SESSION 4

PROJECTION OF SOLIDS

SOLIDS

To understand and remember various solids in this subject properly, those are classified & arranged in to two major groups.
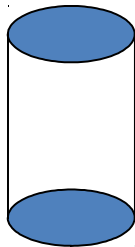
Group A
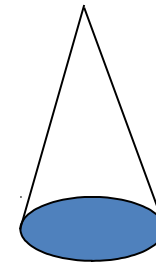
Solids having top and base of same shape

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
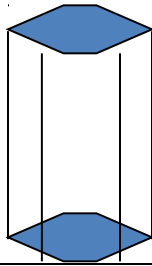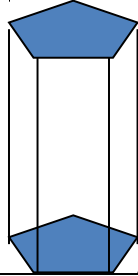
Pyramids

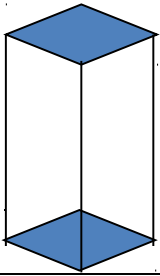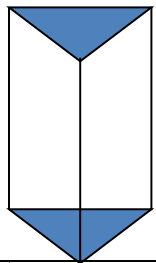Triangular   Square   Pentagonal   Hexagonal
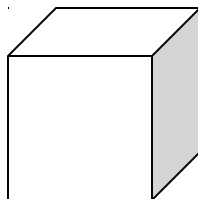
Tetrahedron
(A solid having Four triangular faces)
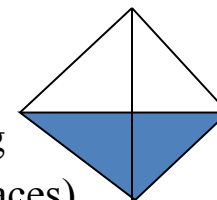
SOLIDS
Dimensional parameters of different solids.
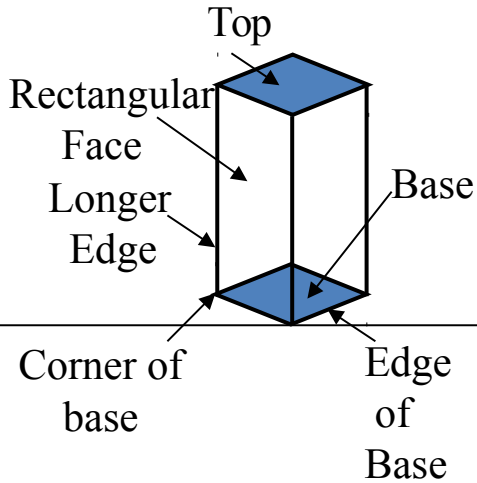
Square Prism	Square Pyramid	Cylinder	Cone

Square Prism

Top

Rectangular
Face

Longer
Edge

Base

Corner of
base

Edge
of
Base

Square Pyramid

Apex

Slant
Edge

Triangular
Face

Base

Edge
of
Base

Corner of
base

Cylinder

Base

Cone

Apex
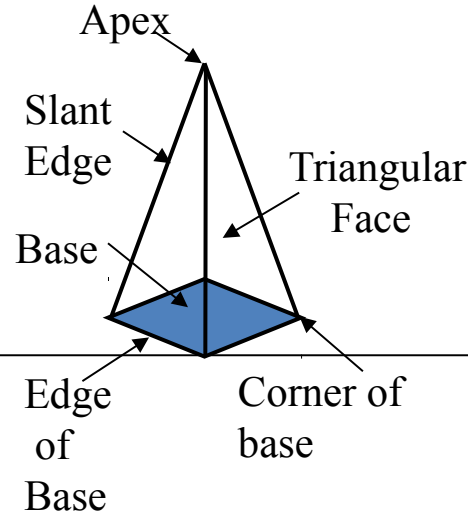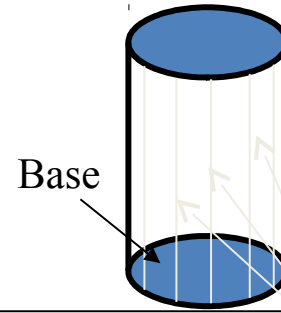
Base

Generators
*Imaginary lines
generating curved surface
of cylinder & cone.*
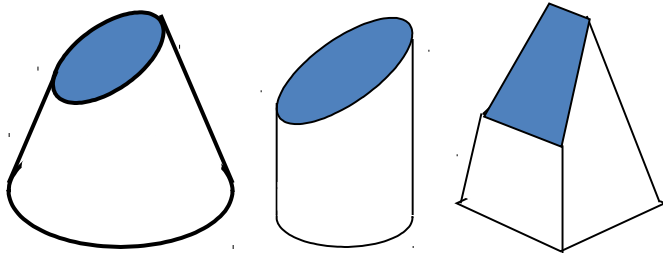
Sections of solids(top & base not parallel)
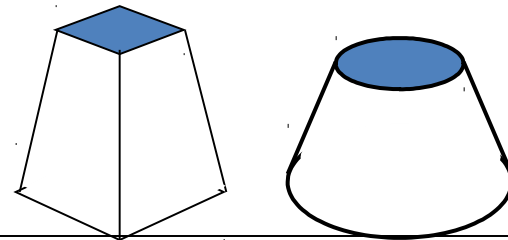
Frustum of cone & pyramids.
(top & base parallel to each other)

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
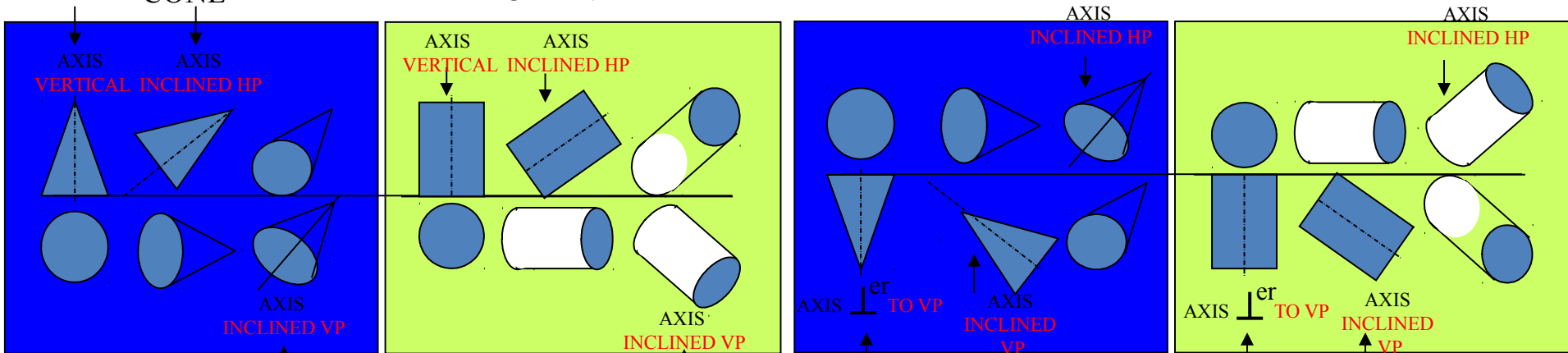
GROUP A SOLID.
CYLINDER

