

Projection of Planes

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What is a plane surface ?

- A plane surface or figure has only two dimension
 - Length
 - Breadth
 - No thickness

Representation of plane

- Three non-collinear points
- A line and a point not in on the line
- Two intersecting lines
- Two parallel lines

Classification of planes

- Principal planes
 - Horizontal plane
 - Vertical plane
- Secondary planes
 - Perpendicular planes
 - Oblique planes

Perpendicular planes

- These planes are perpendicular to one or both the principal planes. They may be Horizontal, vertical or Inclined
 - Perpendicular to both the principal planes
 - Perpendicular to one of the principal planes and parallel to the other
 - Perpendicular to one of the principal planes and inclined to the others

Oblique planes

- Oblique planes is inclined to both the principal planes

Perpendicular planes

Perpendicular to both the principal planes

- Its horizontal trace(H.T) and vertical trace (V.T) are in a straight line perpendicular to xy

Perpendicular planes

Perpendicular to one of the principal planes and parallel to the other

- Plane Perpendicular to H.P and parallel to the V.P.

Perpendicular planes

Perpendicular to one of the principal planes and parallel to the other

- Plane Perpendicular to V.P and parallel to the H.P.

Perpendicular planes

Perpendicular to one of the principal planes and inclined to the other

- Plane Perpendicular to H.P and inclined to the V.P.

Perpendicular planes

Perpendicular to one of the principal planes and inclined to the other

- Plane Perpendicular to V.P and inclined to the H.P.

PROJECTIONS OF PLANES

In this topic various plane figures are the objects.

What is usually asked in the problem?

To draw their projections means F.V, T.V. & S.V.

What will be given in the problem?

1. Description of the plane figure.
2. It's position with HP and VP.

In which manner it's position with HP & VP will be described?

1. **Inclination of it's SURFACE with one of the reference planes will be given.**
2. Inclination of one of it's EDGES with other reference plane will be given
(Hence this will be a case of an object inclined to both reference Planes.)

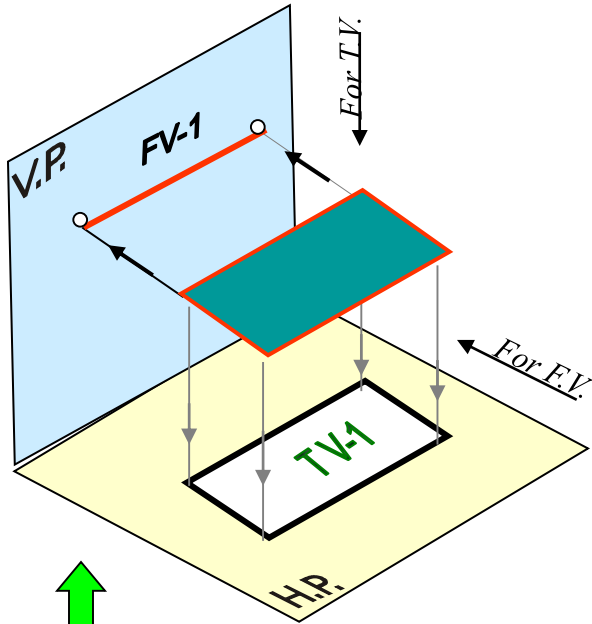
Study the illustration showing
surface & side inclination given on next page.



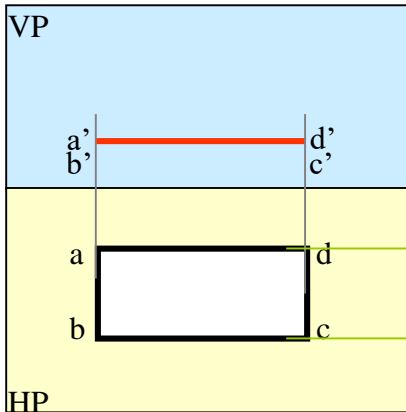
CASE OF A RECTANGLE – OBSERVE AND NOTE ALL STEPS.



SURFACE PARALLEL TO HP
PICTORIAL PRESENTATION

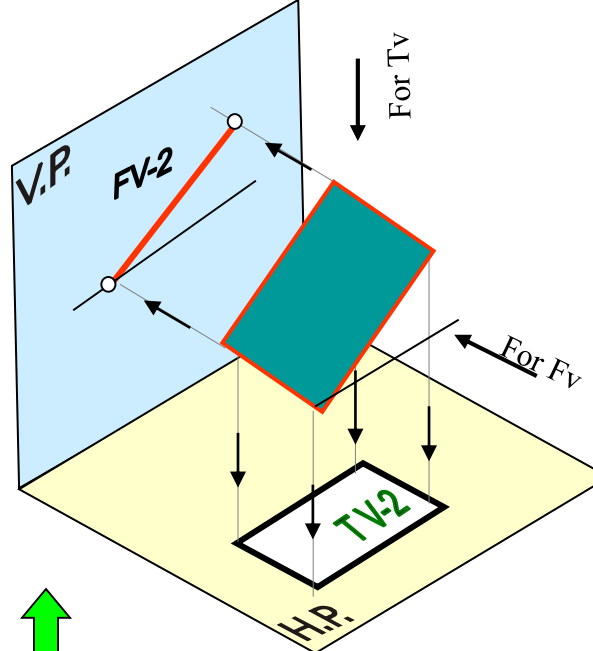


ORTHOGRAPHIC
TV-True Shape
FV- Line // to xy

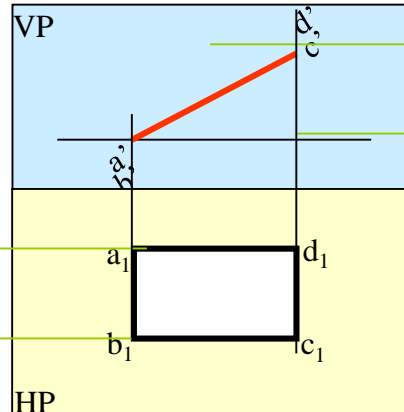


A

SURFACE INCLINED TO HP
PICTORIAL PRESENTATION

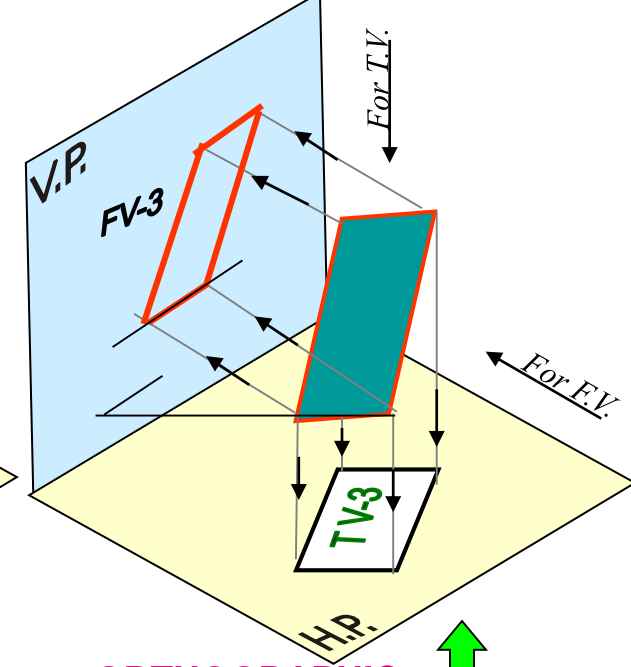


ORTHOGRAPHIC
FV- Inclined to XY
TV- Reduced Shape

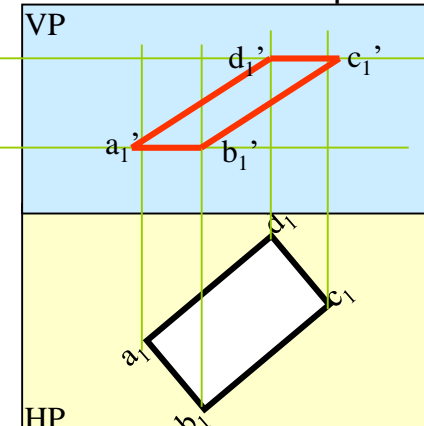


B

ONE SMALL SIDE INCLINED TO VP
PICTORIAL PRESENTATION



ORTHOGRAPHIC
FV- Apparent Shape
TV-Previous Shape



C

PROCEDURE OF SOLVING THE PROBLEM:

IN THREE STEPS EACH PROBLEM CAN BE SOLVED:(As Shown In Previous Illustration)

STEP 1. Assume suitable conditions & draw Fv & Tv of initial position.

STEP 2. Now consider surface inclination & draw 2nd Fv & Tv.

STEP 3. After this, consider side/edge inclination and draw 3rd (final) Fv & Tv.

ASSUMPTIONS FOR INITIAL POSITION:

(Initial Position means assuming surface // to HP or VP)

1.If in problem surface is inclined to HP – assume it // HP

Or If surface is inclined to VP – assume it // to VP

2. Now if surface is assumed // to HP- It's TV will show True Shape.

And If surface is assumed // to VP – It's FV will show True Shape.

3. Hence begin with drawing TV or FV as True Shape.

4. While drawing this True Shape –

keep one side/edge (which is making inclination) perpendicular to xy line
(similar to pair no. **A** on previous page illustration).

