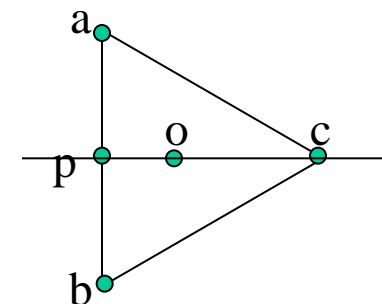
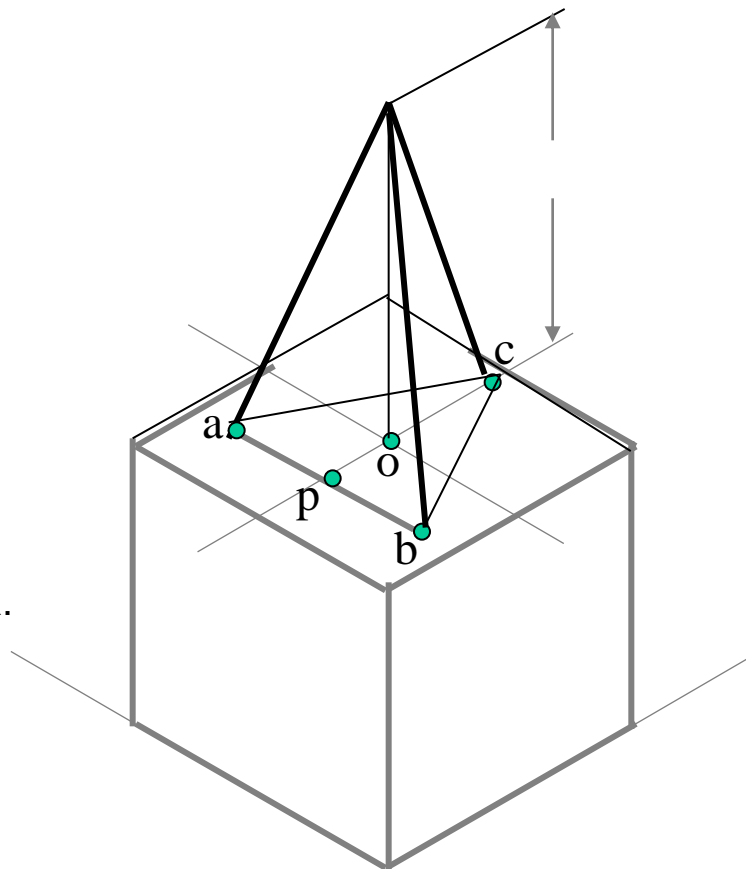


STUDY ILLUSTRATIONS

PROBLEM: A TRIANGULAR PYRAMID OF 30 MM BASE SIDES AND 50 MM LONG AXIS, IS CENTRALLY PLACED ON THE TOP OF A CUBE OF 50 MM LONG EDGES. DRAW ISOMETRIC VIEW OF THE PAIR.



SOLUTION HINTS.

TO DRAW ISOMETRIC OF A CUBE IS SIMPLE. DRAW IT AS USUAL.

BUT FOR PYRAMID AS IT'S BASE IS AN EQUILATERAL TRIANGLE, IT CAN NOT BE DRAWN DIRECTLY. SUPPORT OF IT'S TV IS REQUIRED.

SO DRAW TRIANGLE AS A TV, SEPARATELY AND NAME VARIOUS POINTS AS SHOWN.

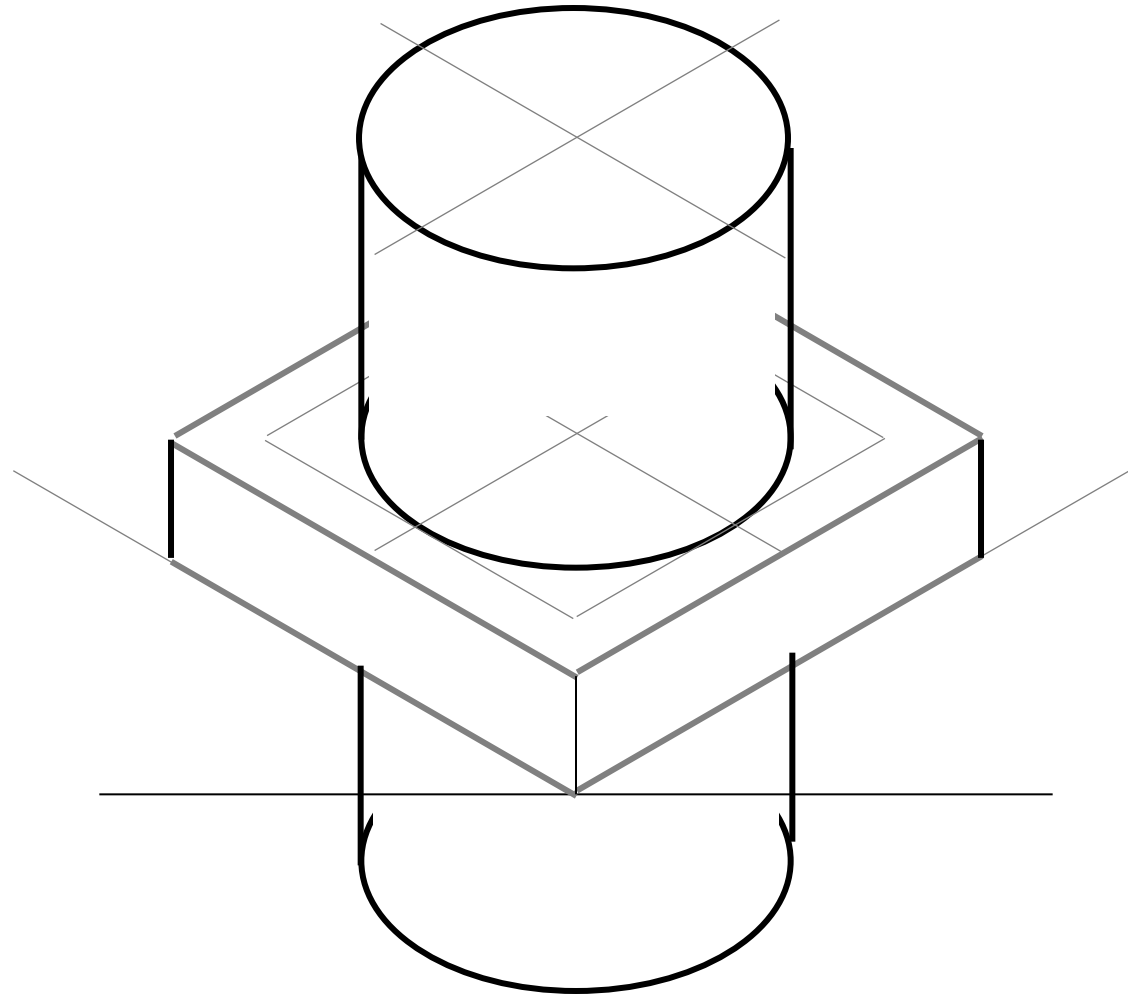
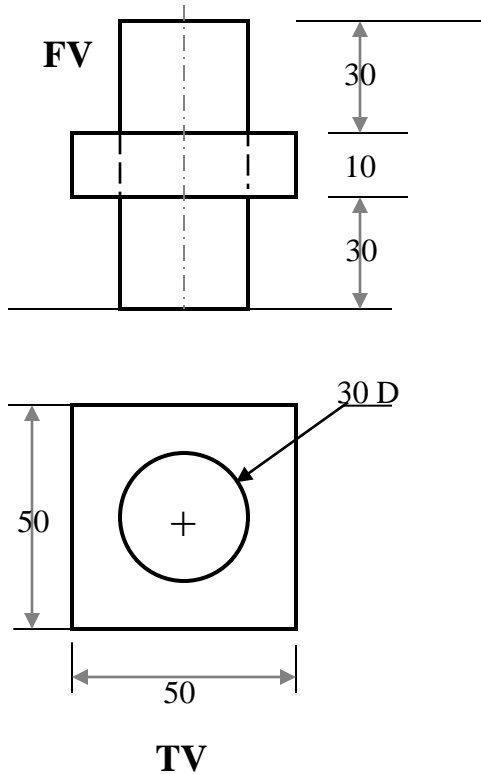
AFTER THIS PLACE IT ON THE TOP OF CUBE AS SHOWN.

THEN ADD HEIGHT FROM IT'S CENTER AND COMPLETE IT'S ISOMETRIC AS SHOWN.

STUDY ILLUSTRATIONS

PROBLEM:

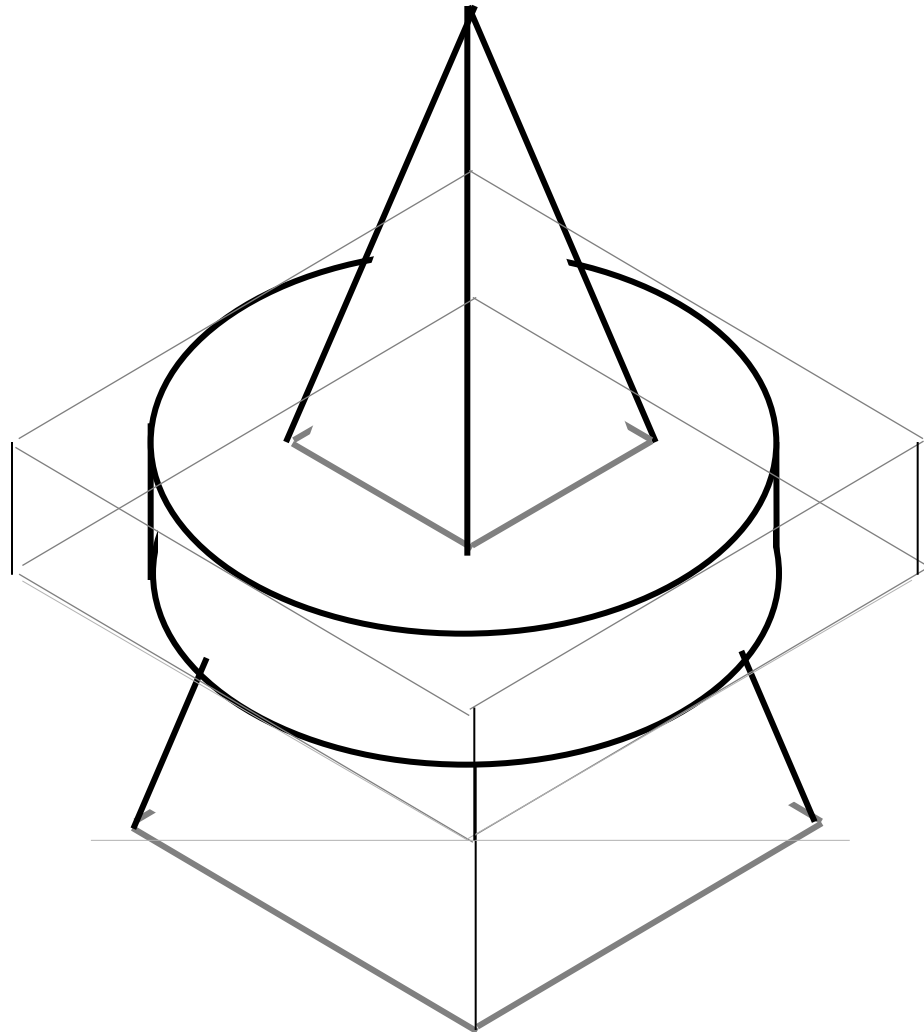
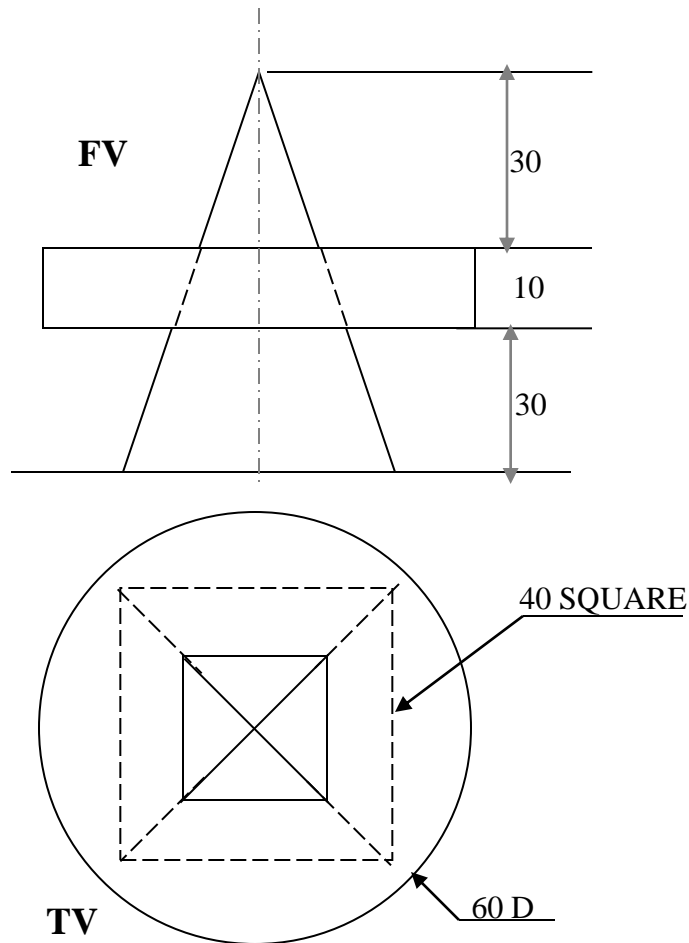
A SQUARE PLATE IS PIERCED THROUGH CENTRALLY BY A CYLINDER WHICH COMES OUT EQUALLY FROM BOTH FACES OF PLATE. IT'S FV & TV ARE SHOWN. DRAW ISOMETRIC VIEW.



STUDY ILLUSTRATIONS

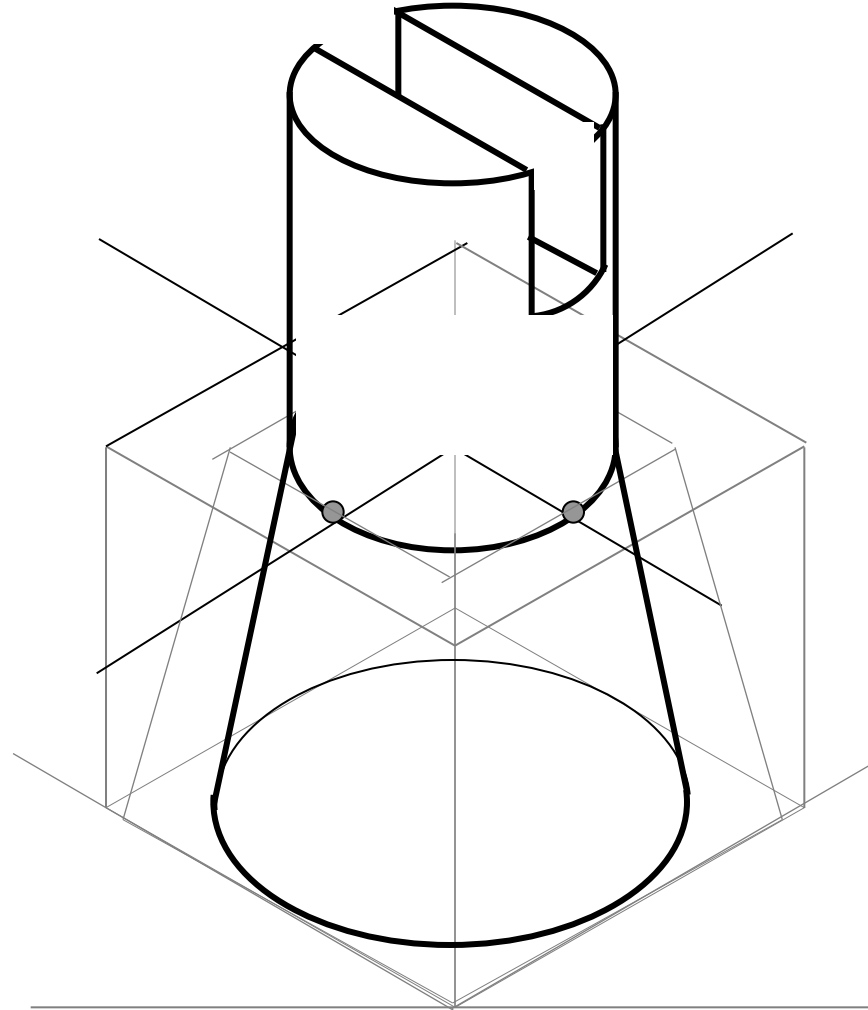
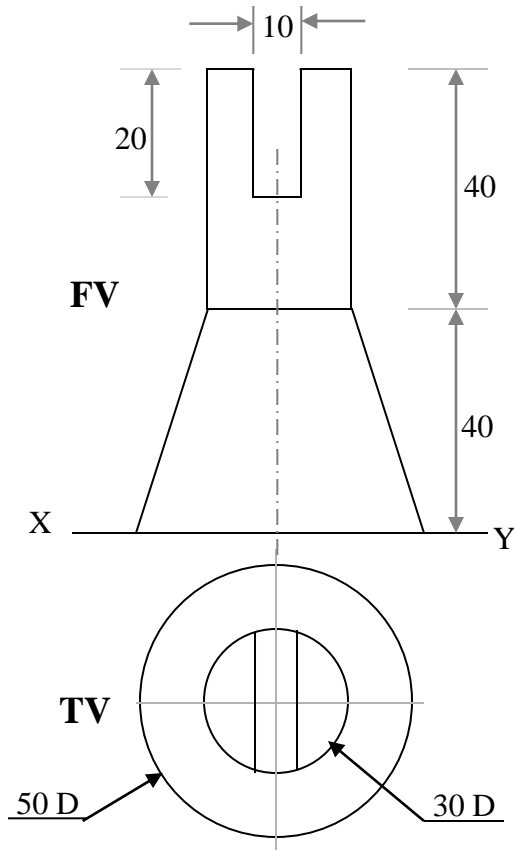
PROBLEM:

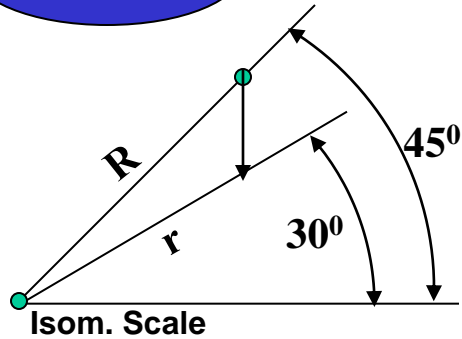
A CIRCULAR PLATE IS PIERCED THROUGH CENTRALLY BY A SQUARE PYRAMID WHICH COMES OUT EQUALLY FROM BOTH FACES OF PLATE. IT'S FV & TV ARE SHOWN. DRAW ISOMETRIC VIEW.



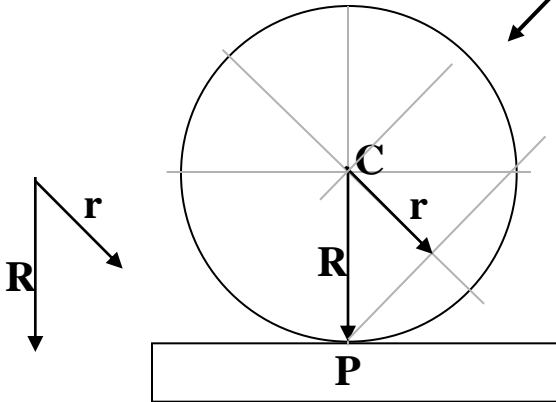
STUDY ILLUSTRATIONS

F.V. & T.V. of an object are given. Draw it's isometric view.

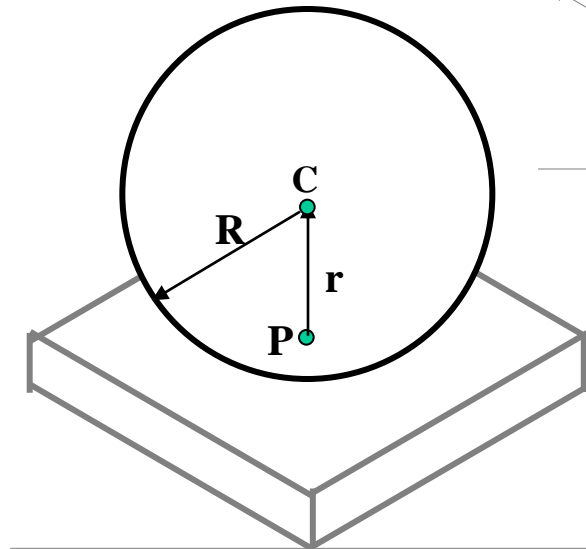




Iso-Direction

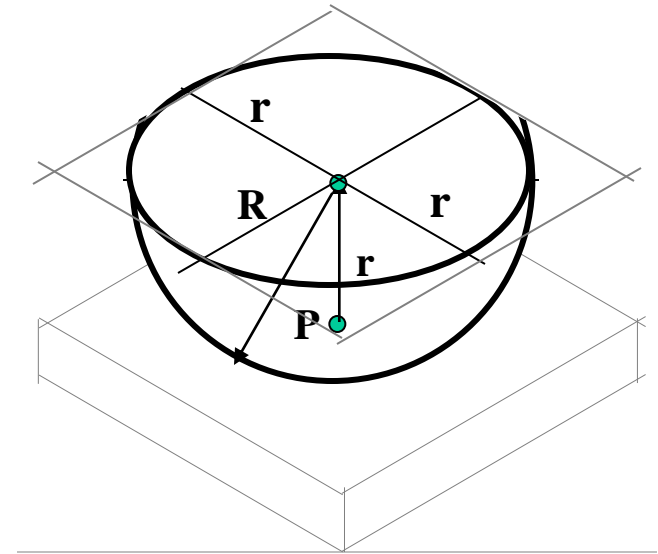


C = Center of Sphere.
P = Point of contact
R = True Radius of Sphere
r = Isometric Radius.