AXIS
VERTICAL

AXIS
INCLINED HP

AXIS
INCLINED VP

AXIS
VERTICAL

AXIS
INCLINED HP

AXIS
INCLINED VP

AXIS
INCLINED HP

AXIS ⊥er TO VP

AXIS
INCLINED VP

AXIS
INCLINED HP

AXIS ⊥er TO VP

AXIS
INCLINED VP

Three steps
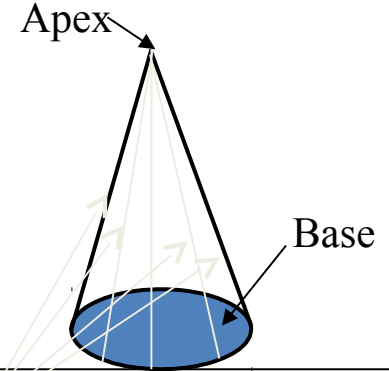If solid is inclined to Hp

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 !!

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

b' 2'

a' 1'   c' 3'

X   e' 5'   d' 4'   45º   Y

25

50

a   e   b   d   c

1 5   2   4 3

b₁'   2₁'

a₁'   c₁'   1₁'   3₁'

e₁'   d₁'   5₁'   4₁'

c

d

b

e

a

3

4

2

5

1
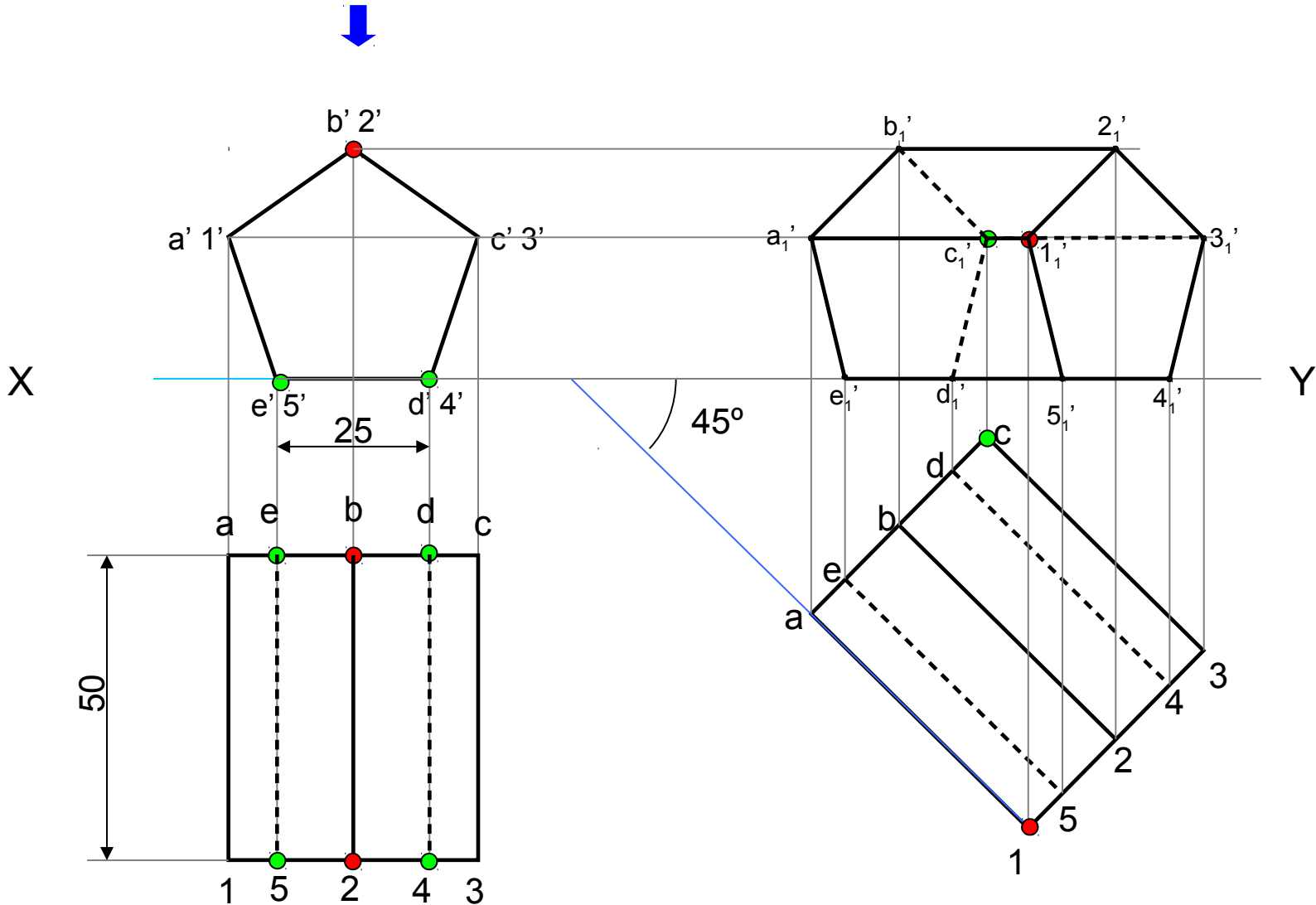
Draw the projections of a square prism , base 25 mm side and axis 50 mm long, resting on one of its base edges on H.P. The axis is inclined at 45º to H.P. and the base edge on which its rests makes an angle of 30º with the VP.

a'b'

a'b'   c'd'

c'd'

1'2'

45°

1'2'   3'4'   3'4'

b2   c3   2₁   3₁   b₁   c₁

a1

d4   1₁   4₁   a₁   d₁

a₁'   b₁'

d₁'   c₁'

1₁'   2₁'

4₁'   30°   3₁'   2₁

1₁   3₁

4₁   b₁

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 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 45º 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 45º with XY in the TV. Then redraw the TV, keeping the axis at new position. Again draw the FV.