**Now Complete STEP 2. By making surface inclined to the rasp plane & project it's other view.
(Ref. 2nd pair **B** on previous page illustration)**

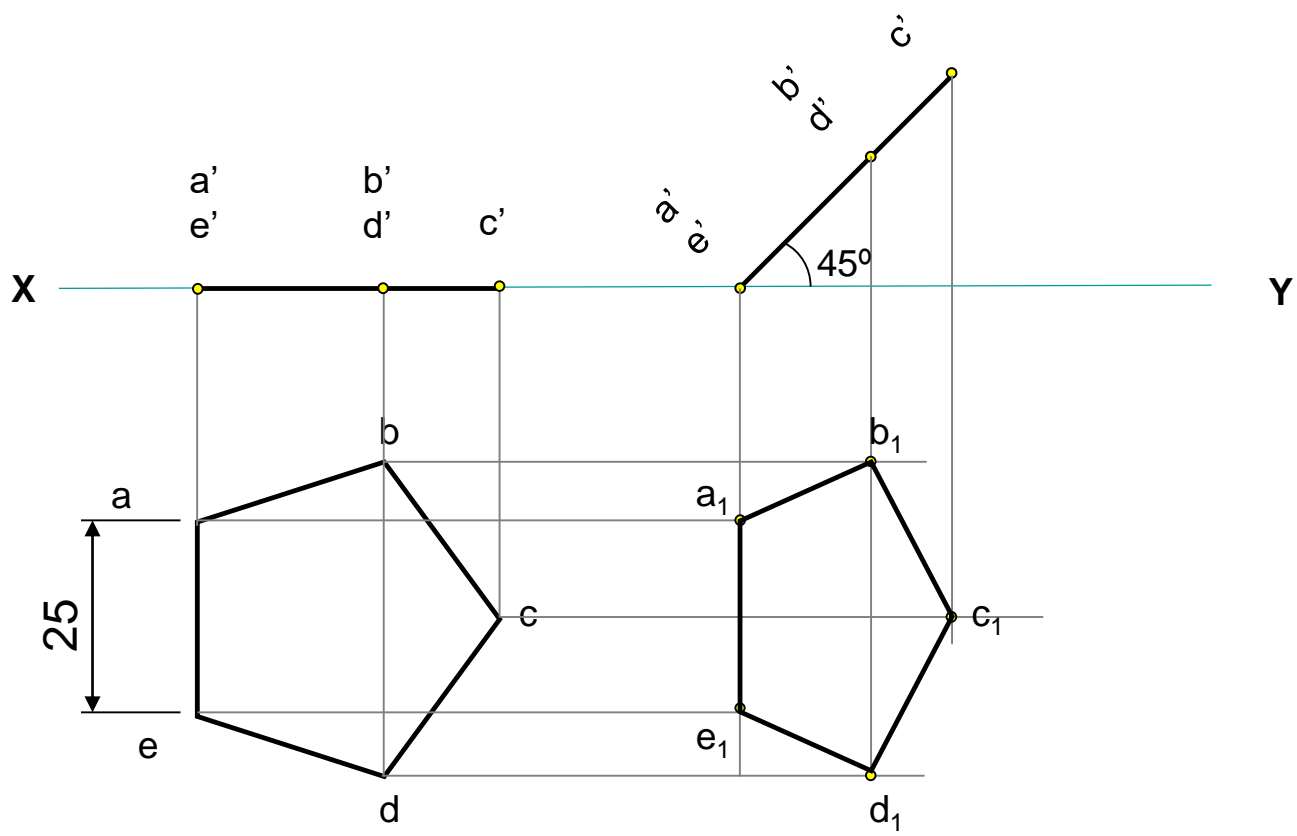
**Now Complete STEP 3. By making side inclined to the rasp plane & project it's other view.
(Ref. 3rd pair **C** on previous page illustration)**

APPLY SAME STEPS TO SOLVE NEXT PROBLEMS

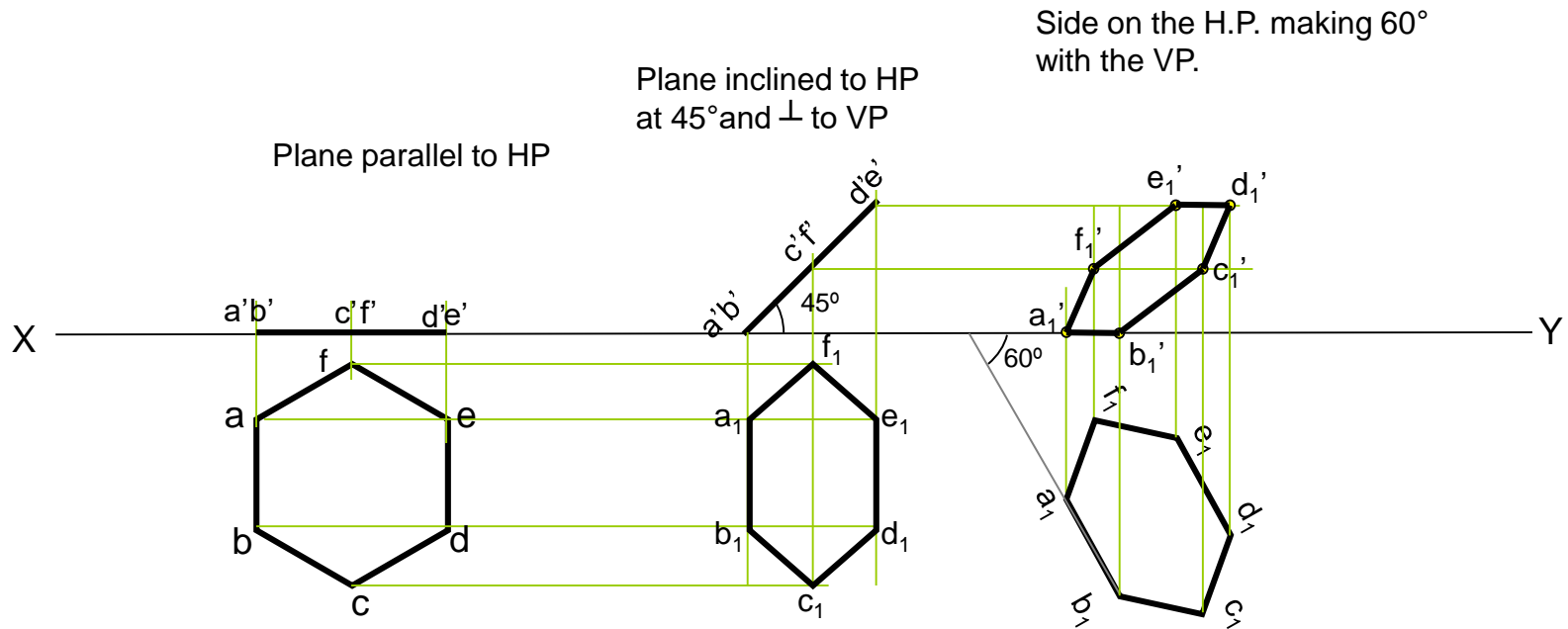
SOLVED EXAMPLES

Ex 1: A regular pentagon of 25mm side has one side on the ground. Its plane is inclined at 45° 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



Ex 2: 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 45° with the H.P.

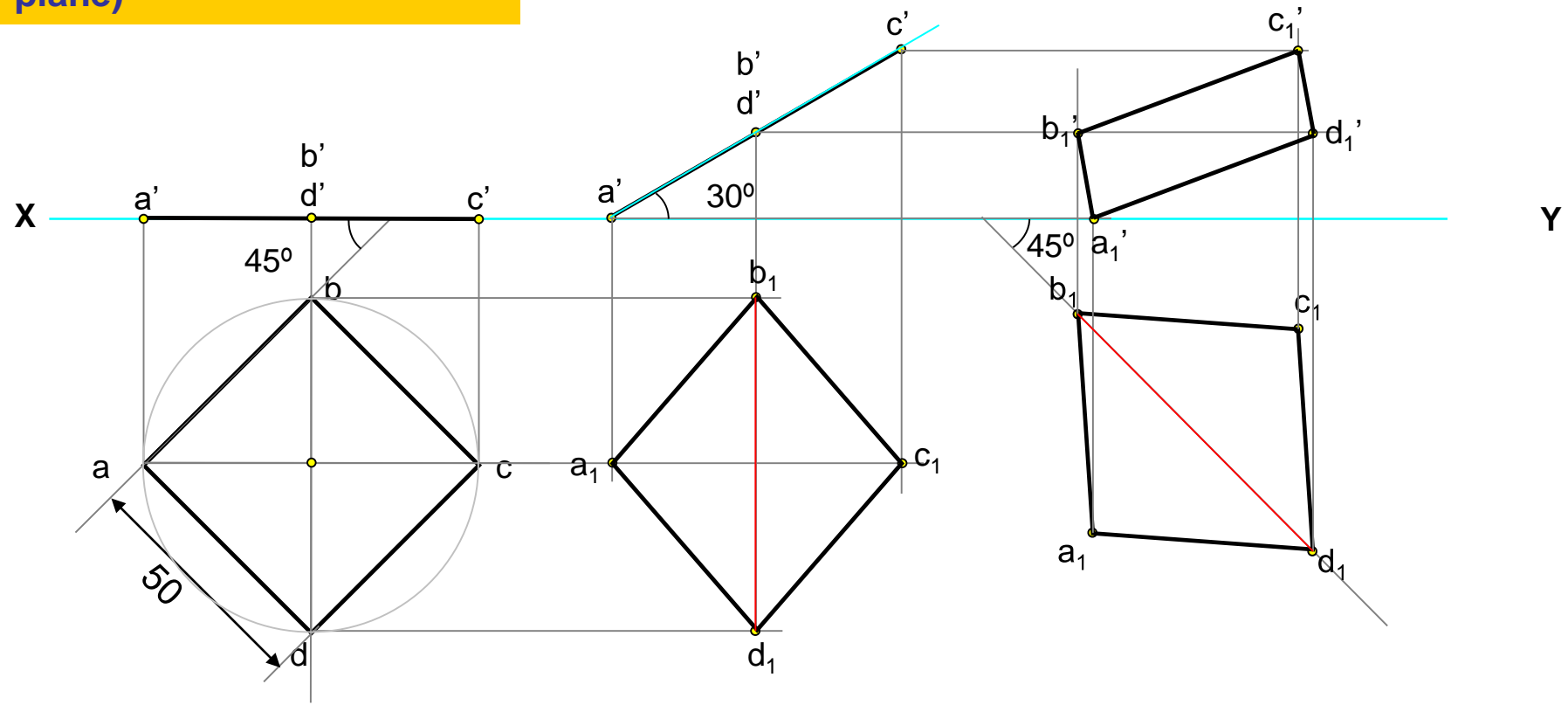


Ex 3: A square ABCD of 50 mm side has its corner A in the H.P., its diagonal AC inclined at 30° to the H.P. and the diagonal BD inclined at 45° to the V.P. and parallel to the H.P. Draw its projections.

