

Trade of Sheet Metalwork

Module 4:	General Sheet Metalwork
Unit 7:	Right Conical Reducer
	Phase 2

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Document Release History

Date	Version	Comments
15/11/06	First draft	
09/04/14	2.0	SOLAS transfer

Module 4 – General Sheet Metalwork

Unit 7 – Right Conical Reducer

Duration – 7 Hours

Learning Outcome:

By the end of this unit each apprentice will be able to:

- Produce right conical reducer
- Organise sequence of operations
- Assemble and join cylindrical spigots
- Assemble and assemble joggled and grooved joints

Key Learning Points:

D	Drawing and development of right conical reducer.
Rk	Attachments to right conical reducer (spigots).
Sk	Notching arrangements.
Sk	Use of universal combination rotary machine, (swaging machine) for joggled joint.
P	Job card completion.
H	Machine safety requirements.
M	Calculate volume/capacity of square, rectangle and cylindrical components.

Training Resources:

- Toolkit
- Conical bench stake
- Universal combination rotary m/c
- Safety equipment and protective clothing
- Tools and machinery/equipment
- Job card
- Work samples
- Notepad
- 0.6mm galvanised mild steel

Key Learning Points Code:

M = Maths **D** = Drawing **RK** = Related Knowledge **Sc** = Science
P = Personal Skills **Sk** = Skill **H** = Hazards

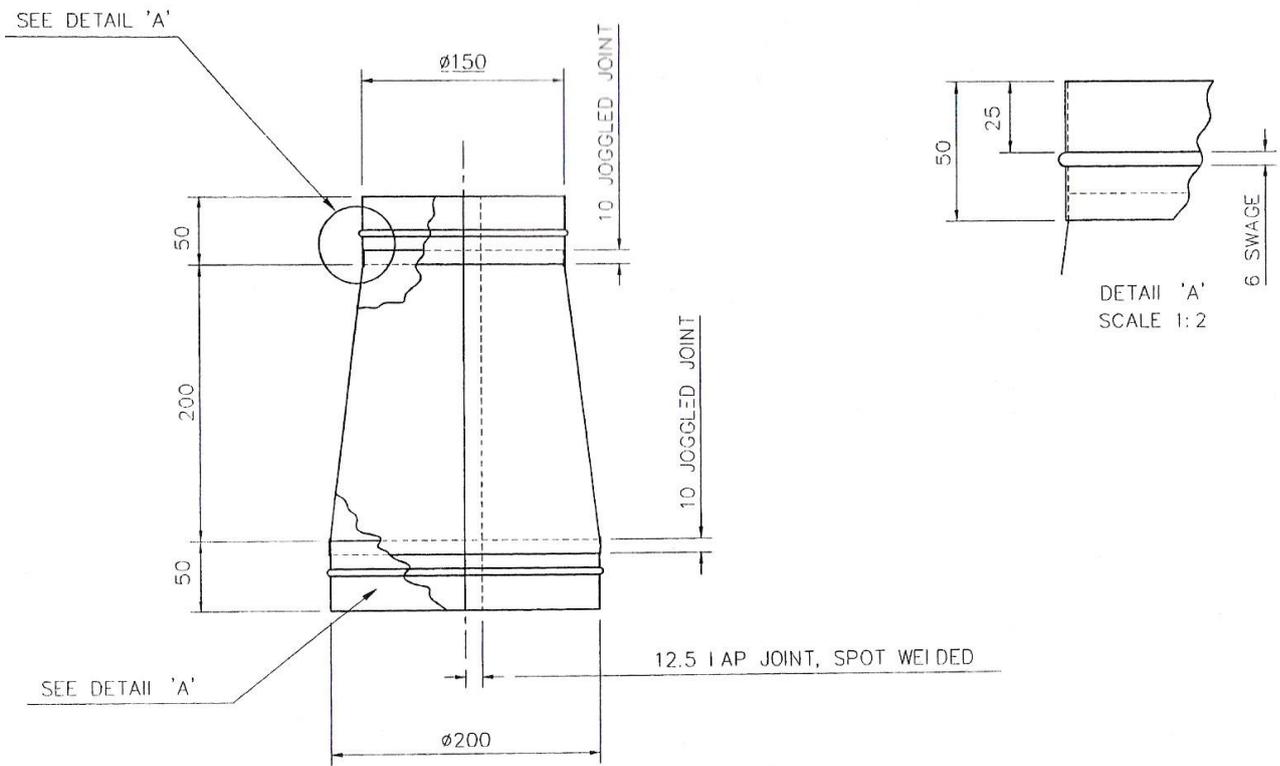
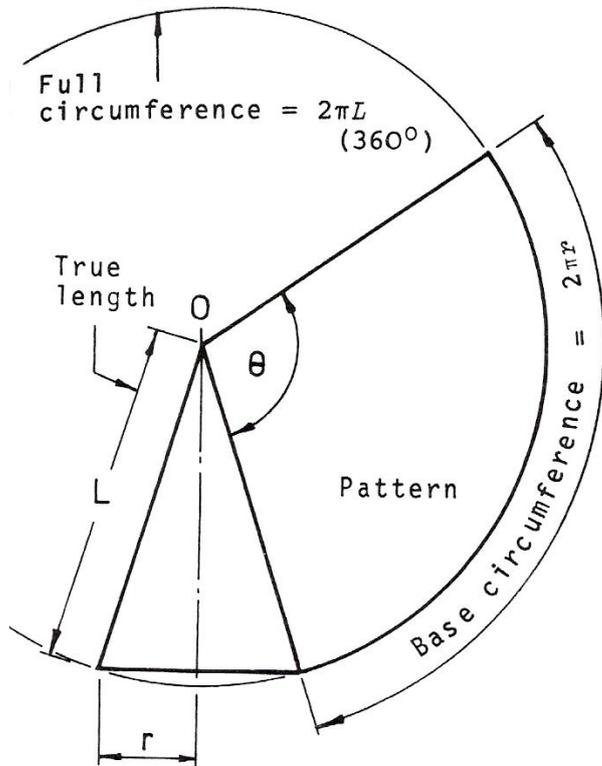
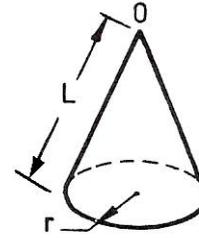


