 0.8 gm/cc.**
***Solution :***

$$\text{Side of hexagon} = \frac{\text{Perimeter}}{\text{Number of sides}} = \frac{600}{6} = 100\ \text{cm}$$

$$\text{Area of regular hexagon} = \frac{3\sqrt{3}}{2} \times 100 \times 100 = 25950\ \text{sq.cm.}$$

Volume = Base area × height
= 25950 × 200 = 5190000 cu.cm. = 5.19 cu.m.
Weight of petrol = Volume × Density
= 5190000 × 0.8 gm/cc
= 4152000 gm = 4152 kg.

**Example** ***15 :*** **A frustum of a right circular cone has a diameter of base 10 cm, top of 6 cm, and a height of 5 cm; find the area of its whole surface and volume.**
***Solution :***
Here $r_1 = 5$ cm, $r_2 = 3$ cm and $h = 5$ cm.

$$\therefore \quad \ell = \sqrt{h^2 + (r_1 - r_2)^2}$$

$$= \sqrt{5^2 + (5-3)^2} = \sqrt{29}\ \text{cm} = 5.385\ \text{cm}$$

$\therefore$ Whole surface area of the frustum

$$= \pi\ell(r_1 + r_2) + \pi r_1^2 + \pi r_2^2$$

$$= \frac{22}{7} \times 5.385(5+3) + \frac{22}{7} \times 5^2 + \frac{22}{7} \times 3^2 = 242.25\ \text{sq.cm.}$$

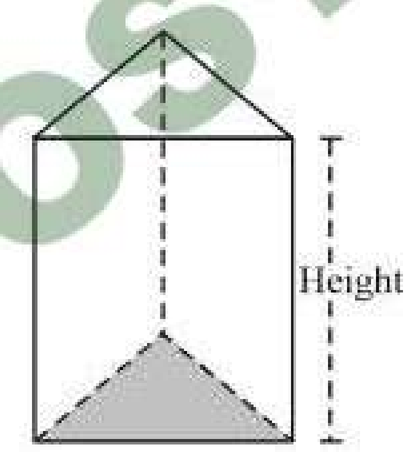
$$\text{Volume} = \frac{\pi h}{3}(r_1^2 + r_1 r_2 + r_2^2)$$

$$= \frac{22}{7} \times \frac{5}{3}\left[5^2 + 5 \times 3 + 3^2\right] = 256.67\ \text{cu. cm.}$$

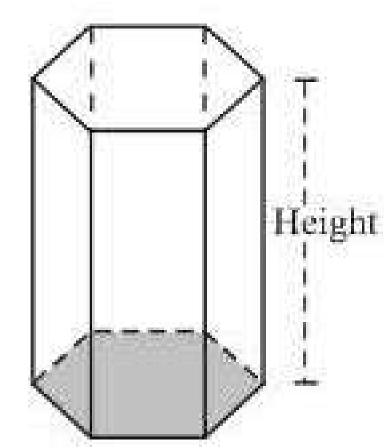
## Prism

A 'prism' is a solid having identical and parallel top and bottom (or base) faces. These identical faces are regular polygon of any number of sides. The side faces of a prism are rectangular and are known as lateral faces. Number of lateral faces is equal to the number of sides in the base.

Here are some example of prisms




Triangular base prism




Hexagonal base prism

- Lateral surface area of the prism
  = (Perimeter of the base) × (Height)
- Total surface area of the prism
  = (Surface area of the top and bottom) + (Lateral surface area)
  = 2 × Area of the base + Perimeter of base × Height
- Volume of the prism = (Area of base) × (Height)

### *NOTE :*

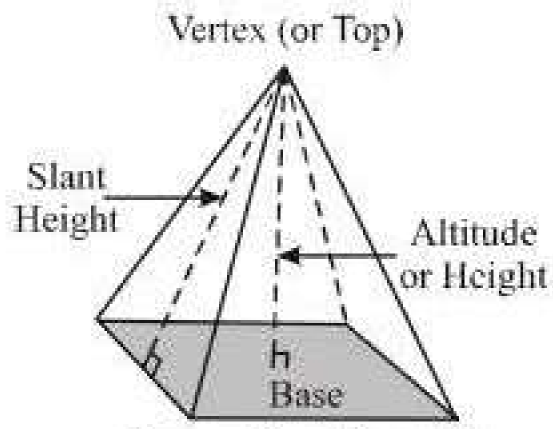
The actual formula used to find the surface area and volume will depend upon the number of sides in the base of the prism.

## Pyramid

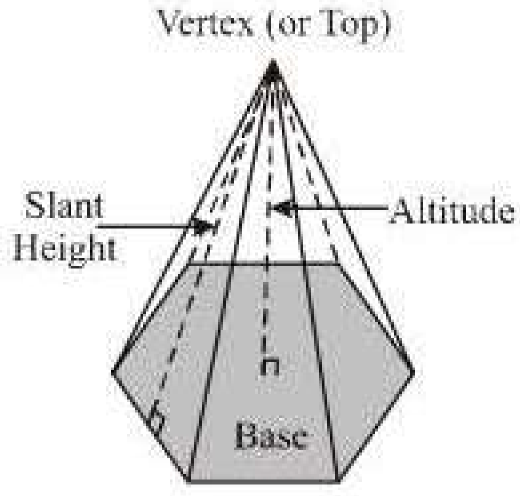
It is a three-dimensional body made up of a regular polygon shaped base and triangular lateral faces that meet at a point called vertex, which is also called the apex of the pyramid.

The number of triangular faces is equal to the number of sides in the base.

- Lower face is called the base and the perpendicular distance of the vertex (or top) from the base is called the height or altitude of the pyramid.
- The altitude of a lateral face of a pyramid is the slant height, which is the perpendicular distance of the vertex (or top) from the mid-point of any side of the base.
- The lateral surface area of a regular pyramid is the sum of the areas of its lateral faces.




Square Based Pyramid




Hexagonal Pyramid

- Lateral surface area of a pyramid

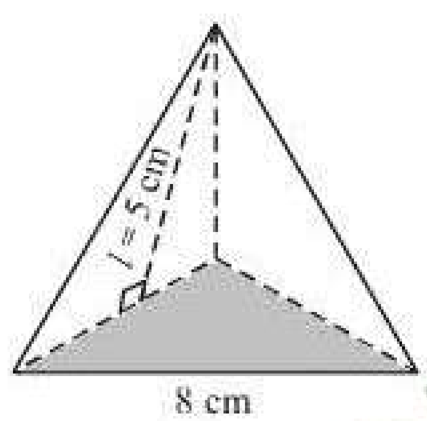
$$= \frac{1}{2} \times (\text{Area of the base}) \times (\text{Slant height})$$

- Total surface area of a pyramid

$$= \frac{1}{2} \times (\text{Perimeter of the base}) \times (\text{Slant height}) + (\text{Area of the base})$$

- Volume of a pyramid = $\frac{1}{3} \times$ Area of base × Height

**Example 16: Find the lateral surface area of a regular pyramid with triangular base, if each edge of the base measures 8 cm and slant height is 5 cm.**




***Solution:***

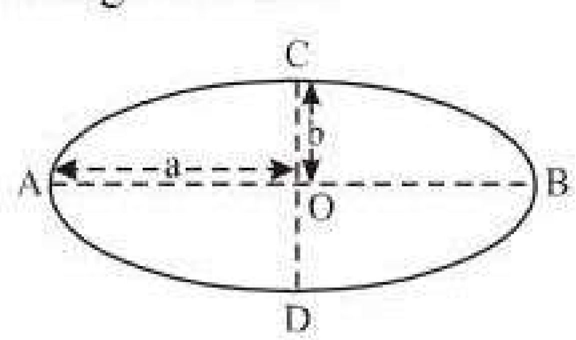
The perimeter of the base is the sum of the sides,

$$p = 3.(8) = 24 \text{ cm}$$

$$\text{L.S.A.} = \frac{1}{2} \times (24) \times (5) = 60 \text{ cm}^2$$

## Ellipse

Figure of an ellipse is given below.



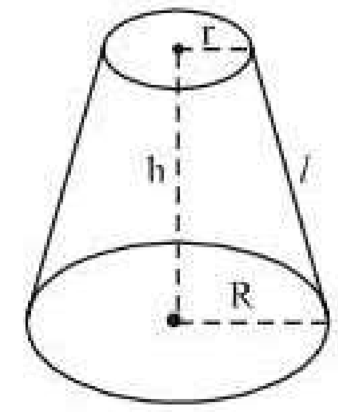

$AB$ and $CD$ are length of major and minor axis of an ellipse
Length of major axis, $AB = 2a$
and length of the minor axis, $CD = 2b$
Then $AO = a$, $OC = b$

- Perimeter of the ellipse = $\pi(a + b)$
- Area of the ellipse = $\pi ab$

## Frustum of a Cone

When top portion of a cone cut off by a plane parallel to the base of it, the left-over part is called the frustum of the cone.

In the figure, $r$ and $R$ are the radius of two ends, $h$ is the height and $l$ is the slant height of the frustum of cone.



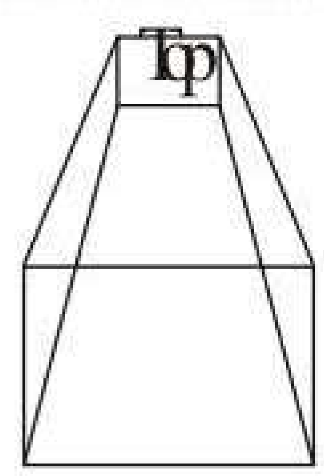

- Slant height, $l = \sqrt{(R-r)^2 + h^2}$
- Curved surface area = $\pi(R + r)l$
- Total surface area
= (Curved surface area) + (Area of two circular ends)
$= \pi(R + r)l + \pi R^2 + \pi r^2$
$= \pi(Rl + rl + R^2 + r^2)$
- Height of the original cone = $\frac{Rh}{R - r}$
- Volume of the frustum of cone

$$= \frac{\pi h}{3}\left(R^2 + r^2 + Rr\right)$$

## Frustum of a Pyramid

When top portion of a pyramid is cut off by a plane parallel to the base of it, the left-over part is called the frustum of the pyramid.