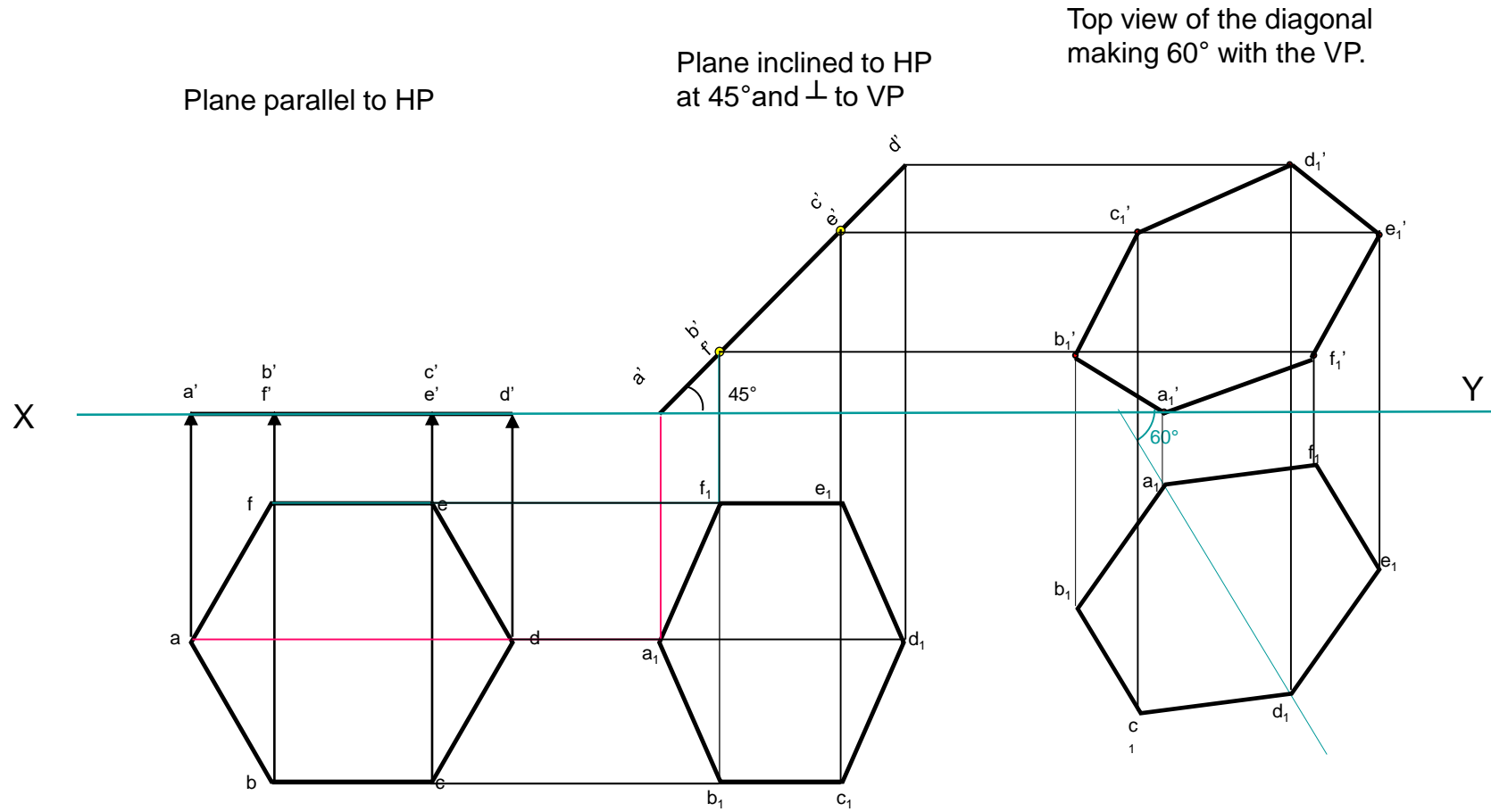
Keep AC parallel to the H.P. & BD perpendicular to V.P. (considering inclination of AC as inclination of the plane)

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

Incline BD at 45° to the V.P.



Ex 4: A regular hexagon of 40mm side has a corner in the HP. Its surface inclined at 45° 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.

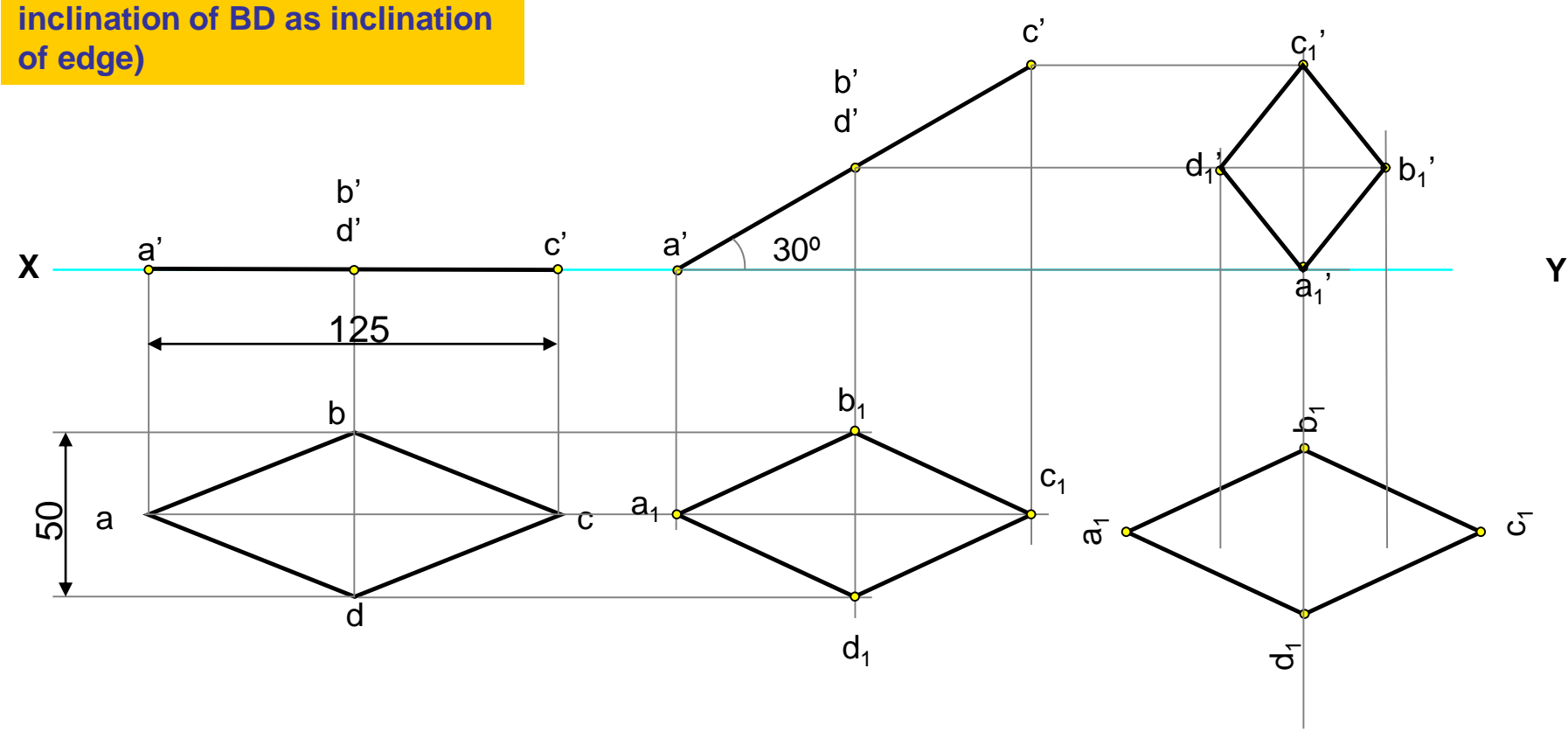


Ex 5: Draw projections of a rhombus having diagonals 125 mm and 50 mm long, the smaller diagonal of which is parallel to both the principal planes, while the other is inclined at 30° to the H.P.

