COMPUTER AIDED DRAWING

COMPUTER AIDED DRAFTING (CAD)

Computer Aided drafting is a process of preparing a drawing of an object on the screen of a computer. There are various types of drawings required in different fields of engineering and science. In the field of mechanical engineering, the drawing of machine components and layouts are prepared. In the field of civil engineering plans and layouts of building are prepared. In the field of electrical engineering the layouts of power distribution system are prepared. In other fields of engineering use of computer made for drawing and drafting.

The use of CAD process provides enhanced graphic capabilities which allows any designers to-

- Conceptualize his ideas.
- Modify the design very easily.
- Uses colors, fonts and others aesthetic features.

DIFFERENT SOFTWARE USED IN DESIGN

1. AutoCAD
2. ANSYS
3. Pro-Engineer
4. CATIA
5. Unigraphics
6. Solid edge classic-290
7. Solid works

Auto CAD

The Word AutoCAD is made up of two words “Auto (logo of company)” and CAD “(computer aided design)”.

Auto CAD is a software package, suitable for accurate and perfect drawing of engineering designs. The drawing of plans and layouts of building , isometric views and assembly drawing are possible in AutoCAD. By using AutoCAD, drawings can be created, modified and erased with ease. This package is suitable for 2-D and 3-D drawings.

AutoCAD is one of the leading drafting software available. It was developed by **“Autodesk”.**

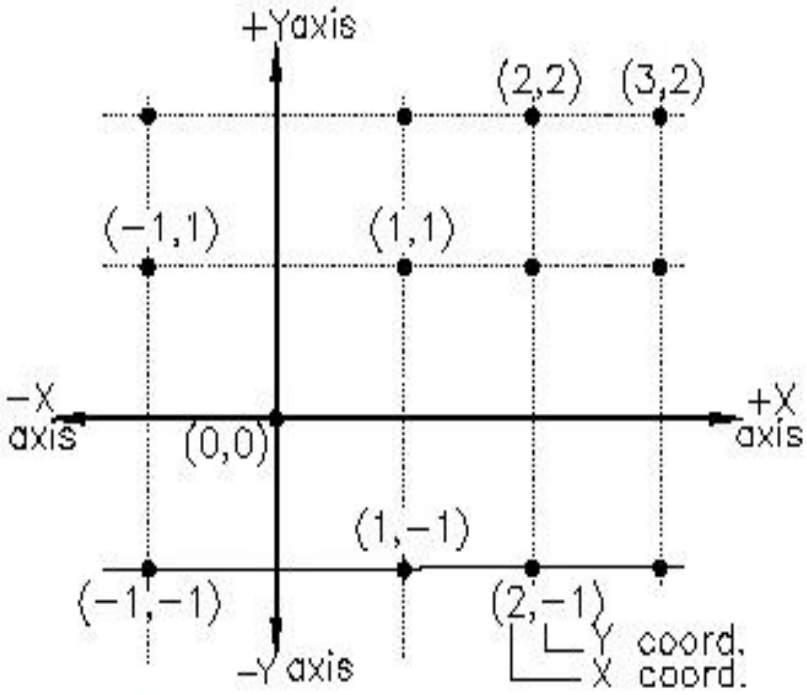
The first release of Auto CAD version 1.0 was in 1982. Many updates and improvements were done constantly. The latest version recently launched is AutoCAD - 2014. Latest version is easy to use and over come the difficulties of old version.

BENEFITS OF AUTOCAD

- Quickly create designs.
- Improved quality over hand drafting.
- Easily modify.
- More Accuracy.
- Easy to transfer.
- Long time save.

COORDINATE SYSTEMS

To specify a point in a plane, we take two mutually perpendicular lines as references. The horizontal line is called the **X axis**, and the vertical line is called the **Y axis.** The point of intersection of these two axes is called the **origin**. The X coordinate measures the horizontal distance from the origin on the X axis. The Y coordinate measures the vertical distance from the origin on the Y axis. The origin has the coordinate values of X = 0, Y = 0. The origin is taken as the reference for locating any point in the XY plane. This method of specifying points is called the **Cartesian coordinate system**.



Cartesian coordinate system

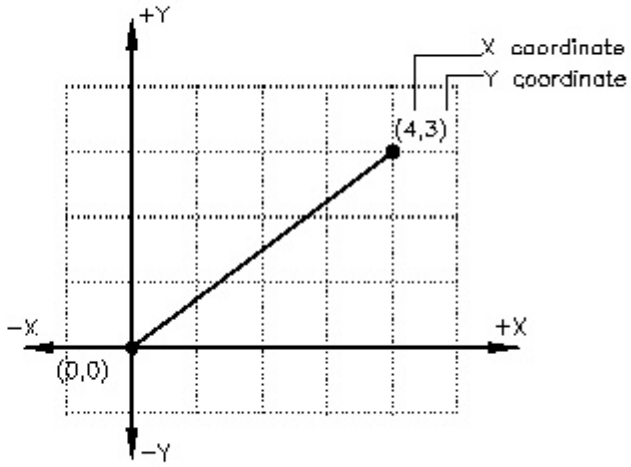
TYPES OF COORDINATES SYSTEM

In AutoCAD, the default origin is located at the lower left corner of the graphics area of the screen. AutoCAD uses the following coordinate system to locate a point in an XY plane.

- Absolute Coordinate system
- Relative Coordinate system
- Polar Coordinate system

Absolute Coordinate System

In the absolute coordinate system the points are located with respect to the origin (0,0). For example, a point with X = 4 and Y = 3 is measured 4 units horizontally (displacement along the X axis) and 3 units vertically (displacement along the Y axis) from the origin. In AutoCAD, the absolute coordinates are specified by entering X and Y coordinates, separated by a comma.



Absolute coordinate system

Command: **LINE** «

Specify first point: **1,1** «

(X = 1 and Y = 1.)

Specify next point or [Undo]: **4,1** «

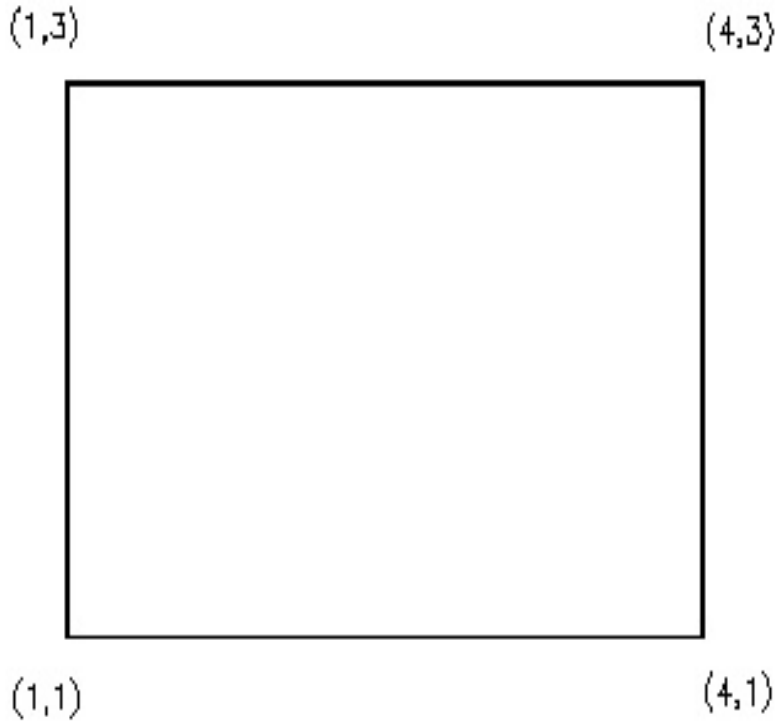
(X = 4 and Y = 1.)

Specify next point or [Undo]: **4,3** «

Specify next point or [Close /Undo]: **1,3** «

Specify next point or [Close/Undo]: **1,1** «

Specify next point or [Close/Undo]: «



Drawing lines using absolute coordinates

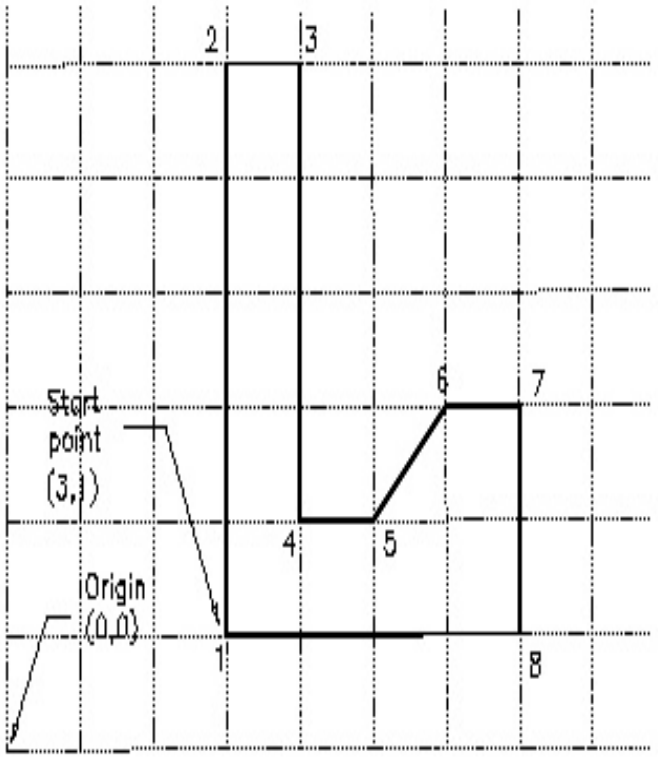
DRAWING A FIGURE USING ABSOLUTE COORDINATES

Point	Coordinates	Point	Coordinates
1	3,1	5	5,2
2	3,6	6	6,3
3	4,6	7	7,3
4	4,2	8	7,1

To draw the figure the prompt sequence is:

Command: **LINE** «

Specify first point: **3,1** « *(Start point.)*



Specify next point or [Undo]: **3,6** «

Specify next point or [Undo]: **4,6** «

Specify next point or [Close/Undo]: **4,2** «

Specify next point or [Close/Undo]: **5,2** «

Specify next point or [close/Undo]: **6,3** «

Specify next point or [close/Undo]: **7,3** «

Specify next point or [close/Undo]: **7,1** «

Specify next point or [close/Undo]: **3,1** «

Specify next point or [close/Undo]: «

Save this drawing. Enter **SAVE** at the Command prompt and then press ENTER. The **Save Drawing As** dialog box is displayed. Enter the name CIVIL in the **File name** edit box to replace Drawing1.dwg and then choose the **Save** button.

Relative Coordinates

The following is the prompt sequence to draw a rectangle with the lower left corner at point (1,1). The length of the rectangle is 4 units and the width is 3 units.

Command: **LINE** «

Specify first point: **1,1** « *(Start point.)*

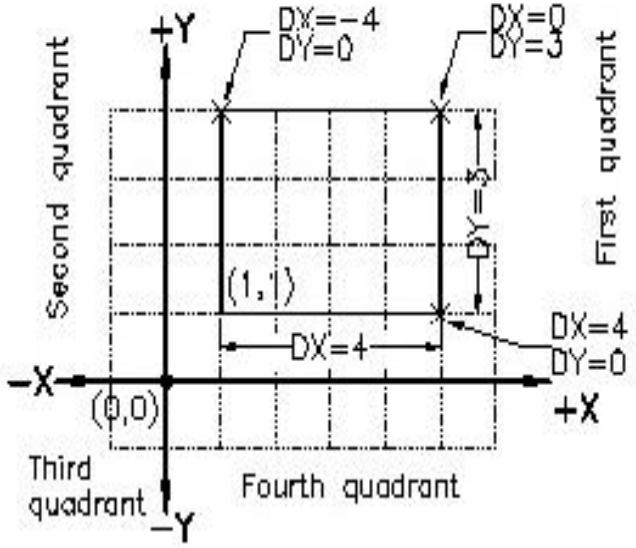
Specify next point or [Undo]: **@4,0** « *(Second point DX = 4, DY = 0.)*

Specify next point or [Undo]: **@0,3** « *(Third point DX = 0, DY = 3.)*

Specify next point or [Close/Undo]: **@-4,0** « *(Fourth point DX = -4, DY = 0.)*

Specify next point or [close/Undo]: **@0,-3** « *(Start point DX = 0, DY = -3.)*

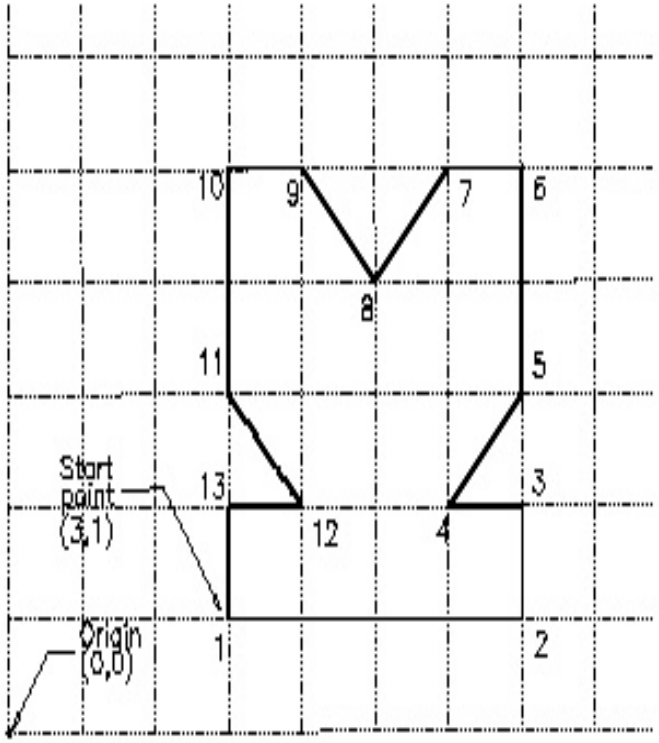
Specify next point or [close/Undo]: «



Drawing lines using the relative coordinates

USING RELATIVE COORDINATES WITH LINE COMMAND

Point	Coordinates	Point	Coordinates
1	3,1	8	@-1,-1
2	@4,0	9	@-1,1
3	@0,1	10	@-1,0
4	@-1,0	11	@0,-2
5	@1,1	12	@1,-1
6	@0,2	13	@-1,0
7	@-1,0	14	@0,-1



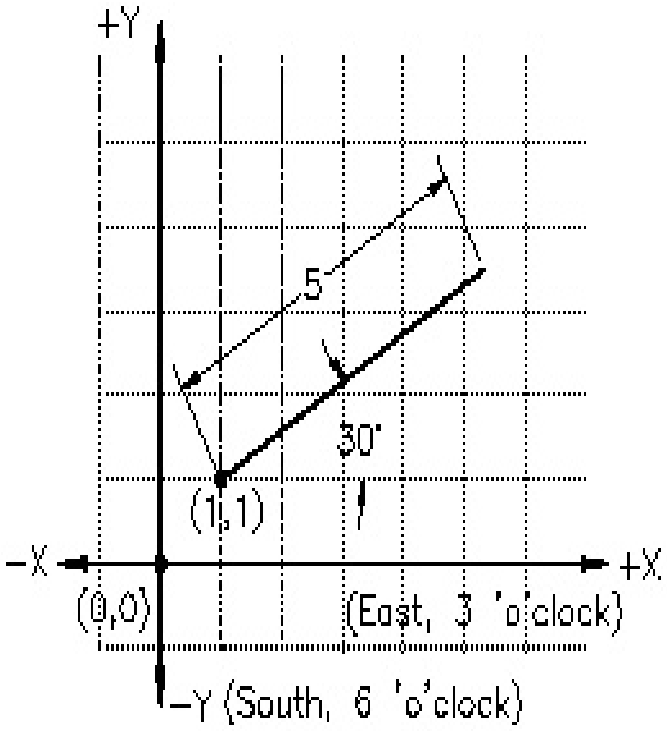
Polar Coordinates

In the relative polar coordinate system, a point can be located by defining both the distance of the point from the current point and the angle that the line between the two points makes with the positive X axis. The prompt sequence to draw a line from a point at 1,1 to a point at a distance of 5 units from the point (1,1), and at an angle of 30 degrees to the X axis is:

Command: **LINE «**

Specify first point: **1,1 «**

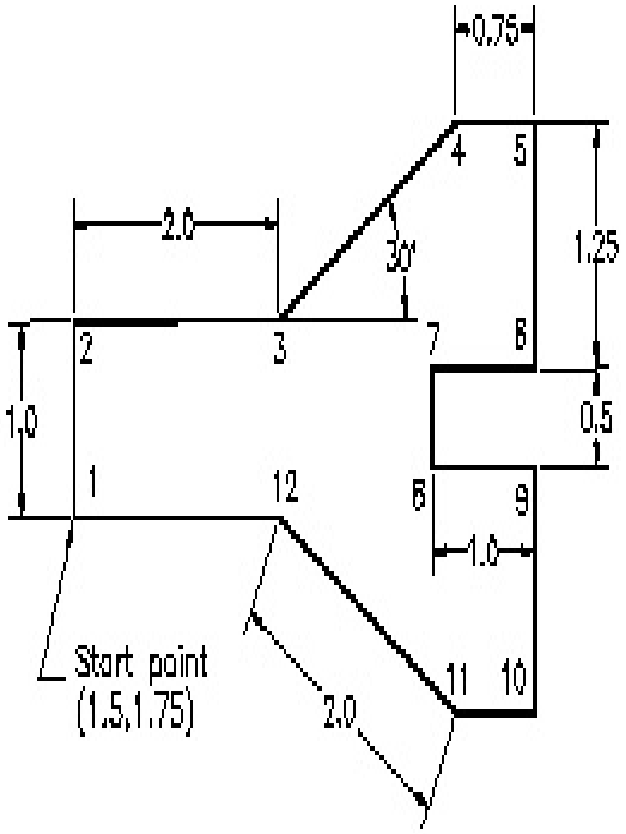
Specify next point or [Undo]: **@5<30 «**

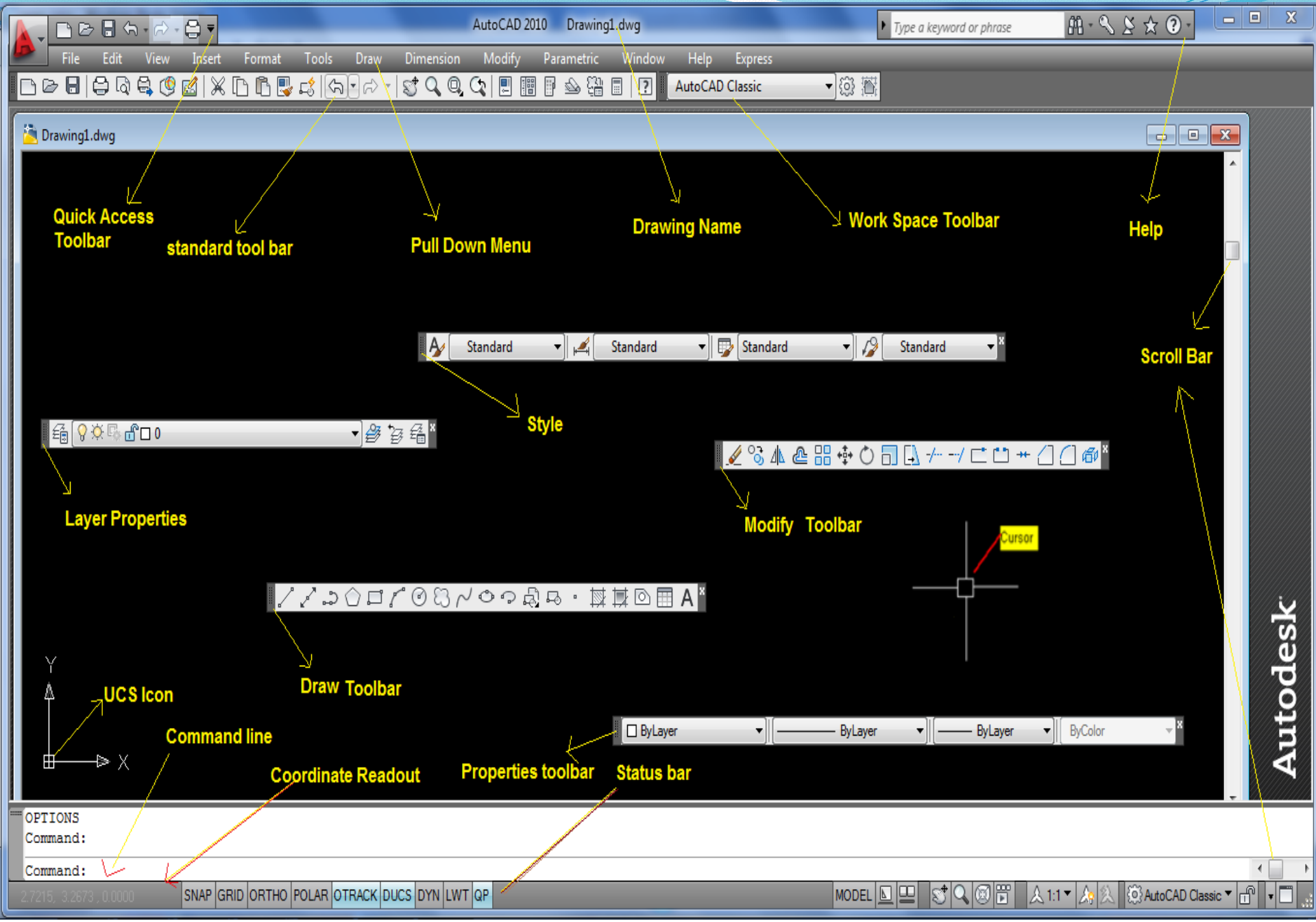


Drawing a line using polar coordinates

Draw using polar coordinates

Point	Coordinates	Point	Coordinates
1	1.5,1.75	7	@1.0<180
2	@1.0<90	8	@0.5<270
3	@2.0<0	9	@1.0<0
4	@2.0<30	10	@1.25<270
5	@0.75<0	11	@0.75<180
6	@1.25<-90	12	@2.0<150




AutoCAD 2010 Drawing1.dwg
Type a keyword or phrase
File Edit View Insert Format Tools Draw Dimension Modify Parametric Window Help Express
AutoCAD Classic
Drawing1.dwg
Quick Access Toolbar
standard tool bar
Pull Down Menu
Drawing Name
Work Space Toolbar
Help
Standard
Standard
Standard
Standard
Scroll Bar
Style
Layer Properties
Modify Toolbar
Cursor
Draw Toolbar
UCS Icon
Command line
Coordinate Readout
Properties toolbar
Status bar
ByLayer
ByLayer
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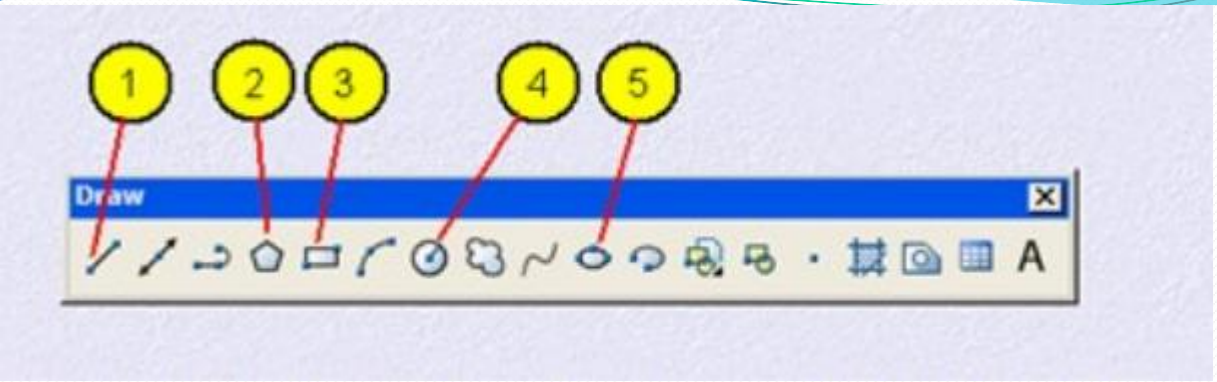
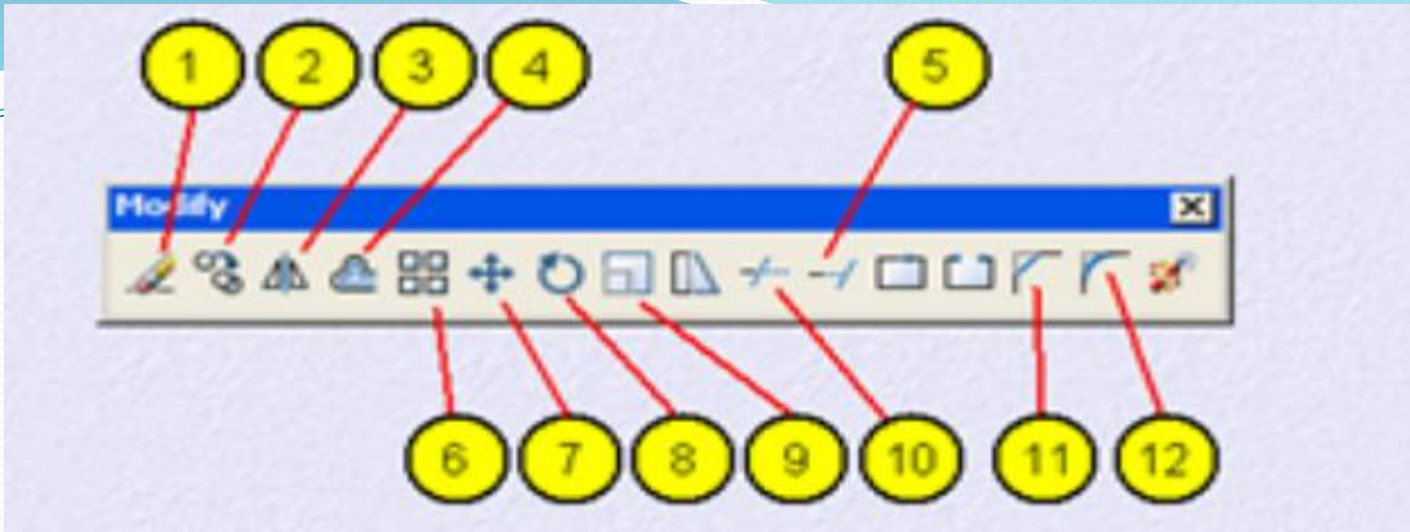
MODEL
1:1
AutoCAD Classic
Autodesk



DRAW TOOLBAR

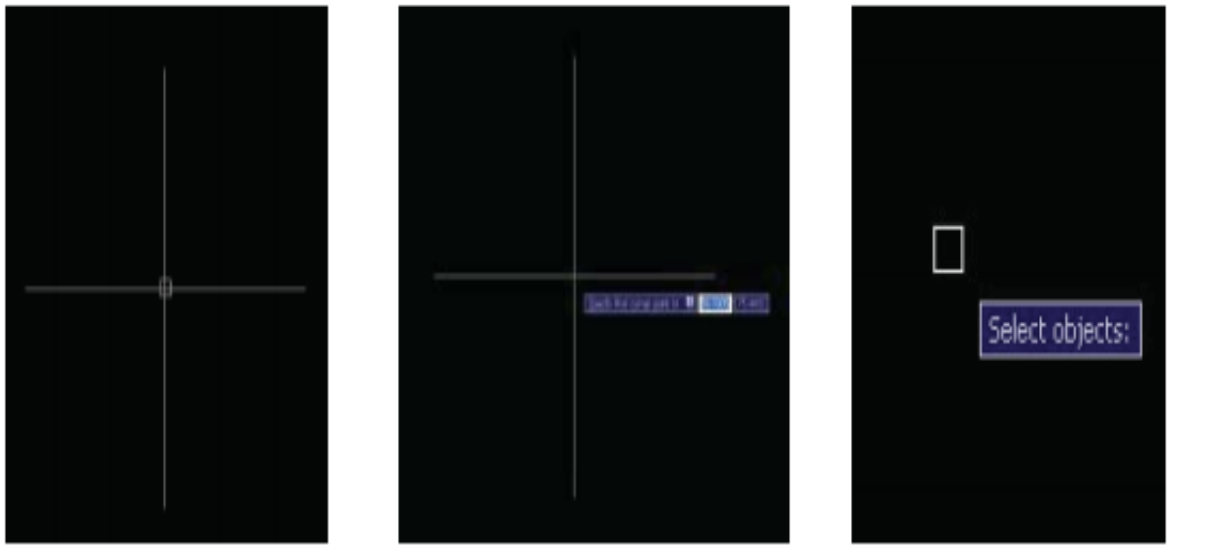
1. LINE- Draw lines in AutoCAD
2. POLYGON- Draw polygons with three or more sides
3. RECTANGLE- Used to draw rectangle
4. CIRCLE- command used to draw circles
5. ELLIPSE- use to draw ellipse



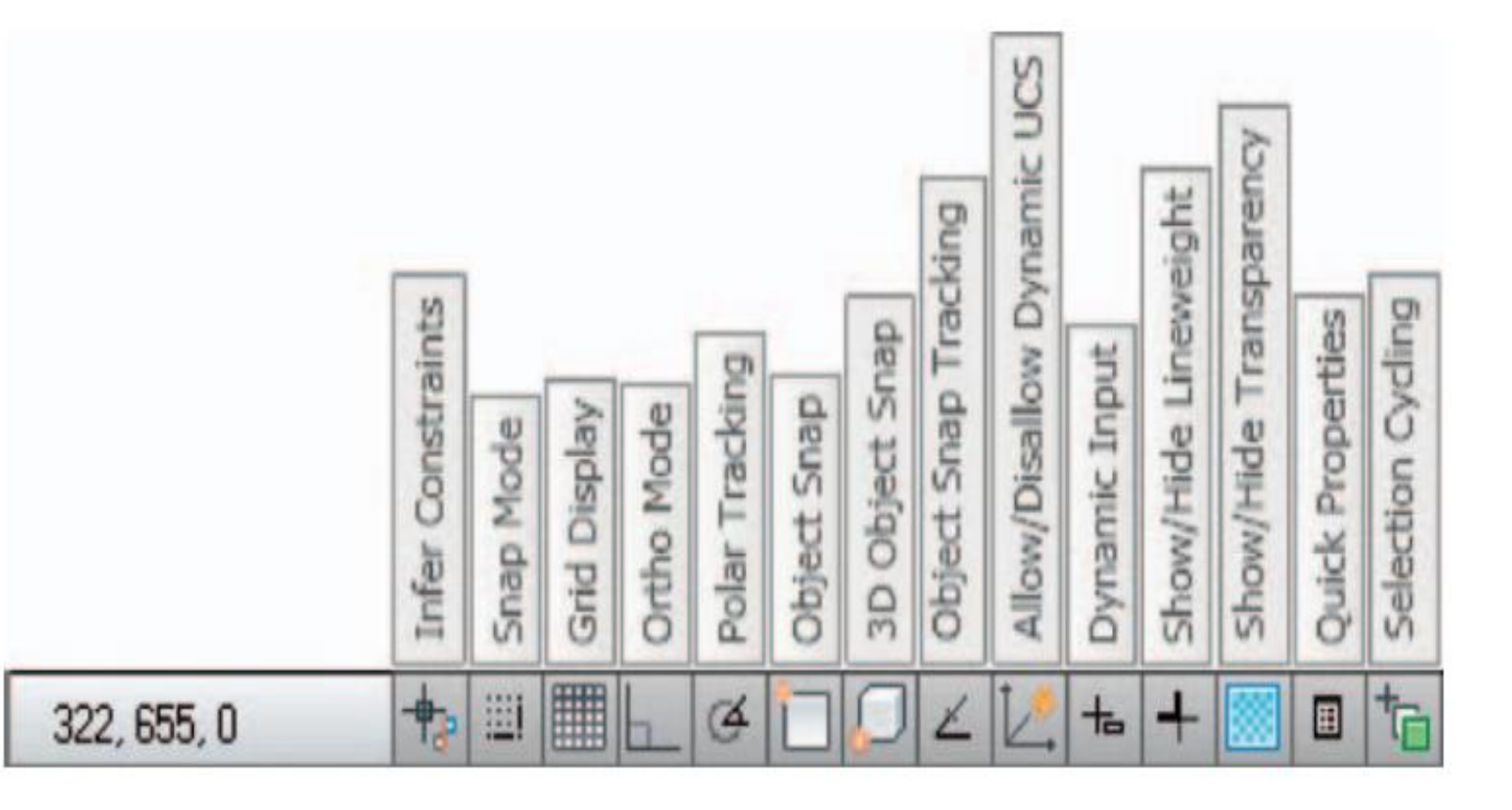
MODIFY TOOLBAR

1. **ERASE**- Erase object in the drawing area.
2. **COPY-** used to copy one or more objects.
3. **MIRROR**- command used to mirror an extra duplicate of an object.
4. **OFFSET**- used to offset one object from another a distance you specify.
5. **EXTEND-** used to extend one line to another.

6. **ARRAY-** used to make a rectangular or polar array of an object.
7. **MOVE**- used to move object around the drawing area.
8. **ROTATE-** used to rotate an object around a base point.
9. **SCALE-** command used to make an object larger or smaller.
10. **TRIM-** command used to trim an object from another object.
11. **CHAMPER**- used to put a chamfer between two lines.
12. **FILLET-** used to put a fillet between two lines as a radius you specify.



