Projection of Solids

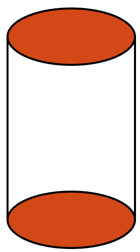
Engineering Graphics and Drafting

SOLIDS

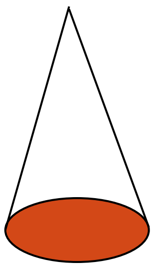
To understand and remember various solids in this subject properly, those are classified & arranged in to two major groups.

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

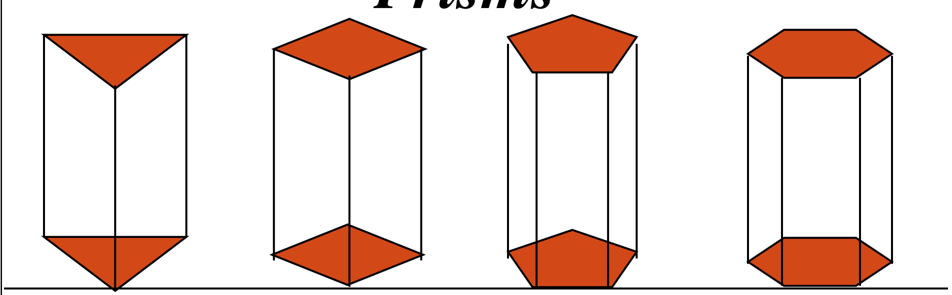
Cylinder



Cone

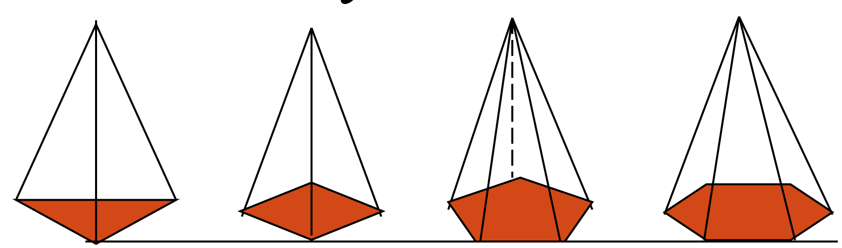


Prisms



Triangular   Square   Pentagonal   Hexagonal

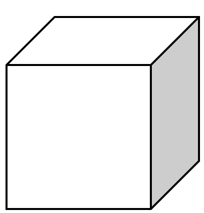
Pyramids



Triangular   Square   Pentagonal   Hexagonal

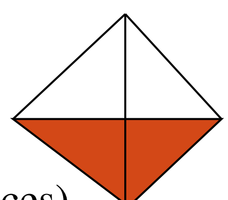
Cube

(A solid having six square faces)

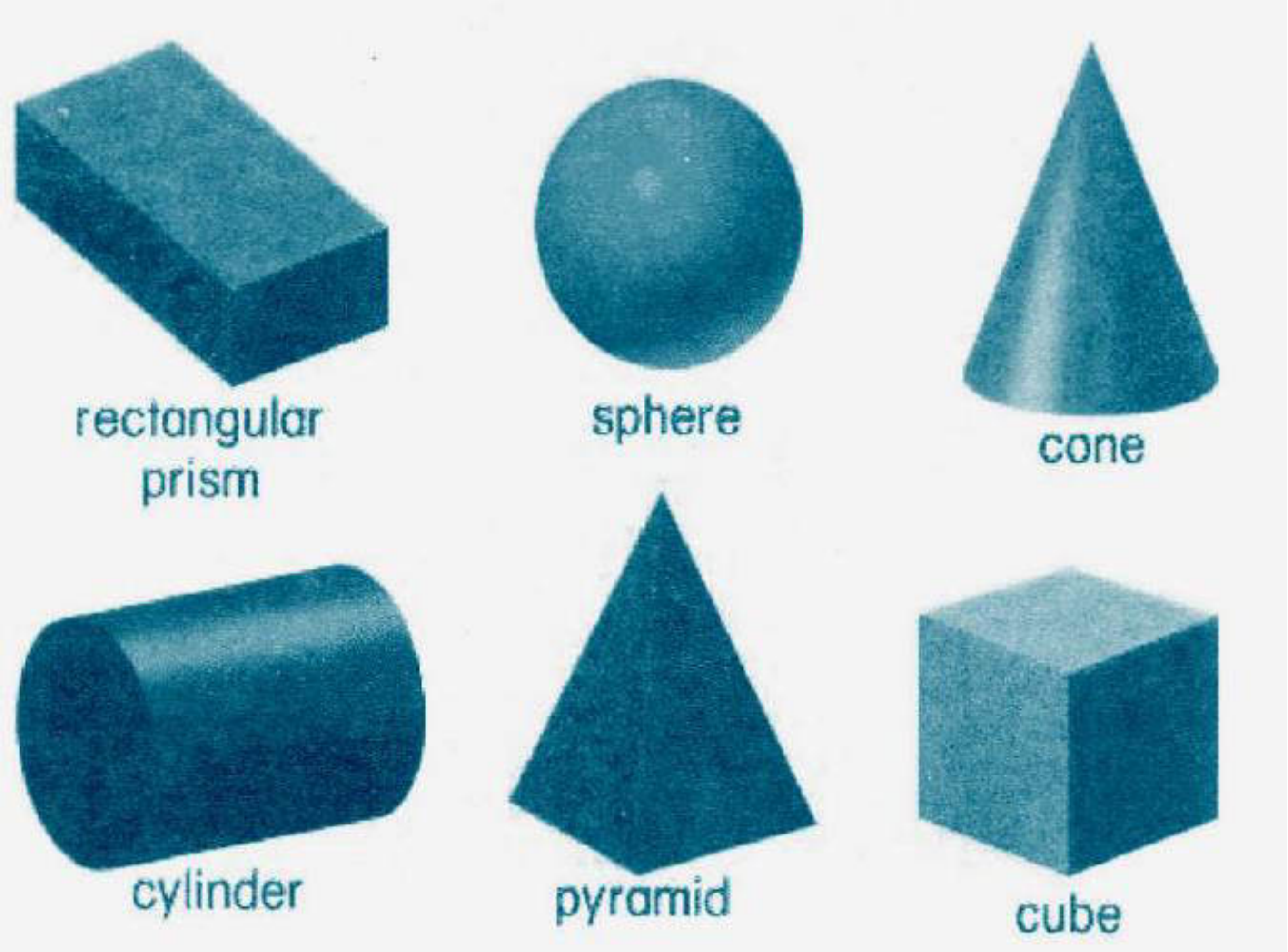


Tetrahedron

(A solid having Four triangular faces)



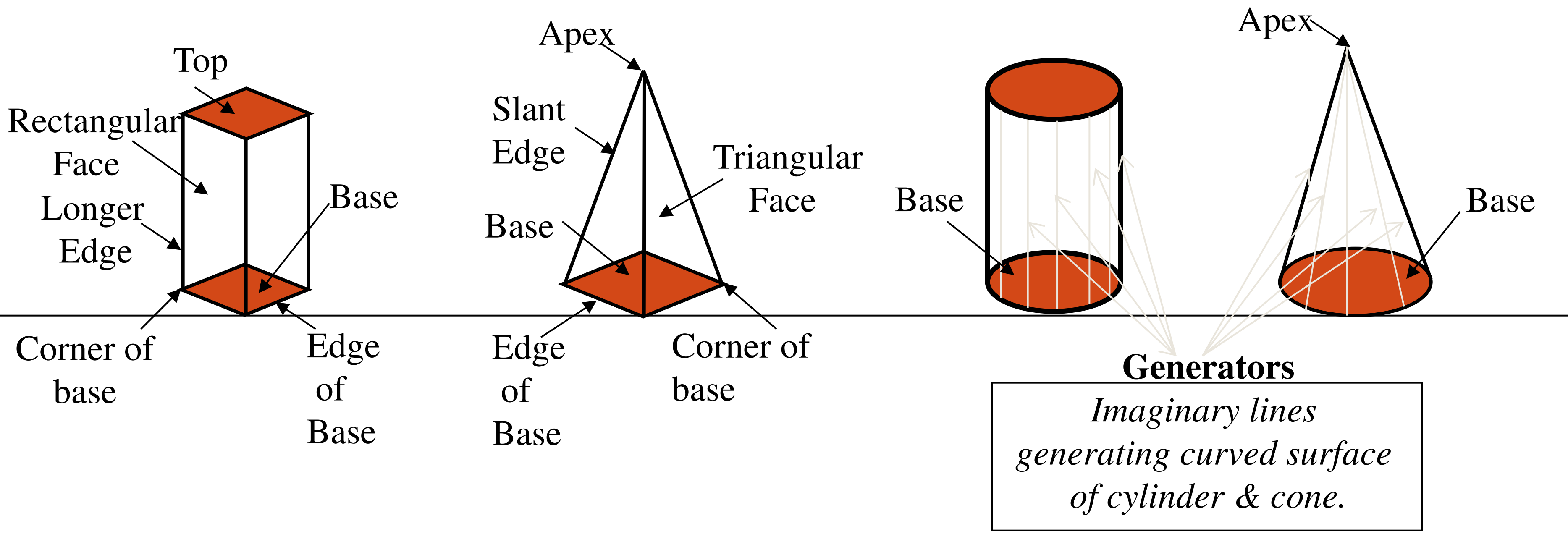
TYPES OF SOLID

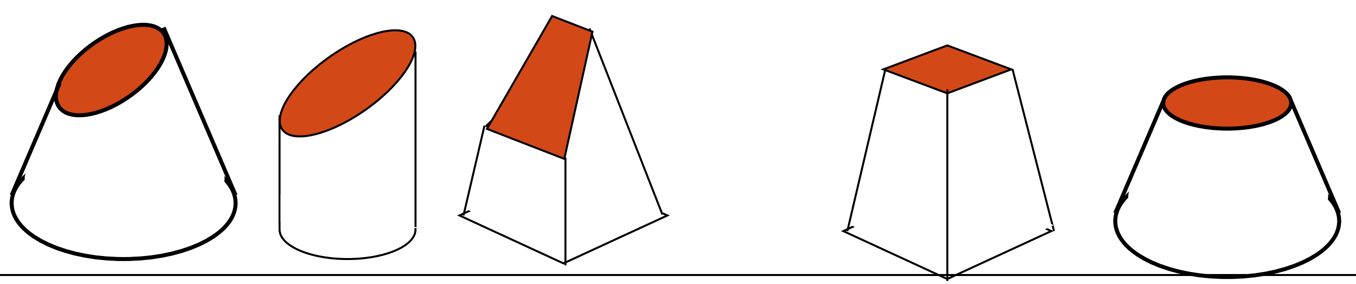


SOLIDS

Dimensional parameters of different solids.

Square Prism **Square Pyramid** **Cylinder** **Cone**





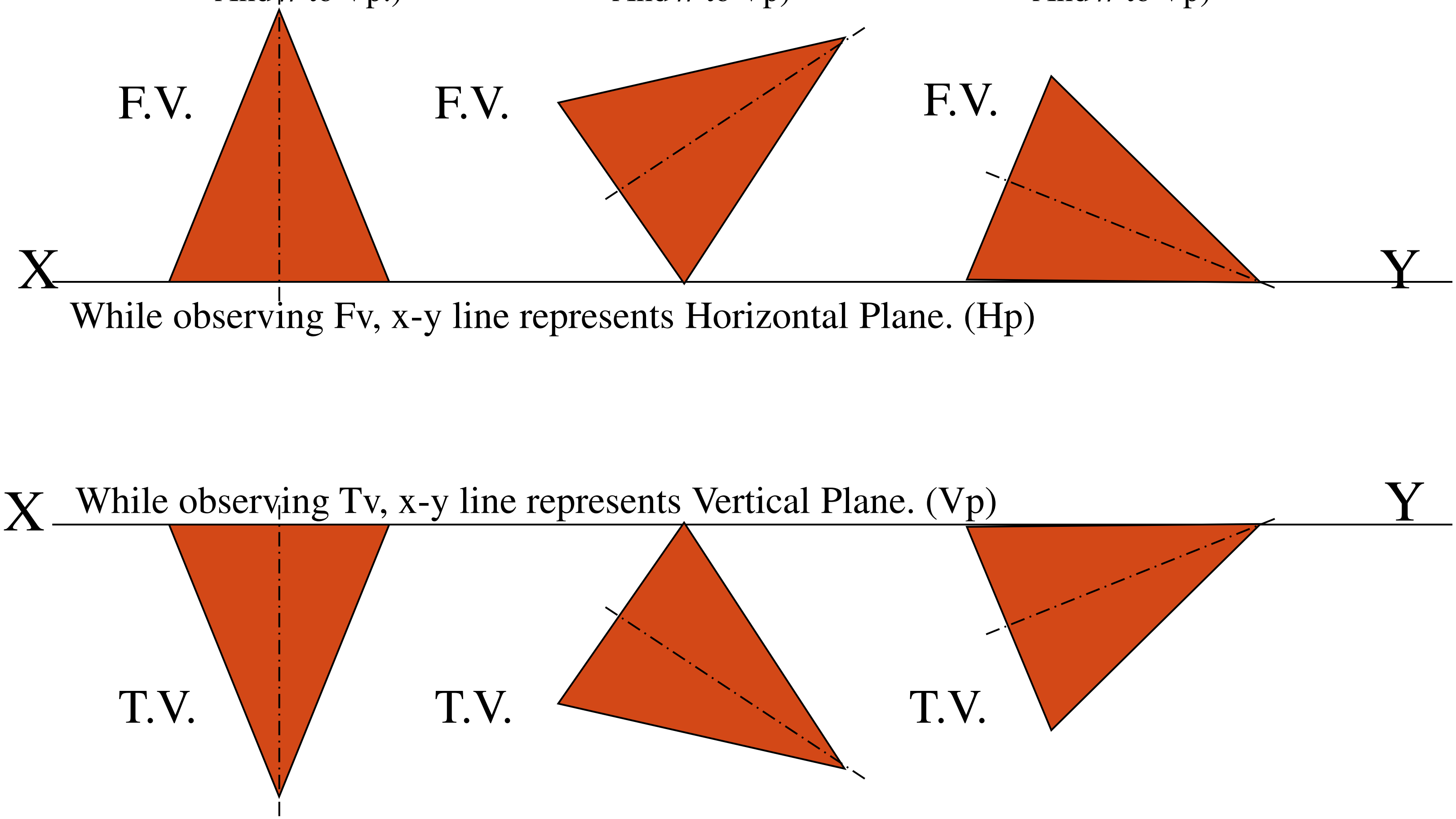
Sections of solids(top & base not parallel)

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)



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:

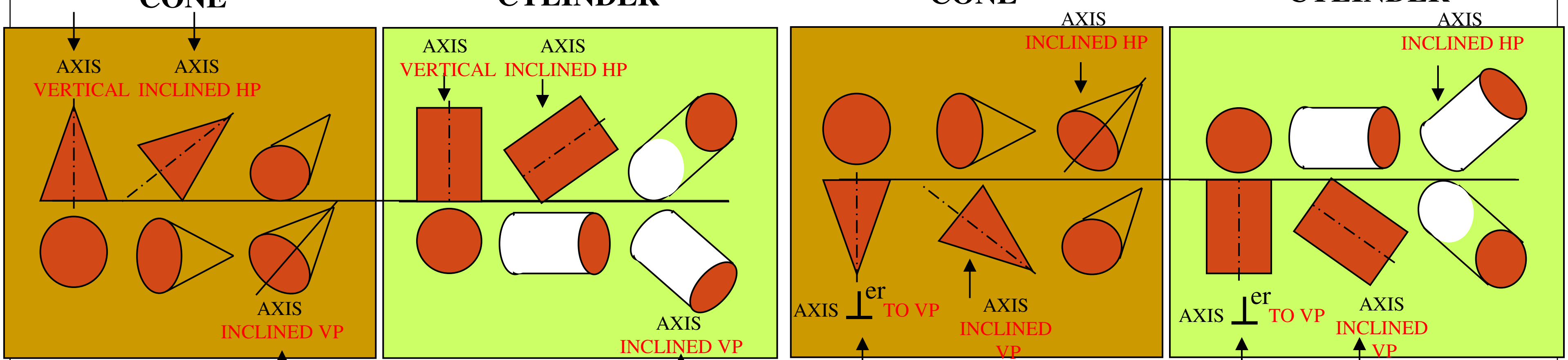
STEP 1: ASSUME SOLID STANDING ON THE PLANE WITH WHICH IT IS MAKING INCLINATION.
(IF IT IS INCLINED TO HP, ASSUME IT STANDING ON HP)
(IF IT IS INCLINED TO VP, ASSUME IT STANDING ON VP)
IF STANDING ON HP - IT'S TV WILL BE TRUE SHAPE OF IT'S BASE OR TOP:
IF STANDING ON VP - IT'S FV WILL BE TRUE SHAPE OF 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	GROUP A SOLID. CYLINDER	GROUP B SOLID. CONE	GROUP A SOLID. CYLINDER



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

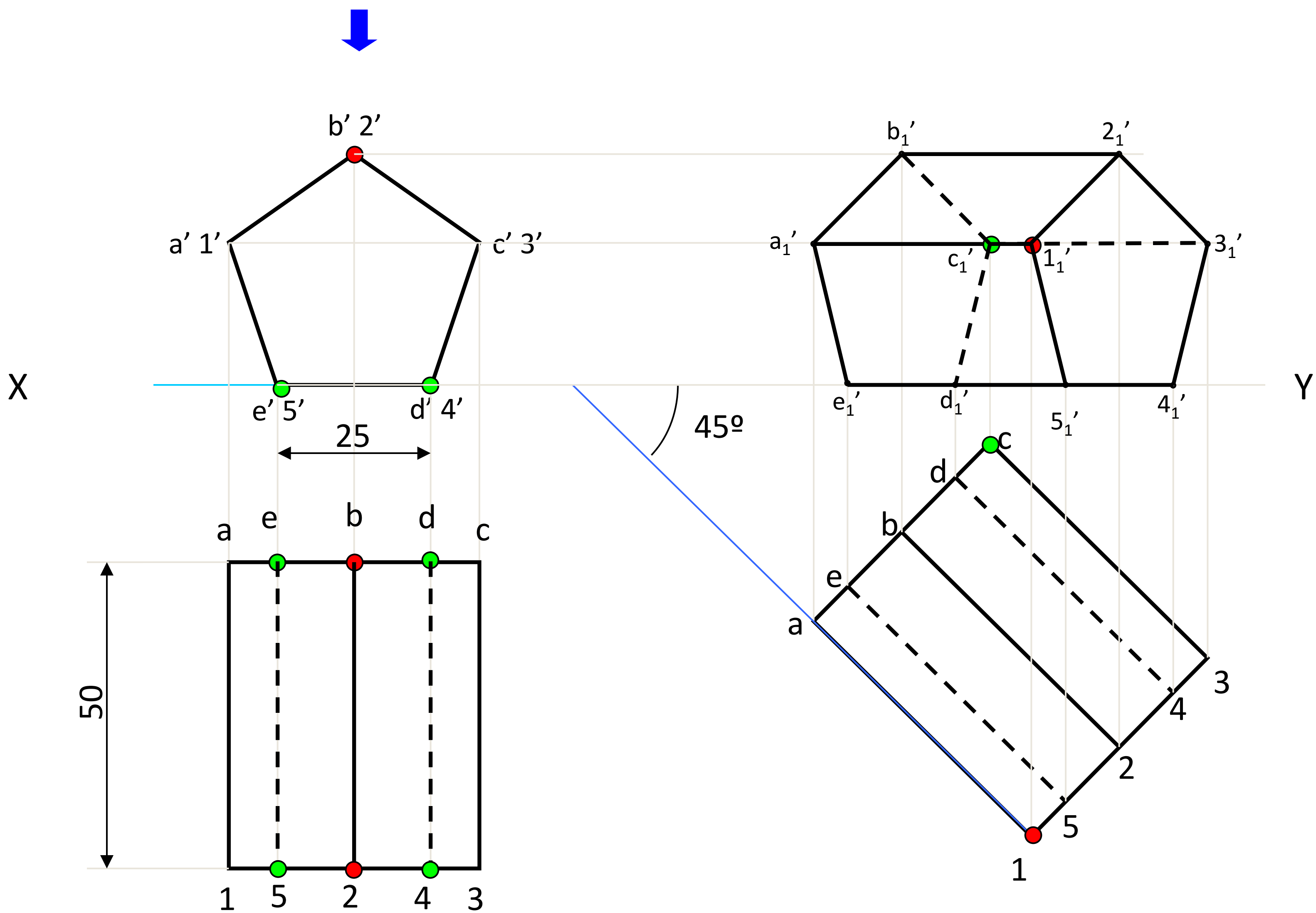
Study Next *Twelve* Problems and Practice them separately !!

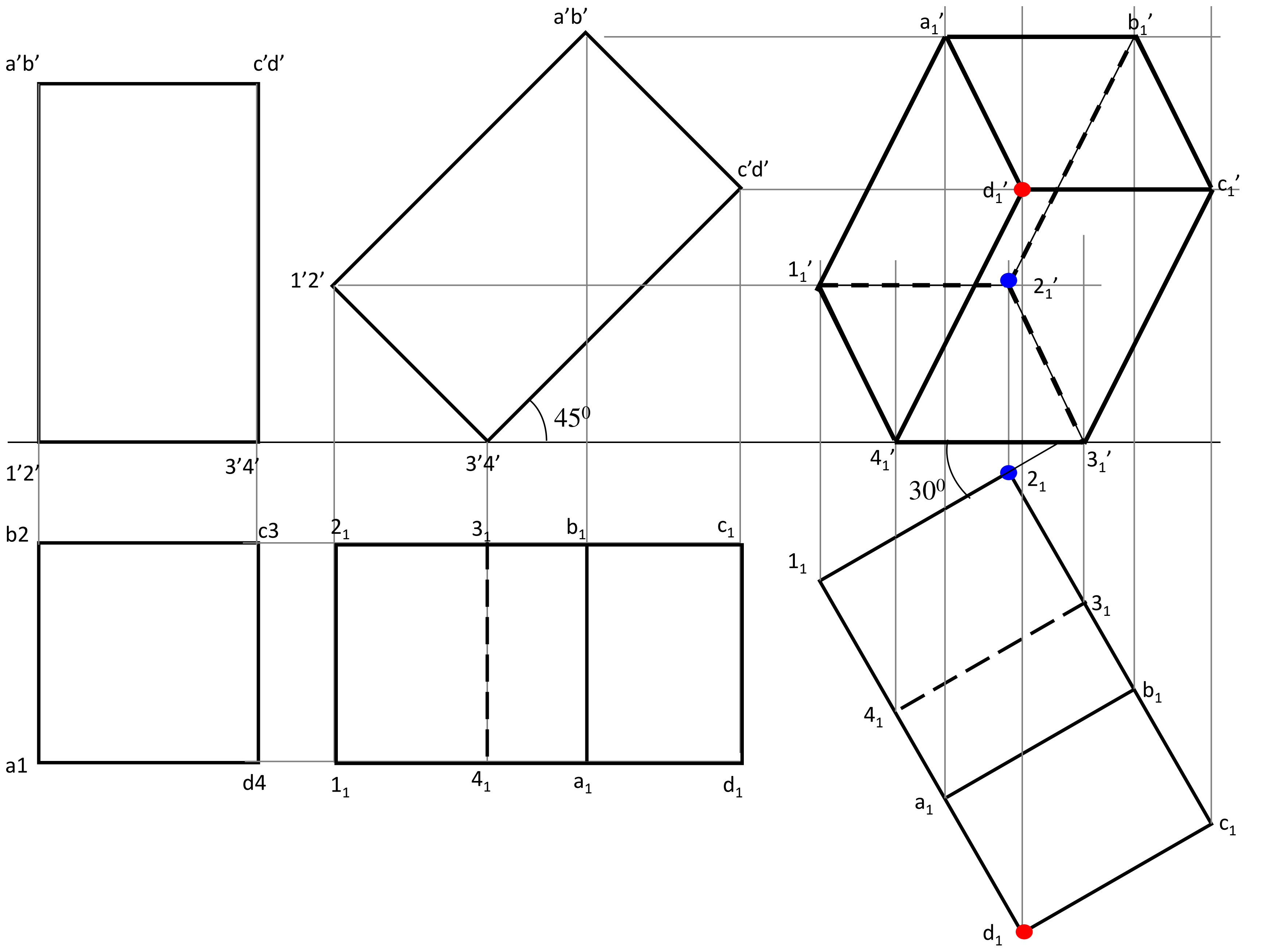
CATEGORIES OF ILLUSTRATED PROBLEMS!