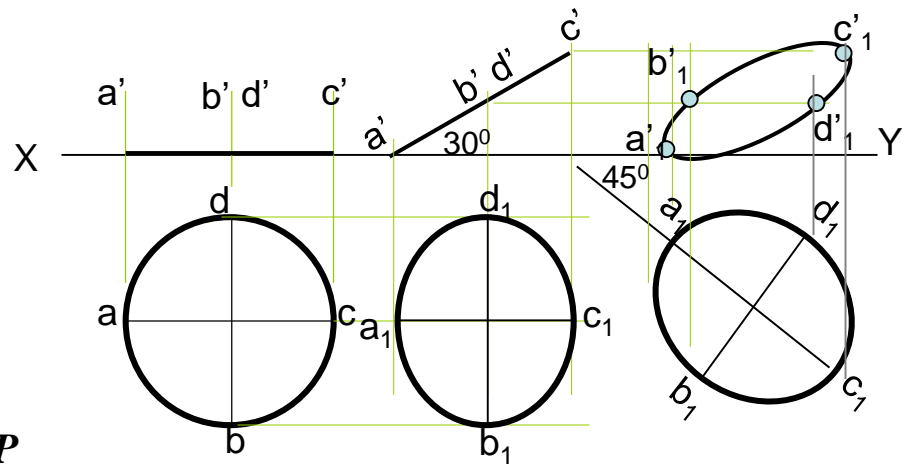
Keep AC parallel to the H.P. & BD perpendicular to V.P.
(considering inclination of AC as inclination of the plane and inclination of BD as inclination of edge)

Incline AC at 30° to the H.P.

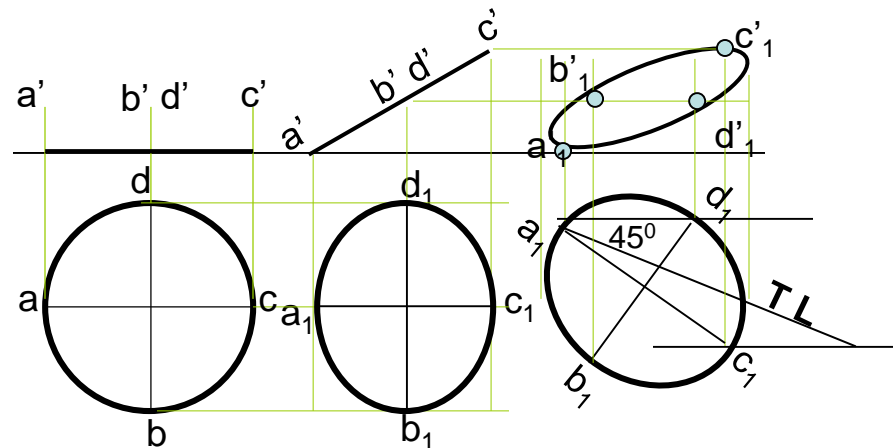
Make BD parallel to XY



Problem 8: A circle of 50 mm diameter is resting on Hp on end A of it's diameter AC which is 30° inclined to Hp while it's Tv is 45° inclined to Vp. Draw it's projections.



The difference in these two problems is in step 3 only. In problem no.8 inclination of Tv of that AC is given, It could be drawn directly as shown in 3rd step. While in no.9 angle of AC itself i.e. it's TL, is given. Hence here angle of TL is taken, locus of c_1 is drawn and then LTV i.e. a_1, c_1 is marked and final TV was completed. Study illustration carefully.



Read problem and answer following questions

1. Surface inclined to which plane? ----- **HP**
2. Assumption for initial position? ----- // to **HP**
3. So which view will show True shape? --- **TV**
4. Which diameter horizontal? ----- **AC**

Hence begin with TV, draw rhombus below X-Y line, taking longer diagonal // to X-Y

Problem 9: A circle of 50 mm diameter is resting on Hp on end A of it's diameter AC which is 30° inclined to Hp while it makes 45° inclined to Vp. Draw it's projections.

Note the difference in construction of 3rd step in both solutions.

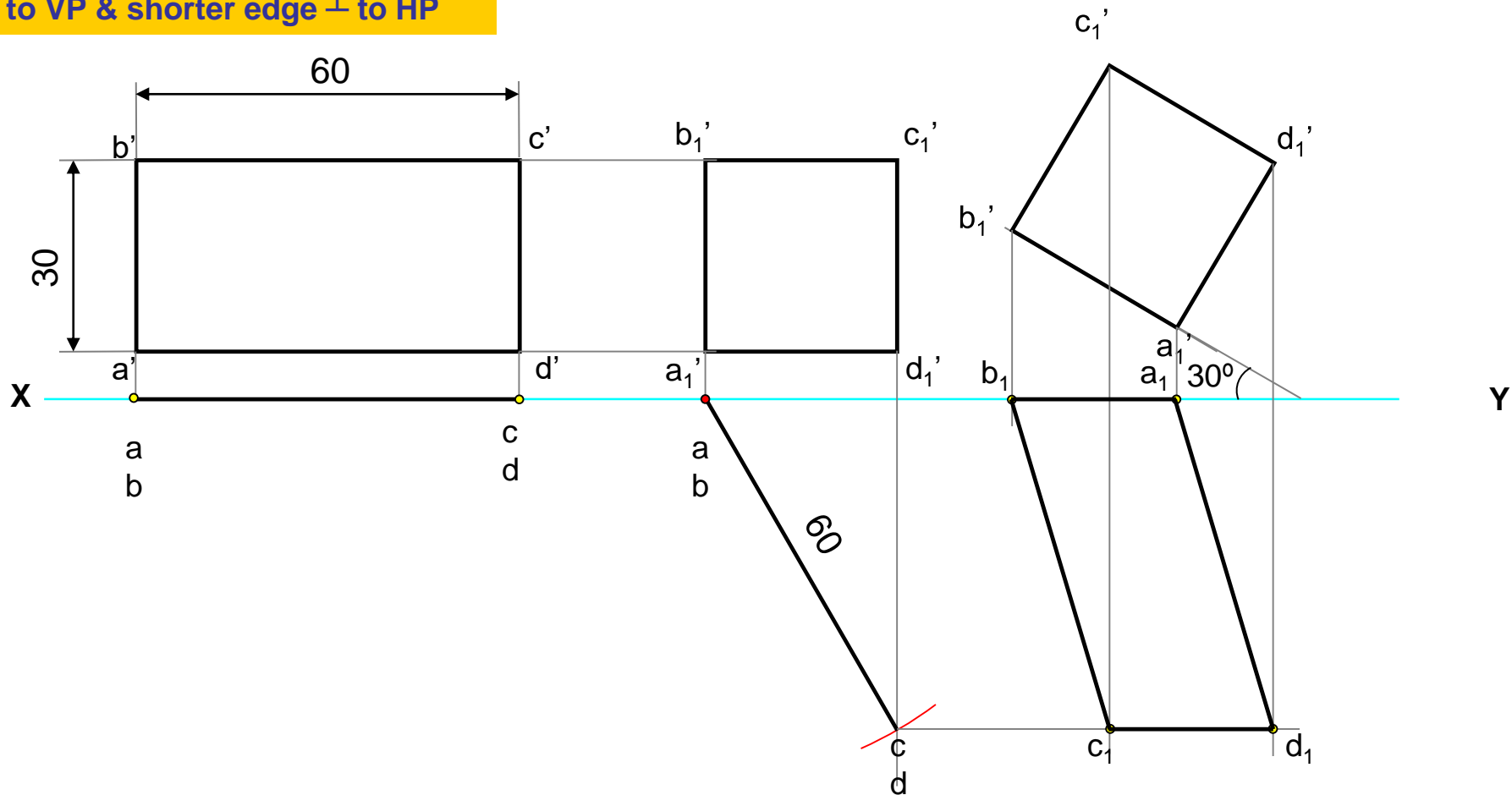
Thank You

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

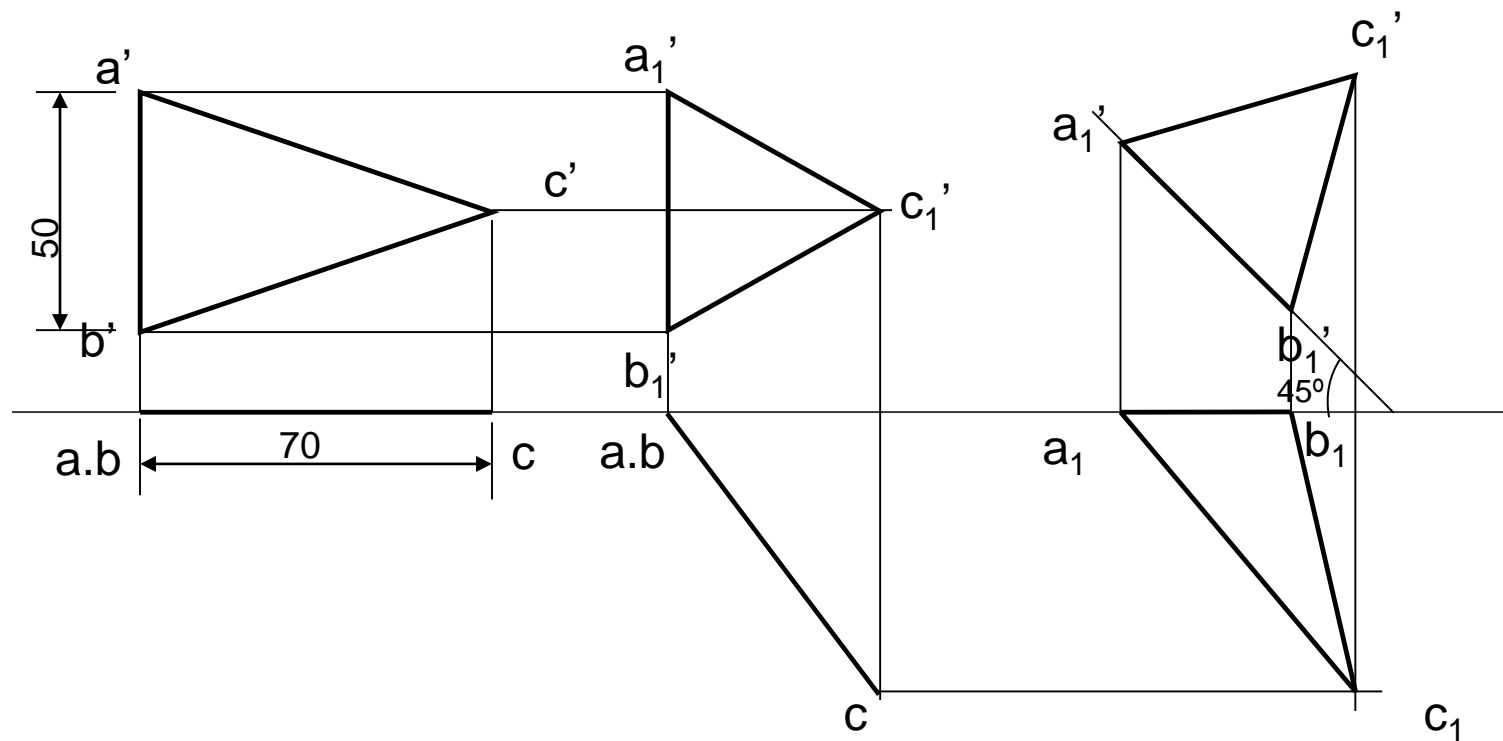
A rectangle can be seen as a square in the F.V. only when its surface is inclined to VP. So for the first view keep the plane // to VP & shorter edge \perp to HP