TO DRAW ISOMETRIC PROJECTION OF A SPHERE

1. FIRST DRAW ISOMETRIC OF SQUARE PLATE.
2. LOCATE IT'S CENTER. NAME IT P.
3. FROM P DRAW VERTICAL LINE UPWARD, LENGTH ' r mm' AND LOCATE CENTER OF SPHERE "C"
4. 'C' AS CENTER, WITH RADIUS 'R' DRAW CIRCLE.
THIS IS ISOMETRIC PROJECTION OF A SPHERE.

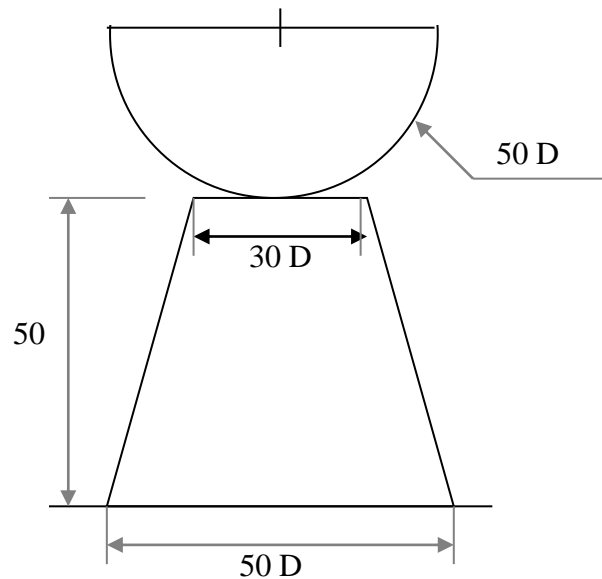


TO DRAW ISOMETRIC PROJECTION
OF A HEMISPHERE

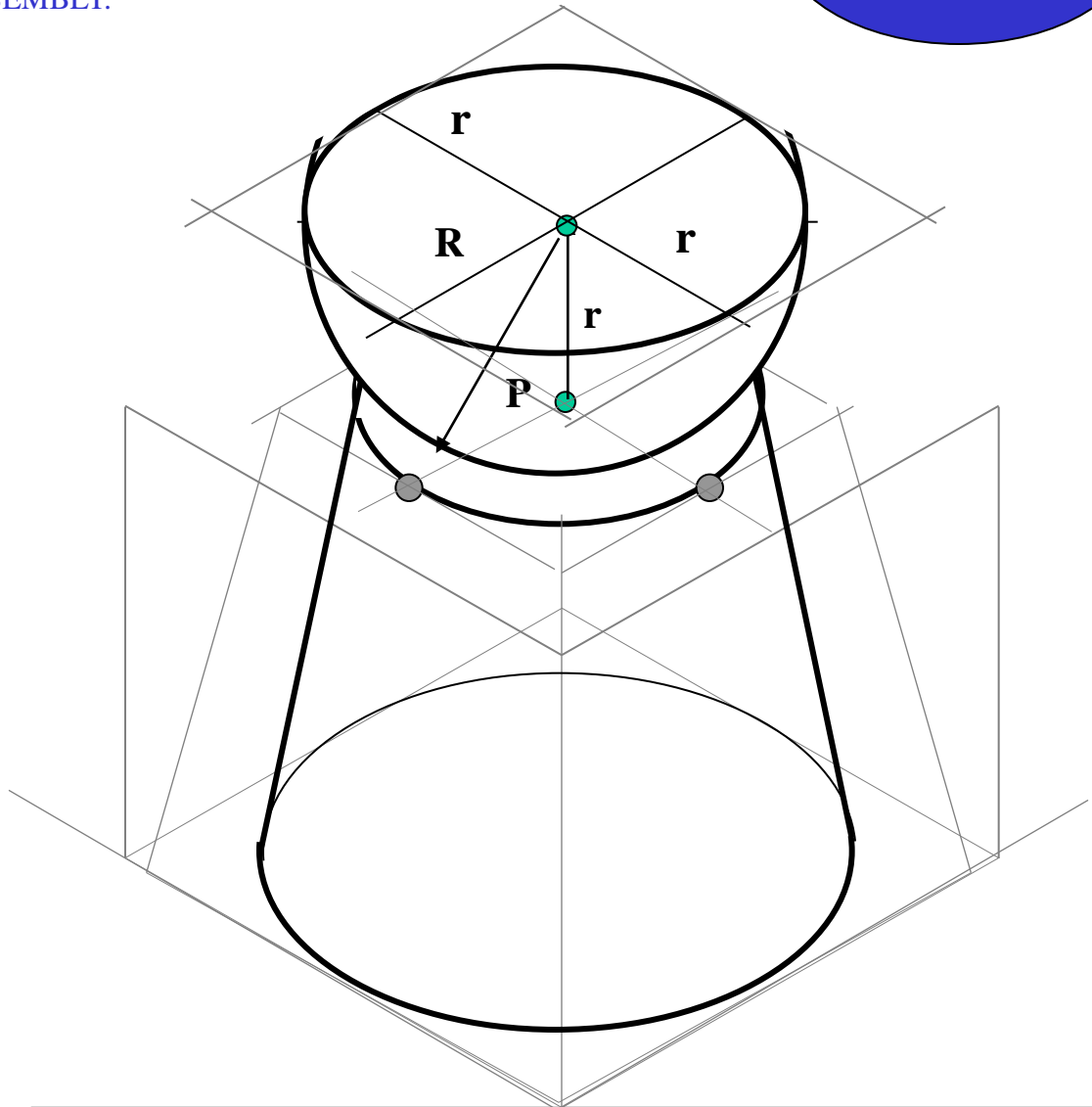
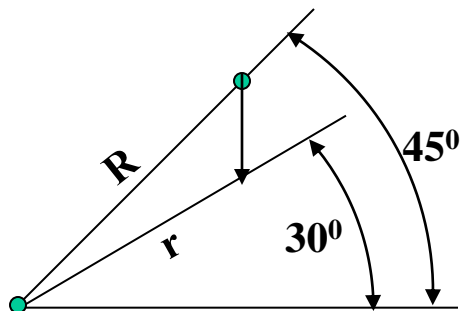
Adopt same procedure.
 Draw lower semicircle only.
 Then around 'C' construct
 Rhombus of Sides equal to
 Isometric Diameter.
 For this use iso-scale.
 Then construct ellipse in
 this Rhombus as usual
 And Complete
 Isometric-Projection
 of Hemi-sphere.

PROBLEM:

A HEMI-SPHERE IS CENTRALLY PLACED
ON THE TOP OF A FRUSTUM OF CONE.
DRAW ISOMETRIC PROJECTIONS OF THE ASSEMBLY.

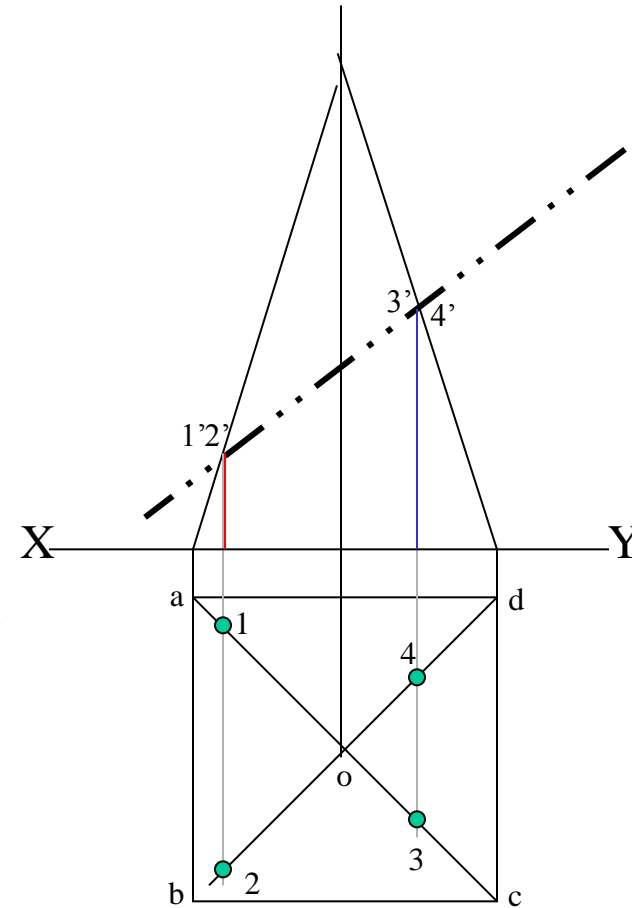
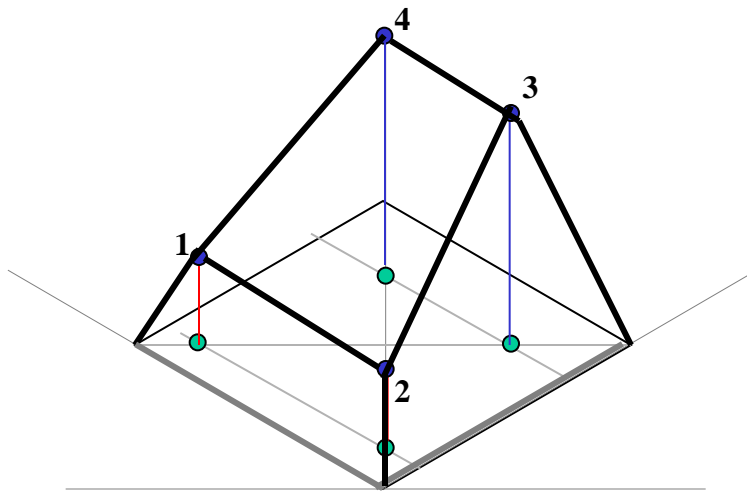


**FIRST CONSTRUCT ISOMETRIC SCALE.
USE THIS SCALE FOR ALL DIMENSIONS
IN THIS PROBLEM.**



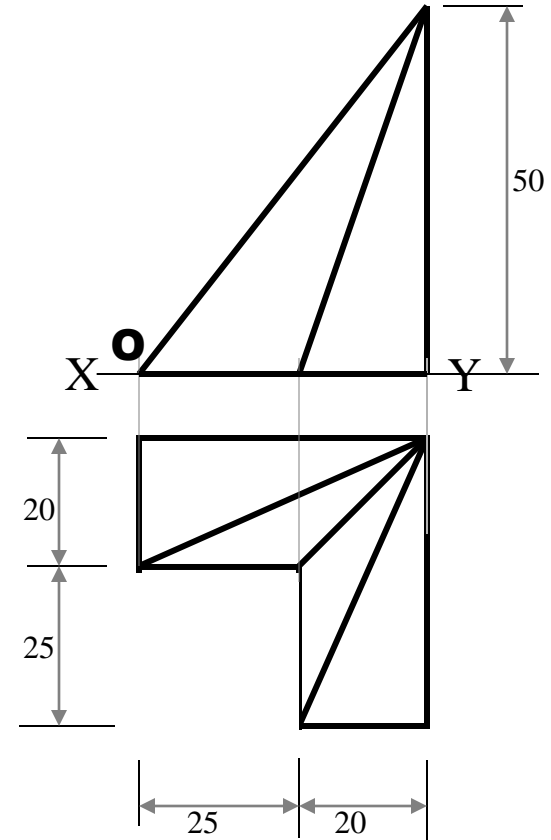
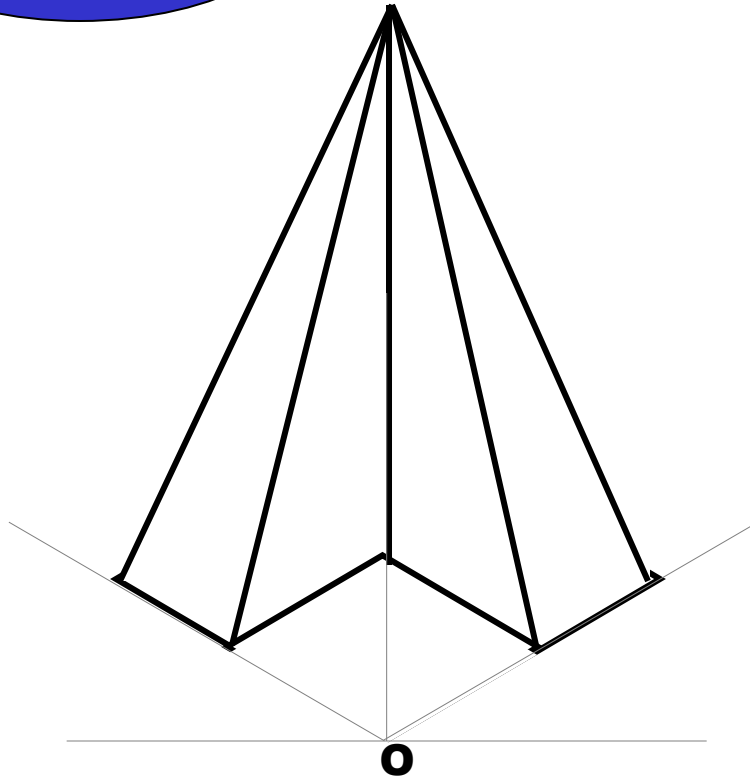
STUDY ILLUSTRATIONS

A SQUARE PYRAMID OF 40 MM BASE SIDES AND 60 MM AXIS IS CUT BY AN INCLINED SECTION PLANE THROUGH THE MID POINT OF AXIS AS SHOWN. DRAW ISOMETRIC VIEW OF SECTION OF PYRAMID.



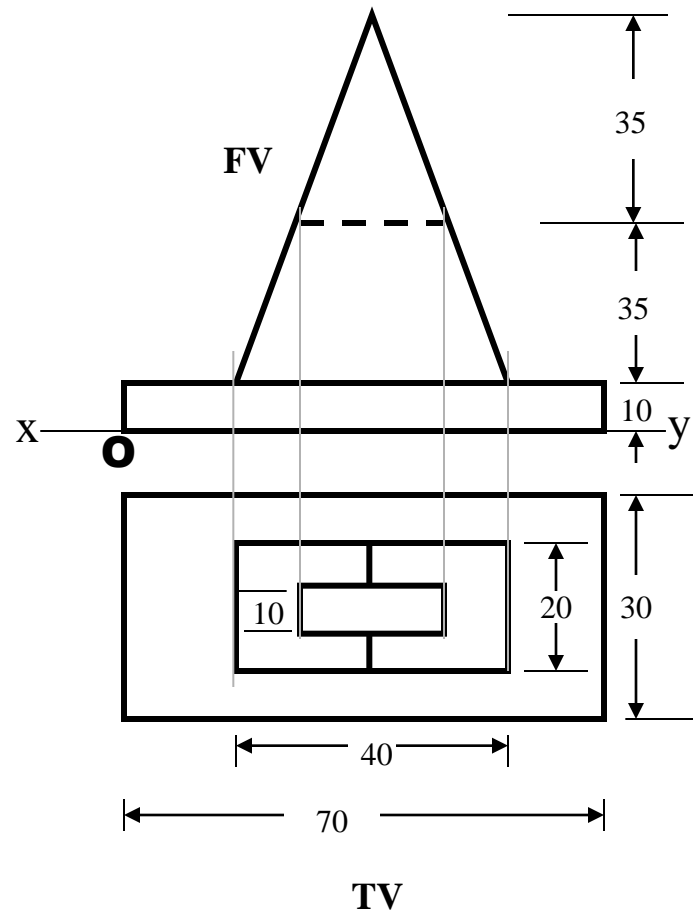
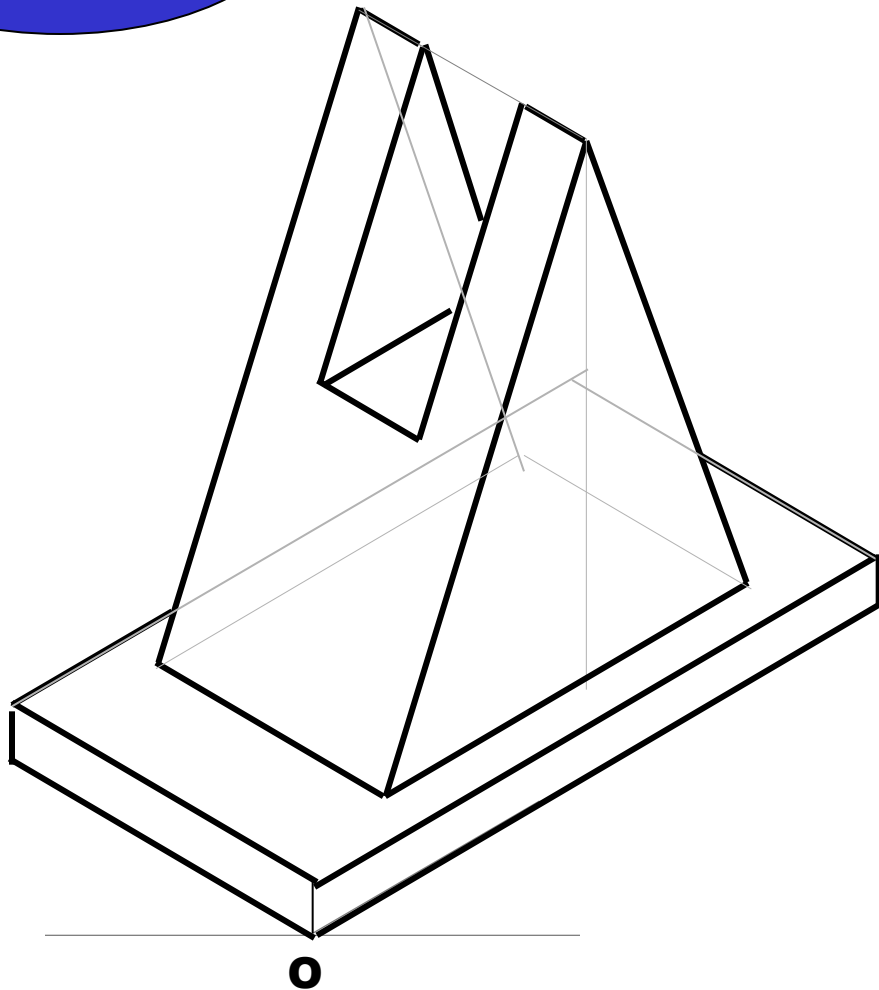
STUDY ILLUSTRATIONS

F.V. & T.V. of an object are given. Draw it's isometric view.