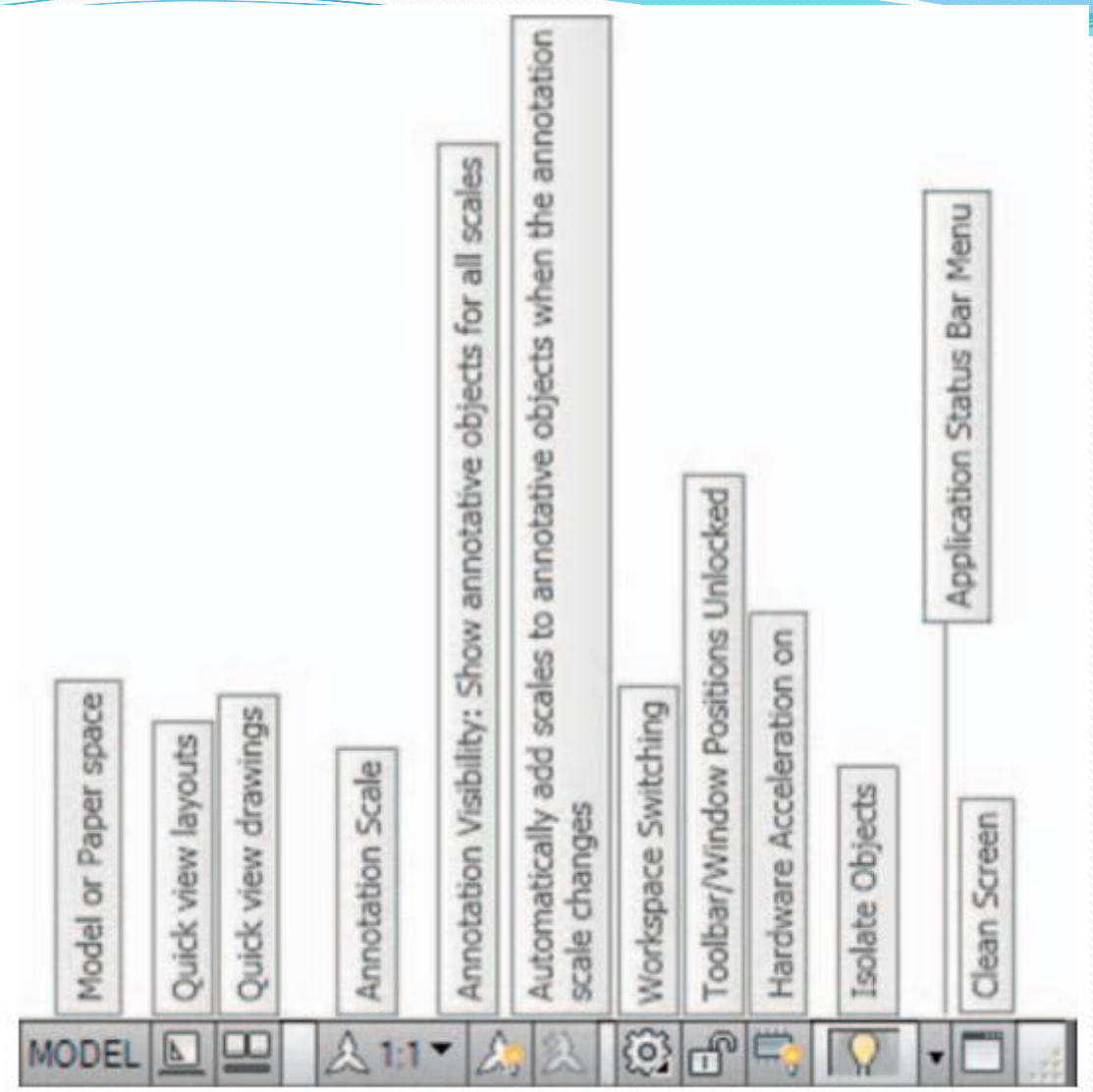
POSITION OF CURSIOR DURING DIFFERENT COMMAND



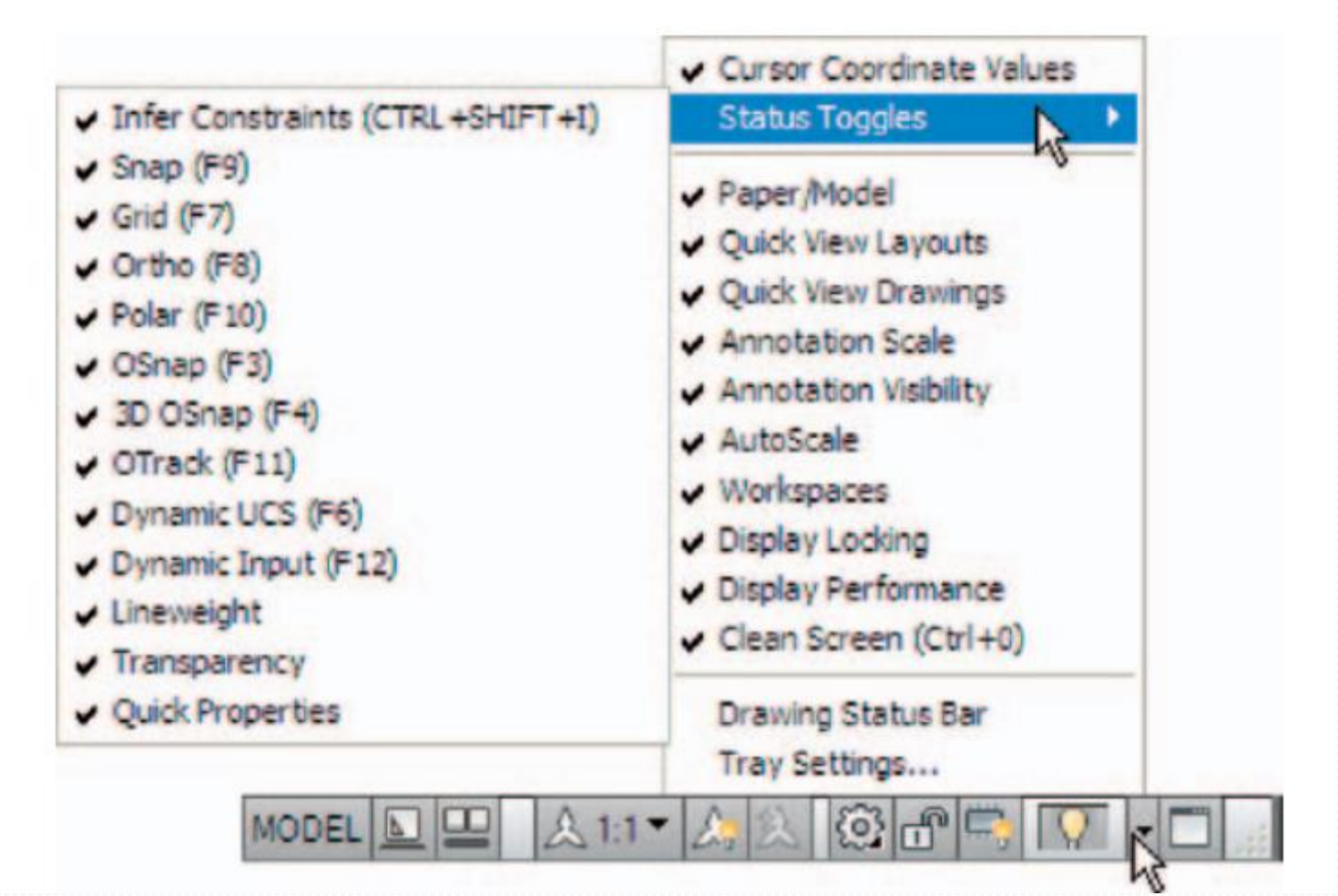
THE BUTTONS AT THE LEFT-HAND END OF THE STATUS BAR

1. **Snap Mode**: Also toggled using the **F9 key**. When snap on, the cursor under mouse control can only be moved in jumps from one snap point to another.
2. **Grid Display**: Also toggled using the **F7 key**. When set on, a series of grid points appears in the drawing area .
3. **Ortho Mode**: Also toggled using the **F8 key**. When set on, lines, etc. can only be drawn vertically or horizontally.
4. **Polar Tracking**: Also toggled using the **F10 key**. When set on, a small tip appears showing the direction and length of lines, etc. in degrees and units.
5. **Object Snap**: Also toggled using the **F3 key**. When set on, an osnap icon appears at the cursor pick box.

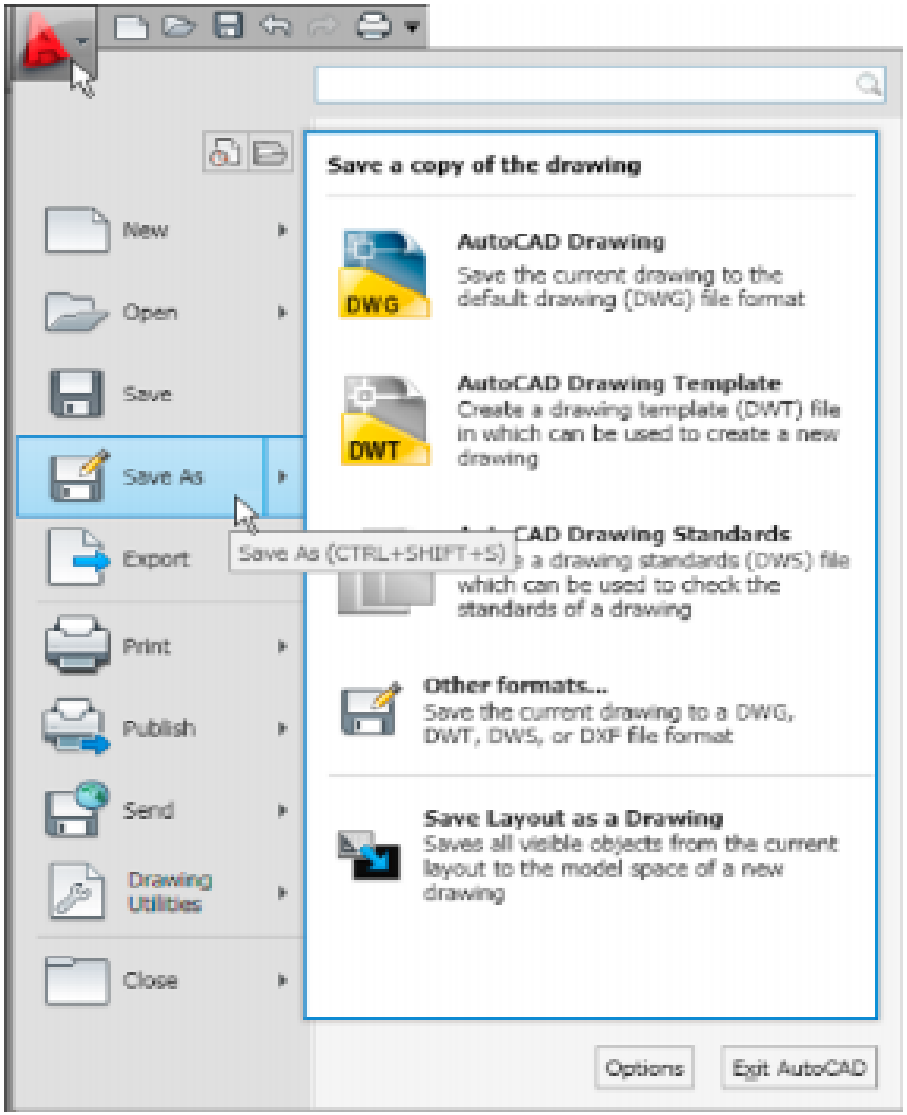
1. **Object Snap Tracking**: Also toggled by the **F11 key**. When set on, lines, etc. can be drawn at exact coordinate points and precise angles.
2. **Allow/Disallow Dynamic UCS**: Also toggled by the **F6 key**. Used when constructing 3D solid models.
3. **Dynamic Input**: Also toggled by **F12 key**. When set on, the x,y coordinates and prompts show when the cursor hairs are moved.
4. **Show/Hide Line weight**: When set on, line weights show on screen. When set off, line weights only show in plotted/printed drawings.
5. **Quick Properties**: A right-click brings up a popup menu, from which a click on Settings …causes the Drafting Settings dialog to appear.



THE BUTTONS AT THE RIGHT-HAND END OF THE STATUS BAR



THE APPLICATION STATUS BAR MENU



FOR SAVING THE DRAWING

Function Keys

- F1 HELP
- F2 FLIPSCREEN
- F3 OSNAP
- F4 TABLET
- F5 ISOPLANE
- F6 COORDINATE DISPLAY
- F7 GRID
- F8 ORTHO
- F9 SNAP
- F10 POLAR
- F11 OTRACK

SHORTCUTS

Draw		Modify	
Shortcut	**Command**	**Shortcut**	**Command**
L	LINE	E	ERASE
XL	CONSTURCTION LINE	CO	COPY
PL	POLYLINE	MI	MIRROR
POL	POLYGON	O	OFFSET
REC	RECTANG	AR	ARRAY
A	ARC	M	MOVE
C	CIRCLE	RO	ROTATE
REVCLOUD	REVCLOUD	SC	SCALE
SPL	SPLINE	S	STRETCH
EL	ELLIPSE	TR	TRIM
I	INSERT BLOCK	EX	EXTEND
B	DEFINE BLOCK	BR	BREAK, BREAK AT POINT
W	WRITE BLOCK	J	JOIN
H	HATCHING	CHA	CHAMFER
DT	TEXT (SINGLE LINE)	F	FILLET
T	MTEXT (MULTILINE)	X	EXPLODE

PROJECTION OF STRAIGHT LINES

PROJECTION OF STRAIGHT LINES

OBJECTIVES

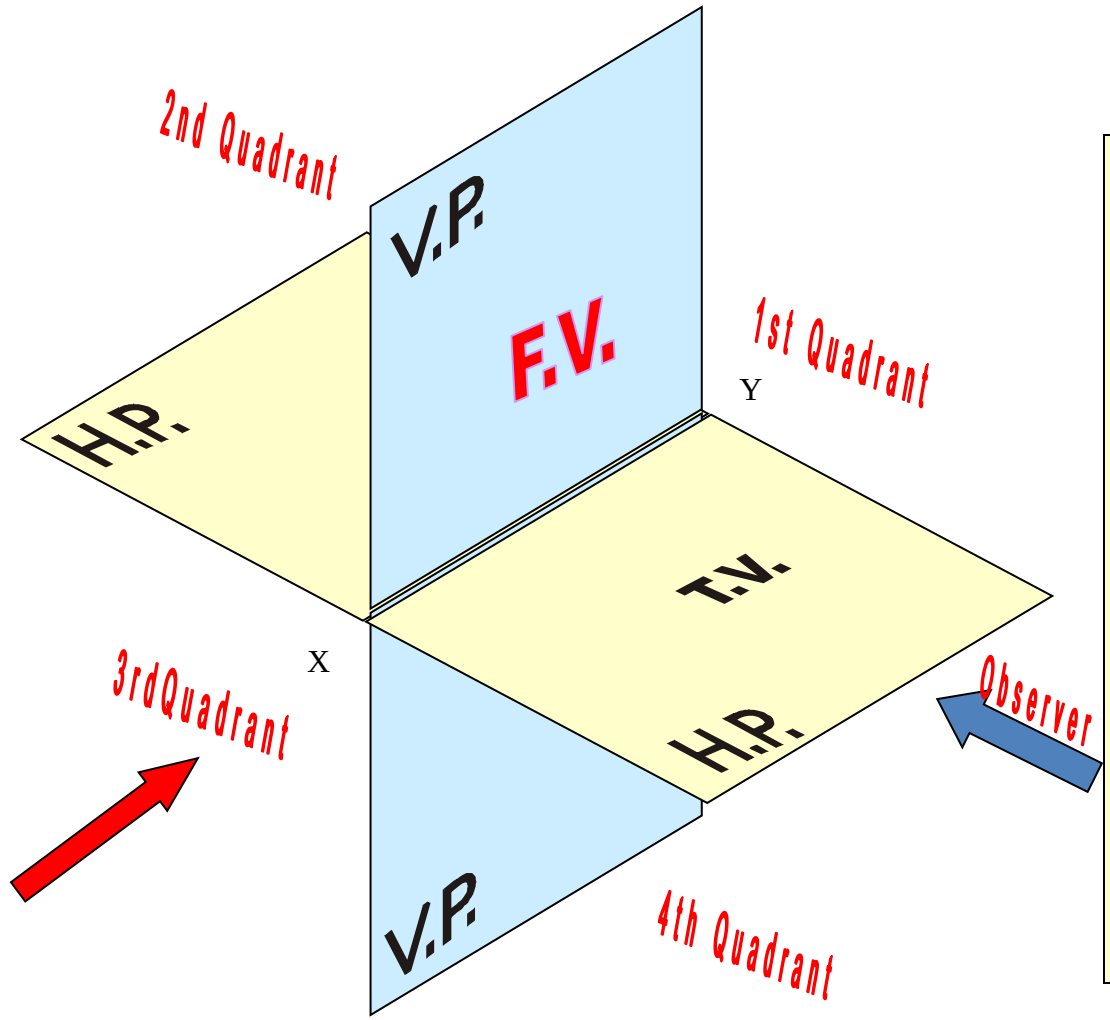
- Draw the projections of straight lines inclined to both the reference plane
- Find the true length of straight line
- Find the true inclinations of straight lines with the reference plane
- Show the traces of straight lines

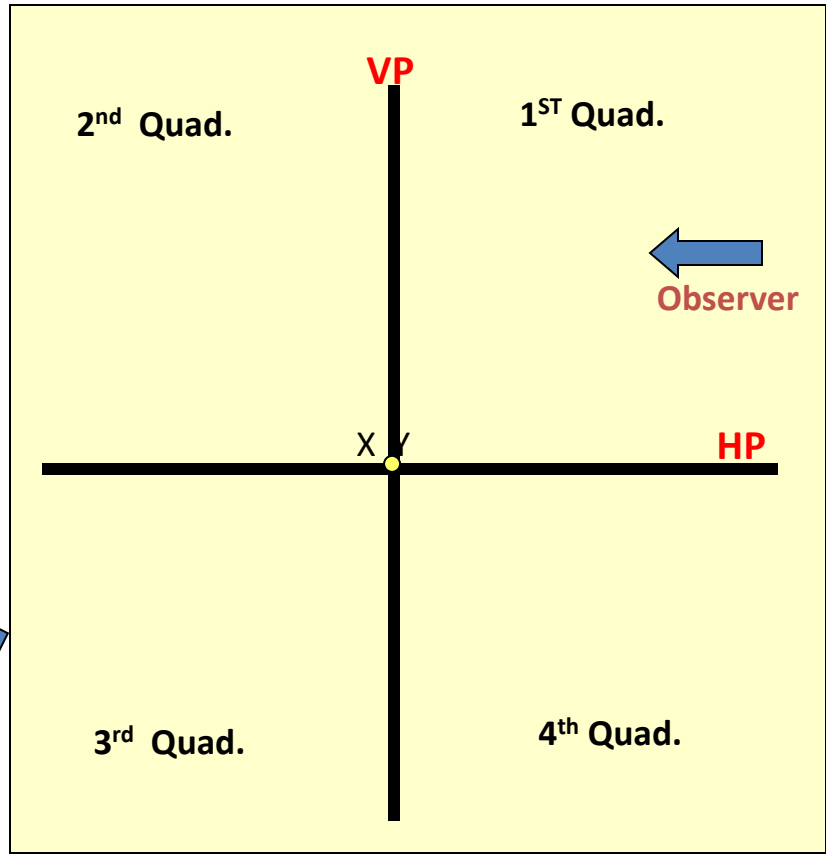
NOTATIONS

FOLLOWING NOTATIONS SHOULD BE FOLLOWED WHILE NAMEING DIFFERENT VIEWS IN ORTHOGRAPHIC PROJECTIONS.

OBJECT	POINT A	LINE AB
IT'S TOP VIEW	a	a b
IT'S FRONT VIEW	a'	a' b'
IT'S SIDE VIEW	a"	a" b"

SAME SYSTEM OF NOTATIONS SHOULD BE FOLLOWED INCASE NUMBERS, LIKE 1, 2, 3 – ARE USED.





THIS QUADRANT PATTERN,
IF OBSERVED ALONG X-Y LINE (IN RED ARROW DIRECTION)
WILL EXACTLY APPEAR AS SHOWN ON RIGHT SIDE AND HENCE,
IT IS FURTHER USED TO UNDERSTAND ILLUSTRATION PROPERLLY.

PROJECTIONS OF STRAIGHT LINES.

INFORMATION REGARDING A LINE *means*
IT'S LENGTH,
POSITION OF IT'S ENDS WITH HP & VP
IT'S INCLINATIONS WITH HP & VP WILL BE GIVEN.
AIM:- TO DRAW IT'S PROJECTIONS - MEANS FV & TV.

SIMPLE CASES OF THE LINE

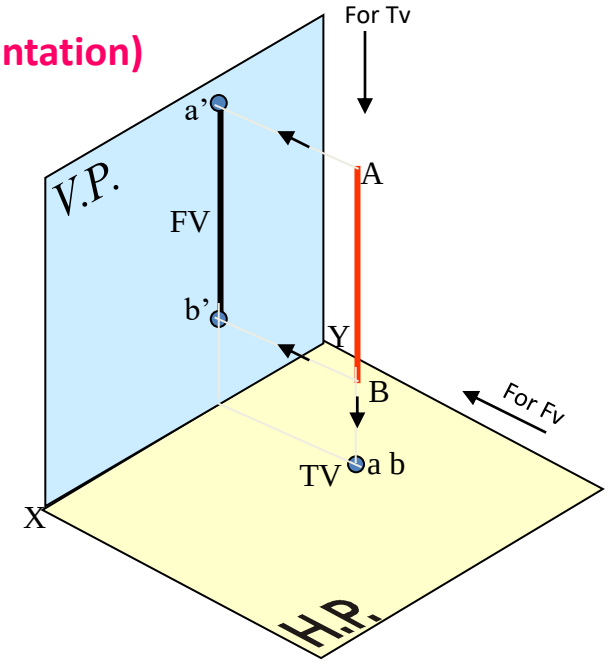
1. A VERTICAL LINE (LINE PERPENDICULAR TO HP & // TO VP)
2. LINE PARALLEL TO BOTH HP & VP.
3. LINE INCLINED TO HP & PARALLEL TO VP.
4. LINE INCLINED TO VP & PARALLEL TO HP.
5. LINE INCLINED TO BOTH HP & VP.

STUDY ILLUSTRATIONS GIVEN ON NEXT PAGE SHOWING CLEARLY THE NATURE OF FV & TV OF LINES LISTED ABOVE AND NOTE RESULTS.

(Pictorial Presentation)

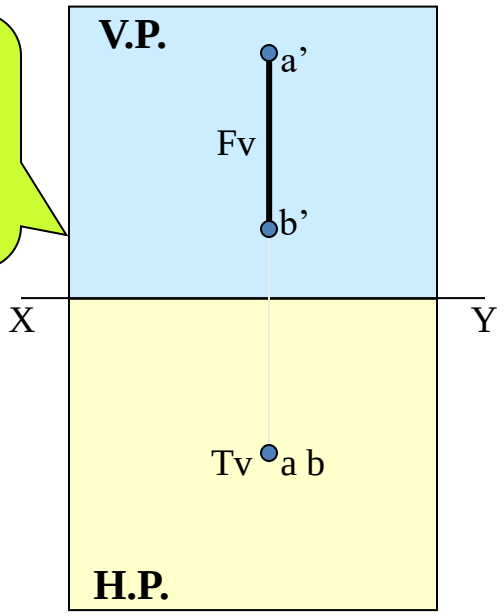
1.

A Line
perpendicular
to Hp
&
// to Vp



Orthographic Pattern

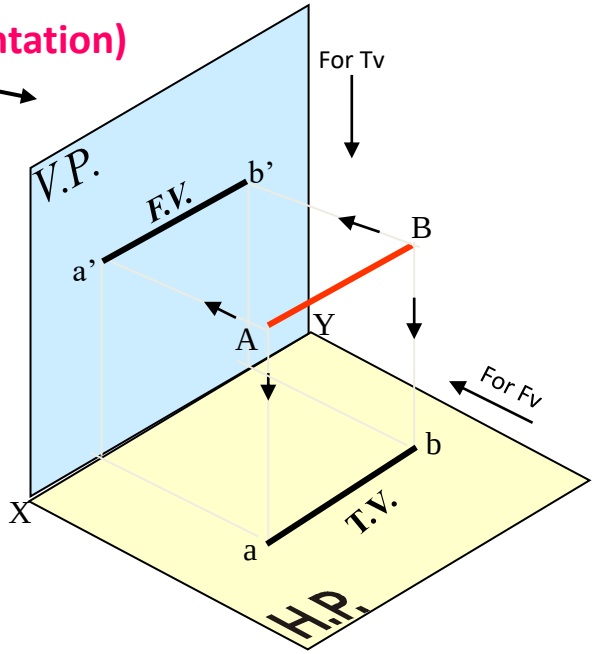
Note:
Fv is a vertical line
Showing True Length
&
Tv is a point.



(Pictorial Presentation)

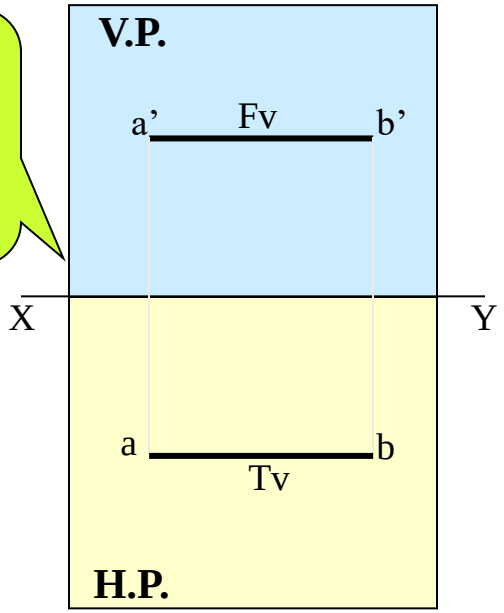
2.

A Line
// to Hp
&
// to Vp



Orthographic Pattern

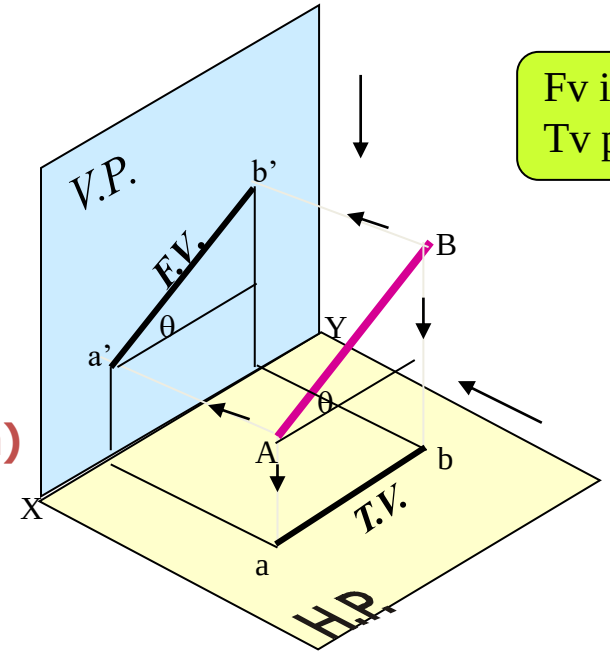
Note:
Fv & Tv both are
// to xy
&
both show T. L.



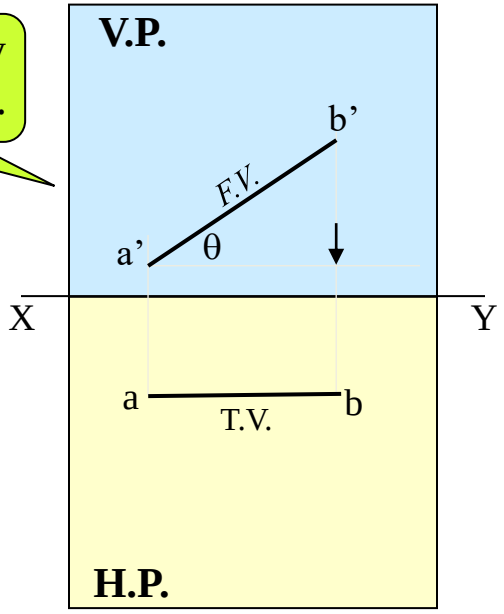
3.

A Line inclined to Hp
and
parallel to Vp

(Pictorial presentation)



Fv inclined to xy
Tv parallel to xy.

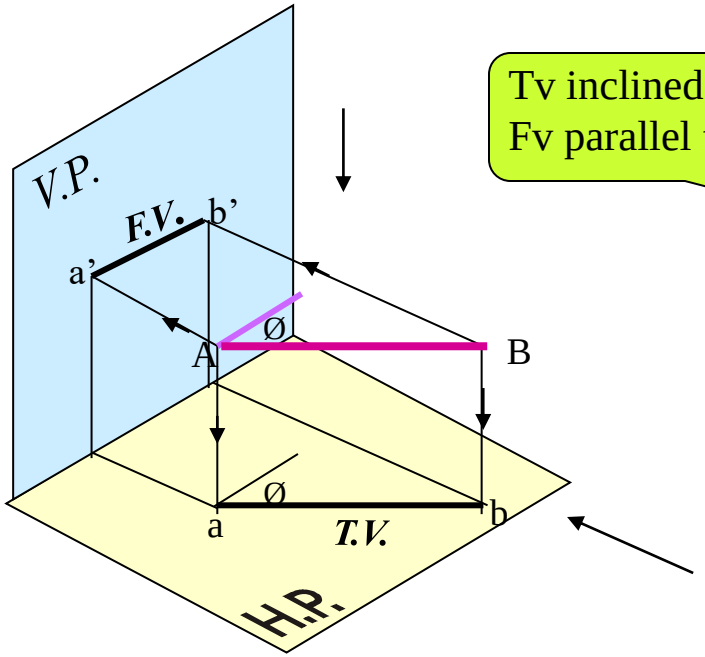


Orthographic Projections

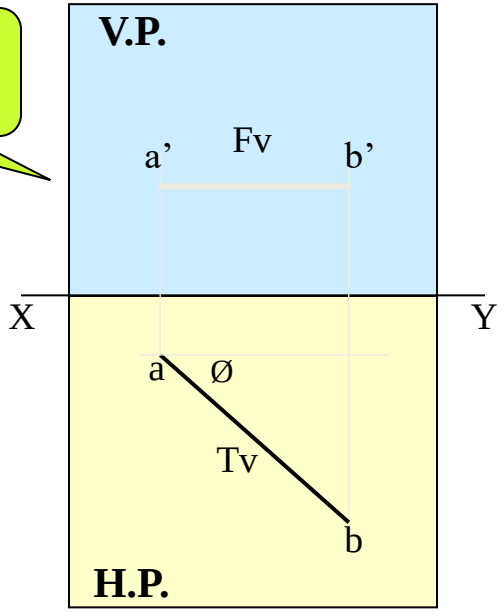
4.

A Line inclined to Vp
and
parallel to Hp

(Pictorial presentation)

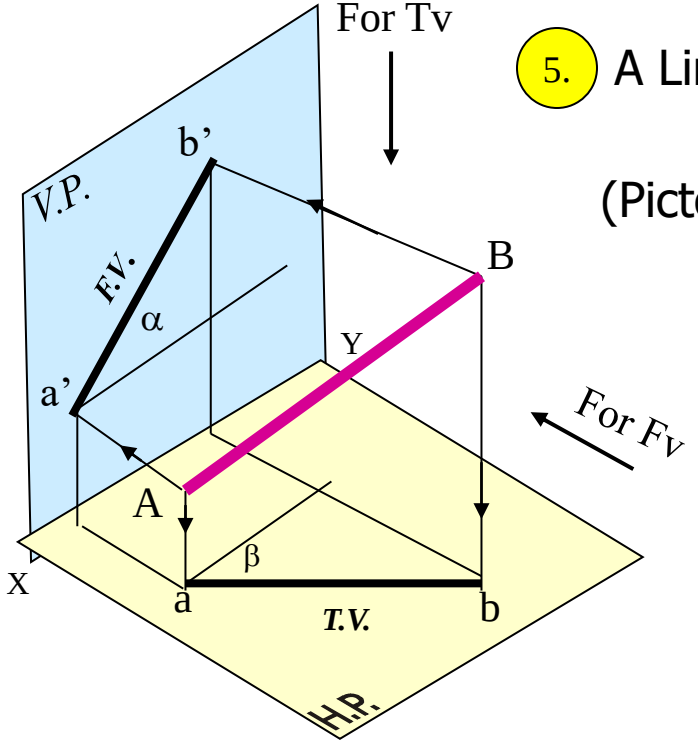


Tv inclined to xy
Fv parallel to xy.