F.V. (square) is drawn first

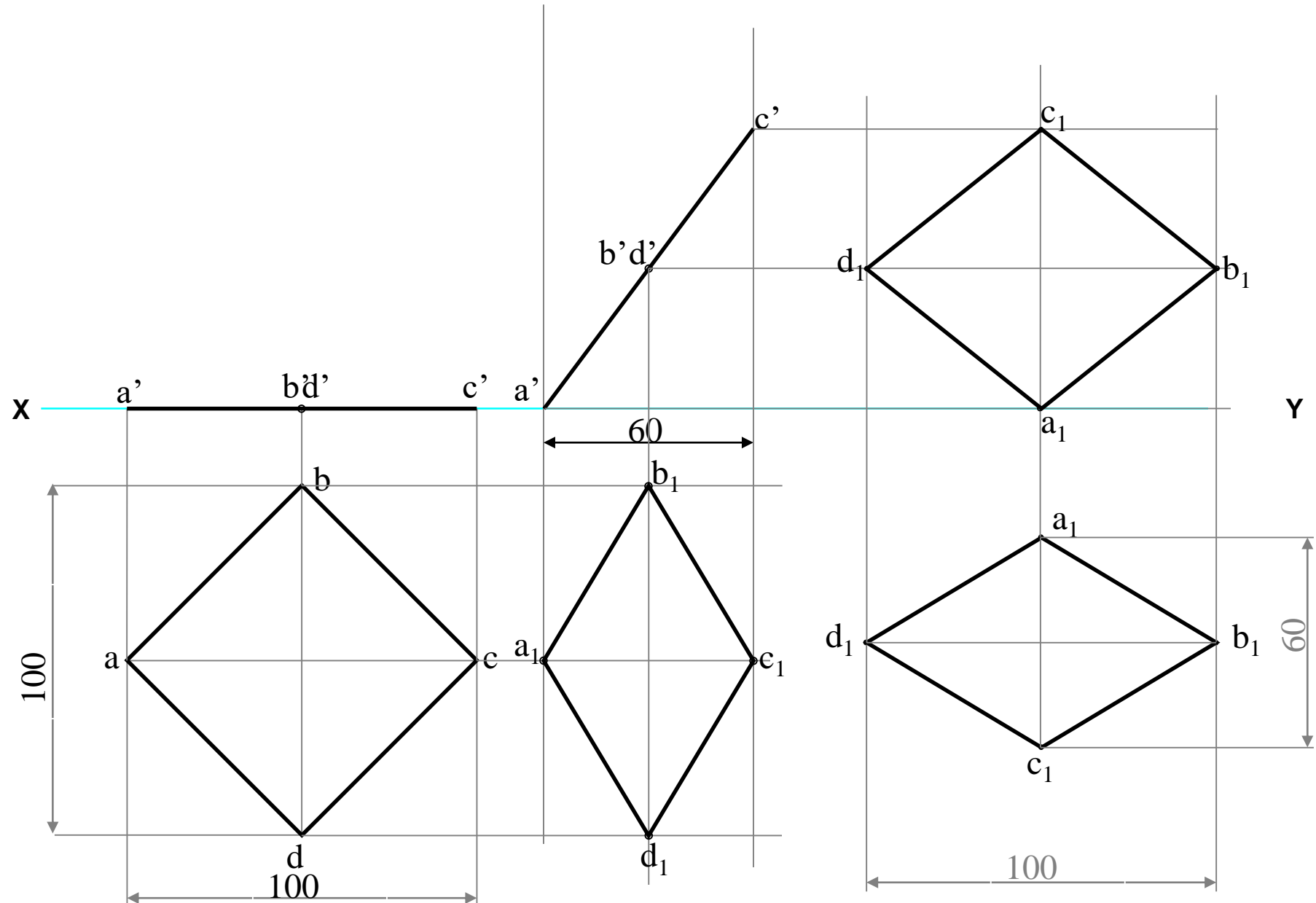
Incline $a_1'b_1'$ at 30° to the H.P.



Ex 7: A plate having shape of an isosceles triangle has base 50 mm long and altitude 70 mm. It is so placed that in the front view it is seen as an equilateral triangle of 50 mm sides and one side inclined at 45° to xy. Draw its top view



Ex 8: Draw a rhombus of 100 mm and 60 mm long diagonals with longer diagonal horizontal. The figure is the top view of a square having 100 mm long diagonals. Draw its front view.



SOLVED PROBLEMS

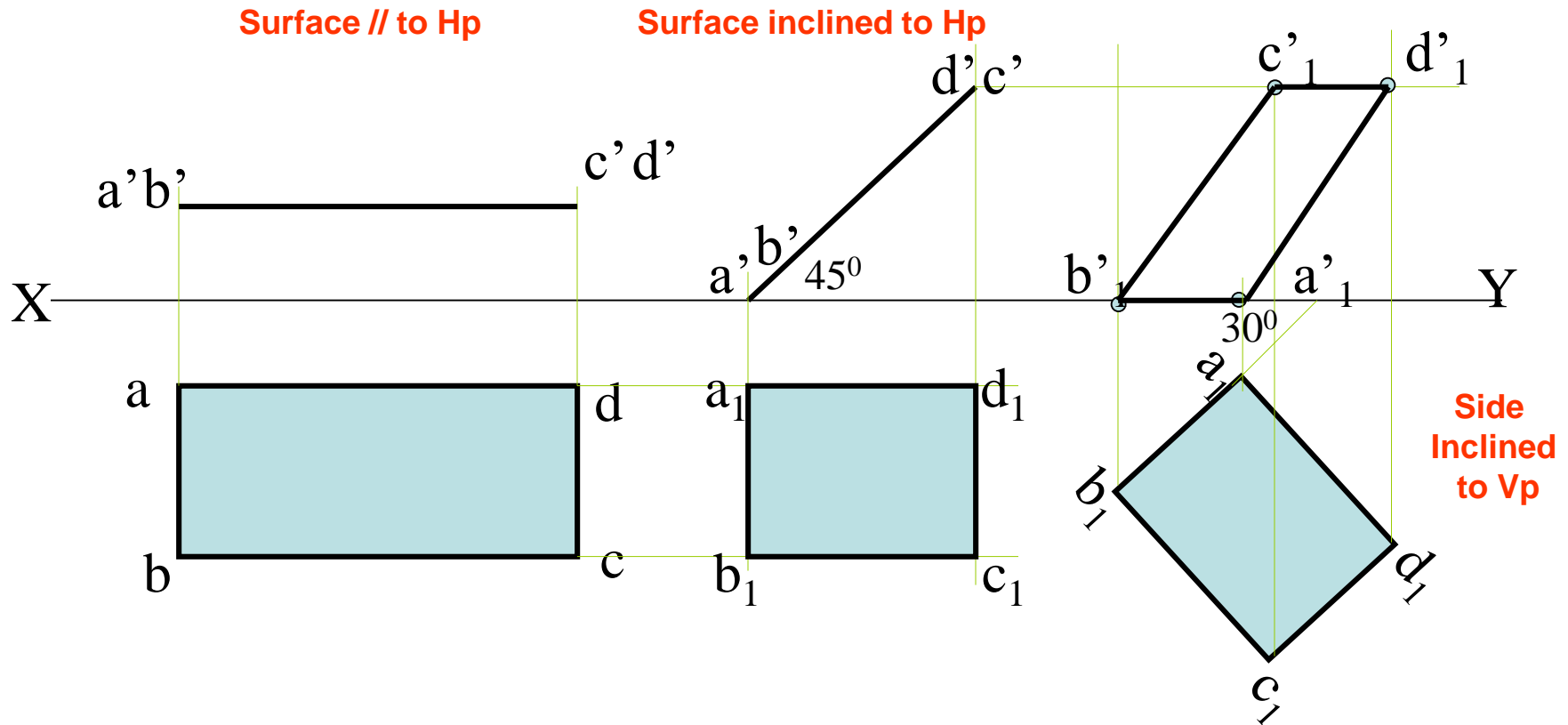
Problem 1:

Rectangle 30mm and 50mm sides is resting on HP on one small side which is 30° inclined to VP, while the surface of the plane makes 45° inclination with HP. Draw its projections.