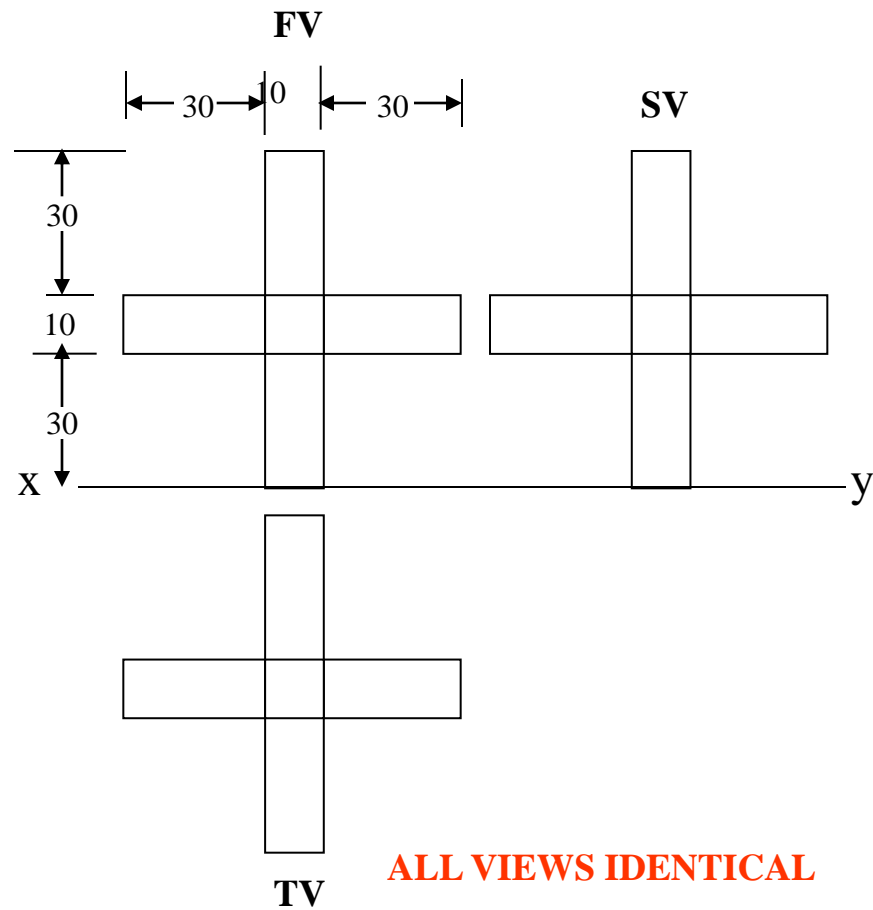
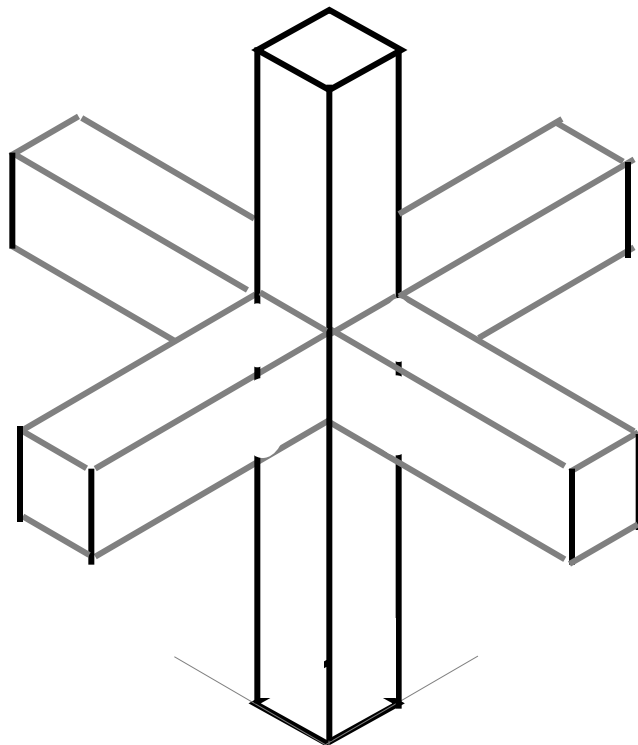
STUDY ILLUSTRATIONS

F.V. & T.V. of an object are given. Draw its isometric view.



STUDY ILLUSTRATIONS

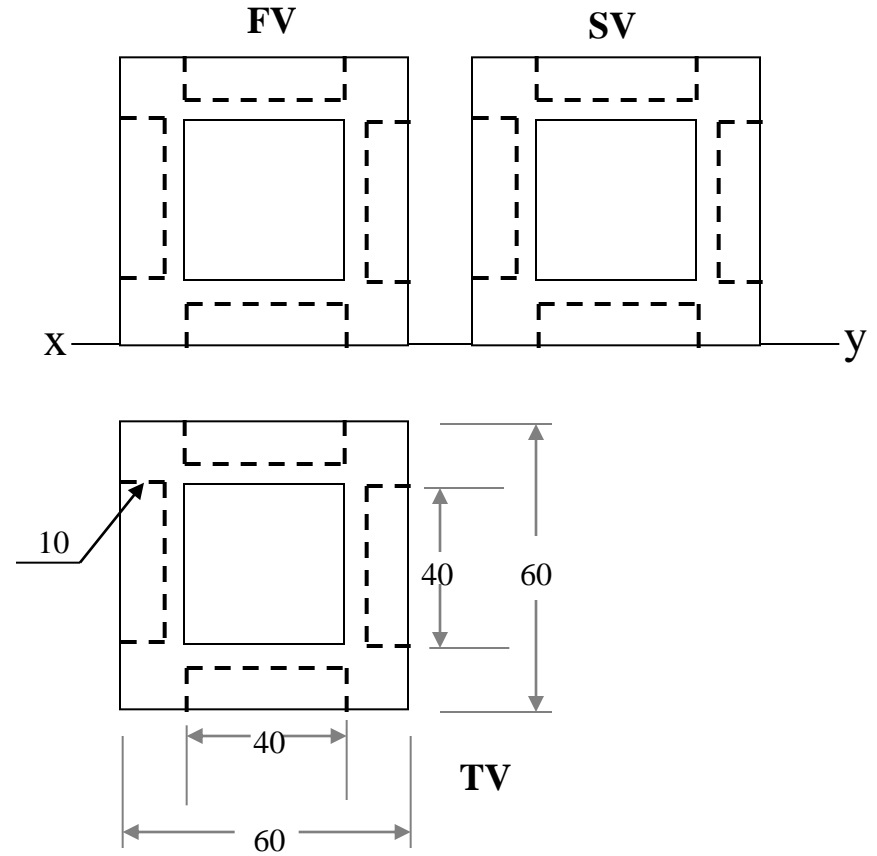
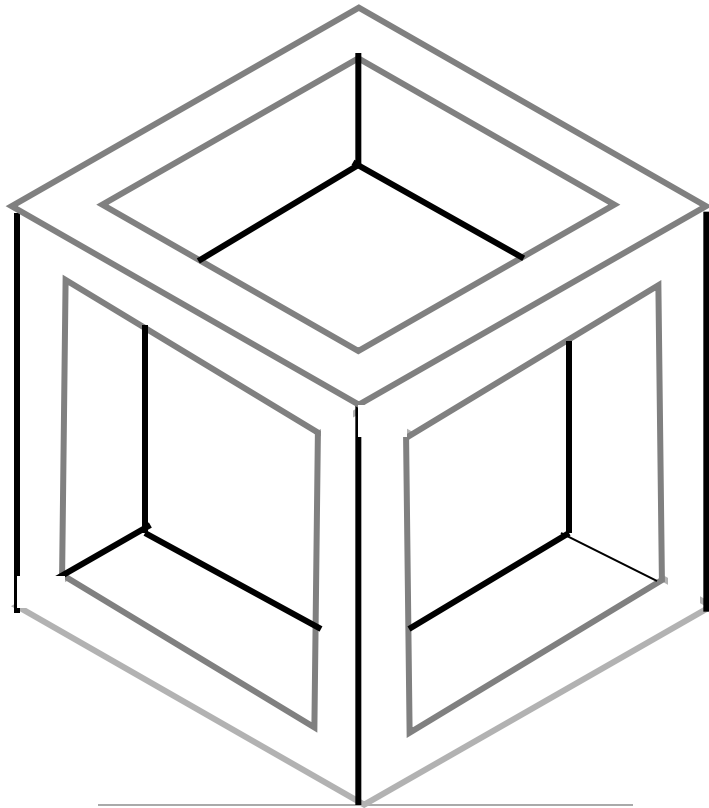
F.V. & T.V. and S.V. of an object are given. Draw its isometric view.



STUDY ILLUSTRATIONS

F.V. & T.V. and S.V. of an object are given. Draw its isometric view.

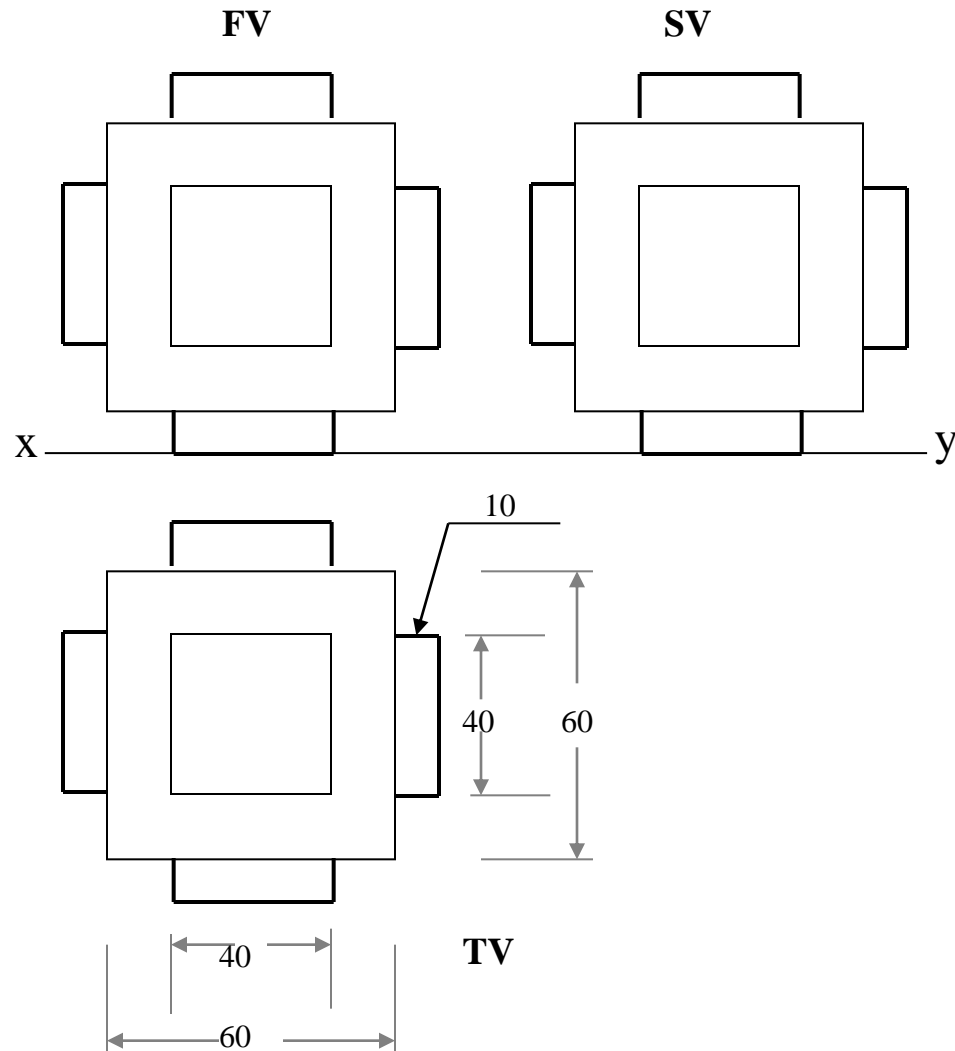
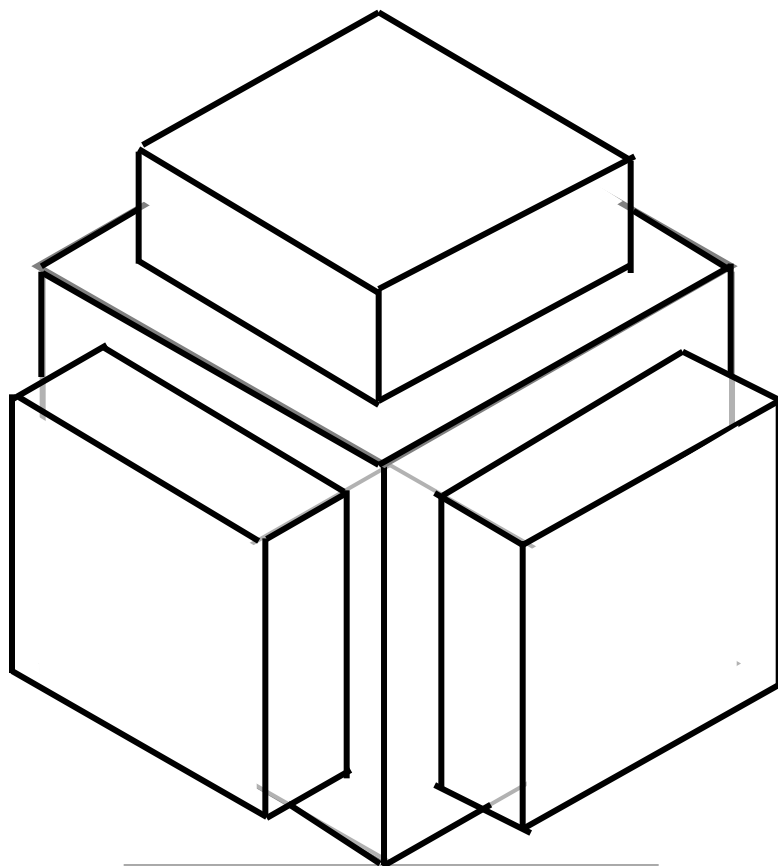
ALL VIEWS IDENTICAL



**STUDY
ILLUSTRATIONS**

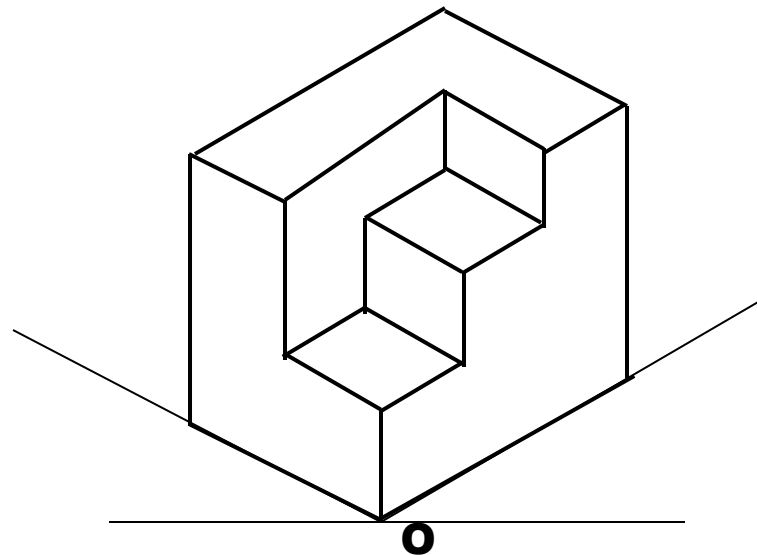
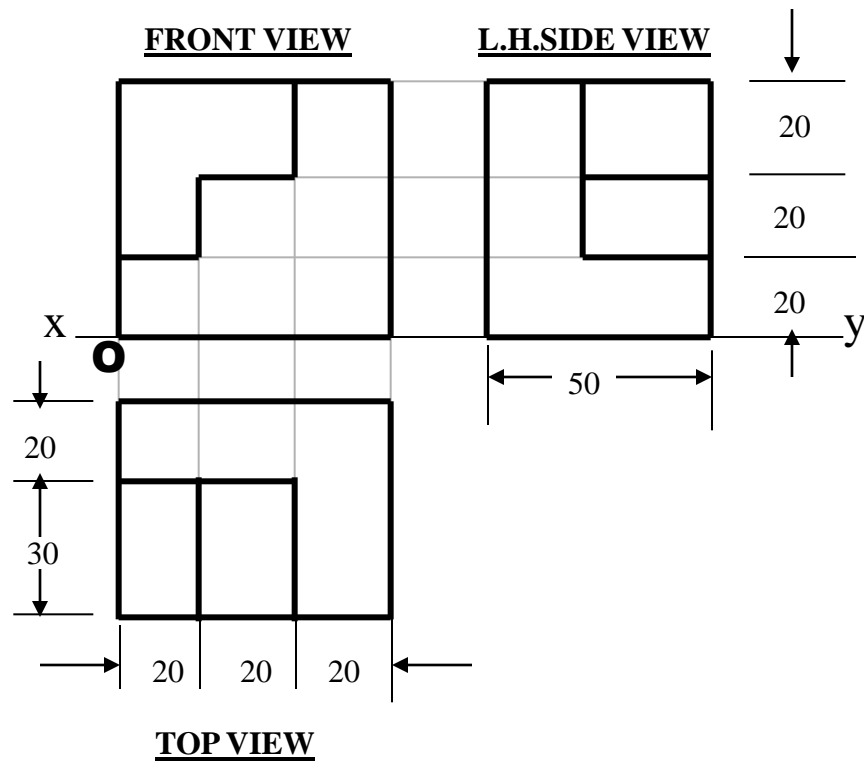
F.V. & T.V. and S.V. of an object are given. Draw its isometric view.

ALL VIEWS IDENTICAL



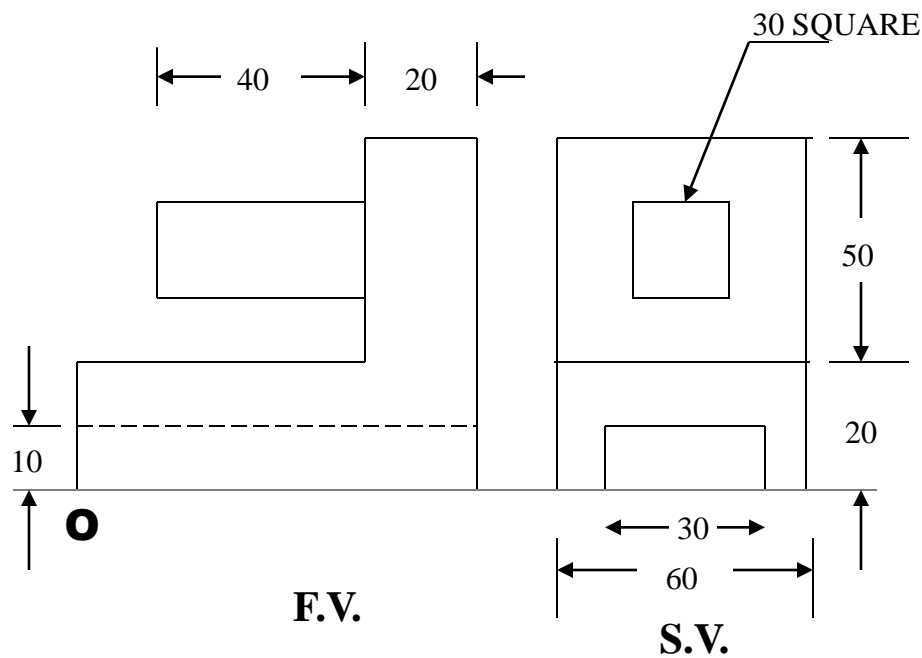
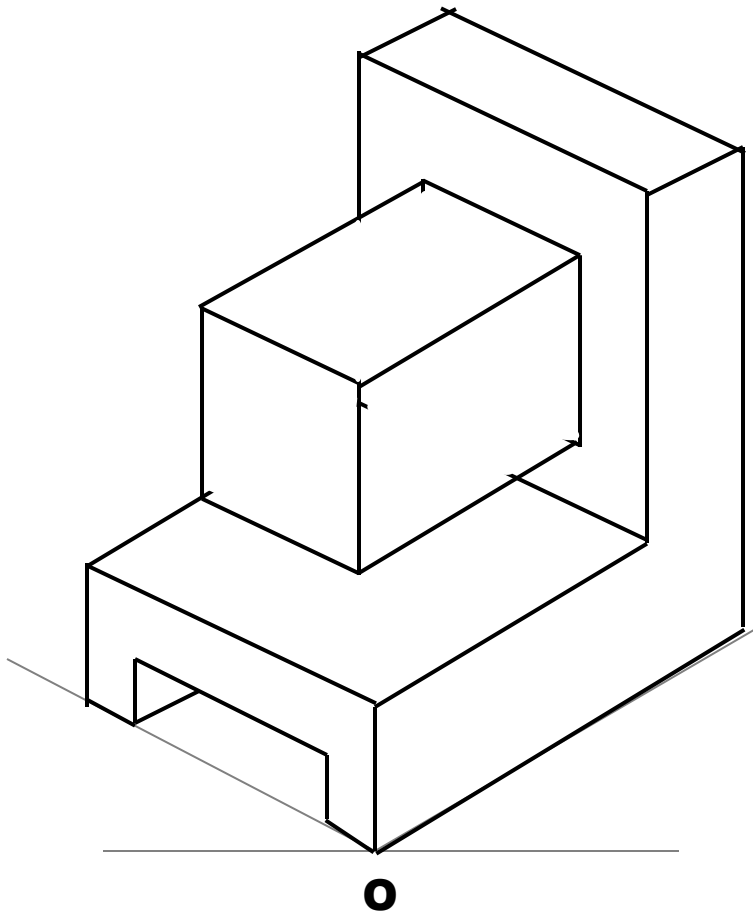
F.V. & T.V. and S.V. of an object are given. Draw its isometric view.