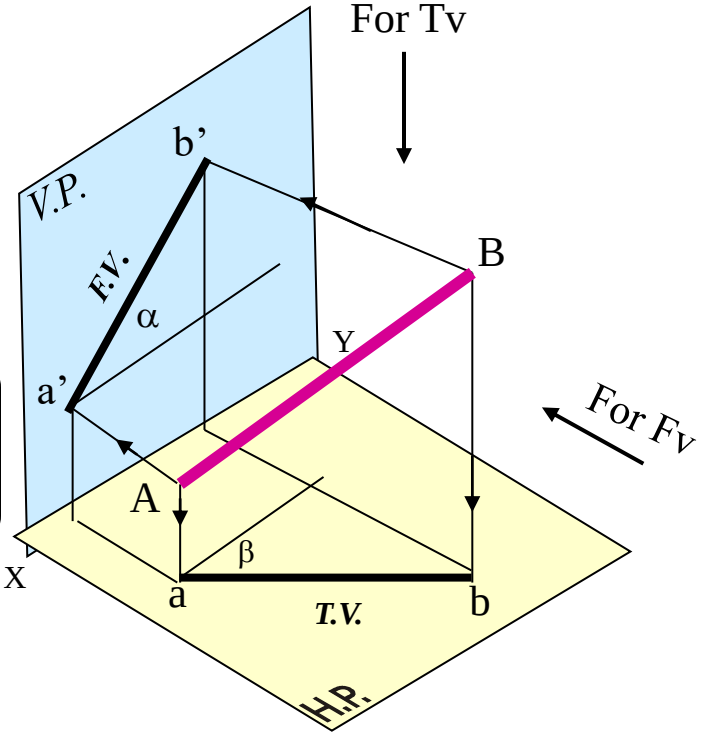


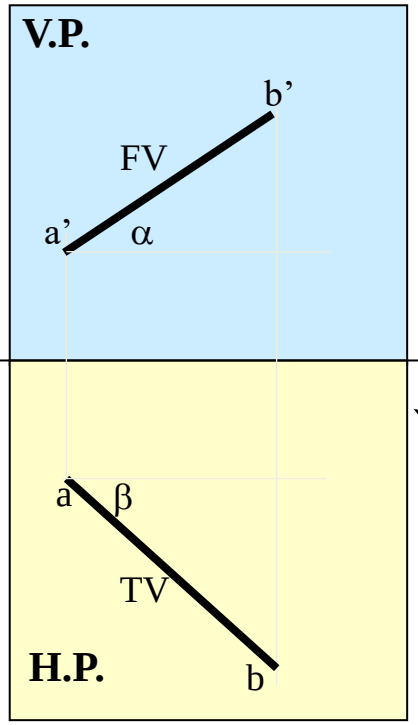
5. A Line inclined to both Hp and Vp

(Pictorial presentation)



On removal of object i.e. Line AB
Fv as a image on Vp.
Tv as a image on Hp,

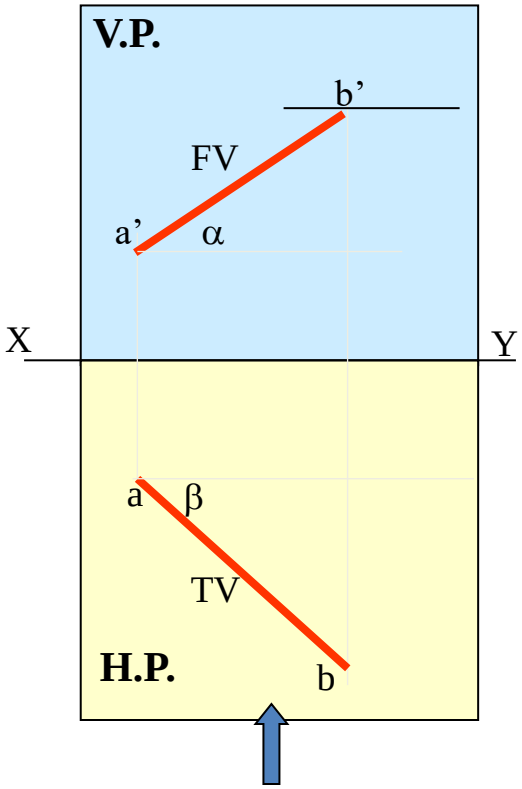




Orthographic Projections
Fv is seen on Vp clearly.
To see Tv clearly, HP is rotated 90^0 downwards,
Hence it comes below xy.

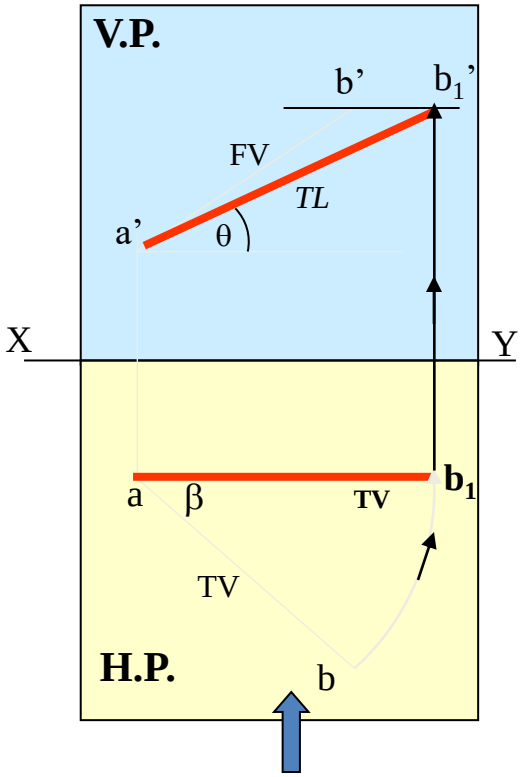
Note These Facts:-
Both Fv & Tv are inclined to xy.
(No view is parallel to xy)
Both Fv & Tv are reduced lengths.
(No view shows True Length)

Orthographic Projections
Means Fv & Tv of Line AB
are shown below,
with their apparent Inclinations
α & β



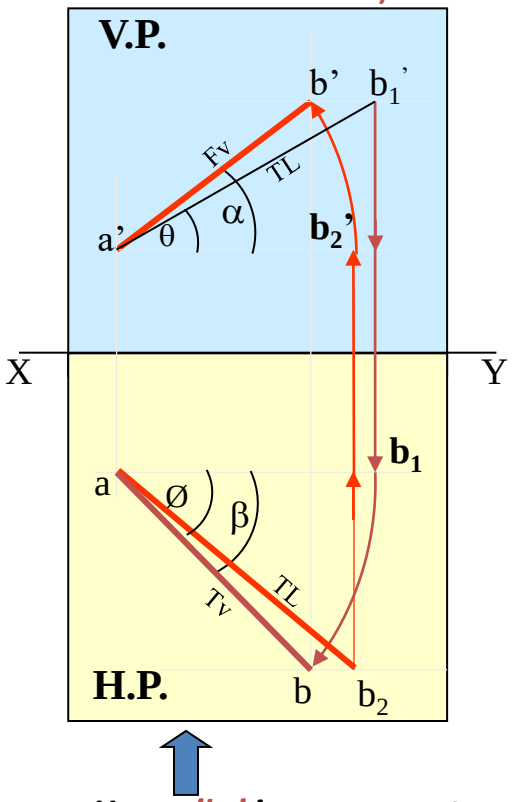
Here TV (ab) is not // to XY line
Hence it's corresponding FV
a' b' is not showing
True Length &
True Inclination with Hp.

Note the procedure
When Fv & Tv known,
How to find True Length.
(Views are rotated to determine
True Length & it's inclinations
with Hp & Vp).



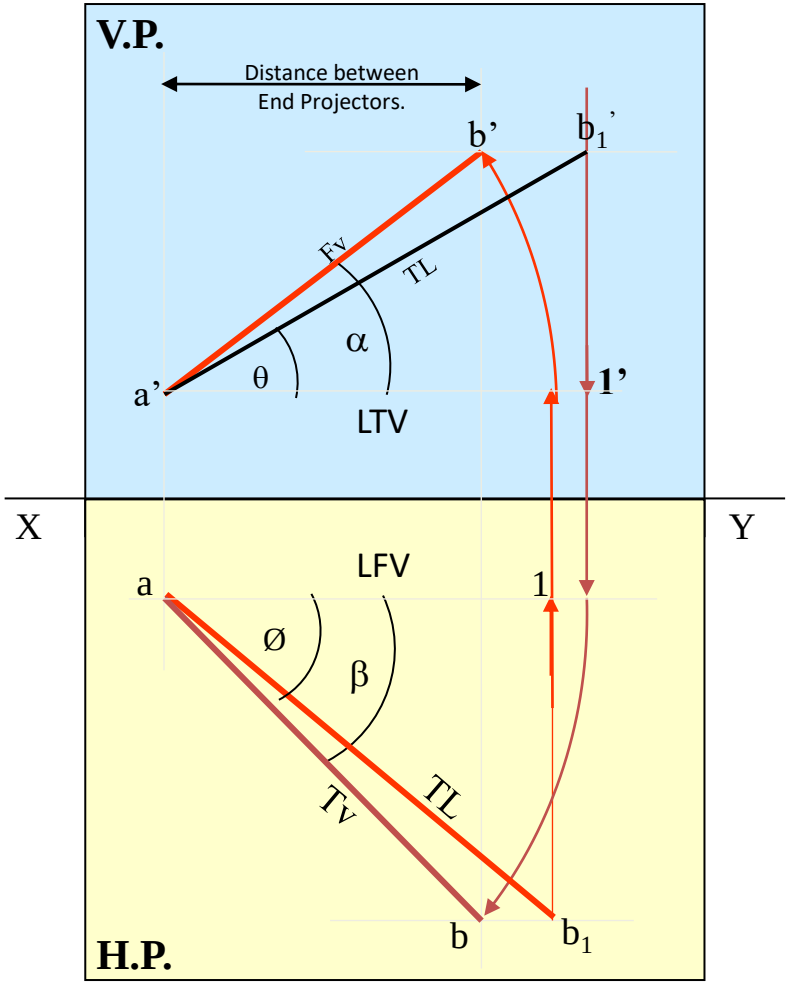
In this sketch, TV is rotated
and made // to XY line.
Hence it's corresponding
FV a' b1' Is showing
True Length
&
True Inclination with Hp.

Note the procedure
When True Length is known,
How to locate FV & TV.
(Component a'b2' of TL is drawn
which is further rotated
to determine FV)



Here a'b1' is component
of TL ab1 gives length of FV.
Hence it is brought Up to
Locus of a' and further rotated
to get point b'. a' b' will be Fv.
Similarly drawing component
of other TL(a'b1') TV can be drawn.

The most important diagram showing graphical relations among all important parameters of this topic.
Study and memorize it as a ***CIRCUIT DIAGRAM***
And use in solving various problems.



1) True Length (TL) – a' b_1' & a b

2) Angle of TL with Hp - θ $\emptyset$

3) Angle of TL with Vp – α β

Important TEN parameters to be remembered with Notations used here onward

4) Angle of FV with xy –

5) Angle of TV with xy –

6) LTV (length of FV) – Component **(a-1)**

7) LFV (length of TV) – Component **(a'-1')**

8) Position of A- **Distances of a & a' from xy**

9) Position of B- **Distances of b & b' from xy**

10) Distance between End Projectors

PROJECTION OF PLANES

PROJECTION OF PLANES

OBJECTIVES

- Obtain the traces of plane figures
- Draw the projections of plane figures

PLANE

A plane is a two dimensional entity having only length and breadth.

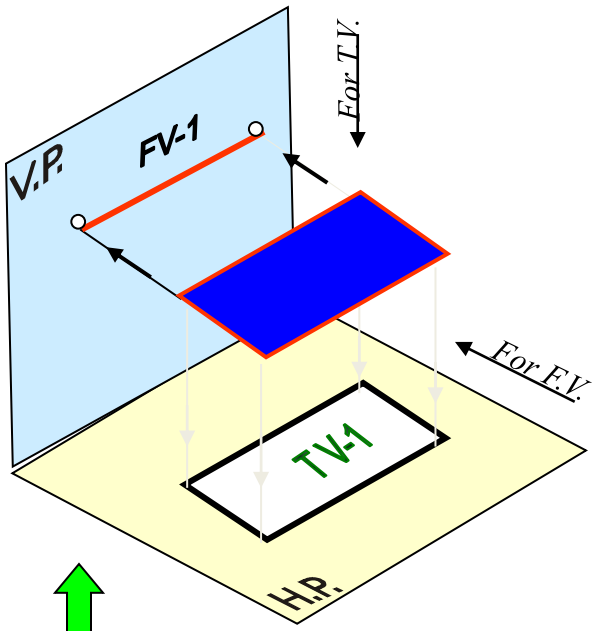
TRACES

The lines along which a plane meets the reference planes are called the traces of the plane.

CASE OF A RECTANGLE – OBSERVE AND NOTE ALL STEPS.

SURFACE **PARALLEL** TO HP

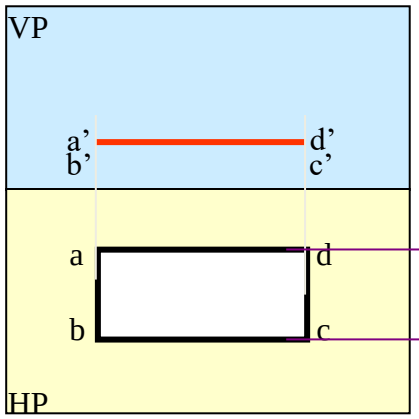
PICTORIAL PRESENTATION



ORTHOGRAPHIC

TV-True Shape

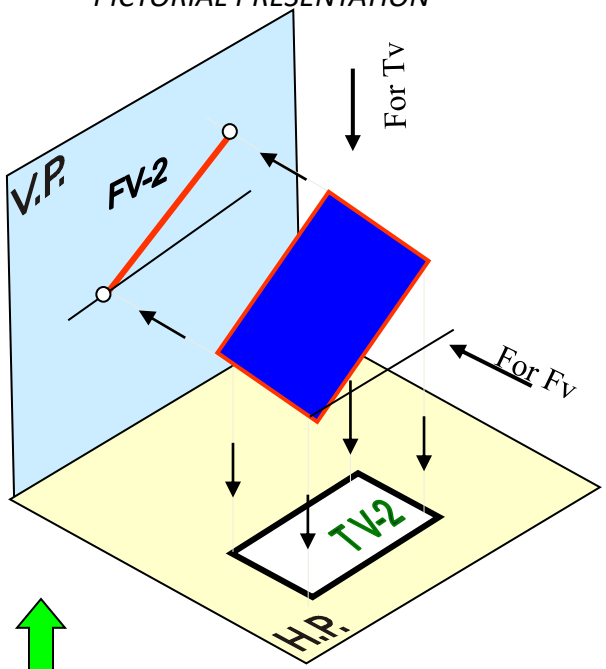
FV- Line // to xy



A

SURFACE **INCLINED** TO HP

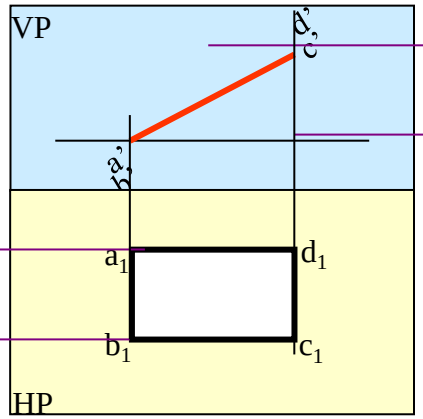
PICTORIAL PRESENTATION



ORTHOGRAPHIC

FV- Inclined to XY

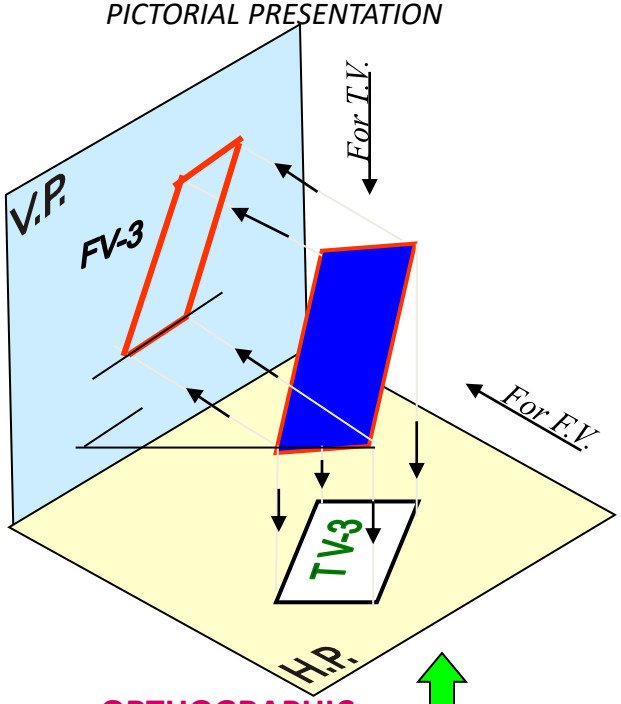
TV- Reduced Shape



B

ONE SMALL SIDE INCLINED TO VP

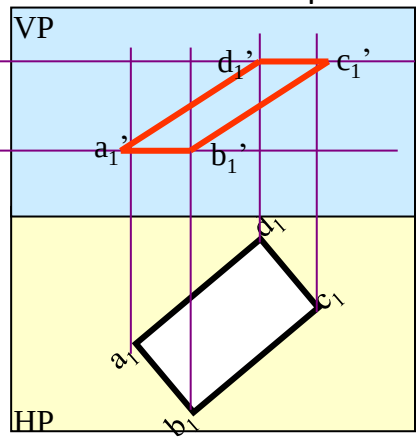
PICTORIAL PRESENTATION



ORTHOGRAPHIC

FV- Apparent Shape

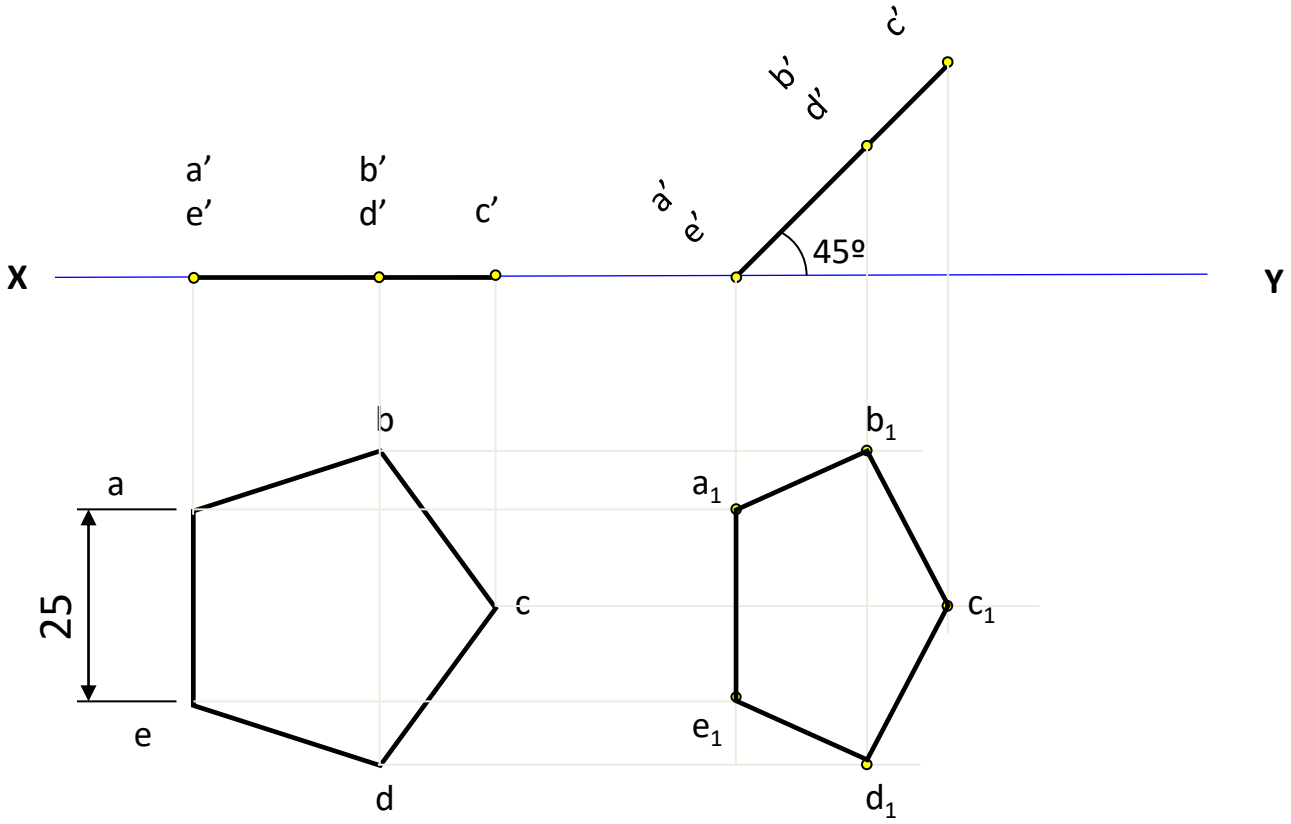
TV-Previous Shape



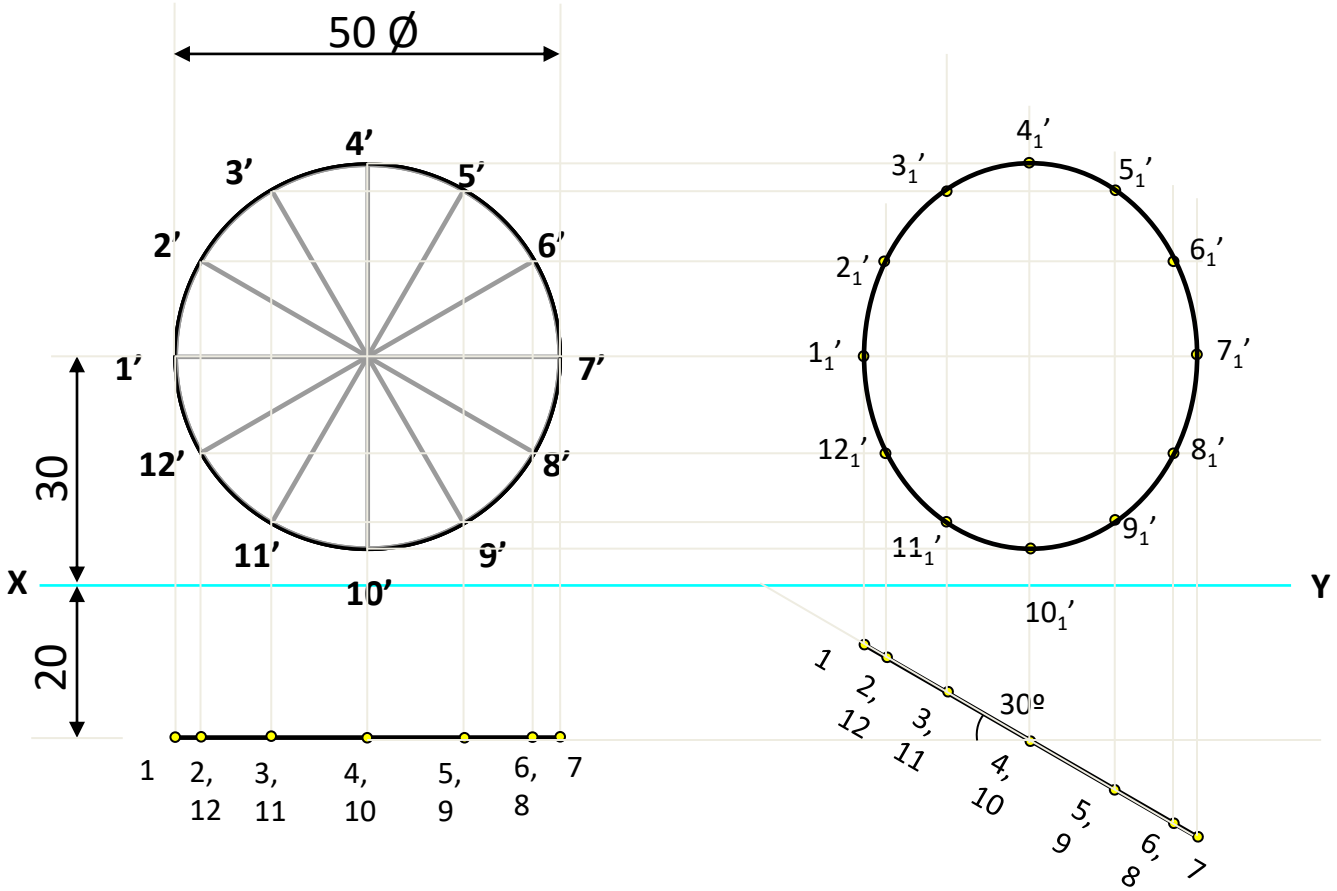
C

Q1: A regular pentagon of 25mm side has one side on the ground. Its plane is inclined at 45º to the HP and perpendicular to the VP. Draw its projections and show its traces

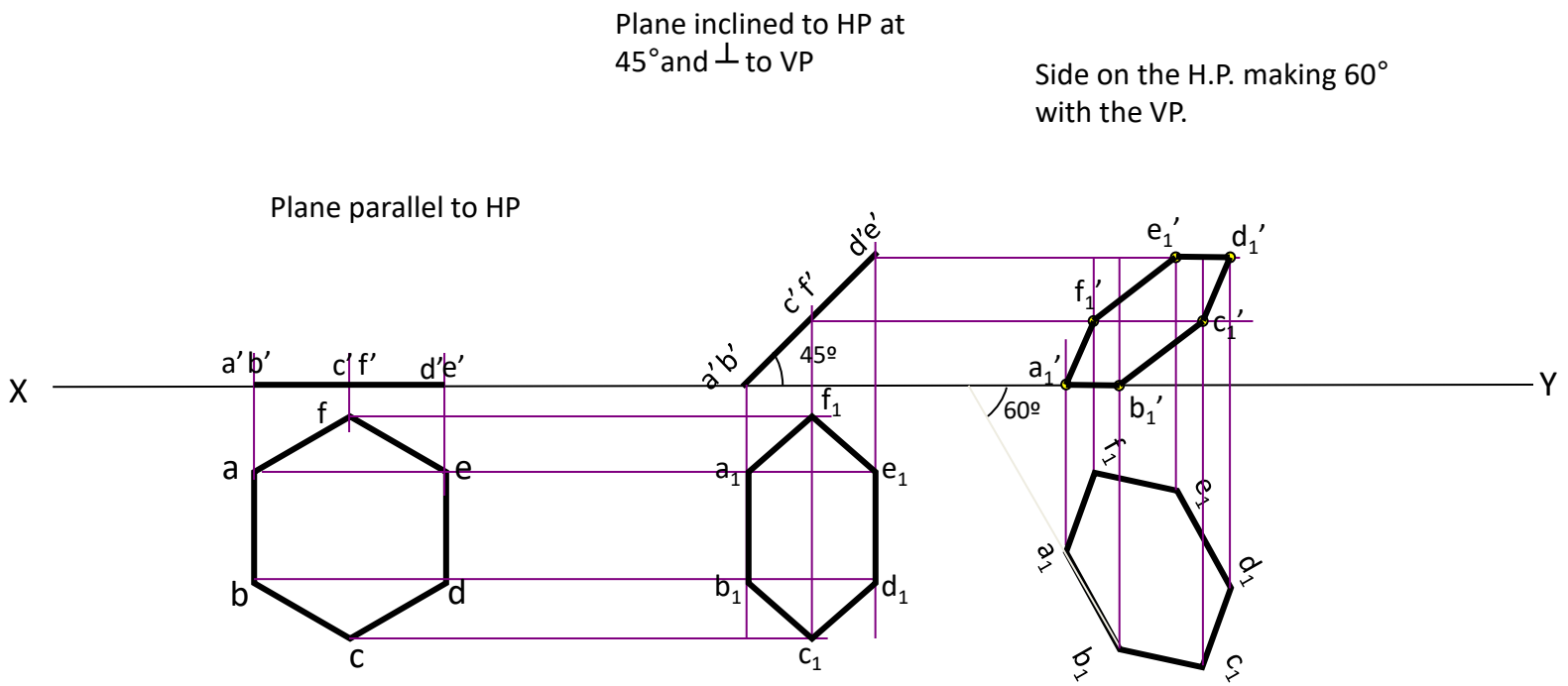
Hint: As the plane is inclined to HP, it should be kept parallel to HP with one edge perpendicular to VP



Q 2:Draw the projections of a circle of 5 cm diameter having its plane vertical and inclined at 30º to the V.P. Its centre is 3cm above the H.P. and 2cm in front of the V.P. Show also its traces



Q 3: Draw the projections of a regular hexagon of 25mm sides, having one of its side in the H.P. and inclined at 60 to the V.P. and its surface making an angle of 45º with the H.P.

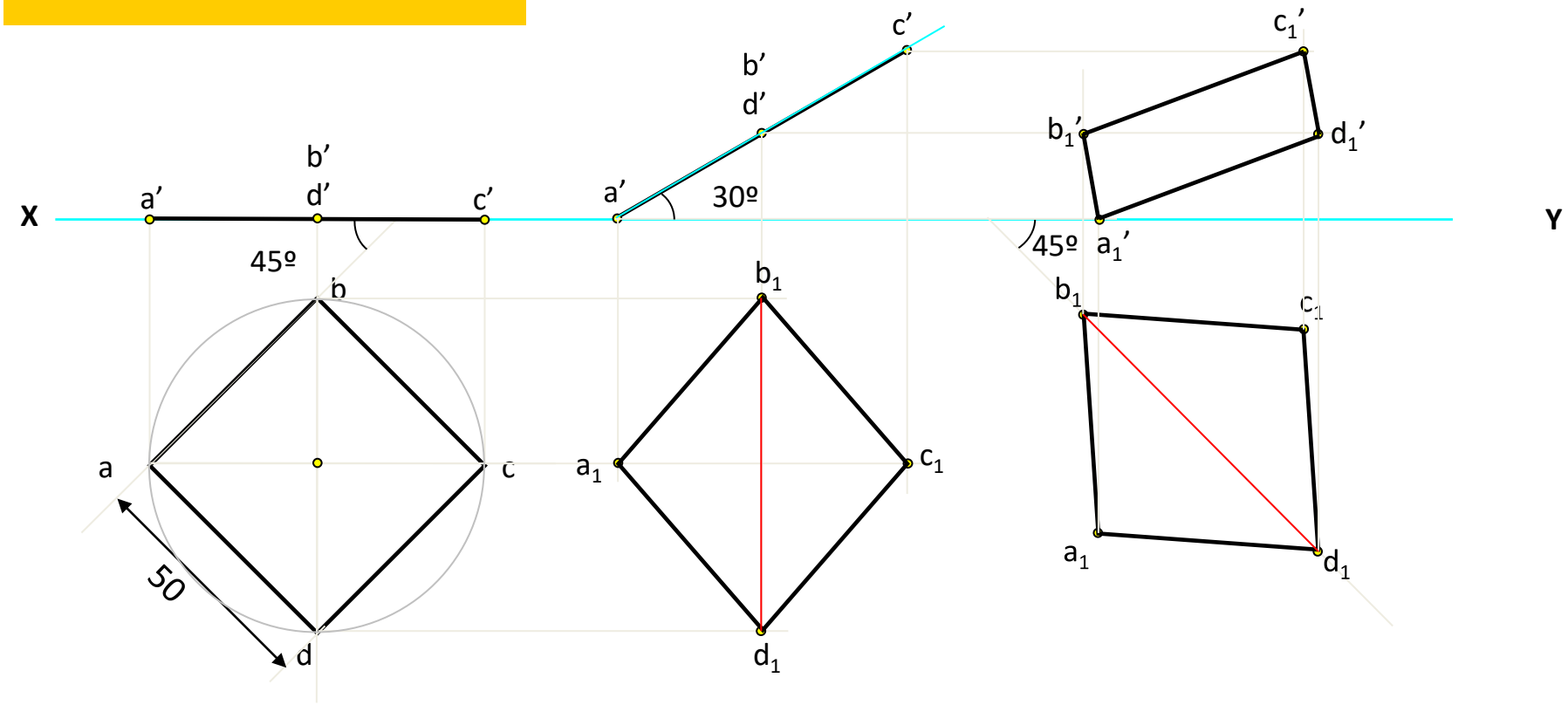


Q 4: A square ABCD of 50 mm side has its corner A in the H.P., its diagonal AC inclined at 30º to the H.P. and the diagonal BD inclined at 45º to the V.P. and parallel to the H.P. Draw its projections.

