# Projections of Solids:

1. Classification of Solids:
2. Important parameters:
3. Positions with Hp & Vp: Info:
4. Pattern of Standard Solution.
5. Problem no 1,2,3,4: General cases:
6. Problem no 5 & 6 (cube & tetrahedron)
7. Problem no 7 : Freely suspended:
8. Problem no 8 : Side view case:
9. Problem no 9 : True length case:
10. Problem no 10 & 11 Composite solids:
11. Problem no 12 : Frustum & auxiliary plane:

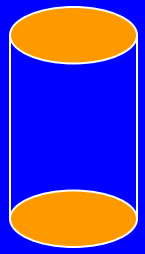
# SOLIDS

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

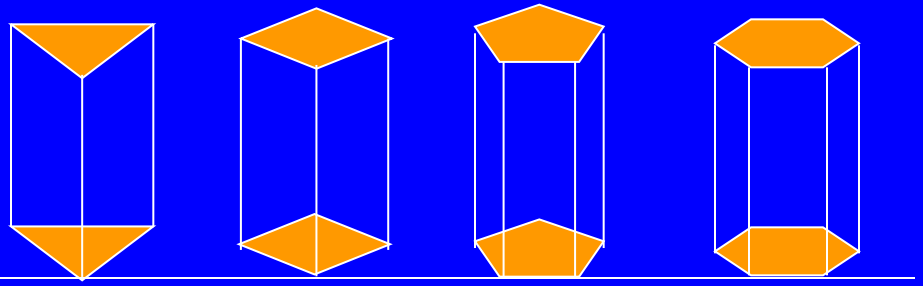
## Group A

Solids having top and base of same shape

***Cylinder***



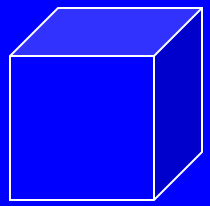
***Prisms***



Triangular Square Pentagonal Hexagonal

***Cube***

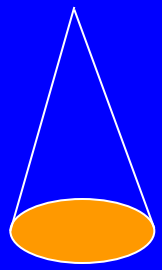
( A solid having six square faces)



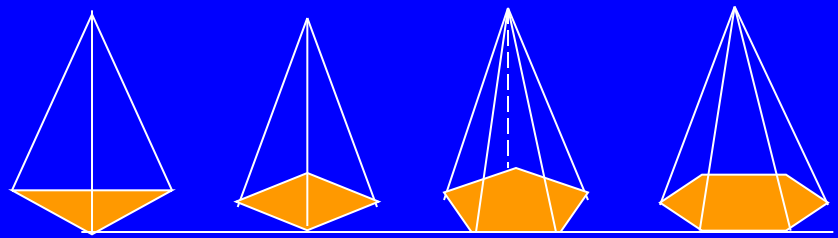
## Group B

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

***Cone***



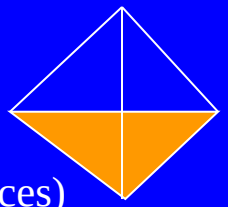
***Pyramids***



Triangular Square Pentagonal Hexagonal

***Tetrahedron***

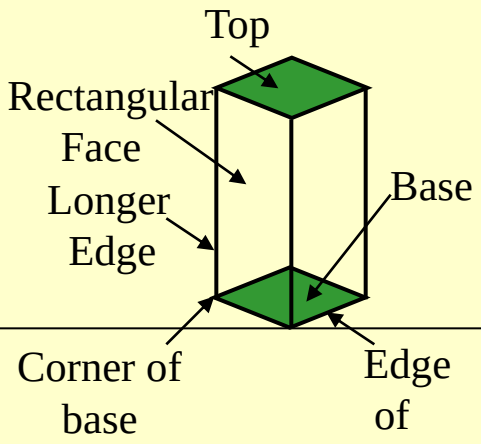
( A solid having Four triangular faces)



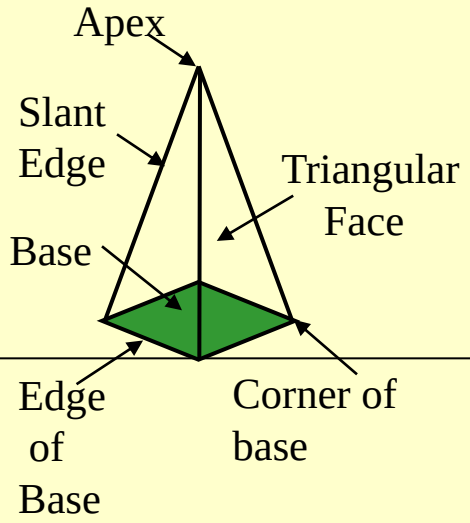
# SOLIDS

Dimensional parameters of different solids.

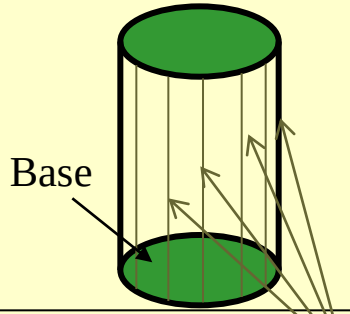
## Square Prism



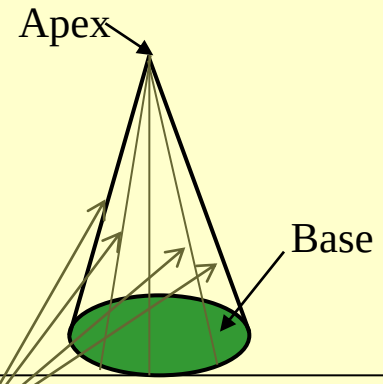

## Square Pyramid




## Cylinder

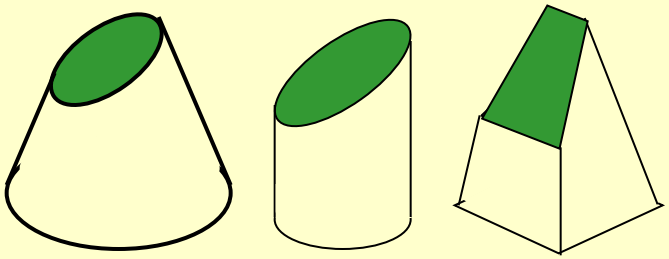



## Cone

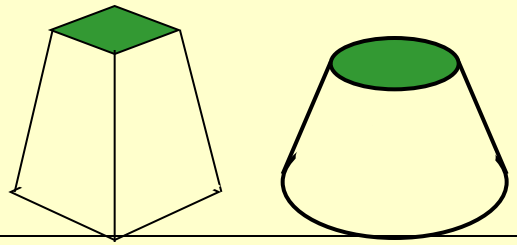



**Generators**

*Imaginary lines generating curved surface of cylinder & cone.*



Sections of solids( top & base not parallel)

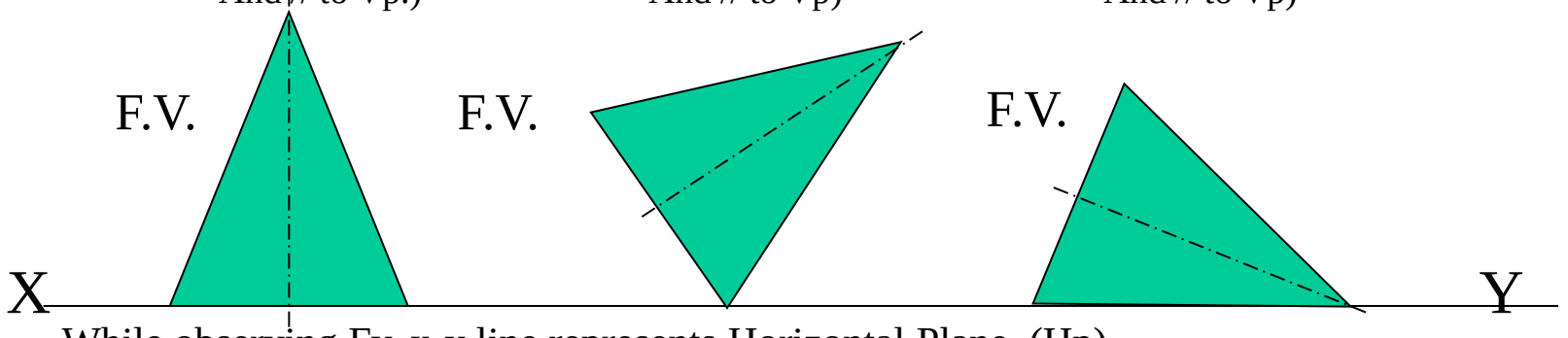


Frustum of cone & pyramids.
( top & base parallel to each other)