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)

Q 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.

As the 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



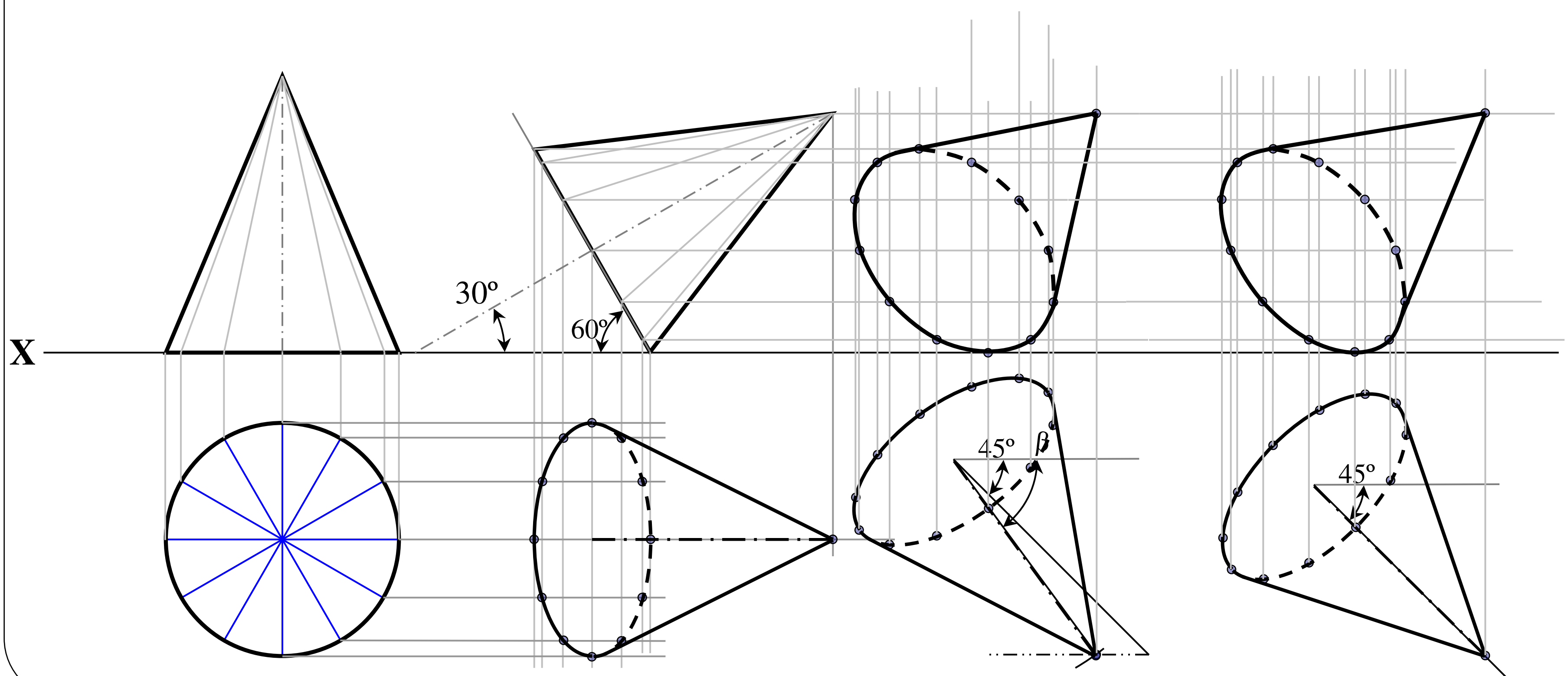


a'b'
c'd'
1'2'
3'4'
a'b'
c'd'
1'2'
3'4'
45⁰
a_1'
b_1'
d_1'
c_1'
$1_1'$
$2_1'$
$4_1'$
$3_1'$
30⁰
2_1
b2
c3
a1
d4
2_1
3_1
b_1
c_1
1_1
4_1
a_1
d_1
1_1
3_1
4_1
b_1
a_1
c_1
d_1

Problem 13.19: Draw the projections of a cone, base 45 mm diameter and axis 50 mm long, when it is resting on the ground on a point on its base circle with **(a)** the axis making an angle of 30º with the HP and 45º with the VP **(b)** the axis making an angle of 30º with the HP and its top view making 45º with the VP

Steps

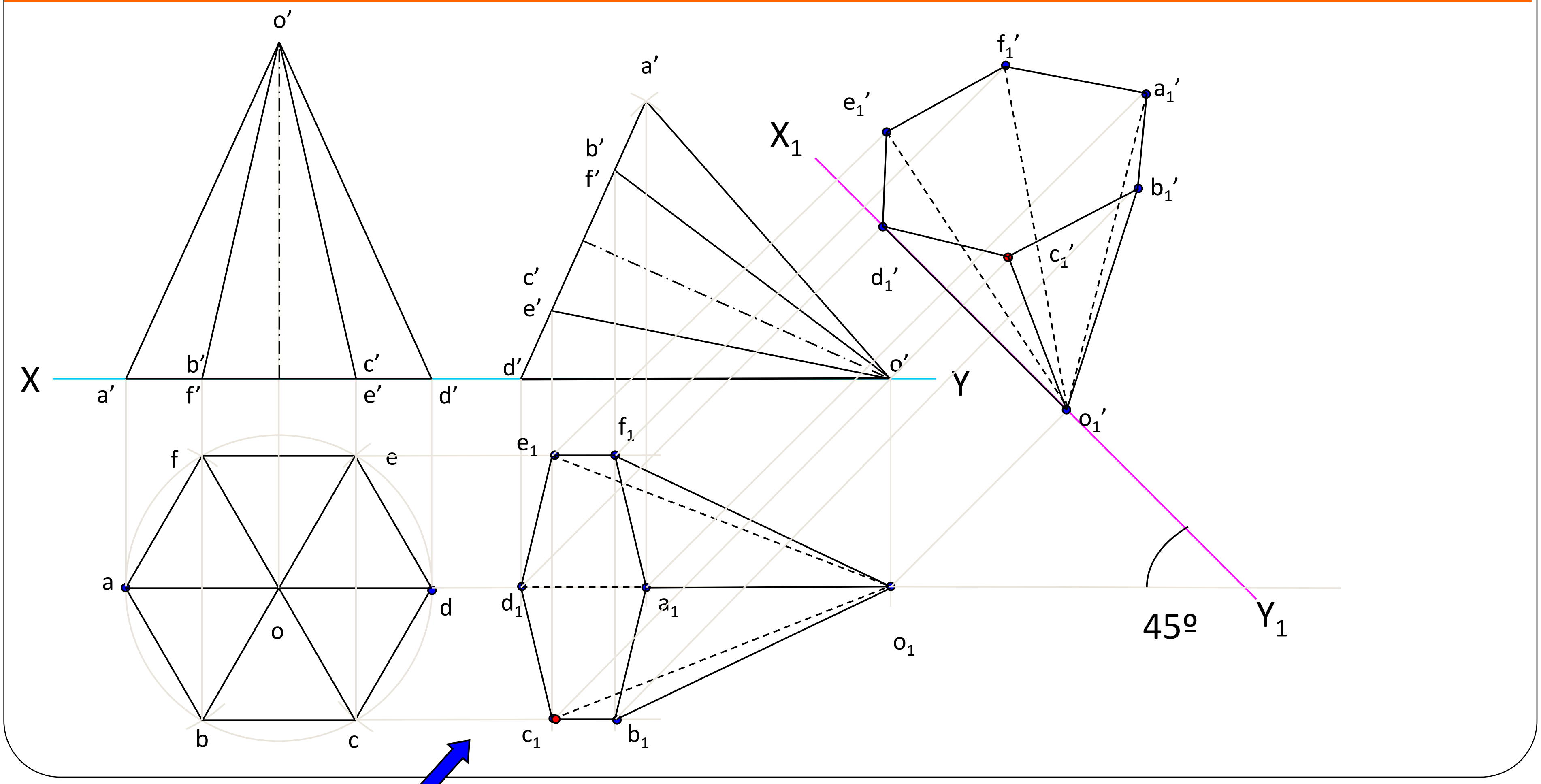
(1) Draw the TV & FV of the cone assuming its base on the HP
(2) To incline axis at 30º with the HP, incline the base at 60º with HP and draw the FV and then the TV.
(3) For part (a), to find β, draw a line at 45° with XY in the TV, of 50 mm length. Draw the locus of the end of axis. Then cut an arc of length equal to TV of the axis when it is inclined at 30º with HP. Then redraw the TV, keeping the axis at new position. Then draw the new FV
(4) For part (b), draw a line at 45° with XY in the TV. Then redraw the TV, keeping the axis at new position. Again draw the FV.



Q13.22: A hexagonal pyramid base 25 mm side and axis 55 mm long has one of its slant edge on the ground. A plane containing that edge and the axis is perpendicular to the H.P. and inclined at 45º to the V.P. Draw its projections when the apex is nearer to the V.P. than the base.

The inclination of the axis is given indirectly in this problem. When the slant edge of a pyramid rests on the HP its axis is inclined with the HP so while deciding first view the axis of the solid must be kept perpendicular to HP i.e. true shape of the base will be seen in the TV. Secondly when drawing hexagon in the TV we have to keep the corners at the extreme ends.

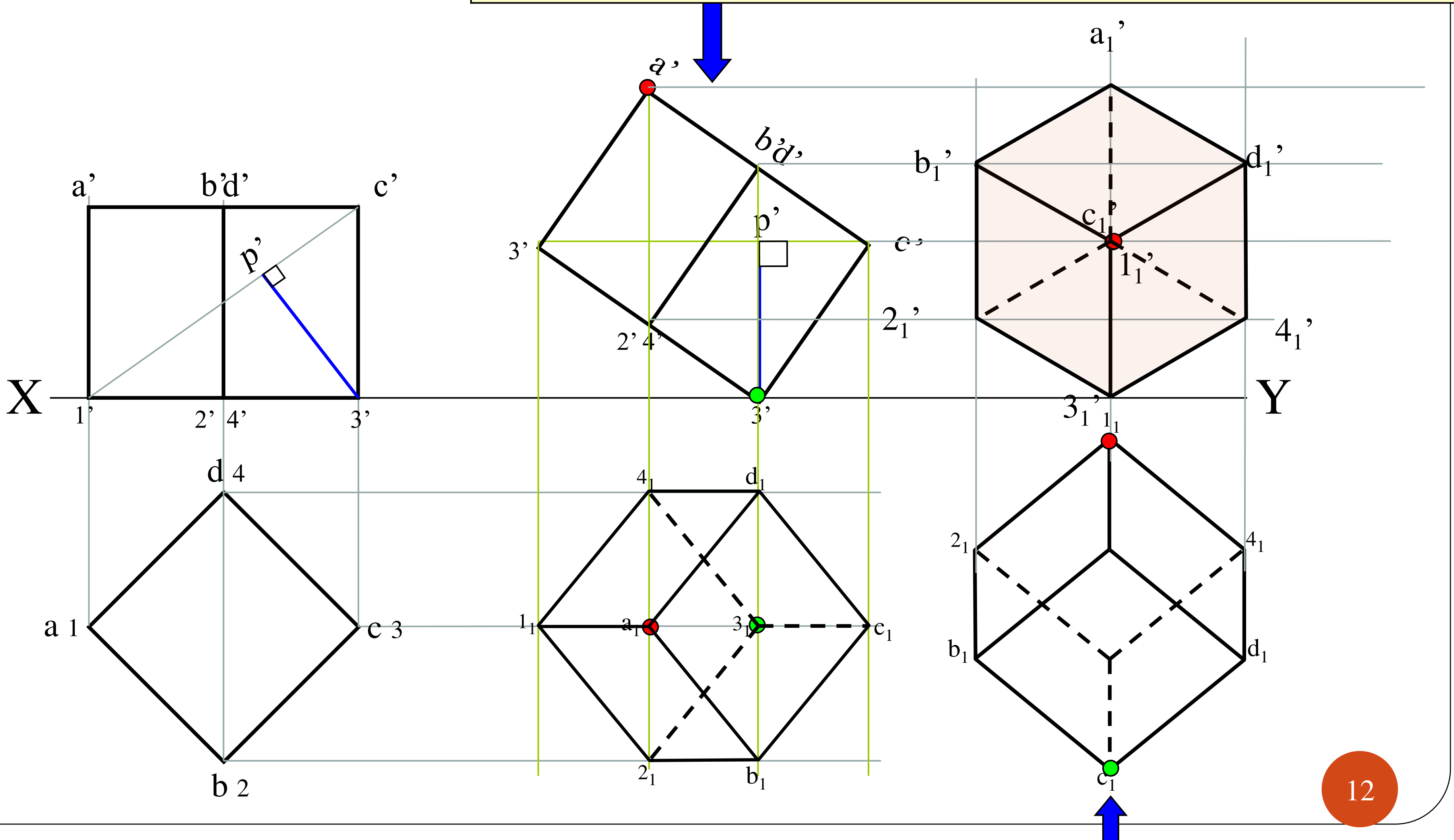
The vertical plane containing the slant edge on the HP and the axis is seen in the TV as o_1d_1 for drawing auxiliary FV draw an auxiliary plane X_1Y_1 at 45º from d_1o_1 extended. Then draw projectors from each point i.e. a_1 to f_1 perpendicular to X_1Y_1 and mark the points measuring their distances in the FV from old XY line.



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 1'(This can become // to xy)
3.From 3' drop a perpendicular on this and name it p'
4.Draw 2nd Fv in which 3'p' line is vertical *means* c'-1' 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.

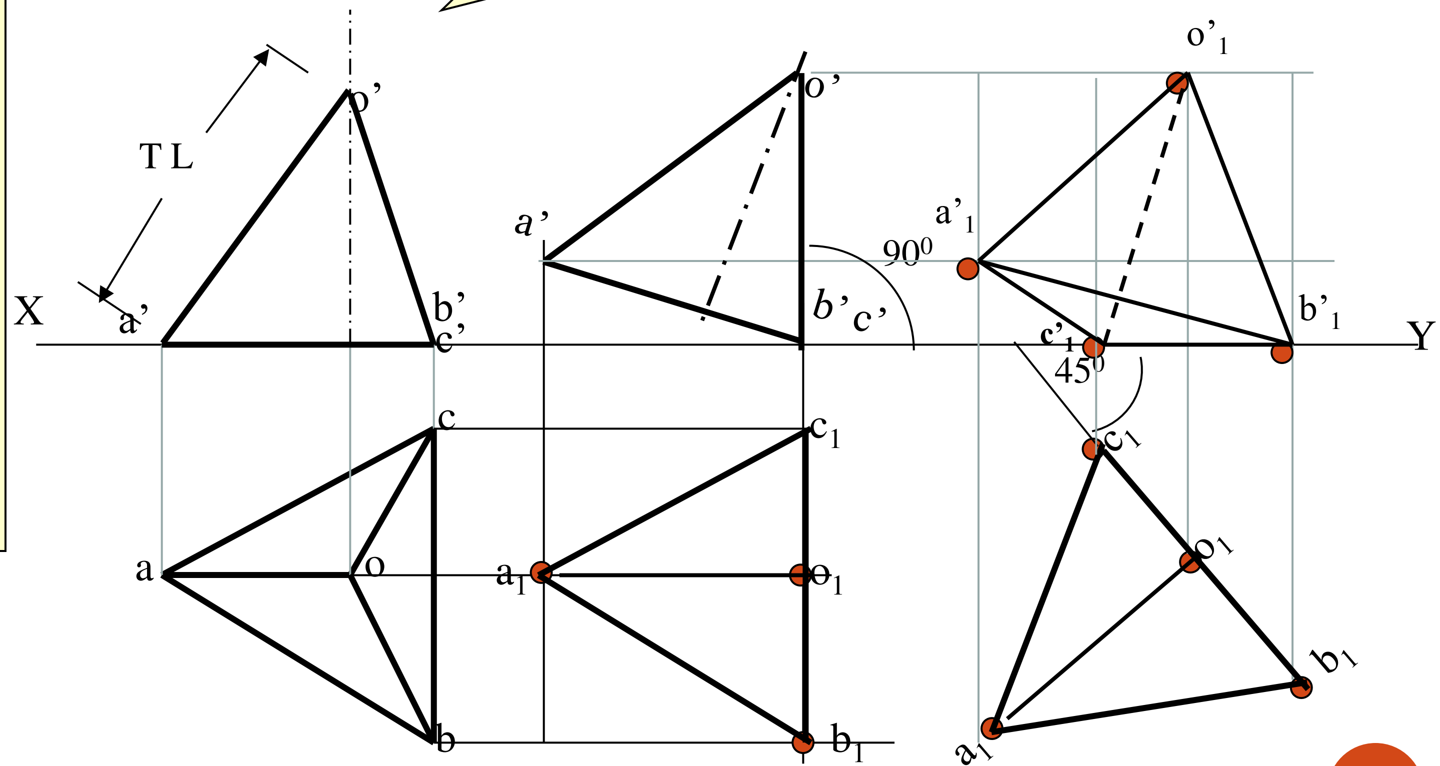


Problem 6: A tetrahedron of 50 mm long edges is resting on one edge on Hp while one triangular face containing this edge is vertical and 45^0 inclined to Vp. Draw projections.

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.



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)

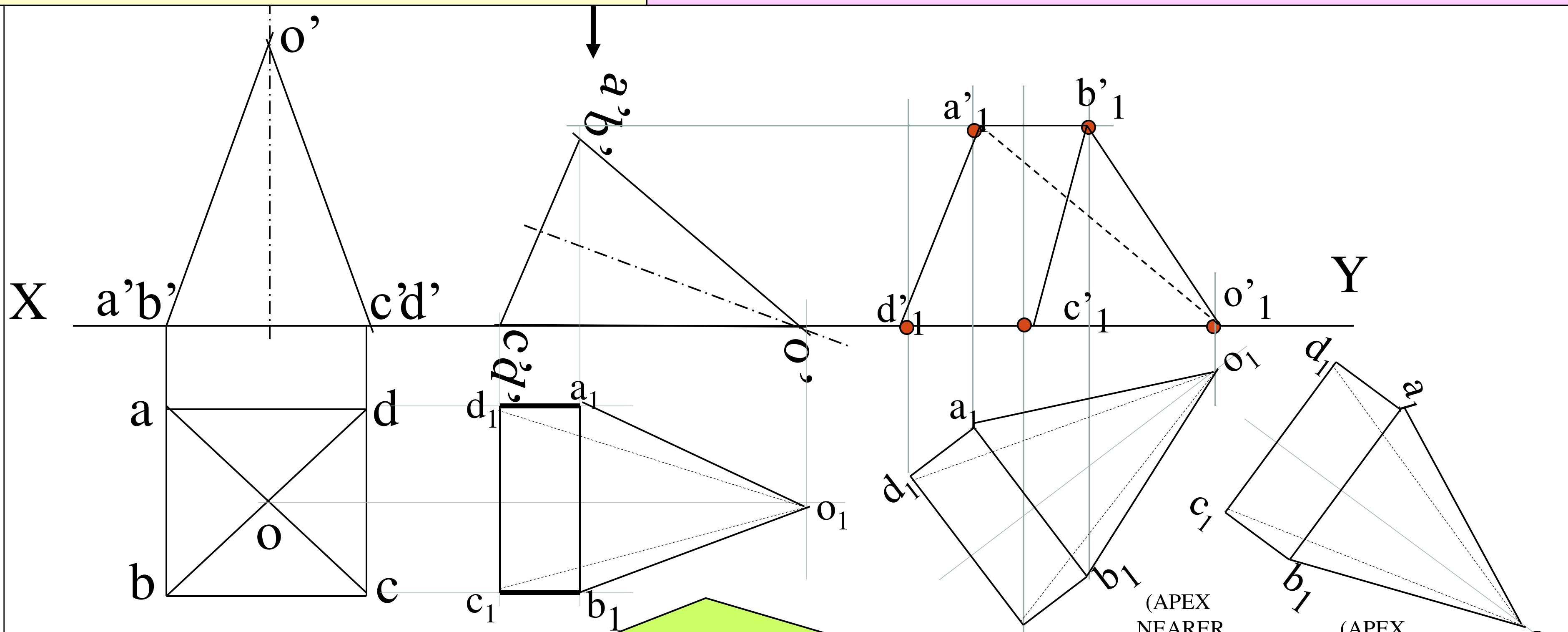
3.Draw square of 40mm sides with one side vertical Tv & taking 50 mm axis project Fv. (a triangle)

4.Name all points as shown in illustration.

5.Draw 2^{nd} 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 2^{nd} 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.

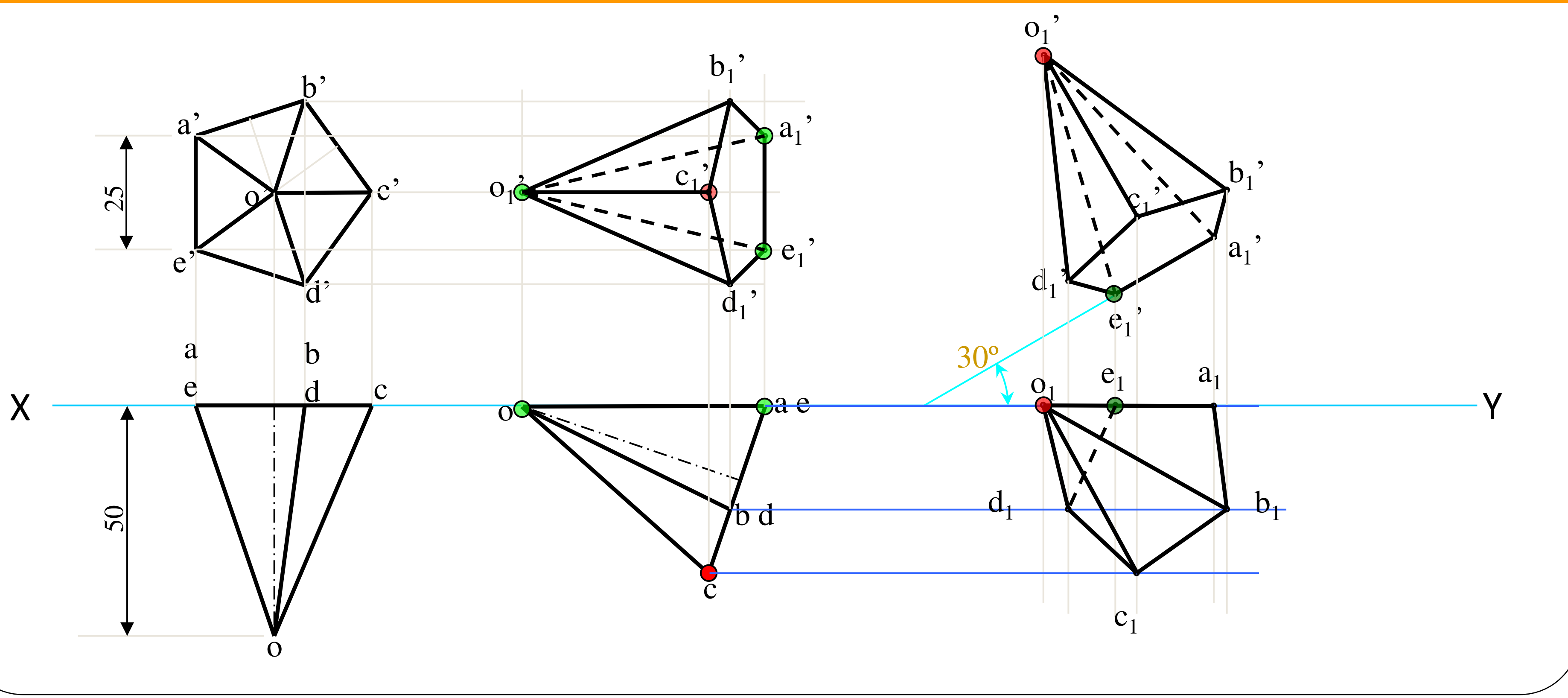
4. Select farthest point to observer and draw all lines (remaining)from it- dotted.