- If $A_1$, $A_2$ are of top and bottom face, $P_1$ and $P_2$ are the perimeters of top and bottom face, $h$ is the height and $l$ is the slant height of the frustum of the pyramid, then




- Lateral surface area = $\frac{1}{2}(P_1 + P_2)l$
- Total surface area = Lateral surface area + $A_1 + A_2$

$$= \frac{1}{2}(P_1 + P_2)l + A_1 + A_2$$

$$\text{Volume} = \frac{1}{2} h\left(A_1 + A_2 + \sqrt{A_1 . A_2}\right)$$

# EXERCISE

1. The length, breadth and height of a cuboid are in the ratio 1 : 2 : 3. The length, breadth and height of the cuboid are increased by 100%, 200% and 200%, respectively. Then, the increase in the volume of the cuboid will be :
(a) 5 times (b) 6 times
(c) 12 times (d) 17 times
2. A rectangular reservoir is 54 m × 44 m × 10 m. An empty pipe of circular cross-section is of radius 3 cms, and the water runs through the pipe at 20 m section. Find the time the empty pipe will take to empty the reservoir full of water.
(a) 116.67 hours (b) 110 .42 hours
(c) 120.37 hours (d) 112 hours
3. A cube of 384 $cm^2$ surface area is melt to make x number of small cubes each of 96 $mm^2$ surface area. The value of x is
(a) 80,000 (b) 8
(c) 8,000 (d) 800
4. The trunk of a tree is a right cylinder 1.5 m in radius and 10 m high. The volume of the timber which remains when the trunk is trimmed just enough to reduce it to a rectangular parallelopiped on a square base is
(a) 44 $m^3$ (b) 46 $m^3$
(c) 45 $m^3$ (d) 47 $m^3$
5. A right circular cone and a right circular cylinder have equal base and equal height. If the radius of the base and the height are in the ratio 5 : 12, then the ratio of the total surface area of the cylinder to that of the cone is
(a) 3 : 1 (b) 13 : 9
(c) 17 : 9 (d) 34 : 9
6. The cost of painting the walls of a room at the rate of ₹ 1.35 per square metre is ₹ 340.20 and the cost of matting the floor at the rate of ₹ 0.85 per $m^2$ is ₹ 91.80. If the length of the room is 12 m, then the height of the room is :
(a) 6m (b) 12 m
(c) 1.2 m (d) 13.27m
7. A copper sphere of radius 3 cm is beaten and drawn into a wire of diametre 0.2 cm. The length of the wire is
(a) 9m (b) 12 m
(c) 18 m (d) 36 m
8. A cone of height 9 cm with diameter of its base 18 cm is carved out from a wooden solid sphere of radius 9 cm. The percentage of the wood wasted is:
(a) 25% (b) 30%
(c) 50% (d) 75%
9. A hemispherical bowl is filled to the brim with a beverage. The contents of the bowl are transfered into a cylindrical vessel whose radius is 50% more than its height. If the diameter is same for both the bowl and the cylinder, the volume of the beverage in the cylindrical vessel is:
(a) $66\frac{2}{3}\%$ (b) $78\frac{1}{2}\%$
(c) 100% (d) More than 100%
10. A cylindrical container of radius 6 cm and height 15 cm is filled with ice-cream. The whole ice-cream has to be distributed to 10 children in equal cones with hemispherical tops. If the height of the conical portion is four times the radius of its base, then find the radius of the ice-cream cone.
(a) 2 cm (b) 3 cm
(c) 4 cm (d) 5 cm
11. A cylinder is filled to 4/5th its volume. It is then filled so that the level of water coincides with one edge of its bottom and top edge of the opposite side, In the process, 30 cc of the water is spilled. What is the volume of the cylinder?
(a) 75 cc (b) 96 cc
(c) Data insufficient (d) 100 cc
12. A monument has 50 cylindrical pillars each of diameter 50 cm and height 4 m. What will be the labour charges for getting these pillars cleaned at the rate of 50 paise per sq. m? (use $\pi = 3.14$)
(a) ₹ 237 (b) ₹ 157
(c) ₹ 257 (d) ₹ 353
13. In a swimming pool measuring 90 m by 40 m, 150 men take a dip. If the average displacement of water by a man is 8 cubic metres, what will be the rise in water level?
(a) 33.33 cm (b) 30 cm
(c) 20 cm (d) 25 cm
14. A conical vessel of base radius 2 cm and height 3 cm is filled with kerosene. This liquid leaks through a hole in the bottom and collects in a cylindrical jar of radius 2 cm. The kerosene level in the jar is
(a) $\pi$ cm (b) 1.5 cm
(c) 1 cm (d) 3 cm
15. There are two cones. The curved surface are aof one is twice that of the other. The slant height of the latter is twice that of the former. The ratio of their radii is
(a) 4 : 1 (b) 4 : 3
(c) 3 : 4 (d) 1 : 4
16. Two circular cylinders of equal volume have their heights in the ratio 1 : 2; Ratio of their radii is (Take $\pi = \frac{22}{7}$)
(a) 1 : 4 (b) $1 : \sqrt{2}$
(c) $\sqrt{2} : 1$ (d) 1 : 2
17. A rectangular piece of paper of dimensions 22 cm by 12 cm is rolled along its length to form a cylinder. The volume (in $cm^3$) of the cylinder so formed is (use $\pi = \frac{22}{7}$)
(a) 562 (b) 412
(c) 462 (d) 362

18. A reservoir is supplied from a pipe 6 cm in diameter. How many pipes of 3 cms diameter would discharge the same quantity, supposing the velocity of water is same ?
(a) 4 (b) 5
(c) 6 (d) 7

19. A conical cavity is drilled in a circular cylinder of 15 cm height and 16 cm base diameter. The height and the base diameter of the cone are same as those of the cylinder. Determine the total surface area of the remaining solid.
(a) $440\pi\text{ cm}^2$ (b) $215\pi\text{ cm}^2$
(c) $542\pi\text{ cm}^2$ (d) $376\pi\text{ cm}^2$

20. Water flows through a cylindrical pipe of internal diameter 7 cm at 2 m per second. If the pipe is always half full, then what is the volume of water (in litres) discharged in 10 minutes?
(a) 2310 (b) 3850
(c) 4620 (d) 9240

21. A hollow sphere of internal and external diameters 4 cm and 8 cm respectively is melted into a cone of base diamater 8 cm. The height of the cone is:
(a) 12 cm (b) 14 cm
(c) 15 cm (d) 18 cm

22. If length, breadth and height of a cuboid is increased by $x$%, $y$% and $z$% respectively then its volume is increased by

(a) $\left[x+y+z+\frac{xy+xz+yz}{100}+\frac{xyz}{(100)^2}\right]\%$

(b) $\left[x+y+z+\frac{xy+xz+yz}{100}\right]\%$

(c) $\left[x+y+z+\frac{xyz}{(100)^2}\right]\%$

(d) None of these

23. A cone, a hemisphere and a cylinder stand on equal bases and have the same height, the height being equal to the radius of the circular base. Their total surface areas are in the ratio:
(a) $(\sqrt{2}+1):3:4$ (b) $(\sqrt{3}+1):3:4$
(c) $\sqrt{2}:3:4$ (d) $\sqrt{3}:7:8$

24. It is required to fix a pipe such that water flowing through it at a speed of 7 metres per minute fills a tank of capacity 440 cubic metres in 10 minutes. The inner radius of the pipe should be :
(a) $\sqrt{2}$ m (b) 2m
(c) $\frac{1}{2}$ m (d) $\frac{1}{\sqrt{2}}$ m

25. There is a solid cube with side 10 m. If the largest possible cone is carved out of it, then what is the surface area of the remaining part of the cube ?
(a) $600+25\sqrt{5}\pi$ (b) $500+25\sqrt{5}\pi$
(c) $600-25(\sqrt{5}+1)\pi$ (d) $600+25(\sqrt{5}-1)\pi$

26. The water in a rectangular reservoir having a base 80 metres by 60 metres is 6.5 metres deep. In what time can the water be emptied by a pipe whose cross section is a square of side 20 cm, if the water runs through the pipe at the rate of 15 km per hour ?
(a) 52 hrs (b) 26 hrs
(c) 65 hrs (d) 42 hrs

27. A metal cube of edge 12 cm is melted and formed into three smaller cubes. If the edges of two smaller cubes are 6 cm and 8 cm, then find the edge of the third smaller cube.
(a) 10 cm (b) 14 cm
(c) 12 cm (d) 16 cm

28. A well 22.5 m deep and of diameter 7 m has to be dug out. Find the cost of plastering its inner curved surface at ₹ 3 per sq. metre.
(a) ₹ 1465 (b) ₹ 1485
(c) ₹ 1475 (d) ₹ 1495

29. A conical tent of given capacity has to be constructed. The ratio of the height to the radius of the base for the minimum area of canvas required for the tent is
(a) 1 : 2 (b) 2 : 1
(c) $1:\sqrt{2}$ (d) $\sqrt{2}:1$

30. A cistern 6 m long and 4 m wide contains water up to a depth of 1 m 25 cm. The total area of the wet surface is:
(a) $49\text{ m}^2$ (b) $50\text{ m}^2$
(c) $53.5\text{ m}^2$ (d) $55\text{ m}^2$

31. The internal measurements of a box with lid are $115\times75\times35\text{ cm}^3$ and the wood of which it is made is 2.5 cm thick. Find the volume of wood.
(a) $82{,}125\text{ cm}^3$ (b) $70{,}054\text{ cm}^3$
(c) $78{,}514\text{ cm}^3$ (d) None of these

32. The water from a roof, 9 sq metres in area, flows down to a cylinder container of $900\text{ cm}^2$ base. To what height will the water rise in cylinder if there is a rainfall of 0.1 mm ?
(a) 1 cm (b) 0.1 metre
(c) 0.11 cm (d) 10 cms

33. A cuboidal block of 6 cm × 9 cm × 12 cm is cut up into an exact number of equal cubes. The least possible number of cubes will be:
(a) 6 (b) 9
(c) 24 (d) 30

34. The volume of spheres are proportional to the cubes of their radii. Two spheres of the same material weigh 3.6 kg and 2.7 kg and the radius of the smaller one is 2 cm. If the two were melted down and formed into a single sphere, what would be its radius?
(a) 4 cm (b) 4.3 cm
(c) 3 cm (d) 2.6 cm

35. A hollow sphere of internal and external diameters 4 cm and 8 cm respectively is melted into a cone of base diamater 8 cm. The height of the cone is:
(a) 12 cm (b) 14 cm
(c) 15 cm (d) 18 cm

**Directions (Q. Nos. 36-37) :** The areas of the ends of a frustum of a cone are P and Q, where P < Q and H is its thickness.