30º

60º

X ——————————————————————————————— Y

45º β

45º
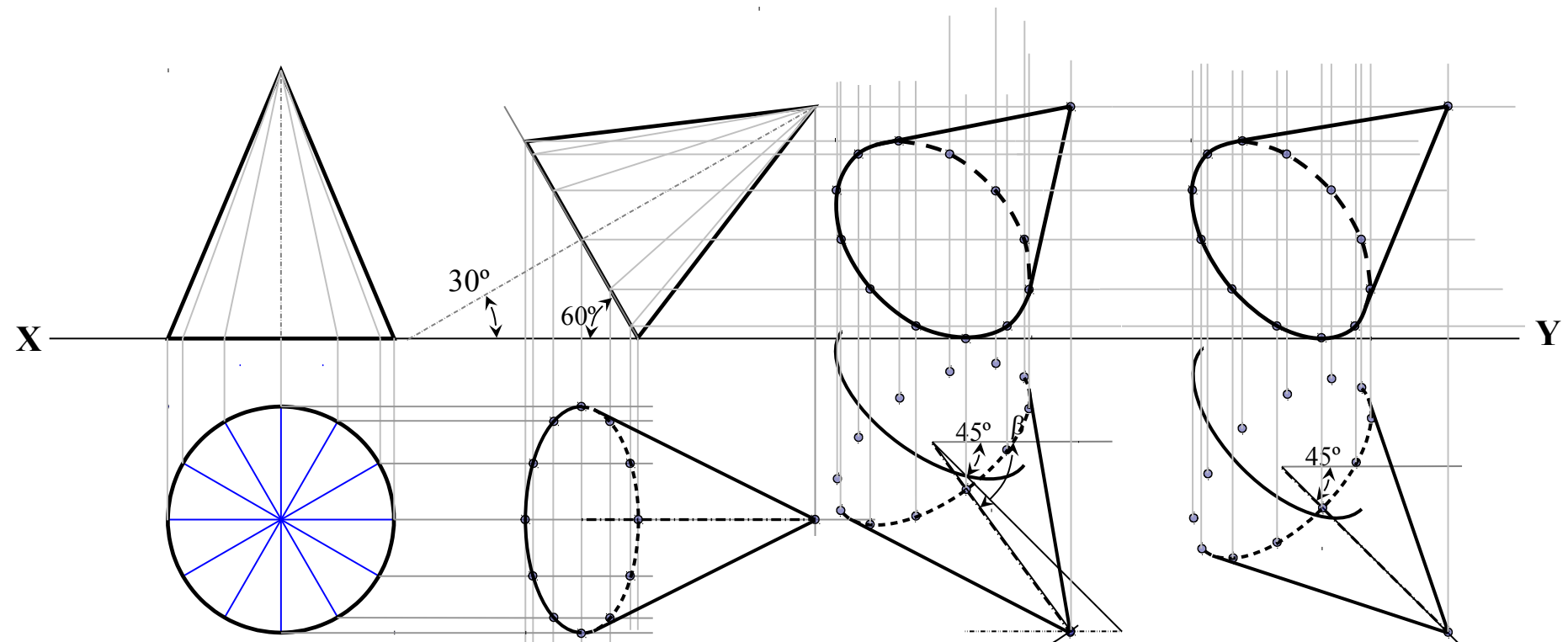
Problem 9: A right circular cone, 40 mm base diameter and 60 mm long axis is resting on Hp on one point of base circle such that it's axis makes 45⁰ inclination with Hp and 40⁰ with Vp. Draw it's Projection if the apex is near to VP