Problem 13.20: A pentagonal pyramid base 25 mm side and axis 50 mm long has one of its triangular faces in the VP and the edge of the base contained by that face makes an angle of 30º with the HP. Draw its projections.

Step 1. Here the inclination of the axis is given indirectly. As one triangular face of the pyramid is in the VP its axis will be inclined with the VP. So for drawing the first view keep the axis perpendicular to the VP. So the true shape of the base will be seen in the FV. Secondly when drawing true shape of the base in the FV, one edge of the base (which is to be inclined with the HP) must be kept perpendicular to the HP.

Step 2. In the TV side aeo represents a triangular face. So for drawing the TV in the second stage, keep that face on XY so that the triangular face will lie on the VP and reproduce the TV. Then draw the new FV with help of TV

Step 3. Now the edge of the base $a_1'e_1'$ which is perpendicular to the HP must be in clined at 30º to the HP. That is incline the FV till a1'e1' is inclined at 30º with the HP. Then draw the TV.



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.

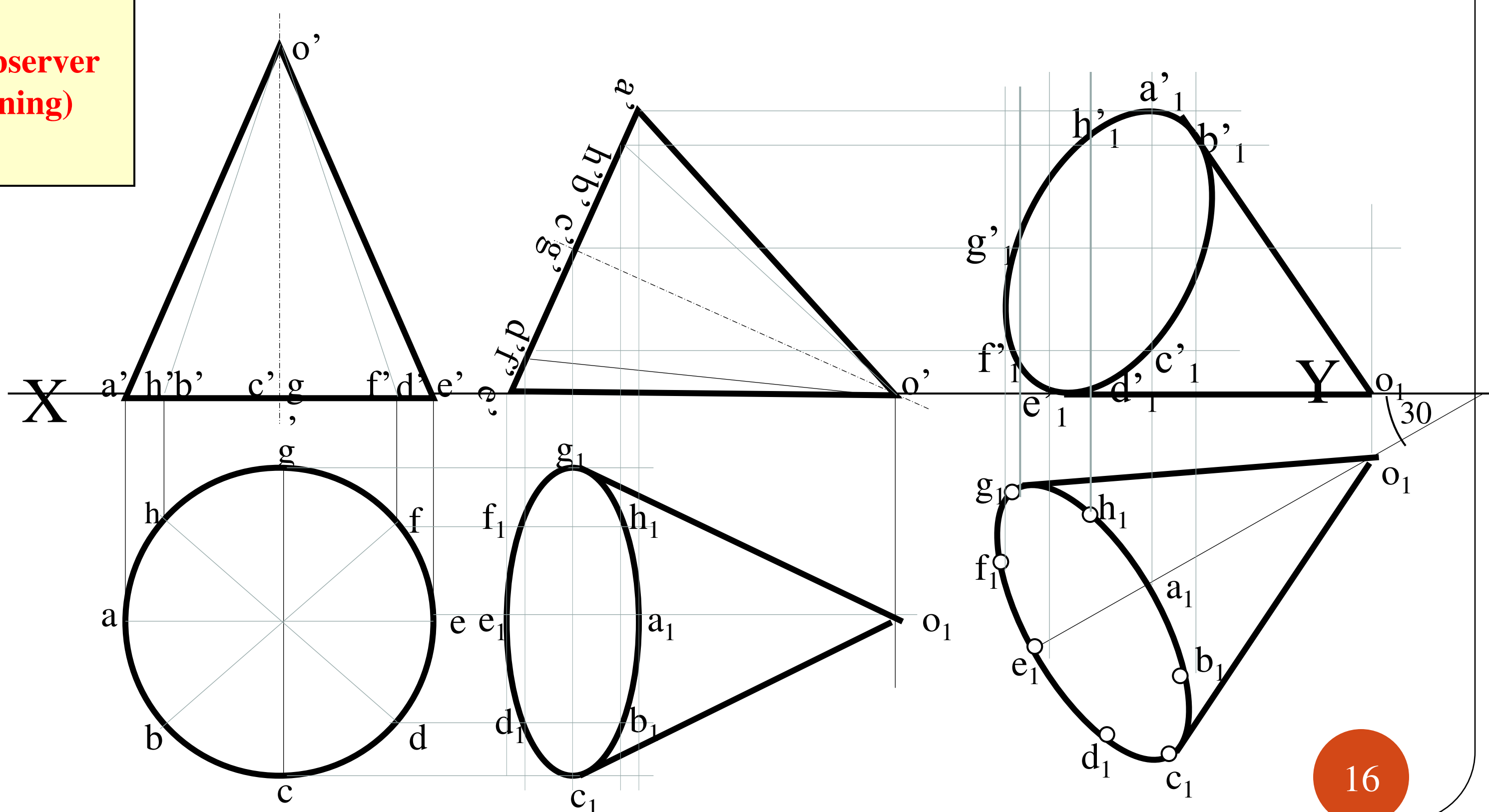
For dark and dotted lines

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 2^{nd} 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)

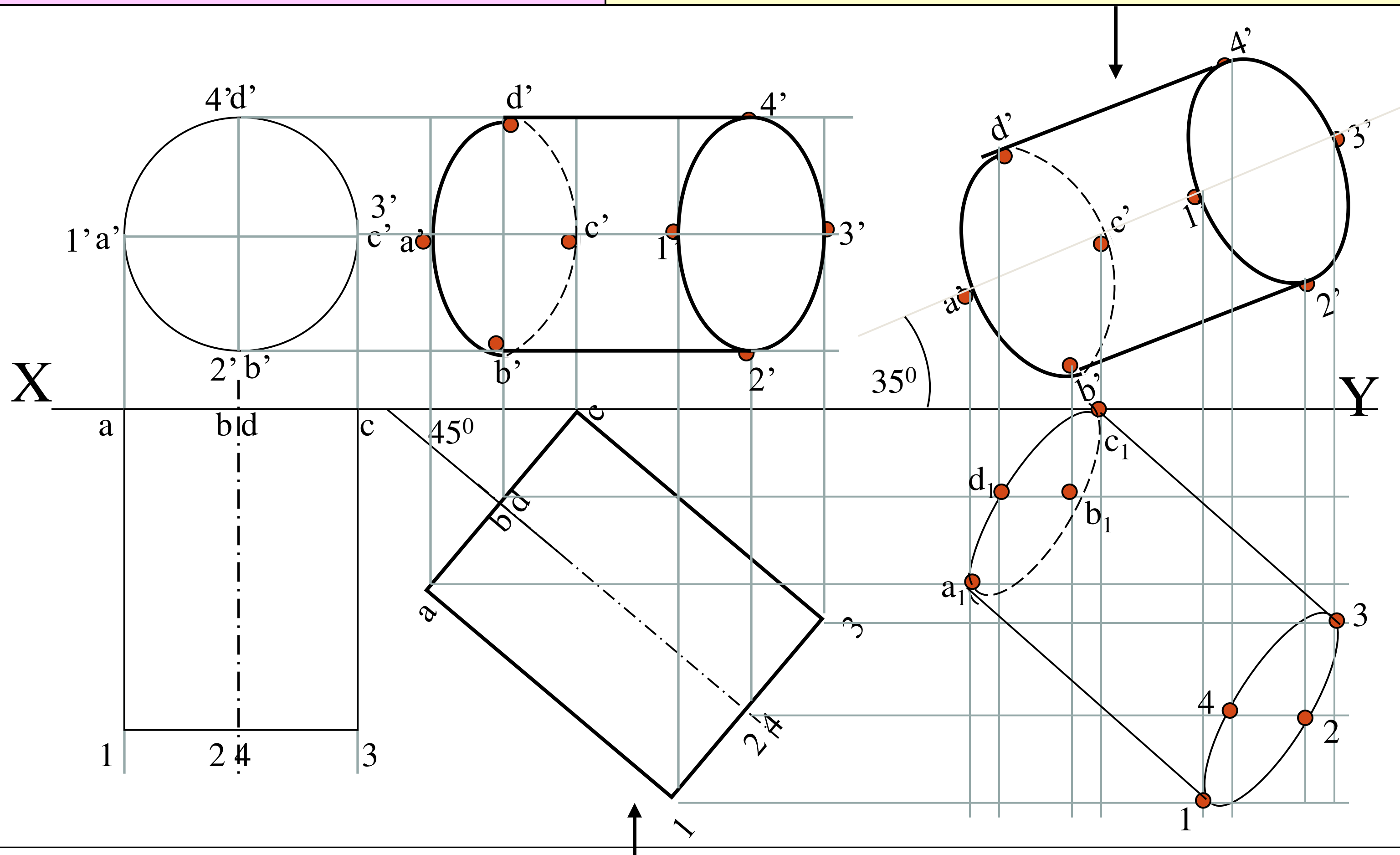
3.Draw 40mm dia. Circle as Fv & taking 50 mm axis project Tv. (a Rectangle)

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.

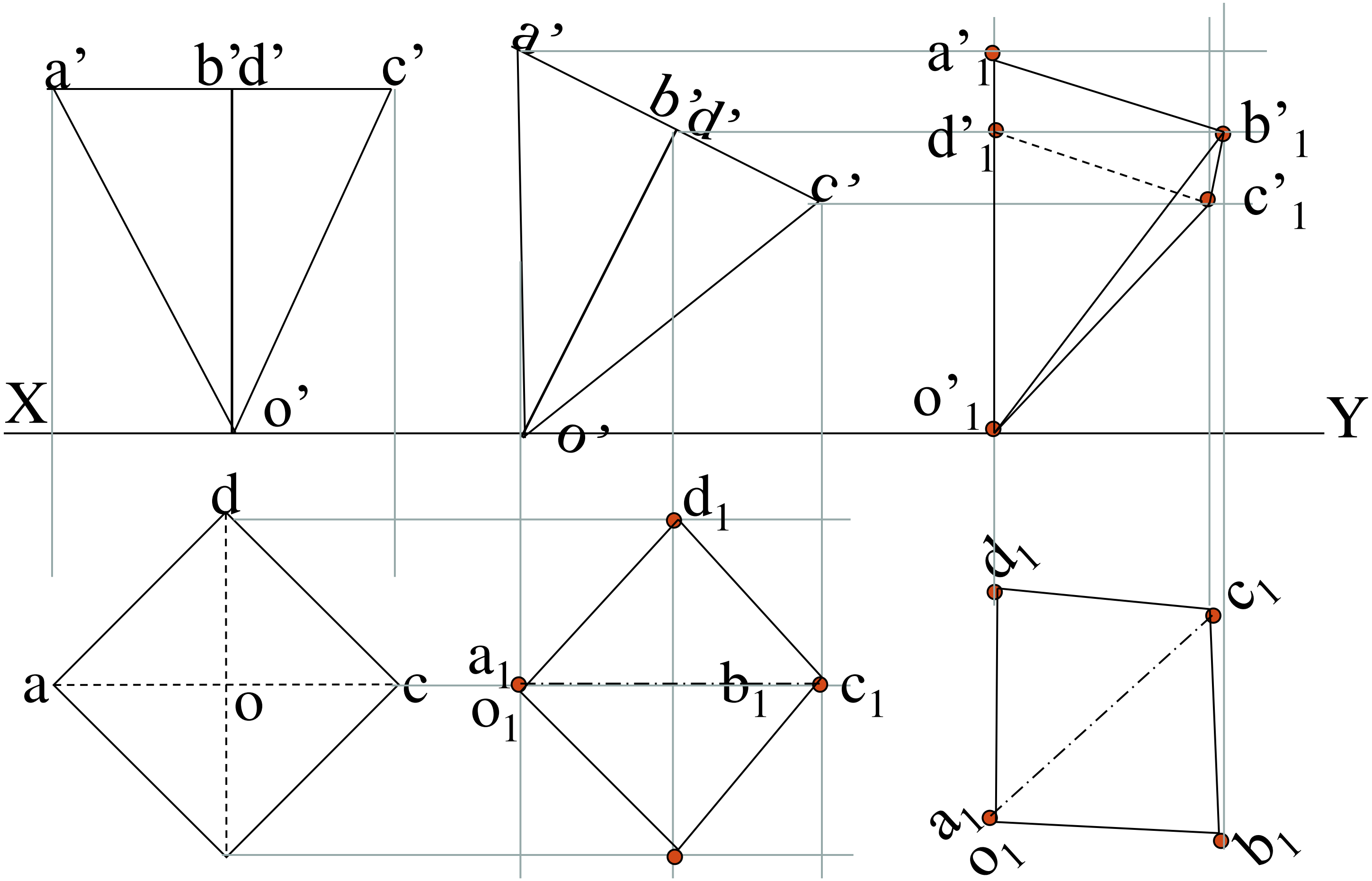
7.Then construct remaining inclination with Hp (Fv of axis I.e. center line of view to xy as shown) & project final Tv.



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.

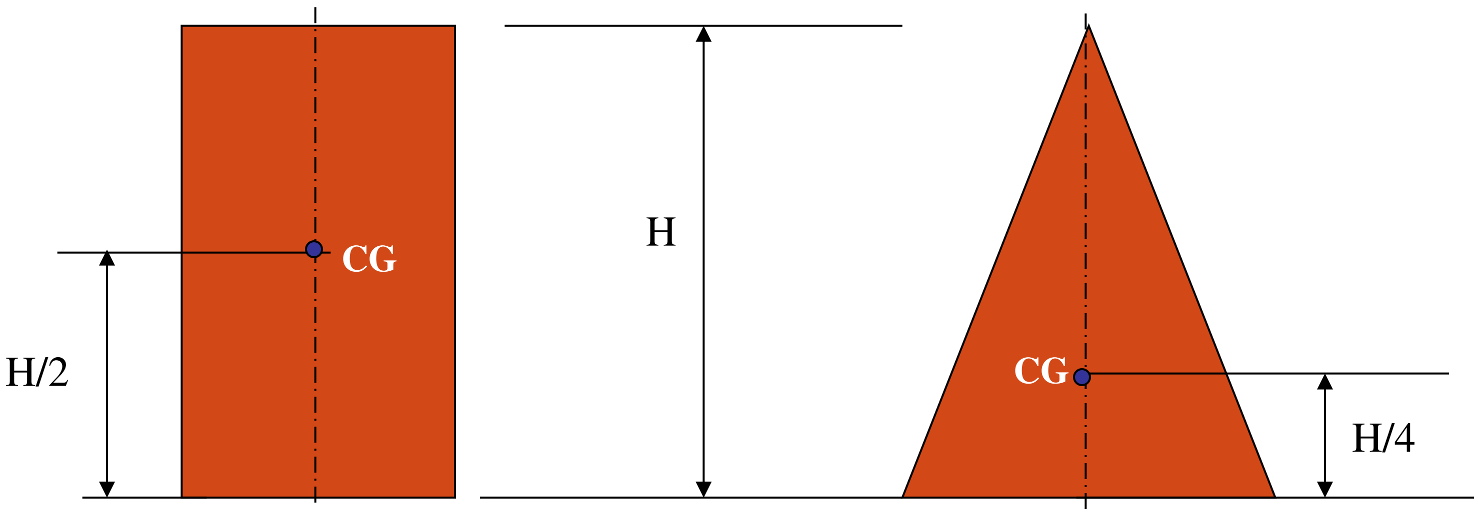
Solution Steps :

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.



FREELY SUSPENDED SOLIDS:

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

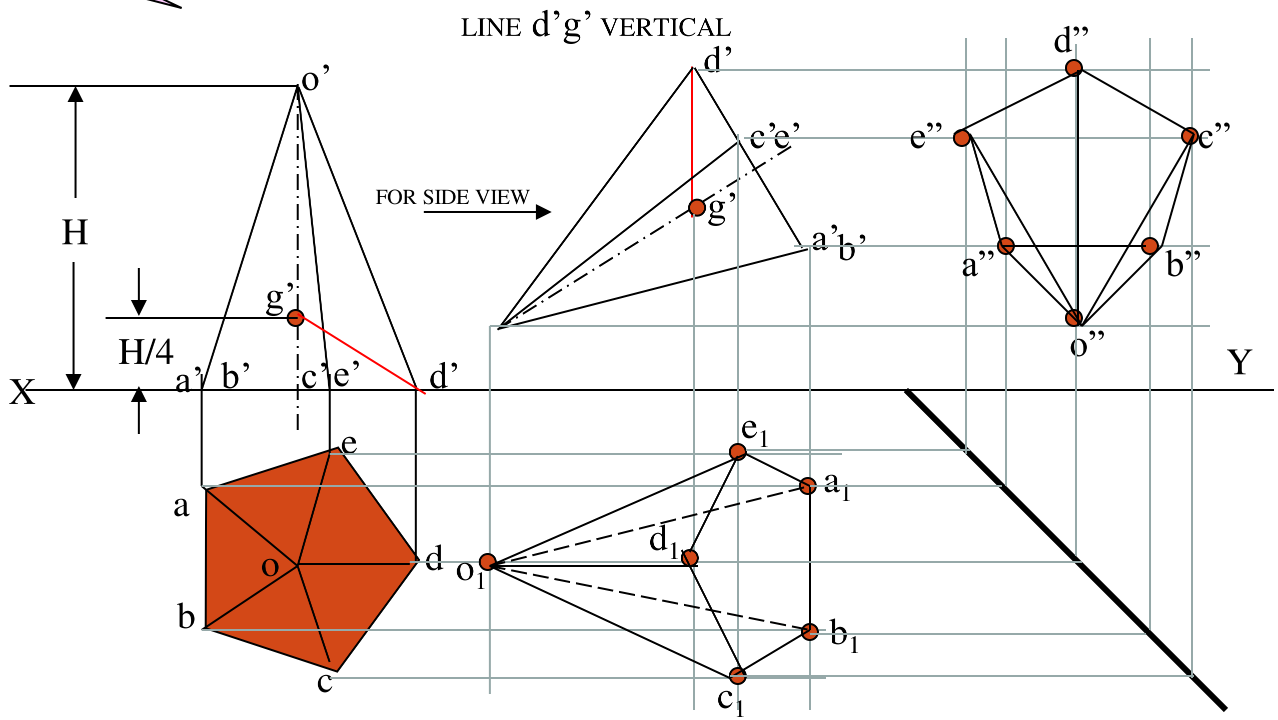


GROUP A SOLIDS
(Cylinder & Prisms)

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.)**

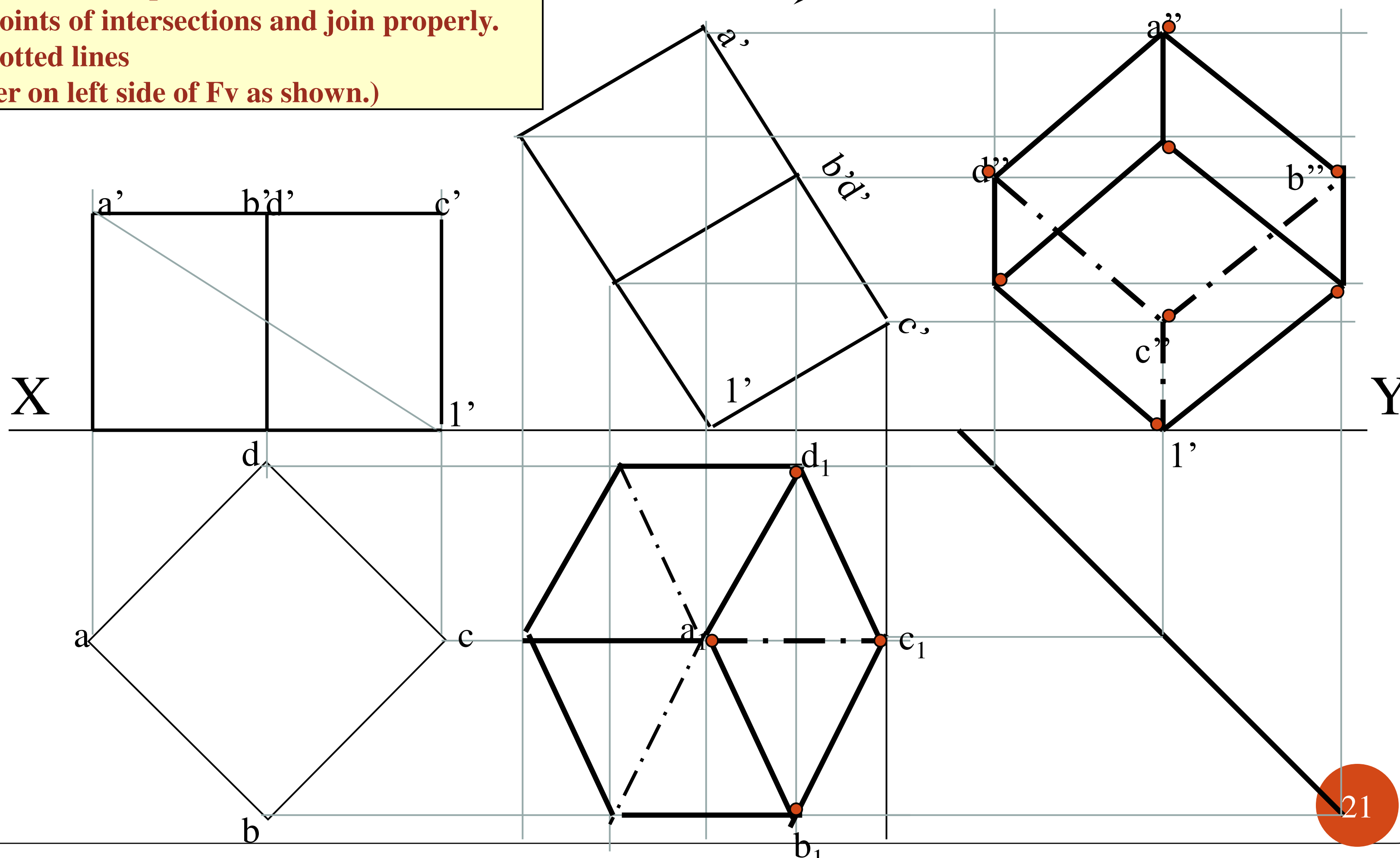
Solution Steps:

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.)

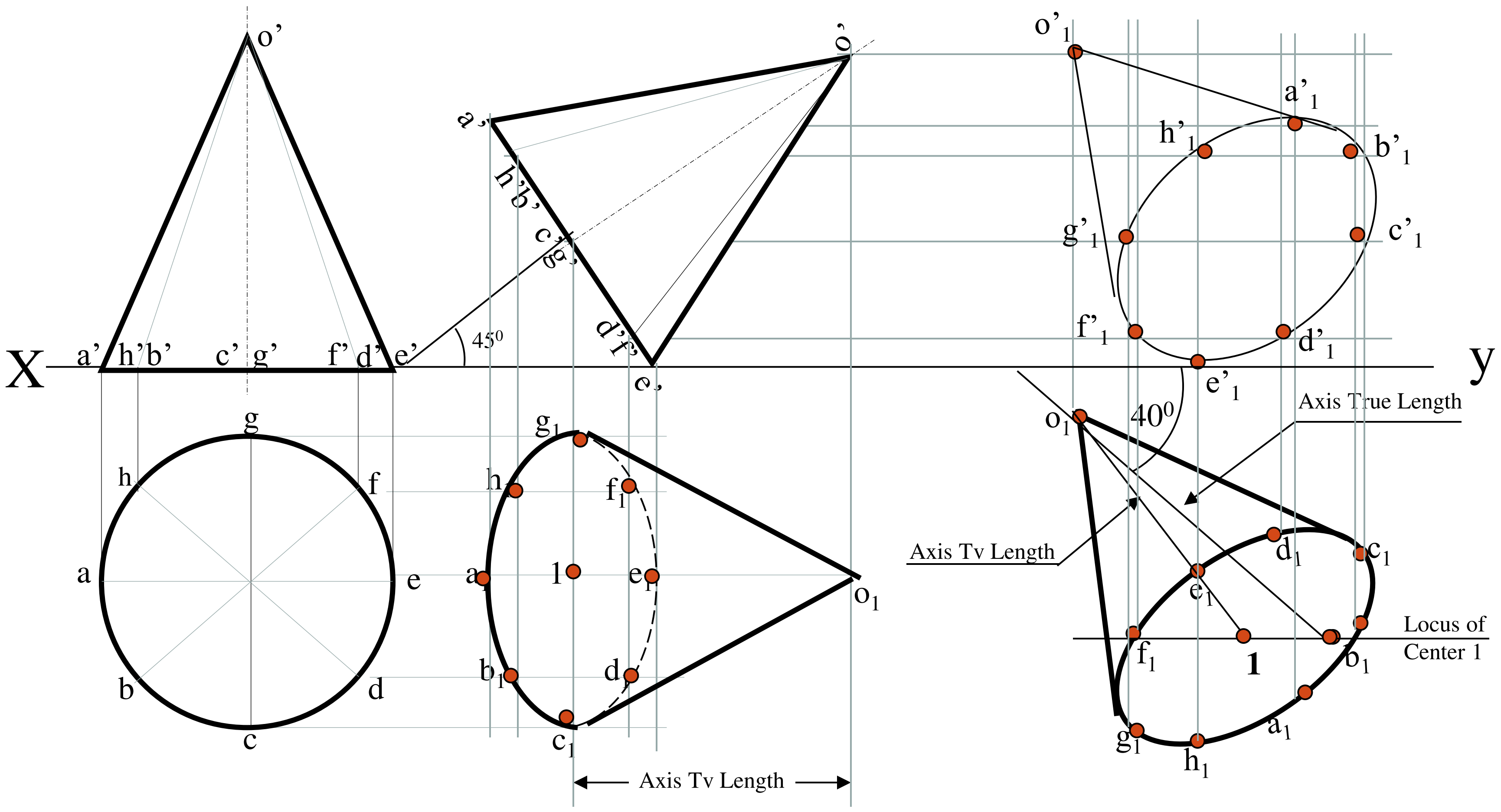
Problem 8:

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.