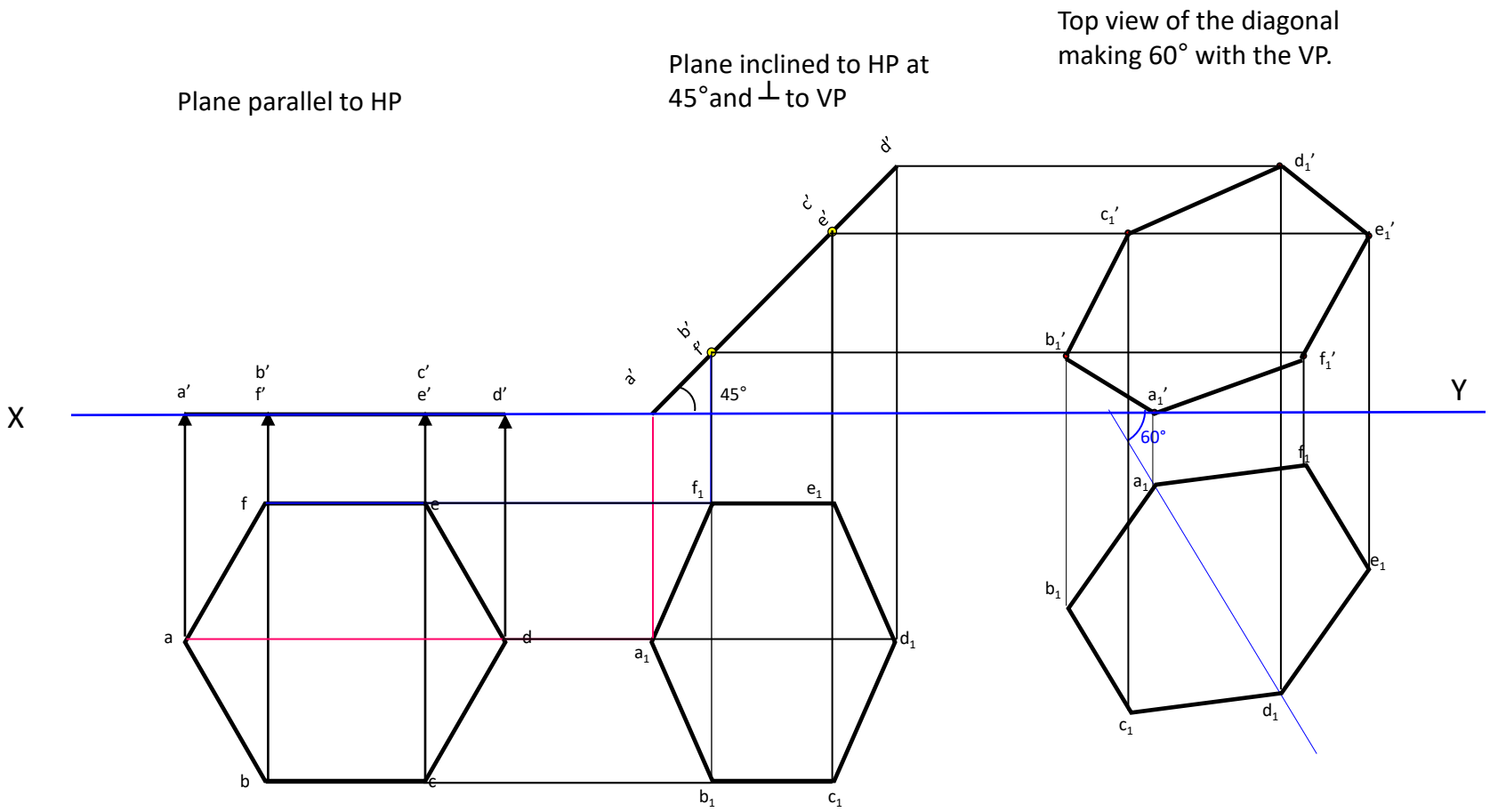
Keep AC parallel to the H.P. & BD perpendicular to V.P. (considering inclination of AC as inclination of the plane)

Incline AC at 30º to the H.P. i.e. incline the edge view (FV) at 30º to the HP

Incline BD at 45º to the V.P.



Q 5 :A regular hexagon of 40mm side has a corner in the HP. Its surface inclined at45° to the HP and the top view of the diagonal through the corner which is in the HP makes an angle of 60° with the VP. Draw its projections.

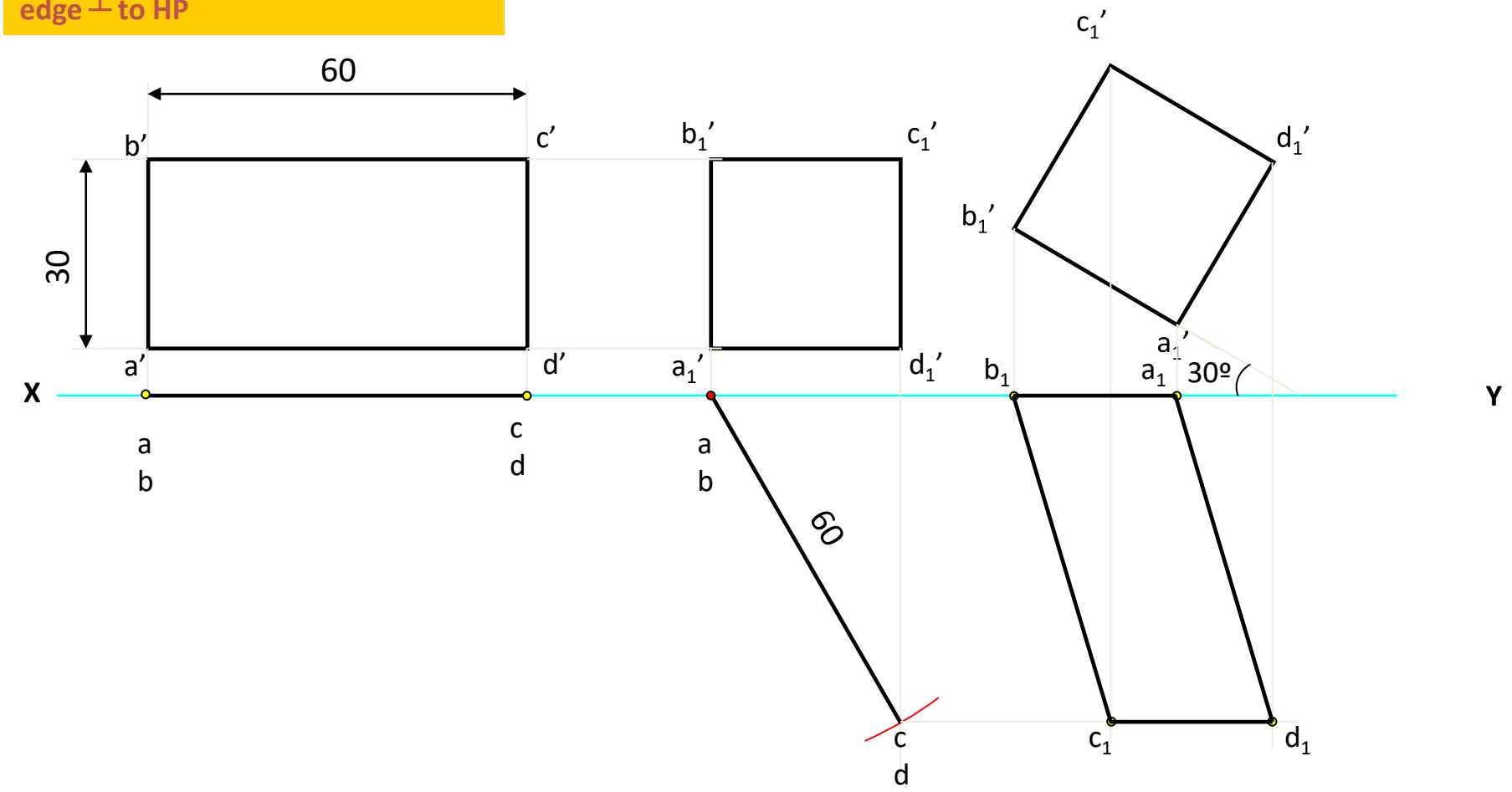


Q 6: A thin rectangular plate of sides 60 mm X 30 mm has its shorter side in the V.P. and inclined at 30º to the H.P. Project its top view if its front view is a square of 30 mm long sides

A rectangle can be seen as a square in the F.V. only when its surface is inclined to VP. So for the first view keep the plane // to VP & shorter edge ⊥ to HP

F.V. (square) is drawn first

Incline $a_1'b_1'$ at 30º to the H.P.

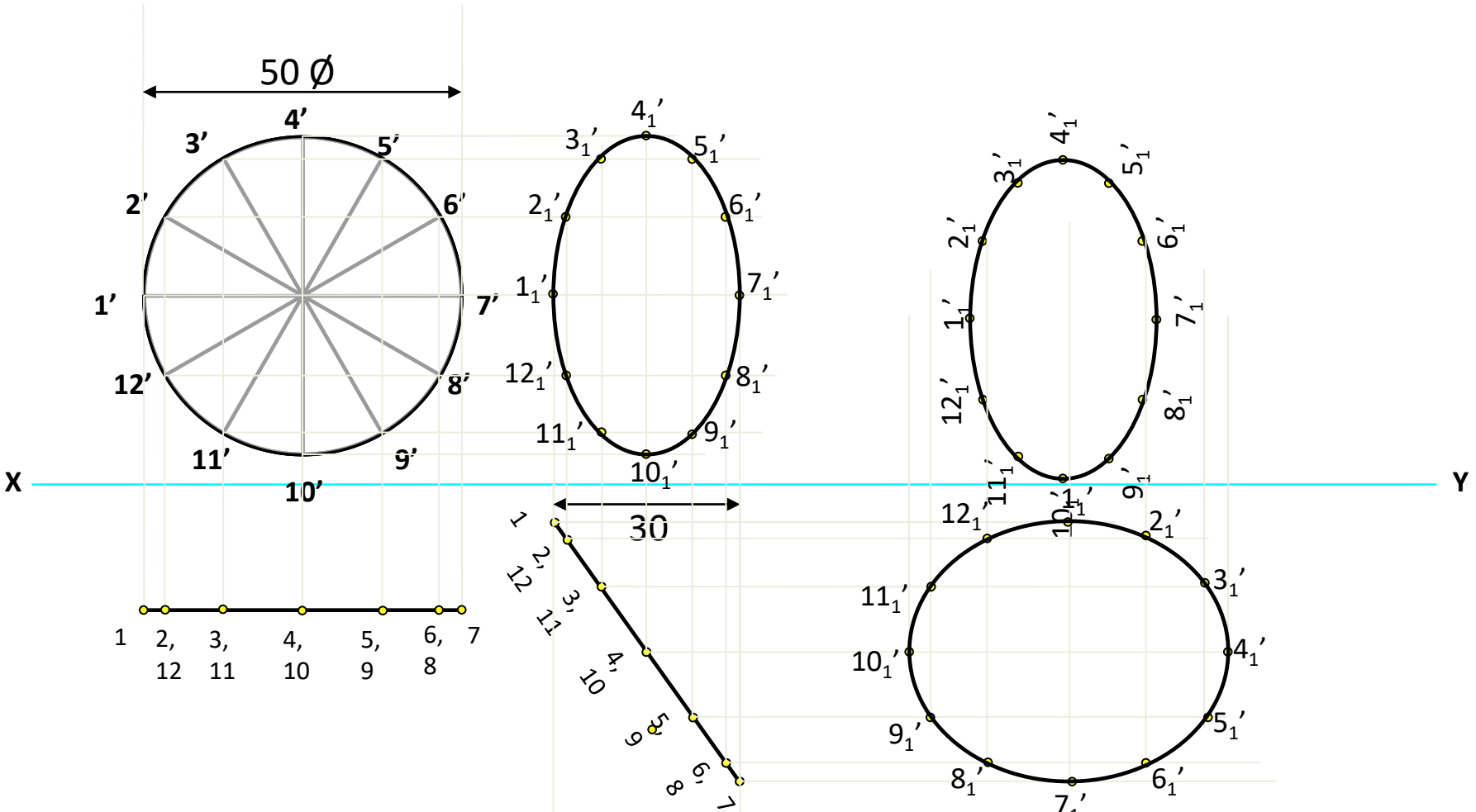


Q 7: A circular plate of negligible thickness and 50 mm diameter appears as an ellipse in the front view, having its major axis 50 mm long and minor axis 30 mm long. Draw its top view when the major axis of the ellipse is horizontal.

A circle can be seen as a ellipse in the F.V. only when its surface is inclined to VP. So for the first view keep the plane // to VP.

Incline the T.V. till the distance between the end projectors is 30 mm

Incline the F.V. till the major axis becomes horizontal



PROJECTION OF SOLIDS

PROJECTION OF SOLIDS

OBJECTIVES

- Draw the projections of geometric solids in the following positions
  - Axis perpendicular to the HP
  - Axis perpendicular to the VP
  - Axis parallel to both the HP and the VP
  - Axis inclined to the VP and parallel to the HP
  - Axis inclined to the HP and parallel to the VP
- Draw the projections of equal and unequal spheres

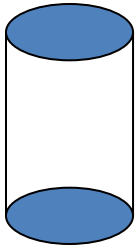
SOLIDS

To understand and remember various solids in this subject properly, those are classified & arranged in to two major groups.

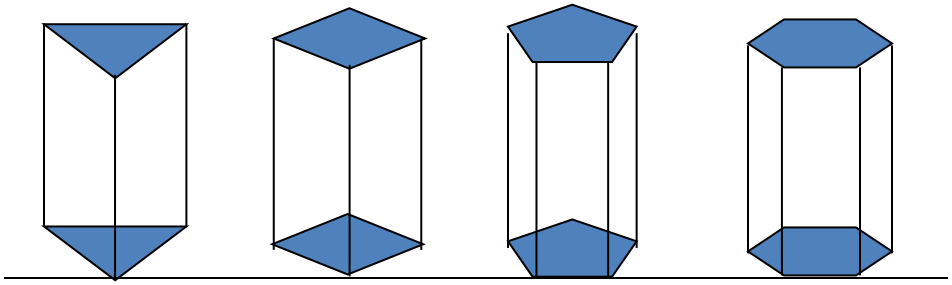
Group A

Solids having top and base of same shape

Cylinder



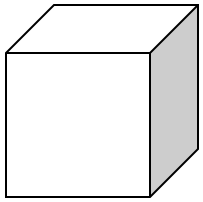
Prisms



Triangular Square Pentagonal Hexagonal

Cube

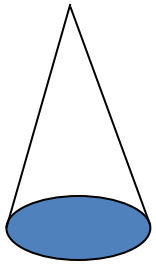
(A solid having six square faces)



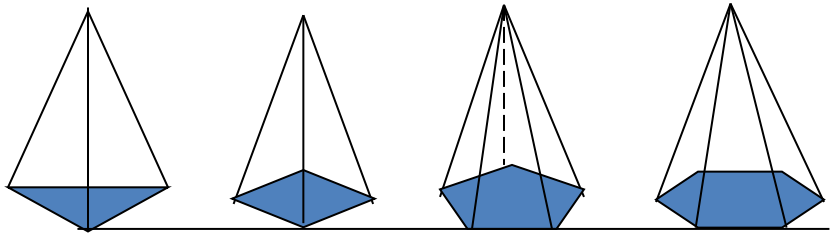
Group B

Solids having base of some shape and just a point as a top, called apex.

Cone



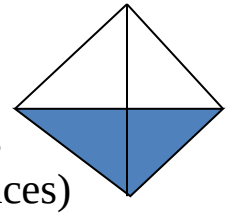
Pyramids



Triangular Square Pentagonal Hexagonal

Tetrahedron

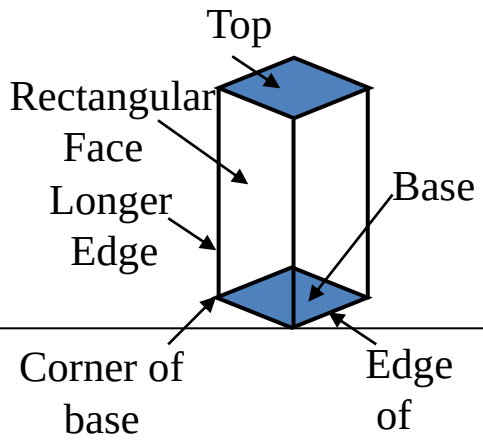
(A solid having Four triangular faces)



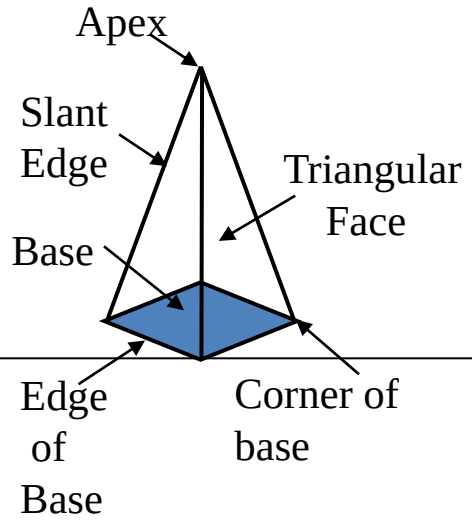
SOLIDS

Dimensional parameters of different solids.

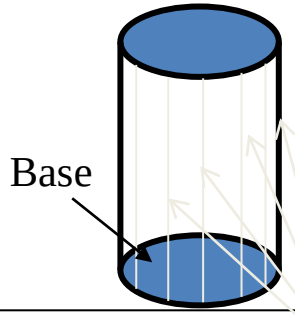
Square Prism



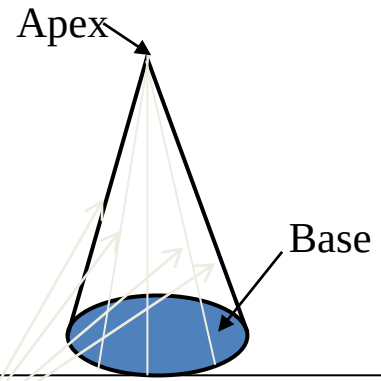
Square Pyramid



Cylinder

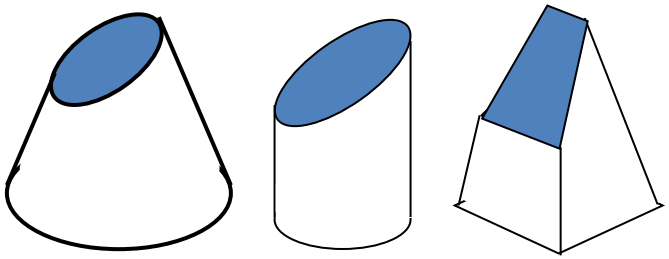


Cone

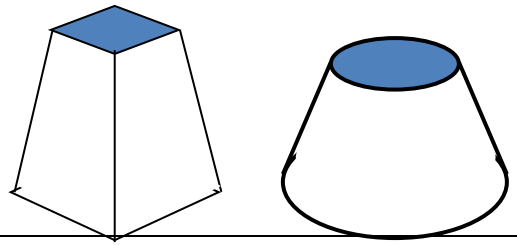


Generators

Imaginary lines generating curved surface of cylinder & cone.



Sections of solids(top & base not parallel)

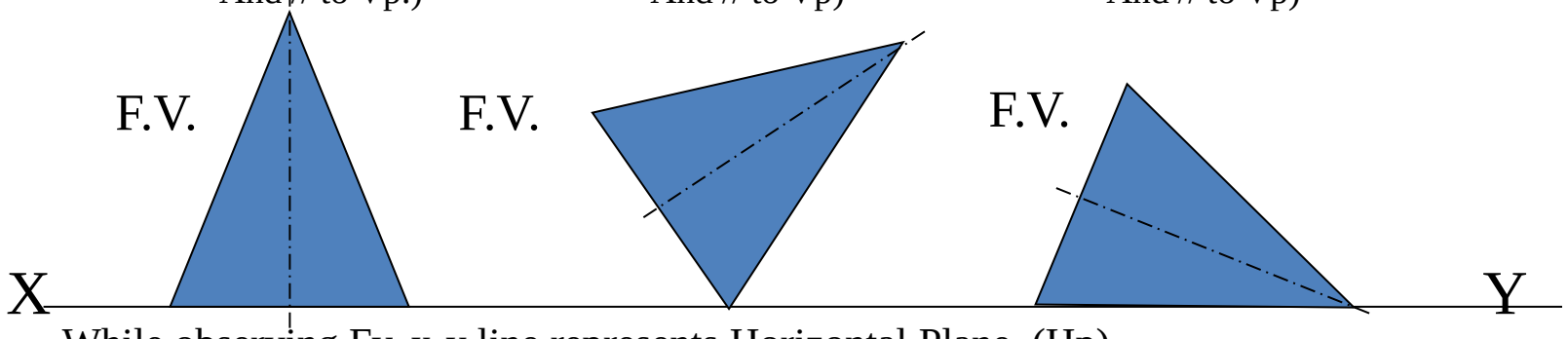


Frustum of cone & pyramids.
(top & base parallel to each other)

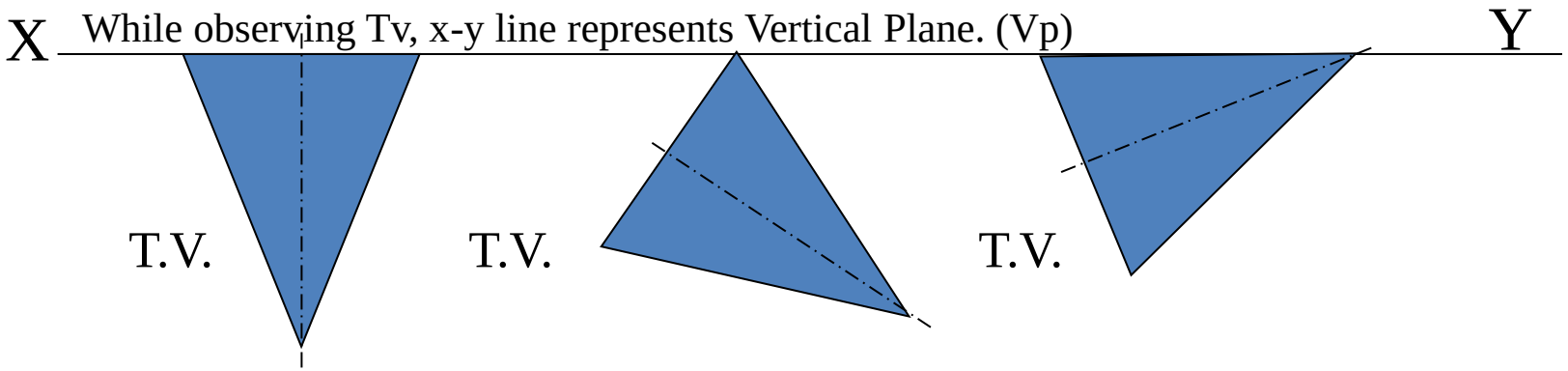
STANDING ON H.P
On it's base.
(Axis perpendicular to Hp
And // to Vp.)

RESTING ON H.P
On one point of base circle.
(Axis inclined to Hp
And // to Vp)

LYING ON H.P
On one generator.
(Axis inclined to Hp
And // to Vp)



While observing Fv, x-y line represents Horizontal Plane. (Hp)



STANDING ON V.P
On it's base.
Axis perpendicular to Vp
And // to Hp

RESTING ON V.P
On one point of base circle.
Axis inclined to Vp
And // to Hp

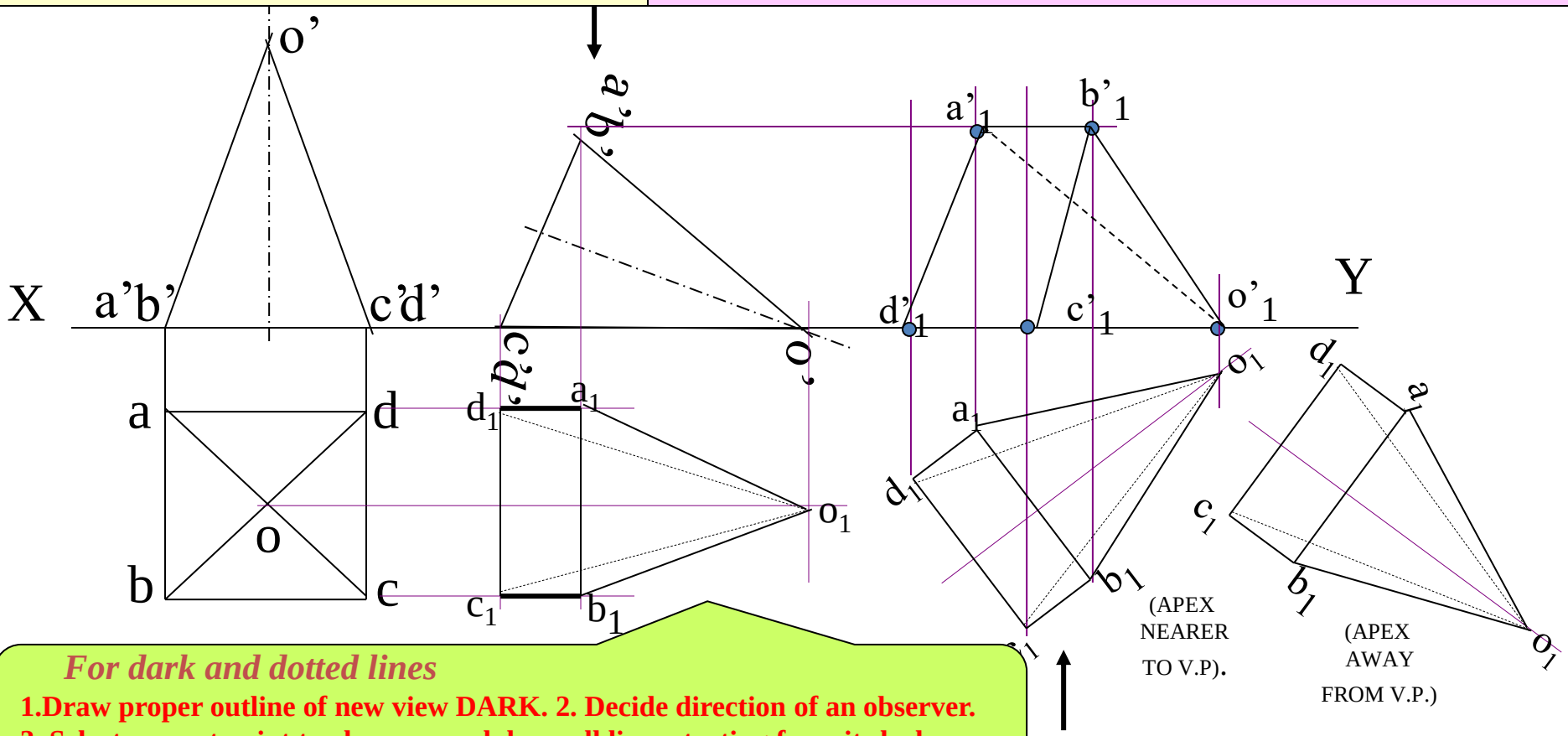
LYING ON V.P
On one generator.
Axis inclined to Vp
And // to Hp

Problem 1. A square pyramid, 40 mm base sides and axis 60 mm long, has a triangular face on the ground and the vertical plane containing the axis makes an angle of 45^0 with the VP. Draw its projections. Take apex nearer to VP

Solution Steps :

Triangular face on Hp , means it is lying on Hp:

1.Assume it standing on Hp.
2.It's Tv will show True Shape of base(square)
3.Draw square of 40mm sides with one side vertical Tv & taking 50 mm axis project Fv. (a triangle)
4.Name all points as shown in illustration.
5.Draw 2nd Fv in lying position I.e.o'c'd' face on xy. And project it's Tv.
6.Make visible lines dark and hidden dotted, as per the procedure.
7.Then construct remaining inclination with Vp (Vp containing axis ic the center line of 2nd Tv.Make it 45^0 to xy as shown take apex near to xy, as it is nearer to Vp) & project final Fv.

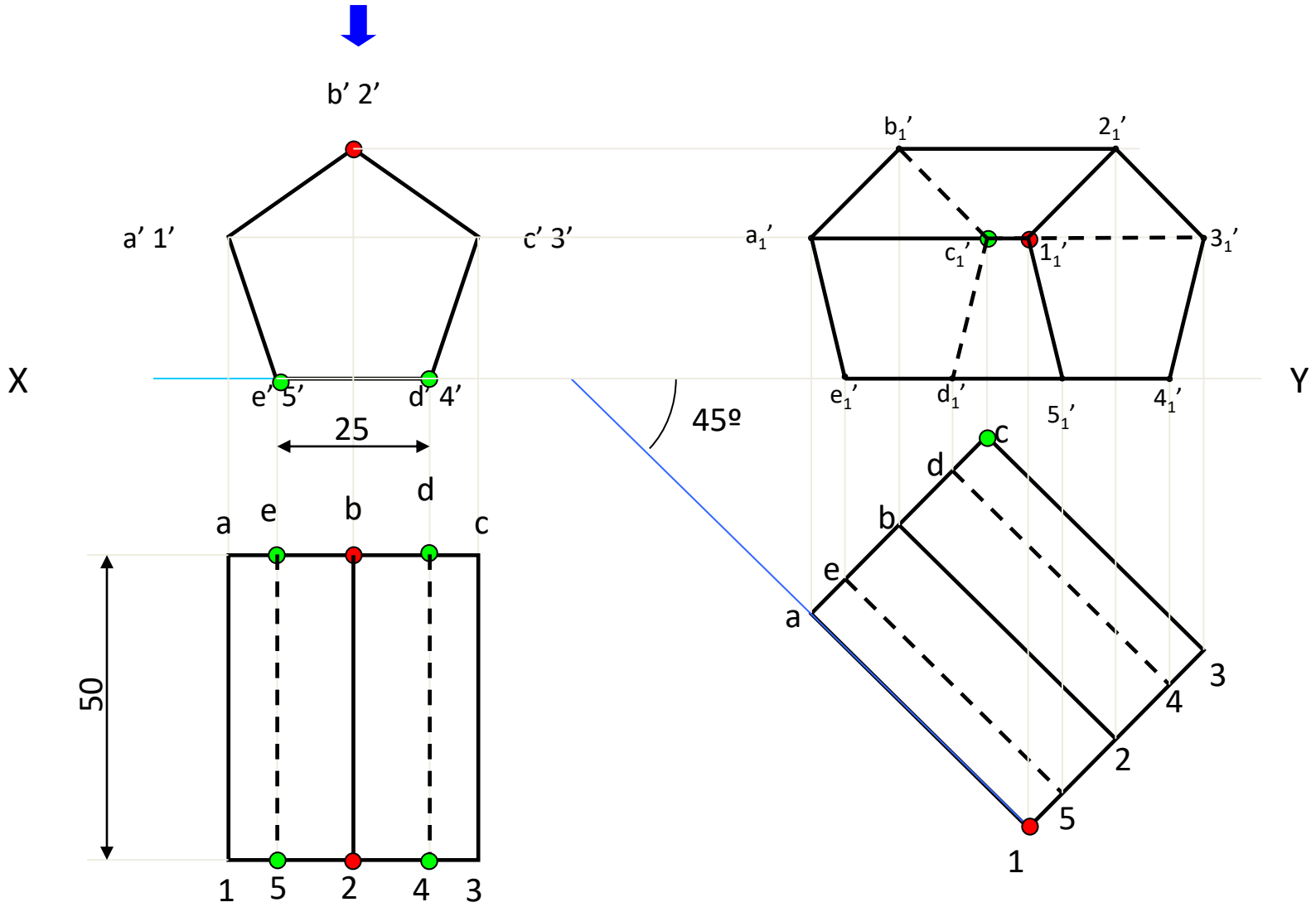


For dark and dotted lines

1.Draw proper outline of new view DARK. 2. Decide direction of an observer.
3. Select nearest point to observer and draw all lines starting from it-dark.
4. Select farthest point to observer and draw all lines (remaining)from it- dotted.

PROBLEM 2 : Draw the projections of a pentagonal prism , base 25 mm side and axis 50 mm long, resting on one of its rectangular faces on the H.P. with the axis inclined at 45º to the V.P.

axis is to be inclined with the VP, in the first view it must be kept perpendicular to the VP i.e. true shape of the base will be drawn in the FV with one side on XY line



Problem 3:

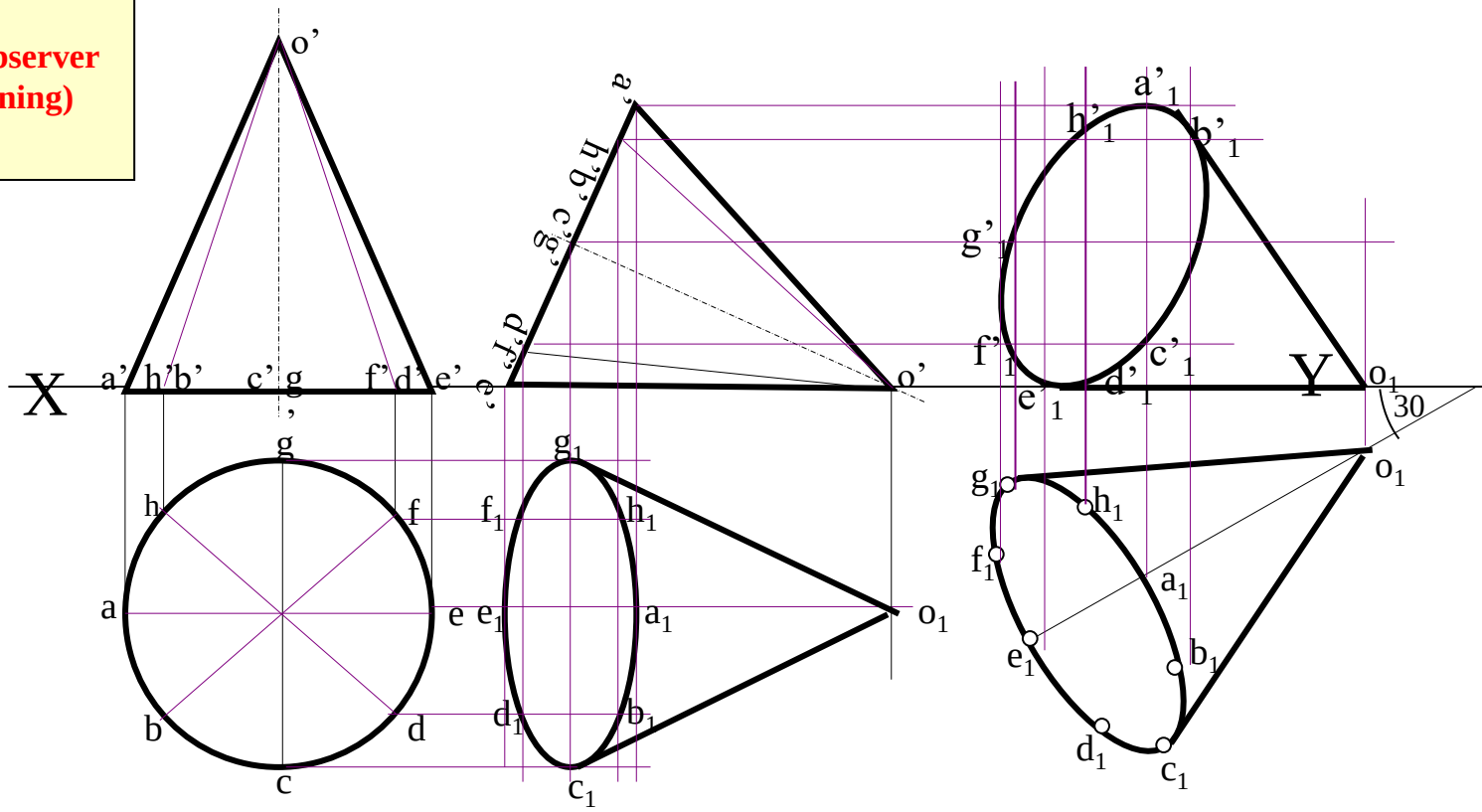
A cone 40 mm diameter and 50 mm axis is resting on one generator on Hp which makes 30^0 inclination with Vp Draw it's projections.