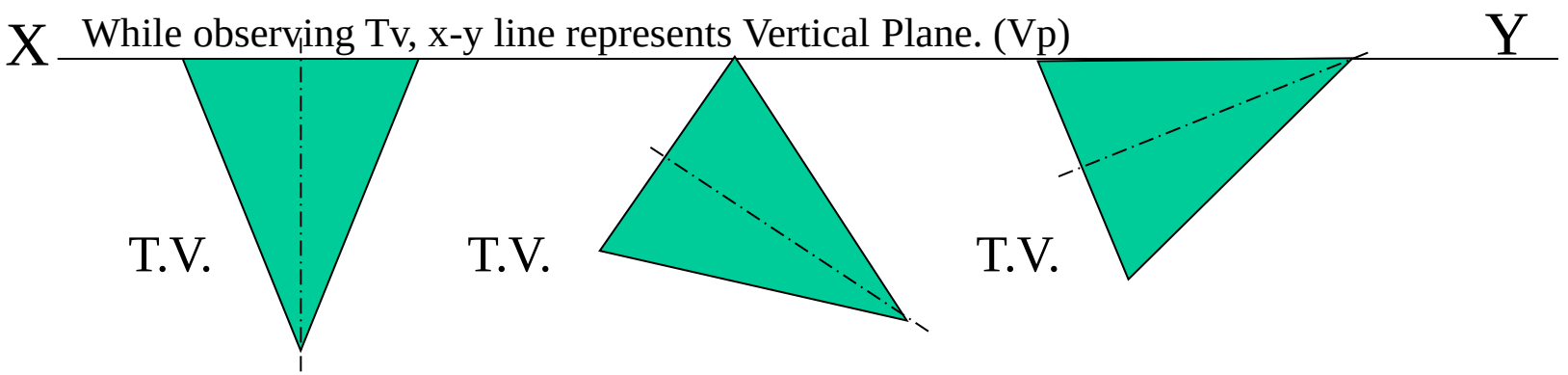
STANDING ON H.P
On it's base.
(Axis perpendicular to Hp
And // to Vp.)

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

# STEPS TO SOLVE PROBLEMS IN SOLIDS

**Problem is solved in three steps:**

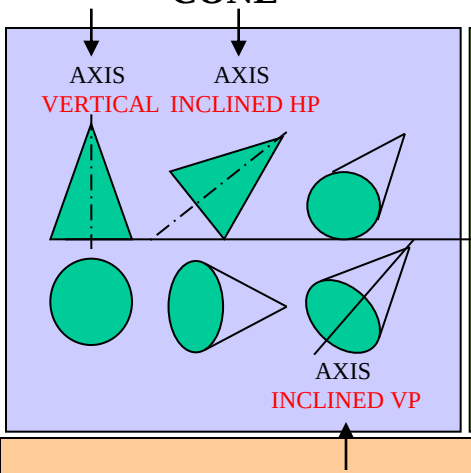
**STEP 1**: ASSUME SOLID STANDING ON THE PLANE WITH WHICH IT IS MAKING INCLINATION.
( IF IT IS INCLINED TO HP, ASSUME IT STANDING ON HP)
( IF IT IS INCLINED TO VP, ASSUME IT STANDING ON VP)
IF STANDING ON HP - IT'S TV WILL BE TRUE SHAPE OF IT'S BASE OR TOP:
IF STANDING ON VP - IT'S FV WILL BE TRUE SHAPE OF IT'S BASE OR TOP.
BEGIN WITH THIS VIEW:
IT'S OTHER VIEW WILL BE A RECTANGLE ( IF SOLID IS ***CYLINDER OR ONE OF THE PRISMS)***:
IT'S OTHER VIEW WILL BE A TRIANGLE ( IF SOLID IS ***CONE OR ONE OF THE PYRAMIDS):***
DRAW FV & TV OF THAT SOLID IN STANDING POSITION:

**STEP 2:** CONSIDERING SOLID'S INCLINATION ( AXIS POSITION ) DRAW IT'S FV & TV.

**STEP 3:** IN LAST STEP, CONSIDERING REMAINING INCLINATION, DRAW IT'S FINAL FV & TV.

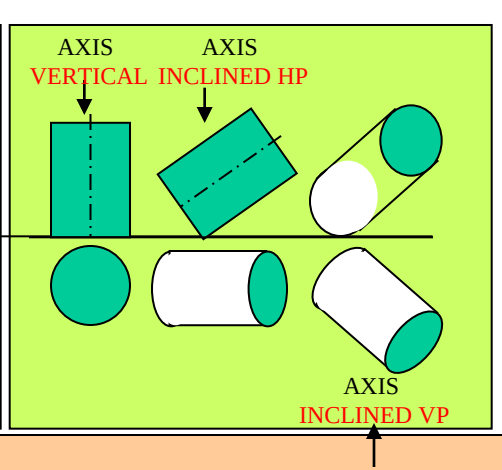
## GENERAL PATTERN ( THREE STEPS ) OF SOLUTION:

**GROUP B SOLID. CONE**



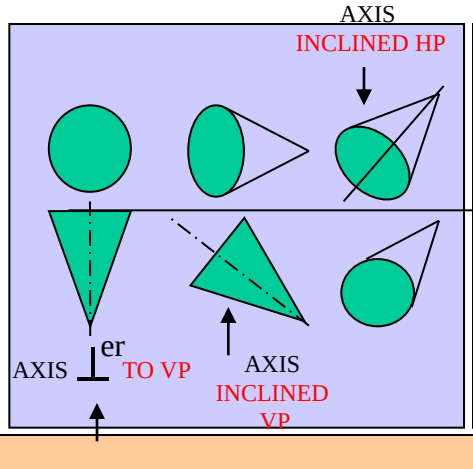

**Three steps**
**If solid is inclined to Hp**

**GROUP A SOLID. CYLINDER**



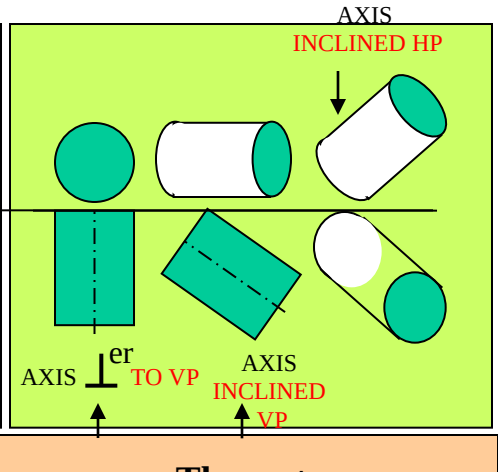

**Three steps**
**If solid is inclined to Hp**

**GROUP B SOLID. CONE**




**Three steps**
**If solid is inclined to Vp**

**GROUP A SOLID. CYLINDER**

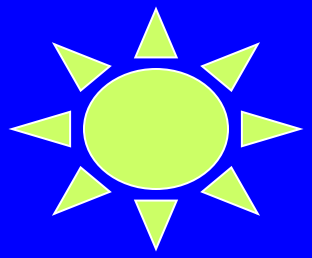
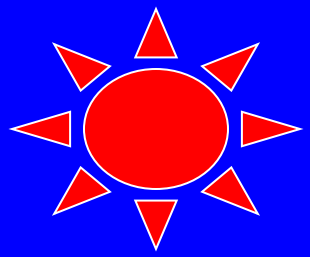
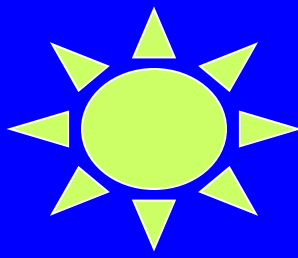