X ———————————————————————————————————— y

45^0

40^0

Axis True Length

Axis Tv Length
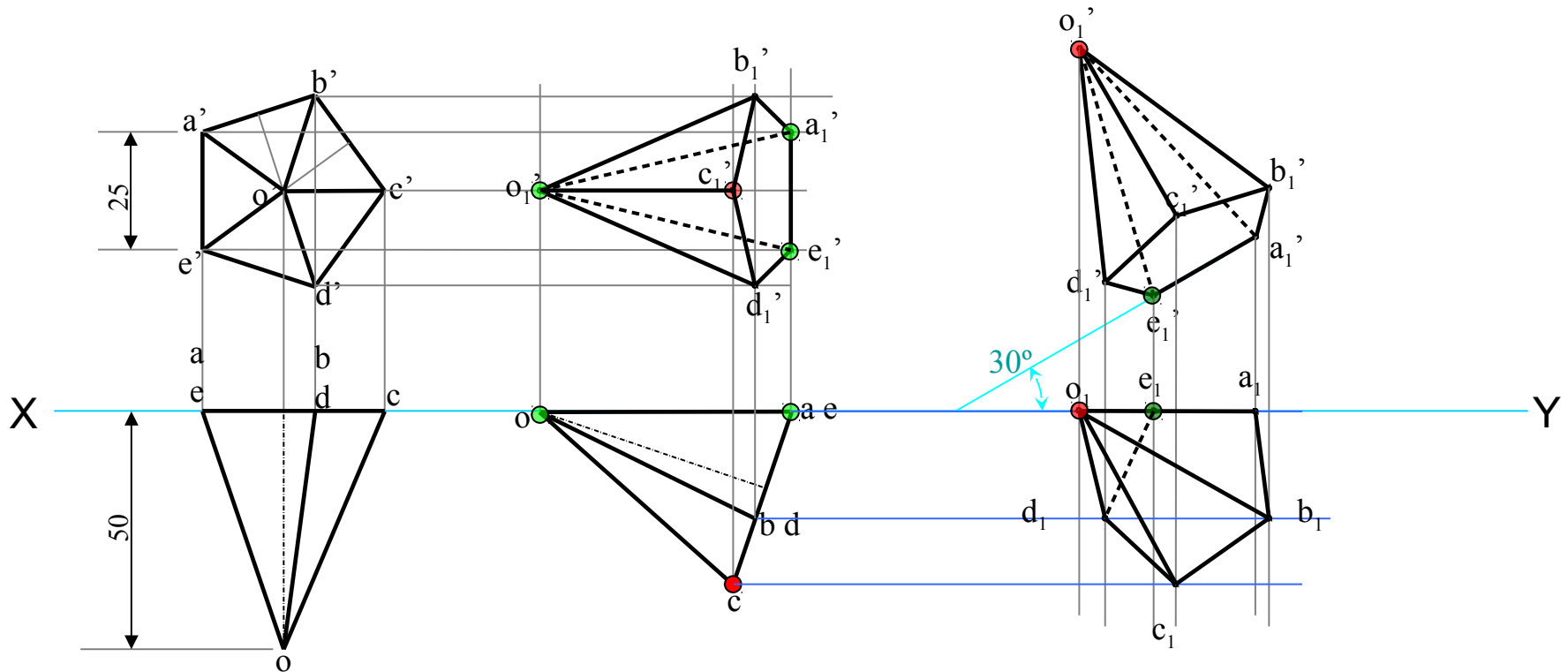
Locus of Center 1

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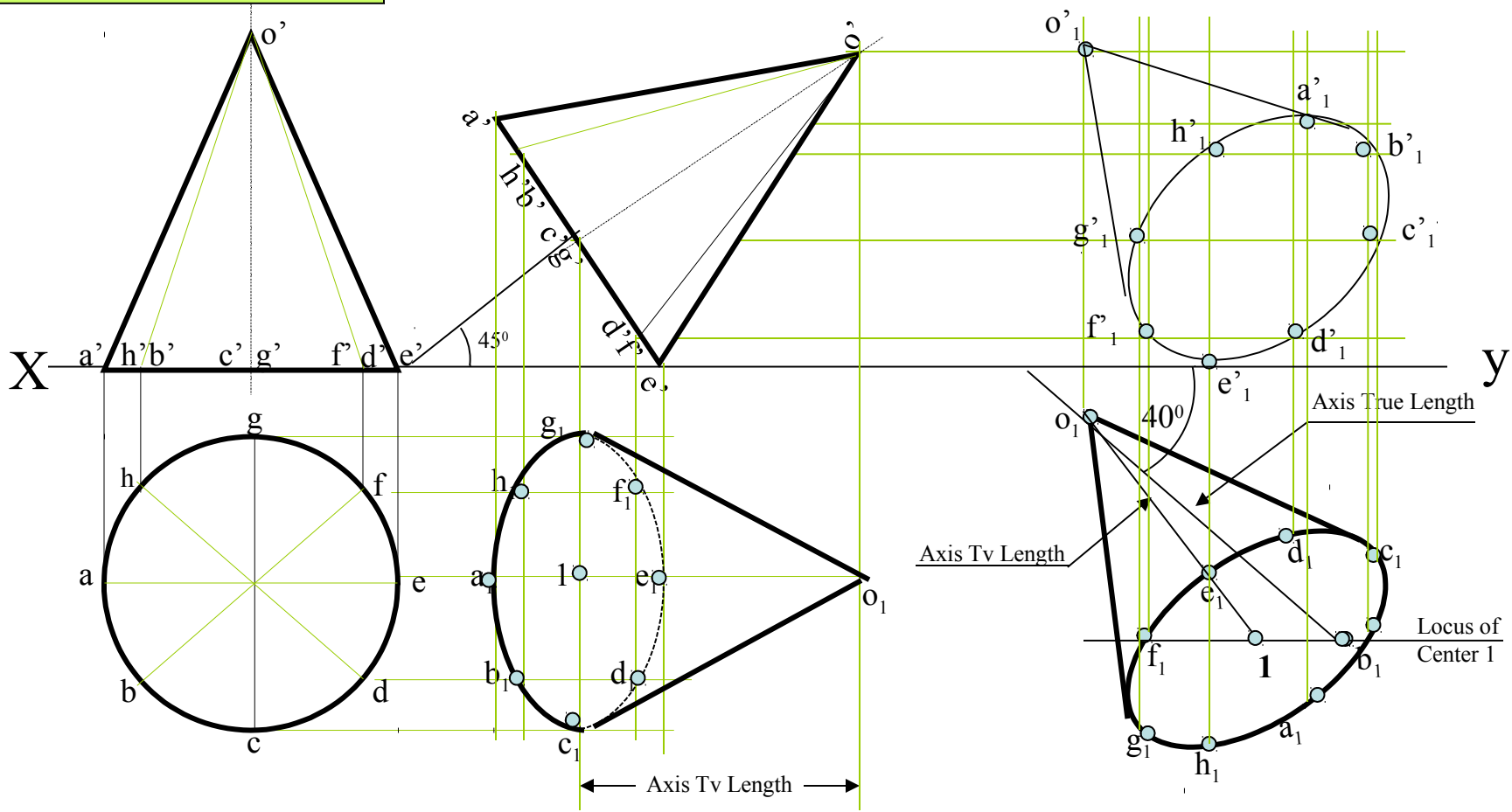
Problem 13.20: A pentagonal pyramid base 25 mm side and axis 50 mm long has one of its triangular faces in the VP and the edge of the base contained by that face makes an angle of 30° with the HP. Draw its projections.