36. What is the volume of the frustum?
    (a) $3H(P + Q + \sqrt{PQ})$ (b) $H(P + Q + \sqrt{PQ})$
    (c) $H(P + Q + \sqrt{PQ})/3$ (d) $H(P + Q + \sqrt{PQ})/3$
37. What is the difference in radii of the ends of the frustum?
    (a) $\frac{\sqrt{Q}-\sqrt{P}}{\sqrt{\pi}}$ (b) $\frac{\sqrt{Q}-\sqrt{P}}{\pi}$
    (c) $\sqrt{Q}-\sqrt{P}$ (d) None of these
38. If the heights and the areas of the base of a right circular cone and a pyramid with square base are the same, then they have
    (a) same volume and same surface area
    (b) same surface area but different volumes
    (c) same volume but different surface areas
    (d) different volumes and different surface areas
39. Let A be a pyramid on a square base and B be a cube. If $a$, $b$ and $c$ denote the number of edges, number of faces and number of corners, respectively. Then, the result $a = b + c$ is true for
    (a) Only A (b) Only B
    (c) Both A and B (d) Neither A nor B
40. If $x$ is the curved surface area and $y$ is the volume of a right circular cylinder, then which one of the following is correct?
    (a) Only the ratio of the height to radius of the cylinder is independent of $x$
    (b) Only the ratio of height to radius of the cylinder is independent of $y$
    (c) Either (a) or (b) (d) Neither (a) nor (b)
41. A cube has each edge 2 cm and a cuboid is 1 cm long, 2 cm wide and 3 cm high. The paint in a certain container is sufficient to paint an area equal to 54 $cm^2$.
    Which one of the following is correct?
    (a) Both cube and cuboid can be painted
    (b) Only cube can be painted
    (c) Only cuboid can be painted
    (d) Neither cube nor cuboid can be painted
42. A cone of radius $r$ cm and height $h$ cm is divided into two parts by drawing a plane through the middle point of its height and parallel to the base. What is the ratio of the volume of the original cone to the volume of the smaller cone?
    (a) 4 : 1 (b) 8 : 1
    (c) 2 : 1 (d) 6 : 1
43. The dimensions of a field are 15 m by 12 m. A pit 8 m long, 2.5 m wide and 2 m deep is dug in one corner of the field and the earth removed is evenly spread over the remaining area of the field. The level of the field is raised by
    (a) 15 cm (b) 20 cm
    (c) 25 cm (d) $\frac{200}{9}$ cm
44. The volume of a hollow cube is $216x^3$. What surface area of the largest sphere which be enclosed in it?
    (a) $18\pi x^2$ (b) $27\pi x^2$
    (c) $36\pi x^2$ (d) $72\pi x^2$
45. Consider the following statements :
    1. The volume of the cone generated when the triangle is made to revolve about its longer leg is same as the volume of the cone generated when the triangle is made to revolve about its shorter leg.
    2. The sum of the volume of the cone generated when the triangle is made to revolve about its longer leg and the volume of the cone generated when the triangle is made to revolve about its shorter leg is equal to the volume of the double cone generated when the triangle is made to revolve about its hypotenuse.

    Which of the above statements is/are correct ?
    (a) Only 1 (b) Only 2
    (c) Both 1 and 2 (d) Neither 1 nor 2
46. Consider the following statements in respect of four spheres $A$,$B$, $C$ and $D$ having respective radii 6, 8, 10 and 12 cm.
    1. The surface area of sphere $C$ is equal to the sum of surface areas of sphere $A$ and $B$ .
    2. The volume of sphere $D$ is equal to the sum of volumes of sphere $A$, $B$ and $C$.

    Which of the above statements is / are correct ?
    (a) Only 1 (b) Only 2
    (c) Both 1 and 2 (d) Neither 1 nor 2
47. A cylindrical vessel of radius 4 cm contains water. A solid sphere of radius 3 cm is lowered into the water until it is completely immersed. The water level in the vessel will rise by **(CDS)**
    (a) 1.5 cm (b) 2 cm
    (c) 2.25 cm (d) 4.5 cm
48. A sphere and a cube have same surface area. The ratio of square of their volumes is **(CDS)**
    (a) 6 : π (b) 5 : π
    (c) 3 : 5 (d) 1 : 1
49. The radius of a sphere is equal to the radius of the base of a right circular cone, and the volume of the sphere is double the volume of the cone. The ratio of the height of the cone to the radius of its base is **(CDS)**
    (a) 2 : 1 (b) 1 : 2
    (c) 2 : 3 (d) 3 : 2
50. A rectangular block of wood having dimensions 3m × 2m × 1.75m has to be painted on all its faces. The layer of paint must be 0.1 mm thick. Paint comes in cubical boxes having their edges equal to 10 cm. The minimum number of boxes of paint to be purchased is **(CDS)**
    (a) 5 (b) 4
    (c) 3 (d) 2

51. The diagonals of three faces of a cuboid are 13, $\sqrt{281}$ and 20 linear units. Then the total surface area of the cuboid is **(CDS)**
(a) 650 square units (b) 658 square units
(c) 664 square units (d) 672 square units

52. A rectangular paper of 44 cm long and 6 cm wide is rolled to form a cylinder of height equal to width of the paper. The radius of the base of the cylinder so rolled is **(CDS)**
(a) 3.5 cm (b) 5 cm
(c) 7 cm (d) 14 cm

53. If three metallic spheres of radii 6 cm, 8 cm and 10 cm are melted to form a single sphere, then the diameter of the new sphere will be **(CDS)**
(a) 12 cm (b) 24 cm
(c) 30 cm (d) 36 cm

54. A pipe with square cross–section is supplying water to a cistern which was initially empty. The area of cross–section is 4 $cm^2$ and the nozzle velocity of water is 40 m/s. The dimensions of the cistern are 10 m × 8 m × 6 m. Then the cistern will be full in **(CDS)**
(a) 9.5 hours (b) 9 hours
(c) 8 hours 20 minutes (d) 8 hours

55. A hollow cylindrical drum has internal diameter of 30cm and a height of 1 m. What is the maximum number of cylindrical boxes of diameter 10 cm and height 10 cm each that can be packed in the drum ? **(CDS)**
(a) 60 (b) 70
(c) 80 (d) 90

56. Consider the following statements : **(CDS)**
1. If the height of acylinder is doubled, the area of the curved surface is doubled.
2. If the radius, of a hemispherical solid is doubled, its total surface area becomes fourfold.

Which of the above statements is/are correct ?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

57. A large water tank has the shape of a cube. If 128 $m^3$ of water is pumped out, the water level goes down by 2 m. Then the maximum capacity of the tank is **(CDS)**
(a) 512 $m^3$ (b) 480 $m^3$
(c) 324 $m^3$ (d) 256 $m^3$

58. From the solid gold in the form of a cube of side length 1 cm, spherical solid balls each having the surface area $\pi^{\frac{1}{3}}$ $cm^2$ are to be made. Assuming that there is no loss of the material in the process of making the balls, the maximum number of balls made will be **(CDS)**
(a) 3 (b) 4
(c) 6 (d) 9

59. 30 metallic cylinders of same size are melted and cast in the form of cones having the same radius and height as those of the cylinders. **(CDS)**
Consider the following statements :
**Statement I :** A maximum of 90 cones will be obtained.
**Statement II :** The curved surface of the cylinder can be flattened in the shape of a rectangle but the curved surface of the cone when flattened has the shape of triangle.
Which one of the following is correct in respect of the above?
(a) Both Statement I and Statement II are correct and Statement II is the correct explanation of Statement I
(b) Both Statement I and Statement II are correct and Statement II is not the correct explanation of Statement I
(c) Statement I is correct but Statement II is not correct
(d) Statement I is not correct but Statement II is correct

60. A water tank, open at the top, is hemispherical at the bottom and cylindrical above it. The radius is 12m and the capacity is $3312\pi\, m^3$. The ratio of the surface areas of the spherical and cylindrical portions is **(CDS)**
(a) 3 : 5 (b) 4 : 5
(c) 1 : 1 (d) 6 : 5

61. The areas of three mutually perpendicular faces of a cuboid are x, y, z. If V is the volume, then xyz is equal to **(CDS)**
(a) V (b) $V^2$
(c) 2V (d) $2V^2$

62. Let V be the volume of an inverted cone with vertex at origin and the axis of the cone is along positive y–axis. The cone is filled with water up to half of its height. The volume of water is **(CDS)**
(a) $\frac{V}{8}$ (b) $\frac{V}{6}$
(c) $\frac{V}{3}$ (d) $\frac{V}{2}$

63. Three rectangles $R_1$, $R_2$ and $R_3$ have the same area. Their lengths $x_1$, $x_2$ and $x_3$ respectively are such that $x_1 < x_2 < x_3$. If $V_1$, $V_2$ and $V_3$ are the volumes of the cylinders formed from the rectangles $R_1$, $R_2$ and $R_3$ respectively by joining the parallel sides along the breadth, then which one of the following is correct? **(CDS)**
(a) $V_3 < V_2 < V_1$ (b) $V_1 < V_3 < V2$
(c) $V_1 < V_2 < V_3$ (d) $V_3 < V_1 < V_2$