ORTHOGRAPHIC PROJECTIONS



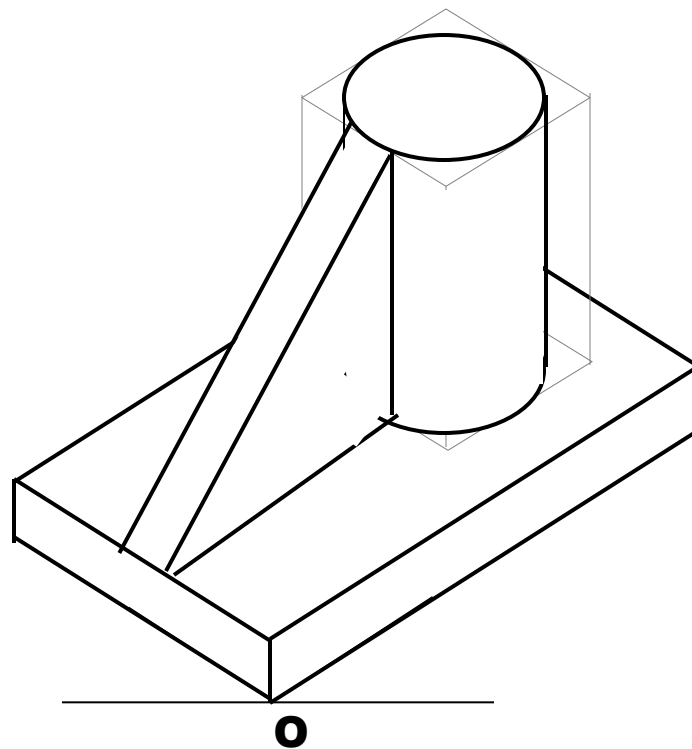
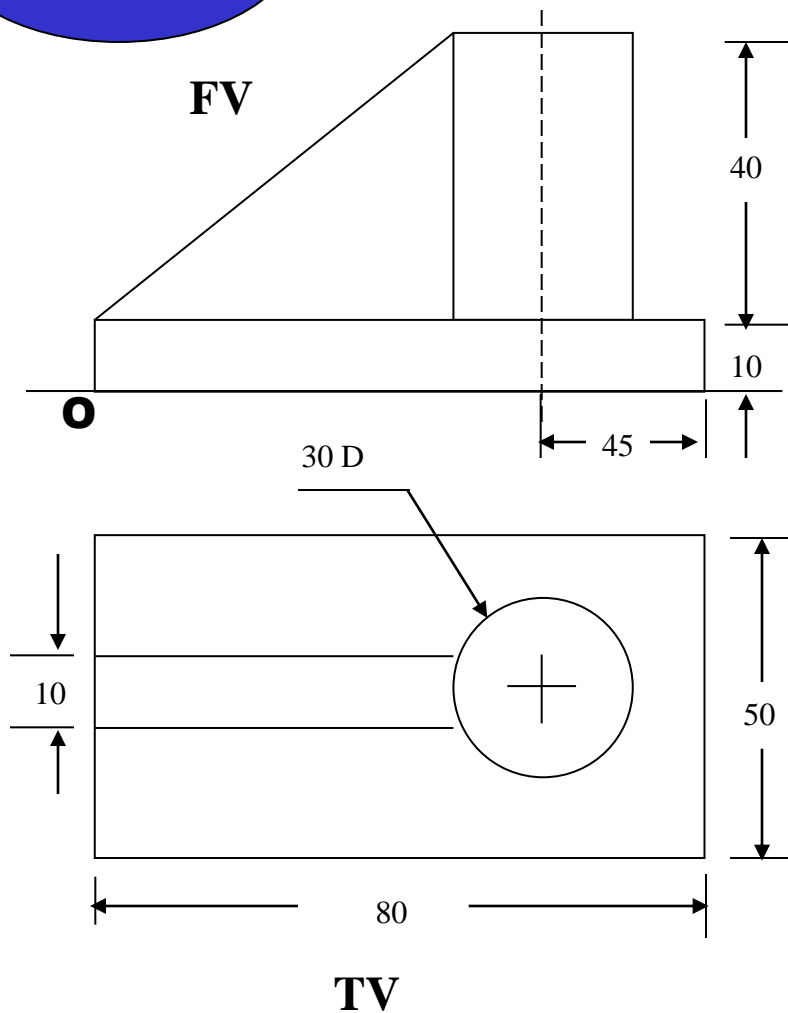
**STUDY
ILLUSTRATIONS**

**F.V. and S.V. of an object are given.
Draw it's isometric view.**



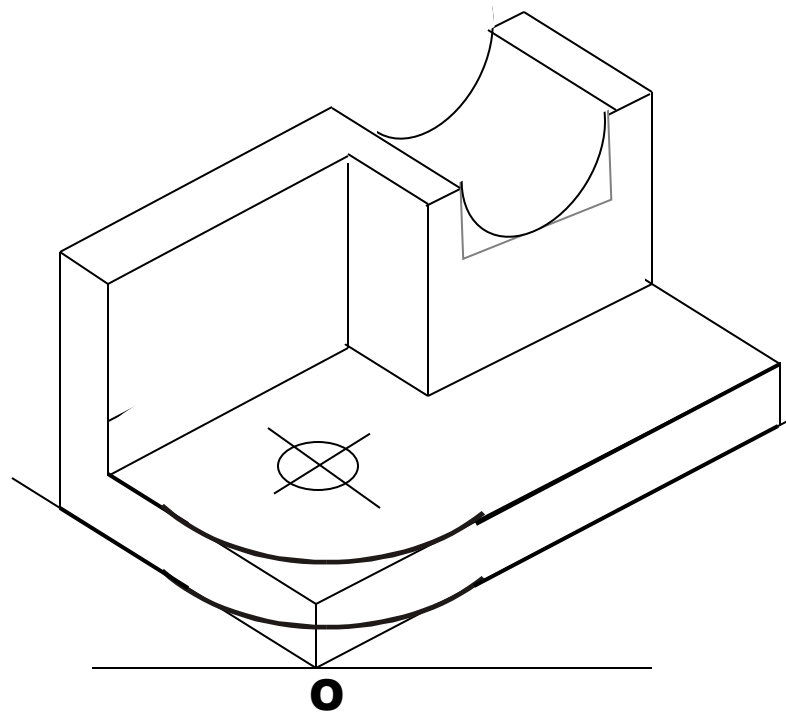
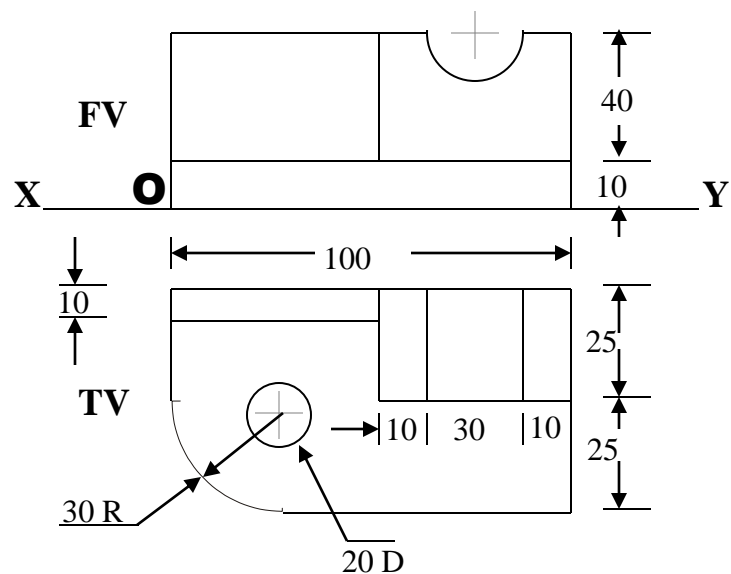
**STUDY
ILLUSTRATIONS**

F.V. & T.V. of an object are given. Draw it's isometric view.



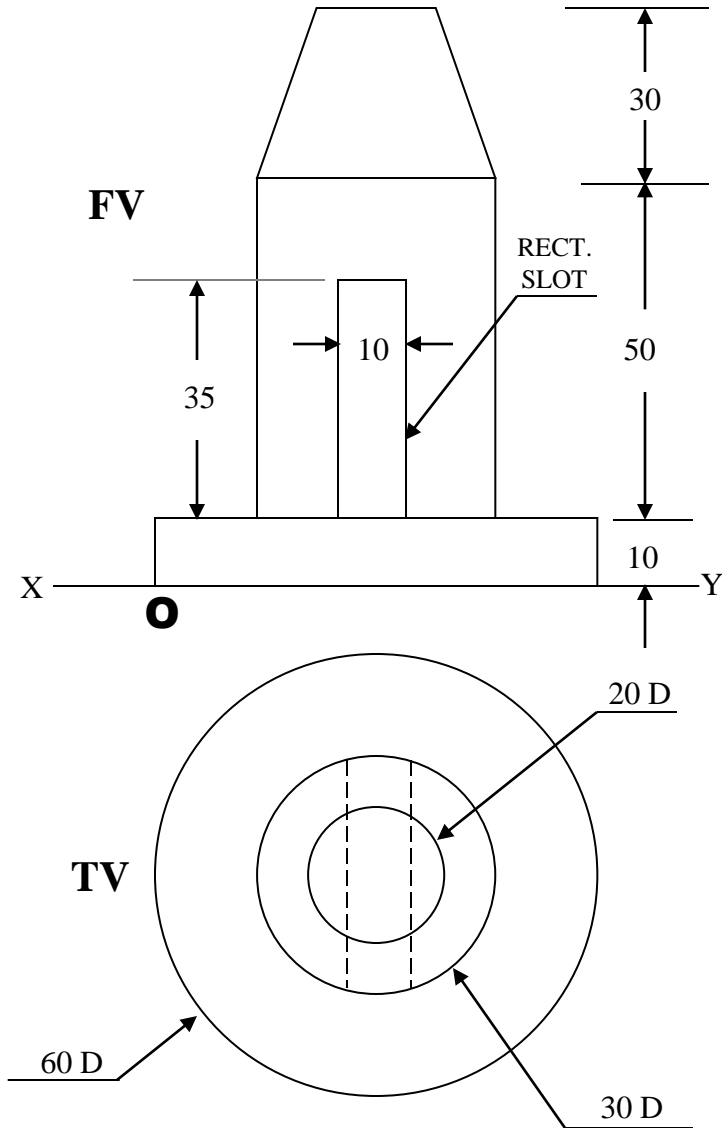
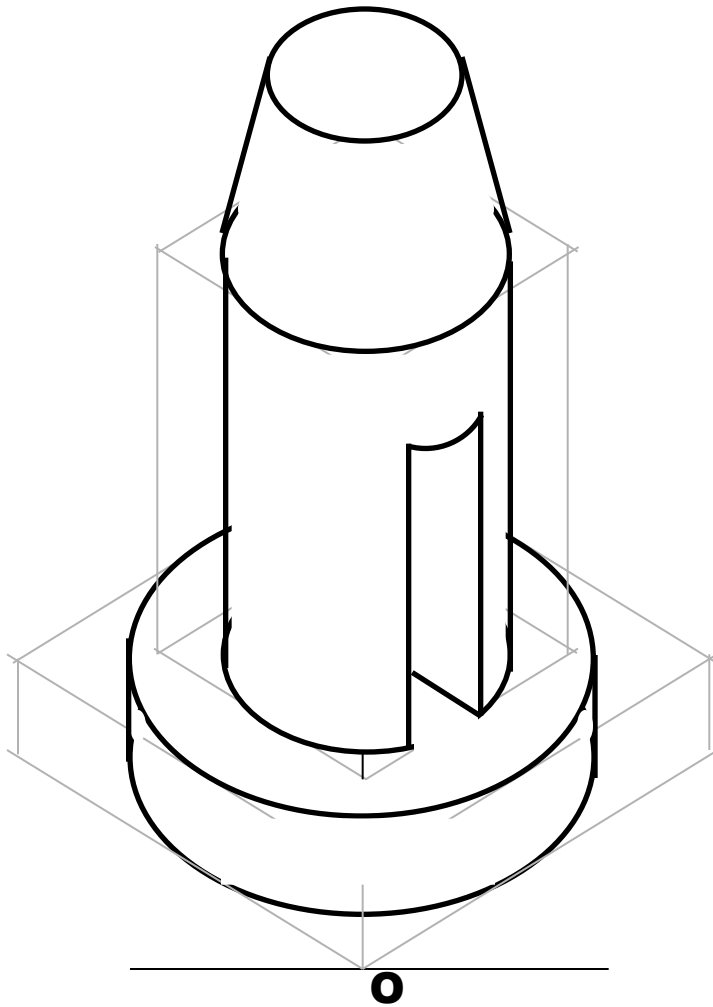
**STUDY
ILLUSTRATIONS**

F.V. & T.V. of an object are given. Draw its isometric view.



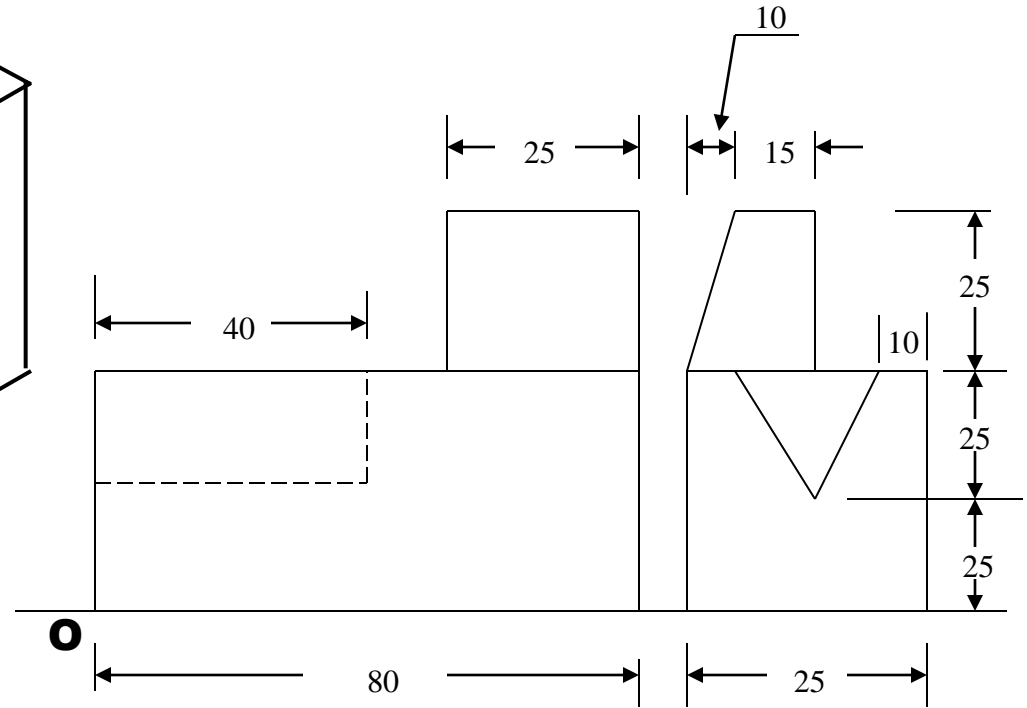
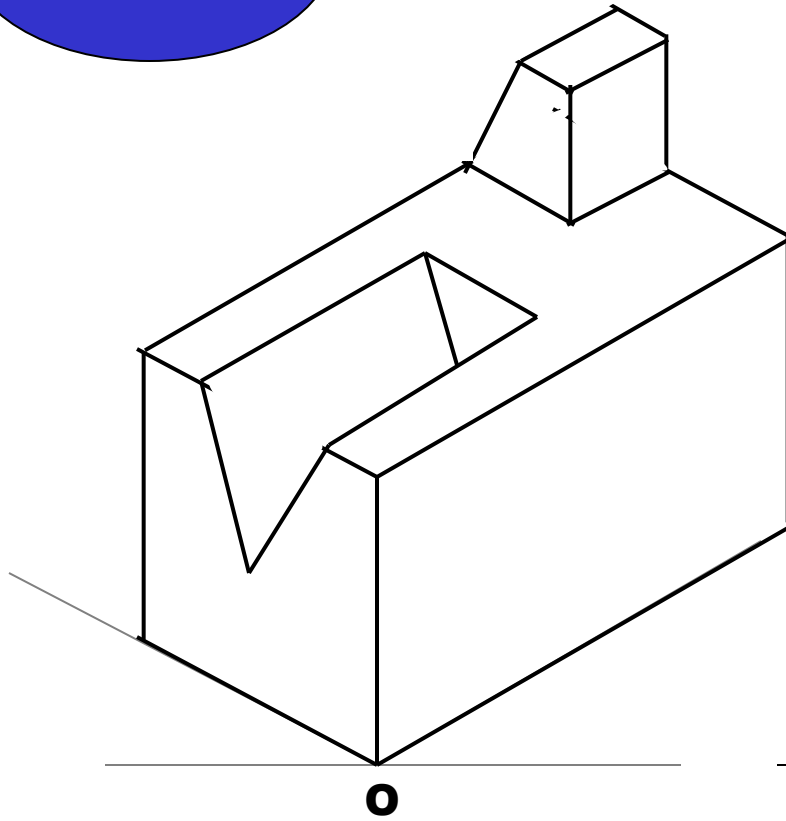
**STUDY
ILLUSTRATIONS**

F.V. & T.V. of an object are given. Draw it's isometric view.



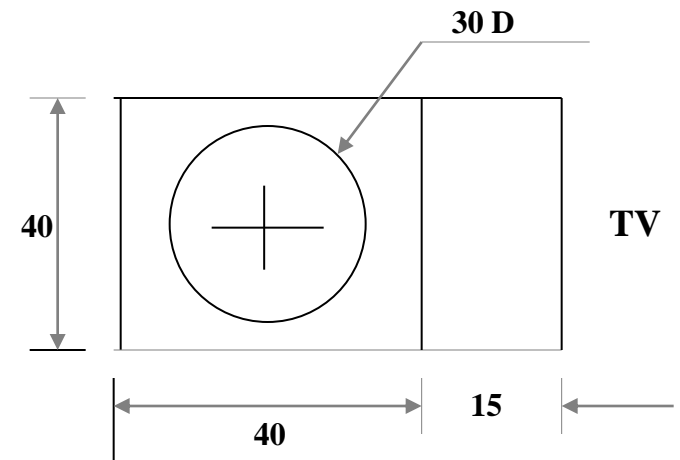
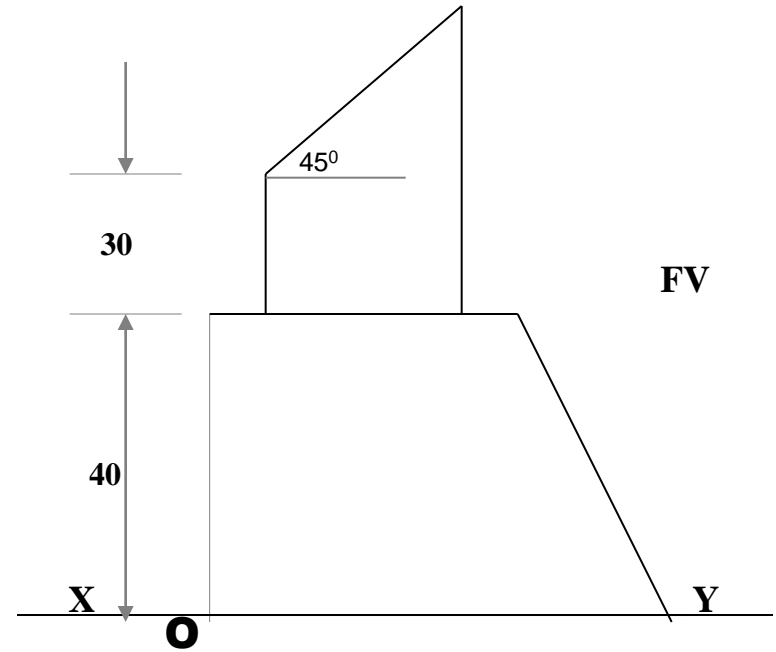
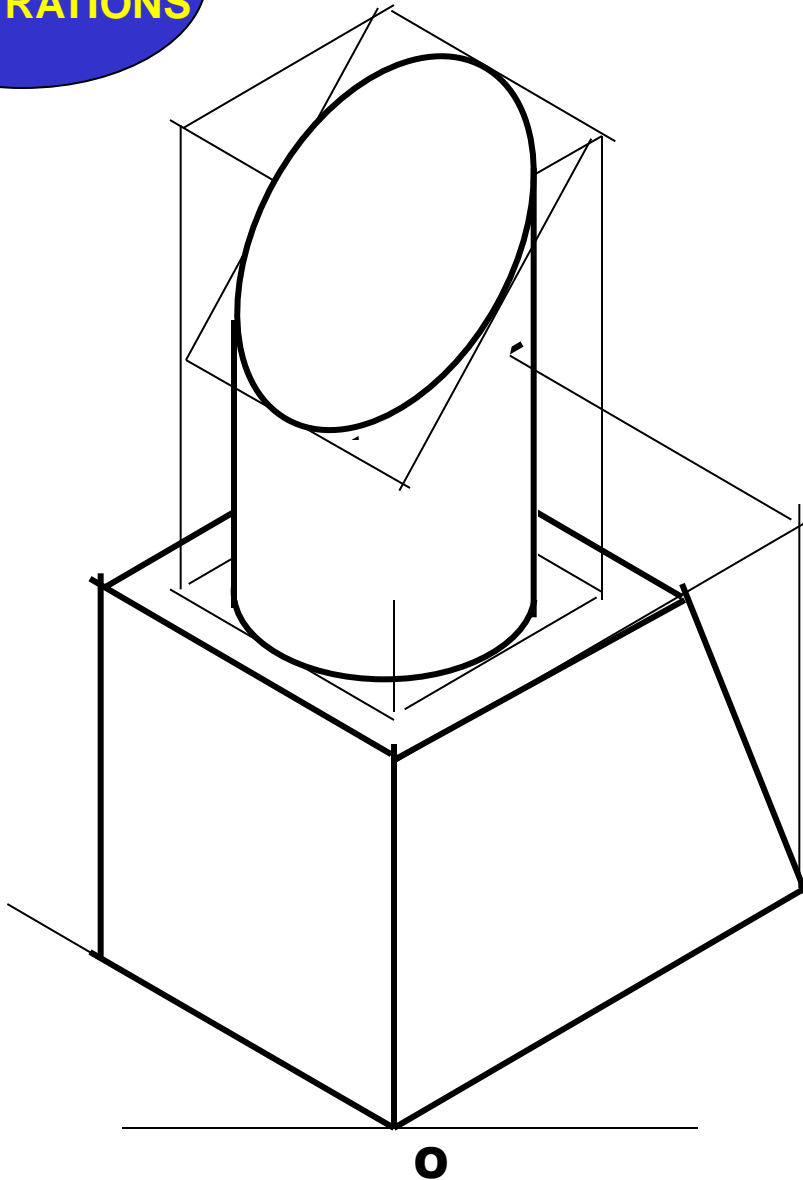
**STUDY
ILLUSTRATIONS**

F.V. and S.V. of an object are given. Draw its isometric view.