**Three steps**
**If solid is inclined to Vp**

**Study Next *Twelve* Problems and Practice them separately !!**

# CATEGORIES OF ILLUSTRATED PROBLEMS!

| | |
|---|---|
| PROBLEM NO.1, 2, 3, 4 | GENERAL CASES OF SOLIDS INCLINED TO HP & VP |
| PROBLEM NO. 5 & 6 | CASES OF CUBE & TETRAHEDRON |
| PROBLEM NO. 7 | CASE OF FREELY SUSPENDED SOLID WITH SIDE VIEW. |
| PROBLEM NO. 8 | CASE OF CUBE ( WITH SIDE VIEW) |
| PROBLEM NO. 9 | CASE OF TRUE LENGTH INCLINATION WITH HP & VP. |
| PROBLEM NO. 10 & 11 | CASES OF COMPOSITE SOLIDS. (AUXILIARY PLANE) |
| PROBLEM NO. 12 | CASE OF A FRUSTUM (AUXILIARY PLANE) |

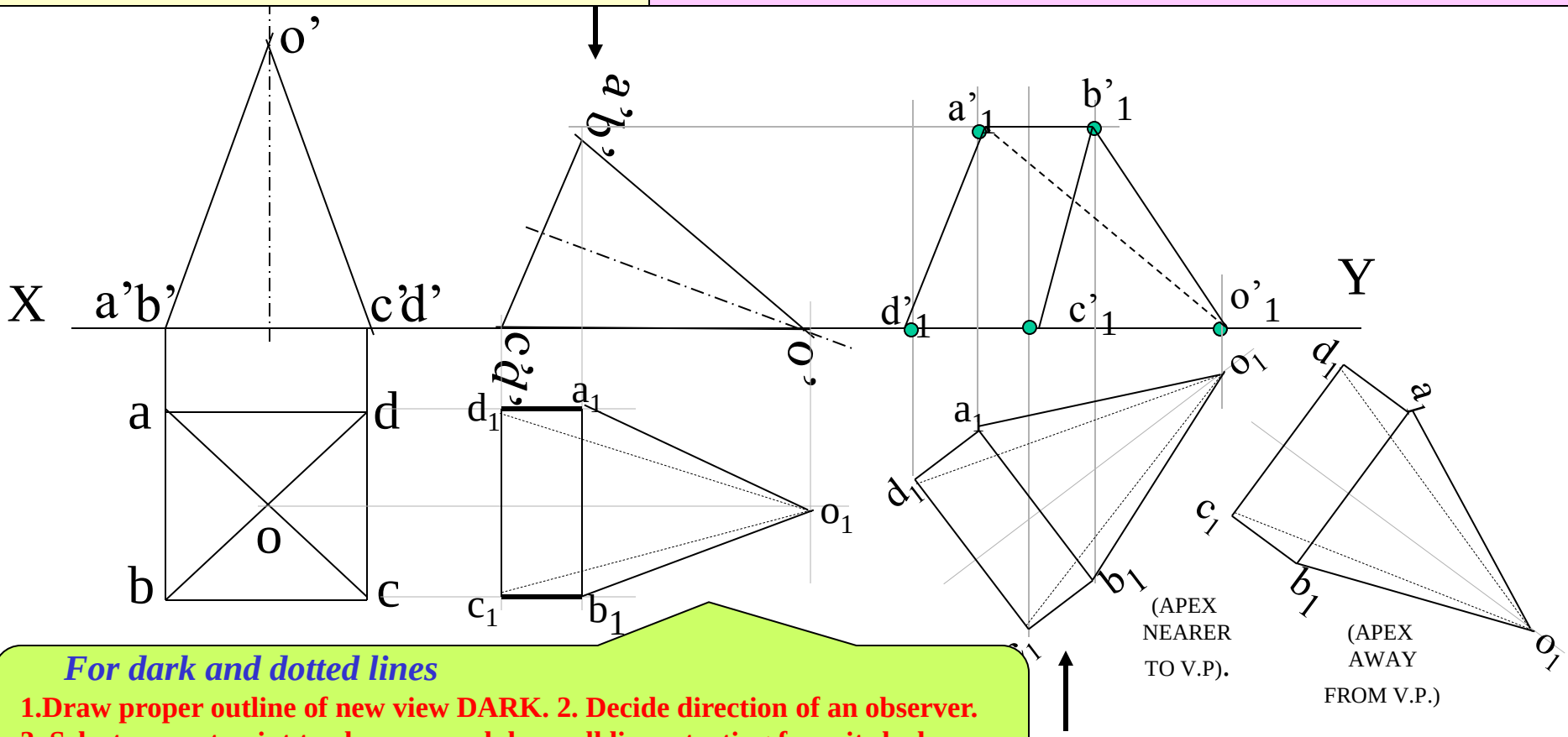




**Problem 1.** A square pyramid, 40 mm base sides and axis 60 mm long, has a triangular face on the ground and the vertical plane containing the axis makes an angle of $45^0$ with the VP. Draw its projections. Take apex nearer to VP

**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:

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.