64. How many spherical bullets each of 4 cm in diameter can be made out of a cube of lead whose edge is 44 cm ? **(CDS)**
(a) 2541 (b) 2551
(c) 2561 (d) 2571

65. How many right angled triangles can be formed by joining the vertices of a cuboid ? **(CDS)**
(a) 24 (b) 28
(c) 32 (d) None of the above

# HINTS & SOLUTIONS

1. (d) Let the length, breadth and height of the cuboid be x, 2x and 3x, respectively.
Therefore, volume $= x \times 2x \times 3x = 6x^3$
New length, breadth and height = 2x, 6x and 9x, respectively.
New volume $= 108x^3$
Thus, increase in volume $= (108 - 6)x^3 = 102\,x^3$

$$\frac{\text{Increase in volume}}{\text{Original volume}} = \frac{102x^3}{6x^3} = 17$$

2. (a) Volume of water in the reservoir
= area of empty pipe × Empty rate × time to empty

$$\text{or } 54 \times 44 \times 10 = \pi \times \left(3 \times \frac{1}{100}\right)^2 \times 20 \times \text{empty time}$$

$$\text{or Empty time} = \frac{54 \times 44 \times 10 \times 100 \times 100 \times 7}{22 \times 20 \times 9} \text{ sec.}$$

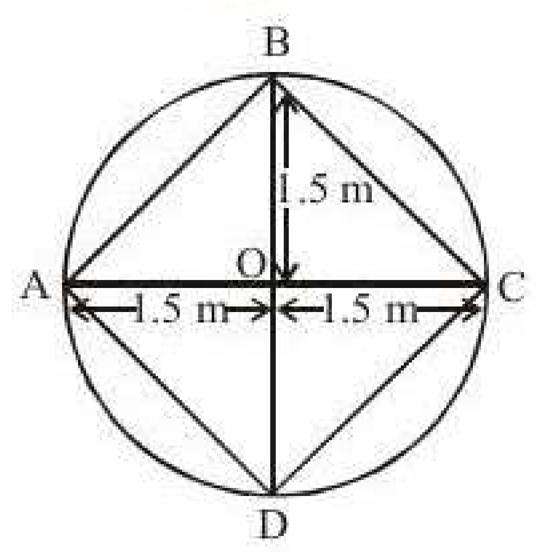
$$= \frac{54 \times 44 \times 10 \times 100 \times 100 \times 7}{22 \times 20 \times 9 \times 3600} \text{hrs} = 116.67 \text{ hours.}$$

3. (c) Let 'A' be the side of bigger cube and 'a' be the side of smaller cube
Surface area of bigger cube $= 6\,A^2$
or $384 = 6A^2$
$\therefore A = 8$ cm.
Surface area of smaller cube $= 6\,a^2$
$96 = 6a^2$
$\therefore\ a = 4$ mm $= 0.4$ cm

$$\text{So, Number of small cube} = \frac{\text{Volume of bigger cube}}{\text{Volume of smaller cube}}$$

$$= \frac{(8)^3}{(0.4)^3} = \frac{512}{0.064} = 8{,}000$$

4. (c)




From $\Delta AOB$,

$AB = \sqrt{1.5^2 + 1.5^2} = \sqrt{2.25 + 2.25} = \sqrt{4.50}$
$\therefore$ Area of the square base of the trunk of the tree
$= \sqrt{4.50} \times \sqrt{4.50} = 4.50\,m^2$
$\therefore$ Volume of the timber = Area of base × height
$= 4.50 \times 10 = 45\,m^3$

5. (c) Let the radius of the base and height are 5k and 12k respectively

$$\therefore \frac{\text{Total surface area of the cylinder}}{\text{Total surface area of the cone}}$$

$$= \frac{2\pi r \times h + 2\pi r^2}{\pi r\sqrt{r^2 + h^2} + \pi r^2}$$

$$= \frac{2h + 2r}{\sqrt{r^2 + h^2} + r} + \frac{24k + 10k}{\sqrt{25k^2 + 144k^2} + 5k}$$

$$= \frac{34k}{13k + 5k} = \frac{34k}{18k} = \frac{17}{9}$$

6. (a) Let length, breadth and height of the room be $\ell$, b and h, respectively.
Then, area of four walls of the room

$$= 2(\ell + b)h = \frac{340.20}{1.35} = 252\text{m}^2$$

$\Rightarrow (\ell + b)h = 126$ ...(i)

And $\ell \times b = \frac{91.8}{0.85} = 108$

$12 \times b = 108$ $(\because \ell = 12\text{ m})$
$\Rightarrow b = 9$ m

Using (i), we get, $h = \frac{126}{21} = 6$ m

7. (d) Let the length of the wire be h cm.
and radius of sphere and wire are R and r respectively.
Then, volume of sphere = volume of wire (cylinder)

or $\frac{4}{3}\pi R^3 = \pi r^2 h$

or $\frac{4}{3}R^3 = r^2 h$ or $\frac{4}{3}(3)^3 = (0.1)^2 h$

$$\therefore\ h = \frac{4 \times (3)^3}{3 \times (0.1)^2} = \frac{108}{0.03} = 3600\text{ cm} = 36\text{ m}$$

8. (d) Volume of sphere $= \left(\frac{4}{3}\pi \times 9 \times 9 \times 9\right)\text{cm}^3$.

Volume of cone $= \left(\frac{1}{3}\pi \times 9 \times 9 \times 9\right)\text{cm}^3$.

Volume of wood wasted

$$= \left[\left(\frac{4}{3}\pi \times 9 \times 9 \times 9\right) - \left(\frac{1}{3}\pi \times 9 \times 9 \times 9\right)\right]\text{cm}^3.$$

$= (\pi \times 9 \times 9 \times 9)\,\text{cm}^3$

$$\therefore \text{ Required percentage} = \left(\frac{\pi \times 9 \times 9 \times 9}{\frac{4}{3} \times \pi \times 9 \times 9 \times 9} \times 100\right)\%$$

$$= \left(\frac{3}{4} \times 100\right)\% = 75\%.$$

9. (c) Let the height of the vessel be x.
Then, radius of the bowl = radius of the vessel = x/2.

Volume of the bowl, $V_1 = \frac{2}{3}\pi\left(\frac{x}{2}\right)^3 = \frac{1}{12}\pi x^3$.

Volume of the vessel, $V_2 = \pi\left(\frac{x}{2}\right)^2 x = \frac{1}{4}\pi x^3$.

Since $V_2 > V_1$, so the vessel can contain 100% of the beverage filled in the bowl.

10. (b) Volume of the cylinder container
$= \pi \times 6^2 \times 15$ cu. cm ...(i)
Let the radius of the base of the cone be r cm, then, height of the cone = 4r cm
∴ Volume of the 10 cylindrical cones of ice-cream with hemispherical tops

$$= 10 \times \left[\frac{1}{3} \times \pi \times r^2 \times 4r\right] + 10 \times \frac{2}{3}\pi r^3$$

$$= \frac{40}{3}\pi r^3 + \frac{20}{3}\pi r^3 = 20\pi r^3 \text{ cu. cm} \quad ...(ii)$$

Since the whole ice-cream in the cylindrical container is distributed among 10 children in cones with hemispherical tops,
∴ (i) and (ii), gives
$\Rightarrow \pi \times 6^2 \times 15 = 20\pi r^3$

$\Rightarrow r^3 = \frac{36 \times 15}{20} = 27 \Rightarrow r = 3$ cm

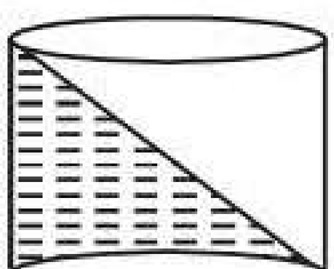
11. (d) Let the original volume of cylinder be V.

When it is filled $\frac{4}{5}$, then it's volume $= \frac{4}{5}V$

When cylinder is filled, the level of water coincides with opposite sides of bottom and top edges then

Volume become $= \frac{1}{2}V$

Since, in this process 30 cc of the water is spilled, therefore



$\frac{4}{5}V - 30 = \frac{1}{2}V$

$\Rightarrow \frac{4}{5}V - \frac{1}{2}V = 30$

$\Rightarrow V(3/10) = 30$
$\Rightarrow V = 100$ cc

12. (b) Curved surface area of cylinder $= 2\pi rh$
∴ Surface area of 50 cylindrical pillars $= 50 \times 2\pi rh$
Now, Diameter of each cylindrical pillar = 50 cm

∴ Radius $= \frac{50}{2} = 25$ cm $= 0.25$ m

Also, height = 4m

∴ Surface area $= 50 \times 2 \times 3.14 \times 0.25 \times 4$
$= 314 \times 1$ sq m.
$= 314$ sq. m.
Now, labour charges at the rate of 50 paise per sq. m $= 314 \times 0.5 = 157.0$
$\equiv$ ₹ 157

13. (a) Let the rise in water level = x m
Now, volume of pool $= 40 \times 90 \times x = 3600x$
When 150 men take a dip, then displacement of water $= 8m^3$

$\therefore \frac{3600x}{150} = 8 \Rightarrow \frac{900}{150}x = 2 \Rightarrow x = 0.33m$

$\Rightarrow x = 33.33$ cm

14. (c) Let the kerosene level of cylindrical jar be h.

Now, Volume of conical vessel $= \frac{1}{3}\pi r^2 h$

Since, radius (r) = 2 cm and height(h) = 3cm of conical vessel.

$\therefore$ Volume $= \frac{1}{3}\pi \times 4 \times 3 = 4\pi$

Now, Volume of cylinderical jar $= \pi r^2 h$
$= \pi (2)^2 h$
$= 4\pi h$
Now, Volume of conical vessel = Volume of cylindrical jar

$\Rightarrow 4\pi = 4\pi h$
$h = 1$ cm
Hence, kerosene level in jar is 1 cm.