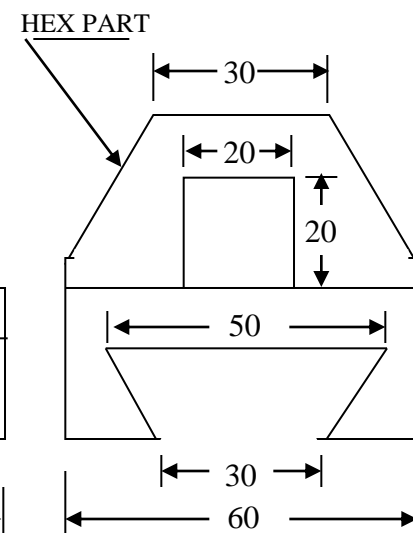
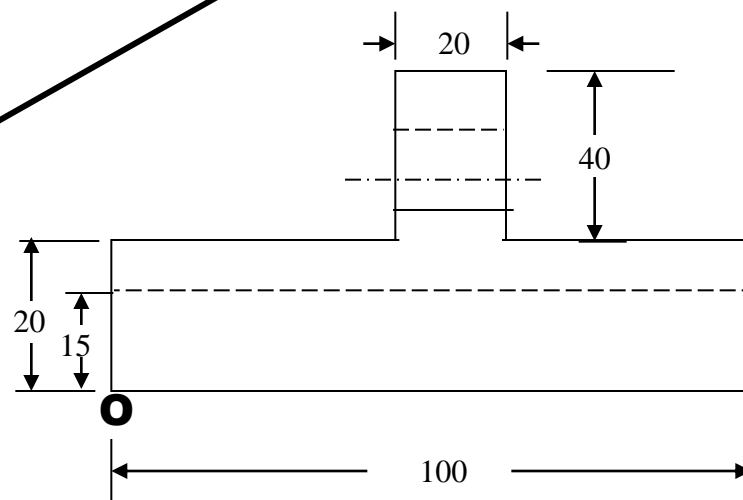
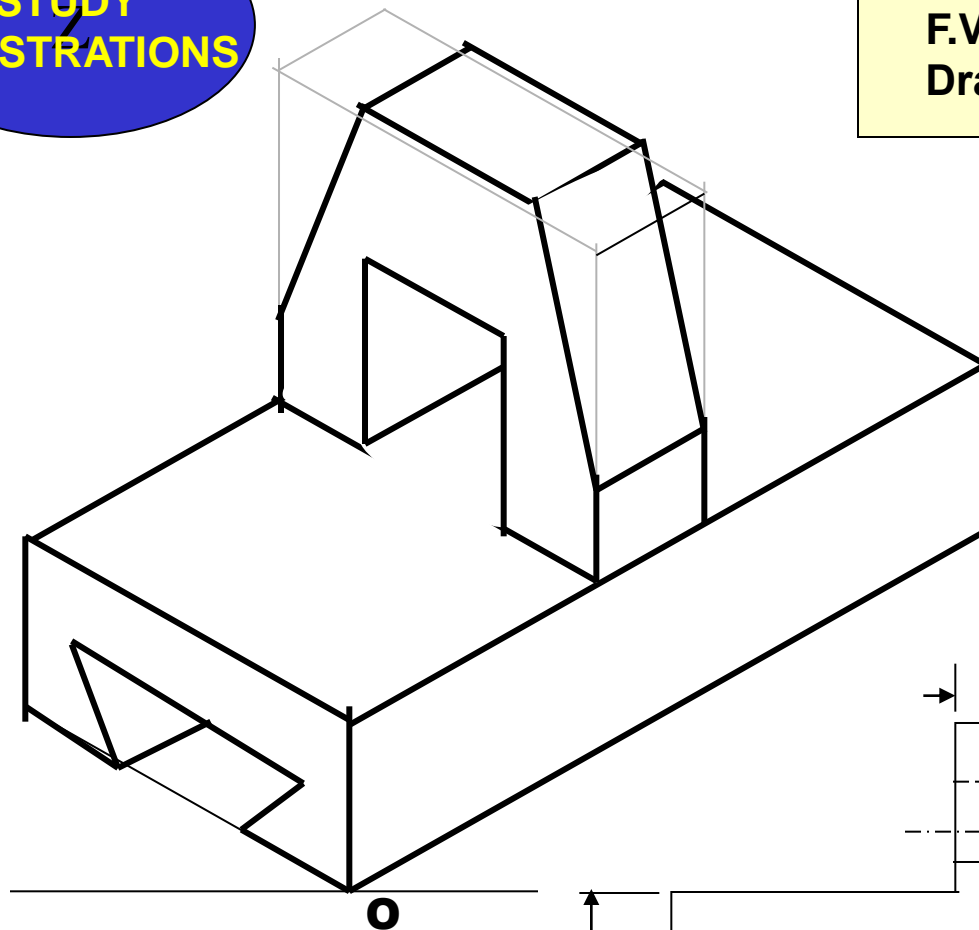
F.V. & T.V. of an object are given. Draw it's isometric view.

**STUDY
ILLUSTRATIONS**



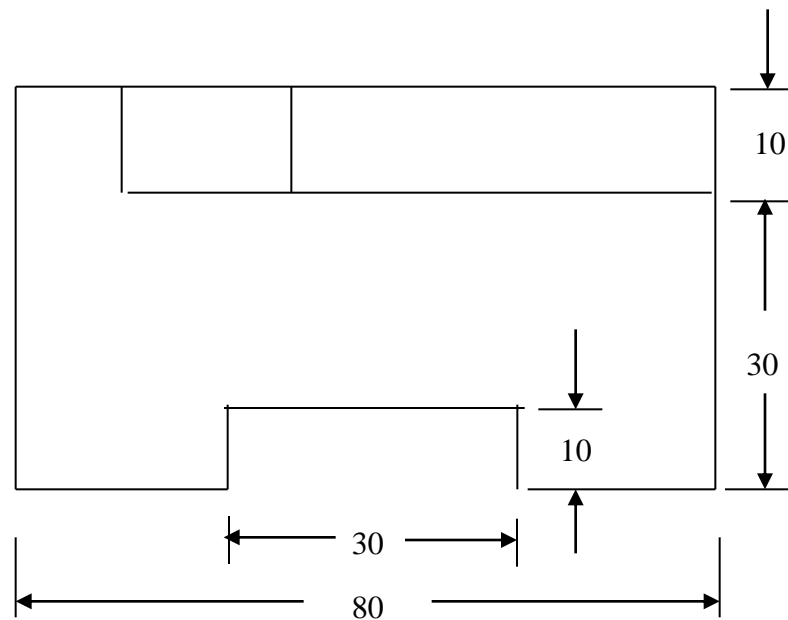
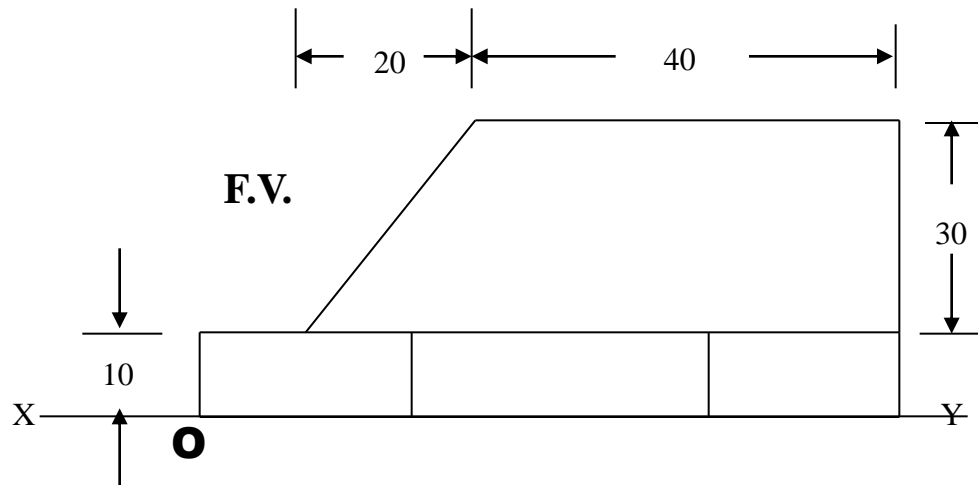
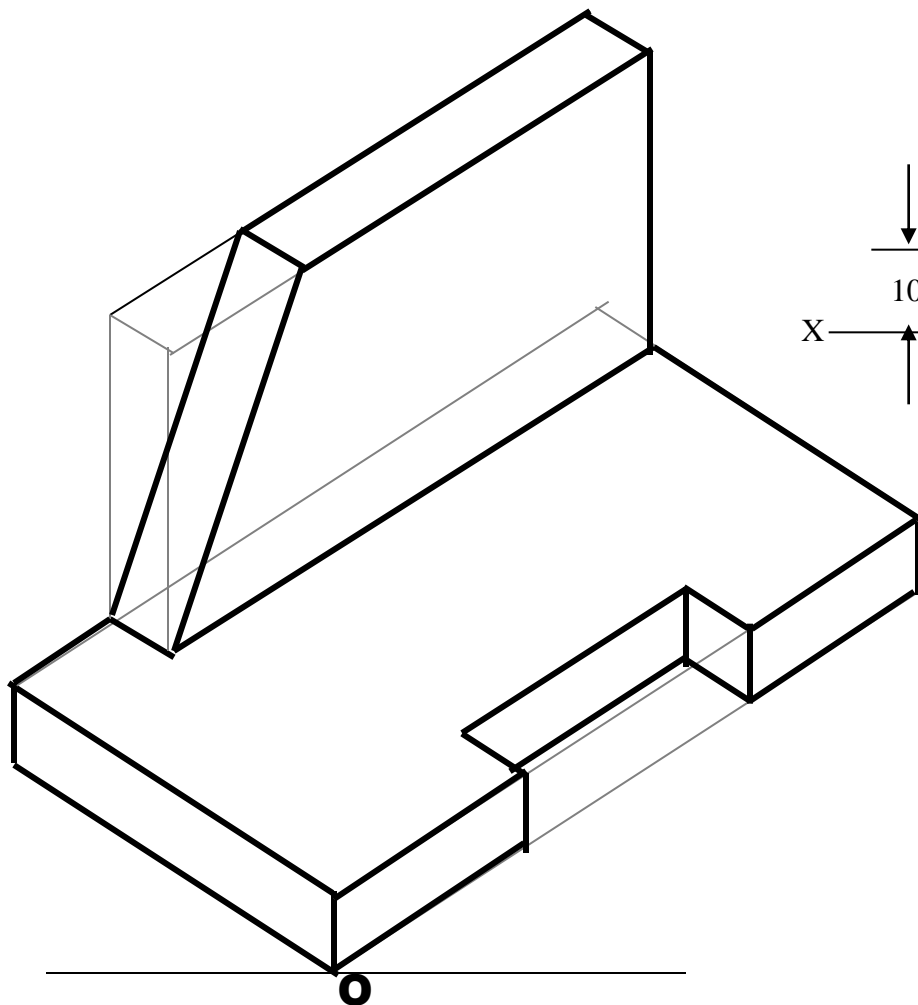
F.V. and S.V. of an object are given.
Draw it's isometric view.

STUDY
ILLUSTRATIONS



**STUDY
ILLUSTRATIONS**

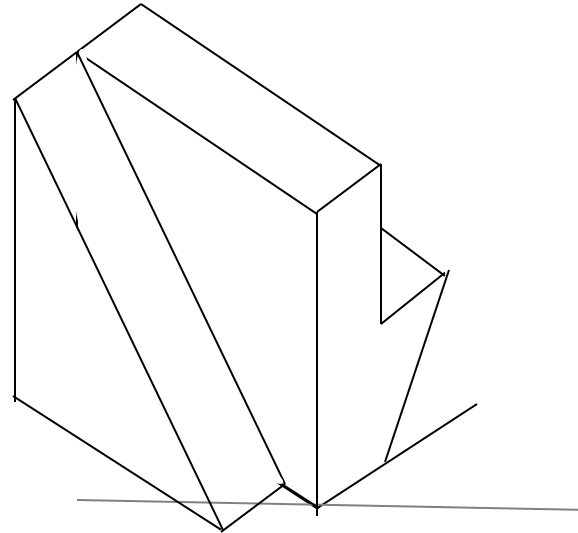
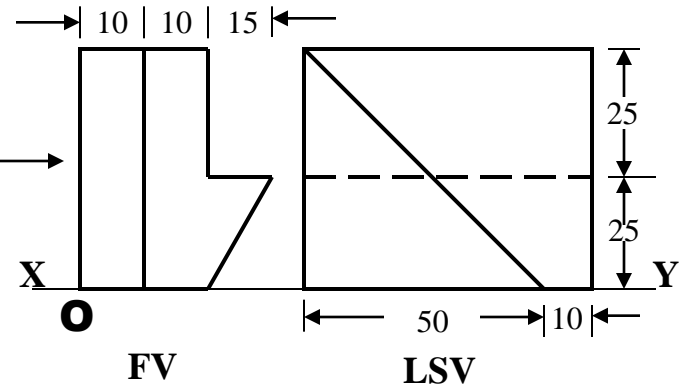
F.V. & T.V. of an object are given. Draw it's isometric view.



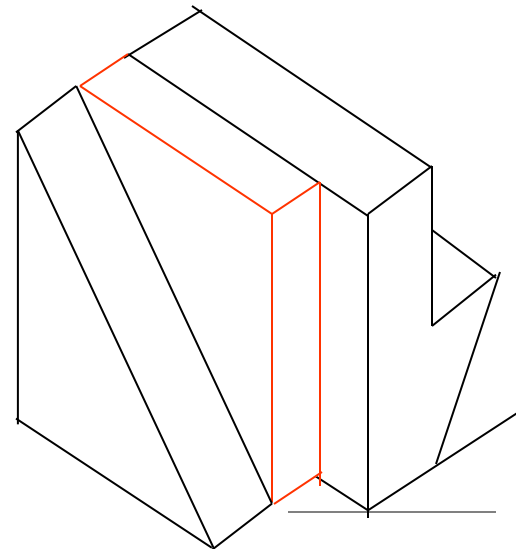
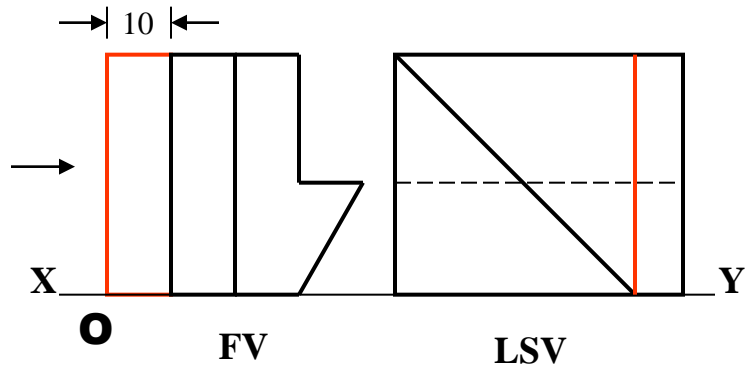
T.V.

F.V. and S.V. of an object are given.
Draw its isometric view.

**STUDY
ILLUSTRATIONS**

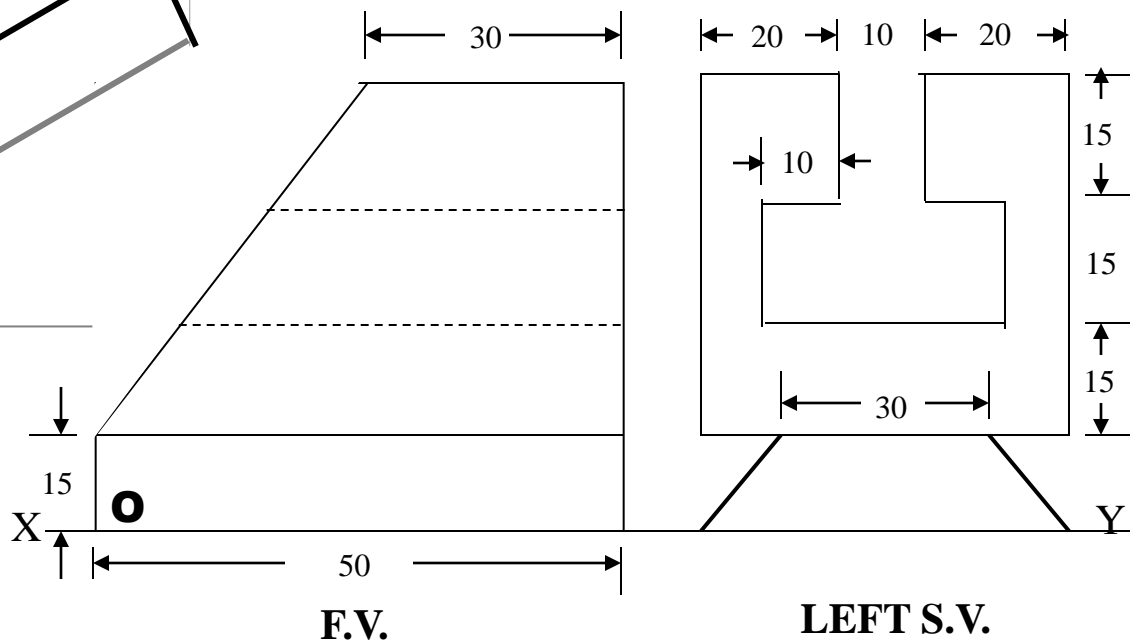
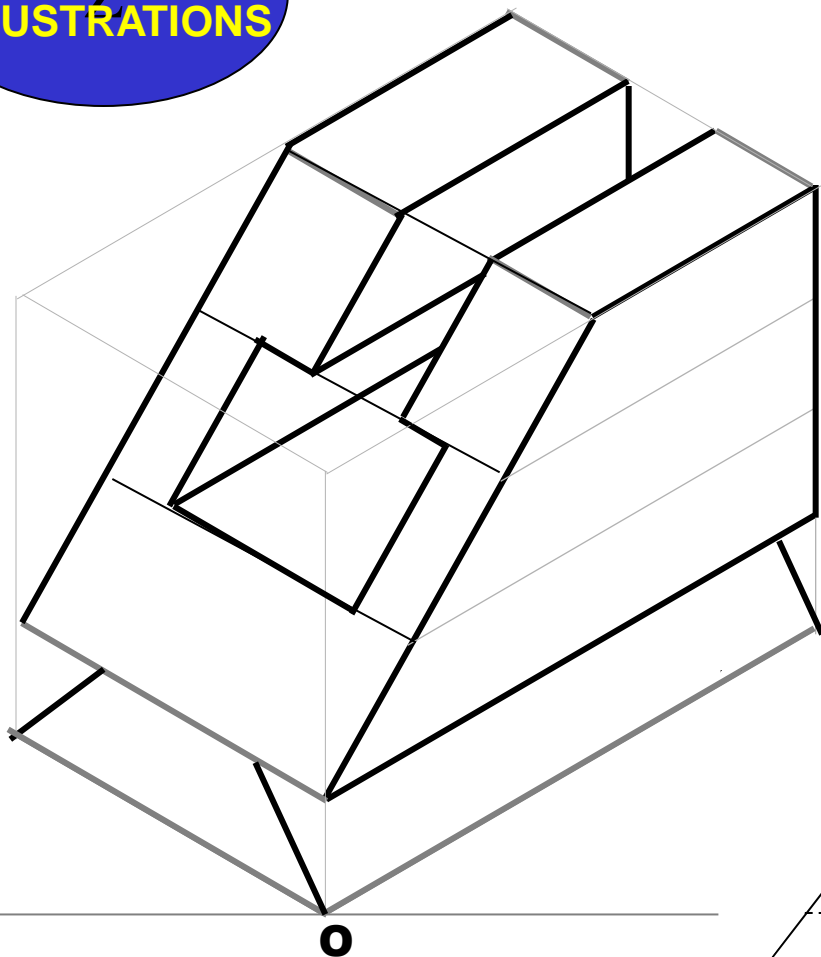