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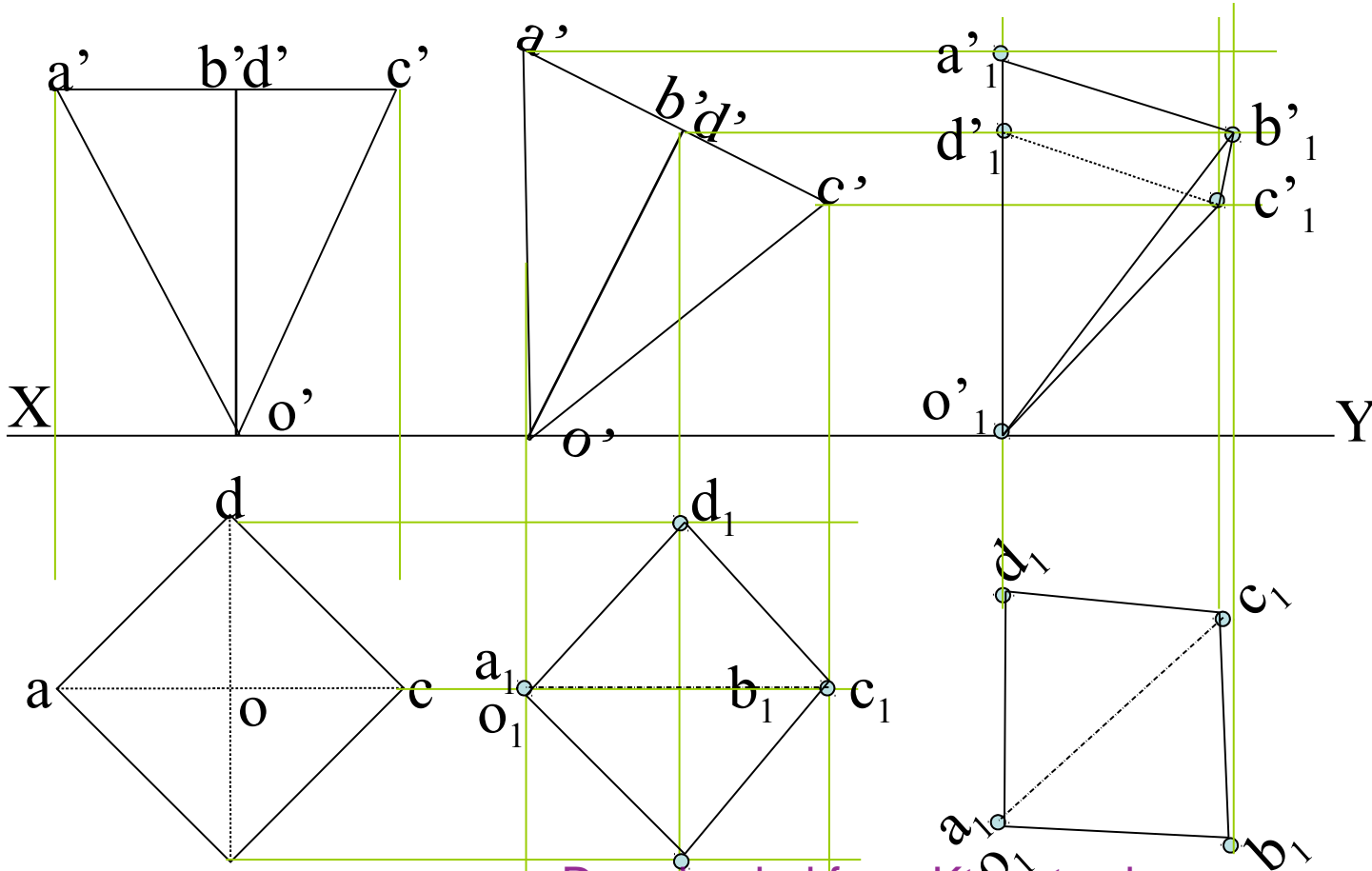
Step 3. Now the edge of the base $a_1'e_1'$ which is perpendicular to the HP must be inclined at 30° to the HP. That is incline the FV till $a1'e1'$ is inclined at 30° with the HP. Then draw the TV.

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 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.

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.

(APEX NEARER TO V.P).

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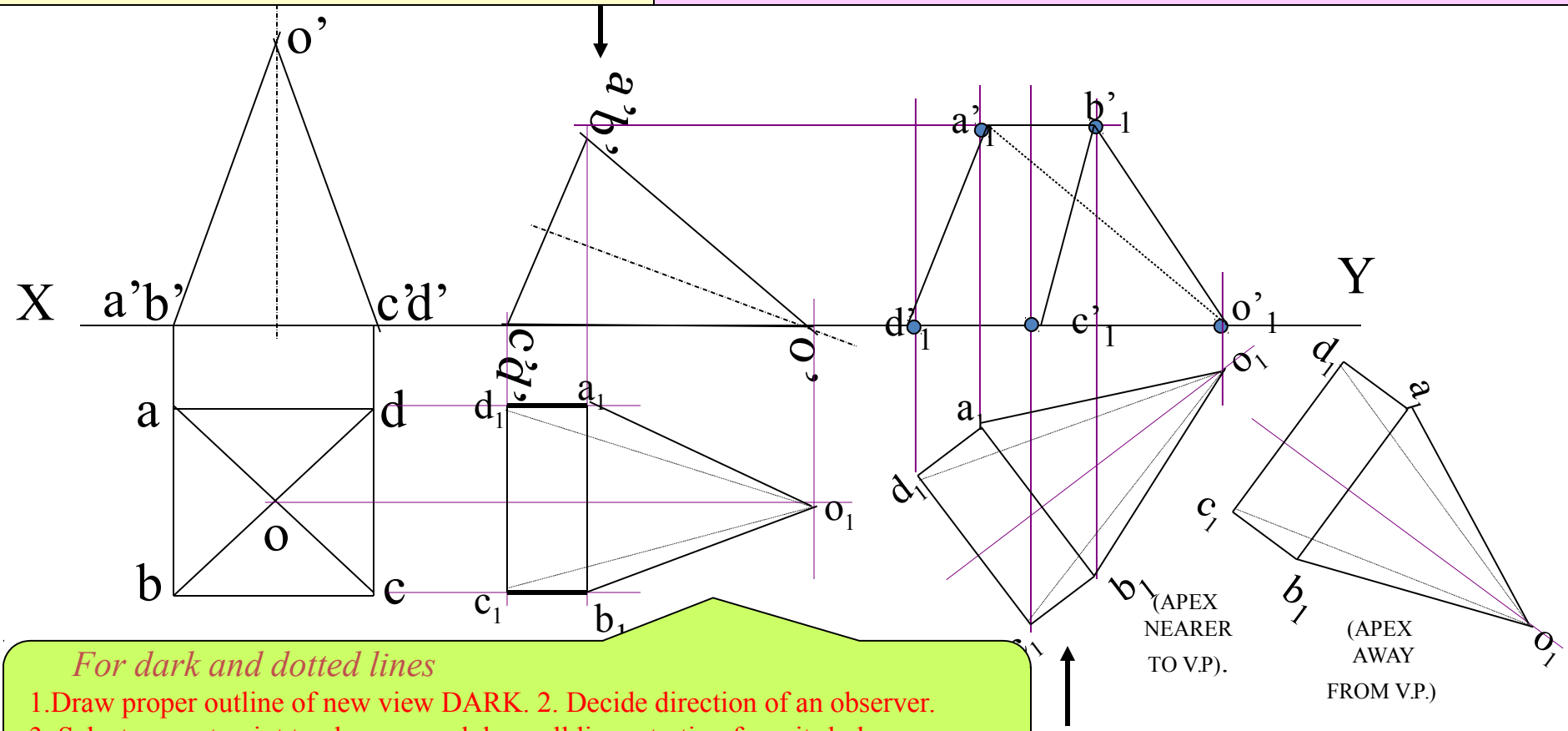
For dark and dotted lines
1. Draw proper outline of new view DARK. 2. Decide direction of an observer.
3. Select nearest point to observer and draw all lines starting from it-dark.
4. Select farthest point to observer and draw all lines (remaining)from it- dotted