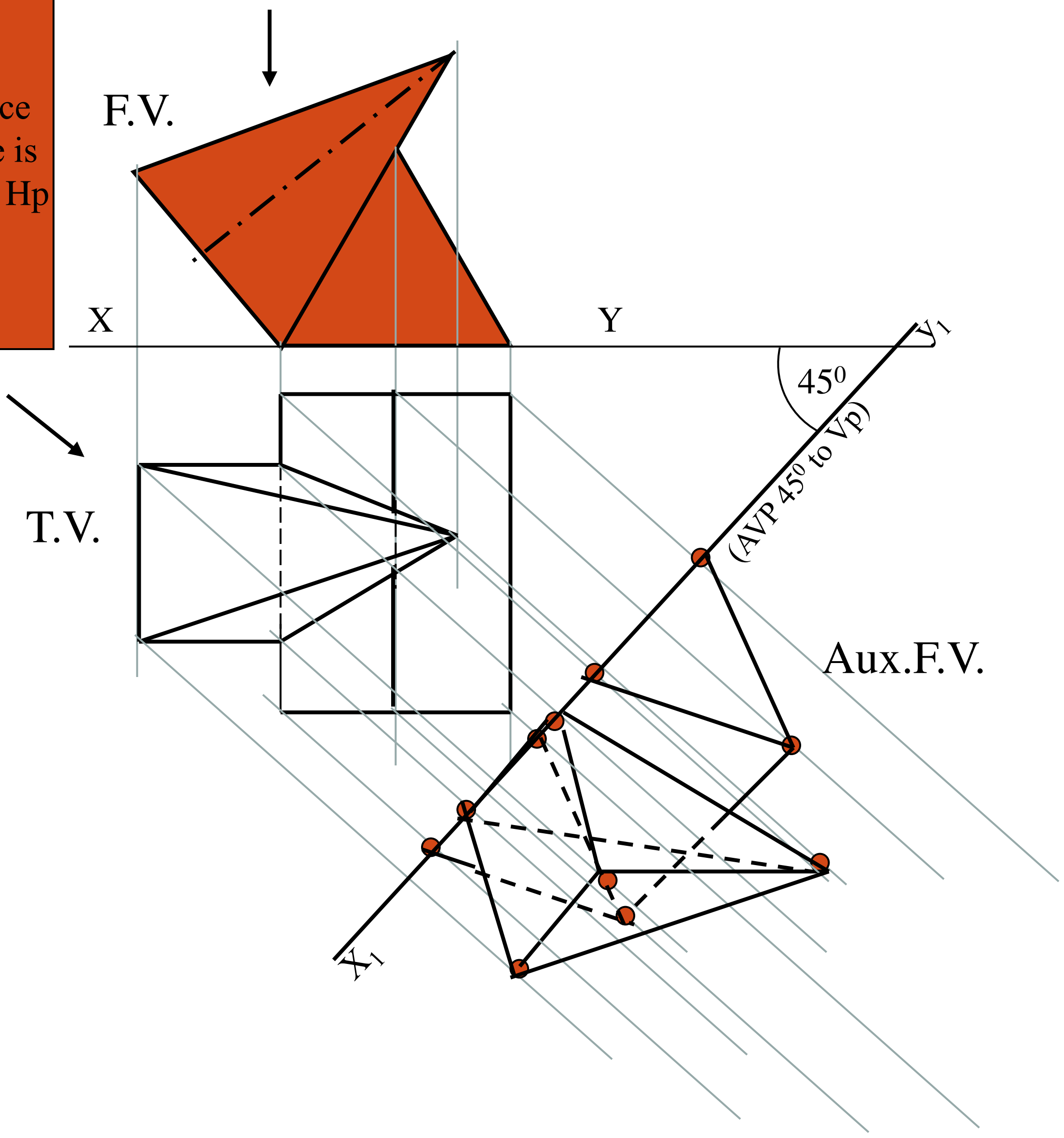
Problem 9: A right circular cone, 40 mm base diameter and 60 mm long axis is resting on Hp on one point of base circle such that it's axis makes 45^0 inclination with Hp and 40^0 inclination with Vp. Draw it's projections.

This case resembles to **problem no.7 & 9 from projections of planes** topic.
In previous all cases 2^{nd} 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.



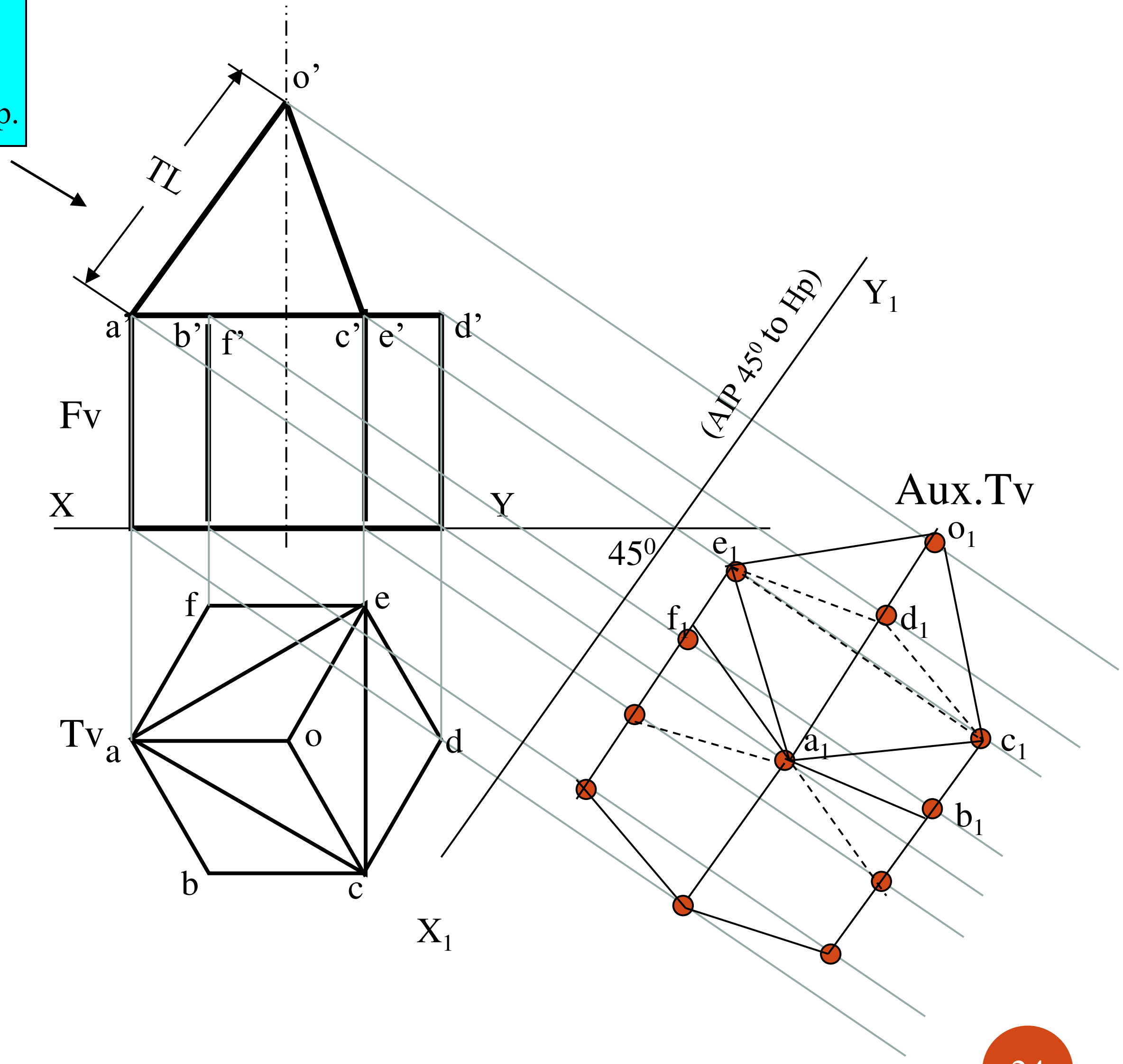
Problem 10: A triangular prism, 40 mm base side 60 mm axis is lying on Hp on one rectangular face with axis perpendicular to Vp. One square pyramid is leaning on it's face centrally with axis // to vp. It's base side is 30 mm & axis is 60 mm long resting on Hp on one edge of base.Draw FV & TV of both 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.

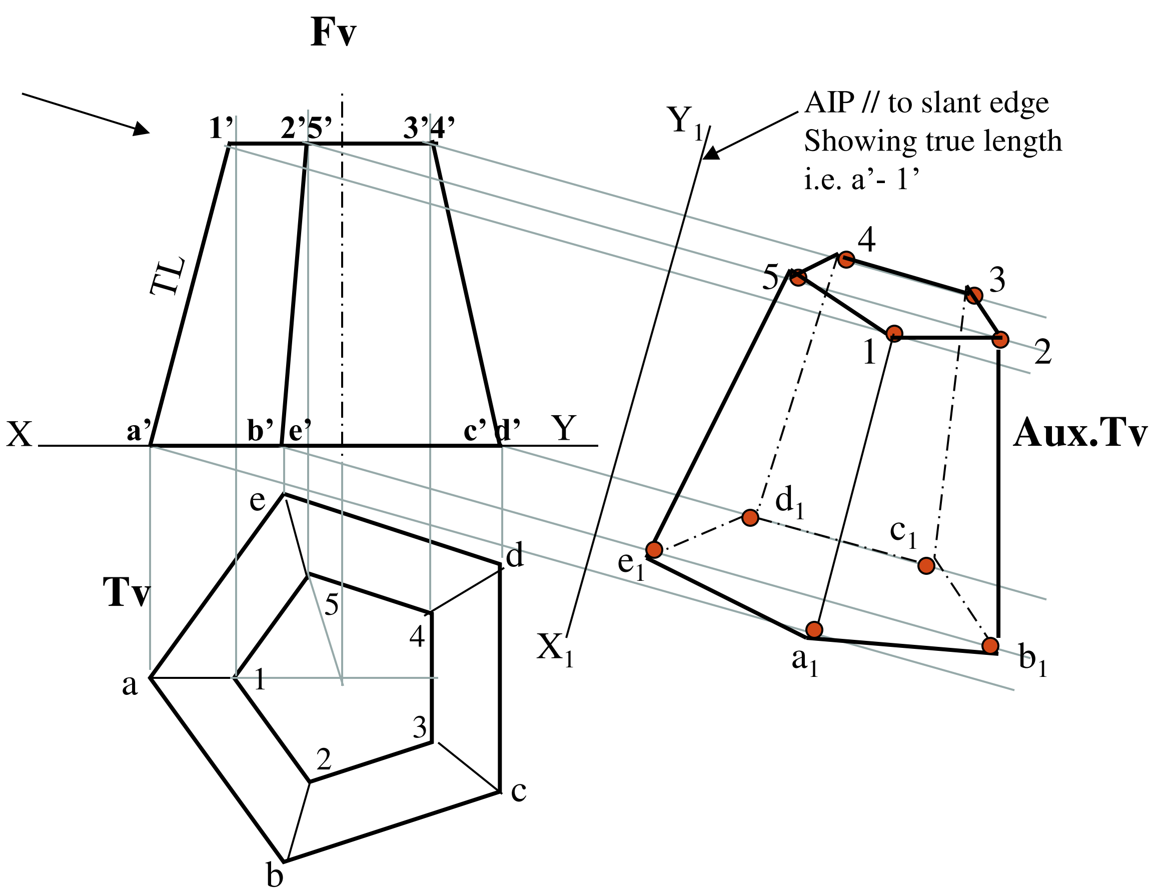


Problem 11: A hexagonal prism of base side 30 mm longand axis 40 mm long, is standing on Hp on it's base with one base edge // to Vp. A tetrahedron is placed centrally on the top of it.The base of tetrahedron is a triangle formed by joining alternate corners of top of prism..Draw projections of both 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.

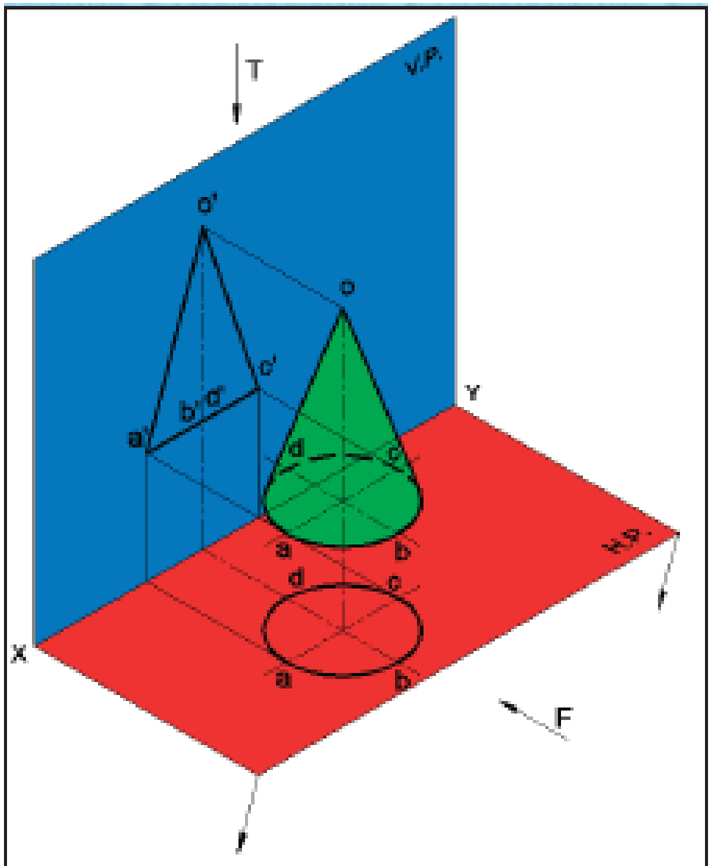


Problem 12: A frustum of regular hexagonal pyrami is standing on it's larger base On Hp with one base side perpendicular to Vp.Draw it's Fv & Tv.
Project it's Aux.Tv on an AIP parallel to one of the slant edges showing TL.
Base side is 50 mm long , top side is 30 mm long and 50 mm is height of frustum.

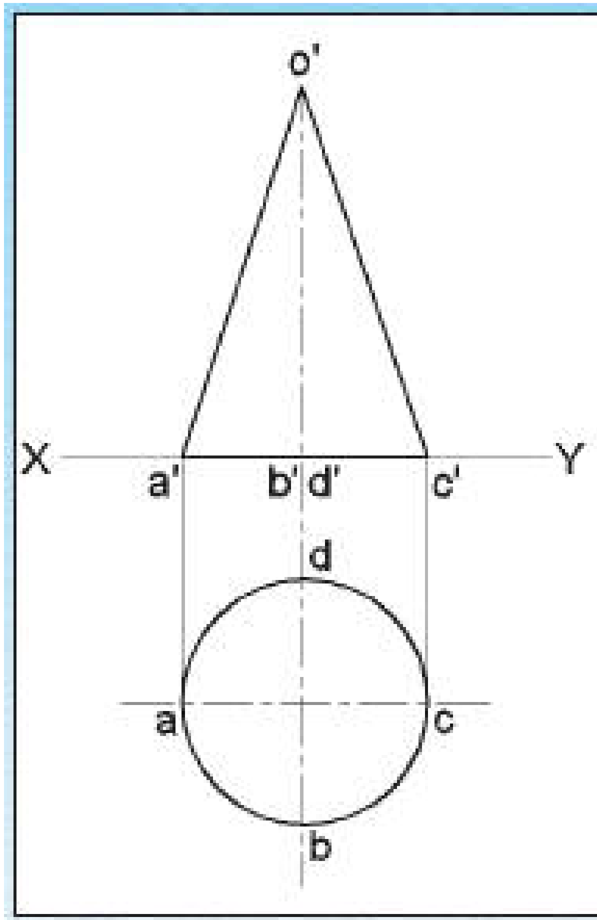


PROJECTION OF SOLIDS WHEN ITS AXIS PERPENDICULAR TO ONE REFERENCE PLANE AND PARALLEL TO THE OTHER

Case (1) Axis perpendicular to the H.P and Parallel to the V.P

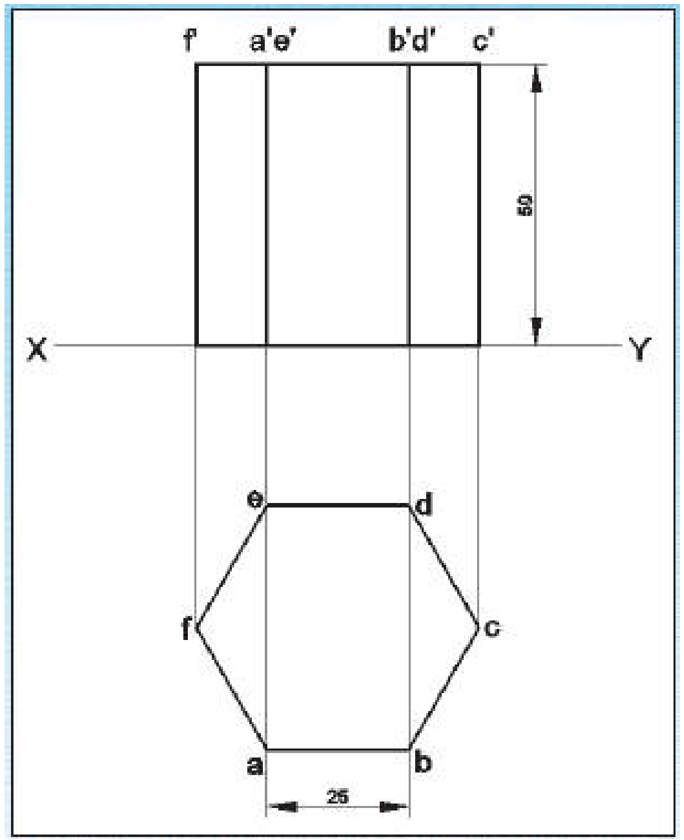


PICTORIAL VIEW



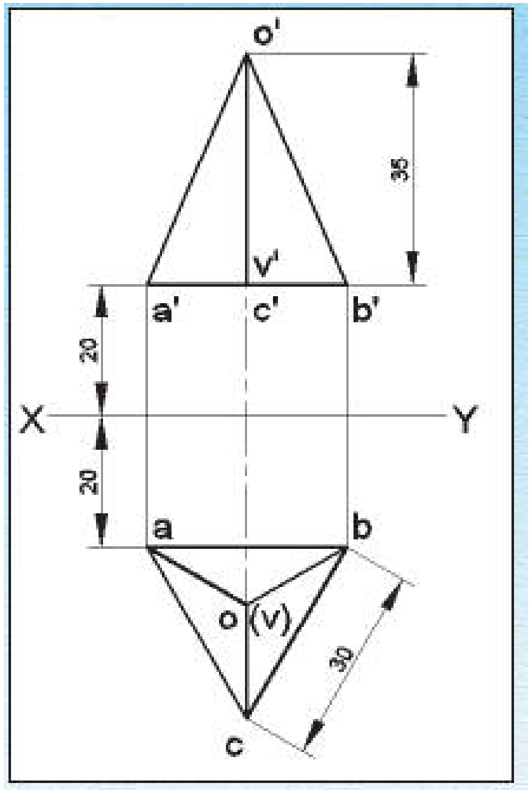
EXAMPLE:-

Project the front view and top view of a hexagonal prism of 25 mm base edges and 50 mm height, having two of its vertical rectangular faces parallel to V.P; and its base resting on H.P



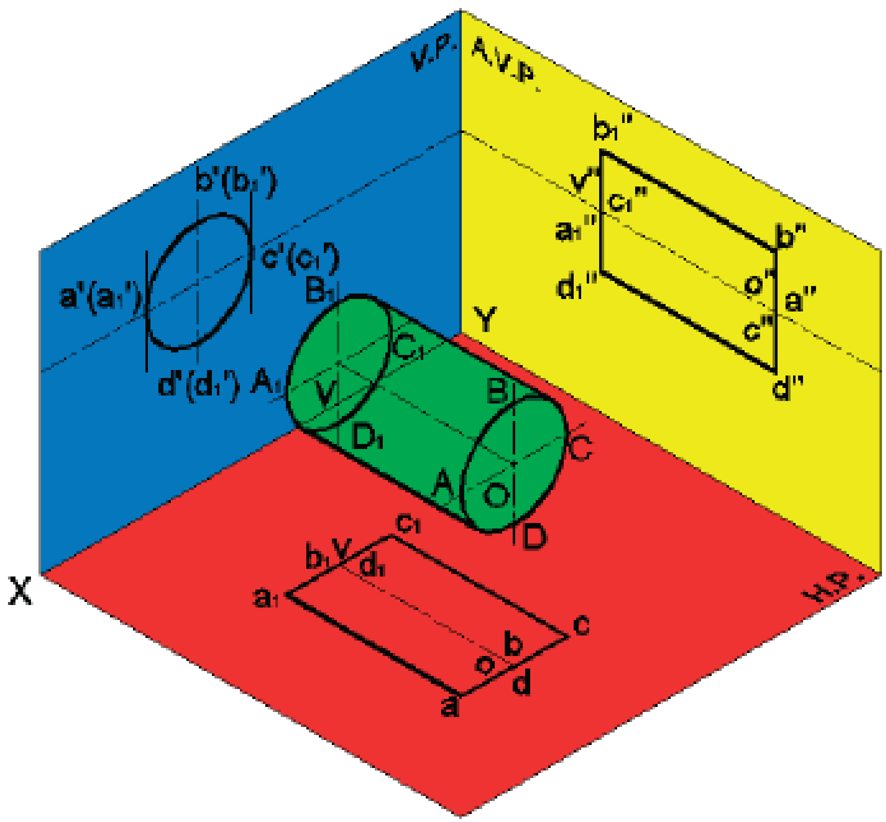
EXAMPLE:-

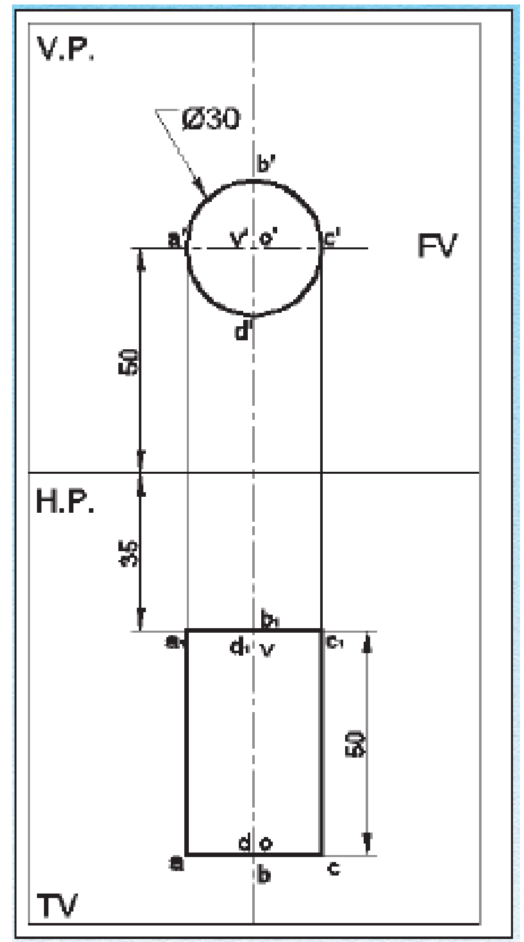
A triangular pyramid with 30 mm edges at its base and 35 mm long axis resting on its base with an edge of the base near the V.P, parallel to and 20 mm from the V.P; Draw the projections of the pyramid, if the base is 20 mm above the H.P