For dark and dotted lines

1.Draw proper outline of new vie DARK.
2. Decide direction of an observer.
3. Select nearest point to observer and draw all lines starting from it-dark.
4. Select farthest point to observer and draw all lines (remaining) from it- dotted.

Solution Steps:

Resting on Hp on one generator, means lying on Hp:
1.Assume it standing on Hp.
2.It's Tv will show True Shape of base(circle)
3.Draw 40mm dia. Circle as Tv &
taking 50 mm axis project Fv. (a triangle)
4.Name all points as shown in illustration.
5.Draw 2nd Fv in lying position I.e.o'e' on xy. And project it's Tv below xy.
6.Make visible lines dark and hidden dotted, as per the procedure.
7.Then construct remaining inclination with Vp (generator o_1e_1 30^0 to xy as shown) & project final Fv.



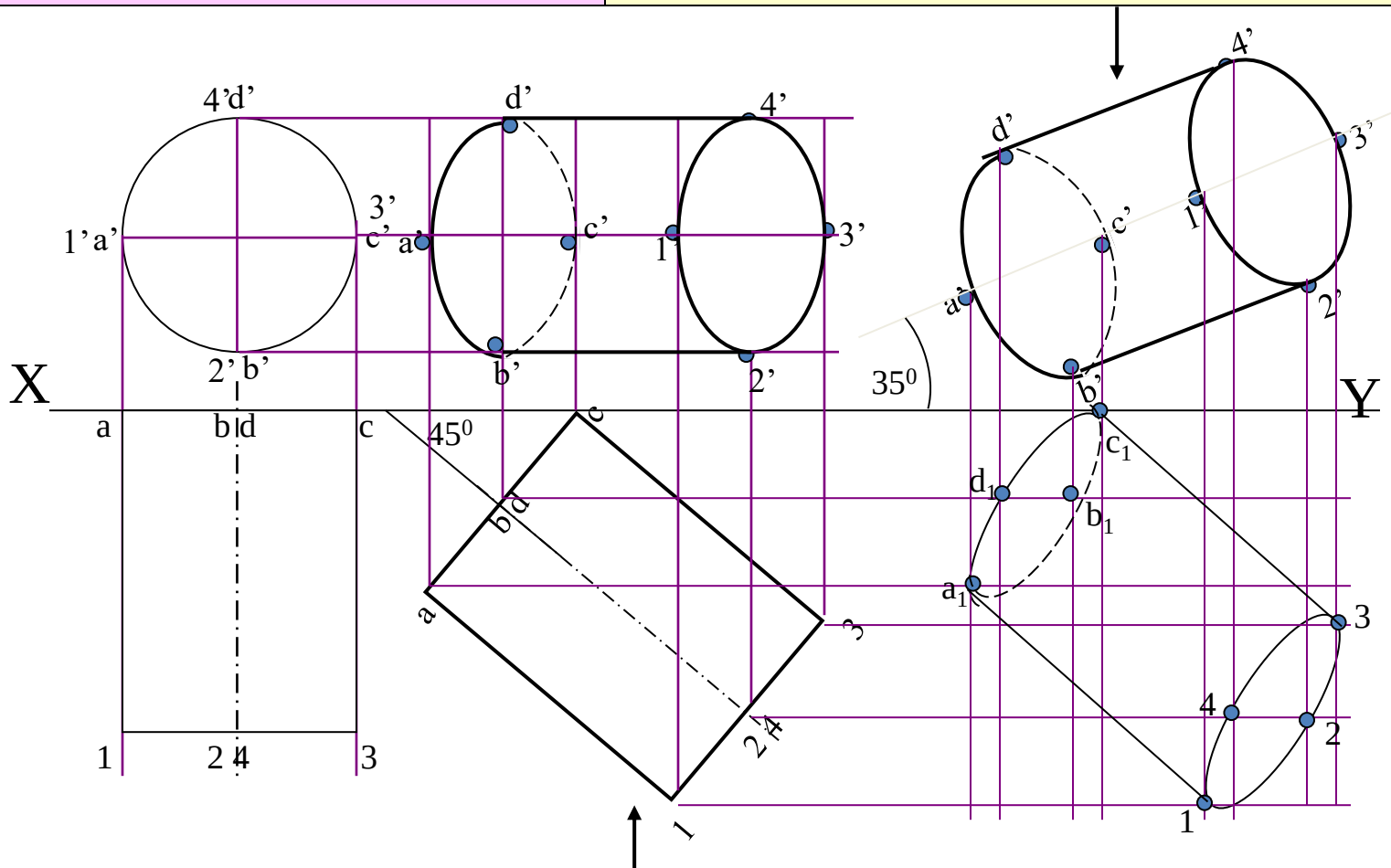
Problem 4:

A cylinder 40 mm diameter and 50 mm axis is resting on one point of a base circle on Vp while it's axis makes 45^0 with Vp and Fv of the axis 35^0 with Hp. Draw projections..

Solution Steps:

Resting on Vp on one point of base, means inclined to Vp:

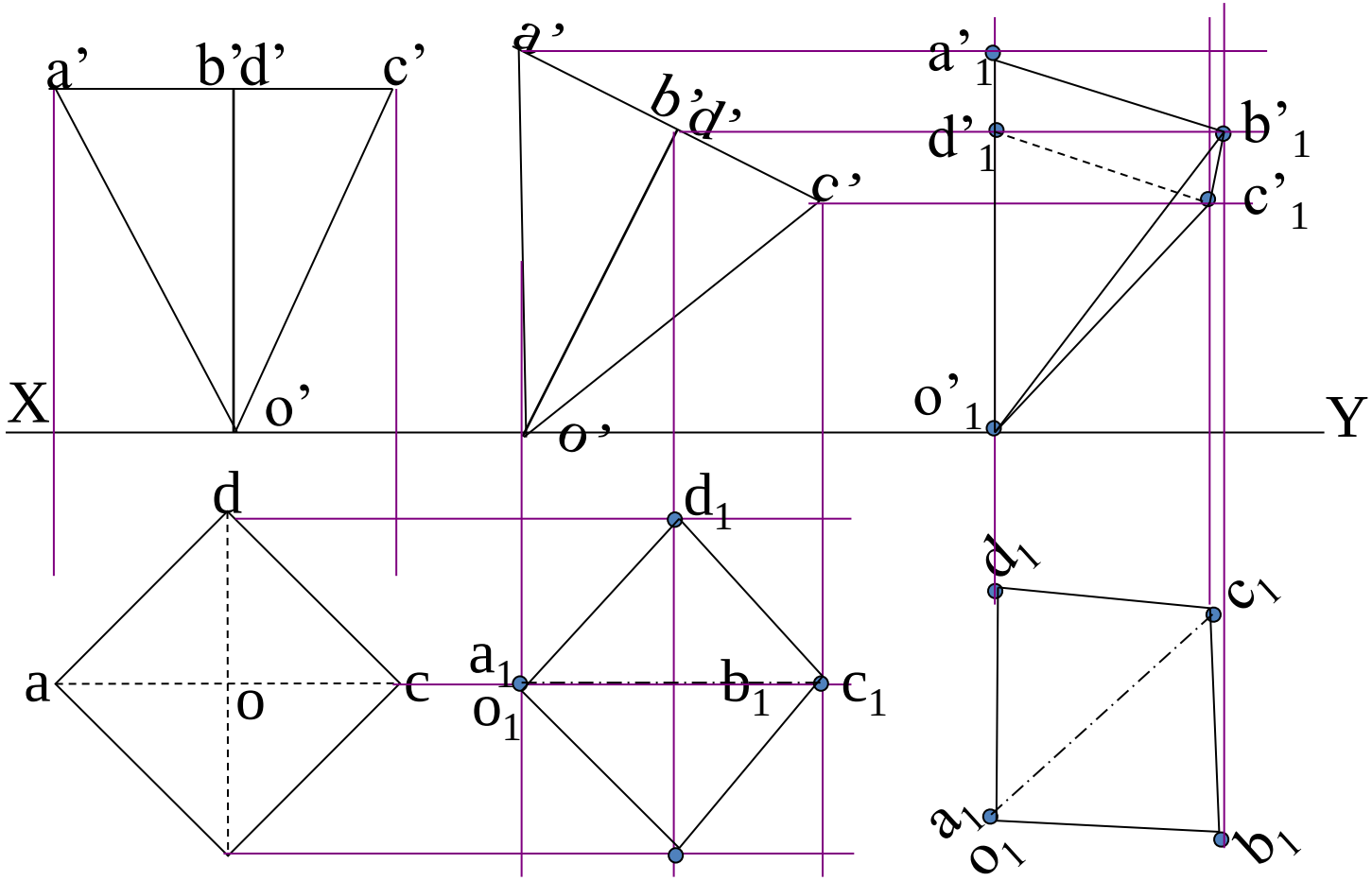
1. Assume it standing on Vp
2. It's Fv will show True Shape of base & top(circle)
3. Draw 40mm dia. Circle as Fv & taking 50 mm axis project Tv. (a Rectangle)
4. Name all points as shown in illustration.
5. Draw 2nd Tv making axis 45^0 to xy And project it's Fv above xy.
6. Make visible lines dark and hidden dotted, as per the procedure.
7. Then construct remaining inclination with Hp (Fv of axis I.e. center line of view to xy as shown) & project final Tv.



Problem 5: A square pyramid 30 mm base side and 50 mm long axis is resting on it's apex on Hp, such that it's one slant edge is vertical and a triangular face through it is perpendicular to Vp. Draw it's projections.

Solution Steps :

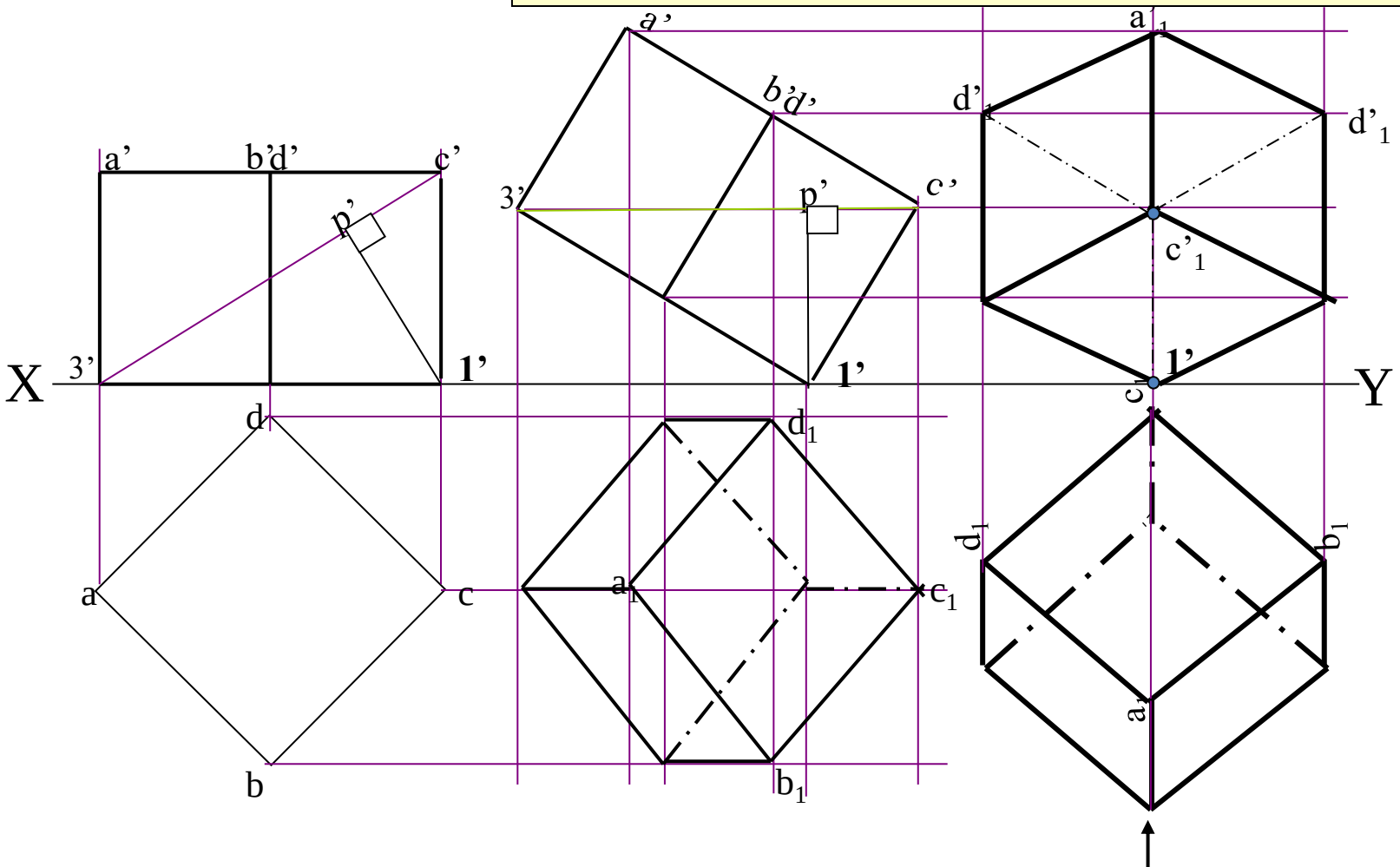
1. Assume it standing on Hp but as said on apex.(inverted).
2. It's Tv will show True Shape of base(square)
3. Draw a corner case square of 30 mm sides as Tv(as shown) Showing all slant edges dotted, as those will not be visible from top.
4. taking 50 mm axis project Fv. (a triangle)
5. Name all points as shown in illustration.
6. Draw 2nd Fv keeping o'a' slant edge vertical & project it's Tv
7. Make visible lines dark and hidden dotted, as per the procedure.
8. Then redrew 2nd Tv as final Tv keeping $a_1o_1d_1$ triangular face perpendicular to Vp I.e.xy. Then as usual project final Fv.



Problem 6: A cube of 50 mm long edges is so placed on Hp on one corner that a body diagonal is parallel to Hp and perpendicular to Vp Draw it's projections.

Solution Steps:

1.Assuming standing on Hp, begin with Tv,a square with all sides equally inclined to xy.Project Fv and name all points of FV & TV.
2.Draw a body-diagonal joining c' with 3'(This can become // to xy)
3.From 1' drop a perpendicular on this and name it p'
4.Draw 2nd Fv in which 1'-p' line is vertical ***means*** c'-3' diagonal must be horizontal. .Now as usual project Tv..
6.In final Tv draw same diagonal is perpendicular to Vp as said in problem. Then as usual project final FV.



Problem 7: A pentagonal pyramid 30 mm base sides & 60 mm long axis, is freely suspended from one corner of base so that a plane containing it's axis remains parallel to Vp.
Draw it's three views.

Solution Steps:

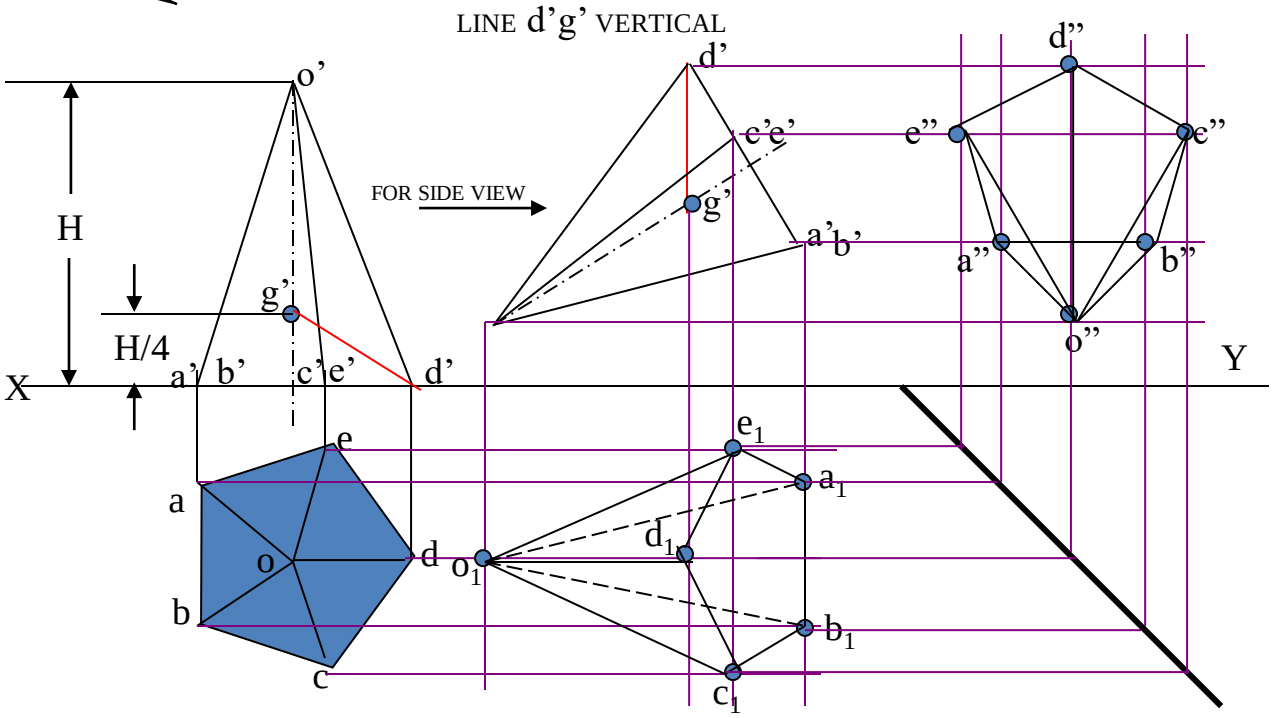
In all suspended cases axis shows inclination with Hp.

1.Hence assuming it standing on Hp, drew Tv - a regular pentagon,corner case.

2.Project Fv & locate CG position on axis – (¼ H from base.) and name g' and Join it with corner d'

3.As 2nd Fv, redraw first keeping line g'd' vertical.

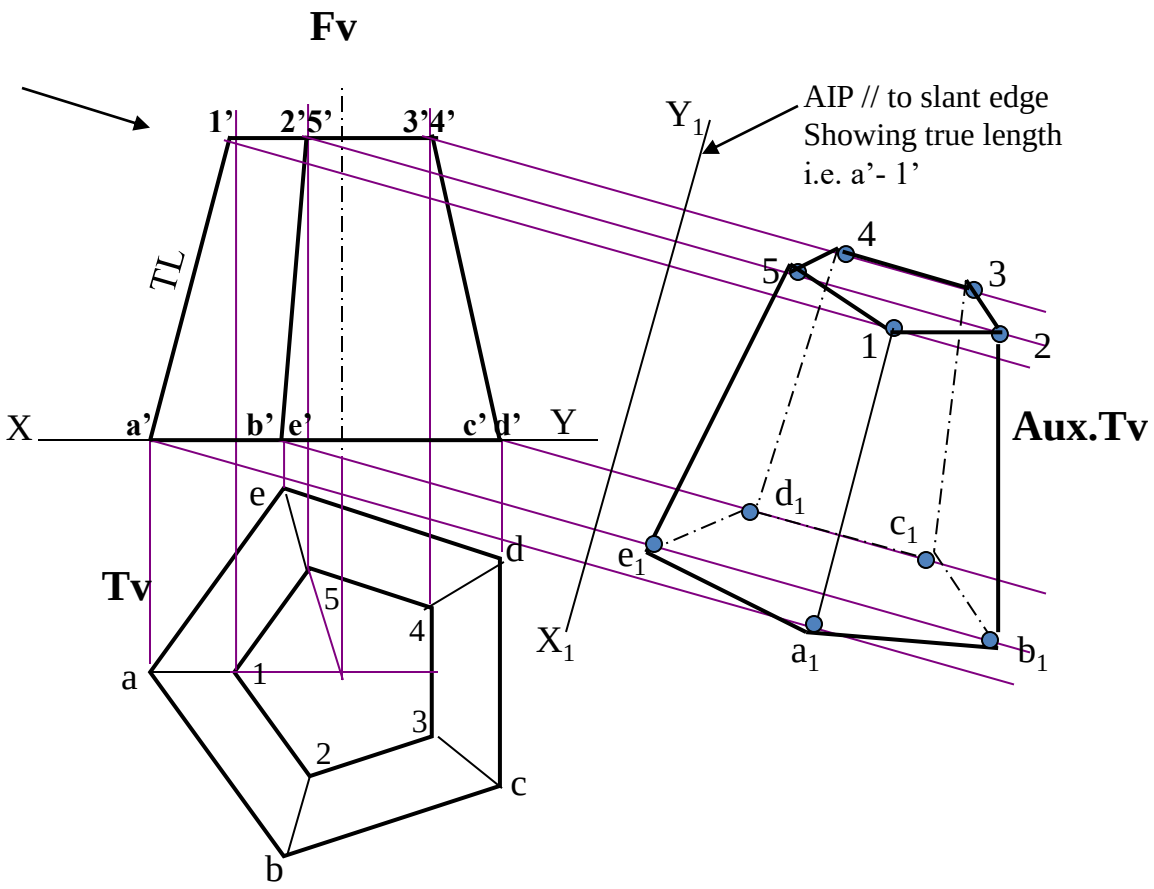
4.As usual project corresponding Tv and then Side View looking from.



IMPORTANT:

When a solid is freely suspended from a corner, then line joining point of contact & C.G. remains vertical.
(Here axis shows inclination with Hp.)
So in all such cases, assume solid standing on Hp initially.)

Problem 8: A frustum of regular hexagonal pyrami is standing on it's larger base On Hp with one base side perpendicular to Vp.Draw it's Fv & Tv.
Project it's Aux.Tv on an AIP parallel to one of the slant edges showing TL.
Base side is 50 mm long , top side is 30 mm long and 50 mm is height of frustum.



SECTION OF SOLIDS

SECTION OF SOLIDS

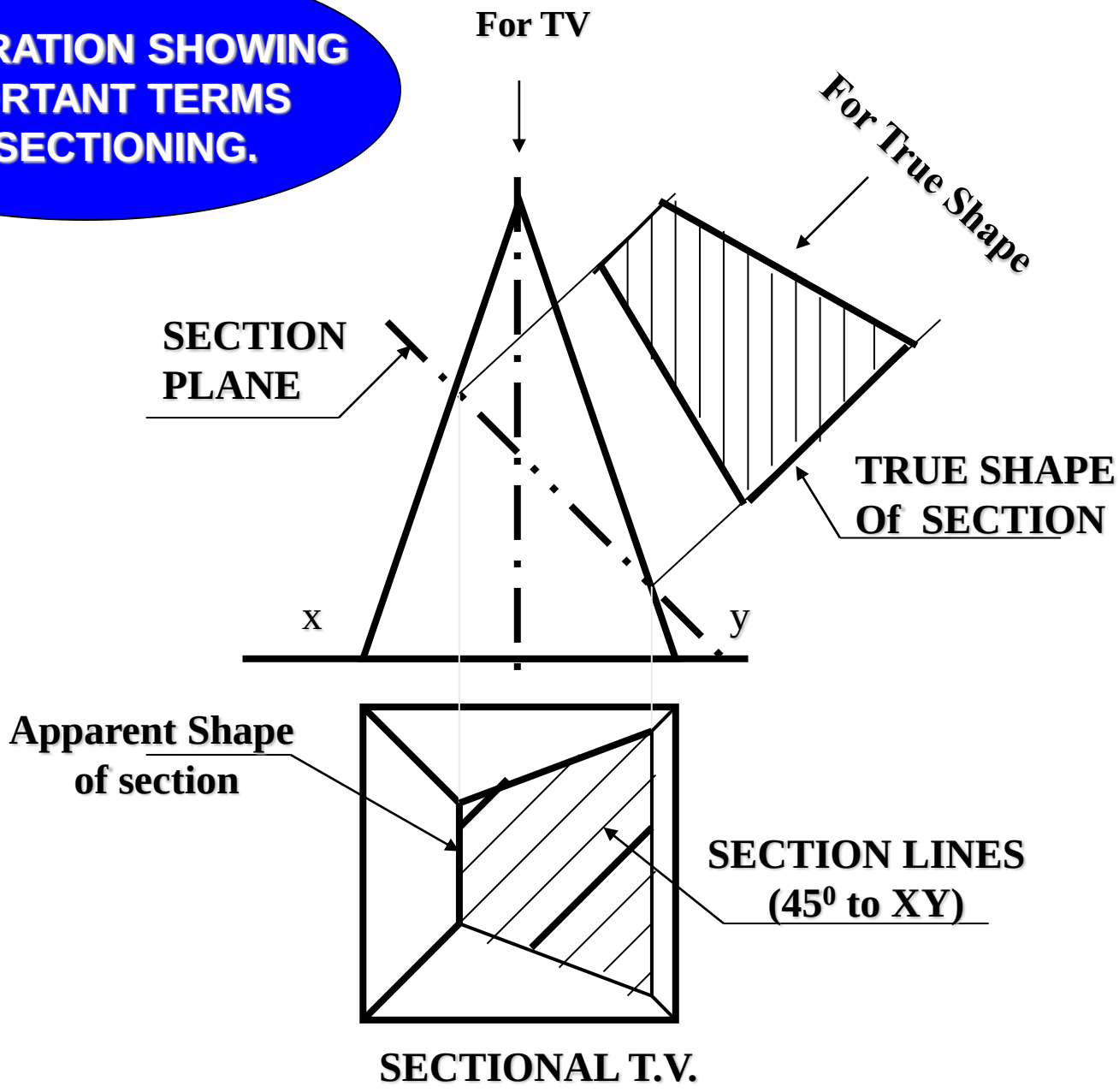
OBJECTIVES

- Draw the sectional views of solids like cubes, prisms, pyramids, cylinders, cones and spheres,
- Draw the true shape of sections

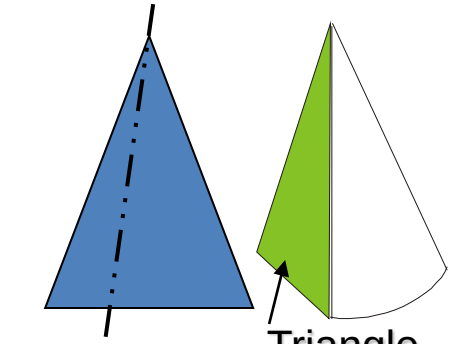
CUTTING PLANE

The imaginary plane which is assumed to cut the object as required is called a cutting plane or section plane.

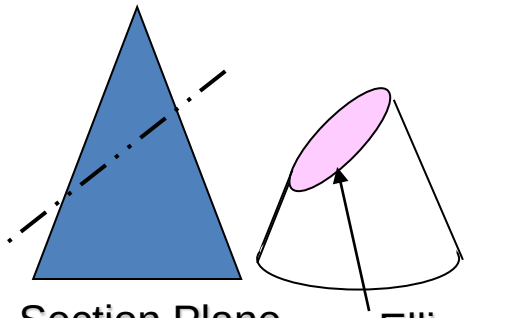
ILLUSTRATION SHOWING IMPORTANT TERMS IN SECTIONING.



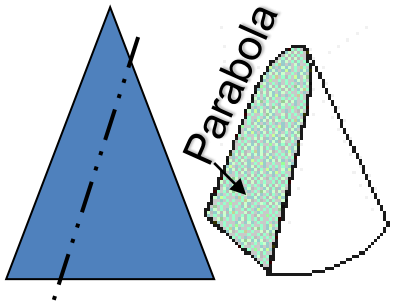
Typical Section Planes
&
Typical Shapes
Of
Sections.



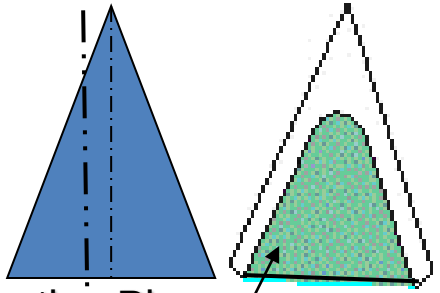
Section Plane
Through Apex



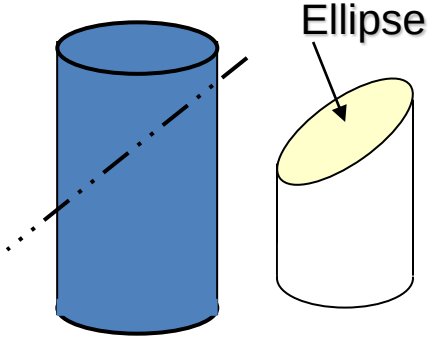
Section Plane
Through Generators



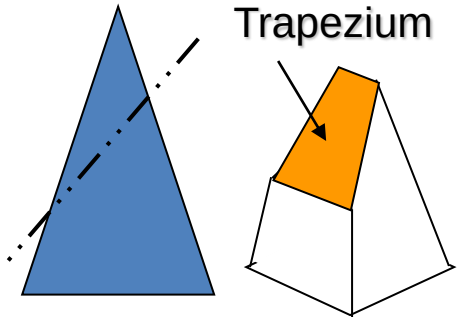
Section Plane Parallel
to end generator.



Section Plane
Parallel to Axis.

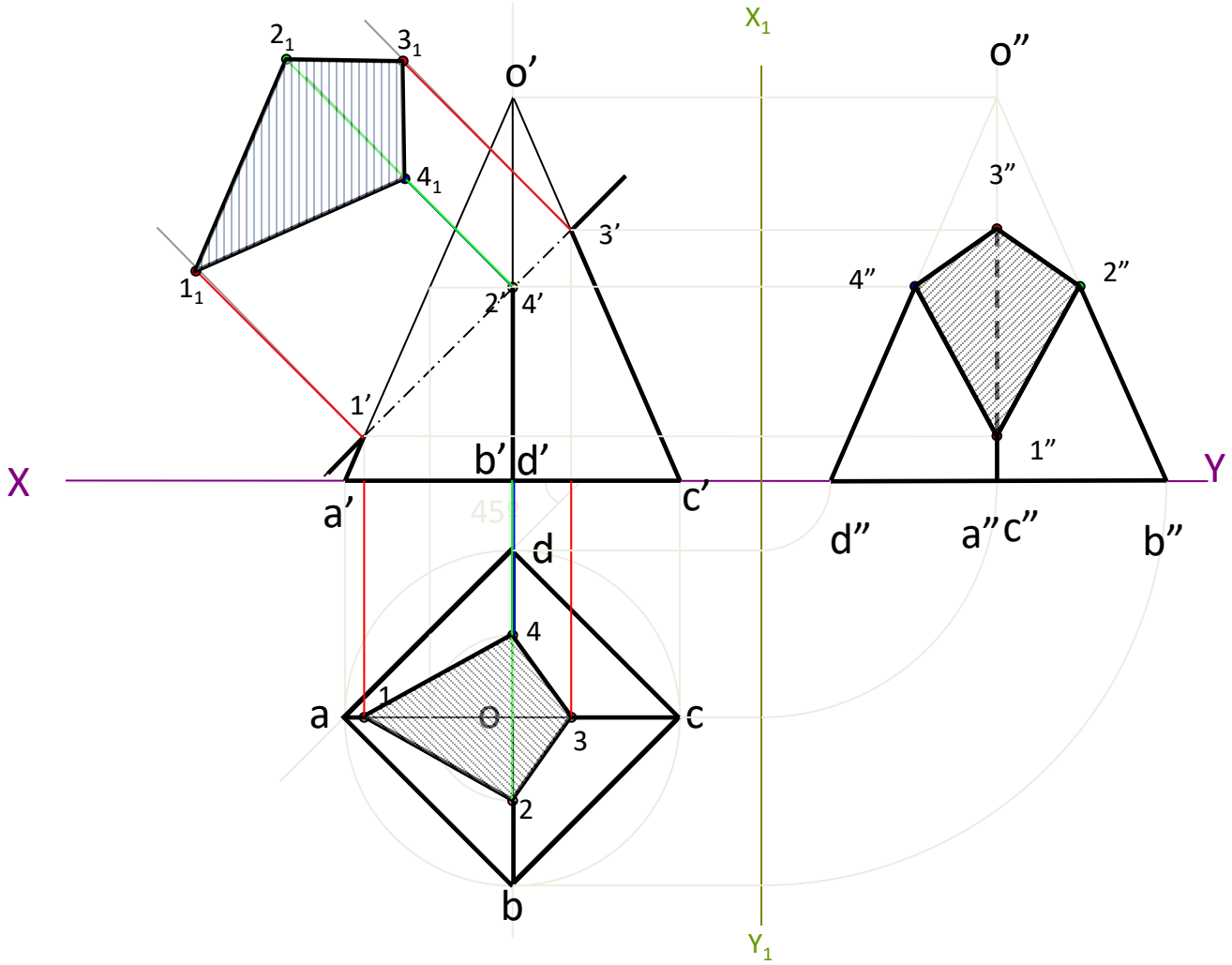


Cylinder through
generators.