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.
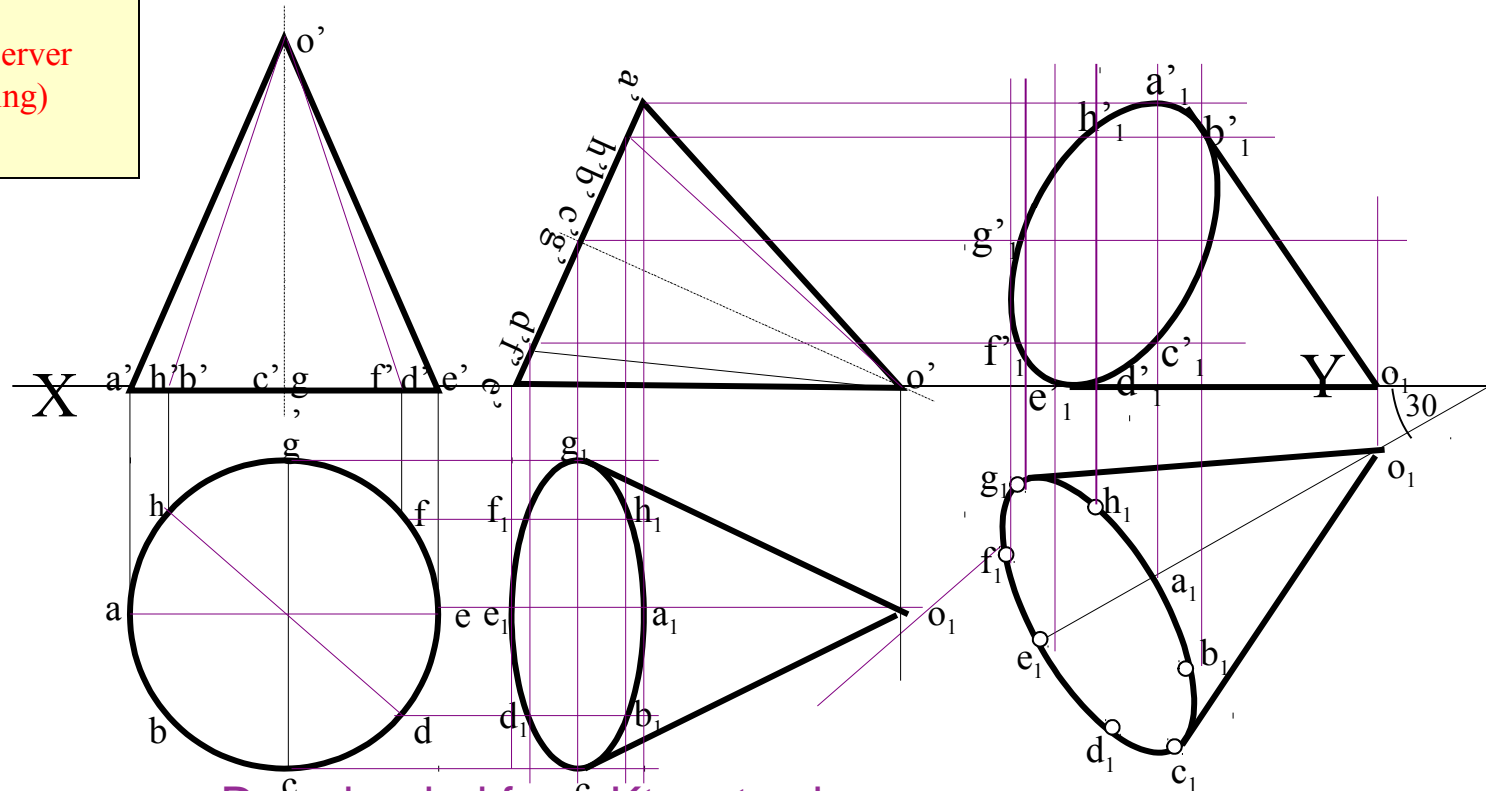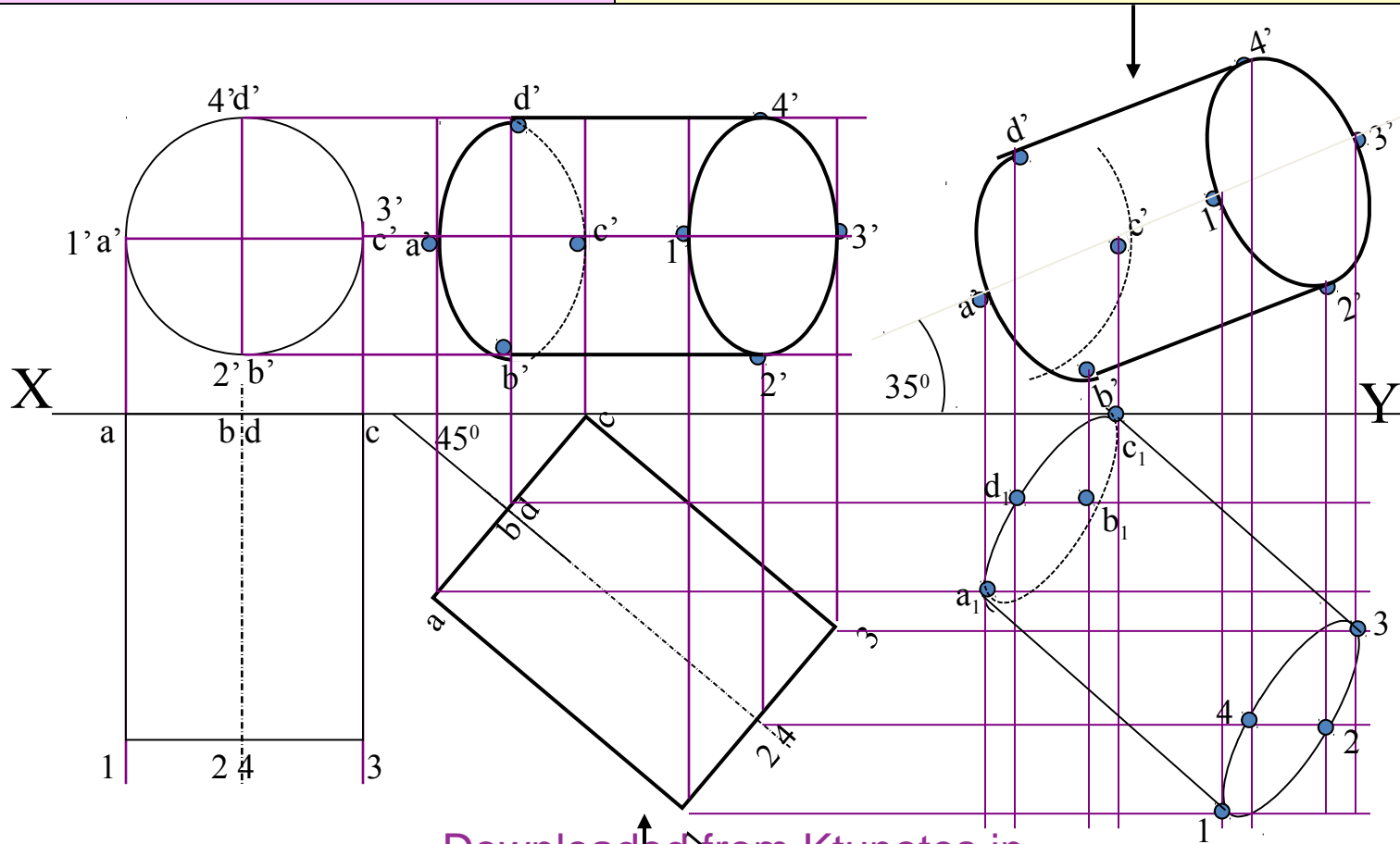
Problem 3:

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 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.
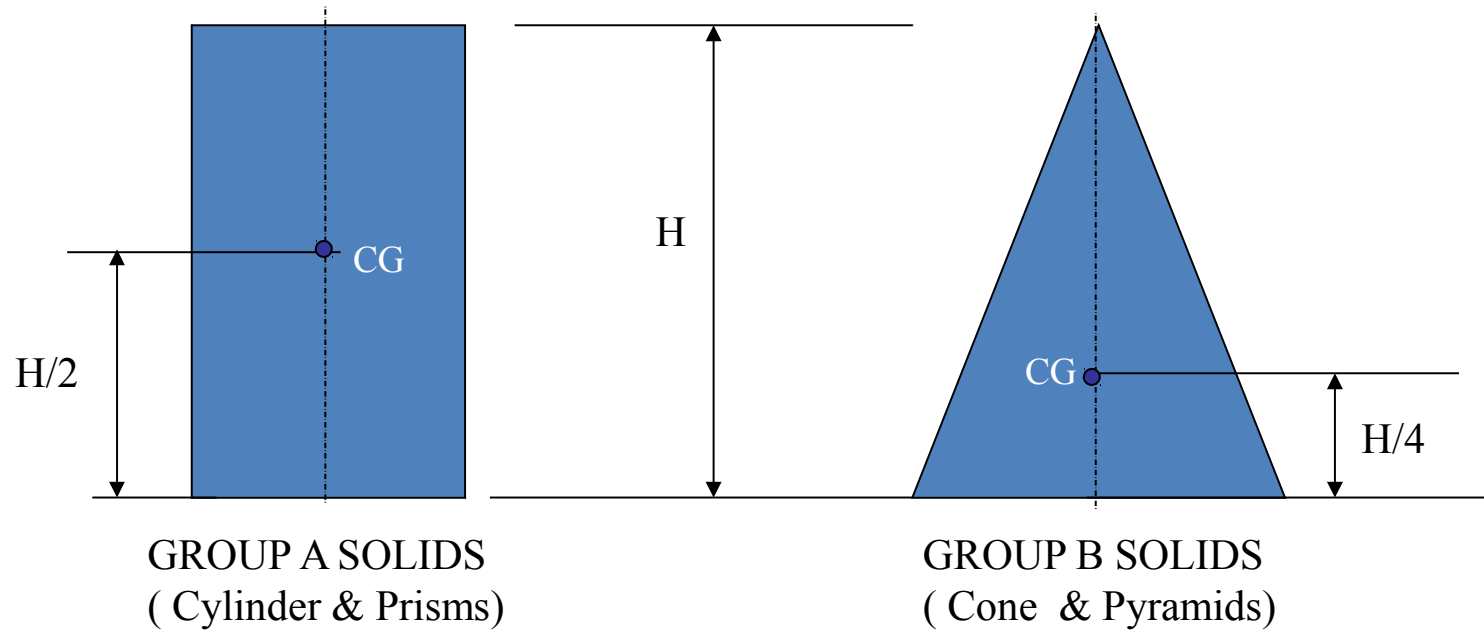
Solution Steps:
1. Assuming standing on Hp, begin with Tv,a square with all sides equally inclined to xy.Project Fv and name all points of FV & TV.
2. Draw a body-diagonal joining c' with 3'(This can become // to xy)
3. From 1' drop a perpendicular on this and name it p'
4. Draw 2ⁿᵈ Fv in which 1'-p' 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.
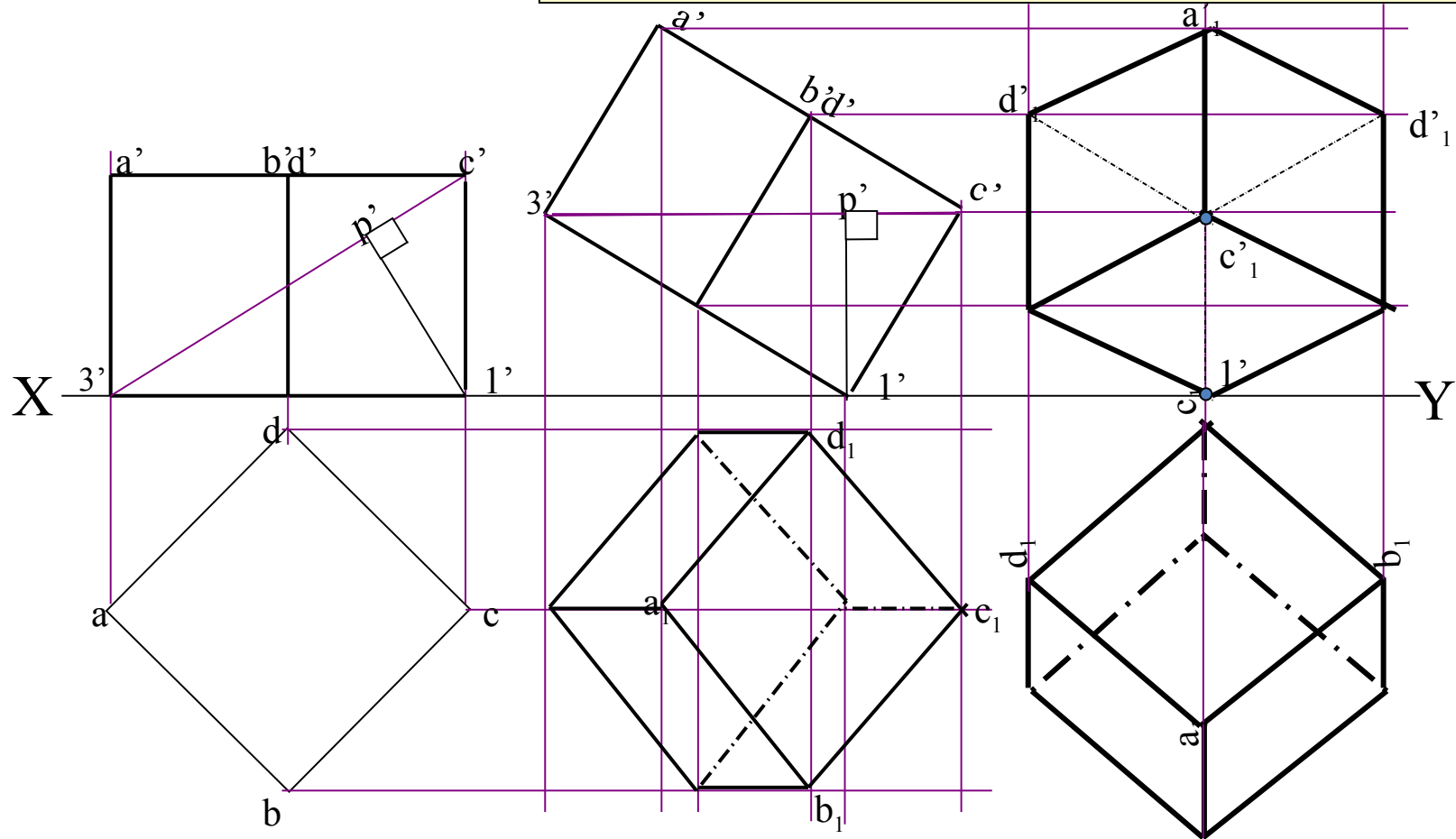
FREELY SUSPENDED SOLIDS:

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

CG

H

H/2

CG

H/4

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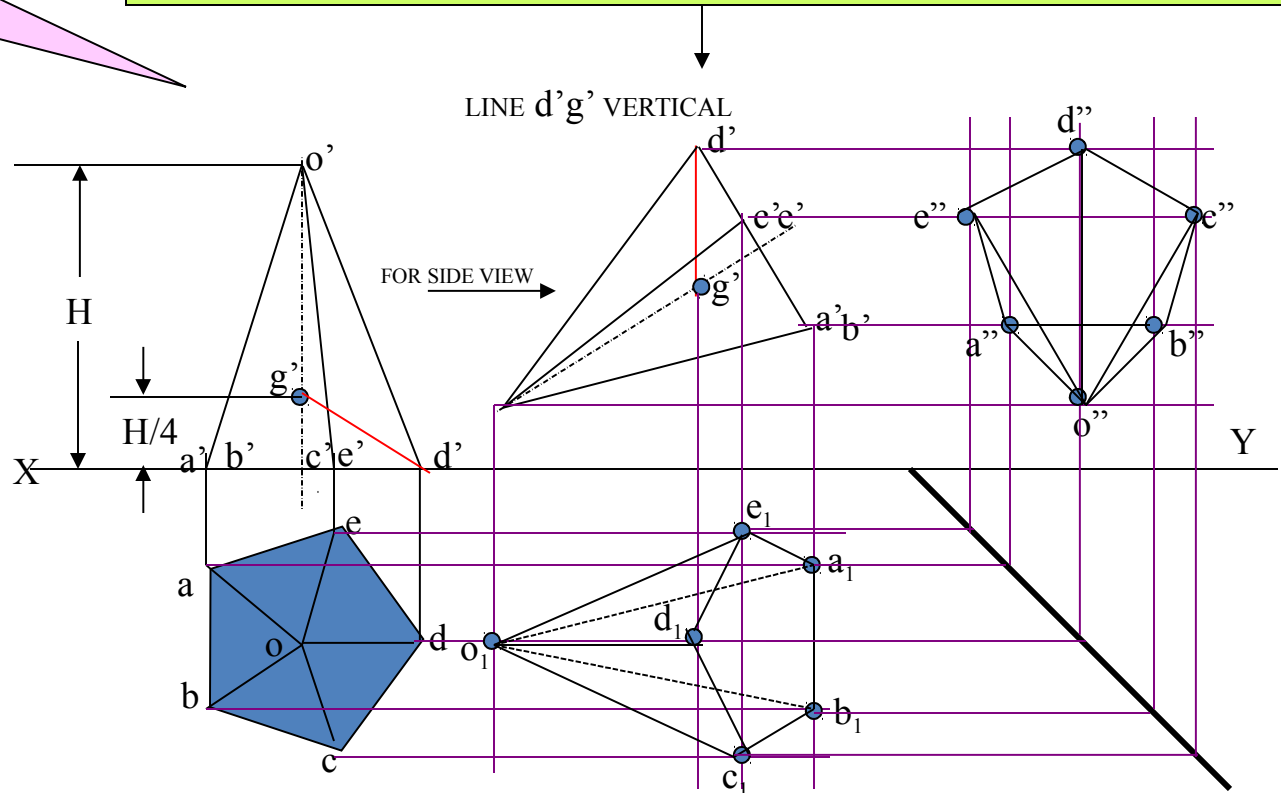
IMPORTANT:
When a solid is freely
suspended from a
corner, then line
joining point of contact
& C.G. remains
vertical.
(Here axis shows
inclination with Hp.)
So in all such cases,
assume solid standing
on Hp initially.)

LINE d'g' VERTICAL

FOR SIDE VIEW

H

H/4

X

Y

END OF SESSION 4

NEXT SESSION
SECTIONS OF SOLIDS