**NOTE THE SMALL CHZNGE IN 2ND FV & SV.
DRAW ISOMETRIC ACCORDINGLY.**



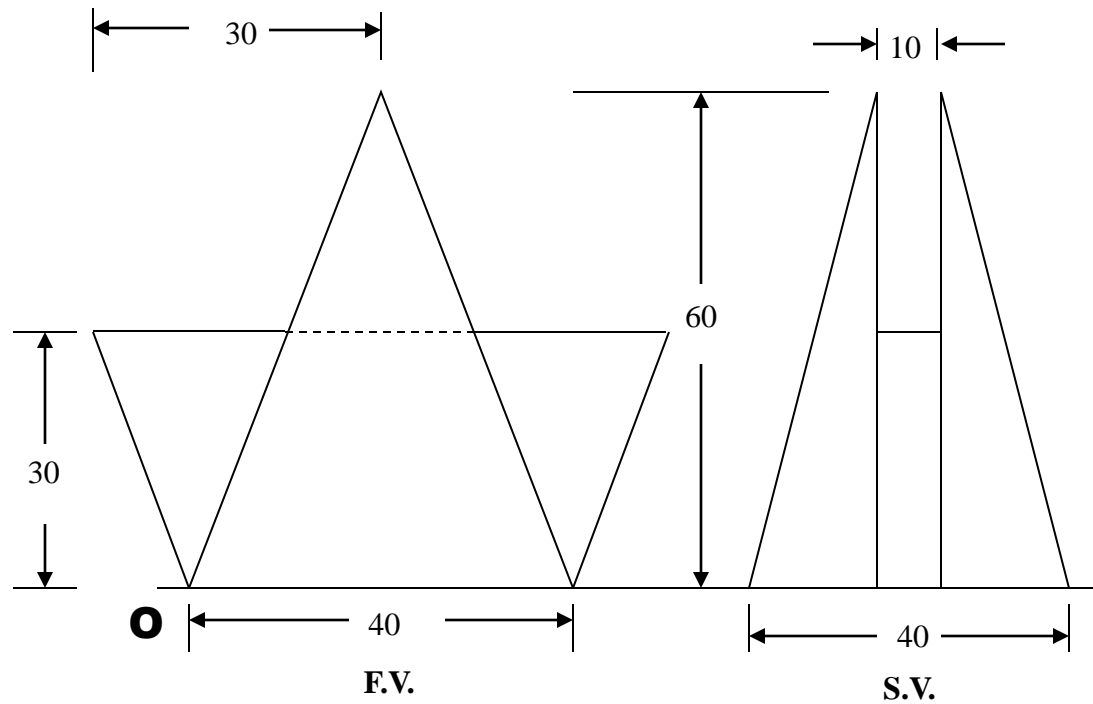
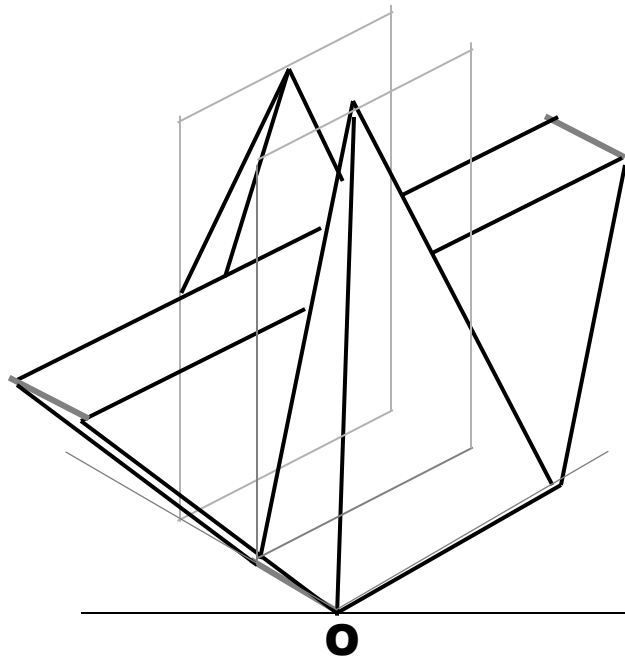
STUDY ILLUSTRATIONS

F.V. and S.V. of an object are given.
Draw it's isometric view.



STUDY ILLUSTRATIONS

F.V. and S.V. of an object are given.
Draw its isometric view.



EXERCISES:

PROJECTIONS OF STRAIGHT LINES

1. A line AB is in first quadrant. Its ends A and B are 25mm and 65mm in front of VP respectively. The distance between the end projectors is 75mm. The line is inclined at 30° to VP and its VT is 10mm above HP. Draw the projections of AB and determine its true length and HT and inclination with HP.
2. A line AB measures 100mm. The projections through its VT and end A are 50mm apart. The point A is 35mm above HP and 25mm in front VP. The VT is 15mm above HP. Draw the projections of line and determine its HT and Inclinations with HP and VP.
3. Draw the three views of line AB, 80mm long, when it is lying in profile plane and inclined at 35° to HP. Its end A is in HP and 20mm in front of VP, while other end B is in first quadrant. Determine also its traces.
4. A line AB 75 mm long, has its one end A in VP and other end B 15mm above HP and 50mm in front of VP. Draw the projections of line when sum of inclinations with HP and VP is 90° . Determine the true angles of inclination and show traces.
5. A line AB is 75mm long and lies in an auxiliary inclined plane (AIP) which makes an angle of 45° with the HP. The front view of the line measures 55mm. The end A is in VP and 20mm above HP. Draw the projections of the line AB and find its inclination with HP and VP.
6. Line AB lies in an AVP 50° inclined to Vp while line is 30° inclined to Hp. End A is 10 mm above Hp. & 15 mm in front of Vp. Distance between projectors is 50 mm. Draw projections and find TL and inclination of line with Vp. Locate traces also.

APPLICATIONS OF LINES



Room , compound wall cases

- 7) A room measures $8\text{m} \times 5\text{m} \times 4\text{m}$ high. An electric point hang in the center of ceiling and 1m below it. A thin straight wire connects the point to the switch in one of the corners of the room and 2m above the floor. Draw the projections of the and its length and slope angle with the floor.
- 8) A room is of size $6\text{m} \setminus 5\text{m} \setminus 3.5\text{m}$ high. Determine graphically the real distance between the top corner and its diagonally apposite bottom corners. consider appropriate scale
- 9) Two pegs A and B are fixed in each of the two adjacent side walls of the rectangular room $3\text{m} \times 4\text{m}$ sides. Peg A is 1.5m above the floor, 1.2m from the longer side wall and is protruding 0.3m from the wall. Peg B is 2m above the floor, 1m from other side wall and protruding 0.2m from the wall. Find the distance between the ends of the two pegs. Also find the height of the roof if the shortest distance between peg A and and center of the ceiling is 5m .
- 10) Two fan motors hang from the ceiling of a hall $12\text{m} \times 5\text{m} \times 8\text{m}$ high at heights of 4m and 6m respectively. Determine graphically the distance between the motors. Also find the distance of each motor from the top corner joining end and front wall.
- 11) Two mangos on a two tree are 2m and 3m above the ground level and 1.5m and 2.5m from a 0.25m thick wall but on apposite sides of it. Distances being measured from the center line of the wall. The distance between the apples, measured along ground and parallel to the wall is 3m . Determine the real distance between the ranges.



POLES,ROADS, PIPE LINES,, NORTH- EAST-SOUTH WEST, SLOPE AND GRADIENT CASES.

12) Three vertical poles AB, CD and EF are lying along the corners of equilateral triangle lying on the ground of 100m sides. Their lengths are 5m, 8m and 12m respectively. Draw their projections and find real distance between their top ends.

13) A straight road going up hill from a point A due east to another point B is 4km long and has a slope of 25° . Another straight road from B due 30° east of north to a point C is also 4 kms long but going downward and has slope of 15° . Find the length and slope of the straight road connecting A and C.

14) An electric transmission line laid along an uphill from the hydroelectric power station due west to a substation is 2km long and has a slope of 30° . Another line from the substation, running $W 45^\circ N$ to village, is 4km long and laid on the ground level. Determine the length and slope of the proposed telephone line joining the the power station and village.

15) Two wire ropes are attached to the top corner of a 15m high building. The other end of one wire rope is attached to the top of the vertical pole 5m high and the rope makes an angle of depression of 45° . The rope makes 30° angle of depression and is attached to the top of a 2m high pole. The pole in the top view are 2m apart. Draw the projections of the wire ropes.

16) Two hill tops A and B are 90m and 60m above the ground level respectively. They are observed from the point C, 20m above the ground. From C angles and elevations for A and B are 45° and 30° respectively. From B angle of elevation of A is 45° . Determine the two distances between A, B and C.

PROJECTIONS OF PLANES:-

1. A thin regular pentagon of 30mm sides has one side // to Hp and 30° inclined to Vp while its surface is 45° inclines to Hp. Draw its projections.
2. A circle of 50mm diameter has end A of diameter AB in Hp and AB diameter 30° inclined to Hp. Draw its projections if
 - a) the TV of same diameter is 45° inclined to Vp, OR
 - b) Diameter AB is in profile plane.
3. A thin triangle PQR has sides PQ = 60mm. QR = 80mm. and RP = 50mm. long respectively. Side PQ rest on ground and makes 30° with Vp. Point P is 30mm in front of Vp and R is 40mm above ground. Draw its projections.
4. An isosceles triangle having base 60mm long and altitude 80mm long appears as an equilateral triangle of 60mm sides with one side 30° inclined to XY in top view. Draw its projections.
5. A 30° - 60° set-square of 40mm long shortest side in Hp appears is an isosceles triangle in its TV. Draw projections of it and find its inclination with Hp.
6. A rhombus of 60mm and 40mm long diagonals is so placed on Hp that in TV it appears as a square of 40mm long diagonals. Draw its FV.
7. Draw projections of a circle 40 mm diameter resting on Hp on a point A on the circumference with its surface 30° inclined to Hp and 45° to Vp.
8. A top view of plane figure whose surface is perpendicular to Vp and 60° inclined to Hp is regular hexagon of 30mm sides with one side 30° inclined to xy. Determine it's true shape.
9. Draw a rectangular abcd of side 50mm and 30mm with longer 35° with XY, representing TV of a quadrilateral plane ABCD. The point A and B are 25 and 50mm above Hp respectively. Draw a suitable Fv and determine its true shape.
10. Draw a pentagon abcde having side 50° to XY, with the side ab = 30mm, bc = 60mm, cd = 50mm, de = 25mm and angles abc 120° , cde 125° . A figure is a TV of a plane whose ends A, B and E are 15, 25 and 35mm above Hp respectively. Complete the projections and determine the true shape of the plane figure.

PROJECTIONS OF SOLIDS

1. Draw the projections of a square prism of 25mm sides base and 50mm long axis. The prism is resting with one of its corners in VP and axis inclined at 30^0 to VP and parallel to HP.
2. A pentagonal pyramid, base 40mm side and height 75mm rests on one edge on its base on the ground so that the highest point in the base is 25mm. above ground. Draw the projections when the axis is parallel to Vp. Draw an another front view on an AVP inclined at 30^0 to edge on which it is resting so that the base is visible.
3. A square pyramid of side 30mm and axis 60 mm long has one of its slant edges inclined at 45^0 to HP and a plane containing that slant edge and axis is inclined at 30^0 to VP. Draw the projections.
4. A hexagonal prism, base 30mm sides and axis 75mm long, has an edge of the base parallel to the HP and inclined at 45^0 to the VP. Its axis makes an angle of 60^0 with the HP. Draw its projections. Draw another top view on an auxiliary plane inclined at 50^0 to the HP.
5. Draw the three views of a cone having base 50 mm diameter and axis 60mm long It is resting on a ground on a point of its base circle. The axis is inclined at 40^0 to ground and at 30^0 to VP.
6. Draw the projections of a square prism resting on an edge of base on HP. The axis makes an angle of 30^0 with VP and 45^0 with HP. Take edge of base 25mm and axis length as 125mm.
7. A right pentagonal prism is suspended from one of its corners of base. Draw the projections (three views) when the edge of base apposite to the point of suspension makes an angle of 30^0 to VP. Take base side 30mm and axis length 60mm.s
8. A cone base diameter 50mm and axis 70mm long, is freely suspended from a point on the rim of its base. Draw the front view and the top view when the plane containing its axis is perpendicular to HP and makes an angle of 45^0 with VP.

CASES OF COMPOSITE SOLIDS.

9. A cube of 40mm long edges is resting on the ground with its vertical faces equally inclined to the VP. A right circular cone base 25mm diameter and height 50mm is placed centrally on the top of the cube so that their axis are in a straight line. Draw the front and top views of the solids.

Project another top view on an AIP making 45° with the HP

10. A square bar of 30mm base side and 100mm long is pushed through the center of a cylindrical block of 30mm thickness and 70mm diameter, so that the bar comes out equally through the block on either side. Draw the front view, top view and side view of the solid when the axis of the bar is inclined at 30° to HP and parallel to VP, the sides of a bar being 45° to VP.

11. A cube of 50mm long edges is resting on the ground with its vertical faces equally inclined to VP. A hexagonal pyramid, base 25mm side and axis 50mm long, is placed centrally on the top of the cube so that their axes are in a straight line and two edges of its base are parallel to VP. Draw the front view and the top view of the solids, project another top view on an AIP making an angle of 45° with the HP.

12. A circular block, 75mm diameter and 25mm thick is pierced centrally through its flat faces by a square prism of 35mm base sides and 125mm long axis, which comes out equally on both sides of the block. Draw the projections of the solids when the combined axis is parallel to HP and inclined at 30° to VP, and a face of the prism makes an angle of 30° with HP. Draw side view also.

SECTION & DEVELOPMENT

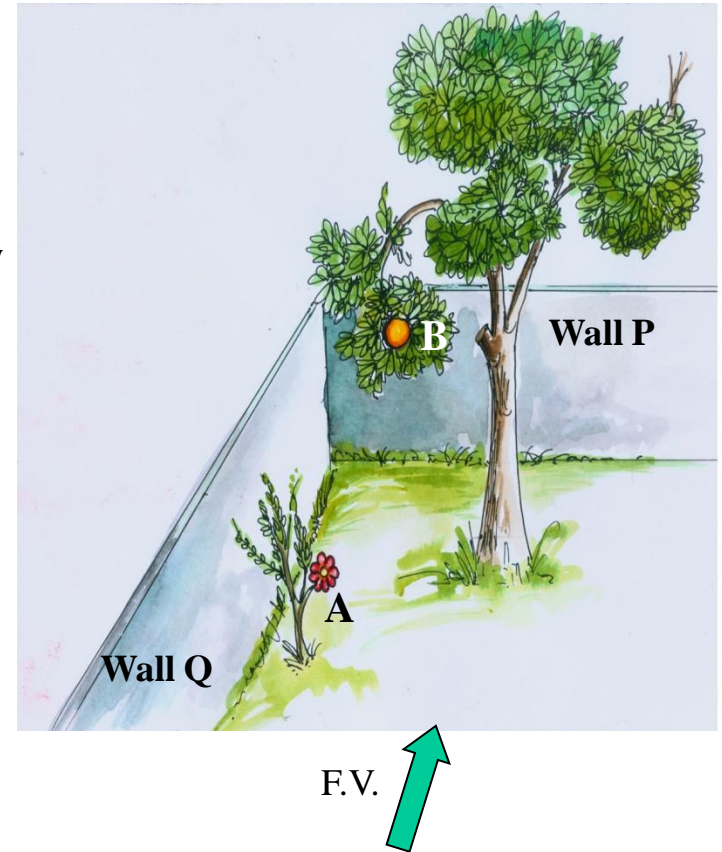
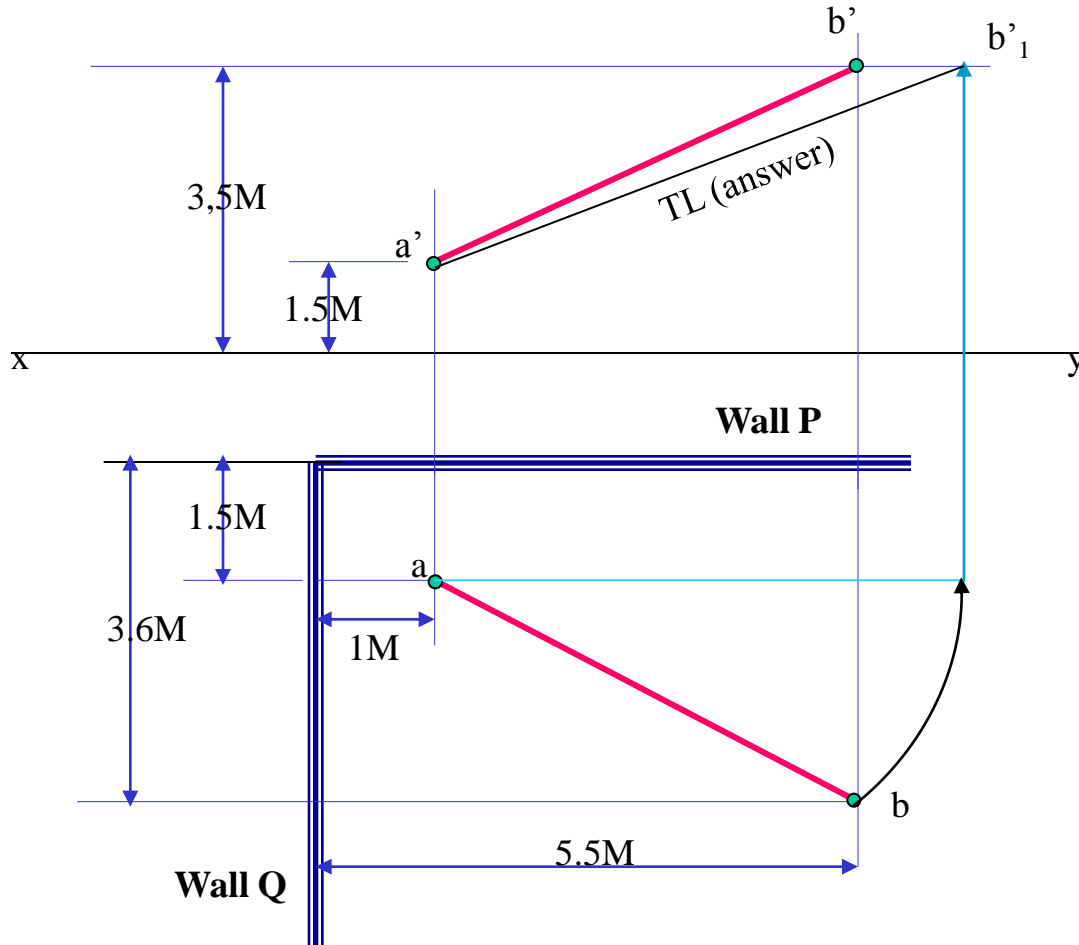


- 1) A square pyramid of 30mm base sides and 50mm long axis is resting on its base in HP. Edges of base is equally inclined to VP. It is cut by section plane perpendicular to VP and inclined at 45° to HP. The plane cuts the axis at 10mm above the base. Draw the projections of the solid and show its development.
- 2) A hexagonal pyramid, edge of base 30mm and axis 75mm, is resting on its edge on HP which is perpendicular to VP. The axis makes an angle of 30° to HP. the solid is cut by a section plane perpendicular to both HP and VP, and passing through the mid point of the axis. Draw the projections showing the sectional view, true shape of section and development of surface of a cut pyramid containing apex.
- 3) A cone of base diameter 60mm and axis 80mm, long has one of its generators in VP and parallel to HP. It is cut by a section plane perpendicular HP and parallel to VP. Draw the sectional FV, true shape of section and develop the lateral surface of the cone containing the apex.
- 4) A cube of 50mm long slid diagonal rest on ground on one of its corners so that the solid diagonal is vertical and an edge through that corner is parallel to VP. A horizontal section plane passing through midpoint of vertical solid diagonal cuts the cube. Draw the front view of the sectional top view and development of surface.
- 5) A vertical cylinder cut by a section plane perpendicular to VP and inclined to HP in such a way that the true shape of a section is an ellipse with 50mm and 80mm as its minor and major axes. The smallest generator on the cylinder is 20mm long after it is cut by a section plane. Draw the projections and show the true shape of the section. Also find the inclination of the section plane with HP. Draw the development of the lower half of the cylinder.
- 6) A cube of 75mm long edges has its vertical faces equally inclined to VP. It is cut by a section plane perpendicular to VP such that the true shape of section is regular hexagon. Determine the inclination of cutting plane with HP. Draw the sectional top view and true shape of section.
- 7) The pyramidal portion of a half pyramidal and half conical solid has a base of three sides, each 30mm long. The length of axis is 80mm. The solid rest on its base with the side of the pyramid base perpendicular to VP. A plane parallel to VP cuts the solid at a distance of 10mm from the top view of the axis. Draw sectional front view and true shape of section. Also develop the lateral surface of the cut solid.