Figure 1 - Reducer

Development of Right Cones

There are two methods commonly used for developing patterns of conic shapes. Both are explained below.



1. The accurate method (top illustration)

The true length of the sloping edge of the cone is L . Using O as centre, an arc is drawn of radius L . Before the circumference of the base of the cone can be drawn along this arc, angle θ must be calculated as follows.

$$\frac{\theta}{2\pi r} = \frac{360^\circ}{2\pi L} \quad \theta = \frac{2\pi r \cdot 360^\circ}{2\pi L}$$

$$\theta = \frac{r}{L} \times 360^\circ$$

Exercise: Measure r and L (in millimetres) from the top illustration, calculate angle θ , and check that the pattern is correctly drawn.

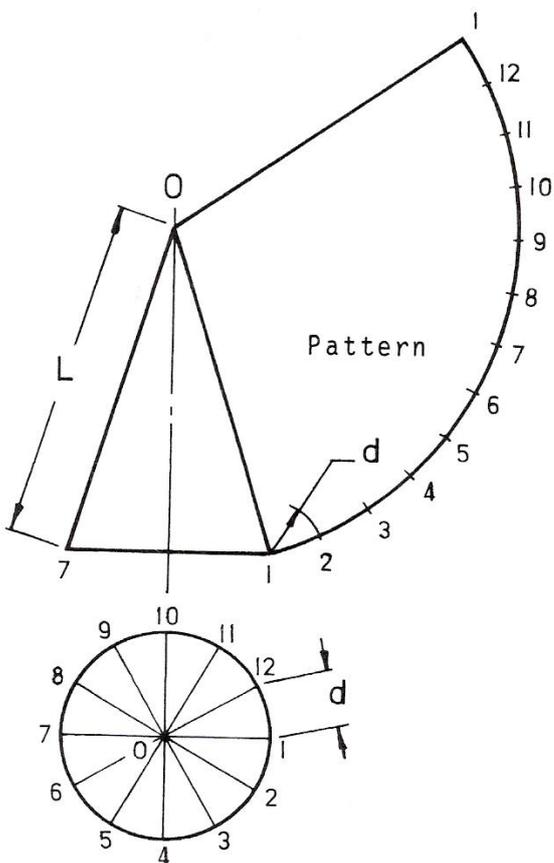
2. The approximate method (bottom illustration)

An arc is drawn with O as centre and radius L as in method 1. The plan view is divided into equal parts as shown. 12 parts are convenient, being easily obtained using a 30° set-square. Distance d , which is the approximate length of the distance between pairs of points on the base circle, is stepped off around the arc 12 times to complete the development.