Read problem and answer following questions

1. Surface inclined to which plane? ----- HP
2. Assumption for initial position? -----// to HP
3. So which view will show True shape? --- TV
4. Which side will be vertical? ---One small side.

Hence begin with TV, draw rectangle below X-Y drawing one small side vertical.



Problem 2:

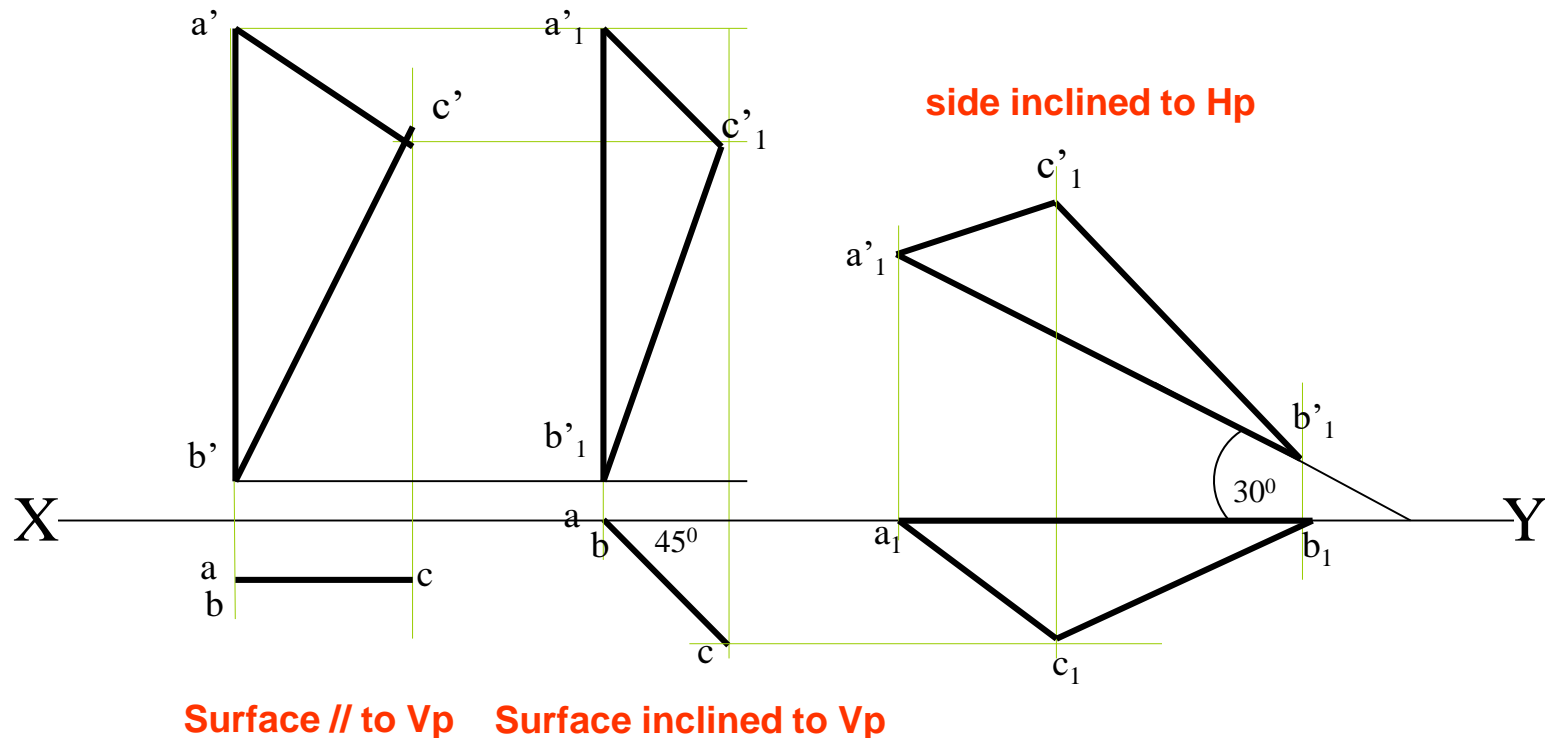
A $30^\circ - 60^\circ$ set square of longest side 100 mm long, is in VP and 30° inclined to HP while it's surface is 45° inclined to VP. Draw its projections

(Surface & Side inclinations directly given)

Read problem and answer following questions

1. Surface inclined to which plane? ----- VP
2. Assumption for initial position? ----- // to VP
3. So which view will show True shape? --- FV
4. Which side will be vertical? ----- longest side.

Hence begin with FV, draw triangle above X-Y
keeping longest side vertical.



Problem 3:

A $30^\circ - 60^\circ$ set square of longest side 100 mm long is in VP and its surface 45° inclined to VP. One end of longest side is 10 mm and other end is 35 mm above HP. Draw its projections

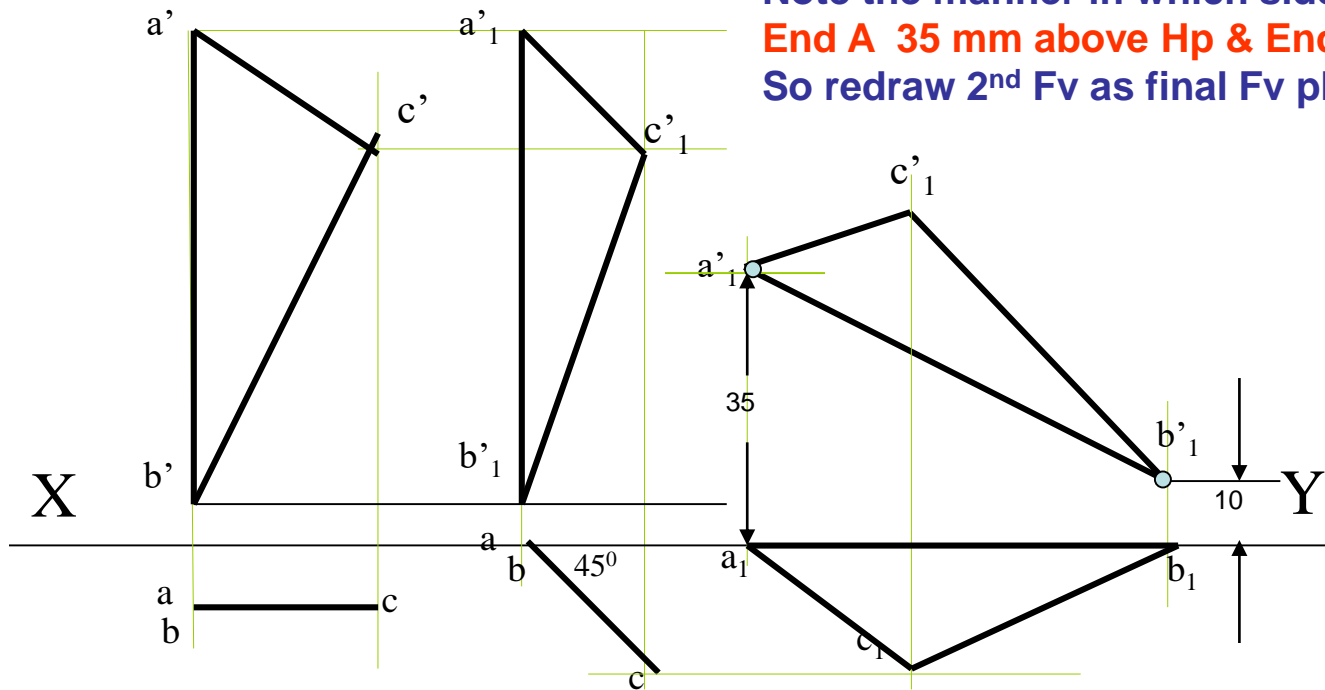
(Surface inclination directly given.
Side inclination indirectly given)

Read problem and answer following questions

1. Surface inclined to which plane? ----- VP
2. Assumption for initial position? -----// to VP
3. So which view will show True shape? --- FV
4. Which side will be vertical? -----longest side.

Hence begin with FV, draw triangle above X-Y
keeping longest side vertical.

First TWO steps are similar to previous problem.
Note the manner in which side inclination is given.
End A 35 mm above Hp & End B is 10 mm above Hp.
So redraw 2nd Fv as final Fv placing these ends as said.



Problem 4:

A regular pentagon of 30 mm sides is resting on HP on one of its sides with its surface 45° inclined to HP.