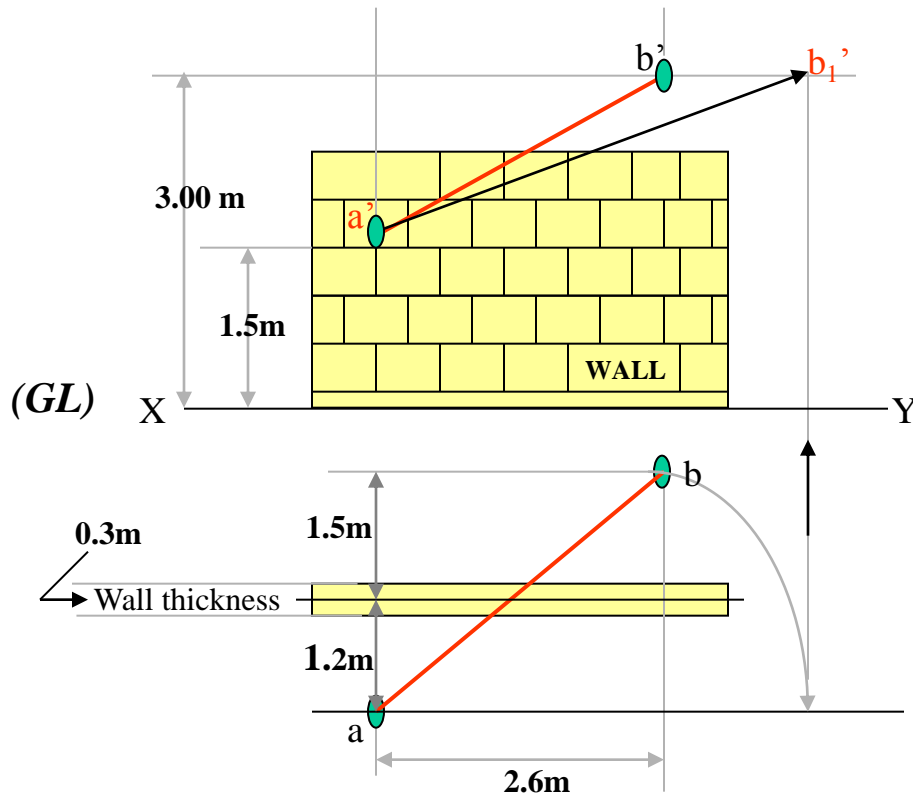
- 8) A hexagonal pyramid having edge to edge distance 40mm and height 60mm has its base in HP and an edge of base perpendicular to VP. It is cut by a section plane, perpendicular to VP and passing through a point on the axis 10mm from the base. Draw three views of solid when it is resting on its cut face in HP, resting the larger part of the pyramid. Also draw the lateral surface development of the pyramid.
- 9) A cone diameter of base 50mm and axis 60mm long is resting on its base on ground. It is cut by a section plane perpendicular to VP in such a way that the true shape of a section is a parabola having base 40mm. Draw three views showing section, true shape of section and development of remaining surface of cone removing its apex.
- 10) A hexagonal pyramid, base 50mm side and axis 100mm long is lying on ground on one of its triangular faces with axis parallel to VP. A vertical section plane, the HT of which makes an angle of 30° with the reference line passes through center of base, the apex being retained. Draw the top view, sectional front view and the development of surface of the cut pyramid containing apex.
- 11) Hexagonal pyramid of 40mm base side and height 80mm is resting on its base on ground. It is cut by a section plane parallel to HP and passing through a point on the axis 25mm from the apex. Draw the projections of the cut pyramid. A particle P, initially at the mid point of edge of base, starts moving over the surface and reaches the mid point of apposite edge of the top face. Draw the development of the cut pyramid and show the shortest path of particle P. Also show the path in front and top views
- 12) A cube of 65 mm long edges has its vertical face equally inclined to the VP. It is cut by a section plane, perpendicular to VP, so that the true shape of the section is a regular hexagon, Determine the inclination of the cutting plane with the HP and draw the sectional top view and true shape of the section.



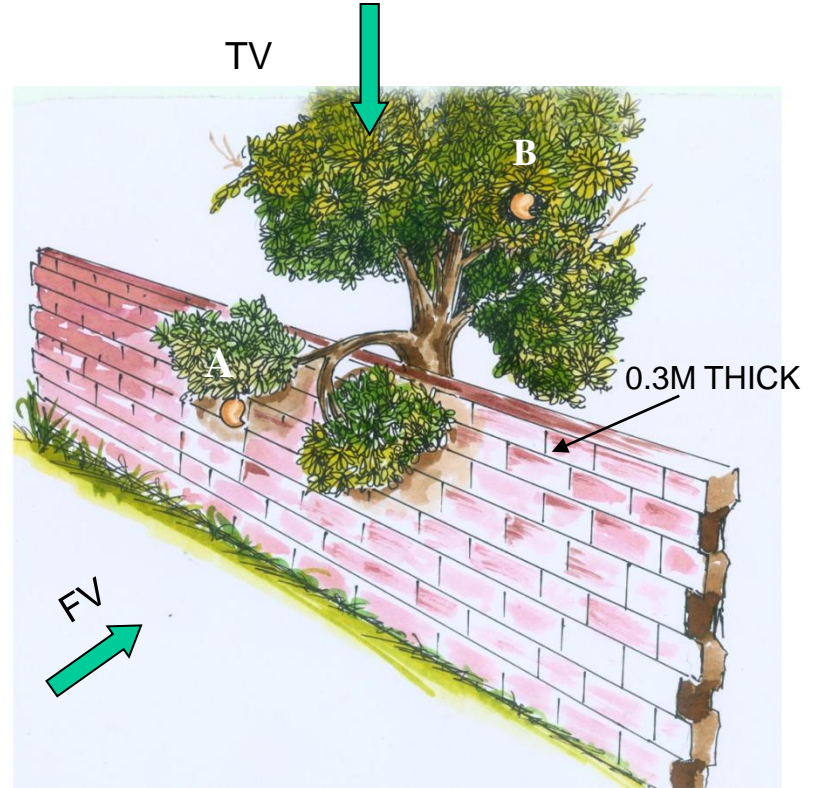
PROBLEM 14:-Two objects, a flower (A) and an orange (B) are within a rectangular compound wall, whose P & Q are walls meeting at 90° . Flower A is 1.5M & 1 M from walls P & Q respectively. Orange B is 3.5M & 5.5M from walls P & Q respectively. Drawing projection, find distance between them If flower is 1.5 M and orange is 3.5 M above the ground. Consider suitable scale..



PROBLEM 15 :- Two mangos on a tree A & B are 1.5 m and 3.00 m above ground and those are 1.2 m & 1.5 m from a 0.3 m thick wall but on opposite sides of it. If the distance measured between them along the ground and parallel to wall is 2.6 m, Then find real distance between them by drawing their projections.

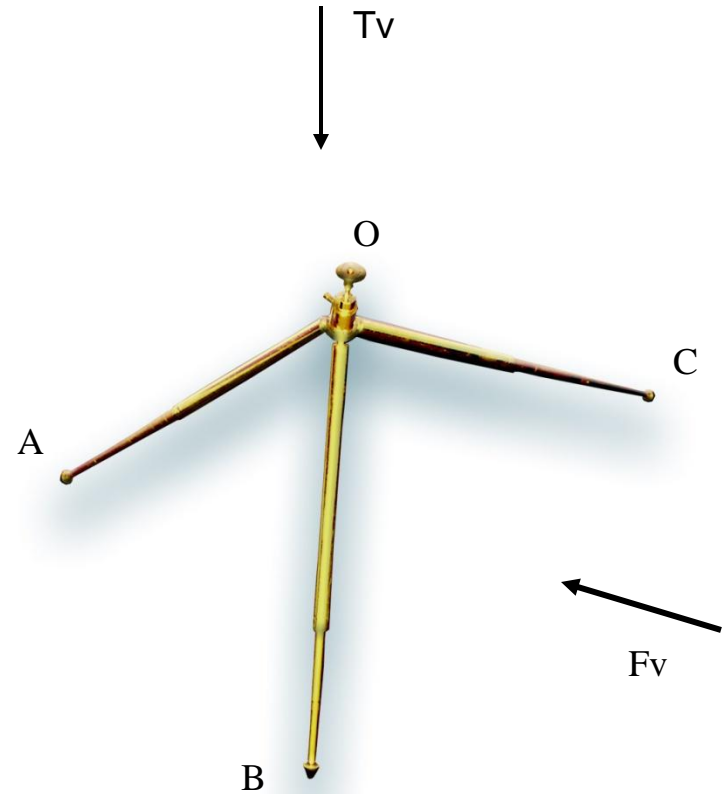
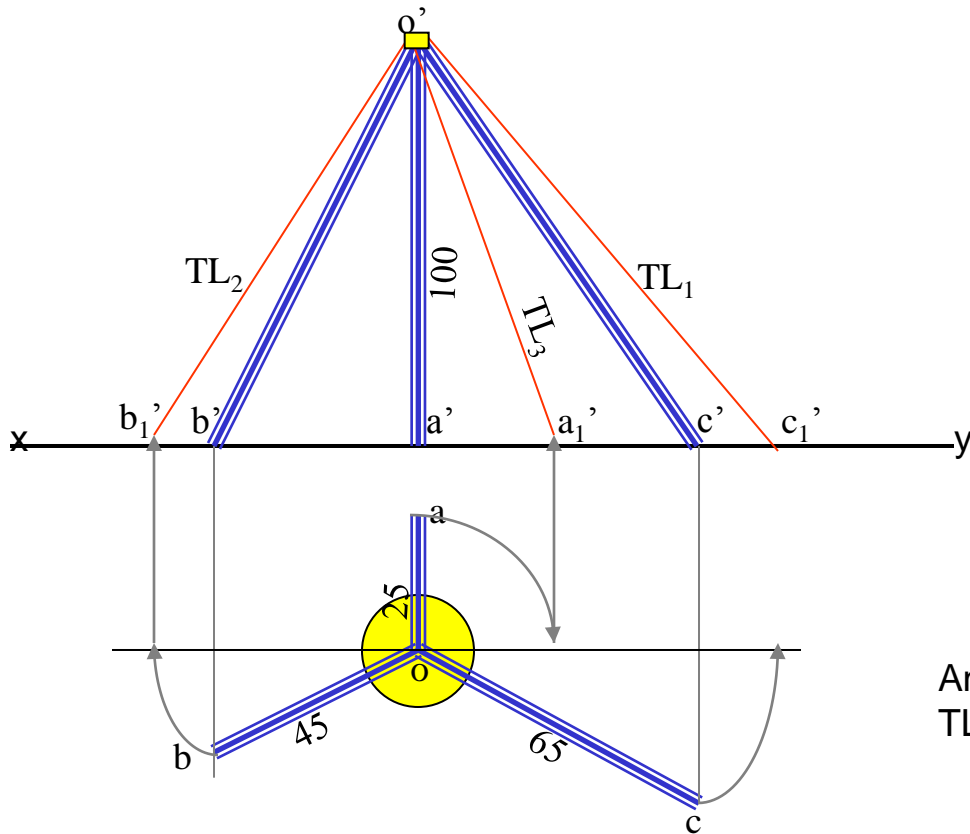


REAL DISTANCE BETWEEN
MANGOS A & B IS = $a'b'$



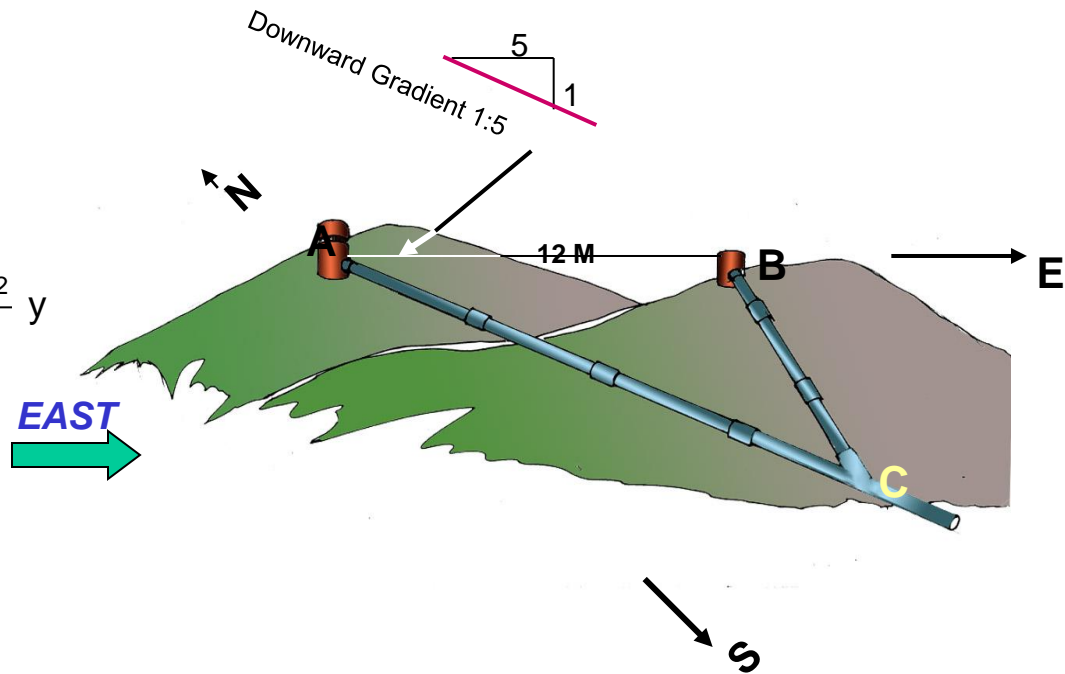
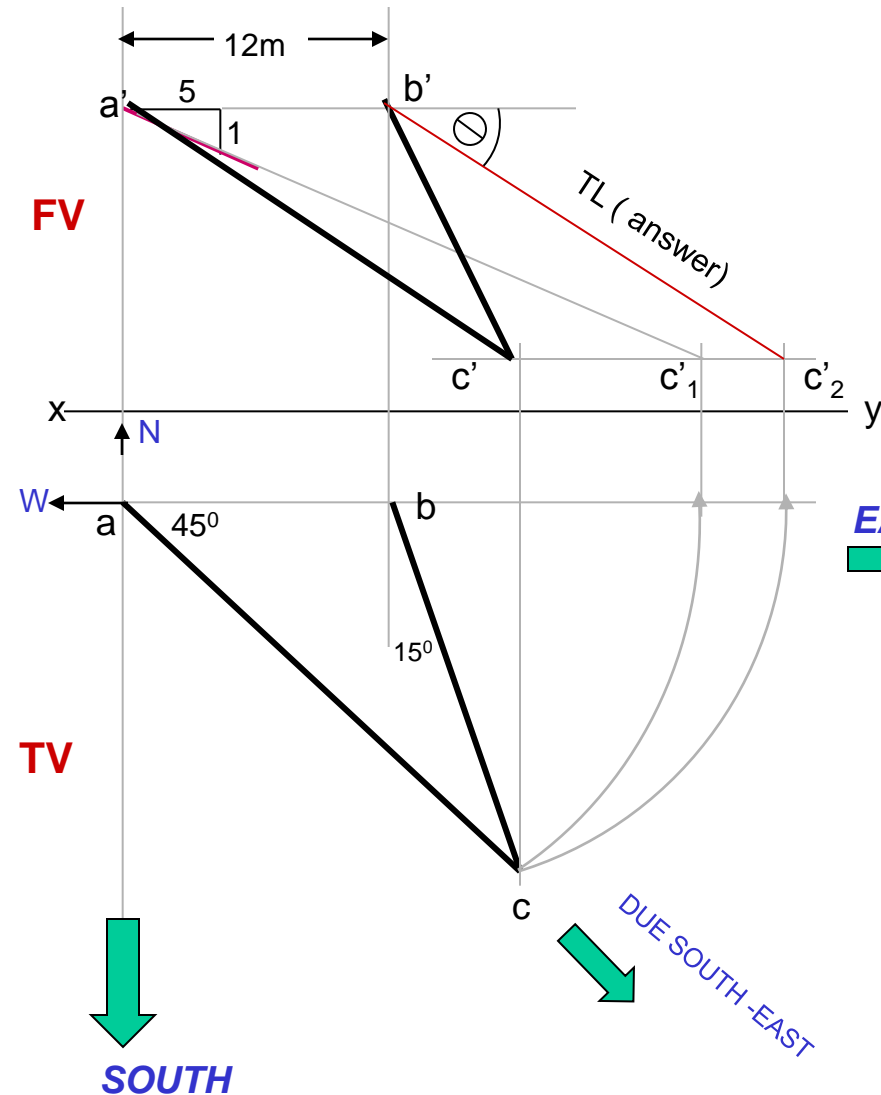
PROBLEM 16 :-

oa, ob & oc are three lines, 25mm, 45mm and 65mm long respectively. All equally inclined and the shortest is vertical. This fig. is TV of three rods OA, OB and OC whose ends A, B & C are on ground and end O is 100mm above ground. Draw their projections and find length of each along with their angles with ground.



Answers:
TL₁ TL₂ & TL₃

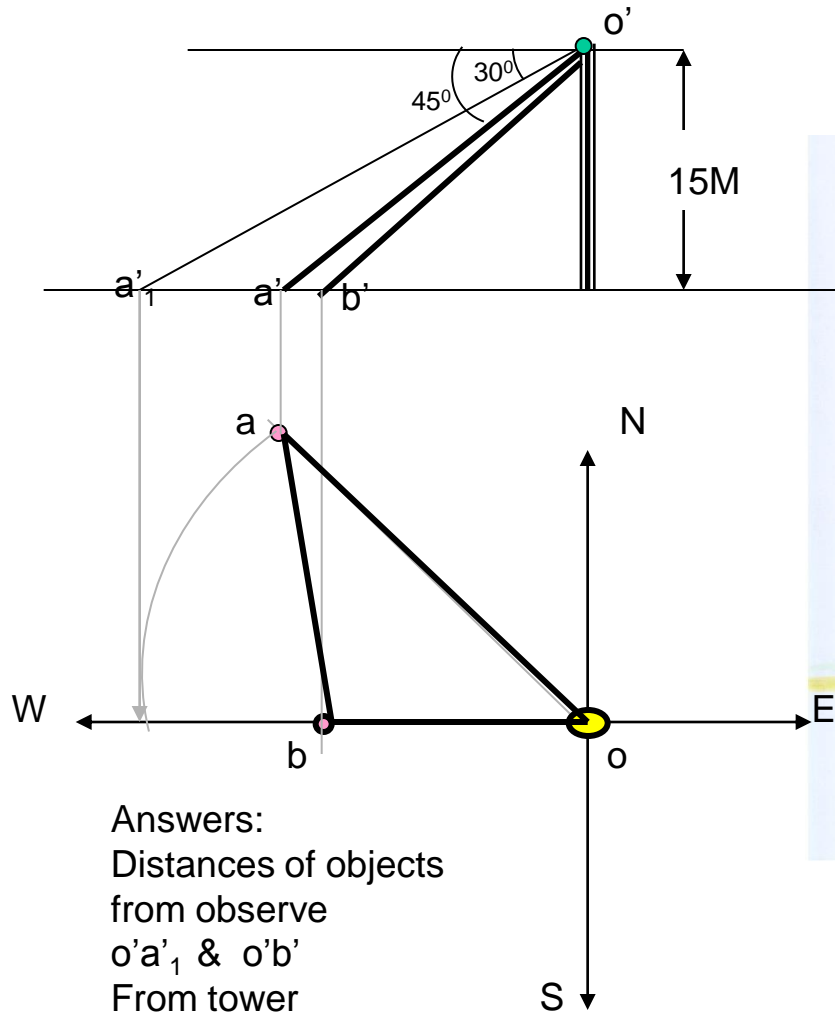
PROBLEM 17:- A pipe line from point A has a downward gradient 1:5 and it runs due South - East. Another Point B is 12 M from A and due East of A and in same level of A. Pipe line from B runs 15° Due East of South and meets pipe line from A at point C. Draw projections and find length of pipe line from B and it's inclination with ground.