PROJECTION OF SOLIDS WHEN ITS AXIS PERPENDICULAR TO ONE REFERENCE PLANE AND PARALLEL TO THE OTHER

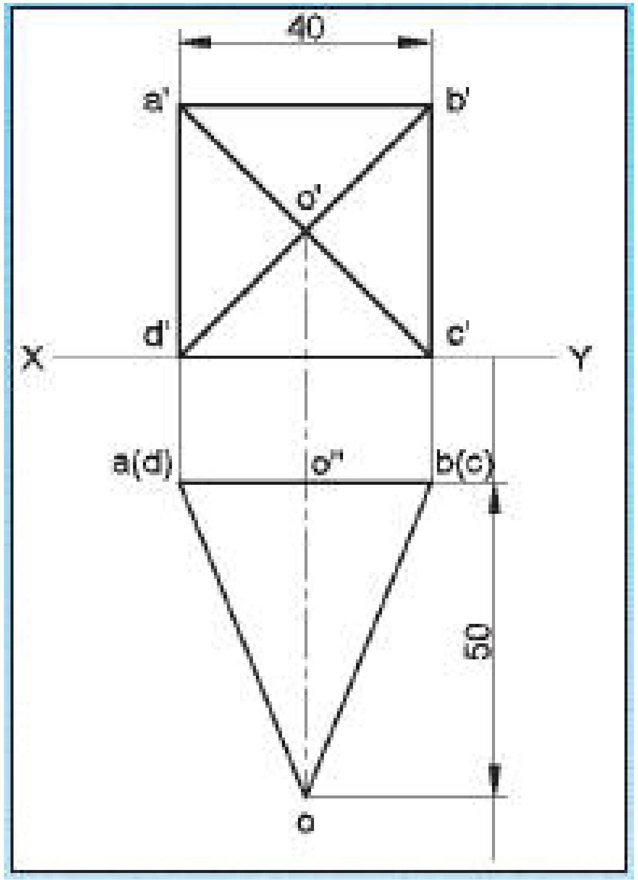
Case (2) Axis perpendicular to the V.P and Parallel to the H.P





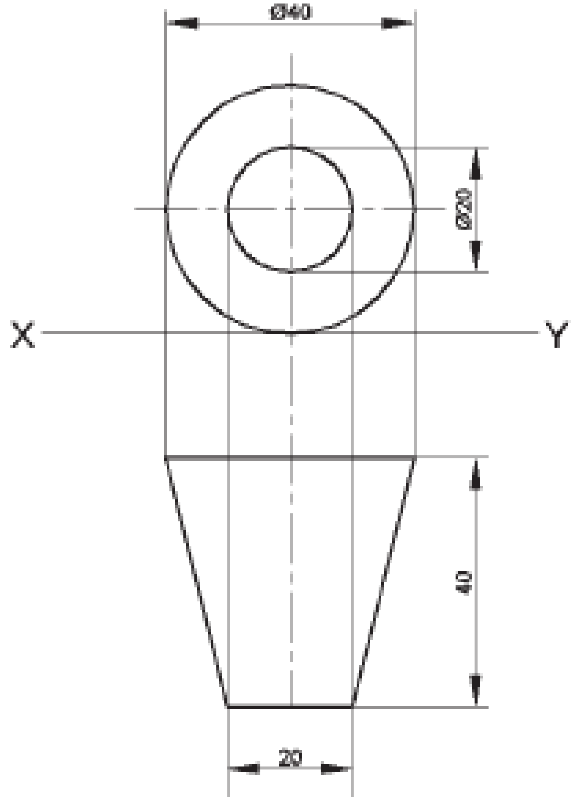
EXAMPLE:-

Draw the front view and top view of a square pyramid of base edge 40 mm and axis 50 mm long, which is perpendicular to V.P, and the vertex is in front

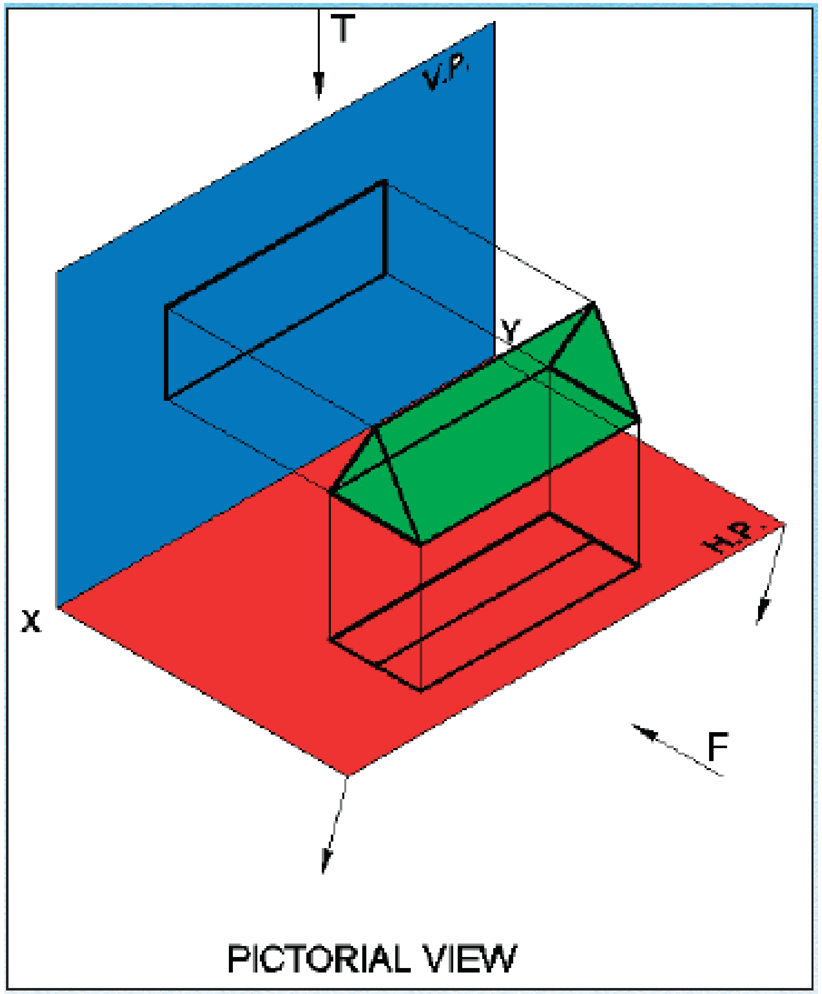


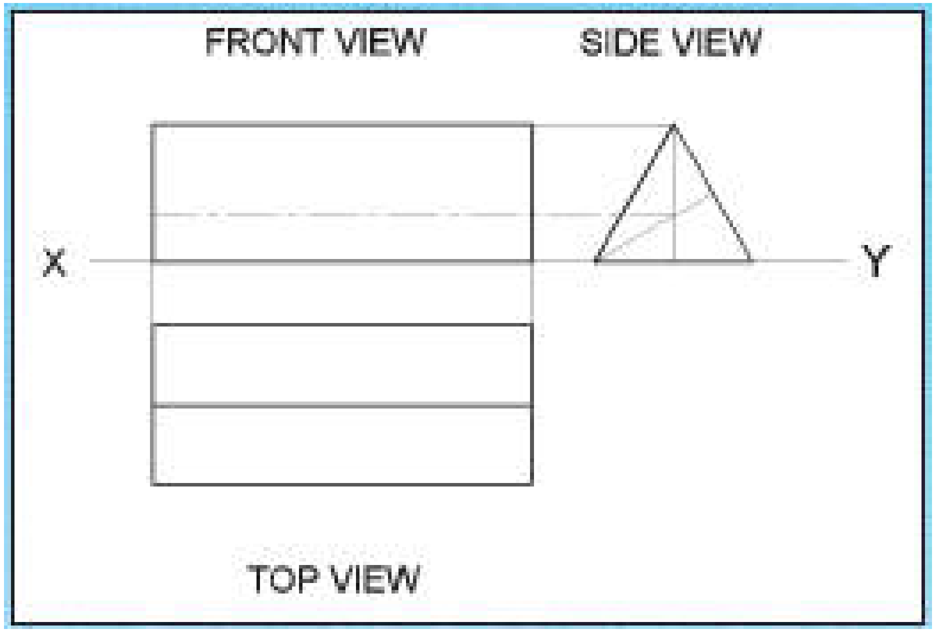
EXAMPLE:-

The frustum of the cone of 40 mm base diameter and 20 mm cut face diameter, rests on H.P with its 40 mm long axis parallel to H.P and at right angles to V.P, the cut face is in front. Project its **front view** and **top view**



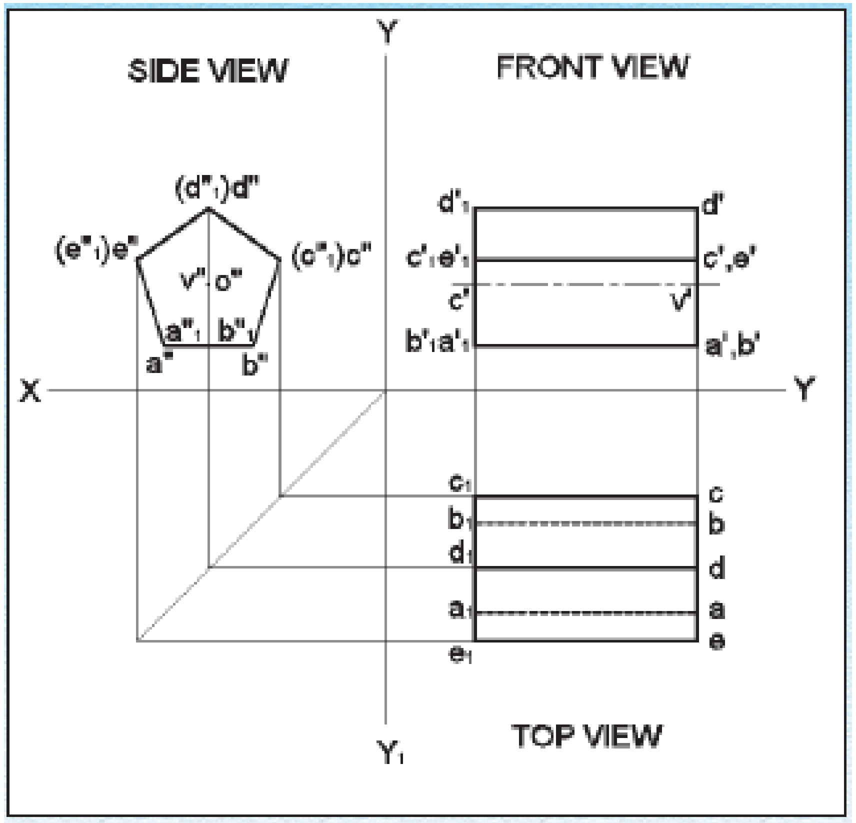
PROJECTION OF SOLIDS WHEN ITS AXIS IS PARALLEL TO BOTH THE REFERENCE PLANES





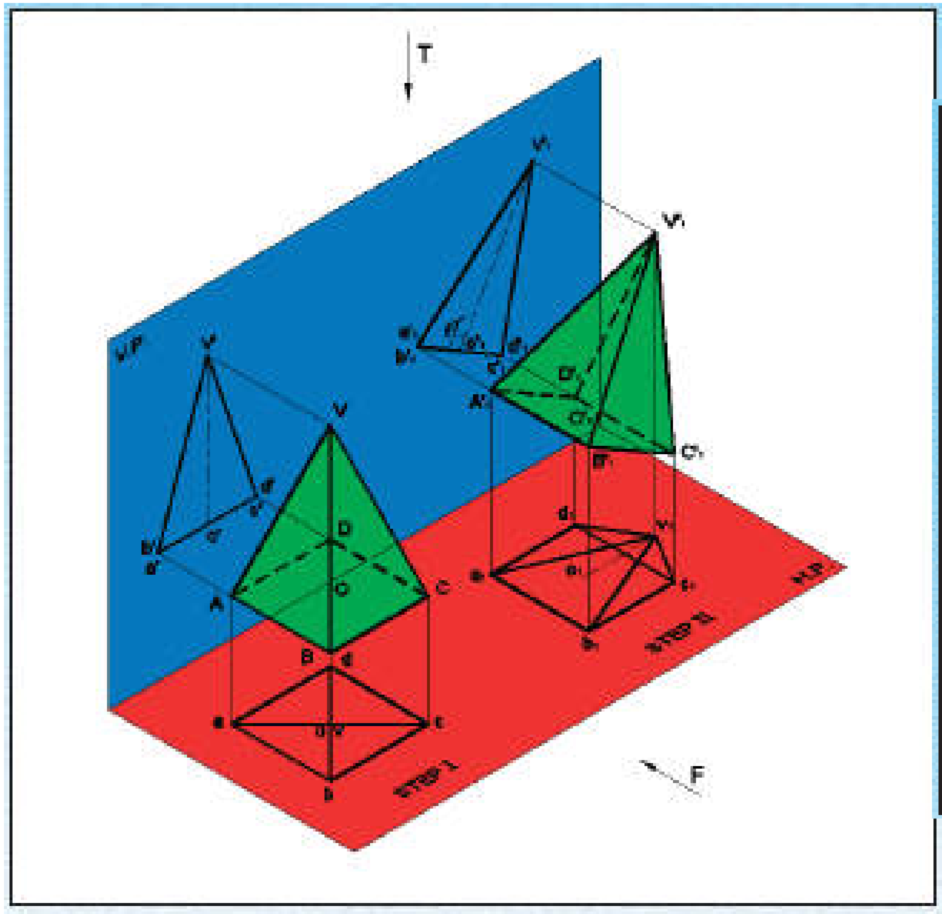
EXAMPLE:-

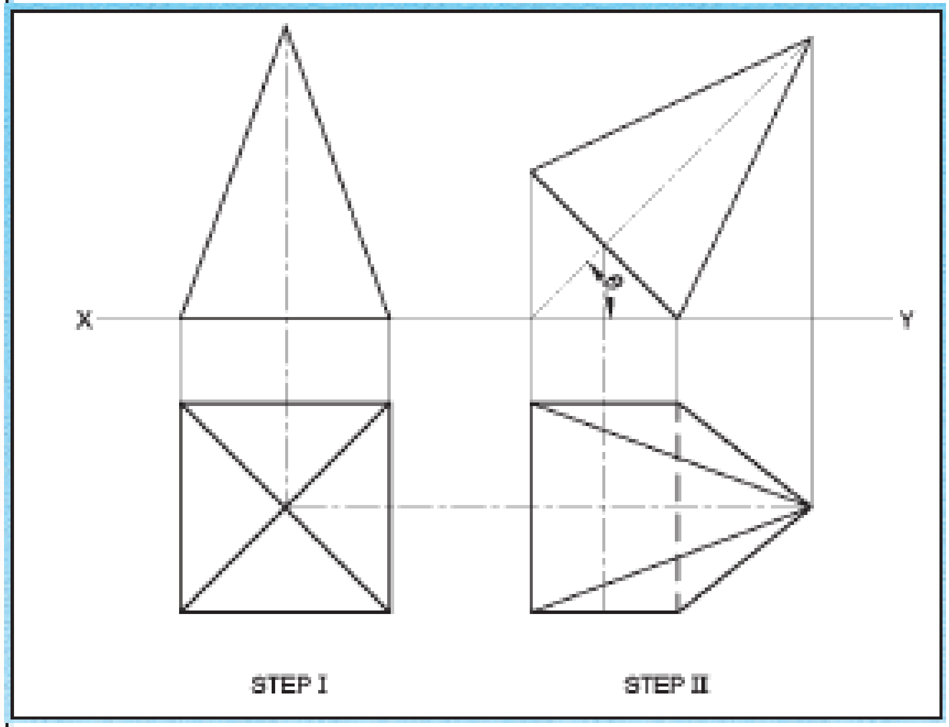
A pentagonal prism having a 20 mm edge of its base and an axis of 50 mm length is resting on one of its rectangular faces with the axis perpendicular to the side plane. Draw the projections of the prism



PROJECTION OF SOLIDS WHEN ITS AXIS PARALLEL TO REFERENCE PLANE AND INCLINED TO THE OTHER

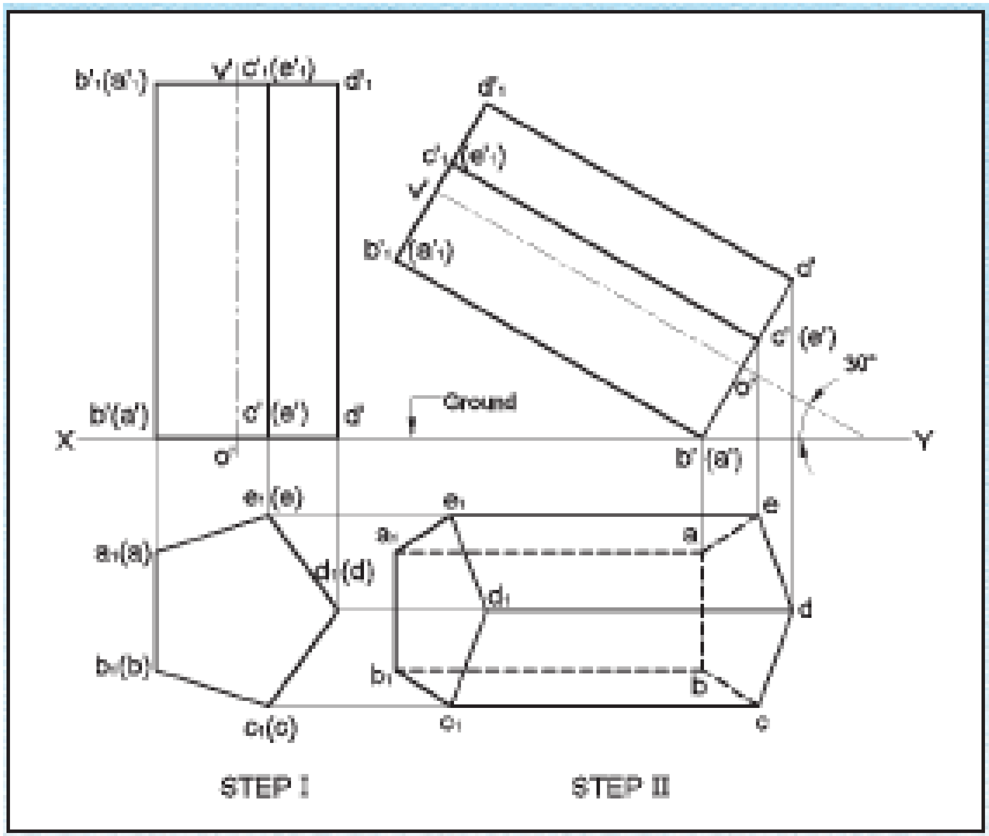
Case (1) Axis inclined to H.P and Parallel to V.P





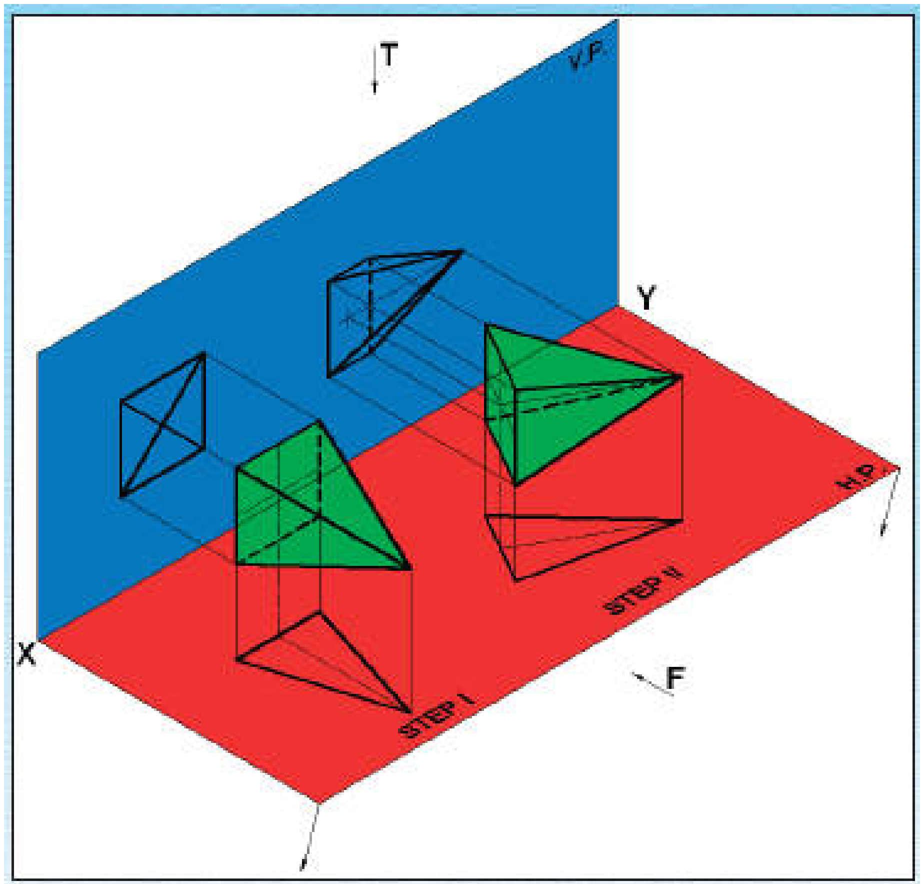
EXAMPLE:-

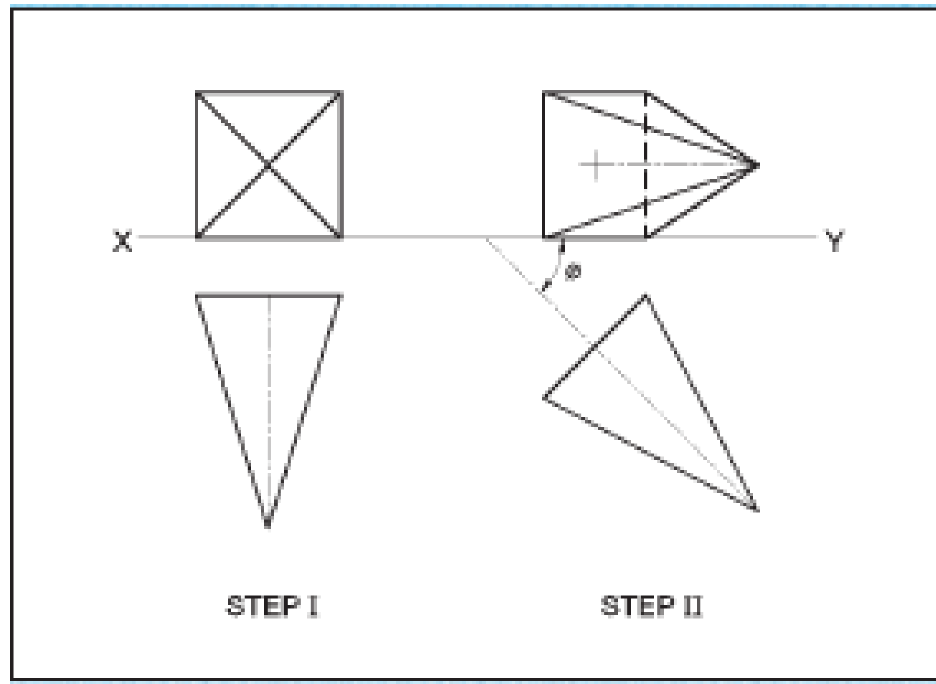
A pentagonal prism having a 20 mm edges at its base and axis of 70 mm length is resting on one of the edges of its base with its axis parallel to the V.P and inclined at 30° to the H.P