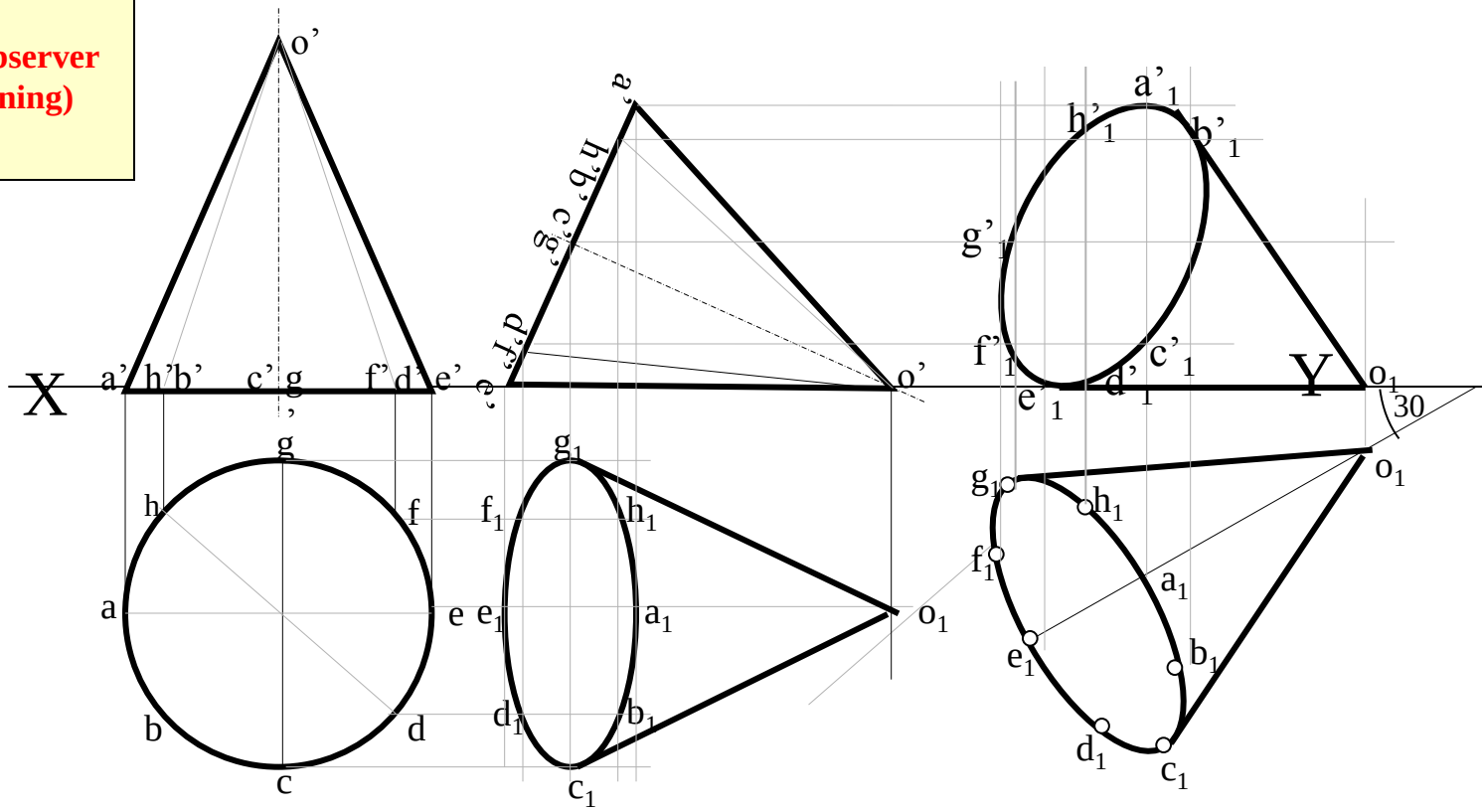
***For dark and dotted lines***

**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.



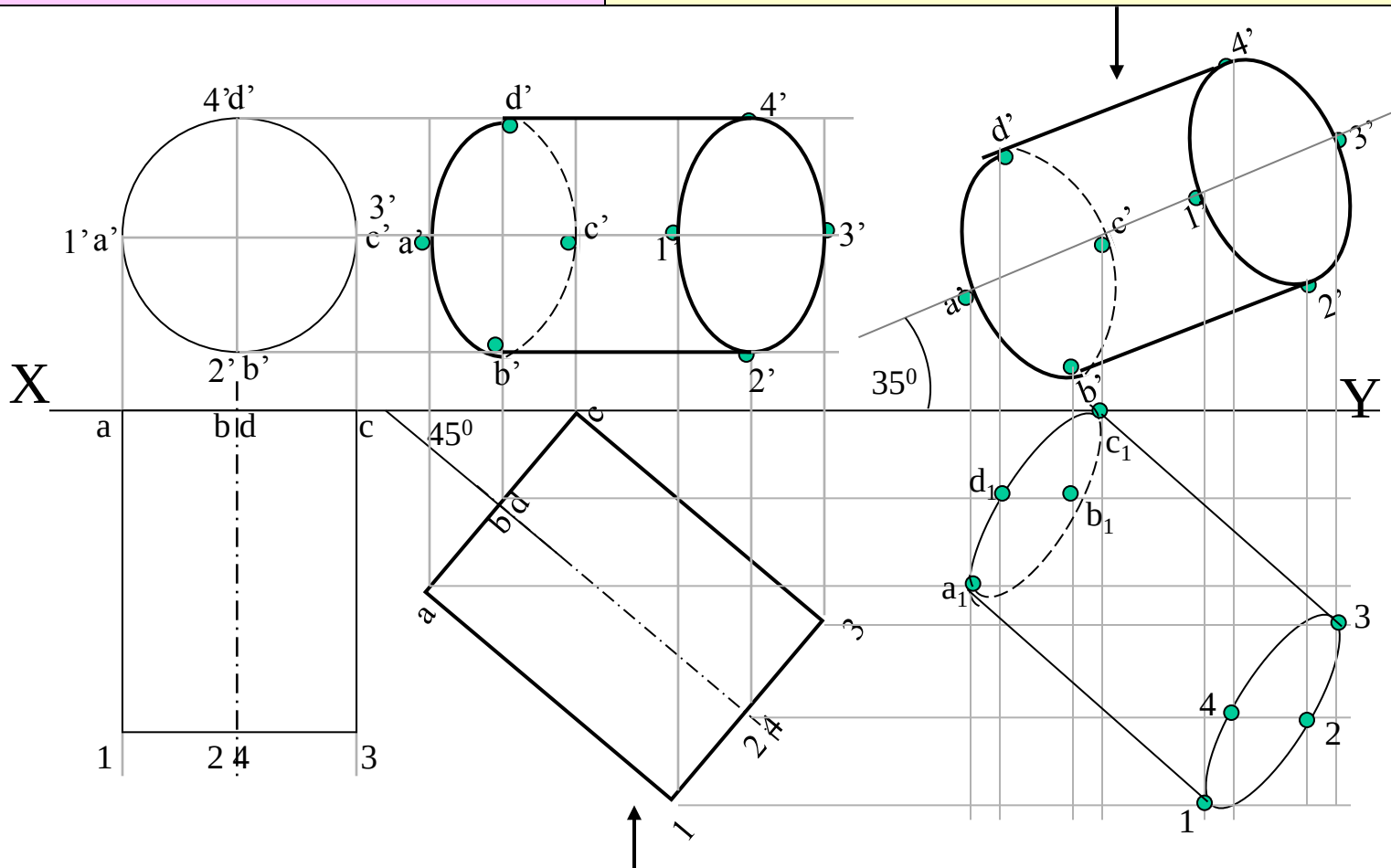
## Problem 3:

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:

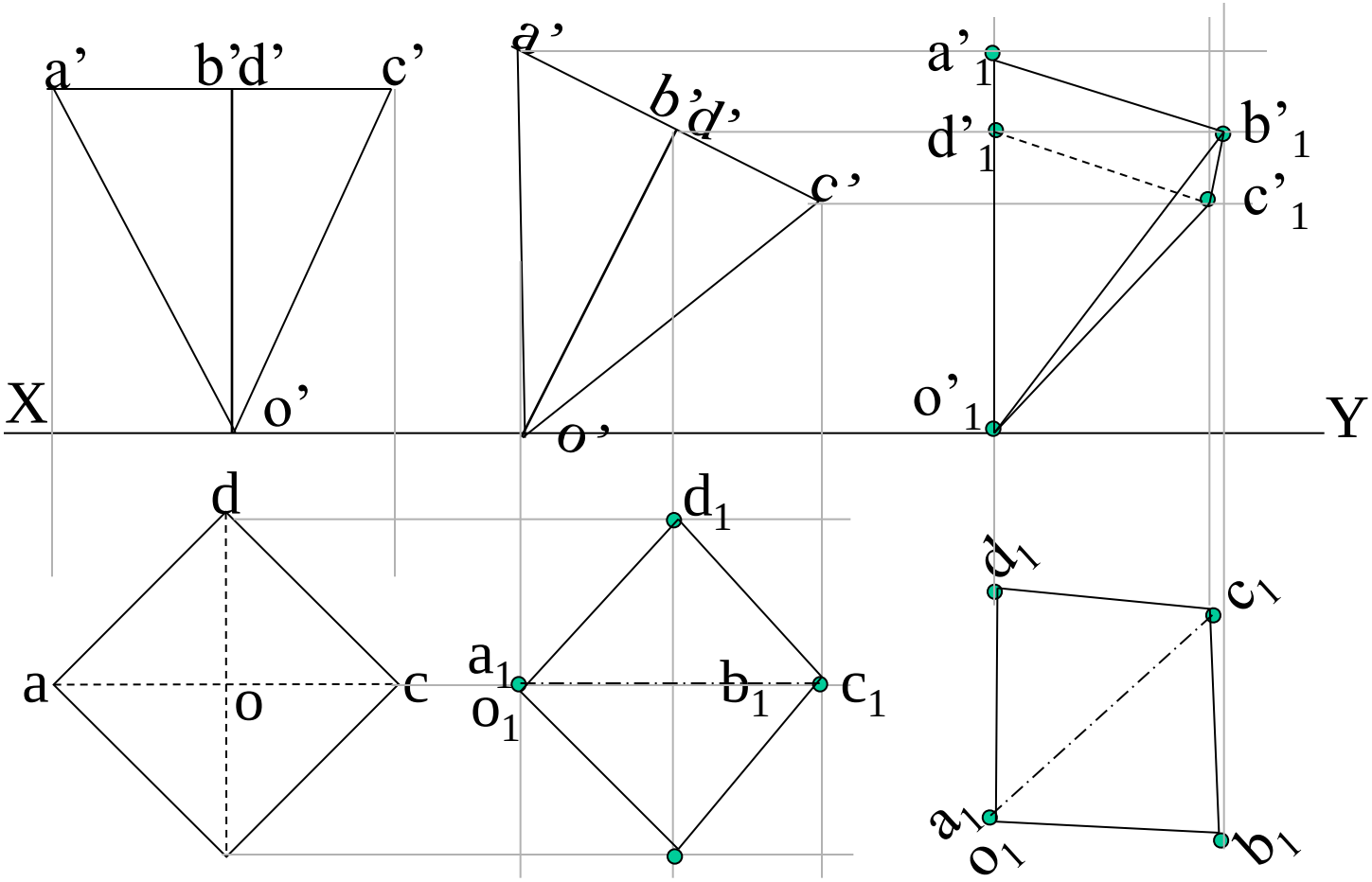
1. Assume it standing on Vp
2. It's Fv will show True Shape of base & top( circle )
3. Draw 40mm dia. Circle as Fv & taking 50 mm axis project Tv. ( a Rectangle)
4. Name all points as shown in illustration.
5. Draw 2nd Tv making axis $45^0$ to xy And project it's Fv above xy.
6. Make visible lines dark 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 4:** 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 :**