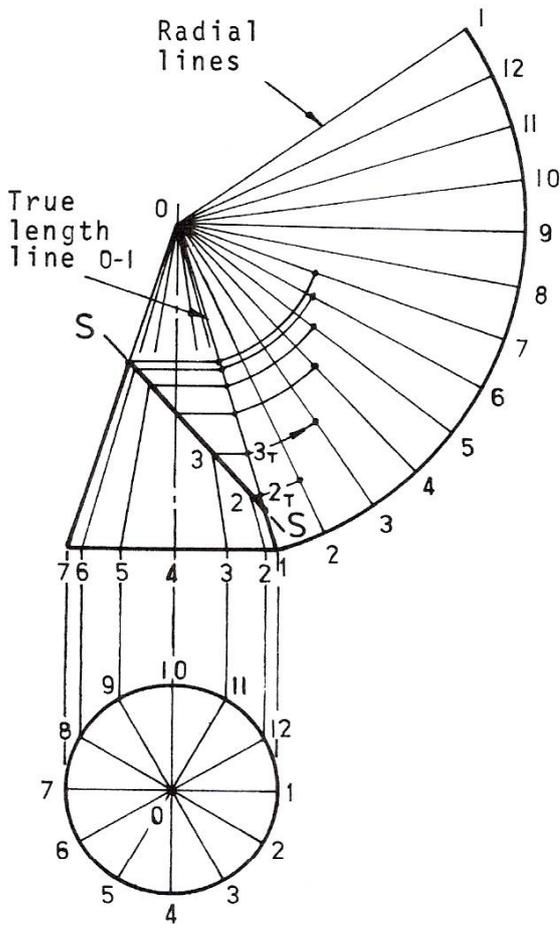
The sketch below shows clearly that a distance stepped off in this way is the true length of the chord between the points and not the true length of the arc.



Exercise: Compare the pattern constructed by this method with the one obtained using the accurate method by measuring the angles at O .



Development of the Frustum of a Right Cone



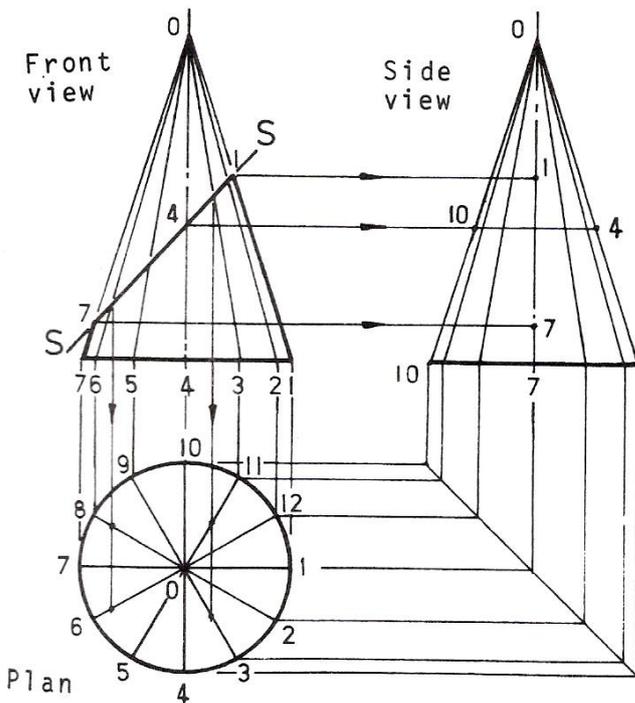
1. Develop the full surface area by using either the approximate method or the accurate method.
2. Add radial lines as shown. These correspond to the radial lines drawn on the surface of the cone.
3. From the points where the radial lines on the surface of the cone intersect the cutting plane SS, project horizontally to the true length line e.g. 2 to 2_T , 3 to 3_T etc.
4. Swing these true lengths from 0 to the corresponding radial lines on the pattern, e.g. 2_T to line 2, 3_T to line 3 etc.
5. *Exercise:* Complete the pattern by adding the remaining points and joining with a heavy line.

Note: All lengths on the pattern must be true lengths.