PROJECTION OF SOLIDS WHEN ITS AXIS PARALLEL TO REFERENCE PLANE AND INCLINED TO THE OTHER

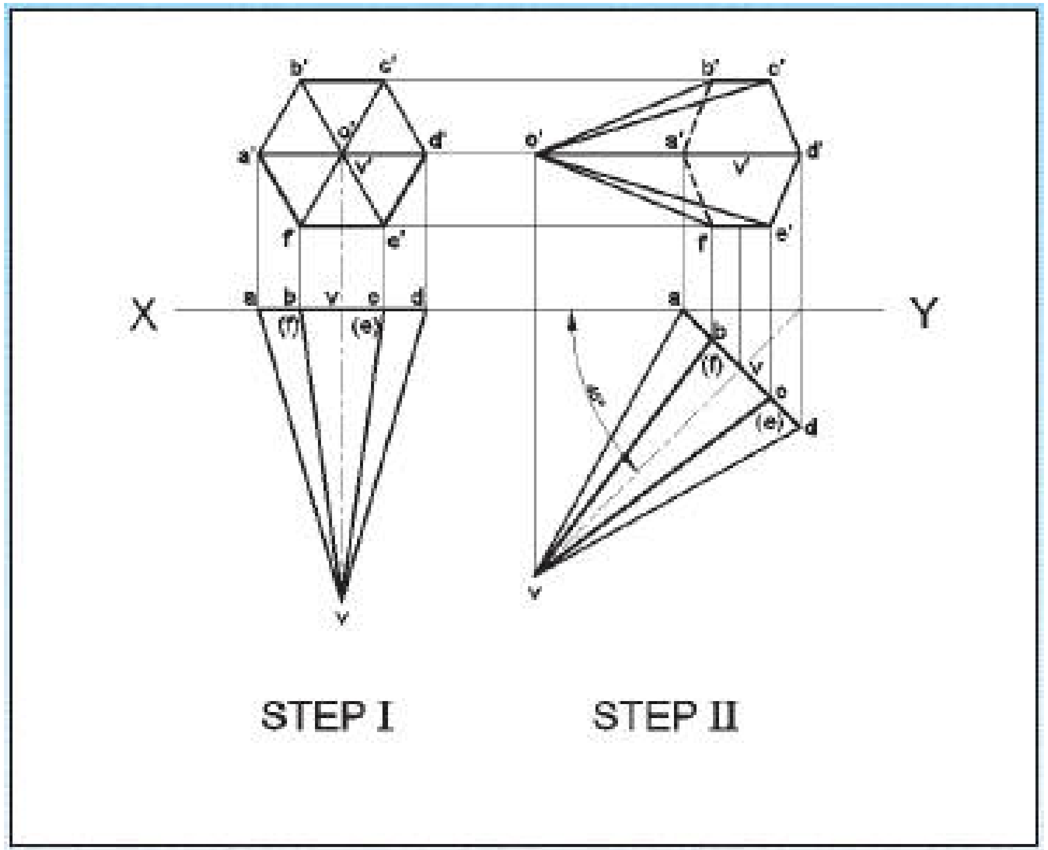
Case (2) Axis inclined to V.P and Parallel to H.P





EXAMPLE:-

A hexogonal pyramid having 20 mm sides at its base and an axis 70 mm long has one of the corners of its base in the V.P and its axis inclined at 45° to the V.P and parallel to the H.P



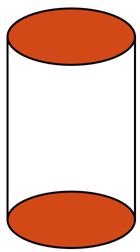
A right regular hexagonal prism, side of base 25 mm and axis 50 mm long, having one of its base edges parallel to the VP with its axis perpendicular to the HP. Draw its front, top and side views.

SOLIDS

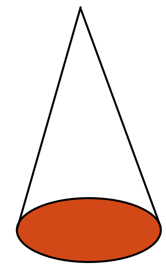
To understand and remember various solids in this subject properly, those are classified & arranged in to two major groups.

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

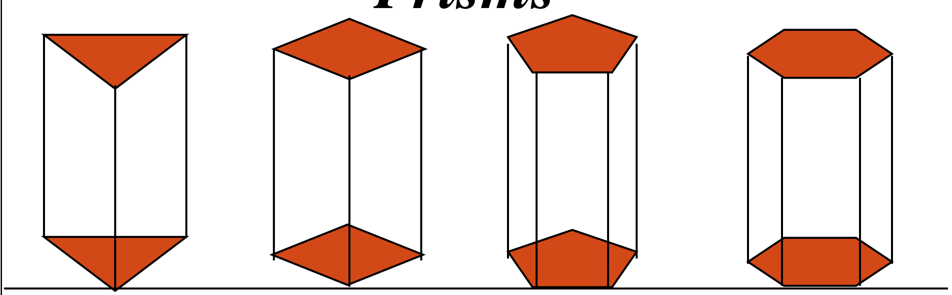
Cylinder



Cone

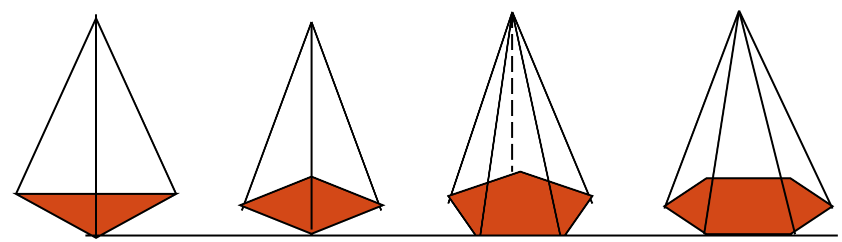


Prisms



Triangular Square Pentagonal Hexagonal

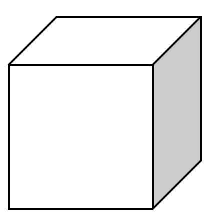
Pyramids



Triangular Square Pentagonal Hexagonal

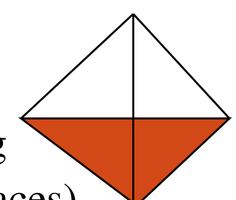
Cube

(A solid having six square faces)



Tetrahedron

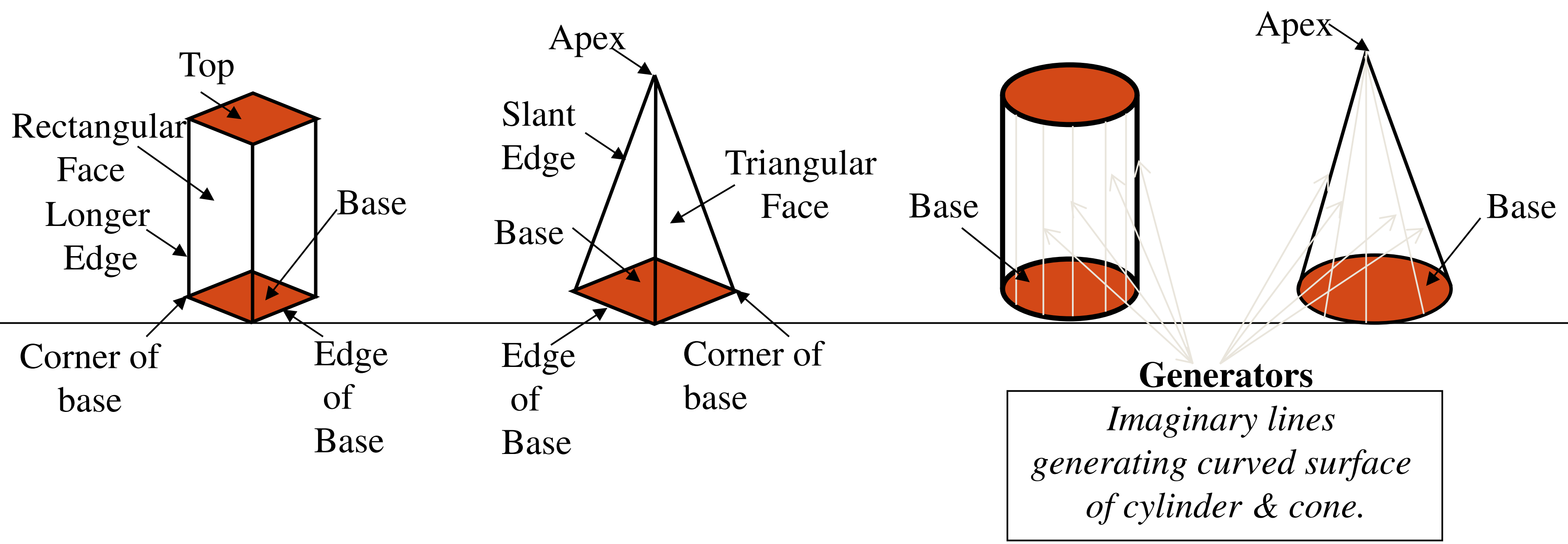
(A solid having Four triangular faces)

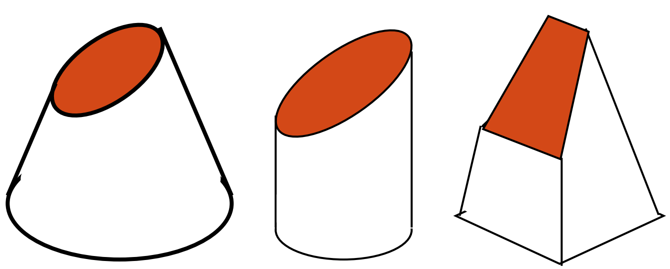


SOLIDS

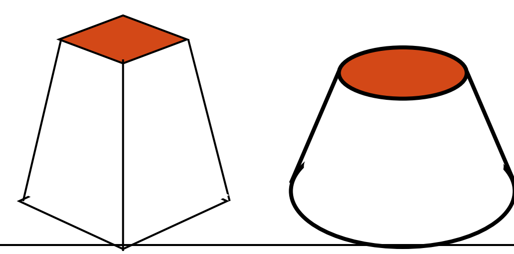
Dimensional parameters of different solids.

Square Prism **Square Pyramid** **Cylinder** **Cone**





Sections of solids(top & base not parallel)

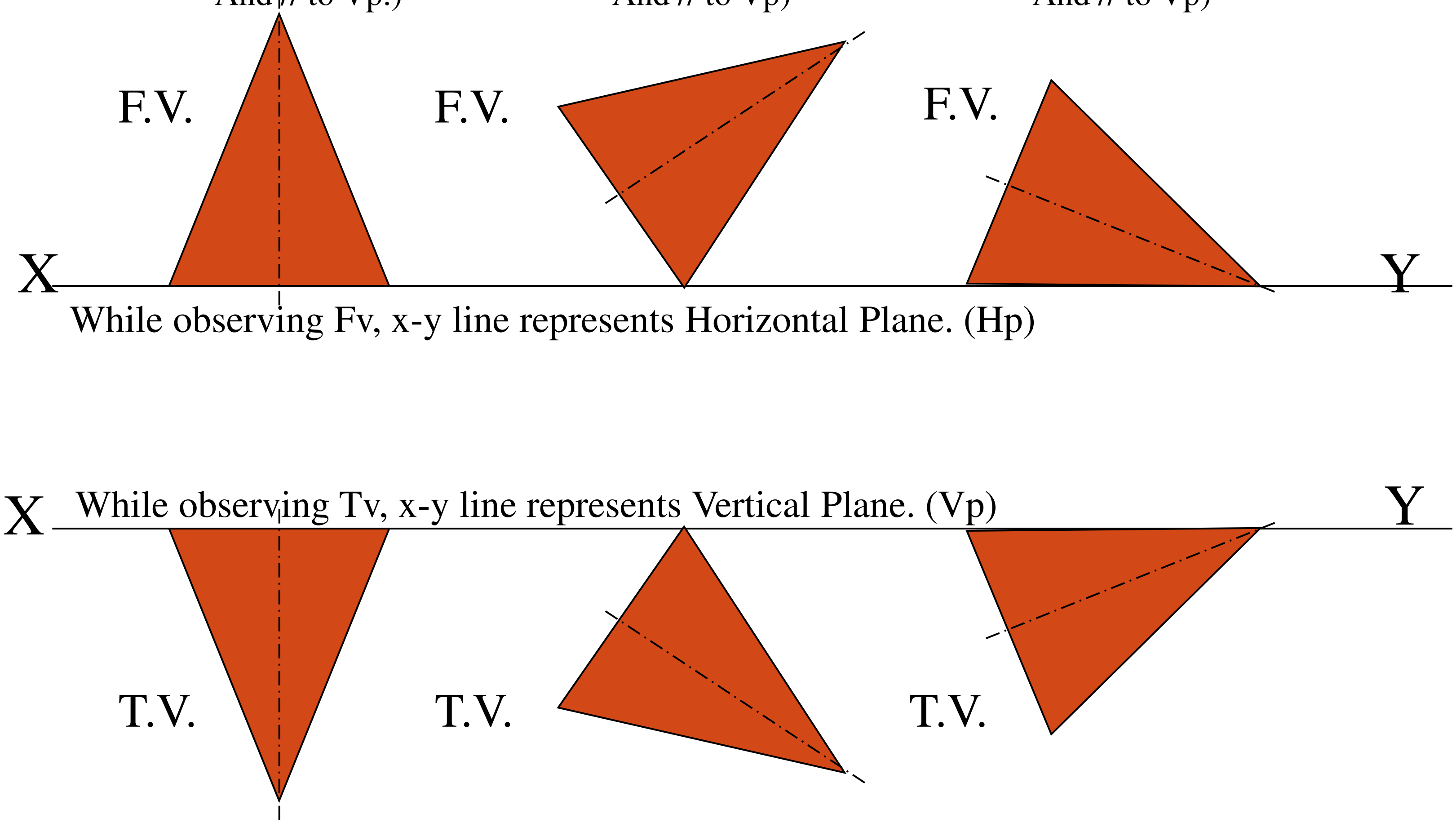


Frustum of cone & pyramids.
(top & base parallel to each other)

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)



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:

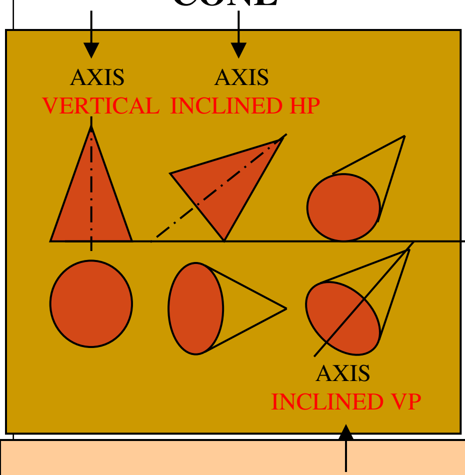
STEP 1: ASSUME SOLID STANDING ON THE PLANE WITH WHICH IT IS MAKING INCLINATION.
(IF IT IS INCLINED TO HP, ASSUME IT STANDING ON HP)
(IF IT IS INCLINED TO VP, ASSUME IT STANDING ON VP)
IF STANDING ON HP - IT'S TV WILL BE TRUE SHAPE OF IT'S BASE OR TOP:
IF STANDING ON VP - IT'S FV WILL BE TRUE SHAPE OF 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.

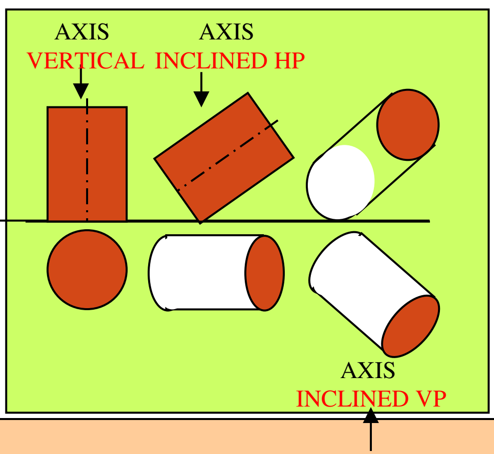
GENERAL PATTERN (THREE STEPS) OF SOLUTION:

GROUP B SOLID. CONE



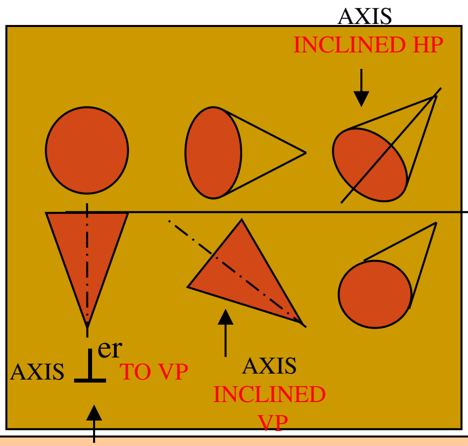
Three steps
If solid is inclined to Hp

GROUP A SOLID. CYLINDER



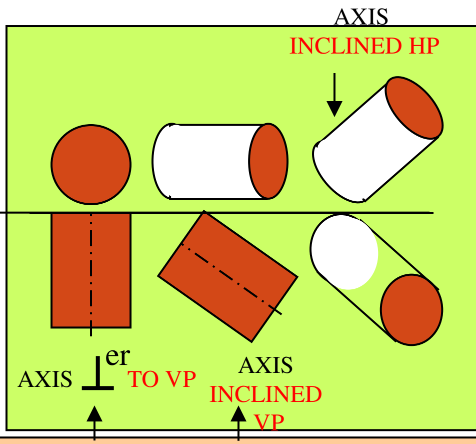
Three steps
If solid is inclined to Hp

GROUP B SOLID. CONE



Three steps
If solid is inclined to Vp

GROUP A SOLID. CYLINDER



Three steps
If solid is inclined to Vp

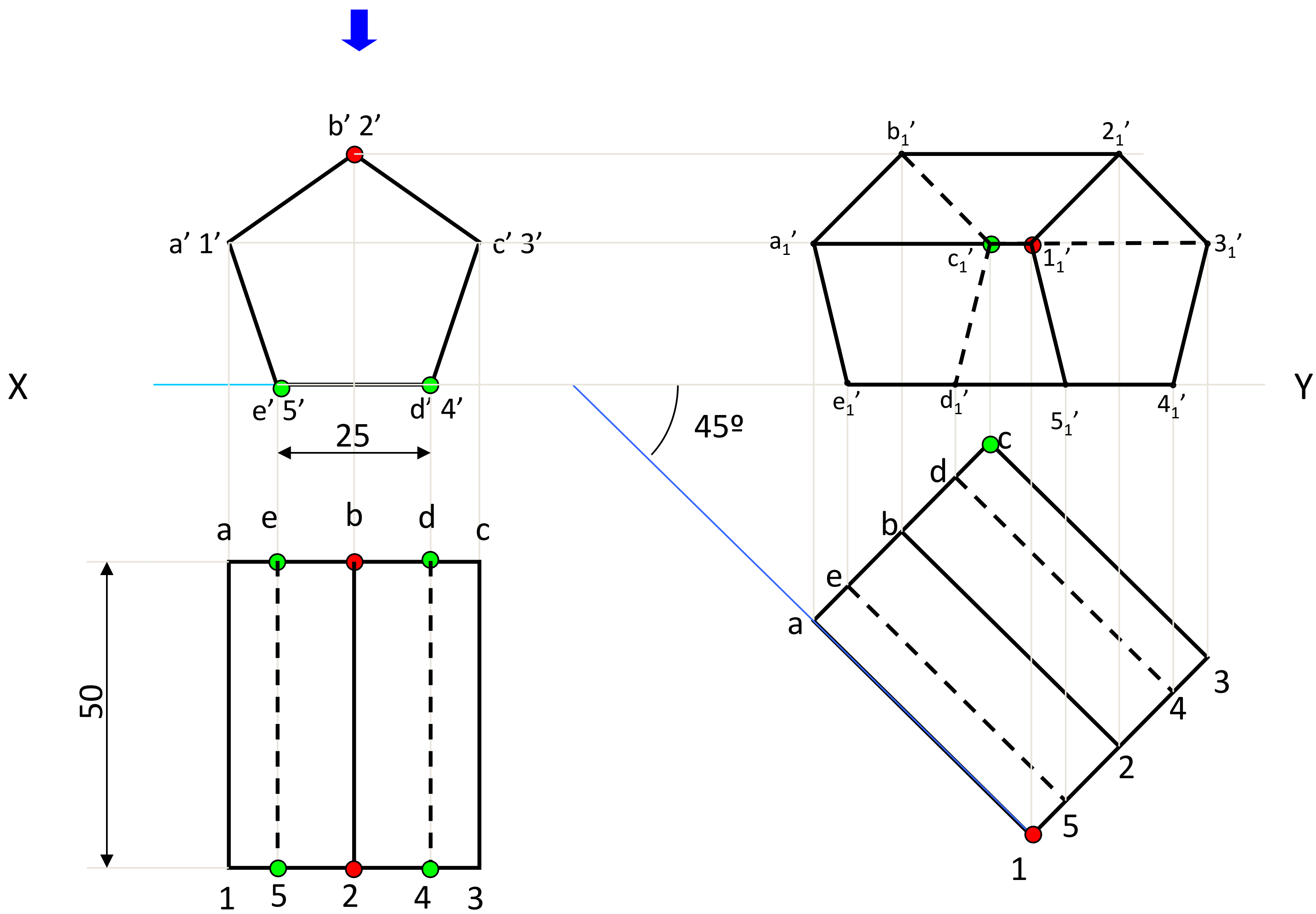
Study Next *Twelve* Problems and Practice them separately !!

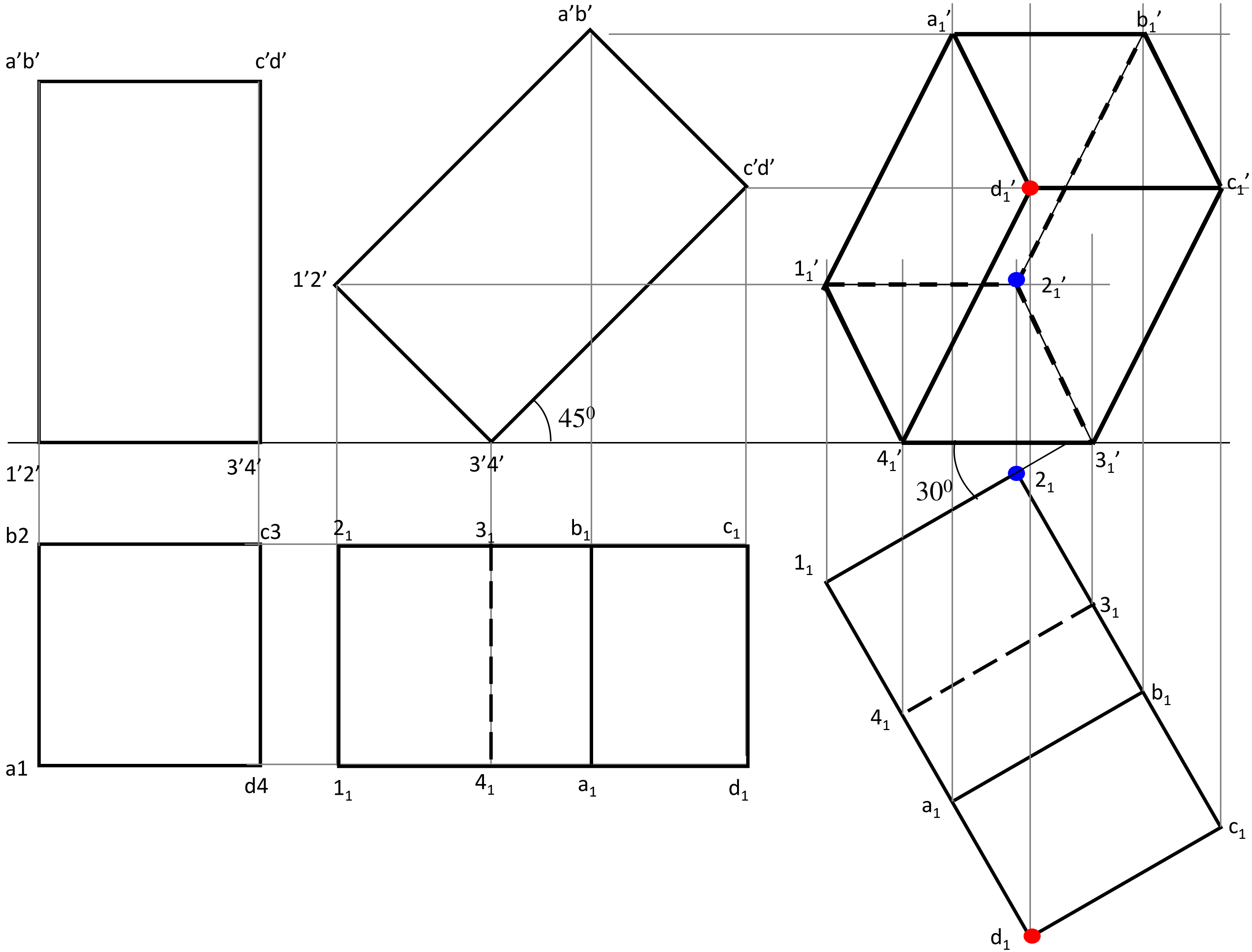
CATEGORIES OF ILLUSTRATED PROBLEMS!