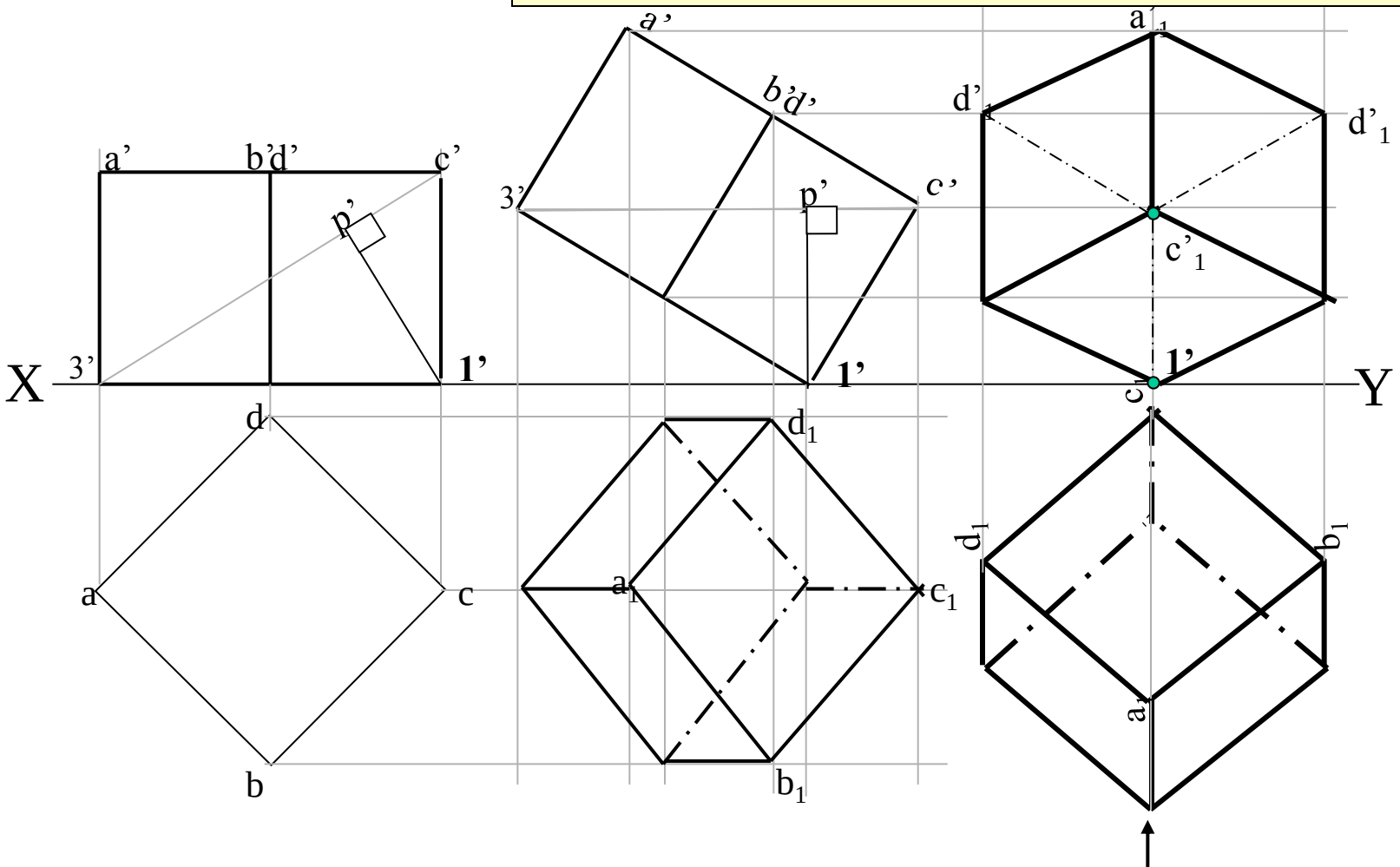
1. Assume it standing on Hp but as said on apex.( inverted ).
2. It's Tv will show True Shape of base( square)
3. Draw a corner case square of 30 mm sides as Tv(as shown) Showing all slant edges dotted, as those will not be visible from top.
4. taking 50 mm axis project Fv. ( a triangle)
5. Name all 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 5:** 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.

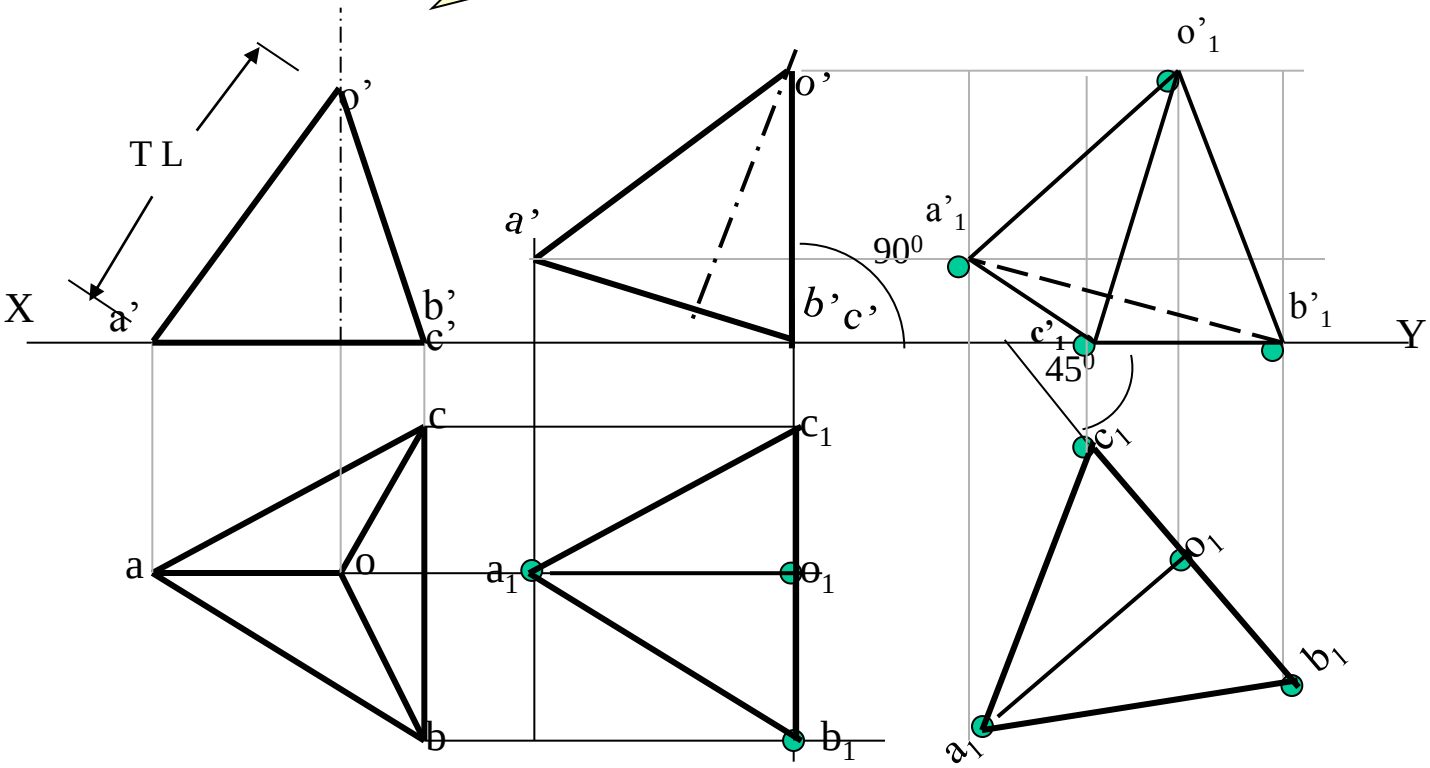


**Problem 6:** A tetrahedron of 50 mm long edges is resting on one edge on Hp while one triangular face containing this edge is vertical and $45^0$ inclined to Vp. Draw projections.