15. (a) $C_1 = 2C_2$
$\pi r_1 l_1 = 2\pi r_2 l_2$
also, $l_2 = 2l_1$
$\pi r_1 l_1 = 2 \times 2_6 \pi r_2 l_1$

$\frac{r_1}{r_2} = \frac{4}{1}$

16. (c) $\pi r_1^2 h_1 = \pi r_2^2 h_2$

$\frac{r_1}{r_2} = \sqrt{\frac{h_2}{h_1}} = \sqrt{\frac{2}{1}}$

$r_1 : r_2 = \sqrt{2} : 1$

17. (c) $2\pi r = 22$ cm

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

Height, h = 12 cm

Volume of cylinder $= \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times 12 = 462 \text{ cm}^3$

18. (a) Number of discharge pipe

$$= \frac{\text{Volume of water supply pipe}}{\text{Volume of water in each discharge pipe}}$$

$$= \frac{\pi \times (3)^2 \times 1}{\pi \times \left(\frac{3}{2}\right)^2 \times 1} = 4 \quad \text{[Since the velocity of water is same]}$$

19. (a) Total surface area of the remaining solid = Curved surface area of the cylinder + Area of the base + Curved surface area of the cone
$= 2\pi rh + \pi r^2 + \pi r \ell$
$= 2\pi \times 8 \times 15 + \pi \times (8)^2 + \pi \times 8 \times 17$
$= 240\pi + 64\pi + 136\pi$
$= 440\,\pi\ cm^2$

20. (c) Volume of one coin $= \left(\frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times 200\right) cm^3 = 7700$ $cm^3$.
Volume of water flown in 10 min. $= (7700 \times 60 \times 10)\, cm^3$
$= \left(\frac{7700 \times 60 \times 10}{1000}\right)$ litres
= 4620 litres.

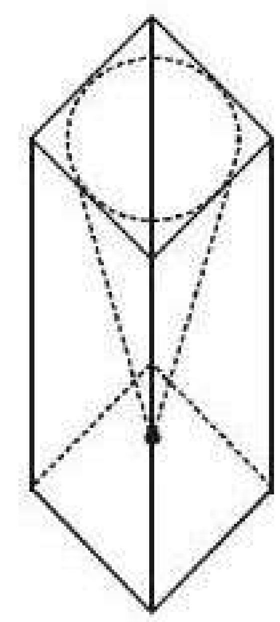
21. (b) Volume of material in the sphere
$= \left[\frac{4}{3}\pi \times \{(4)^3 - (2)^3\}\right] cm^3 = \left(\frac{4}{3}\pi \times 56\right) cm^3.$
Let the height of the cone be h cm.
Then, $\frac{1}{3}\pi \times 4 \times 4 \times h = \left(\frac{4}{3}\pi \times 56\right)$
$\Rightarrow h = \left(\frac{4 \times 56}{4 \times 4}\right) = 14$ cm.

22. (a) Let length, breadth and height of cuboid be $l$, b and h respectively.
Volume of cuboid, V = lbh
Now, length, breadth and height is increased by x%, y% and z% respectively.
New volume, $V' = l\left(1 + \frac{x}{100}\right) b\left(1 + \frac{y}{100}\right) h\left(1 + \frac{z}{100}\right)$
$= lbh\left[1 + \frac{x+y+z}{100} + \frac{xy+yz+zx}{(100)^2} + \frac{xyz}{(100)^3}\right]$
% change in volume $= \frac{V' - V}{V} \times 100$
$= \left[x + y + z + \frac{xy + yz + zx}{100} + \frac{xyz}{(100)^2}\right]\%$

23. (a) $\pi r(r + l) : 3\pi r^2 : 2\pi r(r + h)$
$= \pi \times 1\ (1 + \sqrt{2}) : 3 \times \pi \times 1 : 2 \times \pi \times 1\ (1 + 1)$
$= (\sqrt{2} + 1) : 3 : 4$

24. (a) Let inner radius of the pipe be r.
Then, $440 = \frac{22}{7} \times r^2 \times 7 \times 10$
or $r^2 = \frac{440}{22 \times 10} = 2$
or $r = \sqrt{2}$ m

25. (d) The cone is shown below with its face as a circle inscribed in one of the surfaces of the cube and its vertex on the opposite side.



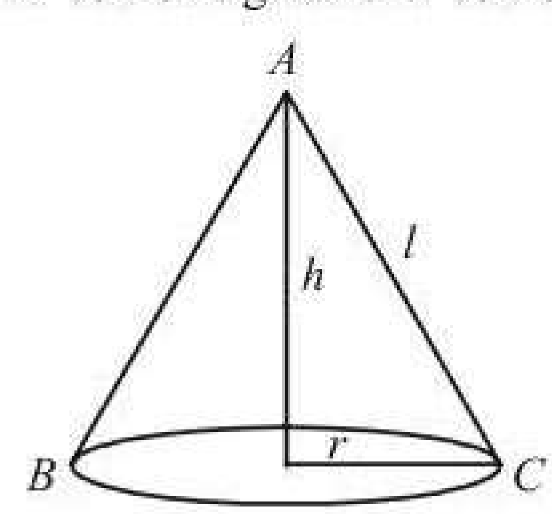
Area of the cube
$= 6 \times 100 = 600\ cm^2$.
The base of the cone $= 25\pi\ cm^2$
Lateral surface of cone
$= \pi \times 5\sqrt{100 + 25} = 25\sqrt{5}\,\pi\ cm^2$
$\therefore$ New surface area
= Area of cube – area of base of cone + lateral surface area of cone = $600 + 25(\sqrt{5} - 1)\,\pi$

26. (a) Volume of the water running through pipe per hour
$= \frac{20}{100} \times \frac{20}{100} \times 15000 = 600$ cubic metre
Required time $= \frac{60 \times 6.5 \times 80}{600} = 52$ hours

27. (a) Let the edge of the third cube be x cm.
Then, $x^3 + 6^3 + 8^3 = 12^3$
$\Rightarrow x^3 + 216 + 512 = 1728$
$\Rightarrow x^3 = 1000 \Rightarrow x = 10.$
Thus the edge of third cube = 10 cm.

28. (b) Area of the inner curved surface of the well dug
$= [2\pi \times 3.5 \times 22.5] = 2 \times \frac{22}{7} \times 3.5 \times 22.5$
$= 44 \times 0.5 \times 22.5 = 495$ sq. m.
$\therefore$ Total cost = 495 × 3 = ₹1485.

29. (d) Let $ABC$ be the conical tent of given capacity $= \frac{1}{3}\pi r^2 h$, where '$h$' be the height and '$r$' be the radius of the base.




Let '$l$' be the slant height of the conical tent.
Now, surface area (S.A) $= \pi r l$
$= \pi r\sqrt{h^2 + r^2}$
$= \pi r^2\sqrt{\left(\frac{h}{r}\right)^2 + 1}$

Now, to find the ratio of the height to the radius for minimum amount of canvas, we consider options

(a) $h = 1, r = 2 \Rightarrow \text{S.A} = 4\pi\sqrt{5/4} = 2\sqrt{5}\pi$

(b) $h = 2, r = 1 \Rightarrow \text{S.A} = \pi\sqrt{5}$

(c) $h = 1, r = \sqrt{2} \Rightarrow \text{S.A} = 2\pi\sqrt{3/2} = \sqrt{6}\pi$

(d) $h = \sqrt{2}, r = 1 \Rightarrow \text{S.A} = \pi\sqrt{2+1} = \sqrt{3}\pi\,(\text{min})$

Hence, only option (d) is the correct option.

30. (a) Area of the wet surface $= [2(\ell b + bh + \ell h) - \ell b]$
$= 2(bh + \ell h) + \ell b$
$= [2(4 \times 1.25 + 6 \times 1.25) + 6 \times 4]\ m^2 = 49\ m^2.$

31. (a) Internal volume $= 115 \times 75 \times 35 = 3{,}01{,}875\ cm^3$
External volume
$= (115 + 2 \times 2.5) \times (75 + 2 \times 2.5) \times (35 + 2 \times 2.5)$
$= 120 \times 80 \times 40 = 3{,}84{,}000\ cm^3$
$\therefore$ Volume of wood = External volume – Internal volume
$= 3{,}84{,}000 - 3{,}01{,}875 = 82{,}125\ cm^3$

32. (a) Let height will be h cm.
Volume of water in roof = Volume of water in cylinder
$$\Rightarrow \frac{9 \times 10000 \times 0.1}{900 \times 10} = h$$
$\therefore$ h = 1 cm

33. (c) Volume of block $= (6 \times 9 \times 12)\ cm^3 = 648\ cm^3$.
Side of largest cube = H.C.F. of 6 cm, 9 cm, 12 cm = 3 cm.
Volume of the cube $= (3 \times 3 \times 3) = 27\ cm^3$.
$$\therefore \text{Number of cubes} = \left(\frac{648}{27}\right) = 24.$$

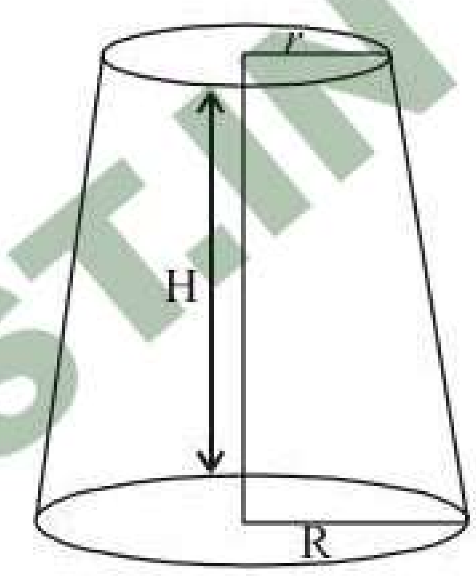
34. (d) $1\ kg = 1000\ cm^3$
$2700 = k.2^3$
$$k = \frac{2700}{8}$$
$6300 = k.\, r^3$
$$r^3 = \frac{6300}{k} = \frac{6300}{2700} = \frac{8}{3},$$
$$r^3 = \frac{56}{3},\ r = 2.6\ \text{cm}$$