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)

Q 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.

As the 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





a'b'
c'd'
1'2'
3'4'
b2
c3
a1
d4
a'b'
c'd'
1'2'
45⁰
3'4'
2₁
3₁
b₁
c₁
1₁
4₁
a₁
d₁
a₁'
b₁'
d₁'
c₁'
1₁'
2₁'
4₁'
3₁'
30⁰
2₁
1₁
3₁
b₁
4₁
a₁
c₁
d₁

Problem 13.19: Draw the projections of a cone, base 45 mm diameter and axis 50 mm long, when it is resting on the ground on a point on its base circle with **(a)** the axis making an angle of 30° with the HP and 45° with the VP **(b)** the axis making an angle of 30° with the HP and its top view making 45° with the VP

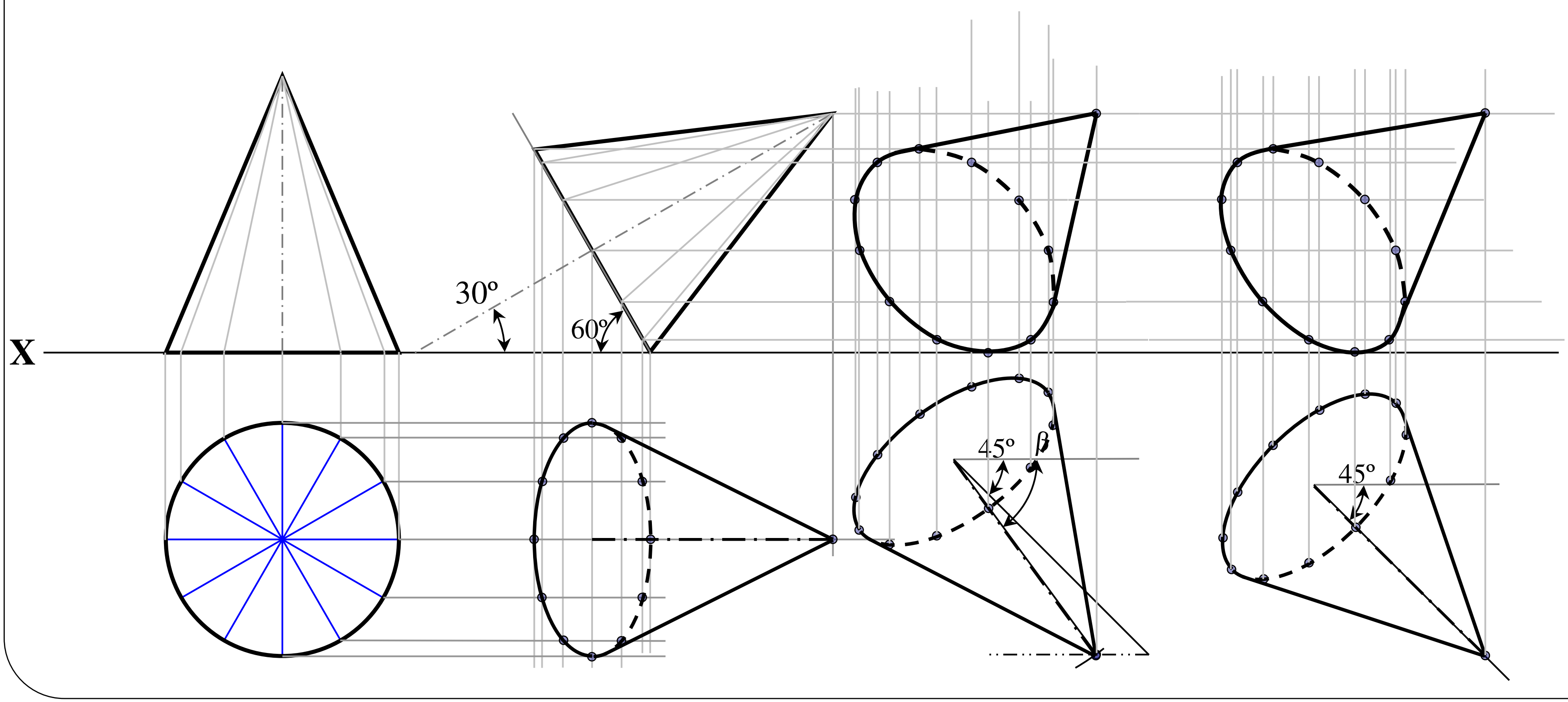
Steps

(1) Draw the TV & FV of the cone assuming its base on the HP

(2) To incline axis at 30° with the HP, incline the base at 60° with HP and draw the FV and then the TV.

(3) For part (a), to find β, draw a line at 45° with XY in the TV, of 50 mm length. Draw the locus of the end of axis. Then cut an arc of length equal to TV of the axis when it is inclined at 30° with HP. Then redraw the TV, keeping the axis at new position. Then draw the new FV

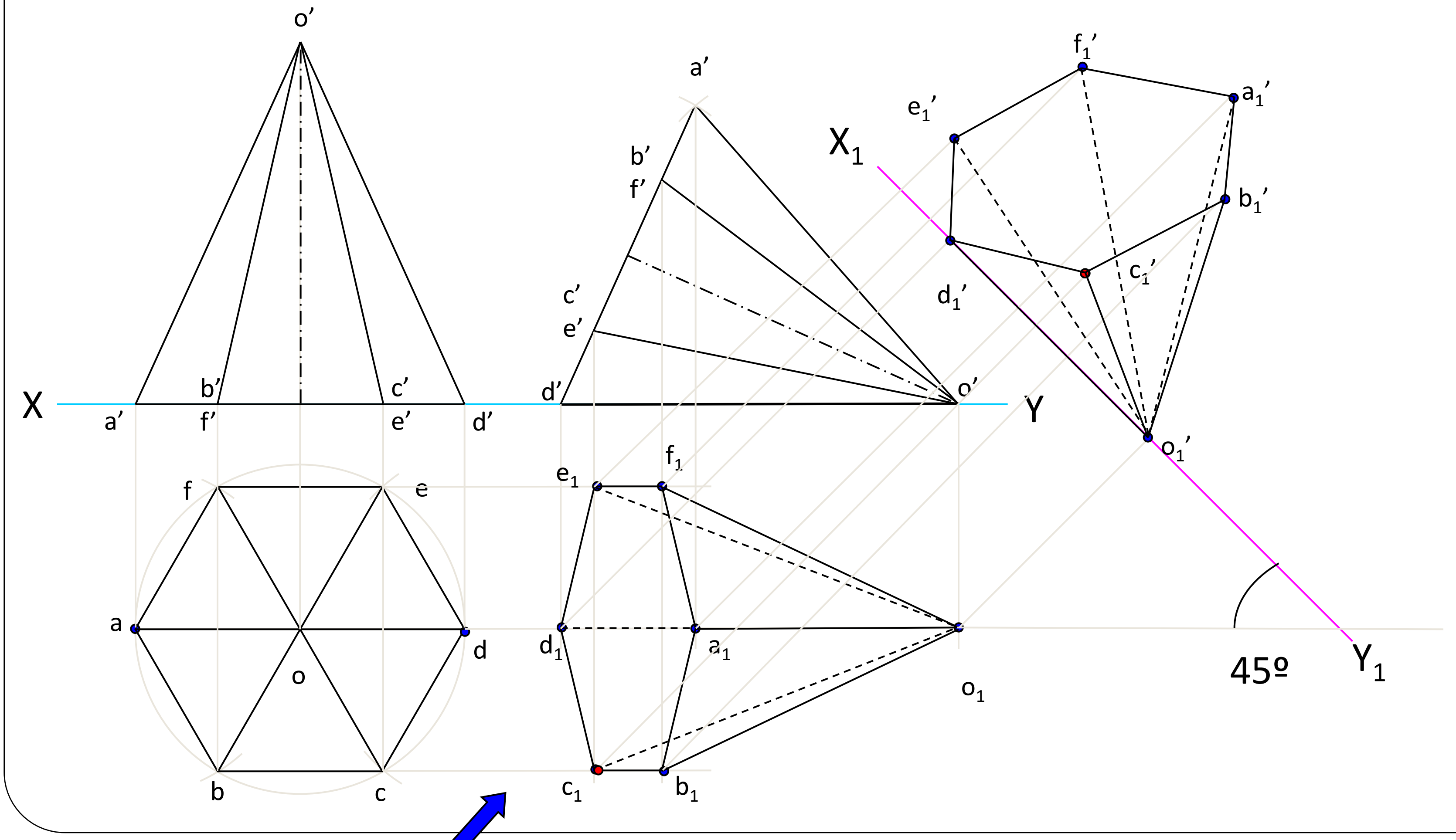
(4) For part (b), draw a line at 45° with XY in the TV. Then redraw the TV, keeping the axis at new position. Again draw the FV.



Q13.22: A hexagonal pyramid base 25 mm side and axis 55 mm long has one of its slant edge on the ground. A plane containing that edge and the axis is perpendicular to the H.P. and inclined at 45º to the V.P. Draw its projections when the apex is nearer to the V.P. than the base.

The inclination of the axis is given indirectly in this problem. When the slant edge of a pyramid rests on the HP its axis is inclined with the HP so while deciding first view the axis of the solid must be kept perpendicular to HP i.e. true shape of the base will be seen in the TV. Secondly when drawing hexagon in the TV we have to keep the corners at the extreme ends.

The vertical plane containing the slant edge on the HP and the axis is seen in the TV as o_1d_1 for drawing auxiliary FV draw an auxiliary plane X_1Y_1 at 45º from d_1o_1 extended. Then draw projectors from each point i.e. a_1 to f_1 perpendicular to X_1Y_1 and mark the points measuring their distances in the FV from old XY line.



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:

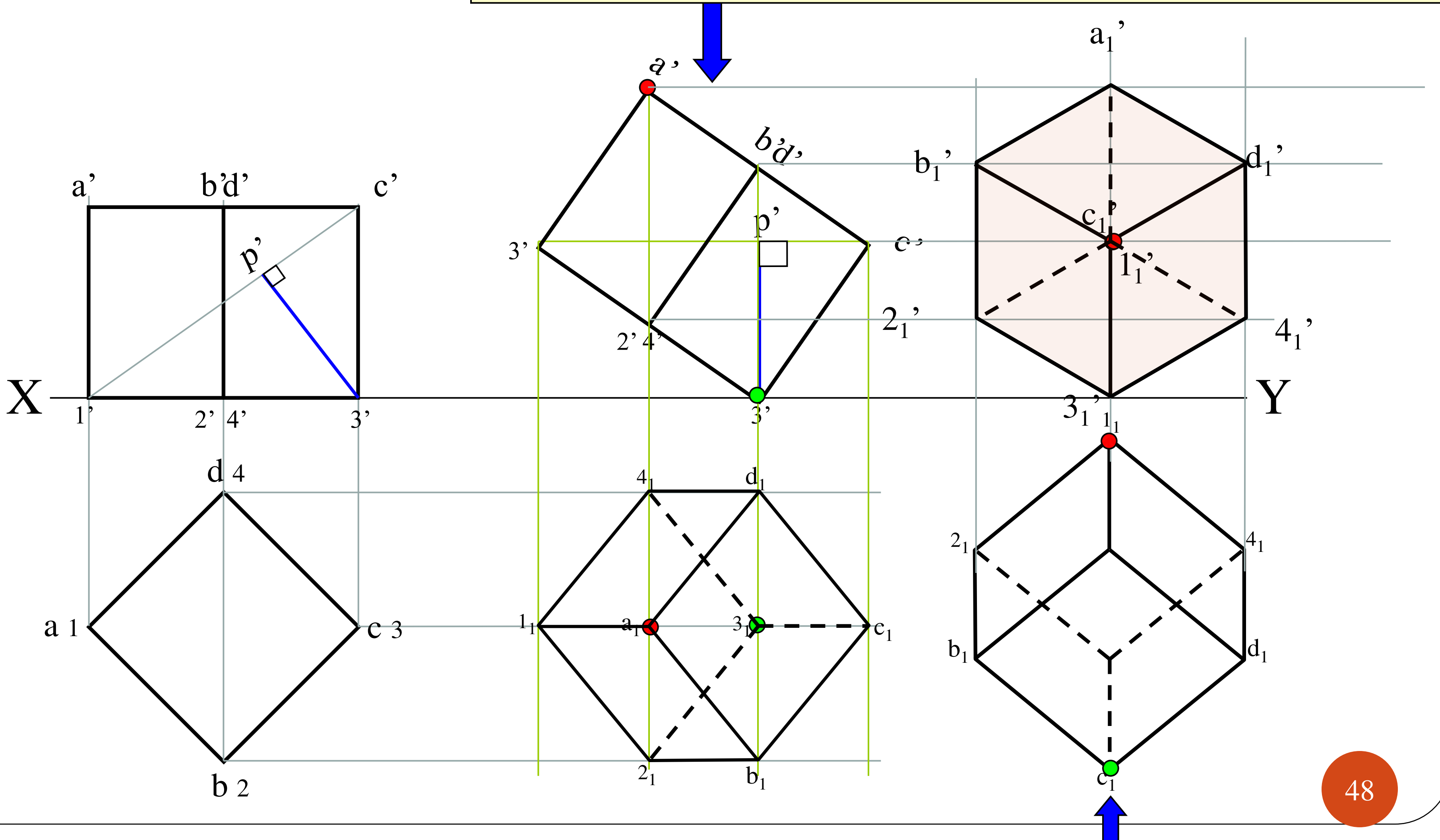
1.Assuming standing on HP, begin with TV,a square with all sides equally inclined to XY. Project FV and name all points of FV & TV.

2.Draw a body-diagonal joining c' with 1'(This can become // to xy)

3.From 3' drop a perpendicular on this and name it p'

4.Draw 2nd Fv in which 3'p' line is vertical ***means*** c'-1' 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.

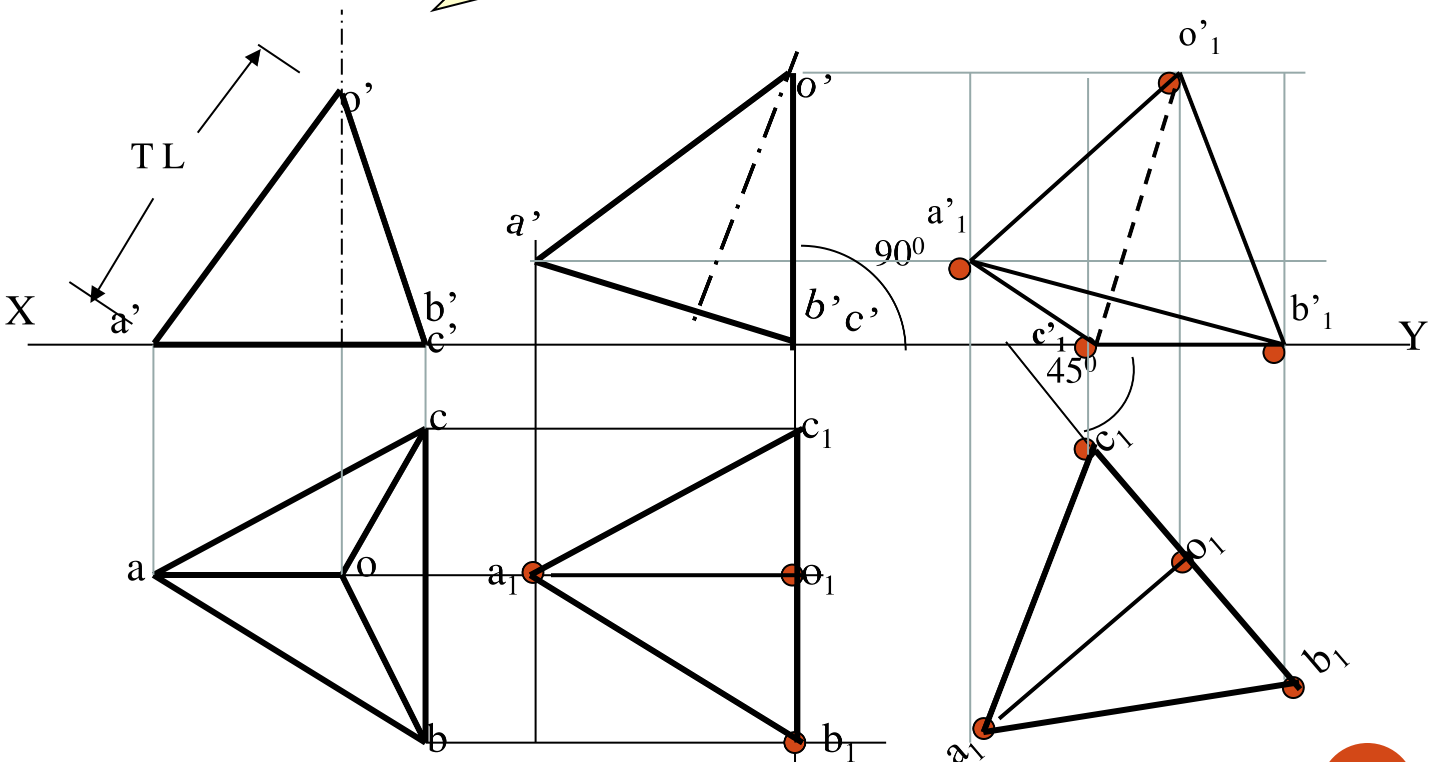


Problem 6: A tetrahedron of 50 mm long edges is resting on one edge on Hp while one triangular face containing this edge is vertical and 45^0 inclined to Vp. Draw projections.

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.

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.



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)

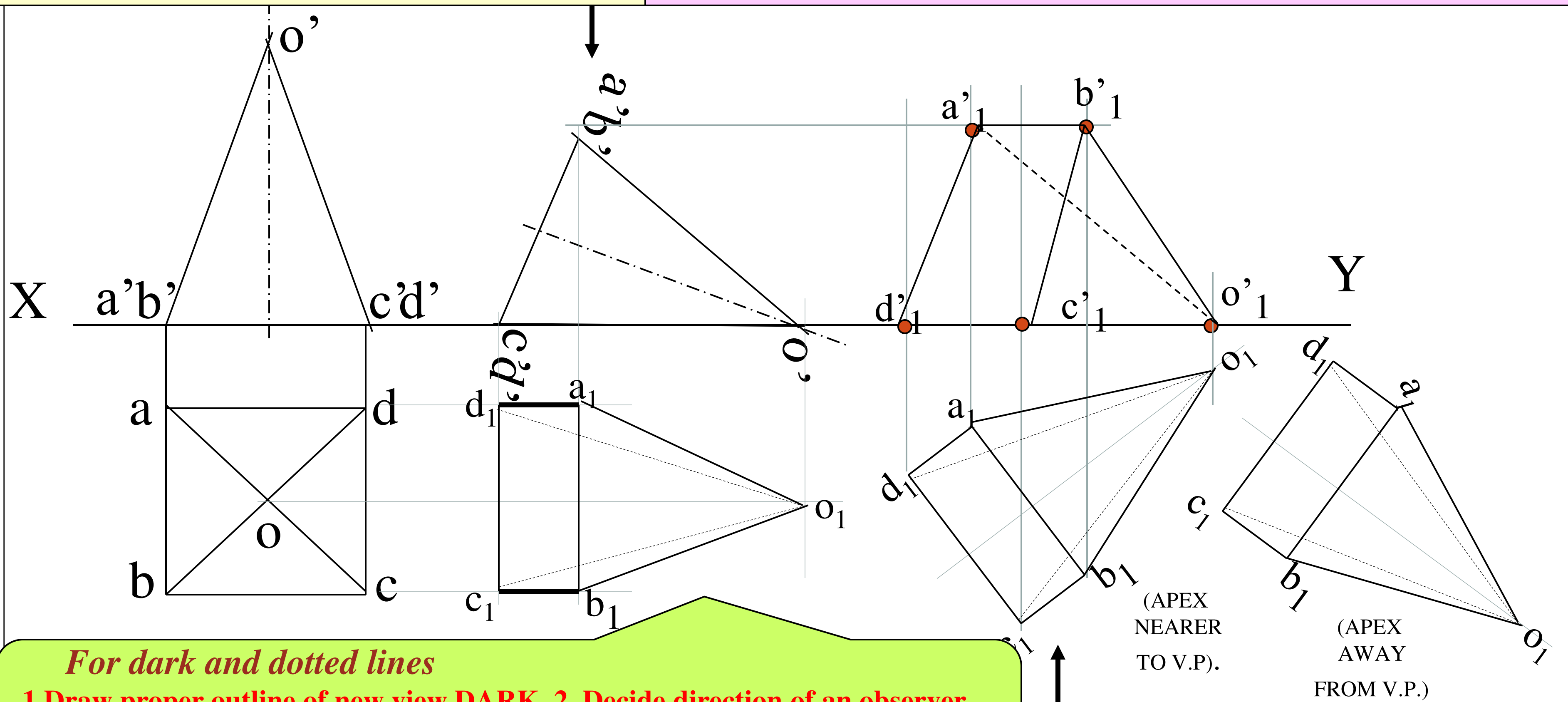
3.Draw square of 40mm sides with one side vertical Tv & taking 50 mm axis project Fv. (a triangle)

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.

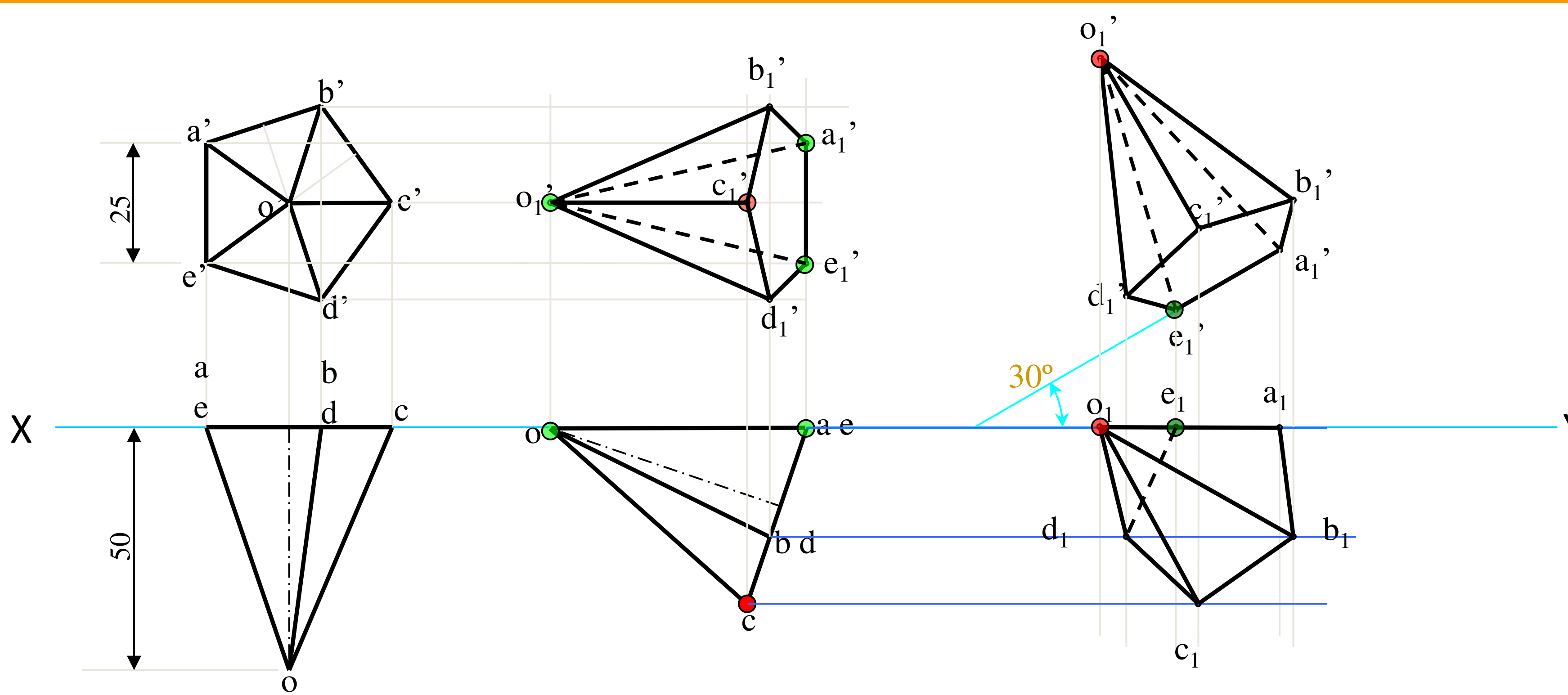
4. Select farthest point to observer and draw all lines (remaining)from it- dotted.