***IMPORTANT:***
***Tetrahedron is a special type of triangular pyramid in which base sides & slant edges are equal in length. Solid of four faces. Like cube it is also described by One dimension only.. Axis length generally not given.***

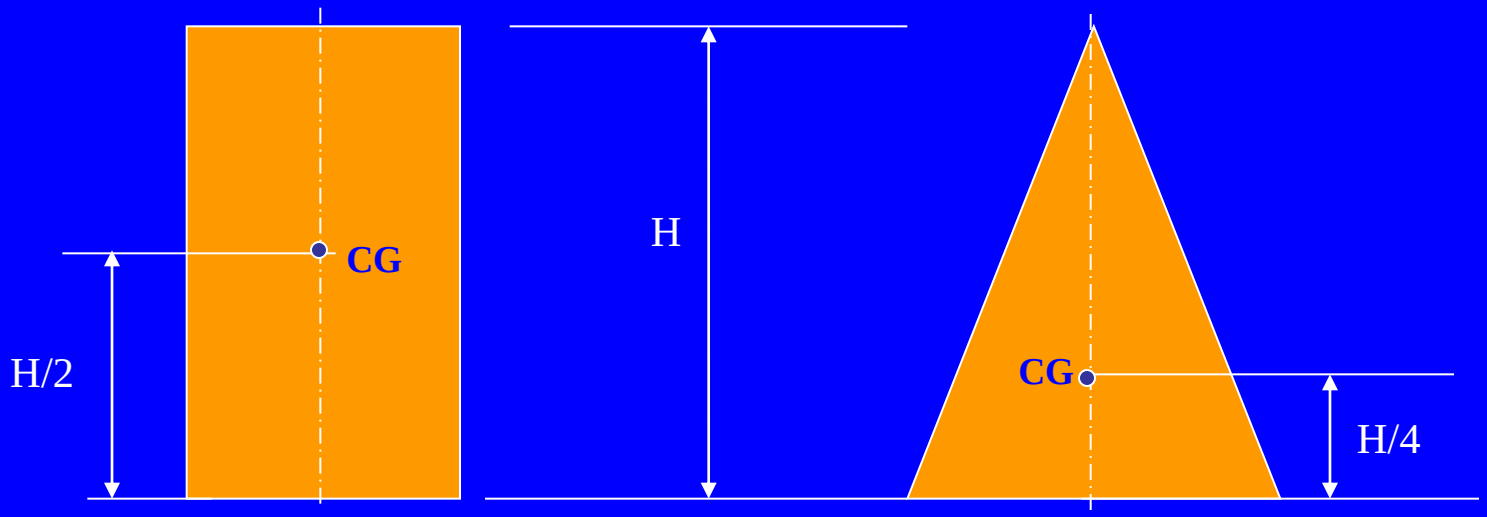
**Solution Steps**

**As it is resting assume it standing on Hp.**
**Begin with Tv , an equilateral triangle as side case as shown:**
**First project base points of Fv on xy, name those & axis line.**
**From a' with TL of edge, 50 mm, cut on axis line & mark o' (as axis is not known, o' is finalized by slant edge length)**
**Then complete Fv.**
**In 2nd Fv make face o'b'c' vertical as said in problem.**
**And like all previous problems solve completely.**



## FREELY SUSPENDED SOLIDS:

**Positions of CG, on axis, from base, for different solids are shown below.**




**GROUP A SOLIDS**
**( Cylinder & Prisms)**

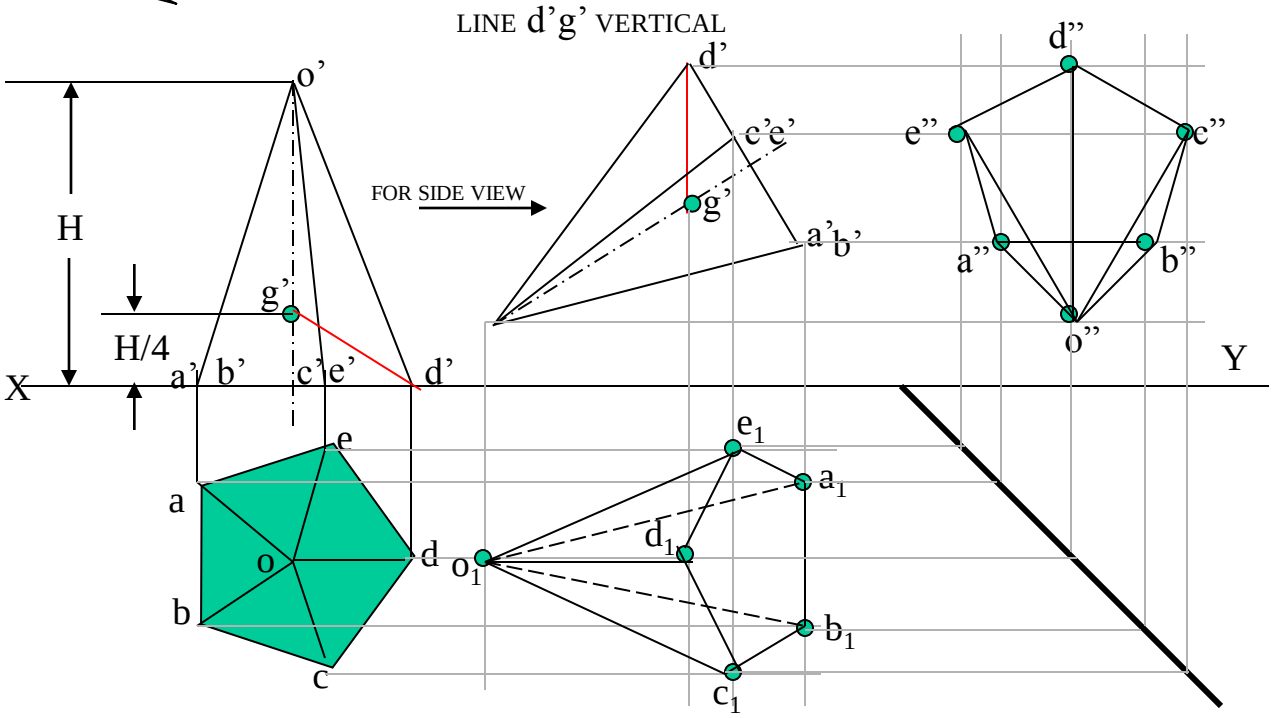
**GROUP B SOLIDS**
**( Cone & Pyramids)**