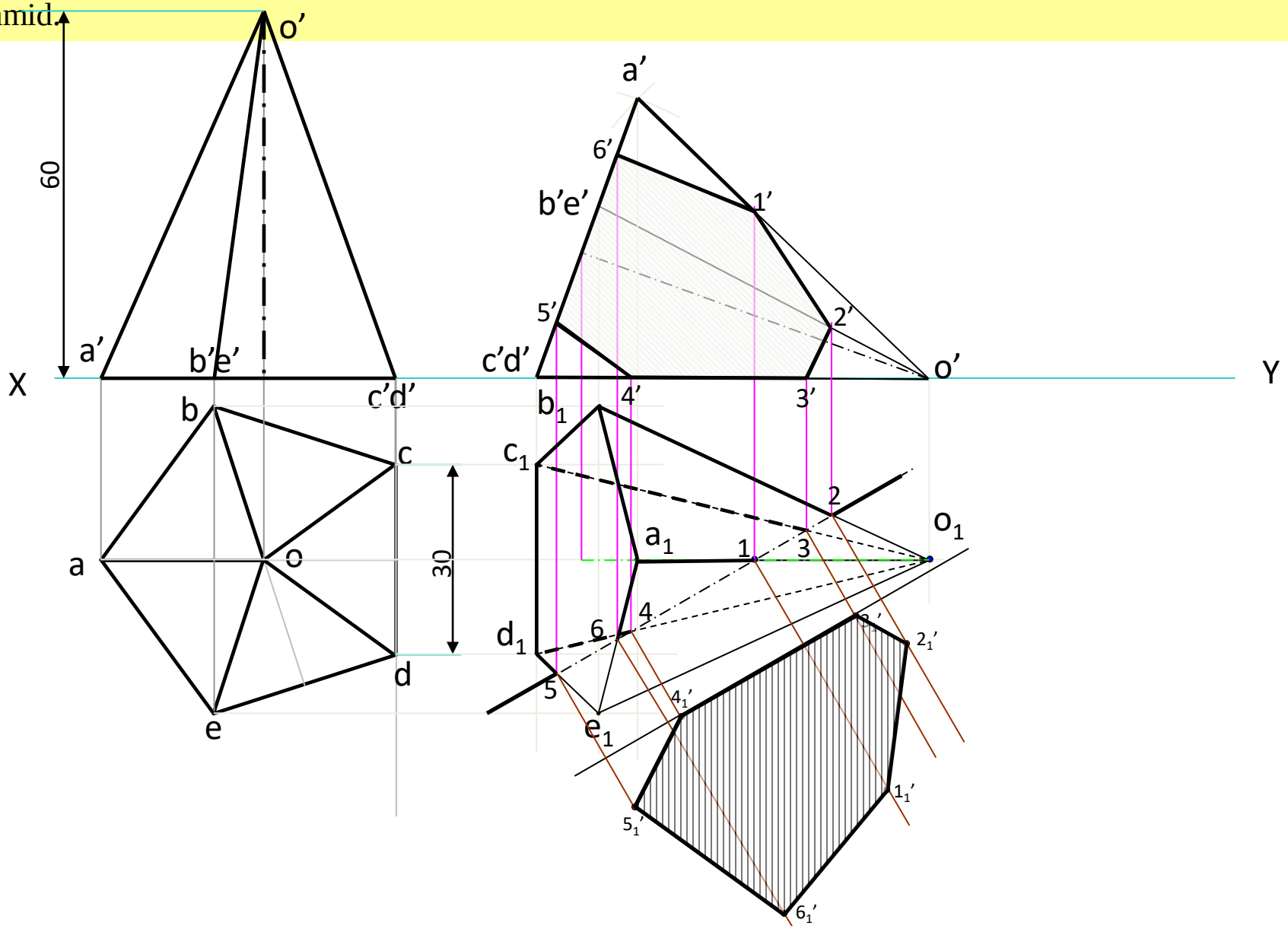


Sq. Pyramid through
all slant edges

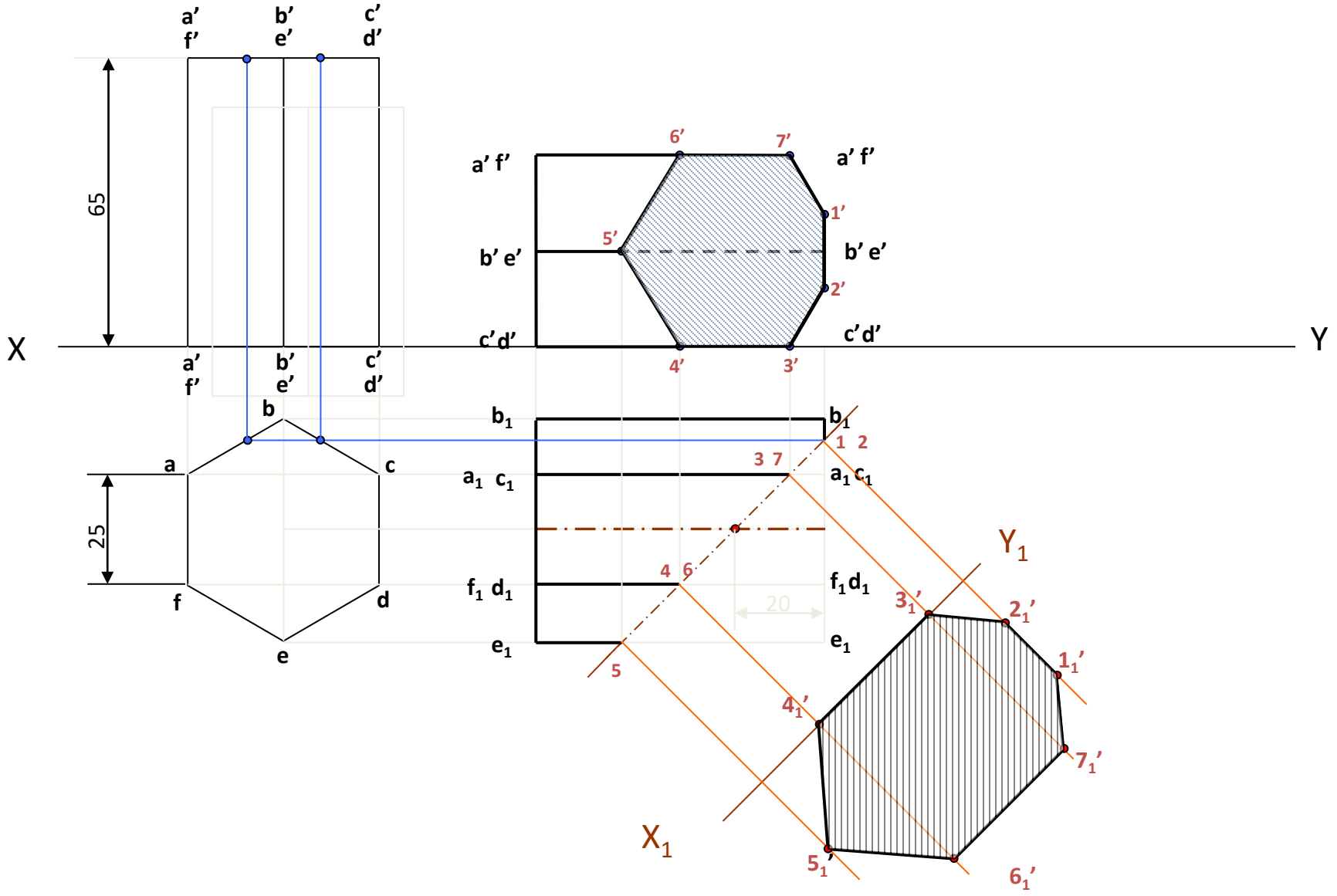
Q 1: A square pyramid, base 40 mm side and axis 65 mm long, has its base on the HP and all the edges of the base equally inclined to the VP. It is cut by a section plane, perpendicular to the VP, inclined at 45º to the HP and bisecting the axis. Draw its sectional top view, sectional side view and true shape of the section.



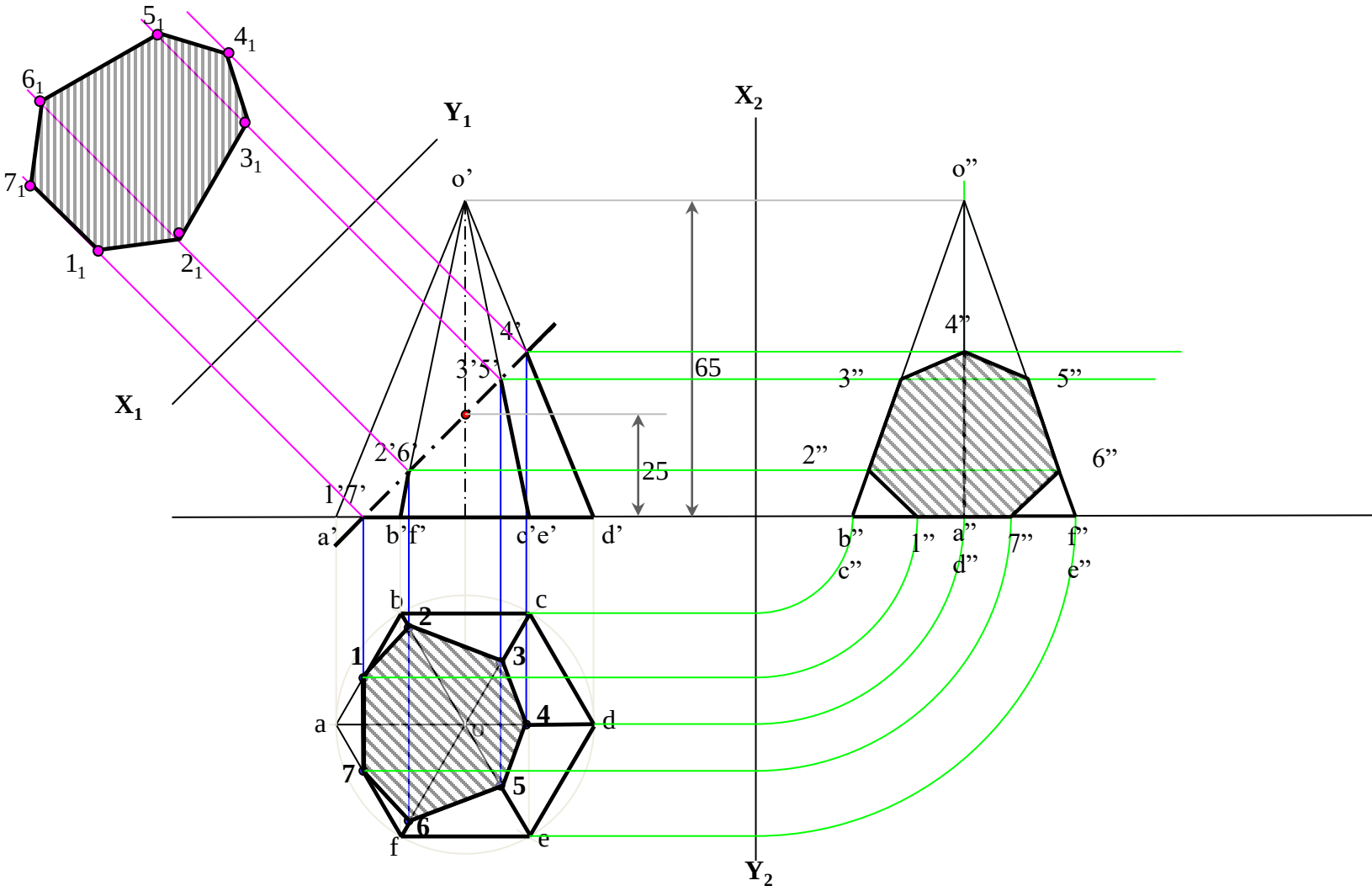
Q 2: A pentagonal pyramid , base 30mm side and axis 60 mm long is lying on one of its triangular faces on the HP with the axis parallel to the VP. A vertical section plane, whose HT bisects the top view of the axis and makes an angle of 30º with the reference line, cuts the pyramid removing its top part. Draw the top view, sectional front view and true shape of the section and development of the surface of the remaining portion of the pyramid.



Q 3: A Hexagonal prism has a face on the H.P. and the axis parallel to the V.P. It is cut by a vertical section plane the H.T. of which makes an angle of 45 with XY and which cuts the axis at a point 20 mm from one of its ends. Draw its sectional front view and the true shape of the section. Side of base 25 mm long height 65mm.



Q 4: A hexagonal pyramid, base 30 mm side and axis 65 mm long is resting on its base on the HP, with two edges of the base parallel to the VP. It is cut by a section plane perpendicular to VP and inclined at 45º to the HP, intersecting the axis at a point 25 mm above the base. Draw the front view, sectional top view, sectional side view and true shape of the section.



DEVELOPMENT OF SURFACES

DEVELOPMENT OF SURFACES

OBJECTIVES

Draw the development of surfaces of solids like cubes, prisms, cylinders, pramids, cones and spheres.

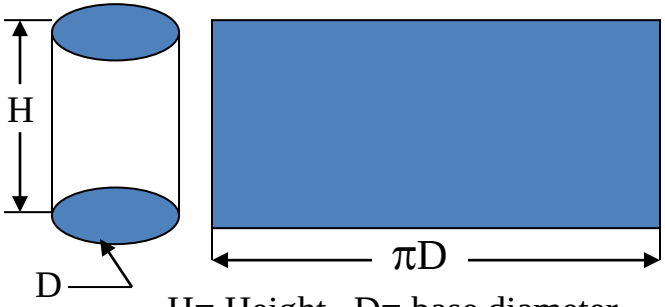
Draw the development of surfaces of the above solids with cuts and slots.

DEFINITIONS

Suppose an object like a square prism is wrapped around by using paper. When the wrapper is opened and spread out on a plane surface, the resulting figure is called the development of the surfaces of the solid.

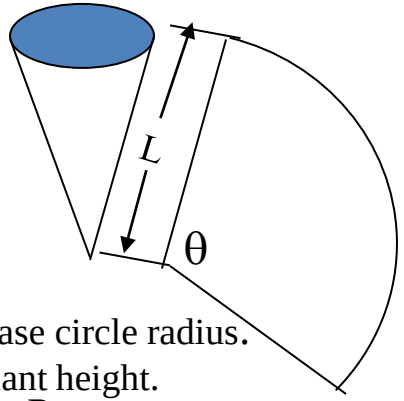
Development of lateral surfaces of different solids.
(Lateral surface is the surface excluding top & base)

Cylinder: A Rectangle



H= Height D= base diameter

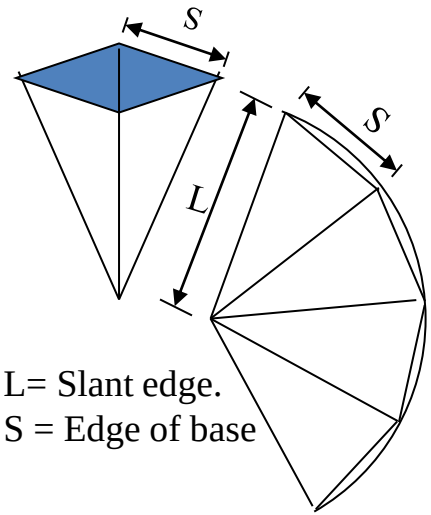
Cone: (Sector of circle)



R=Base circle radius.
L=Slant height.

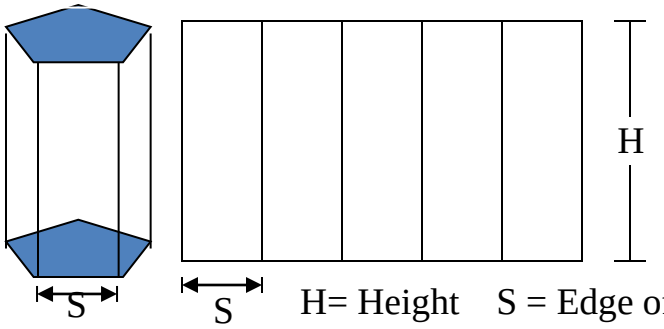
$$\theta = \frac{R}{L} \times 360^0$$

Pyramids: (No.of triangles)



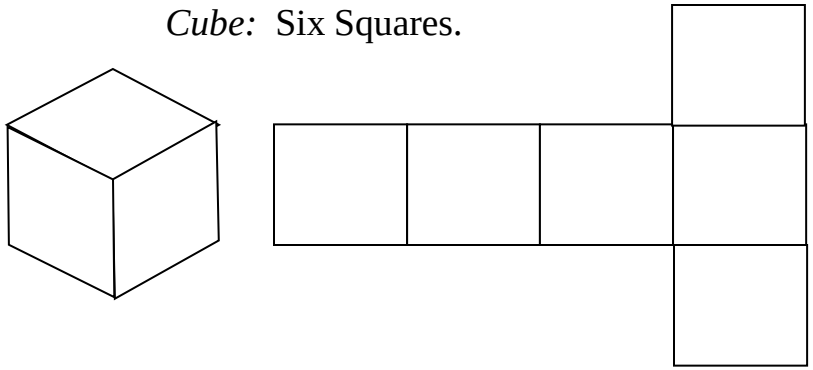
L= Slant edge.
S = Edge of base

Prisms: No.of Rectangles

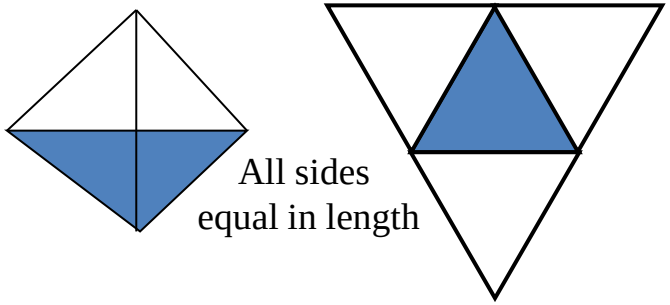


H= Height S = Edge of base

Cube: Six Squares.



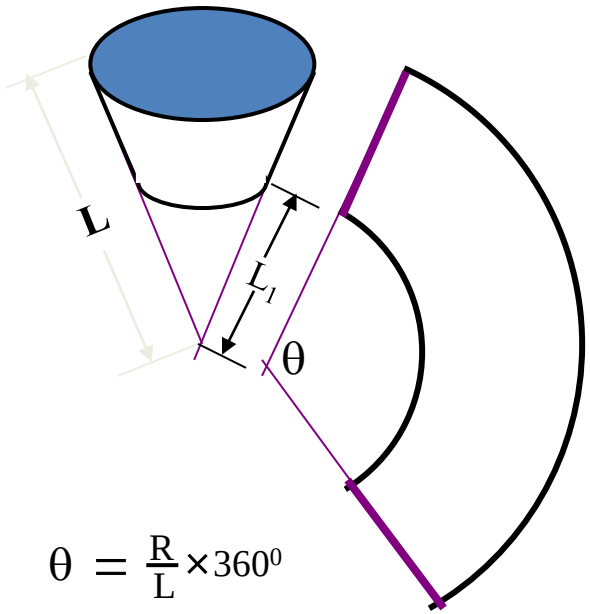
Tetrahedron: Four Equilateral Triangles



All sides
equal in length

FRUSTUMS

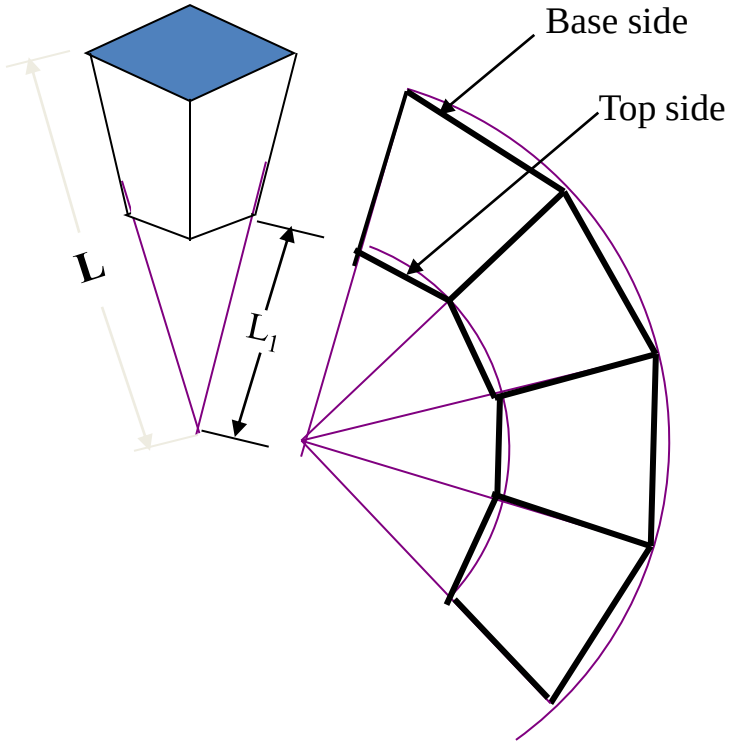
DEVELOPMENT OF FRUSTUM OF CONE



$$\theta = \frac{R}{L} \times 360^0$$

R= Base circle radius of cone
L= Slant height of cone
L_1 = Slant height of cut part.

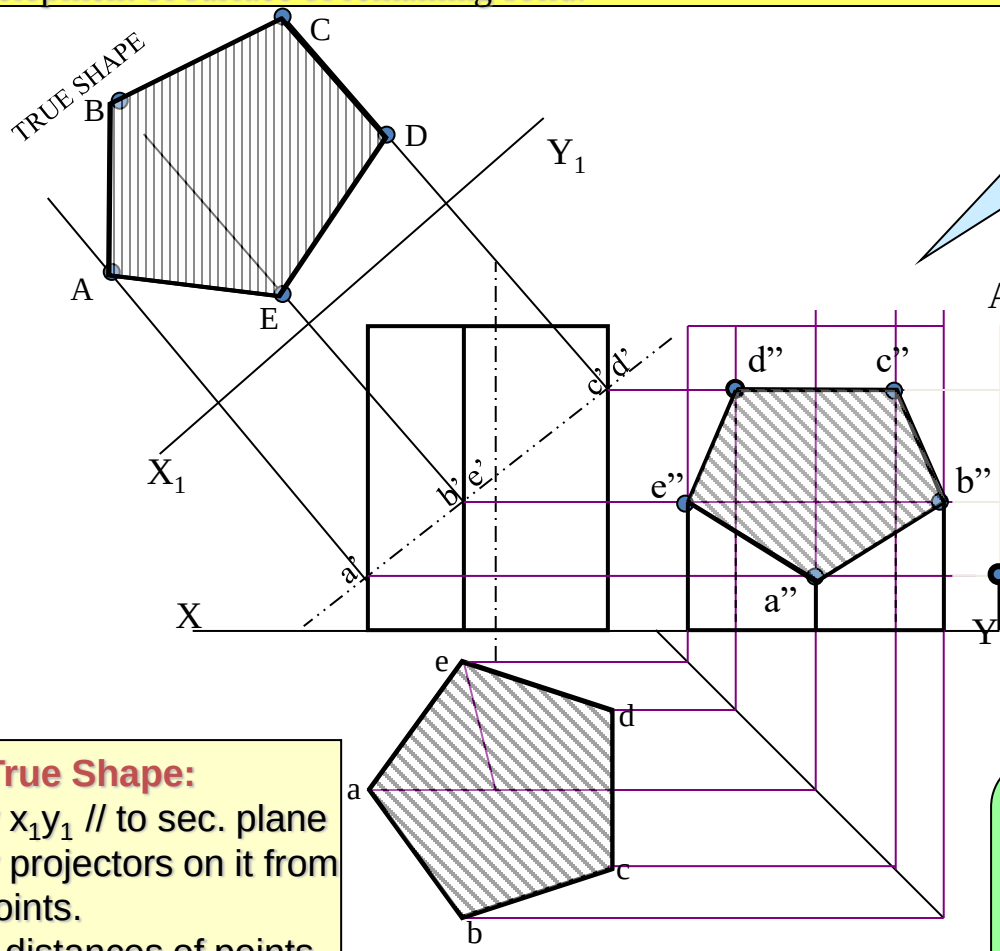
DEVELOPMENT OF FRUSTUM OF SQUARE PYRAMID

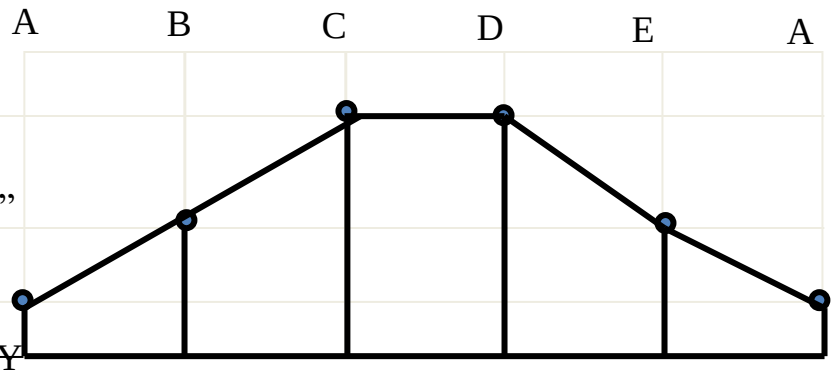


L= Slant edge of pyramid
L_1 = Slant edge of cut part.

Problem 1: A pentagonal prism , 30 mm base side & 50 mm axis is standing on Hp on it's base with one side of the base perpendicular to VP. It is cut by a section plane inclined at 45° to the HP, through mid point of axis. Draw Fv, sec.Tv & sec. Side view. Also draw true shape of section and Development of surface of remaining solid.

Solution Steps: *for sectional views:*
Draw three views of standing prism.
Locate sec.plane in Fv as described.
Project points where edges are getting Cut on Tv & Sv as shown in illustration.
Join those points in sequence and show Section lines in it.
Make remaining part of solid dark.





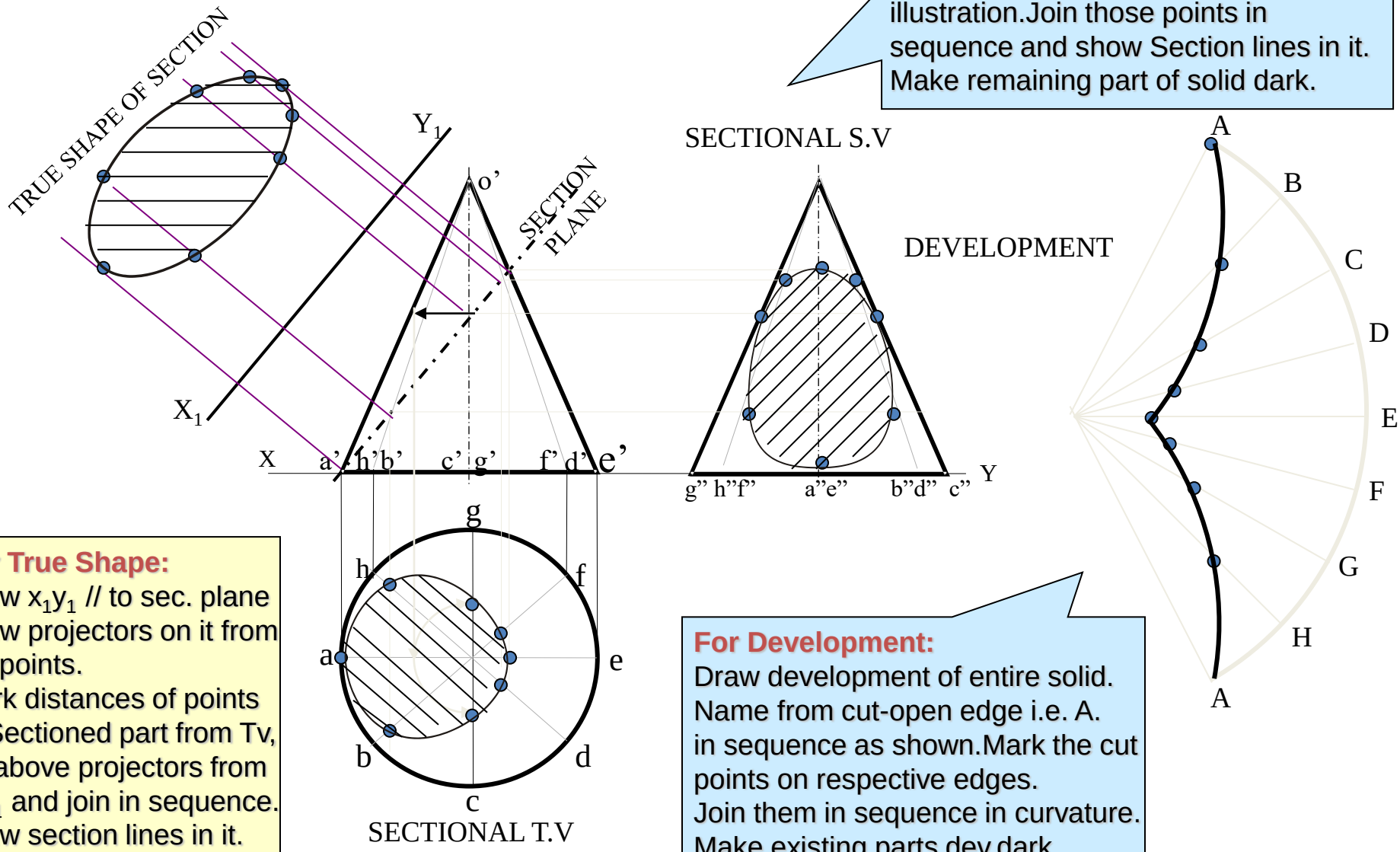
DEVELOPMENT

For True Shape:
Draw x_1y_1 // to sec. plane
Draw projectors on it from cut points.
Mark distances of points of Sectioned part from Tv, on above projectors from x_1y_1 and join in sequence.
Draw section lines in it.
It is required true shape.

For Development:
Draw development of entire solid. Name from cut-open edge I.e. A. in sequence as shown.
Mark the cut points on respective edges.
Join them in sequence in st. lines.
Make existing parts dev.dark.

Problem 2: A cone, 50 mm base diameter and 70 mm axis is standing on it's base on Hp. It cut by a section plane 45^0 inclined to Hp through base end of end generator.Draw projections, sectional views, true shape of section and development of surfaces of remaining solid.

Solution Steps:*for sectional views:*
Draw three views of standing cone.
Locate sec.plane in Fv as described.
Project points where generators are getting Cut on Tv & Sv as shown in illustration.Join those points in sequence and show Section lines in it.
Make remaining part of solid dark.



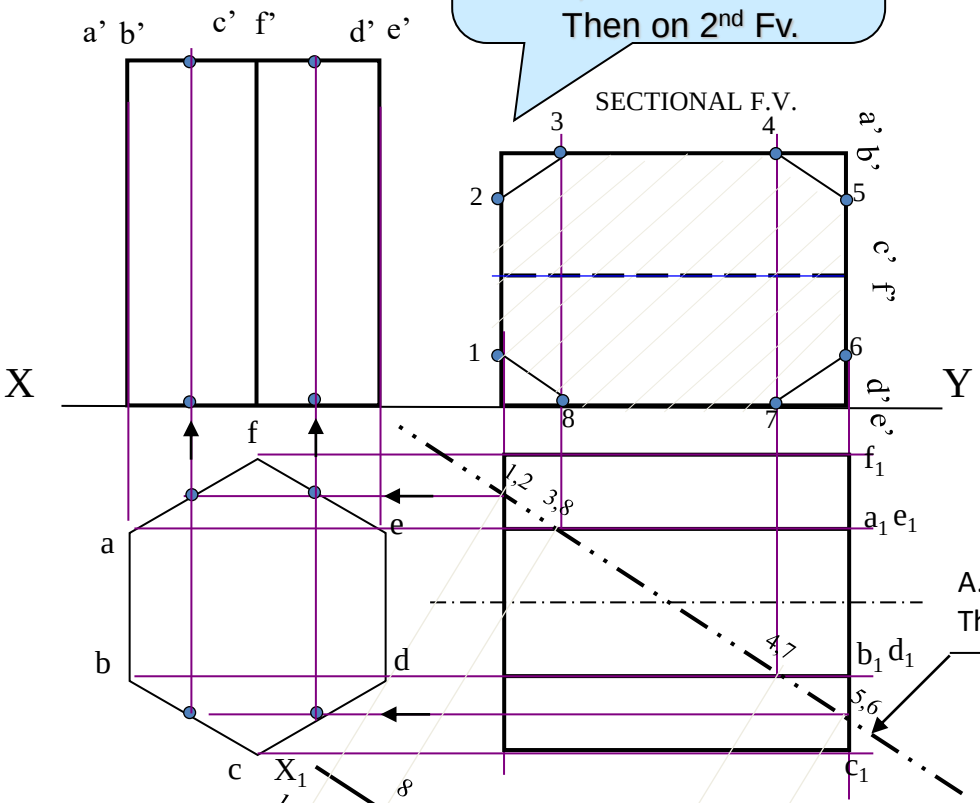
For True Shape:
Draw x_1y_1 // to sec. plane
Draw projectors on it from cut points.
Mark distances of points of Sectioned part from Tv, on above projectors from x_1y_1 and join in sequence.
Draw section lines in it.
It is required true shape.