Draw its projections when the side in HP makes 30° angle with VP

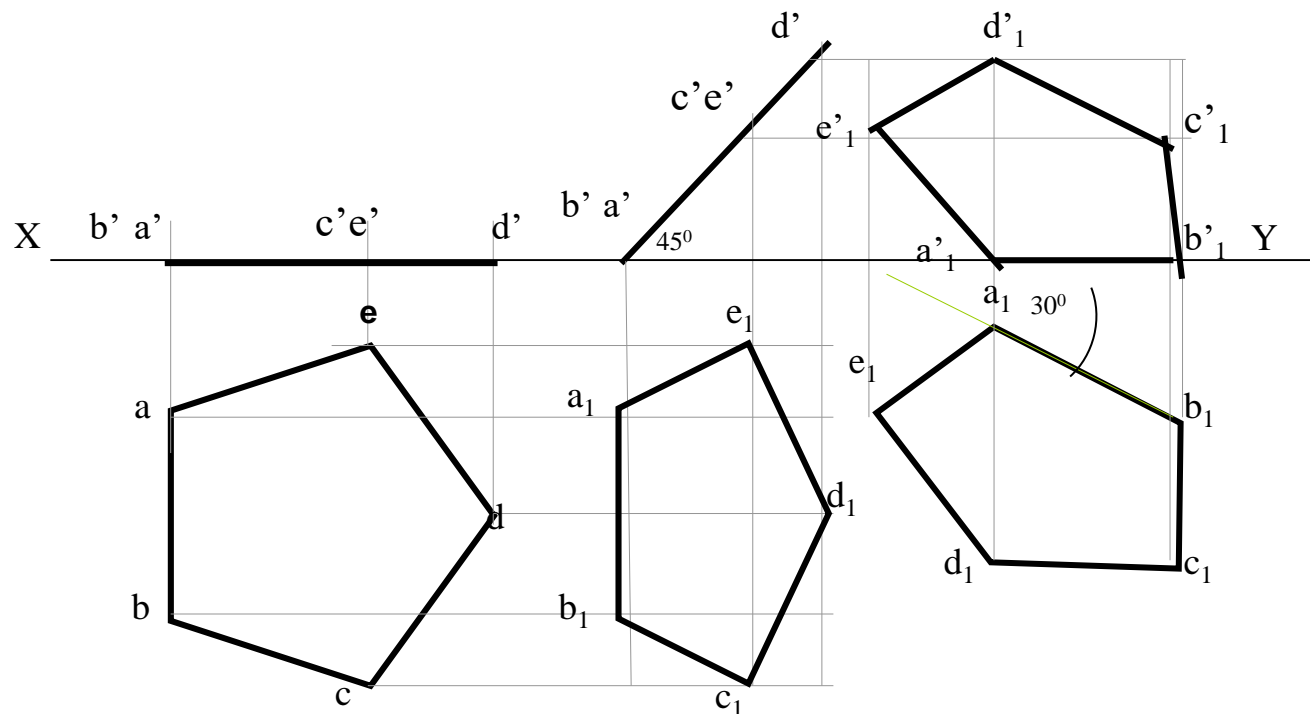
**SURFACE AND SIDE INCLINATIONS
ARE DIRECTLY GIVEN.**

Read problem and answer following questions

1. Surface inclined to which plane? ----- **HP**
2. Assumption for initial position? ----- **// to HP**
3. So which view will show True shape? --- **TV**
4. Which side will be vertical? ----- **any side.**

Hence begin with TV, draw pentagon below

X-Y line, taking one side vertical.



Problem 5:

A regular pentagon of 30 mm sides is resting on HP on one of its sides while its opposite vertex (corner) is 30 mm above HP.

Draw projections when side in HP is 30° inclined to VP.

**SURFACE INCLINATION INDIRECTLY GIVEN
SIDE INCLINATION DIRECTLY GIVEN:**

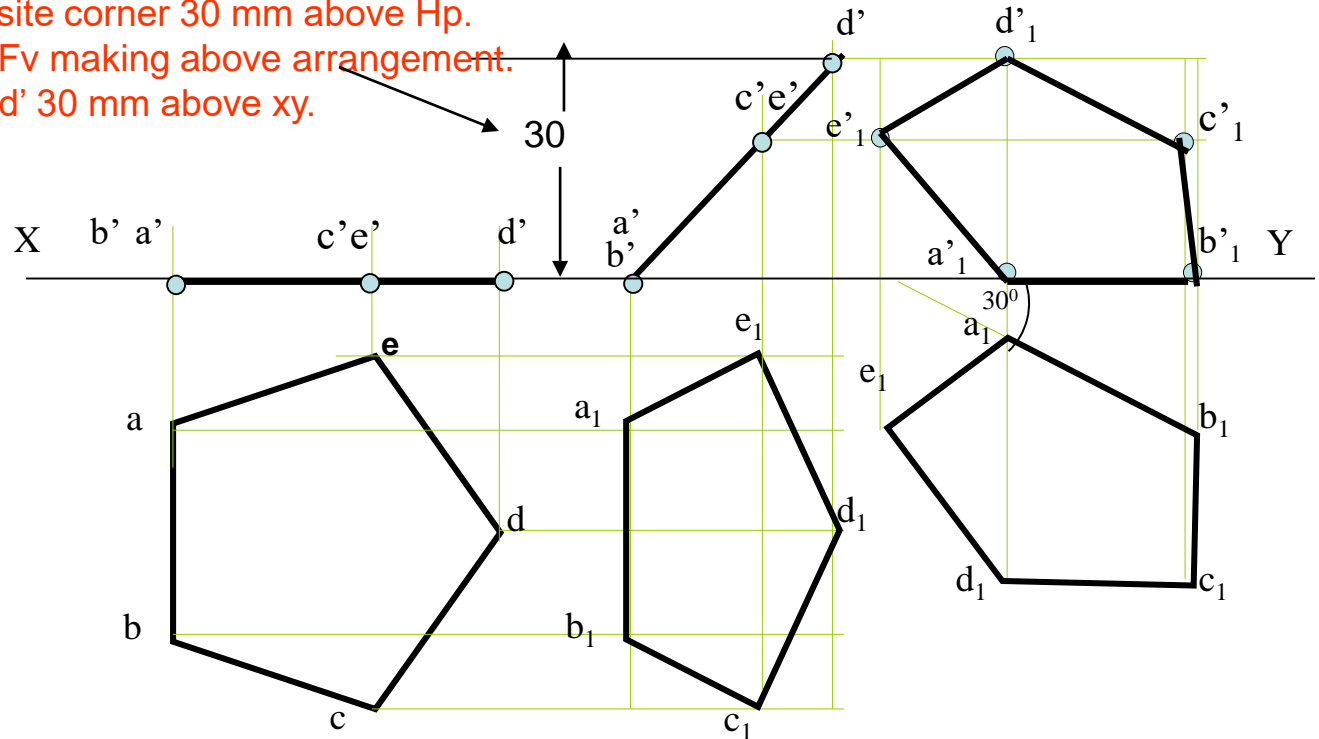
ONLY CHANGE is

the manner in which surface inclination is described:

One side on Hp & its opposite corner 30 mm above Hp.

Hence redraw 1st Fv as a 2nd Fv making above arrangement.

Keep $a'b'$ on xy & d' 30 mm above xy .



Read problem and answer following questions

1. Surface inclined to which plane? ----- **HP**
2. Assumption for initial position? ----- **// to HP**
3. So which view will show True shape? --- **TV**
4. Which side will be vertical? ----- **any side.**

Hence begin with TV, draw pentagon below

X-Y line, taking one side vertical.

Read problem and answer following questions

1. Surface inclined to which plane? ----- **HP**
2. Assumption for initial position? ----- **// to HP**
3. So which view will show True shape? --- **TV**
4. Which diameter horizontal? ----- **AB**

Hence begin with TV, draw CIRCLE below X-Y line, taking DIA. AB // to X-Y

The problem is similar to previous problem of circle – no.9.

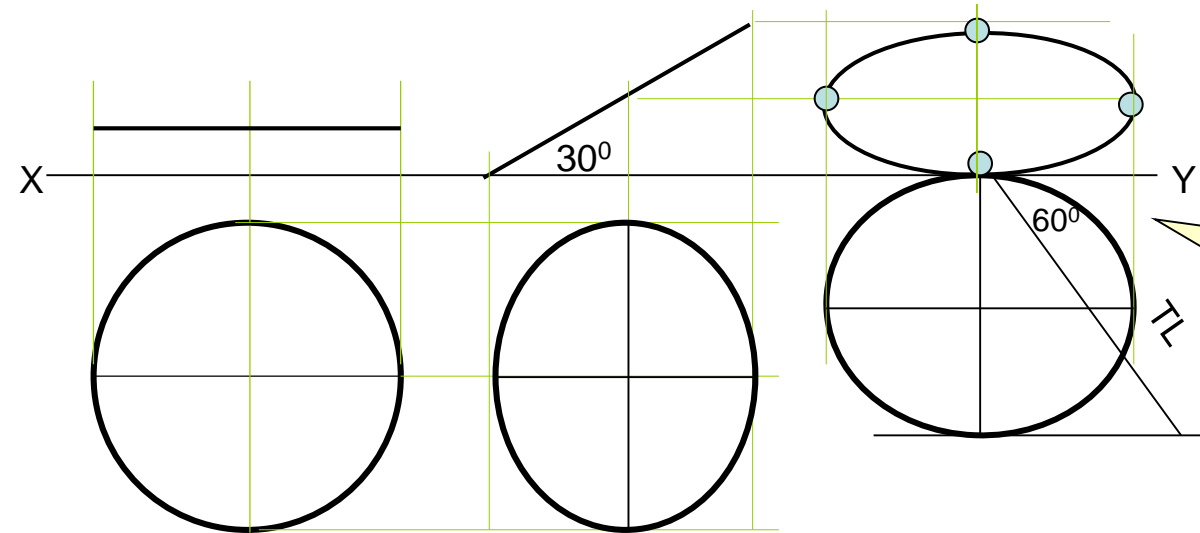
But in the 3rd step there is one more change.

Like 9th problem True Length Inclination of dia.AB is definitely expected but if you carefully note - the the SUM of it's inclinations with HP & VP is 90°.

Means Line AB lies in a Profile Plane.

Hence it's both Tv & Fv must arrive on one single projector.

So do the construction accordingly AND **note the case carefully.**



SOLVE SEPARATELY
ON DRAWING SHEET
GIVING NAMES TO VARIOUS
POINTS AS USUAL,
AS THE CASE IS IMPORTANT

Problem 9:

A hexagonal lamina has its one side in HP and its opposite parallel side is 25mm above HP and in VP. Draw its projections.