The shortest edge is usually used as the joint line. In this case it is along line 0-1.

As an aid to visualising the shape of conic frusta the construction of the front and plan views is illustrated and explained below.

Construction of plan view and side view of a conic frustum.



Plan View

Project the points of intersection of the radial lines and the cutting plane S-S from the front view to the corresponding radial lines in the plan as shown. E.g. points 6/8 to lines 6 and 8.

Side View

Project the points of intersection of the radial lines and the cutting plane S-S from the front view to the corresponding radial lines in the side view as shown. E.g. points 4/10 to lines 4 and 10.

Exercises: Complete the plan and side view.

The cone can be developed in two different ways, by radial line or triangulation. If the apex is a remote distance from the base, triangulation may be the better option.

The spigots may be assembled to the cone on the outside of the cone or slipped inside. Whichever option is chosen it should suit the air flow and so reduce possible leakage.

Possible joints are slip joint, pein joint, feather edge weld and a butt joint welded.

If a slip joint is used, spot welds or rivets may be used to help secure it. Care needs to be exercised with regard to heat when spot welding and also sparks may cause injury. Glasses are required. The spot welder may cause a magnetic field to occur which may damage wrist watches.

Volumes

Volume of square or rectangle = $L \times L \times L$

Where L is equal to length of sides and height.

Volume of cylinder = $\pi R^2 H$

Where H = height of cylinder.

Mass, Weight and Volume

Volume is defined as 'space taken up' and must not be confused with mass which is 'the amount of matter contained'. If you think of two equal sized cubes of lead and aluminium you will realise that, although they have equal volumes, the lead has a much larger mass than the aluminium. Your science teacher will explain this to you in greater detail.

Weight is really force. It is the force exerted by the earth on a body and this force we call gravity. Weight depends on mass and distance but since variations in distance to the earth's centre are very small comparatively, we use mass units as a measure of weight (and thus of force).

In your more advanced studies you will discover that in the SI metric system mass units are not used to measure force but that an absolute unit is used called the Newton.

The volume of an object is found by multiplying 3 linear dimensions together with the result appearing as a cubic measurement, i.e. cubic metres, cubic centimetres, cubic millimetres, etc. Just like the square is the unit of area, we must now recognise the cube as the unit of volume.

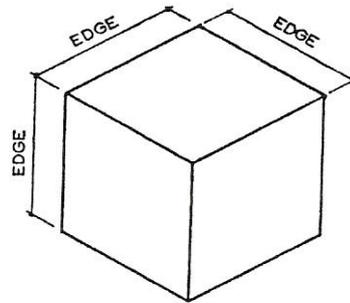


Figure 4 - A Cube

The volume of a cube = edge x edge x edge

If we denote edge by the letter e and volume by the letter V ; we can write $V = e \times e \times e$.

Another way of writing this is $V = e^3$ (V equals e cubed).

The small figure 3 above the e is another index, like the 2 in $A = I^2$ for the area of a square. They are indices.