35. (b) Volume of material in the sphere
$$= \left[\frac{4}{3}\pi \times \left\{(4)^3 - (2)^3\right\}\right] cm^3 = \left(\frac{4}{3}\pi \times 56\right) cm^3.$$
Let the height of the cone be h cm.
$$\text{Then, } \frac{1}{3}\pi \times 4 \times 4 \times h = \left(\frac{4}{3}\pi \times 56\right)$$
$$\Rightarrow h = \left(\frac{4 \times 56}{4 \times 4}\right) = 14\ \text{cm}.$$

36. (c) Volume of frustum
$$= \frac{\pi H}{3}(R^2 + r^2 + Rr)$$
$$= \frac{\pi}{3}H\left\{\left(\sqrt{\frac{Q}{\pi}}\right)^2 + \left(\sqrt{\frac{P}{\pi}}\right)^2 + \sqrt{\frac{Q}{\pi}}\sqrt{\frac{P}{\pi}}\right\}$$
$$= \frac{\pi H}{3}\left\{\frac{Q}{\pi} + \frac{P}{\pi} + \frac{\sqrt{PQ}}{\pi}\right\}$$
$$= \frac{H}{3}(P + Q + \sqrt{PQ})$$

37. (a) Area of first end $P = \pi r^2 \Rightarrow r = \sqrt{\frac{P}{\pi}}$

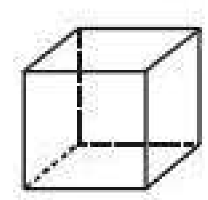
Area of second end $Q = \pi R^2 \Rightarrow R = \sqrt{\frac{Q}{\pi}}$

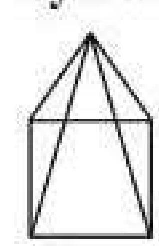



According to question P < Q
$\therefore$ Difference in radii of the ends of the frustum
$= R - r$
$$= \sqrt{\frac{Q}{\pi}} - \sqrt{\frac{P}{\pi}} = \frac{\sqrt{Q} - \sqrt{P}}{\sqrt{\pi}}$$

38. (c) Volume of cone and pyramid $= \frac{1}{3} \times$ Base area $\times$ Height
Since, volume of cone and pyramid are same but their surface area are not same because of their slant height.

39. (d) **Cube figure** **Pyramid figure**





| Cube figure | Pyramid figure |
| --- | --- |
| Edges, $a = 12$ | Edges, $a = 8$ |
| Faces, $b = 6$ | Faces, $b = 5$ |
| Corner, $c = 8$ | Corner, $c = 5$ |

Therefore, the result $a = b + c$ is neither true for cube nor for the pyramid.

40. (d) According to question,
Curved surface area of cylinder $= 2\pi rh = x$
Volume of cylinder $= \pi r^2 h = y$
$$\Rightarrow \frac{2\pi rh}{\pi r^2 h} = \frac{x}{y}$$
$$\Rightarrow r = \frac{2y}{x}$$
Now, Curved surface area of cylinder
$\Rightarrow 2\pi rh = x$
$$\therefore h = \frac{x}{2\pi r}$$

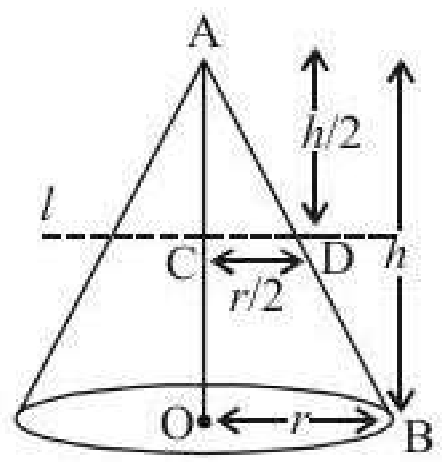
$\therefore$ Required ratio $= \dfrac{h}{r} = \dfrac{\dfrac{x}{2\pi r}}{\dfrac{2y}{x}}$

Now, put the value of $r$,

$$\frac{x}{2\pi} \times \frac{x}{2y} = \frac{x^3}{8\pi y^2}$$

41. (a) Surface area of cube = 6 (Side)$^2$
$= 6(2)^2 = 24 \text{ cm}^2$
Surface area of cuboid
$= 2(lb + bh + lh)$
$= 2(2 + 6 + 3) = 22 \text{ cm}^2$
Total surface area of both cube and cuboid
$= 24 + 22 = 46 \text{ cm}^2$
Give area to point is 54 cm$^2$
But total surface area which is need to be painted is 46 cm$^2$. So both, cube and cuboid painted.

42. (b) Let the cone is divided into two parts by a line $l$.




Now triangle ACD and AOB are similar.
(According to proportionality theorem)

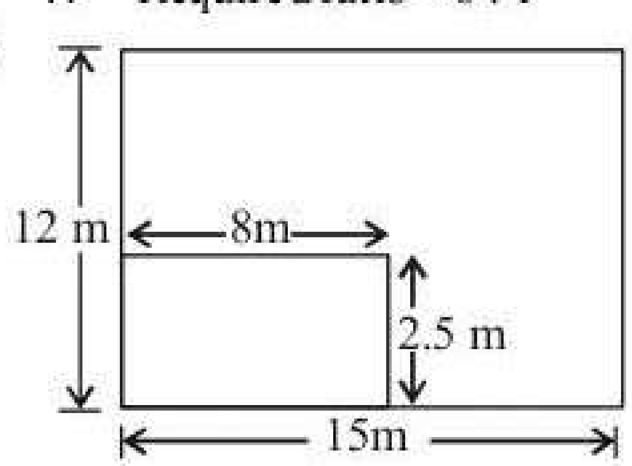
CD $= \dfrac{r}{2}$, since AC $= \dfrac{h}{2}$

Required ratio $= \dfrac{\text{Volume of original cone}}{\text{Volume of smaller cone}}$

$$= \frac{\frac{1}{3}\pi r^2 h}{\frac{1}{3}\pi\left(\frac{r}{2}\right)^2\left(\frac{h}{2}\right)} = \frac{8}{1}$$

$\therefore$ Required ratio = 8 : 1

43. (c)




Volume of pit $= l\,b\,h = 8 \times 2.5 \times 2 = 40 \text{ m}^3$.
Let the label of the earth spread over remaining area $= h$.
Volume of the earth spread = Volume of a pit
$\Rightarrow$ $[(12 \times 15) - (8 \times 2.5)] \times h = 40$

$\therefore$ $h = \dfrac{40}{180 - 20} = \dfrac{40}{160} = \dfrac{1}{4}\text{ m} = 25 \text{ cm}$

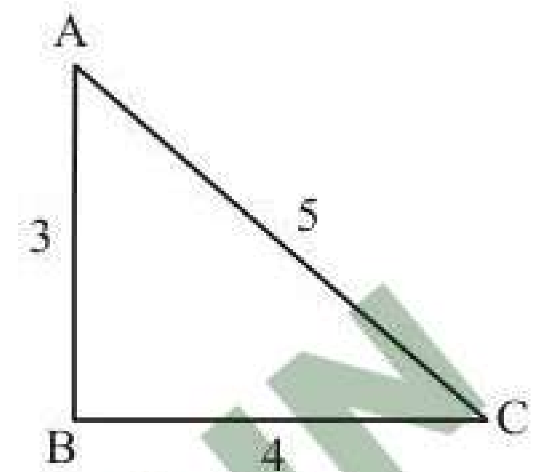
44. (c) Volume of the cube $= 216x^3$
$(\text{Side})^3 = 216x^3 \Rightarrow \text{Side} = 6x$

Largest sphere which is enclosed in cube the diameter of sphere is equal to side of the cube.
$\therefore$ Diameter of sphere $= 6x$

Surface area of the sphere $= 4\pi r^2 = 4\pi\left(\dfrac{6x}{2}\right)^2 = 36\pi x^2$

45. (d) $\Delta ABC$ is right angled triangle.
$AB = 3$cm, $BC = 4$cm and $AC = 5$cm

**1.** When the triangle revolves about its longer leg, $BC$= 4 cm.



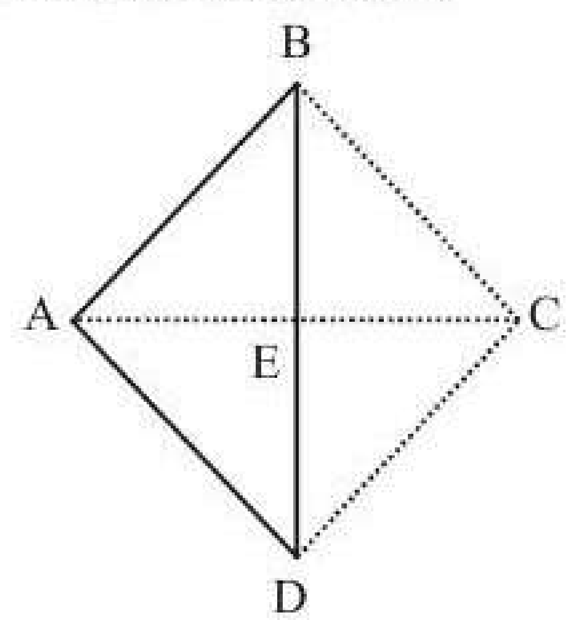

Volume of cone $\dfrac{1}{3}\pi r^2 h = \dfrac{1}{3}\pi(3)^2 \times 4$

$= 12\pi \text{ cm}^3$ .... (i)
Now triangle revolve about its shorter leg, $AB = 3$ cm

Volume of cone $= \dfrac{1}{3}\pi r^2 h = \dfrac{1}{3}\pi(4)^2 \times 3$

$= 16\pi \text{ cm}^3$ .... (ii)
From equations (i) and (ii), it is clear that volume of both cones are not same. So, statement 1 is not correct.