Problem 13.20:A pentagonal pyramid base 25 mm side and axis 50 mm long has one of its triangular faces in the VP and the edge of the base contained by that face makes an angle of 30º with the HP. Draw its projections.

Step 1. Here the inclination of the axis is given indirectly. As one triangular face of the pyramid is in the VP its axis will be inclined with the VP. So for drawing the first view keep the axis perpendicular to the VP. So the true shape of the base will be seen in the FV. Secondly when drawing true shape of the base in the FV, one edge of the base (which is to be inclined with the HP) must be kept perpendicular to the HP.

Step 2. In the TV side aeo represents a triangular face. So for drawing the TV in the second stage, keep that face on XY so that the triangular face will lie on the VP and reproduce the TV. Then draw the new FV with help of TV

Step 3. Now the edge of the base a_1'e_1' which is perpendicular to the HP must be in clined at 30º to the HP. That is incline the FV till a1'e1' is inclined at 30º with the HP. Then draw the TV.



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.

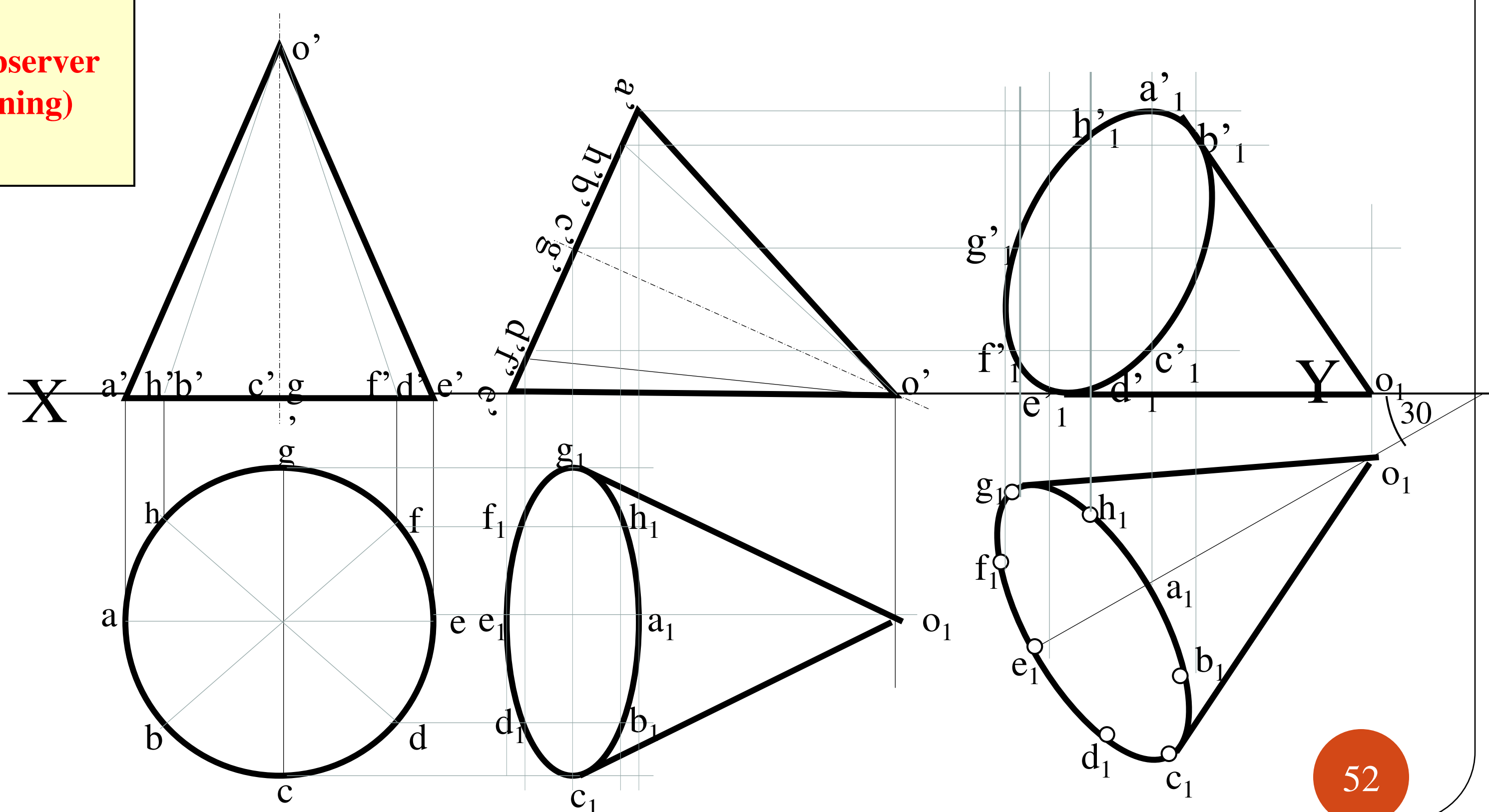
For dark and dotted lines

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 2^{nd} 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.



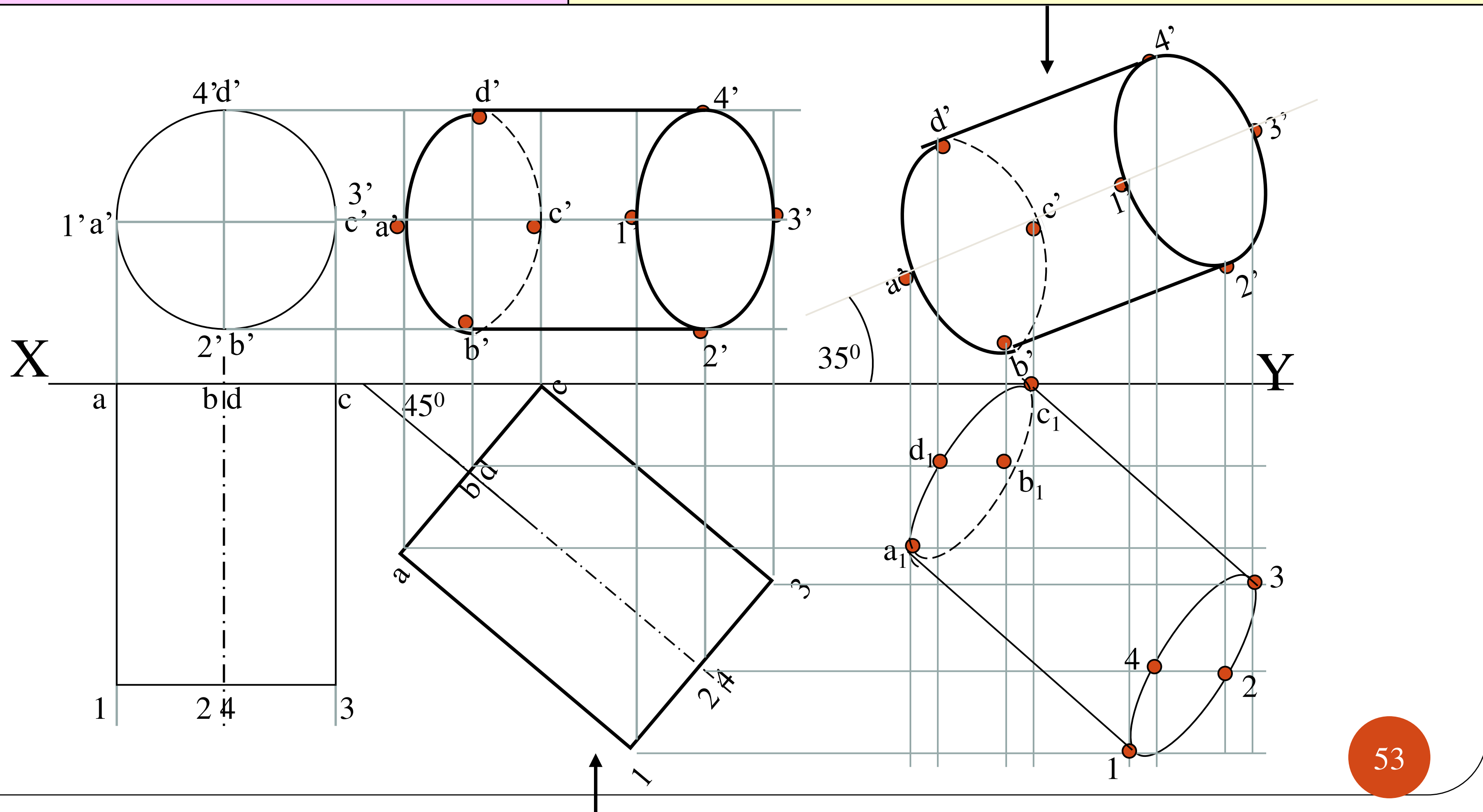
Problem 3:

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:

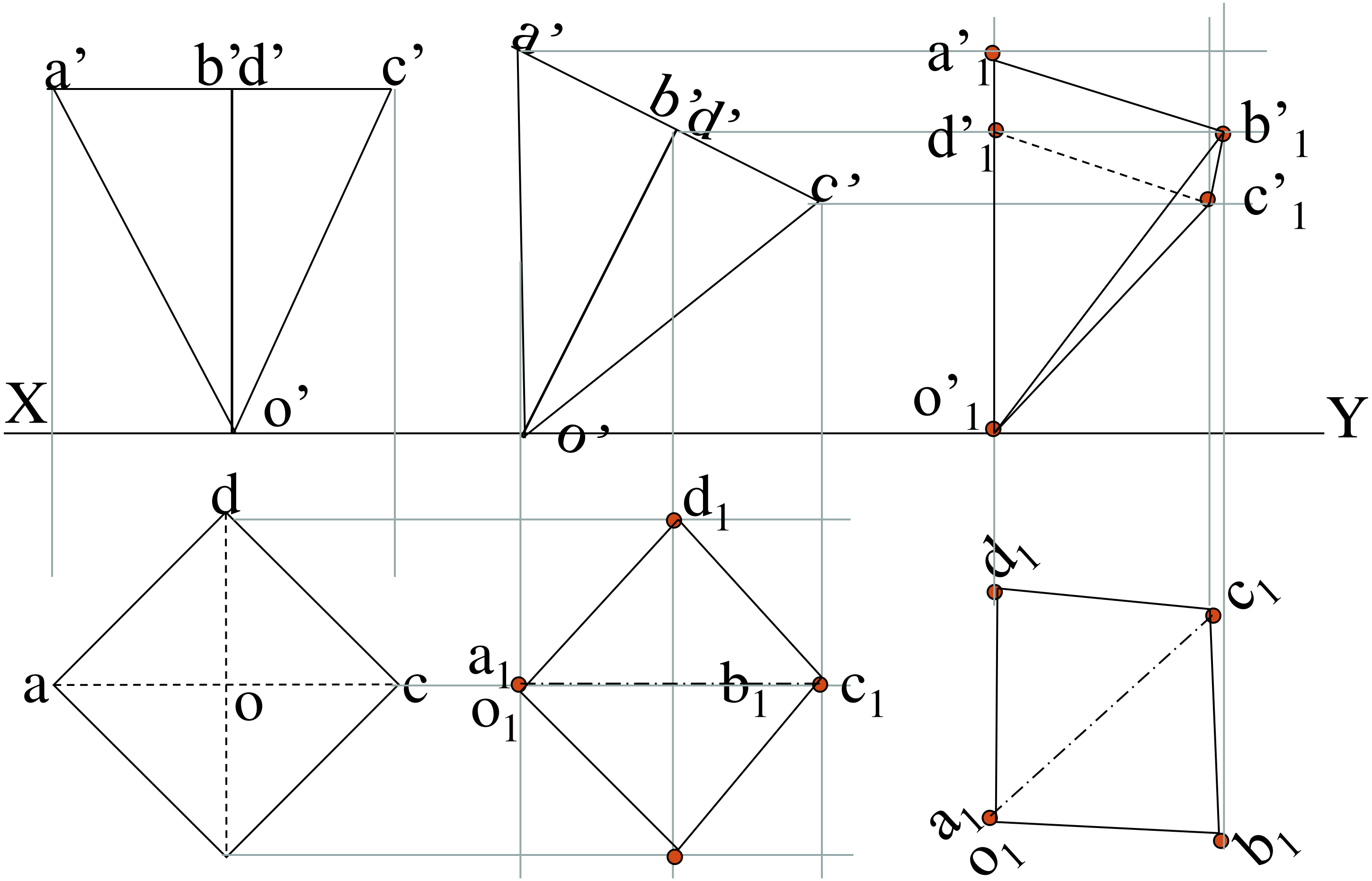
1.Assume it standing on Vp
2.It's Fv will show True Shape of base & top(circle)
3.Draw 40mm dia. Circle as Fv & taking 50 mm axis project Tv. (a Rectangle)
4.Name all points as shown in illustration.
5.Draw 2^{nd} Tv making axis 45^0 to xy And project it's Fv above xy.
6.Make visible lines dark and hidden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

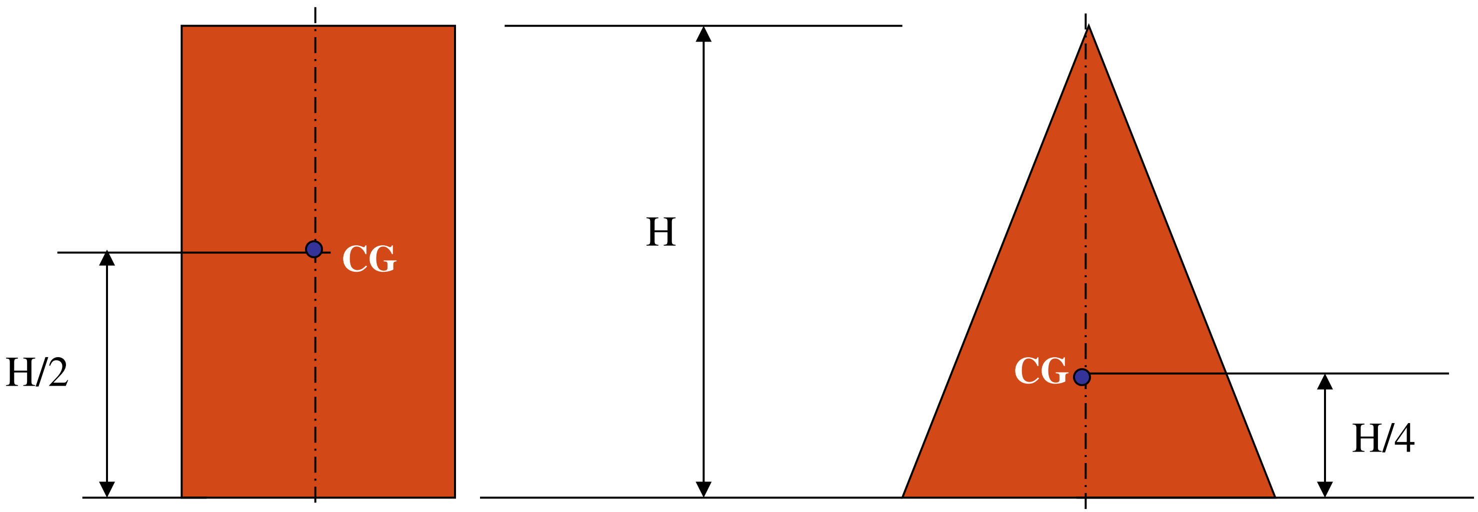
Solution Steps :

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.



FREELY SUSPENDED SOLIDS:

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



GROUP A SOLIDS
(Cylinder & Prisms)

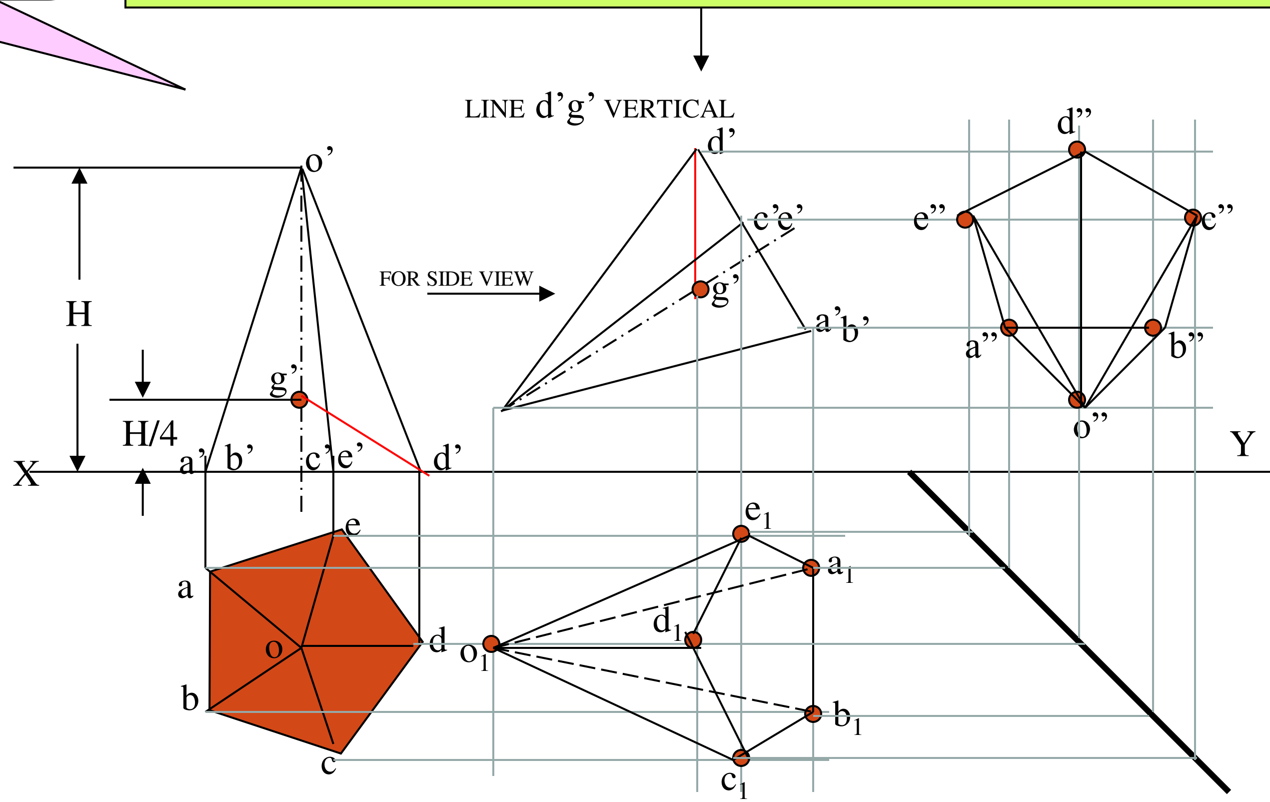
GROUP B SOLIDS
(Cone & Pyramids)

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.)

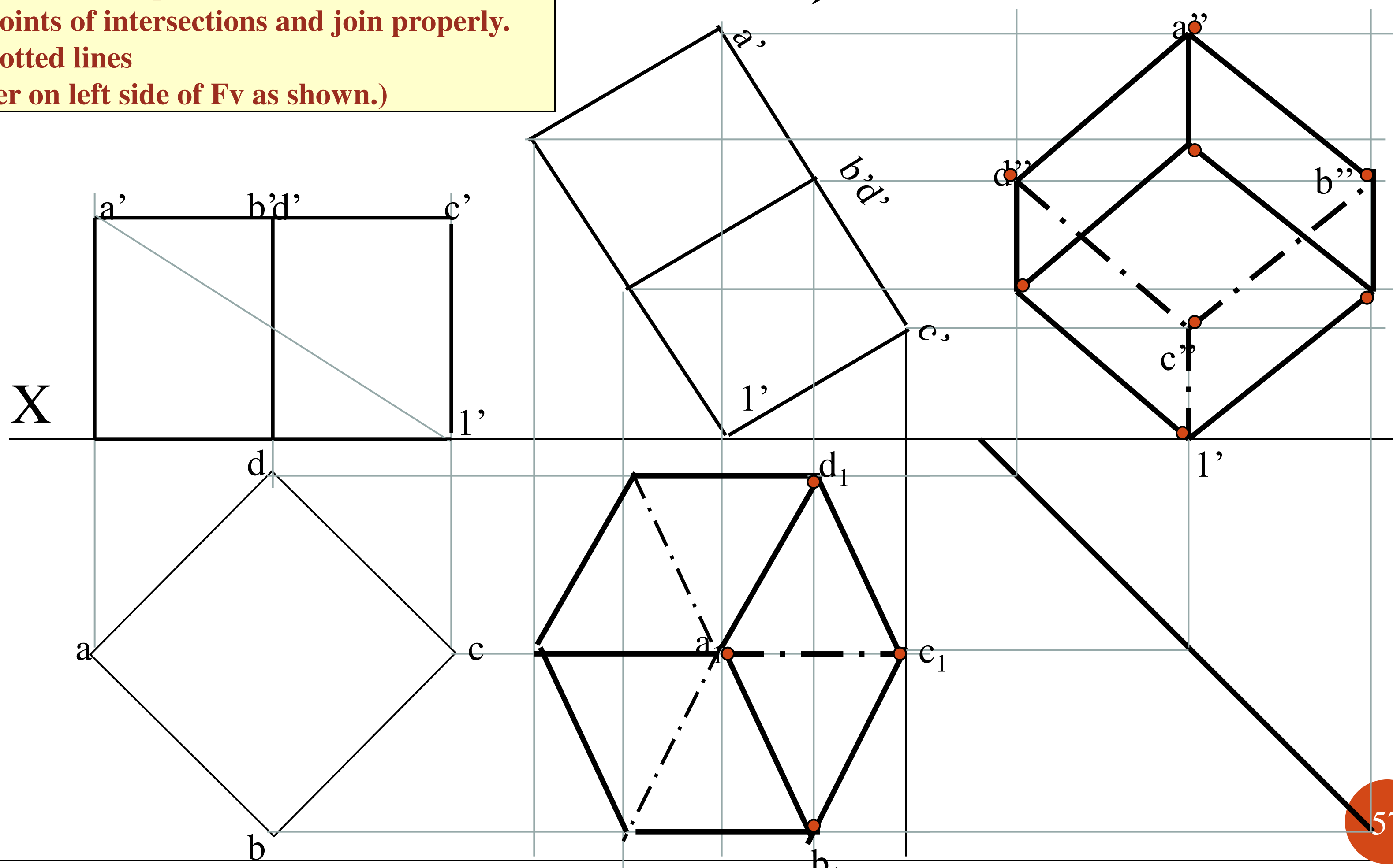
Solution Steps:

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 2^{nd} 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.