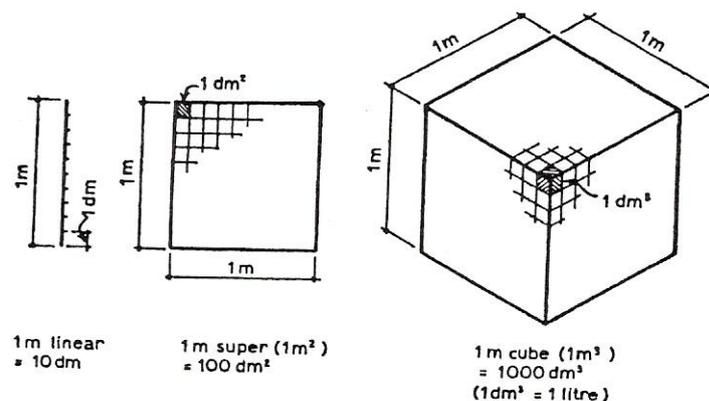


Figure 5 – Indices

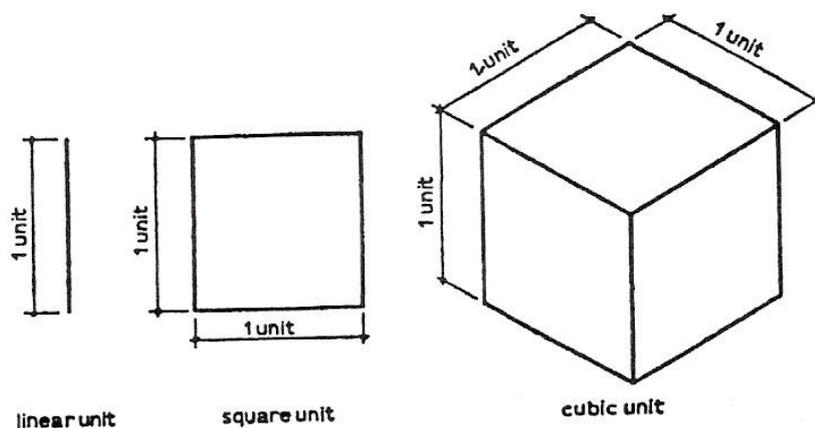


Figure 6 – Cubic Unit

The weights of building materials are expressed as so many kilograms per cubic metre (kg/m^3).

E.g.	structural concrete weighs	2400 kg/m^3
	steel weighs	7830 kg/m^3
	white pine weighs	530 kg/m^3

In each case the figure given is the weight of one unit of volume of the material. This is usually referred to as density. (Although density is strictly mass per unit volume.)

If we have a volume of material we can easily find its weight by multiplying volume by density.

Example

What is the weight of a 150 mm concrete cube if the density of the concrete is 2400 kg/m^3 ?

$$\begin{aligned}\text{Volume} &= 150 \times 150 \times 150 \text{ mm}^3 \\ &\text{or } 0.15 \times 0.15 \times 0.15 \text{ m}^3 \\ &\text{(each edge dimension has been divided by 1000 to convert from mm to m)}\end{aligned}$$

This gives a volume of 0.003375 m^3

$$\begin{aligned}\text{Weight} &= \text{Volume} \times \text{Density} \\ &= 0.003375 \times 2400 \text{ kg} \\ &= 8.1 \text{ kg Ans}\end{aligned}$$

Prisms

A prism is a solid which has the same cross-section throughout its length and its top parallel to its base.

The following are examples of right prisms because the side faces are rectangular (this is even true for the cylinder if you develop the surface). A rectangular prism with all edges of equal length is called a cube.

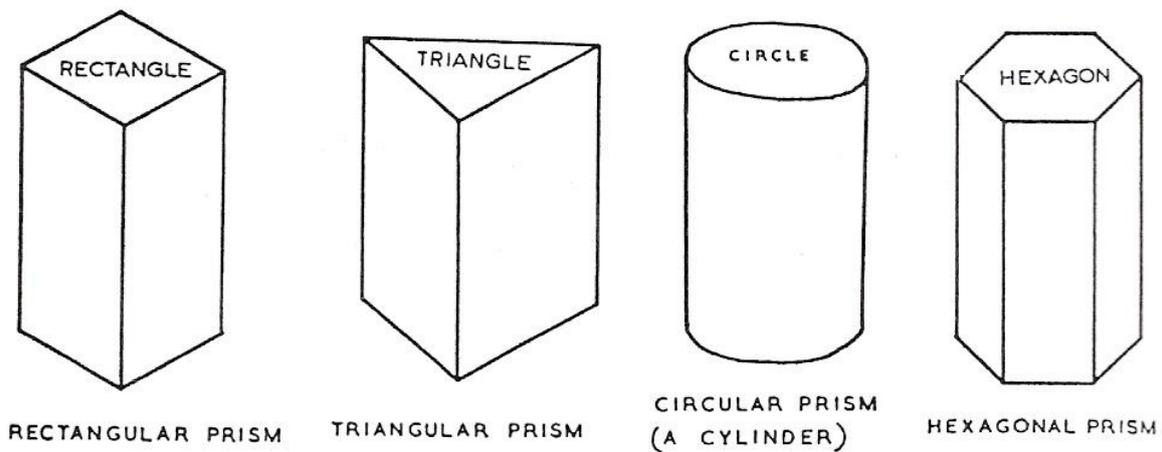


Figure 7 - Prisms

The volume of a right prism is the area of one end multiplied by the height of the prism or, volume of prism = area of cross-section x height.

To find the total surface area of a prism, add the areas of all its faces.

Where the prism is inclined, the formula for the volume holds good provided you remember that the vertical height of the prism must be taken.