**2.** The triangle revolve about hypotenus, then we get double cones $ABD$ and $BCD$.




$\because$ $\Delta BEA \sim \Delta BAC$

$\therefore$ $\dfrac{BE}{BC} = \dfrac{AB}{AC} \Rightarrow \dfrac{BE}{4} = \dfrac{3}{5}$

$BE = 2.4$ cm
Radius of the base of cone, $BE = 2.4$ cm
In right angled $\Delta BEA$,
By Pythagoras theorem,

$AE = \sqrt{(AB)^2 - (BE)^2} = \sqrt{9 - (2.4)^2} = 1.8$ cm
Height of cone $ABD = AE = 1.8$ cm
$\therefore$ Height of cone $BCD = AC - AE = 5 - 1.8 = 3.2$ cm

Now, volume of cone $ABD = \dfrac{1}{3}\pi r^2 h = \dfrac{1}{3}\pi(2.4)^2 \times 1.8$

$= 3.456\pi \text{ cm}^3$

volume of cone $BCD = \dfrac{1}{3}\pi(2.4)^2 \times 3.2 = 6.144\pi \text{ cm}^3$

Volume of double cone = $3.456\pi + 6.144\pi$
$= 9.6\pi \text{ cm}^3$ ... (iii)
From equations (i) and (ii), we get
Volume of both cones = $12\pi + 16\pi = 28\pi \text{ cm}^3$ ...(iv)
From equations (iii) and (iv), we get
Volume of double cone Volume of both cones
So, Statement 2 is also not correct.

46. (c) $\therefore$ Surface area of sphere $A = 4\pi r^2 = 4\pi(6)^2 = 144\pi \text{cm}^2$
Surface area of sphere $B = 4\pi(8)^2 = 256\pi \text{ cm}^2$
Surface area of sphere $C = 4\pi(10)^2 = 400\pi \text{ cm}^2$
and Surface area of sphere $D = 4\pi(12)^2 = 576\,\pi \text{ cm}^2$
Sum of surface area of spheres A and B
$= 144\pi + 256\pi = 400\pi \text{ cm}^2$
= Surface area of Shpere, $C$
Hence, Statements 1 is correct.

**2.** $\because$ Volume of sphere $D = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(12)^3$
$= 2304\pi \text{cm}^3$

Volume of sphere $A = \frac{4}{3}\pi(6)^3 = 288\pi \text{ cm}^3$

Volume of sphere $B = \frac{4}{3}\pi(8)^3 = \frac{2048}{3}\,\pi \text{ cm}^3$

and Volume of sphere $C = \frac{4}{3}\pi(10)^3 = \frac{4000}{3}\,\pi \text{ cm}^3$

According to question
sum of volumes of sphere $A$, $B$ and $C$

$= \left(288\pi + \frac{2048\pi}{3} + \frac{4000}{3}\pi\right)\text{cm}^3$

$= \frac{864 + 2048 + 4000}{3}\pi \text{cm}^3 = \frac{6912}{3}\pi \text{cm}^3$

$= 2304\pi \text{ cm}^3$ = Volume of sphere $D$
Hence, Statement 2 is also correct.

47. (c) Volume of sphere = $\frac{4}{3}\pi r^3$

Here,
Volume of Sphere = Volume displaced in cylinder

$\Rightarrow \frac{4}{3}\pi r_S^{\,3} = \pi r_C^{\,2}(h - h')$

$\Rightarrow \frac{4}{3}\pi \times 27 = \pi \times 16\,(h - h')$

$h - h' = \frac{9}{4} = 2.25 \text{cm}$

48. (a) According to question
$4\pi r^2 = 6a^2$

$\frac{r^2}{a^2} = \frac{6}{4\pi}$

Ratio of their volume = $\frac{\frac{4}{3}\pi r^3}{a^3}$

$= \frac{4}{3}\pi\left(\frac{r}{a}\right)^3 = \frac{4\pi}{3}.\frac{6}{4\pi}\sqrt{\frac{6}{4\pi}} = \sqrt{\frac{6}{\pi}}$

Square of their volume ratio = $\frac{6}{\pi} = 6 : \pi$

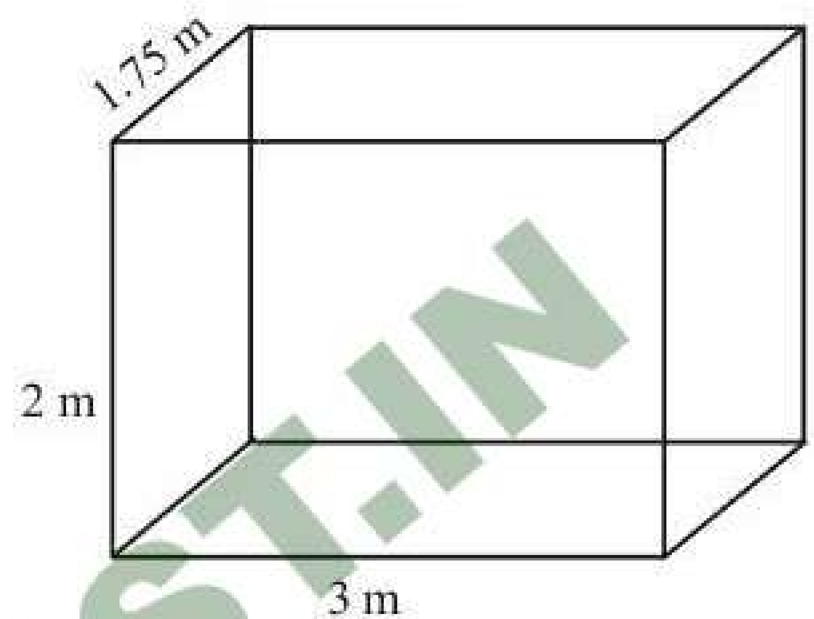
49. (a) Radius of sphere = Radius of right circular cone
Now, Volume of sphere = 2 × Volume of cone

$\Rightarrow \frac{4}{3}\pi r^3 = 2 \times \frac{1}{3}\pi r^2 h$

$\Rightarrow 2r = h$

$\frac{h}{r} = \frac{2}{1} = 2{:}1$

50. (c)




Surface Area of rectangular blocks
$= 2\,(3 \times 2 + 2 \times 1.75 + 3 \times 1.75) = 29.5 \text{m}^2$
Paint required for 0.1 mm

thickness $= 29.5 \times \frac{1}{10{,}000} = 0.00295 \text{m}$

Volume of cubical boxes

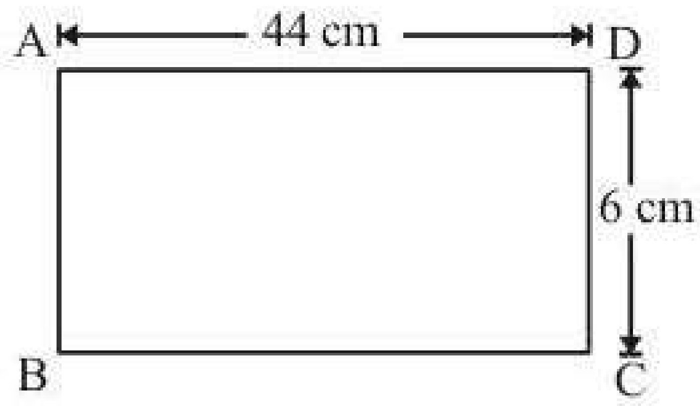
$= \frac{10}{100} \times \frac{10}{100} \times \frac{10}{100} = \frac{1}{1000}\text{cm}^3$

So boxes required = $\frac{0.00295}{0.001} = 2.95 \approx 3$

51. (c) Diagonals of the three faces are 13, $\sqrt{281}$ and 20
Let the sides of cuboid be $l$, $b$ and $h$ respectively
$l^2 + b^2 = (13)^2 = 169$ ... (i)
$b^2 + h^2 = (\sqrt{281})^2 = 281$ ... (ii)
$h^2 + l^2 = (20)^2 = 400$ ... (iii)
On subtracting equation (ii) from equation (iii)
$l^2 - b^2 = 400 - 281 = 119$... (iv)
Now add equations (iv) and (i)
$2l^2 = 119 + 169$

$l^2 = \frac{288}{2} = 144 \Rightarrow l = 12$

Put $l = 12$ in equation (i)
$b^2 = 169 - 144$
$b^2 = 25, b = 5$
Now, put value of $b$ in equation (i)
$b^2 + h^2 = 281$
$25 + h^2 = 281$
$h^2 = 256$
$\because \quad h = 16$
Total surface area of cuboid
$= 2(lb + bh + hl)$
$= 2(12 \times 5 + 5 \times 16 + 16 \times 12) = 2(60 + 80 + 192)$
= 664 square units

52. (c) 


Radius of rolled cylinder

$\Rightarrow$ $2\pi r = 44$

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

53. (a) Volume of new sphere

$V = V_1 + V_2 + V_3$

Formula for volume of sphere is $\frac{4}{3}\pi r^3$

$\Rightarrow V = \frac{4}{3}\pi r_1^3 + \frac{4}{3}\pi r_2^3 + \frac{4}{3}\pi r_3^3$

$= \frac{4}{3}\pi\,(216 + 512 + 1000)$

$\Rightarrow \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(1728)$

$r^3 = 1728$

$\therefore$ $r = 12$

54. (c) Area of cross-section of nozzle = 4 $cm^2$

Velocity of water = 40 m/s = 4000 cm/sec

Water coming from nozzle in 1 sec

= 4 × 4000 = 16000 $cm^3$

Dimension of cistern = 10 × 8 × 6 $m^3$

= 480 × $10^6$ $cm^3$

Time taken to fill the cistern $= \frac{480 \times 10^6}{16000}$ sec

$= \frac{480 \times 10^6}{16000} \times \frac{1}{3600}$ hours

$= \frac{4800}{16 \times 36}$ hours

$= \frac{25}{3}$ hours

= 8 hours 20 minutes.

So, option (c) is correct.