**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.)**

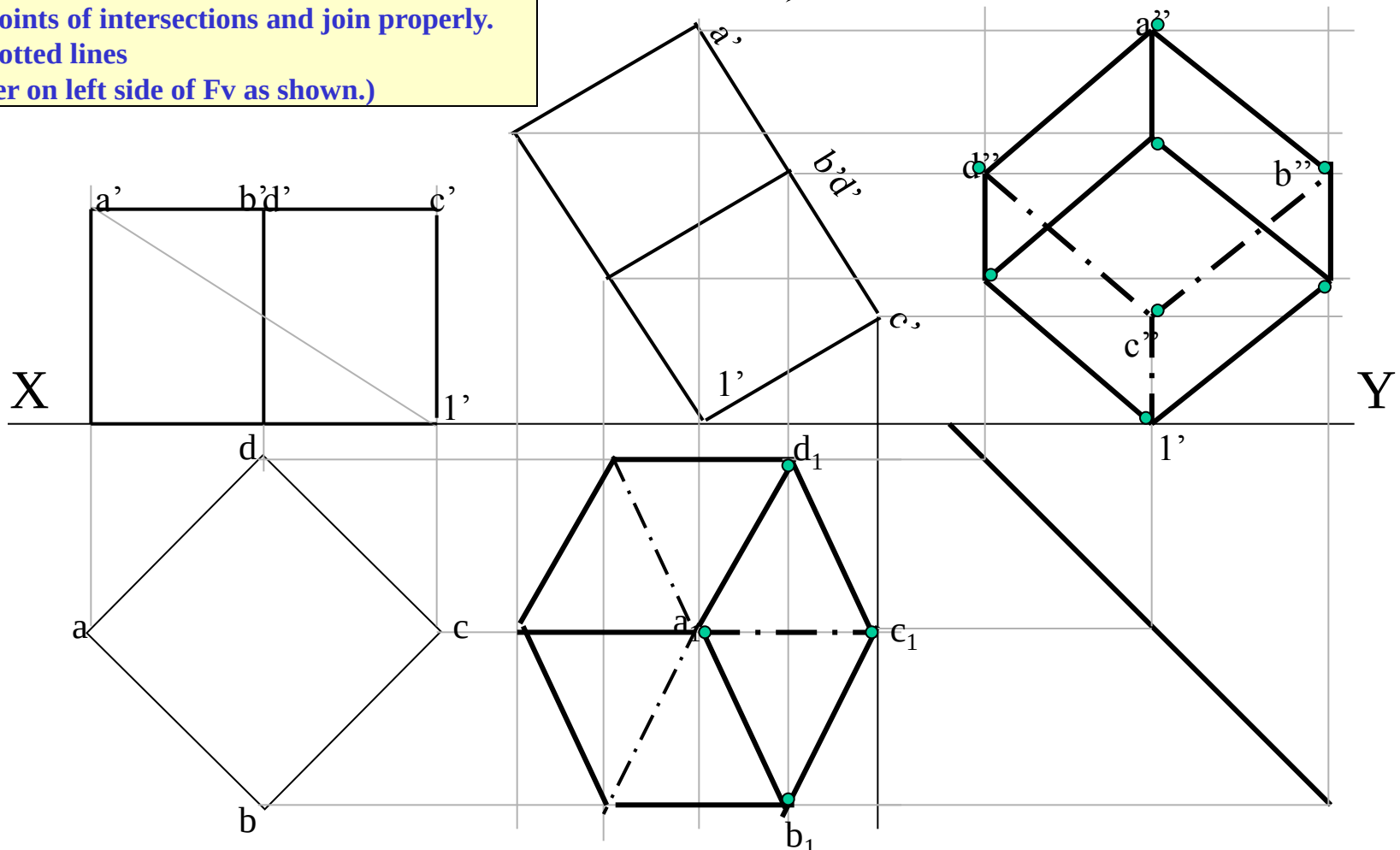
**Solution Steps:**

1.Assuming it standing on Hp begin with Tv, a square of corner case.
2.Project corresponding Fv.& name all points as usual in both views.
3.Join a'1' as body diagonal and draw 2nd Fv making it vertical (I' on xy)
4.Project it's Tv drawing dark and dotted lines as per the procedure.
5.With standard method construct Left-hand side view.

**( Draw a $45^0$ inclined Line in Tv region ( below xy). Project horizontally all points of Tv on this line and reflect vertically upward, above xy.After this, draw horizontal lines, from all points of Fv, to meet these lines. Name points of intersections and join properly. For dark & dotted lines locate observer on left side of Fv as shown.)**

**Problem 8:**

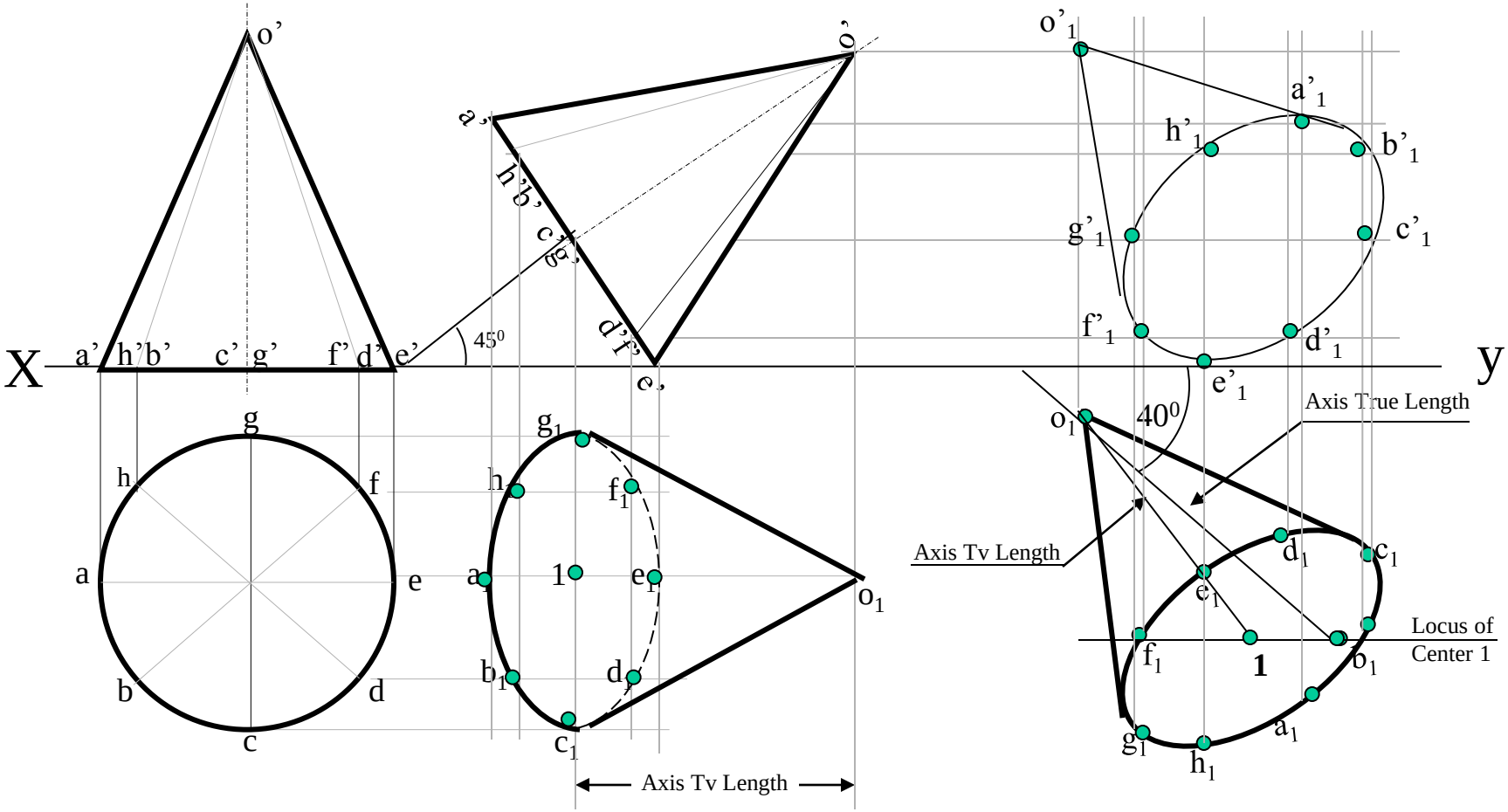
**A cube of 50 mm long edges is so placed on Hp on one corner that a body diagonal through this corner is perpendicular to Hp and parallel to Vp Draw it's three views.**



**Problem 9:** A right circular cone, 40 mm base diameter and 60 mm long axis is resting on Hp on one point of base circle such that it's axis makes $45^0$ inclination with Hp and $40^0$ inclination with Vp. Draw it's projections.