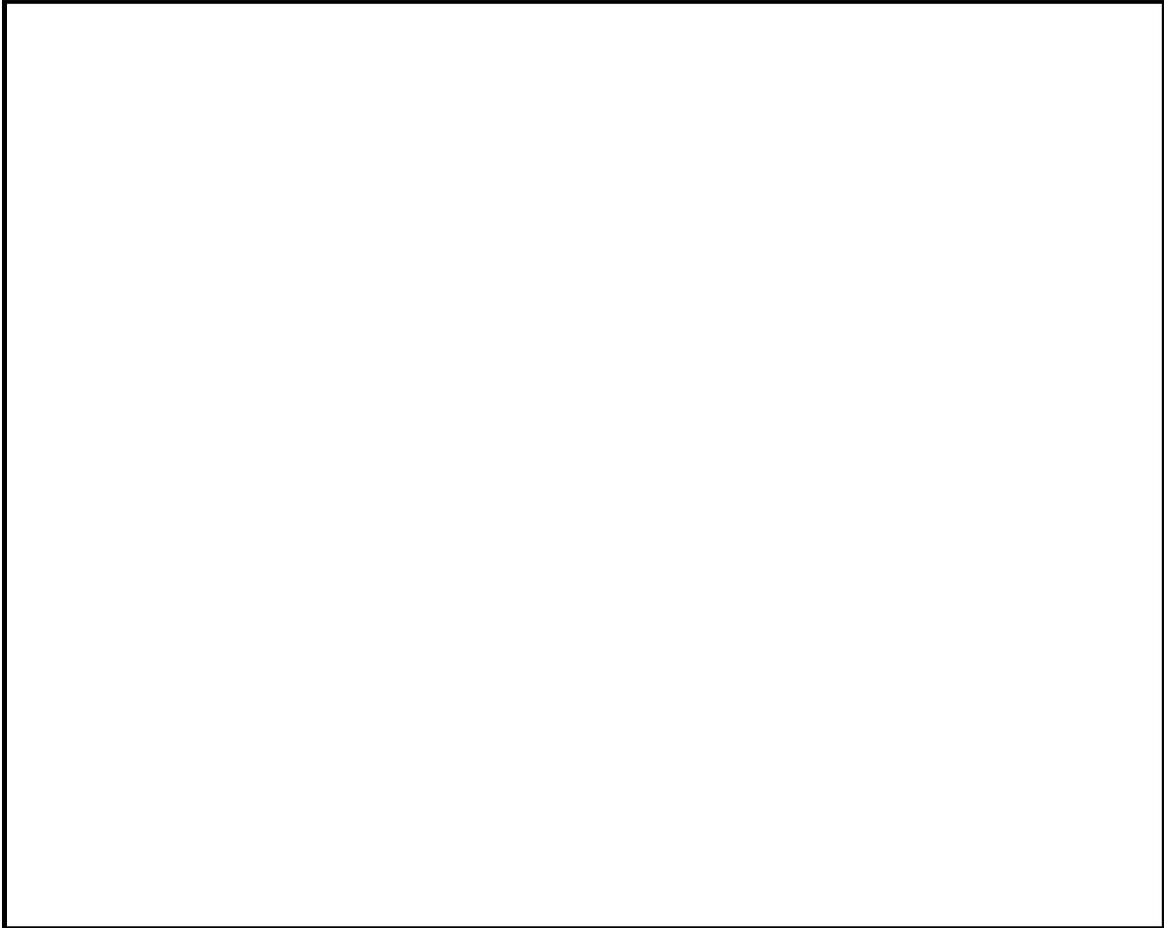
Self Assessment

Questions on Background Notes – Module 4. Unit 7

1. What is the volume of a square cube 40mm wide?

2. What is the volume of a cylinder with a radius of 50mm and a height of 300mm?

3. With the aid of a drawing of a cone explain why there are only 2 true length lines in the elevation.



Answers to Questions 1-3. Module 4. Unit 7

1.

$$\begin{aligned}\text{Volume} &= L \times B \times H &= 40 \times 40 \times 40 \\ & &= 64,000 \text{ mm}^3\end{aligned}$$

2.