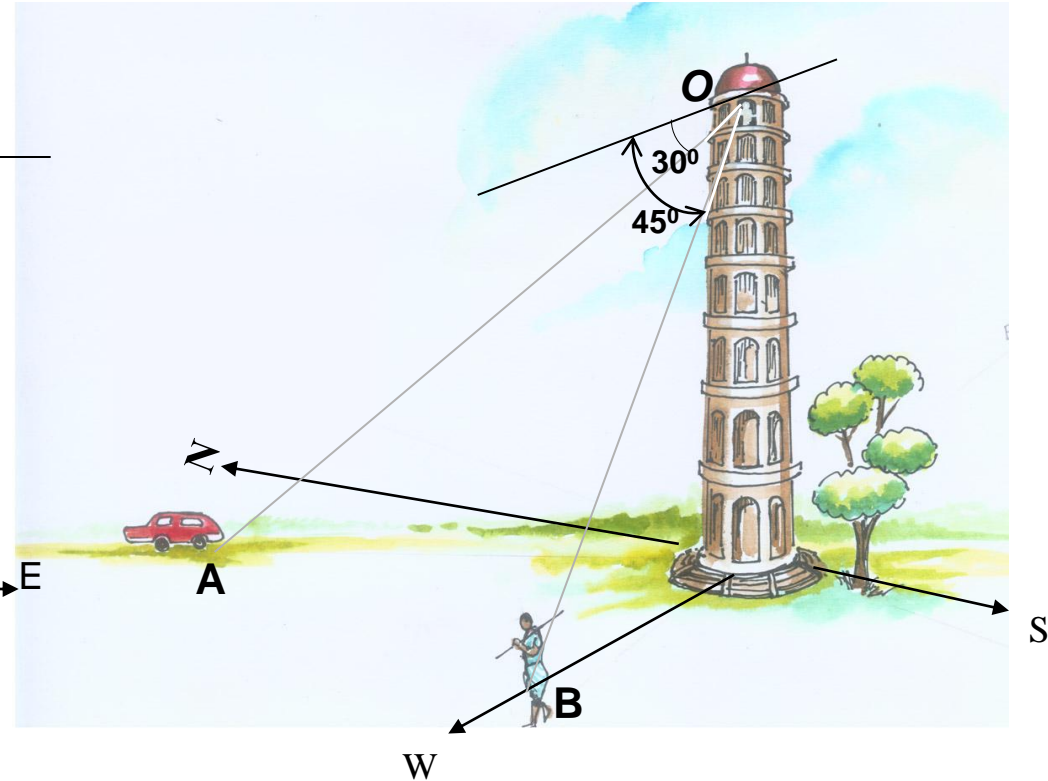
$$TL \text{ (answer) } = a' c'_2$$

\ominus = Inclination of pipe line BC

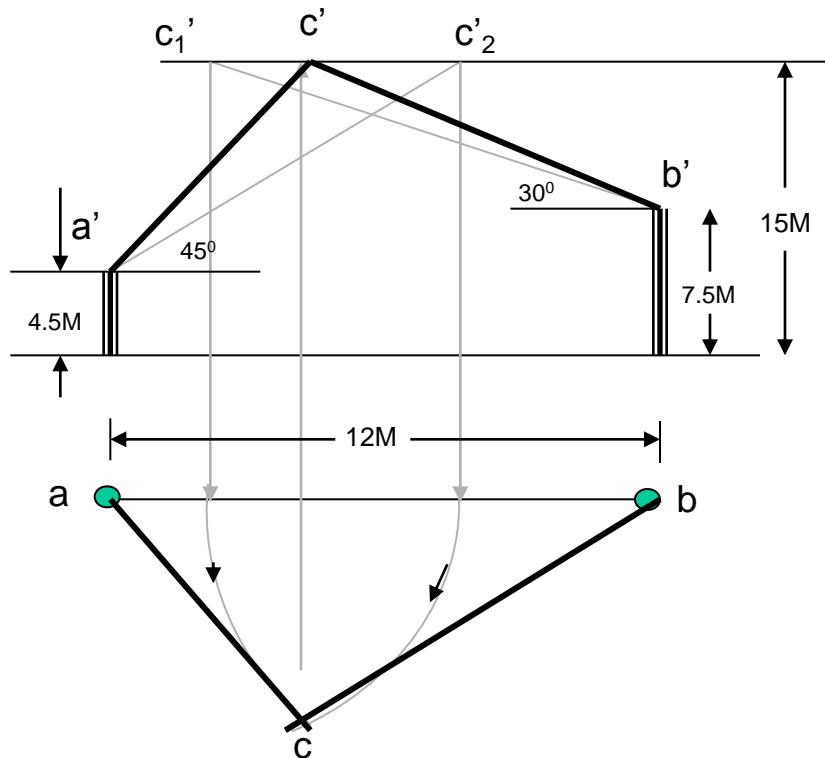
PROBLEM 18: A person observes two objects, A & B, on the ground, from a tower, 15 M high, At the angles of depression 30° & 45° . Object A is in due North-West direction of observer and object B is due West direction. Draw projections of situation and find distance of objects from observer and from tower also.



Answers:
 Distances of objects
 from observer
 $o'a'$ & $o'b'$
 From tower
 oa & ob



PROBLEM 19:- Guy ropes of two poles fixed at 4.5m and 7.5 m above ground, are attached to a corner of a building 15 M high, make 30° and 45° inclinations with ground respectively. The poles are 10 M apart. Determine by drawing their projections, Length of each rope and distance of poles from building.

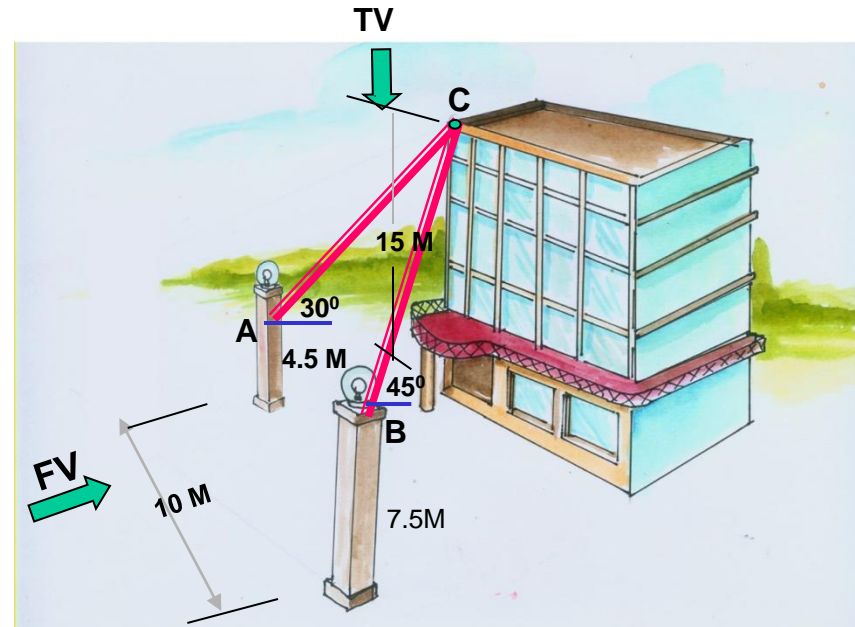


Answers:

Length of Rope $BC = b'c'_2$

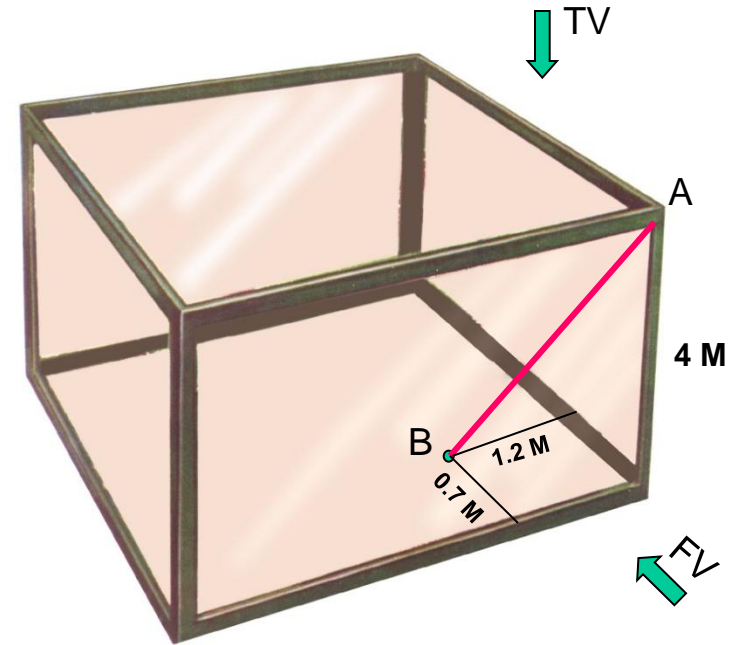
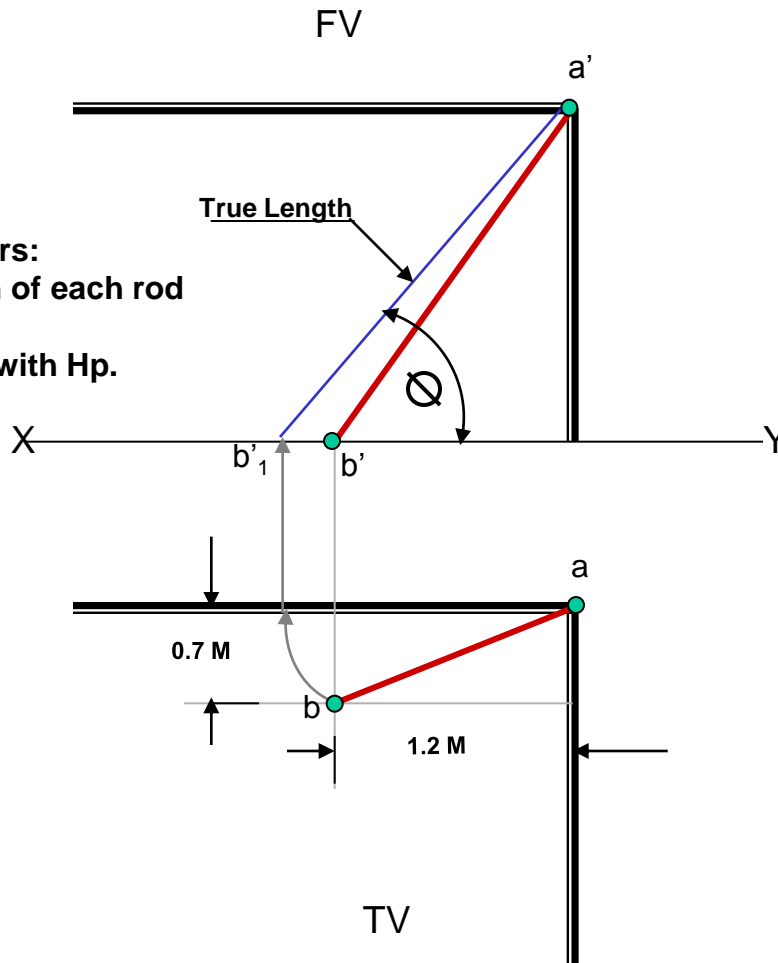
Length of Rope $AC = a'c'_1$

Distances of poles from building = ca & cb

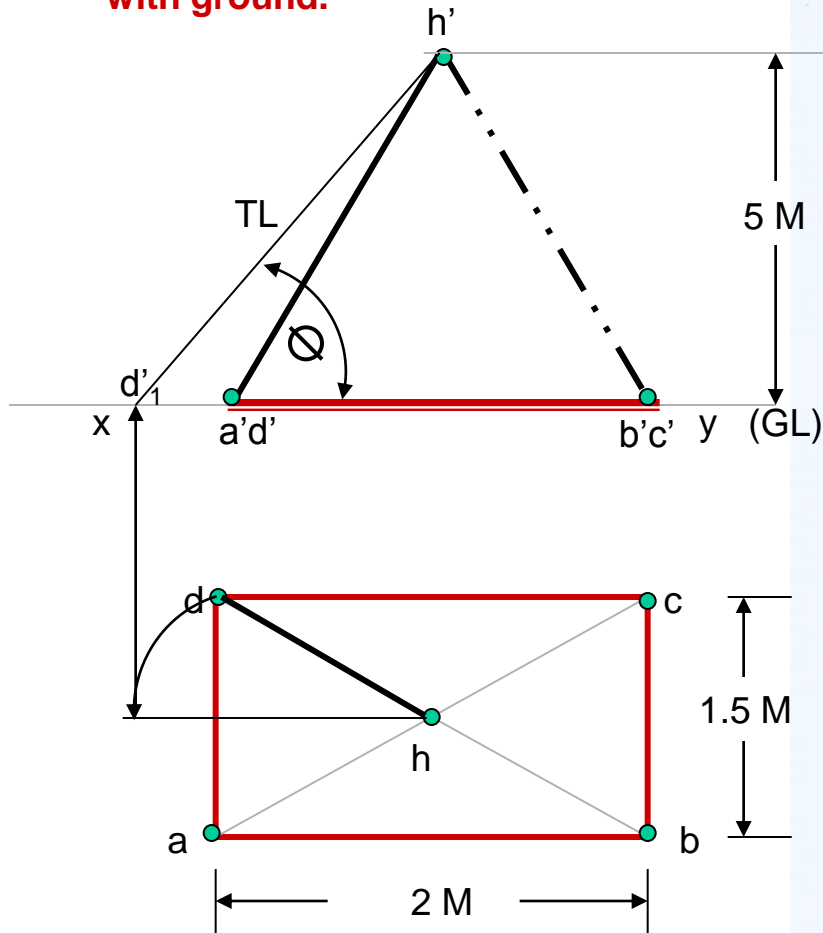


PROBLEM 20:- A tank of 4 M height is to be strengthened by four stay rods from each corner by fixing their other ends to the flooring, at a point 1.2 M and 0.7 M from two adjacent walls respectively, as shown. Determine graphically length and angle of each rod with flooring.

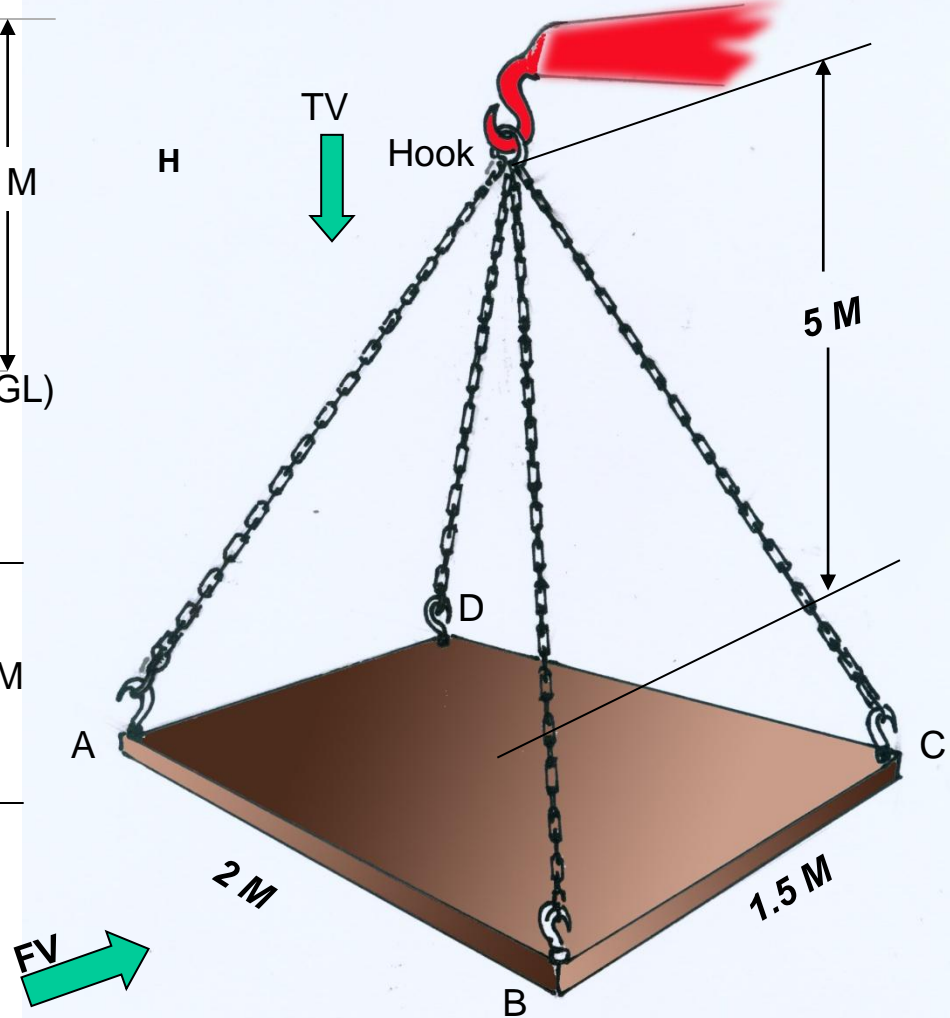
Answers:
Length of each rod
= $a'b'_1$
Angle with Hp.
= θ



PROBLEM 21:- A horizontal wooden platform 2 M long and 1.5 M wide is supported by four chains from its corners and chains are attached to a hook 5 M above the center of the platform. Draw projections of the objects and determine length of each chain along with its inclination with ground.

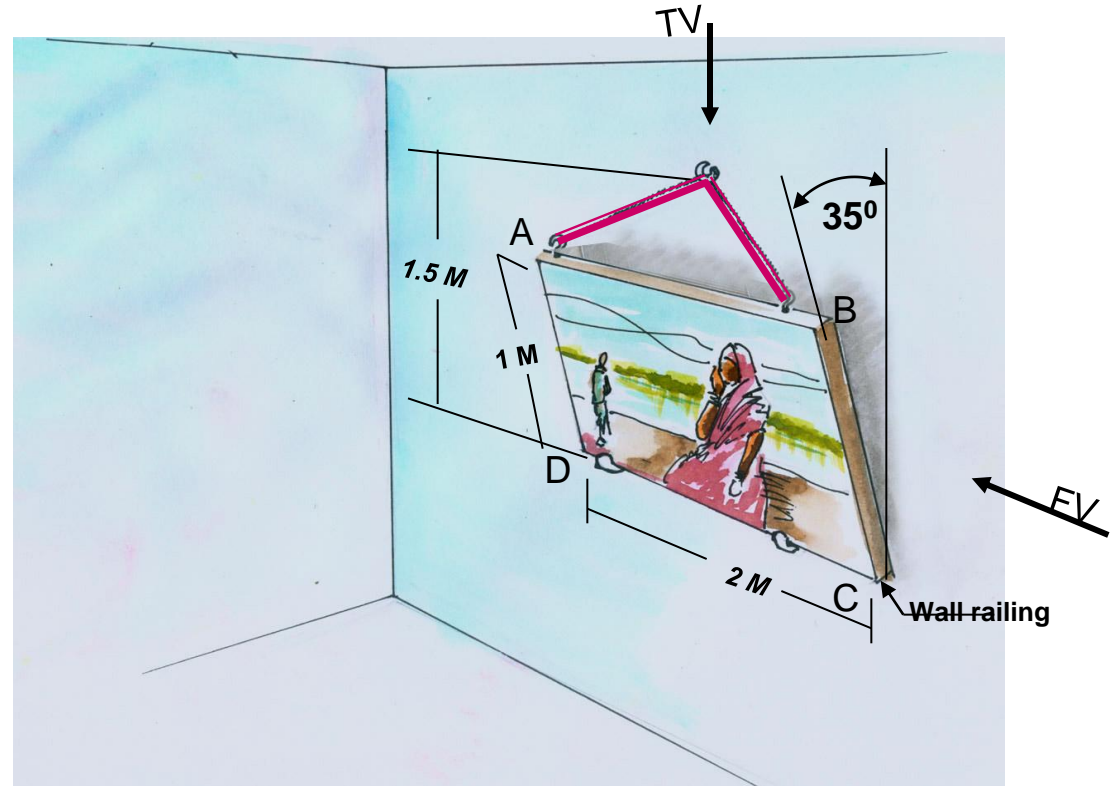
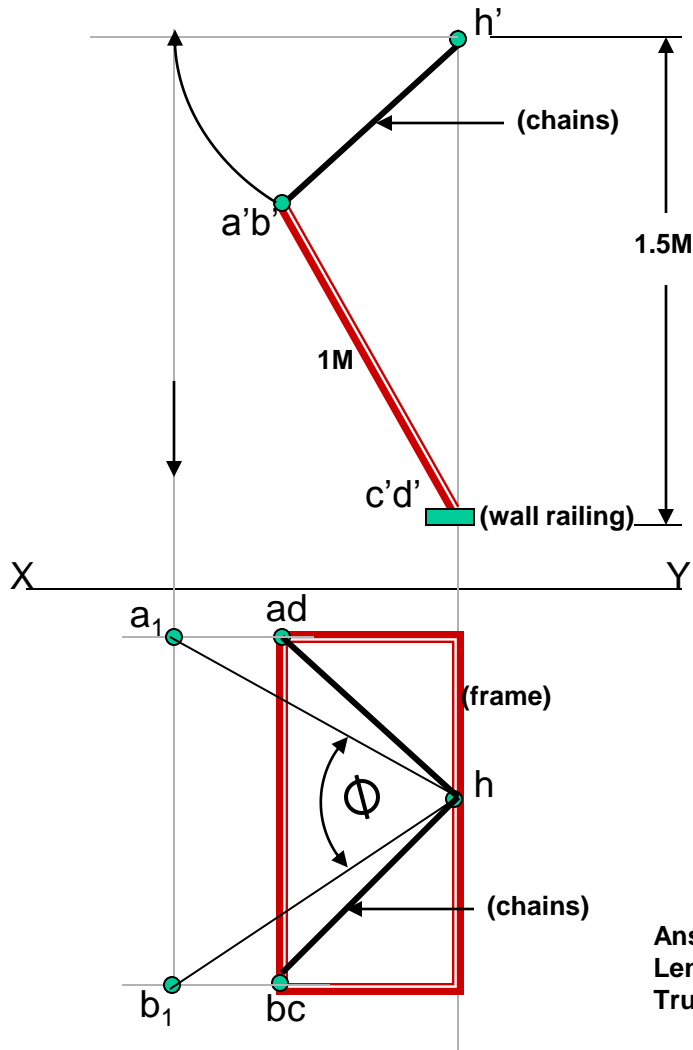


Answers:
 Length of each chain
 = $a'd'_1$
 Angle with Hp.
 = Q



PROBLEM 23:-

A PICTURE FRAME 2 M WIDE AND 1 M TALL IS RESTING ON HORIZONTAL WALL RAILING MAKES 35° INCLINATION WITH WALL. IT IS ATTACHED TO A HOOK IN THE WALL BY TWO STRINGS. THE HOOK IS 1.5 M ABOVE WALL RAILING. DETERMINE LENGTH OF EACH CHAIN AND TRUE ANGLE BETWEEN THEM



Answers:
Length of each chain = hb_1
True angle between chains = Φ