55. (d) Number of cylindrical boxes that can be packed in the drum

$= \frac{\pi \times (15)^2 \times 100}{\pi \times (5)^2 \times 10} = 90$

So, option (d) is correct.

56. (c) Curved surface area of cylinder = $2\pi rh$

$S = 2\pi rh$

If height is doubled-

$S' = 2\pi r\,(2h)$

$S' = 4\pi rh$

$\boxed{S' = 2S}$

Total surface area of hemisphere = $3\pi R^2$

If radius is doubled-

total Surface Area = $3\pi(2R)^2$

= $12\pi R^2 = 4 \times 3\pi R^2$

= 4 × (Initial Surface Area)

So option (c) is correct.

57. (a) Let side of cubical water tank be 'x' meter.

Capacity of tank = $x^3$

According to question-

$\Rightarrow x^3 - 128 = (x-2).x^2$

$\Rightarrow x^3 - 128 = x^3 - 2x^2$

$\Rightarrow 2x^2 = 128$

$\Rightarrow x^2 = 64$

$\Rightarrow x = 8$ metre

Capacity of tank $(8)^3 = 512\ m^3$

So, option (a) is correct.

58. (c) Volume of solid cubical gold = $(1)^3 = 1\ cm^3$

Let radius of spherical solid balls be r.

$4\pi r^2 = \pi^{\frac{1}{3}} = r^2 = \frac{\pi^{\frac{1}{3}}}{4\pi} = r = \frac{\pi^{\frac{1}{3}}}{2}$

No of balls $= \frac{1}{\frac{4}{2}\pi\left(\frac{\pi^{-\frac{1}{3}}}{2}\right)^3}$

$= \frac{3}{4\pi} \times \frac{8}{\pi^{-1}} = 6$

So, option (c) is correct

59. (c) Let the radius and height of each cylinder be 'r' and 'h' respectively.

Volume of 30 metallic cylinders

= 30 × $\pi^2 h$

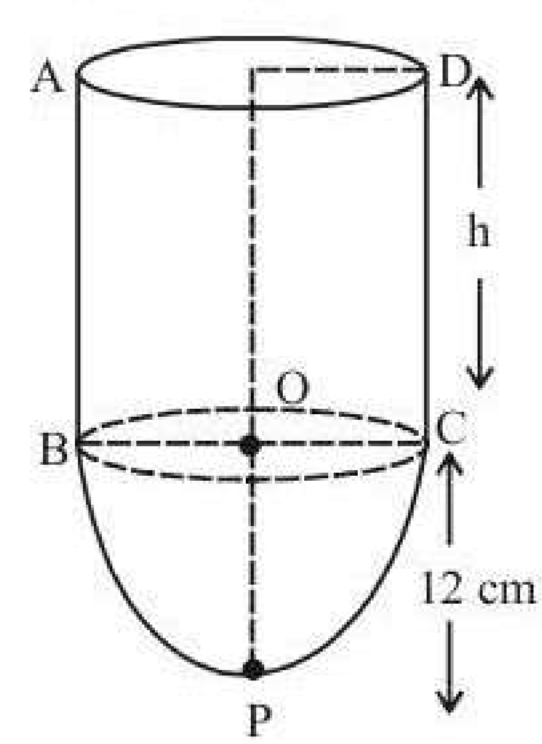
Let the no. of cones casted be 'N'

$N \times \frac{1}{3}\pi r^2 h = 30\,\pi r^2 h$

$\boxed{N = 90}$

The curved surface of cylinder in reactangle and curved surface of cone is semi-circle when they are flattened.

So, option (c) is correct.

60. (b) 


Total capacity

= volume of cylinder + volume of hemisphere

$\Rightarrow 3312\pi = \pi r^2 h + \frac{2}{3}\pi r^3$

$\Rightarrow 3312\pi = \pi\left[(12)^2 h + \frac{2}{3}(12)^3\right]$

$\Rightarrow 3312 = 144\,[h + \frac{2}{3} \times 12]$

$\Rightarrow h + 8 = 23$

$\Rightarrow h = 15$ metre

$\frac{\text{Surface area of hemisphere}}{\text{Surface area of cylinder}} = \frac{2\pi r^2}{2\pi r.h}$

$= \frac{r}{h} = \frac{12}{15} = \frac{4}{5}$

So, option (b) is correct.

61. (b) Let sides of cuboid be a, b, c

$x = a^2$

$y = b^2$

$z = c^2$

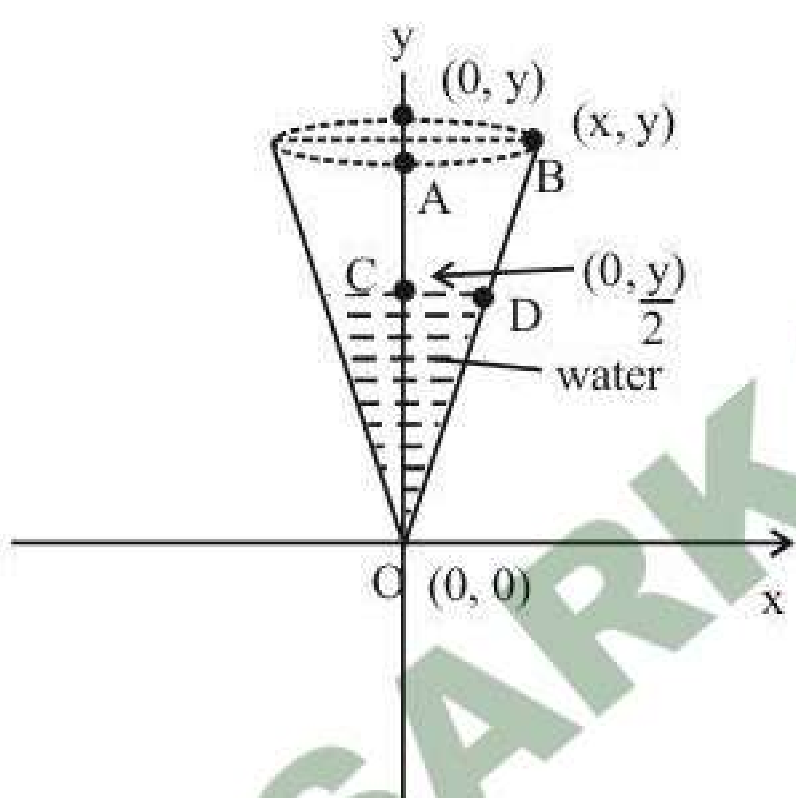
volume of cuboid V = a. b. c

$V^2 = a^2\, b^2\, c^2$

$V^2 = x\,.\,y.\,z$

So, option (b) is correct

62. (a)




$V = \frac{1}{3}\pi x^2 y$ ------------(i)

$\Delta$ COD and $\Delta$ AOB are similar

$\frac{CO}{AO} = \frac{CD}{AB}$

$\frac{\frac{y}{2}}{y} = \frac{CD}{x}$

$CD = \frac{x}{2}$

Volume of water $= \frac{1}{3}\pi(CD)^2 . \frac{y}{2}$

$= \frac{1}{3}\pi.\left(\frac{x}{2}\right)^2 . \frac{y}{2}$

$= \frac{1}{8}\left[\frac{1}{3}\pi x^2 y\right] = \frac{1}{8}v$

So, option (a) is correct.

63. (c) The dimensions of the 3 rectangles are $x_1y_1$; $x_2y_2$; $x_3y_3$. $x_1 < x_2 < x_3$ and $x_1y_1 = x_2y_2 = x_3y_3$ ($\therefore y_1 > y_2 > y_3$). By joining the parallel sides along the breadth to form a cylinder, the length becomes the circumference of the base (i.e. $x = 2\pi r$) and the breadth becomes the height. The quantities are fabulated below:

| | $R_1$ | $R_2$ | $R_3$ |
|---|---|---|---|
| Length | $x_1$ | $x_2$ | $x_3$ |
| Breadth | $y_1$ | $y_2$ | $y_3$ |
| Height of cylinder | $y_1$ | $y_2$ | $y_3$ |
| Base radus | $\frac{x_1}{2\pi}$ | $\frac{x_2}{2\pi}$ | $\frac{x_3}{2\pi}$ |
| Volume | $\frac{x_1y_1}{4\pi}$ | $\frac{x_2y_2}{4\pi}$ | $\frac{x_3y_3}{4\pi}$ |

As $x_1y_1 = x_2y_2 = x_3y_3$

and $x_1, x_2 < x_3$ of follows $v_1 < v_2 < v_3$.

64. (a) No. of bullets

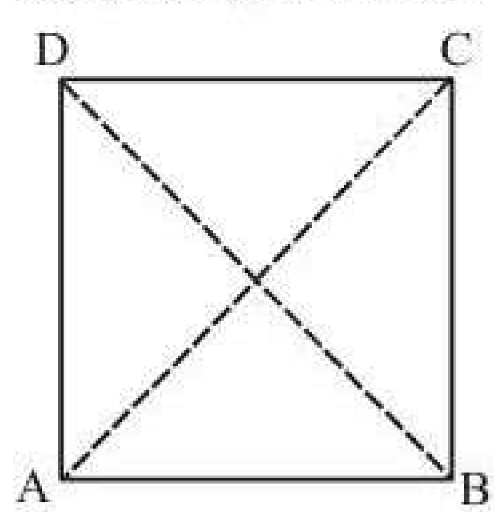
$= \frac{44 \times 44 \times 44}{\frac{4}{3} \times \frac{22}{7} \times \left(\frac{4}{2}\right) \times \left(\frac{4}{2}\right) \times \left(\frac{4}{2}\right)}$

$= \frac{11 \times 11 \times 11 \times 21 \times 8}{22 \times 4}$

$= 2541$

So, option (a) is correct.

65. (a)




On single face of cube no. of right angled Triangles formed = 4 (i.e., $\Delta$ABD, $\Delta$ABC, $\Delta$ABD, $\Delta$ACD)

Total faces of a cube = 6

So, no. of right angle triangles = 4 × 6 = 24

So, option (a) is correct.