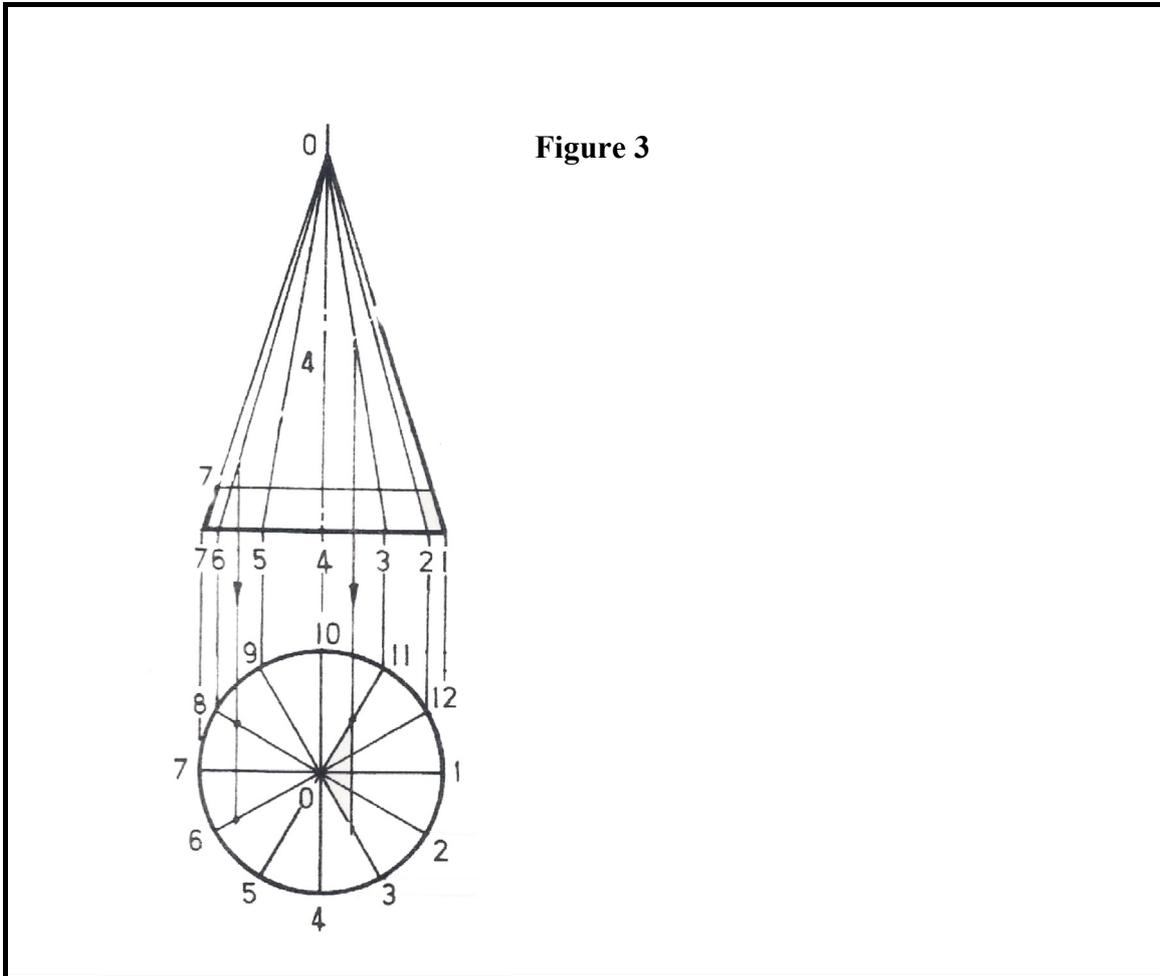
$$\begin{aligned}\text{Volume} &= \pi R^2 \times H &= 3.142 \times 25^2 \times 300\text{mm} \\ & &= 589,125\text{mm}^3\end{aligned}$$

3.

When developing a pattern for a cone we may use all of the construction lines or generators as they are also known. They are usually numbered 1-7 i.e. 1,2,3,4,5,6,7. 1 and 7 are the true lengths. We get the true length by using the plan length which is taken from the apex in the plan to the position of 1,2,3,4,5,6,7 etc which is on the outside of the plan. By observation we note that the distance apex 0 to point 1 and to point 7 is the same as 4 to 1 and 4 to 7 in the elevation. So the lines 0 to 1 and 0 to 7 have already been laid out against their plan length and vertical height giving us true lengths.

Continue.

3. Continued.



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