For Development:
Draw development of entire solid.
Name from cut-open edge i.e. A.
in sequence as shown.Mark the cut points on respective edges.
Join them in sequence in curvature.
Make existing parts dev.dark.

Problem 3: A hexagonal prism. 30 mm base side & 55 mm axis is lying on Hp on it's rect.face with axis // to Vp. It is cut by a section plane normal to Hp and 30^0 inclined to Vp bisecting axis.
Draw sec. Views, true shape & development.

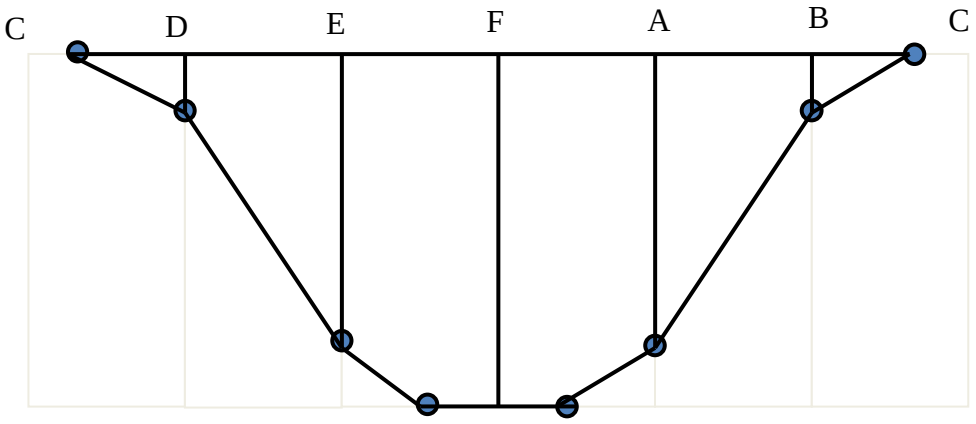
Note the steps to locate Points 1, 2 , 5, 6 in sec.Fv: Those are transferred to 1st TV, then to 1st Fv and Then on 2nd Fv.

Use similar steps for sec.views & true shape.
NOTE: for development, always cut open object from From an edge in the boundary of the view in which sec.plane appears as a line.
Here it is Tv and in boundary, there is c1 edge.Hence it is opened from c and named C,D,E,F,A,B,C.



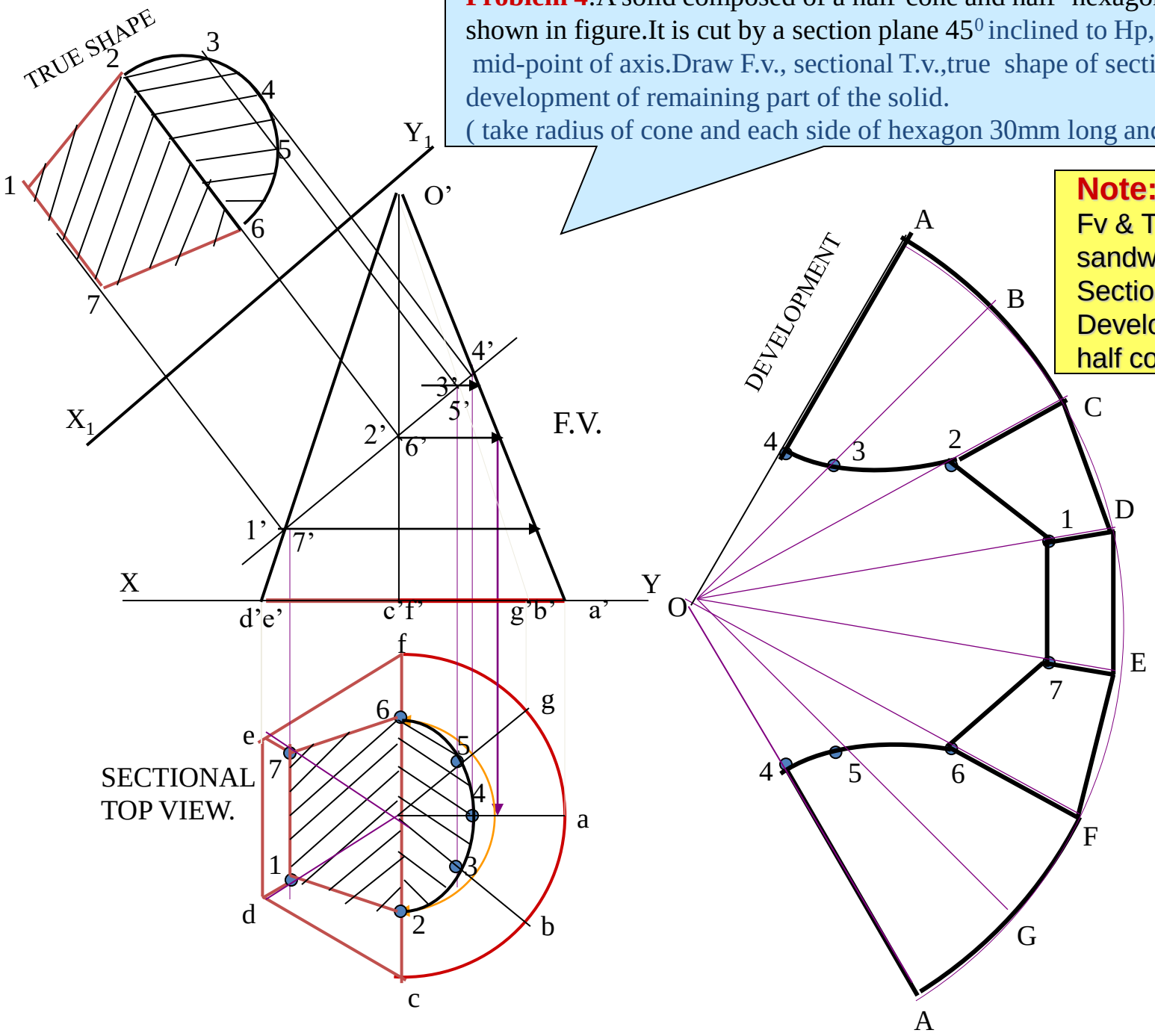
A.V.P30^0 inclined to Vp
Through mid-point of axis.

AS SECTION PLANE IS IN T.V.,
CUT OPEN FROM BOUNDRY EDGE C_1 FOR DEVELOPMENT.

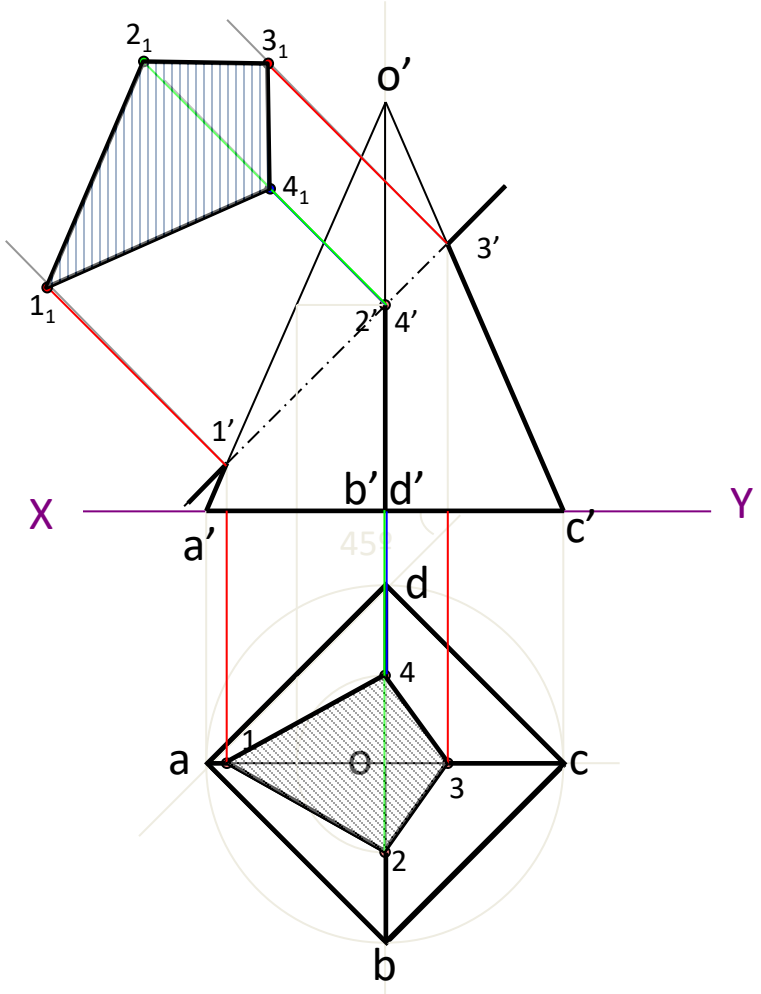


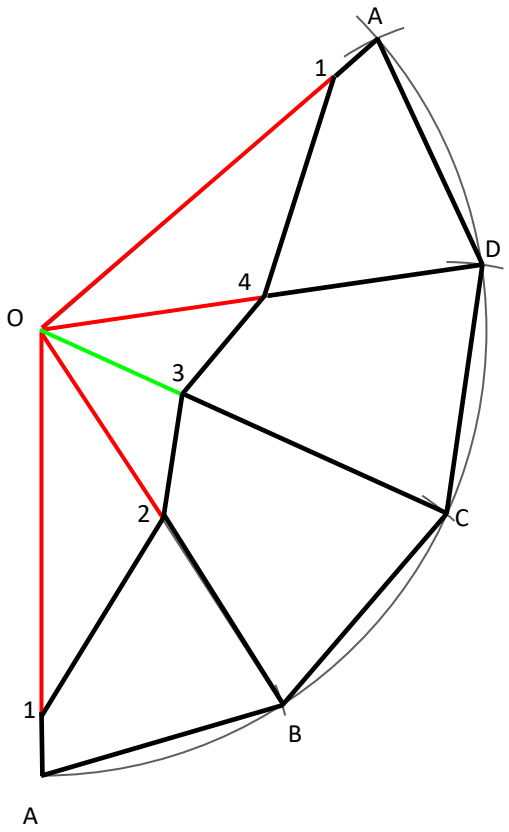
Problem 4:A solid composed of a half-cone and half- hexagonal pyramid is shown in figure.It is cut by a section plane 45^0 inclined to Hp, passing through mid-point of axis.Draw F.v., sectional T.v.,true shape of section and development of remaining part of the solid.
(take radius of cone and each side of hexagon 30mm long and axis 70mm.)

Note:
Fv & TV 8f two solids sandwiched
Section lines style in both:
Development of
half cone & half pyramid:

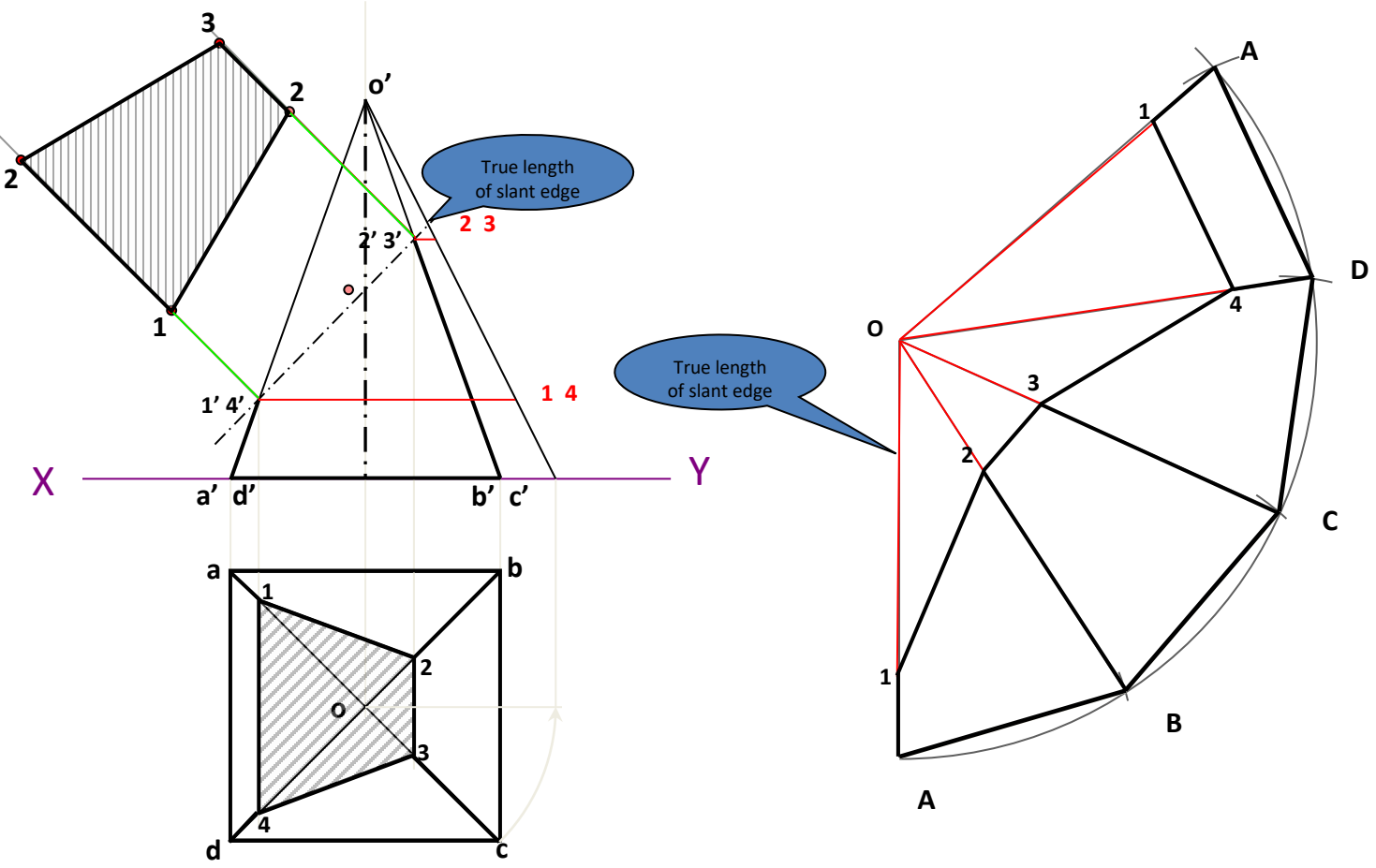


Q 5: A square pyramid, base 40 mm side and axis 65 mm long, has its base on the HP and all the edges of the base equally inclined to the VP. It is cut by a section plane, perpendicular to the VP, inclined at 45º to the HP and bisecting the axis. Draw its sectional top view, sectional side view and true shape of the section. Also draw its development.





Q 6: A square pyramid, base 40 mm side and axis 65 mm long, has its base on the HP with two edges of the base perpendicular to the VP. It is cut by a section plane, perpendicular to the VP, inclined at 45º to the HP and bisecting the axis. Draw its sectional top view and true shape of the section. Also draw its development.



Orthographic Projections

What does the word Orthographic Mean?

- Ortho – 90 Degrees or right angle
- Graphic – to draw or a picture
- To draw pictures 90 degrees from each other.

Orthographic Projections

- 3 views of an object that are 90 degrees to each other
- Usually the Top, Front, and Right Side views are used

Why Orthographic Projections?

- Shows the true size and shape of the features of an object
- Provide certain information on how the object is to be made.

Methods of Drawing Orthographic Projections

First Angle Projections Method

Here views are drawn
by placing object
in 1st Quadrant

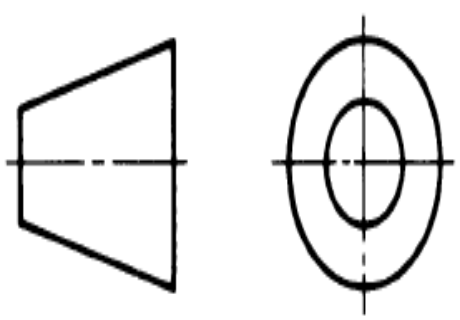
(Fv above X-y, Tv below X-y)

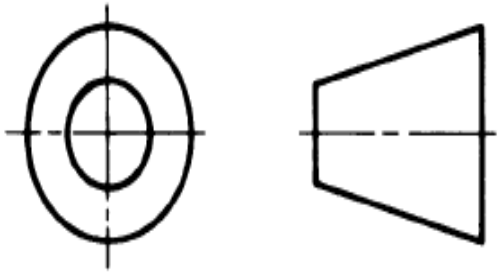
Third Angle Projections Method

Here views are drawn
by placing object
in 3rd Quadrant.

(Tv above X-y, Fv below X-y)

SYMBOLIC PRESENTATION OF BOTH METHODS WITH AN OBJECT STANDING ON HP (GROUND) ON IT'S BASE.

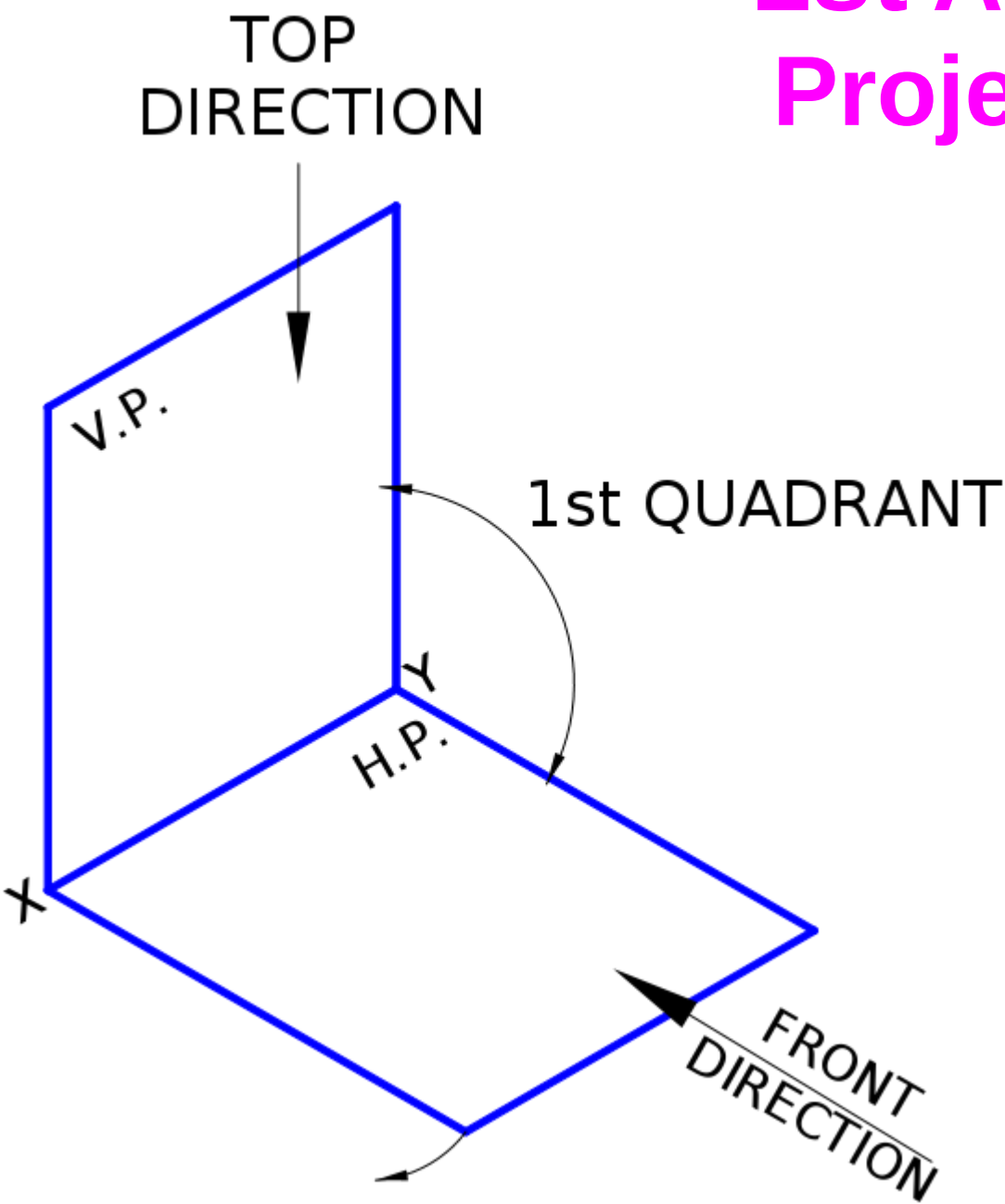




NOTE:-

HP term is used in 1st Angle method
&
For the same
Ground term is used
in 3rd Angle method of projections

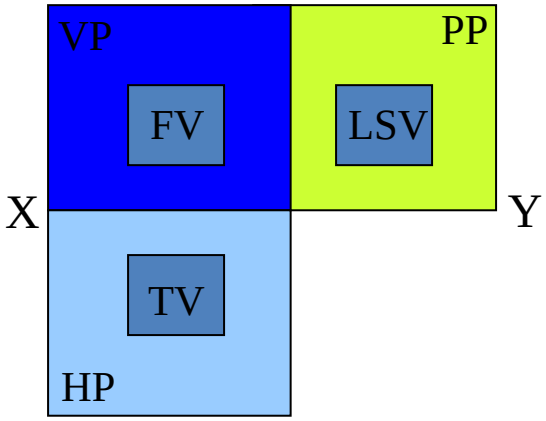
1st ANGLE Projection



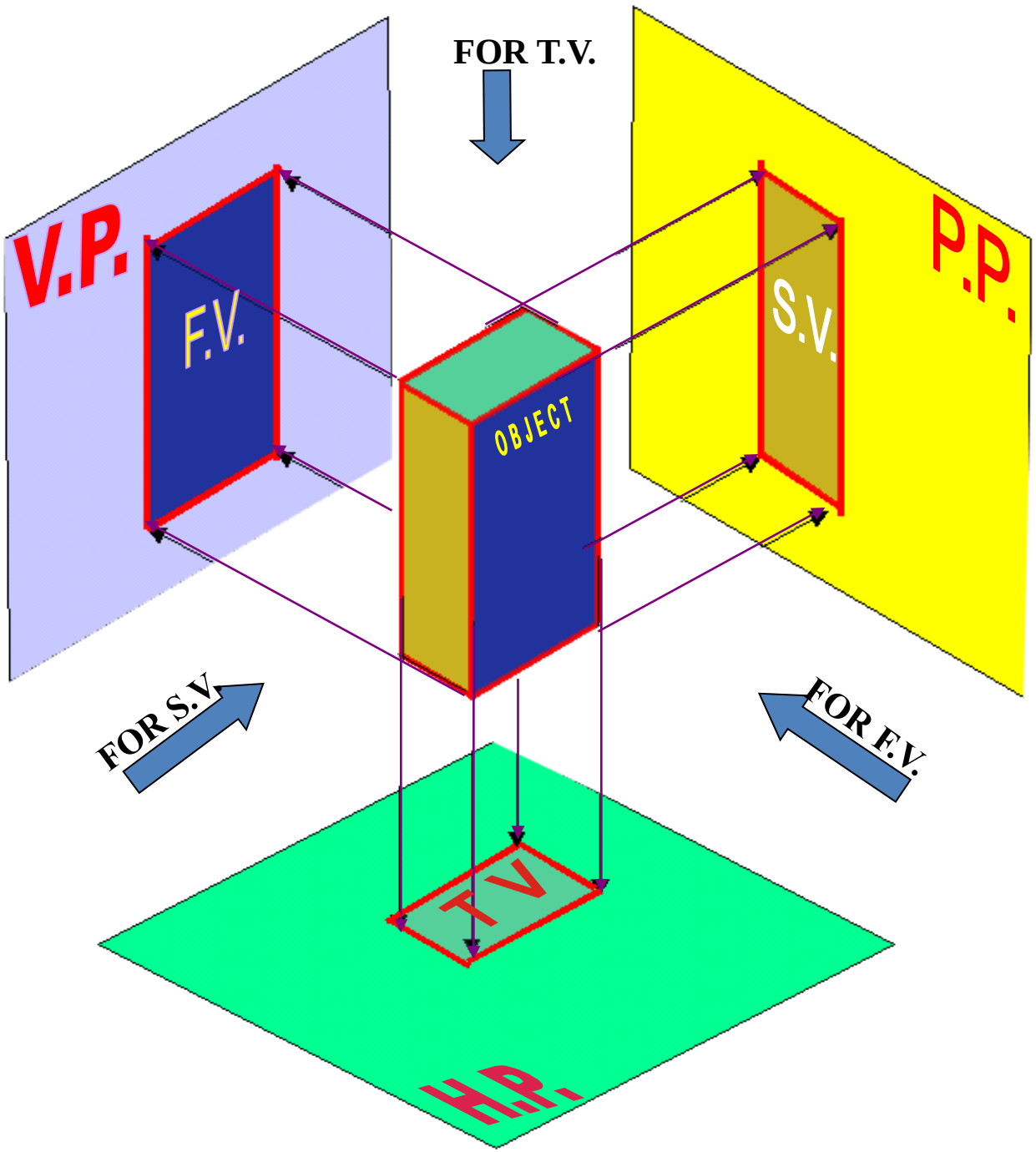
FIRST ANGLE PROJECTION

**IN THIS METHOD,
THE OBJECT IS ASSUMED TO BE SITUATED IN FIRST QUADRANT
MEANS
ABOVE HP & INFRONT OF VP.**

OBJECT IS INBETWEEN OBSERVER & PLANE.



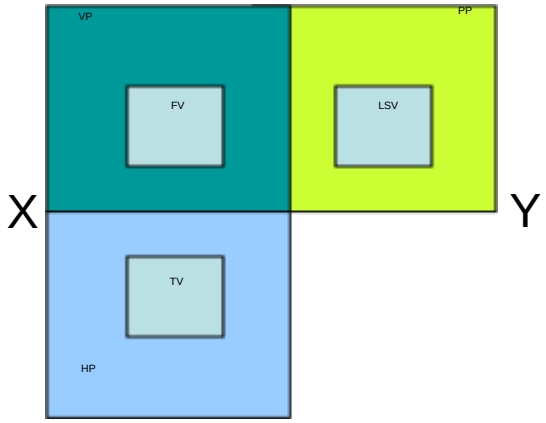
ACTUAL PATTERN OF PLANES & VIEWS IN FIRST ANGLE METHOD OF PROJECTIONS



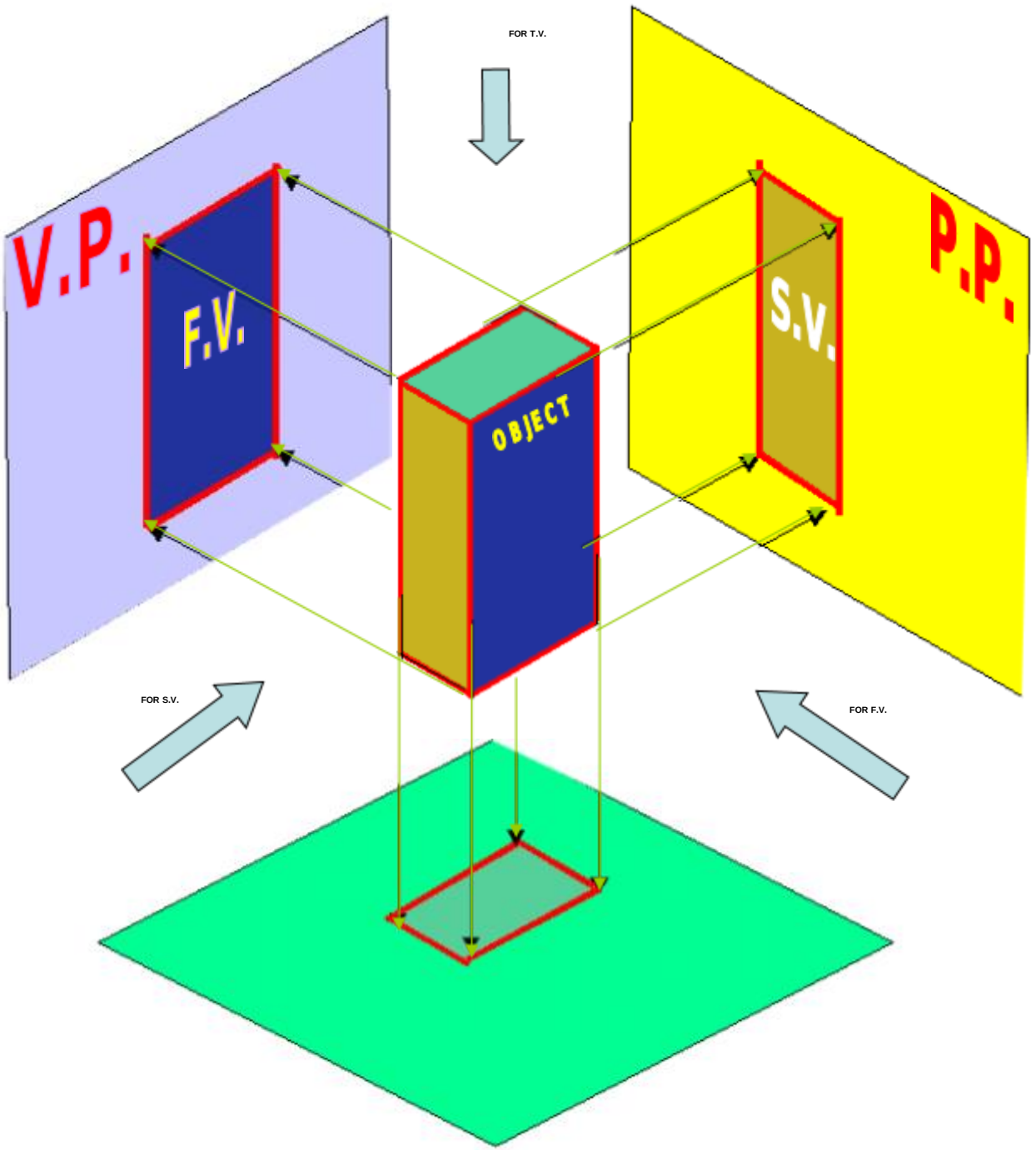
FIRST ANGLE PROJECTION

IN THIS METHOD,
THE OBJECT IS ASSUMED TO BE SITUATED IN FIRST QUADRANT
MEANS
ABOVE HP & INFRONT OF VP.

OBJECT IS INBETWEEN OBSERVER & PLANE.