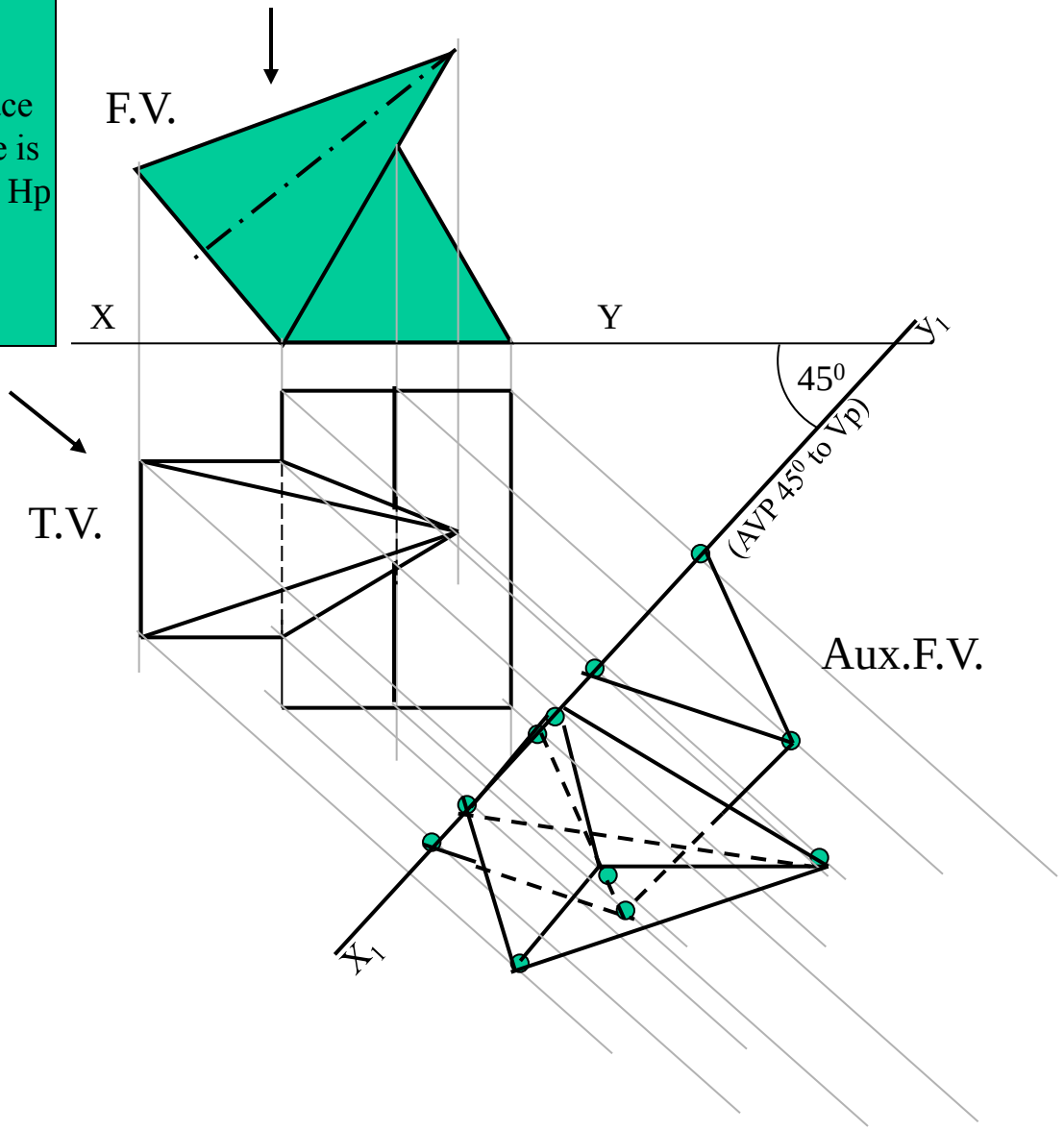
This case resembles to **problem no.7 & 9 from projections of planes** topic. In previous all cases 2nd inclination was done by a parameter not showing TL.Like Tv of axis is inclined to Vp etc. But here it is clearly said that the axis is $40^0$ inclined to Vp. Means here TL inclination is expected. So the same construction done in those Problems is done here also. See carefully the final Tv and inclination taken there.

***So assuming it standing on HP begin as usual.***



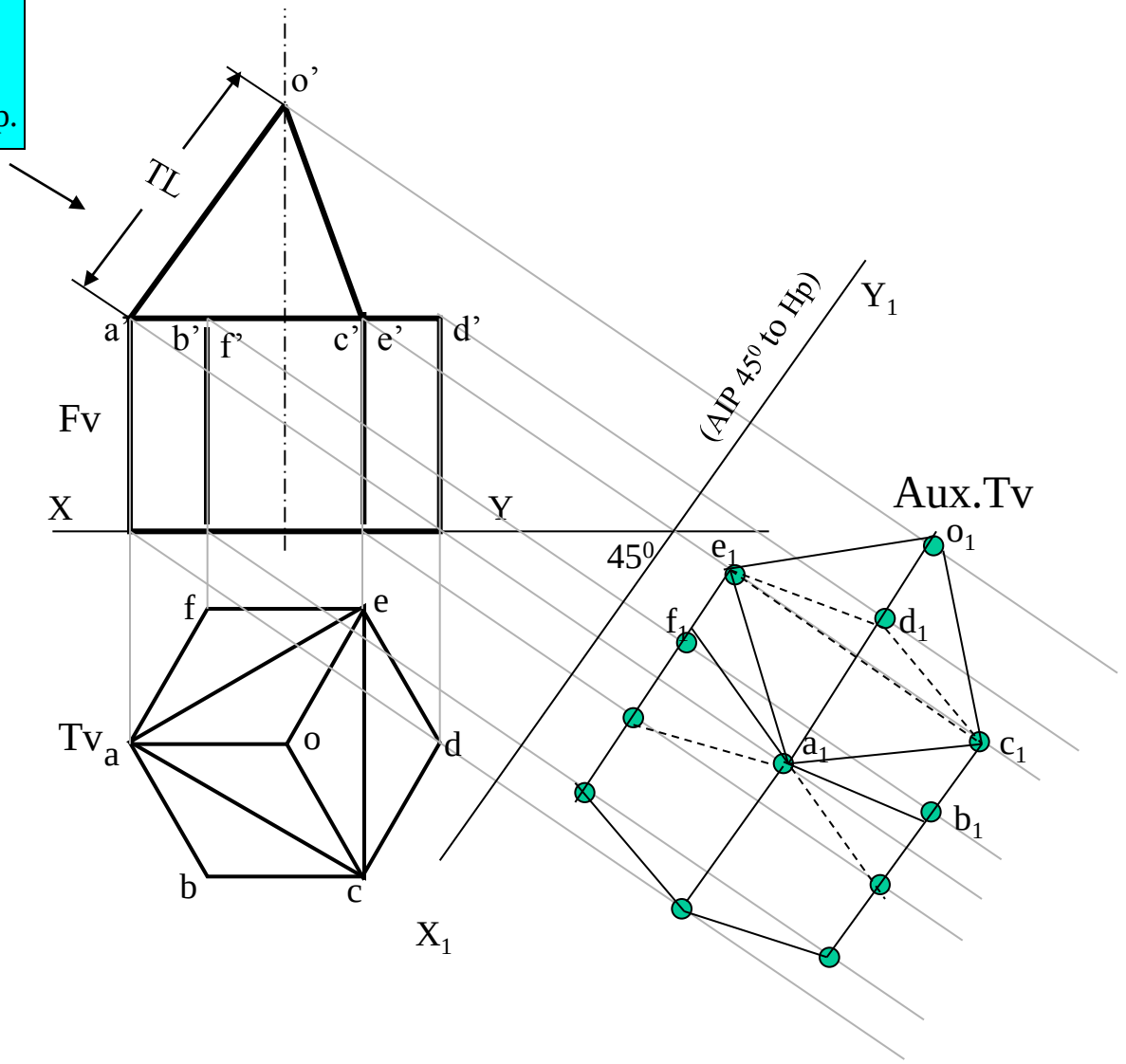
**Problem 10:** A triangular prism, 40 mm base side 60 mm axis is lying on Hp on one rectangular face with axis perpendicular to Vp. One square pyramid is leaning on it's face centrally with axis // to vp. It's base side is 30 mm & axis is 60 mm long resting on Hp on one edge of base.Draw FV & TV of both solids.Project another FV on an AVP $45^0$ inclined to VP.

Steps :
Draw Fv of lying prism ( an equilateral Triangle)
And Fv of a leaning pyramid.
Project Tv of both solids.
Draw $x_1y_1$ $45^0$ inclined to xy and project aux.Fv on it.
Mark the distances of first FV from first xy for the distances of aux. Fv from $x_1y_1$ line.
Note the observer's directions Shown by arrows and further steps carefully.



**Problem 11:** A hexagonal prism of base side 30 mm longand axis 40 mm long, is standing on Hp on it's base with one base edge // to Vp.
A tetrahedron is placed centrally on the top of it.The base of tetrahedron is a triangle formed by joining alternate corners of top of prism..Draw projections of both solids.
Project an auxiliary Tv on AIP $45^0$ inclined to Hp.

STEPS:
Draw a regular hexagon as Tv of standing prism With one side // to xy and name the top points.Project it's Fv – a rectangle and name it's top.
Now join it's alternate corners a-c-e and the triangle formed is base of a tetrahedron as said.
Locate center of this triangle & locate apex o
Extending it's axis line upward mark apex o'
By cutting TL of edge of tetrahedron equal to a-c. and complete Fv of tetrahedron.
Draw an AIP ( x1y1) $45^0$ inclined to xy
And project Aux.Tv on it by using similar Steps like previous problem.



**Problem 12:** A frustum of regular hexagonal pyramid 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.