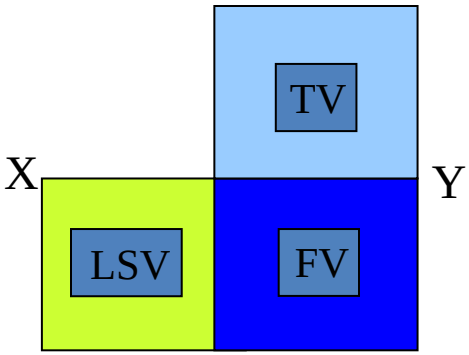
ACTUAL PATTERN OF PLANES & VIEWS IN FIRST ANGLE METHOD OF PROJECTIONS



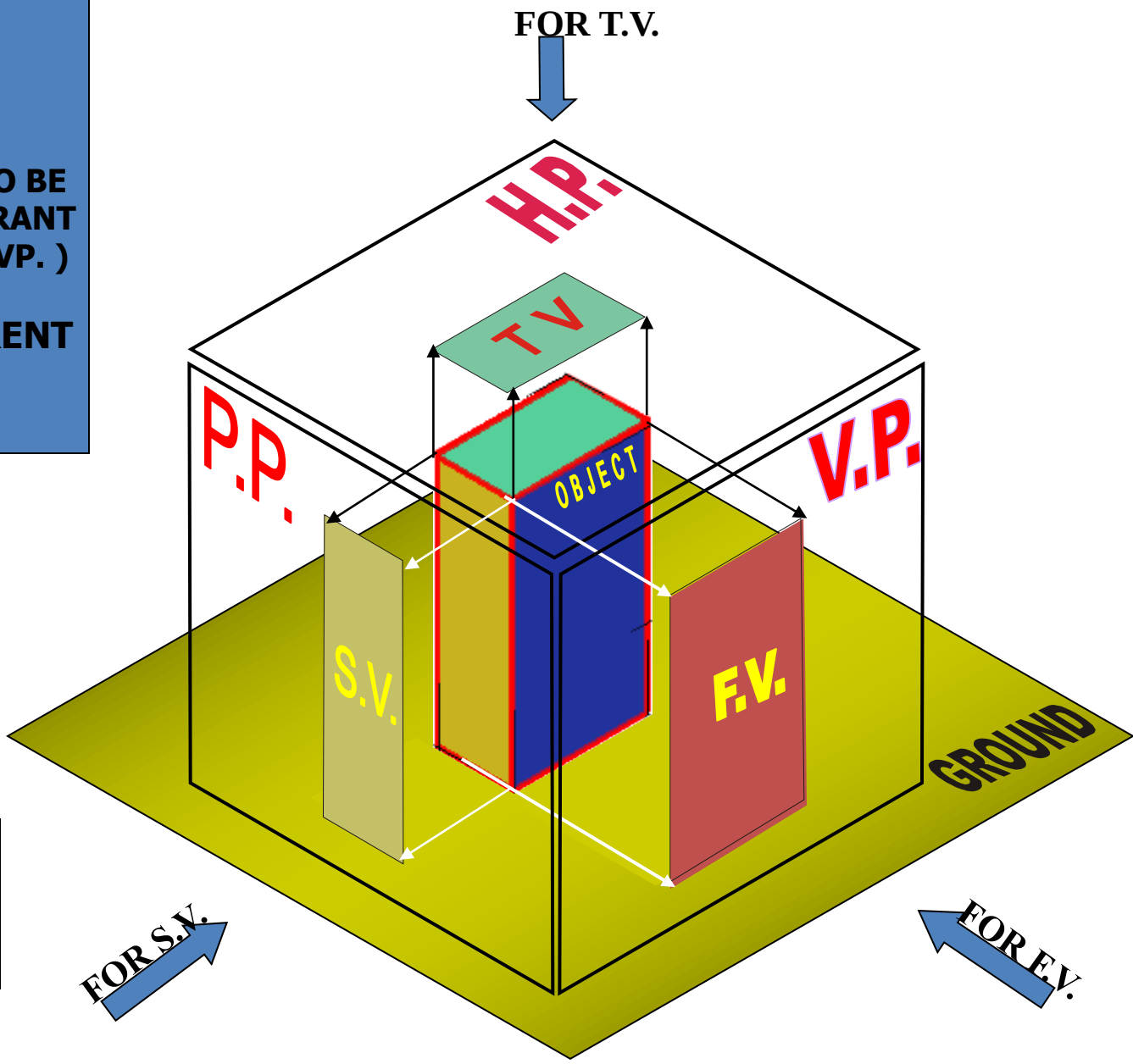
THIRD ANGLE PROJECTION

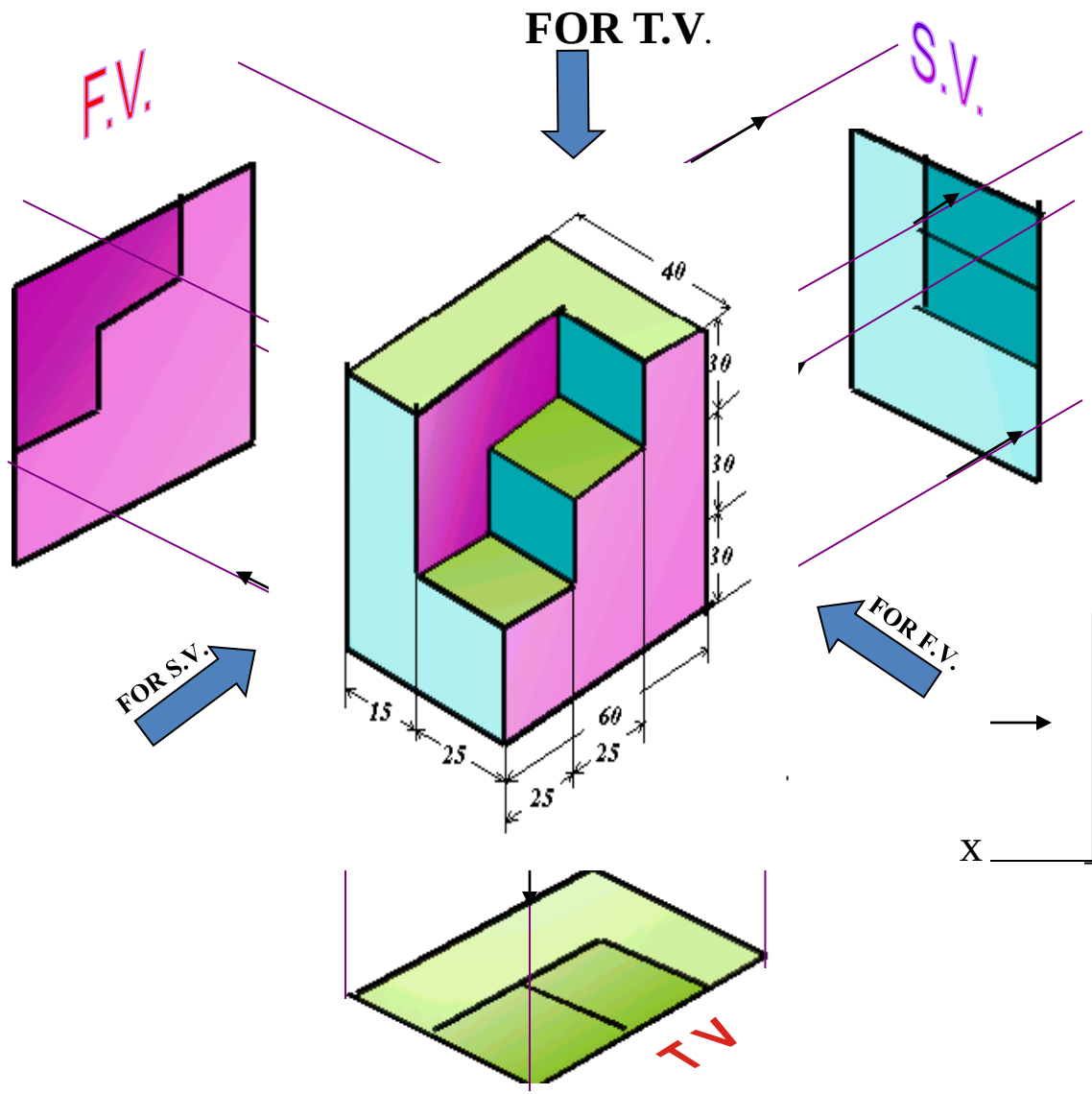
**IN THIS METHOD,
THE OBJECT IS ASSUMED TO BE SITUATED IN THIRD QUADRANT
(BELOW HP & BEHIND OF VP.)**

PLANES BEING TRANSPERENT AND INBETWEEN OBSERVER & OBJECT.

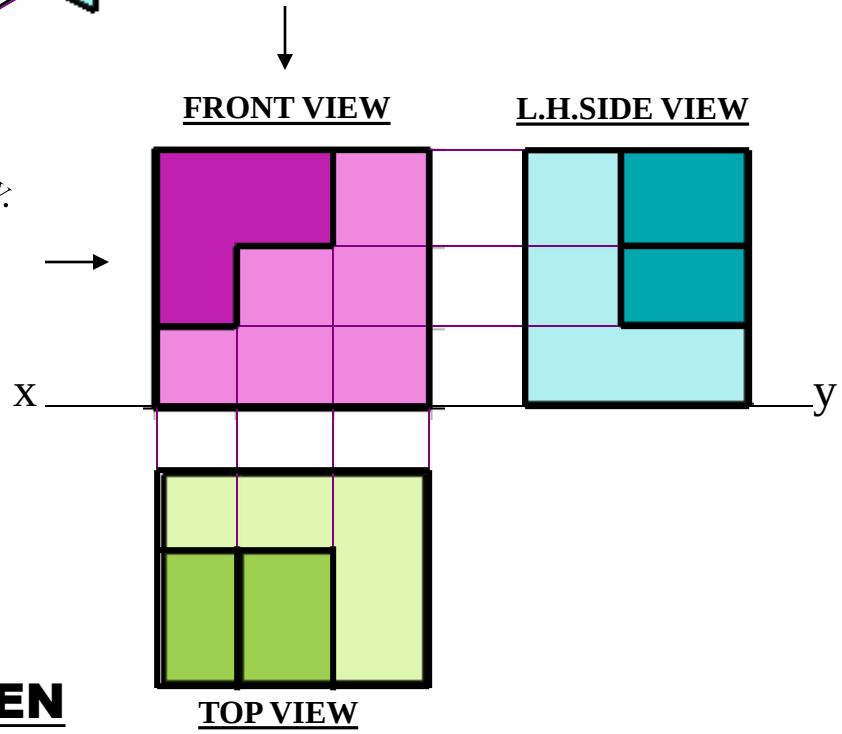


ACTUAL PATTERN OF PLANES & VIEWS OF THIRD ANGLE PROJECTIONS



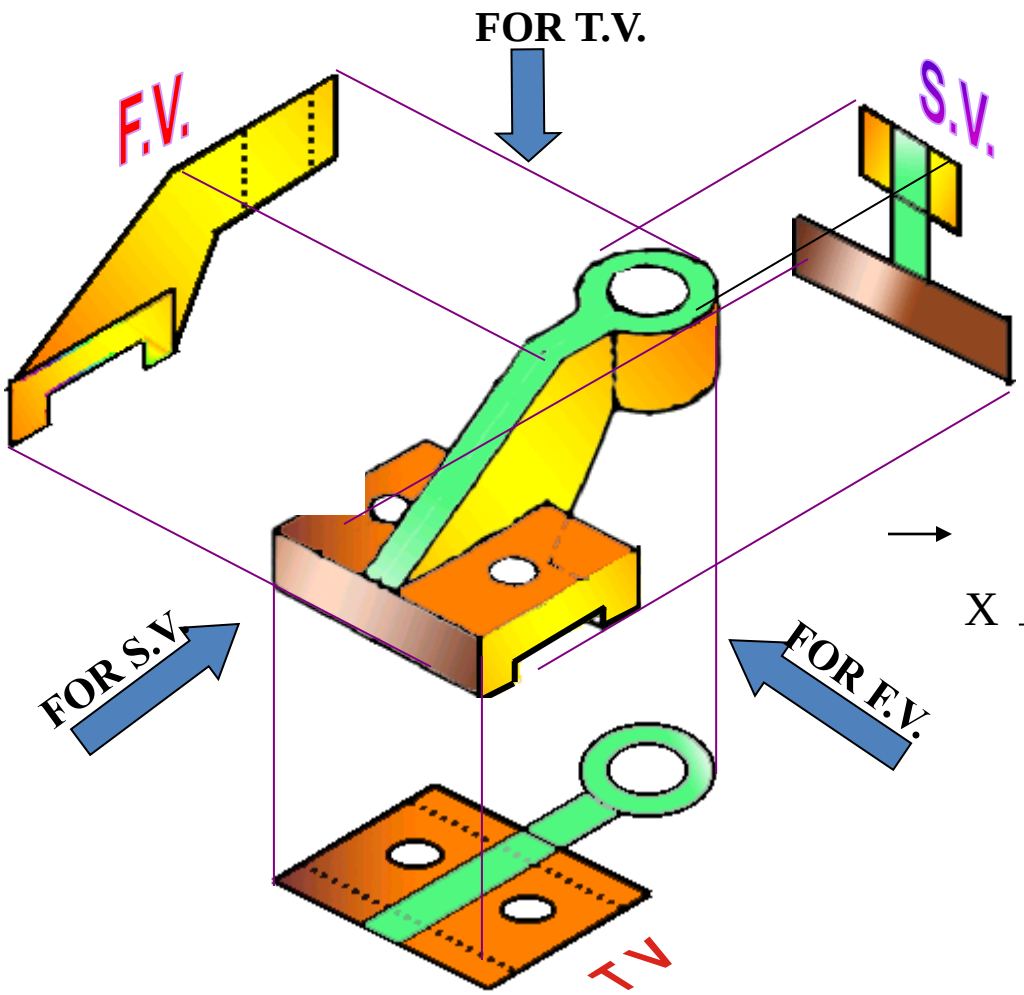


ORTHOGRAPHIC PROJECTIONS

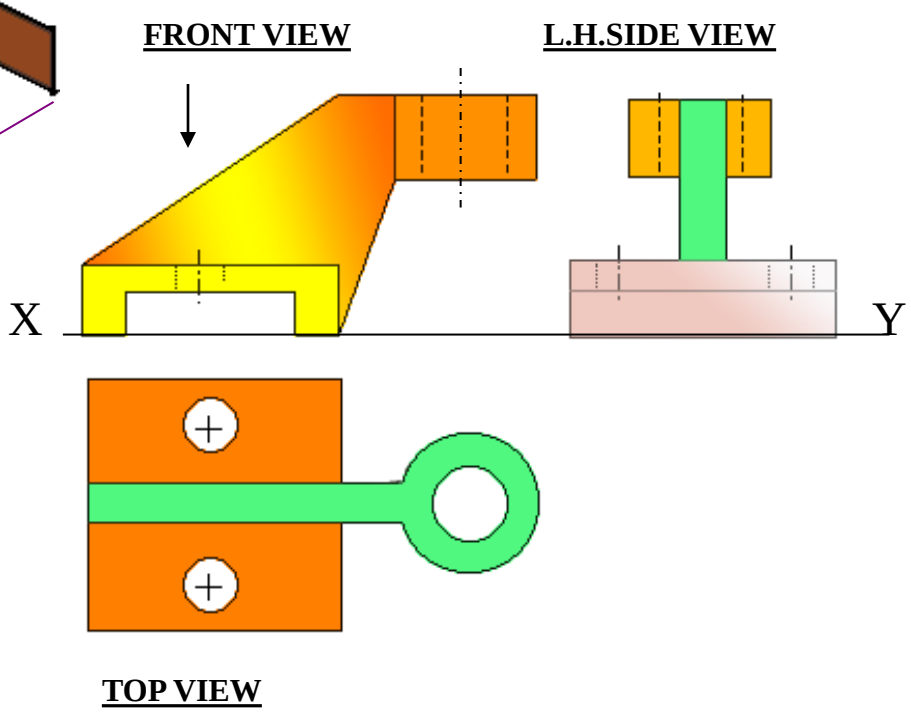


PICTORIAL PRESENTATION IS GIVEN

DRAW THREE VIEWS OF THIS OBJECT BY FIRST ANGLE PROJECTION METHOD

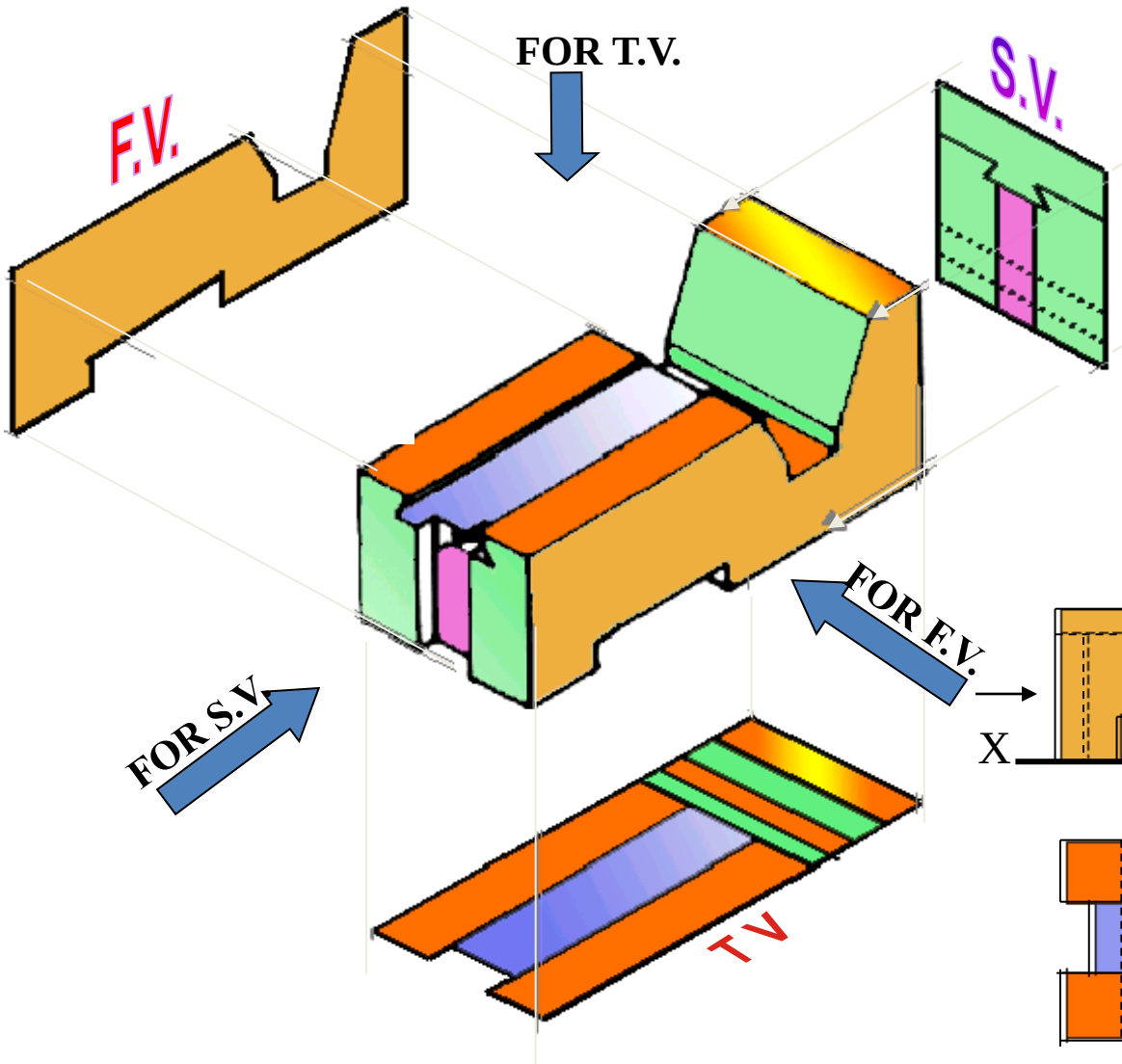


ORTHOGRAPHIC PROJECTIONS

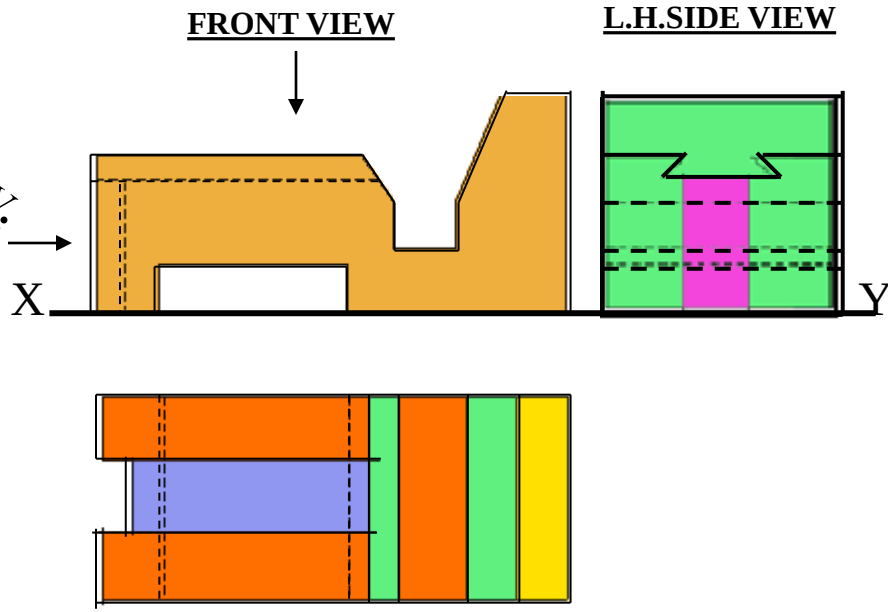


PICTORIAL PRESENTATION IS GIVEN

DRAW THREE VIEWS OF THIS OBJECT
BY FIRST ANGLE PROJECTION METHOD



ORTHOGRAPHIC PROJECTIONS



PICTORIAL PRESENTATION IS GIVEN

DRAW THREE VIEWS OF THIS OBJECT
BY FIRST ANGLE PROJECTION METHOD

ISOMETRIC PROJECTION

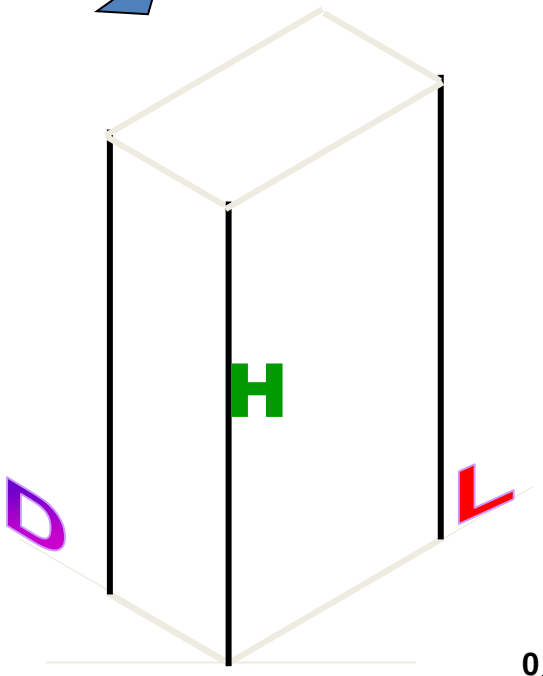
ISOMETRIC PROJECTION

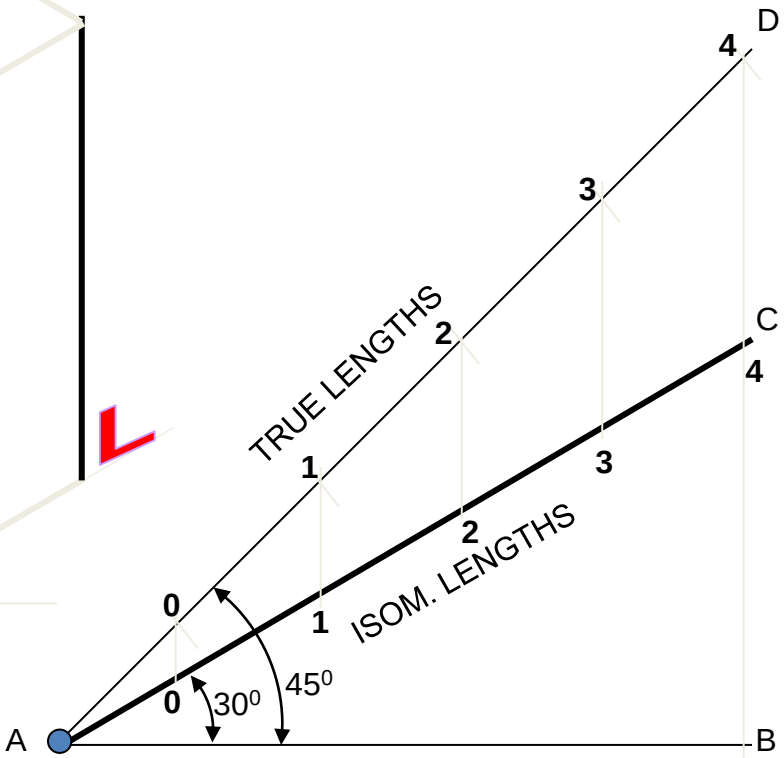
Isometric projection is a method for visually representing three-dimensional objects in two dimensions in technical and engineering drawings.

TYPES OF ISOMETRIC DRAWINGS

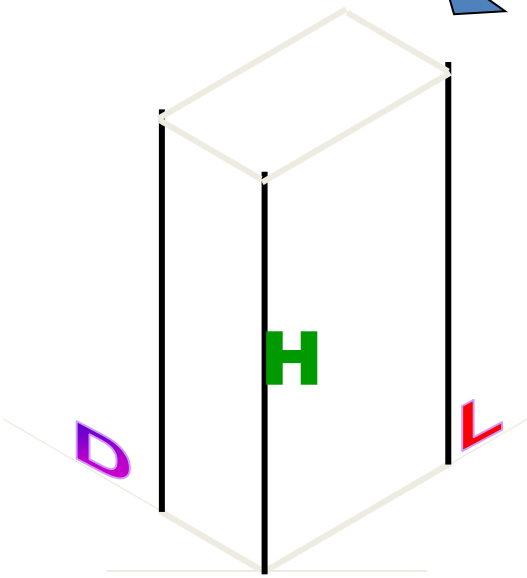
ISOMETRIC VIEW
Drawn by using True scale
(True dimensions)

ISOMETRIC PROJECTION
Drawn by using Isometric scale
(Reduced dimensions)



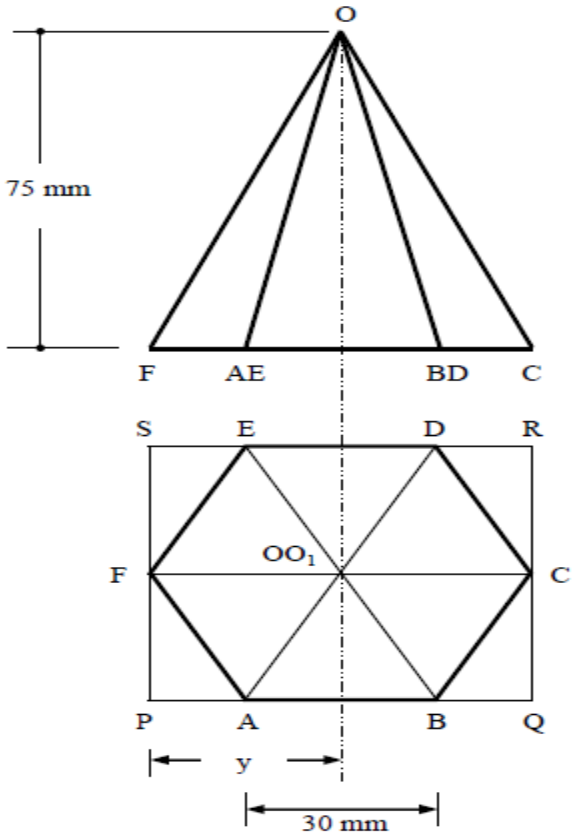


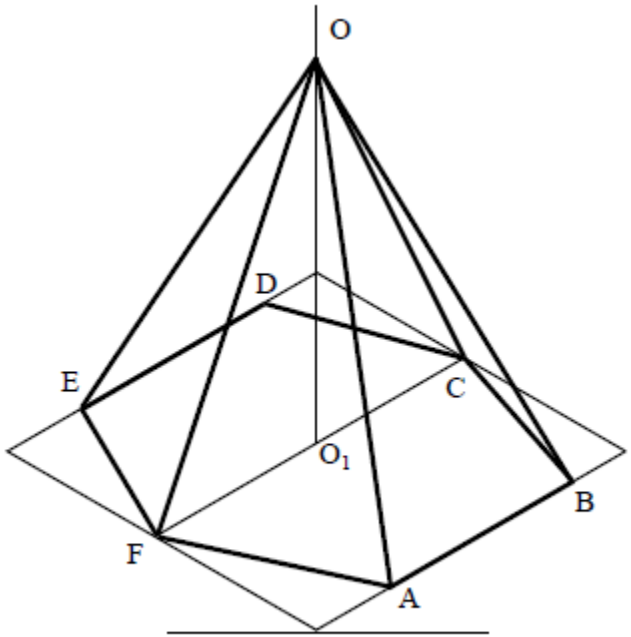
Isometric scale [Line AC]
required for Isometric Projection



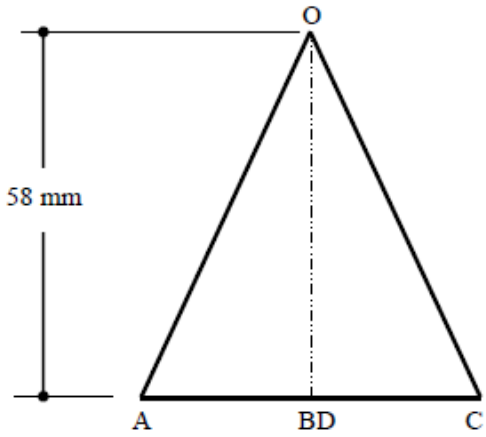
CONSTRUCTION OF ISOM.SCALE.
From point A, with line AB draw 30^0 and 45^0 inclined lines AC & AD resp on AD. Mark divisions of true length and from each division-point draw vertical lines upto AC line.
The divisions thus obtained on AC give lengths on isometric scale.

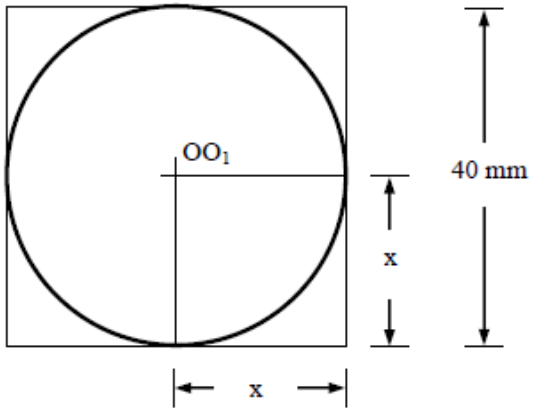
The isometric view of a hexagonal pyramid of side of base 30 mm and height 75 mm, when it is resting on H.P such that an edge of the base is parallel to V.P

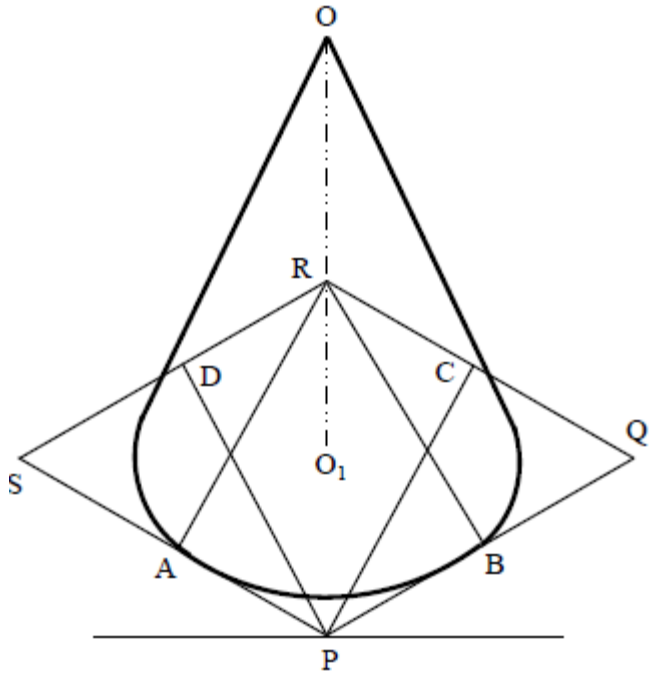




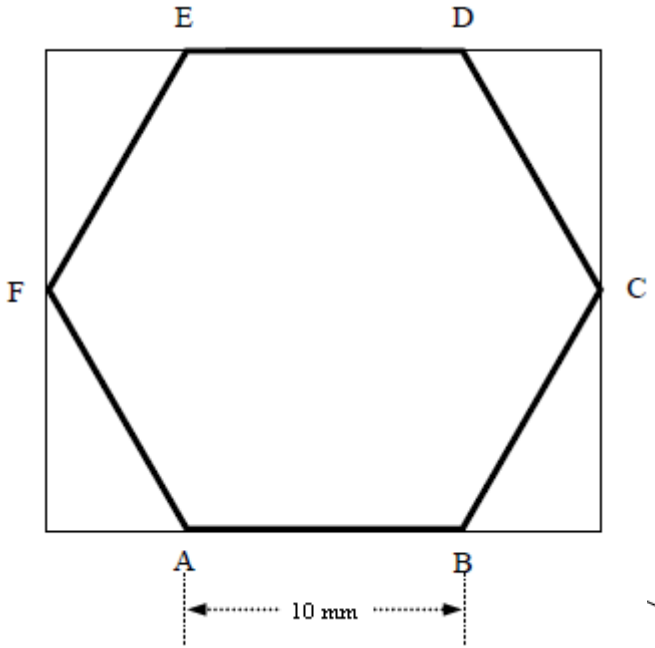
Draw the isometric projection of a cone of base 40 mm diameter and height 58 mm when it rest with its base on H.P

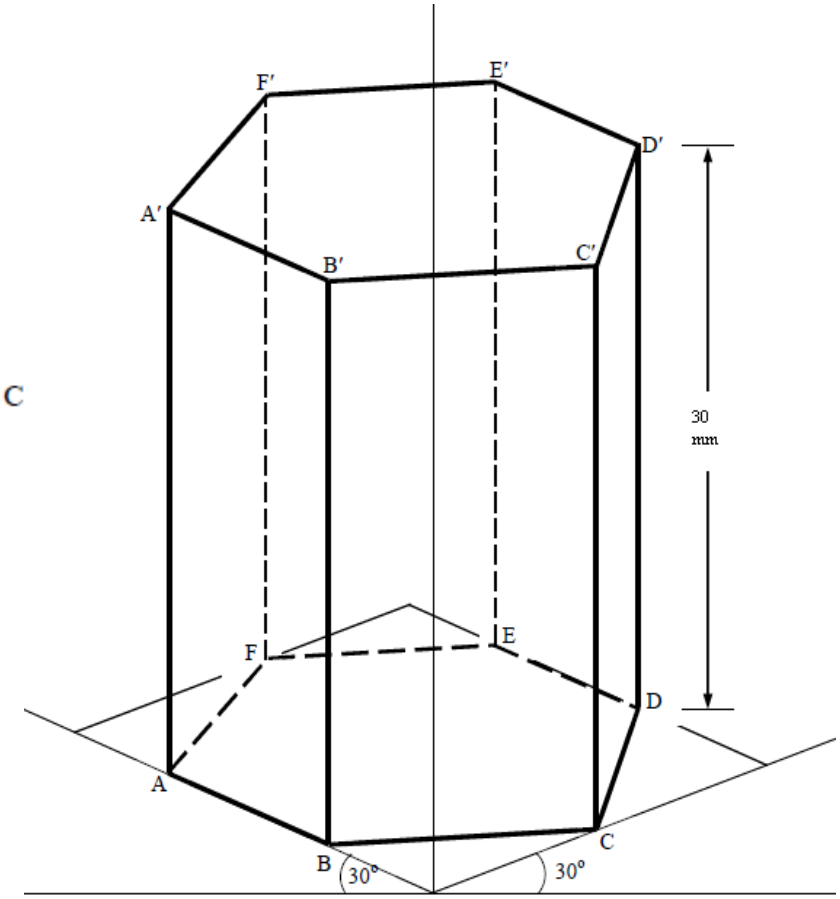






Draw an isometric of a regular Hexagonal Pyramid of base 10 mm and height 30mm resting on one of its hexagonal faces on H.P





Thank you