Take side of hexagon 30 mm long.

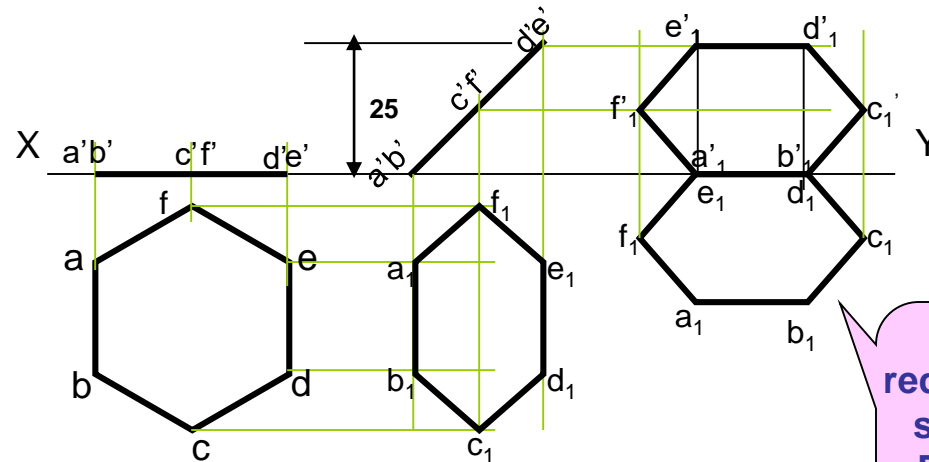
ONLY CHANGE is the manner in which surface inclination is described:

One side on Hp & its opposite side 25 mm above Hp.
Hence redraw 1st Fv as a 2nd Fv making above arrangement.
Keep a'b' on xy & d'e' 25 mm above xy.

Read problem and answer following questions

1. Surface inclined to which plane? ----- **HP**
2. Assumption for initial position? ----- // to **HP**
3. So which view will show True shape? --- **TV**
4. Which diameter horizontal? ----- **AC**

Hence begin with TV, draw rhombus below X-Y line, taking longer diagonal // to X-Y



**As 3rd step
redraw 2nd Tv keeping
side DE on xy line.
Because it is in VP
as said in problem.**

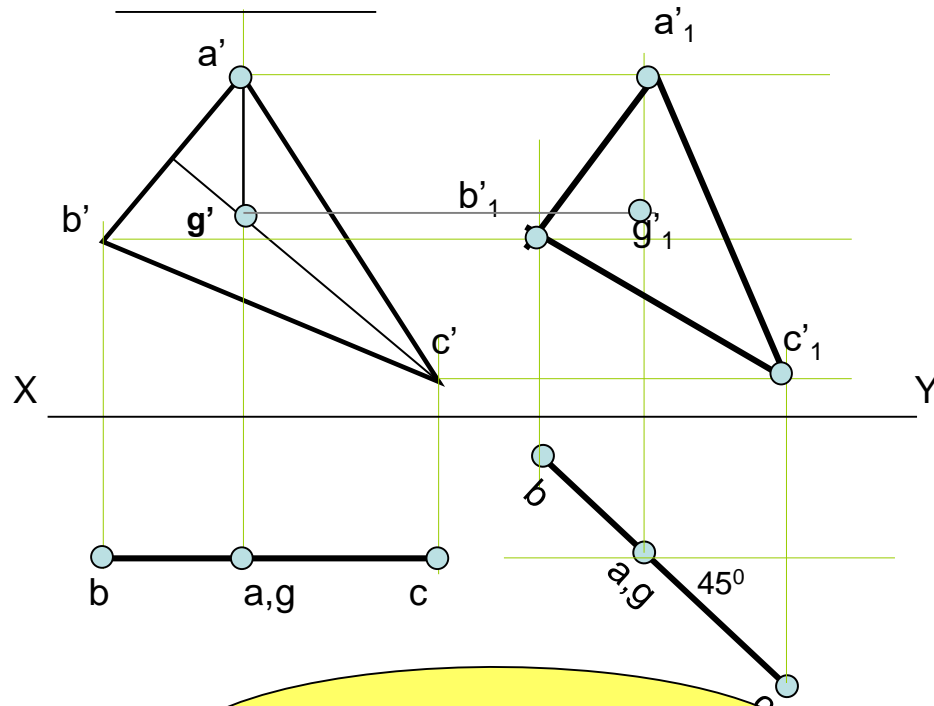
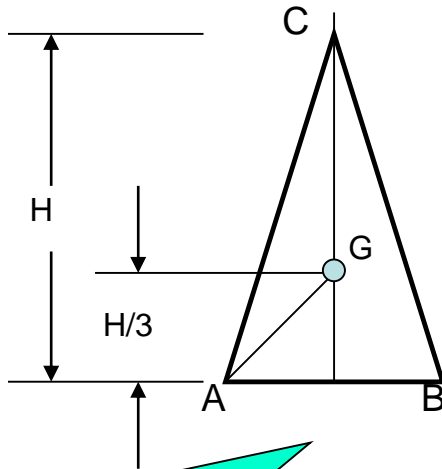
FREELY SUSPENDED CASES.

IMPORTANT POINTS

Problem 10:

An isosceles triangle of 40 mm long base side, 60 mm long altitude is freely suspended from one corner of Base side. Its plane is 45° inclined to Vp. Draw its projections.

1. In this case the plane of the figure always remains *perpendicular to Hp*.
2. It may remain parallel or inclined to Vp.
3. Hence **TV** in this case will be always a **LINE view**.
4. Assuming surface // to Vp, draw true shape in suspended position as FV.
(Here keep *line joining point of contact & centroid of fig. vertical*)
5. Always begin with FV as a True Shape but in a suspended position.
AS shown in 1st FV.



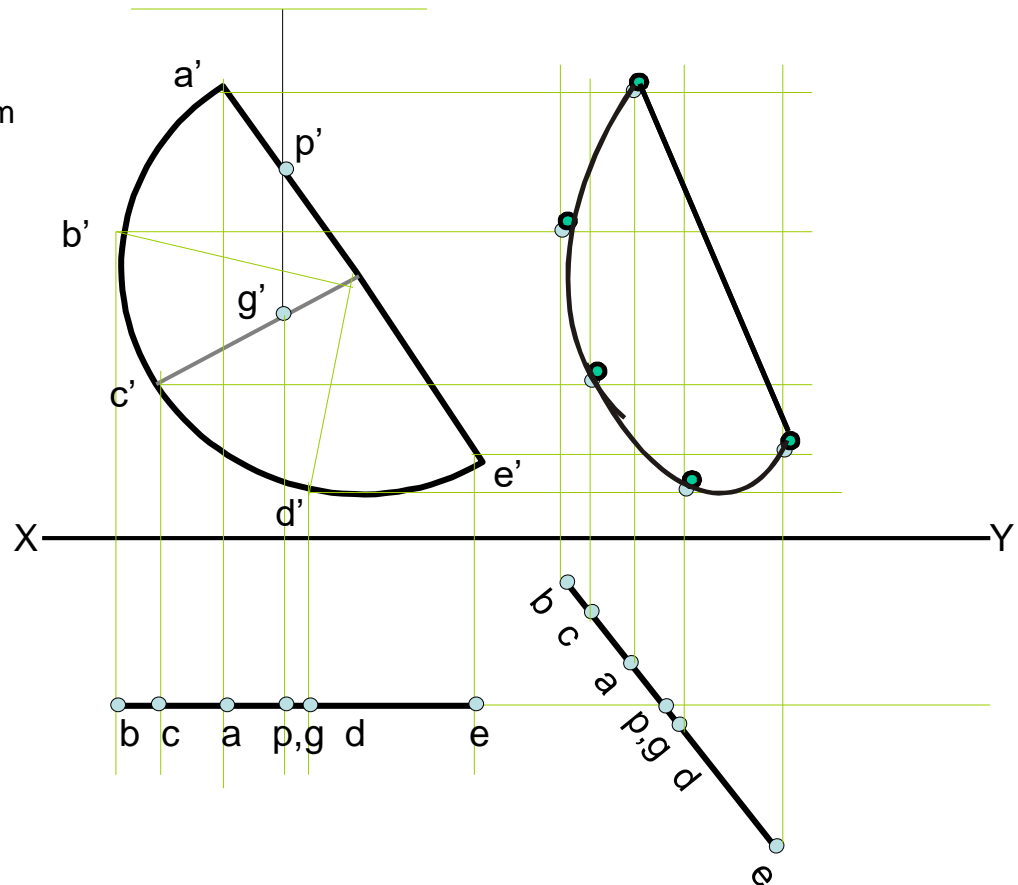
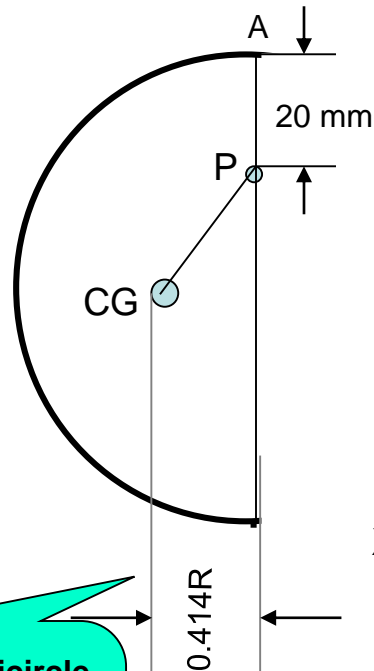
First draw a given triangle
With given dimensions,
Locate its centroid position
And
join it with point of suspension.

Similarly solve next problem
of Semi-circle

Problem 11

A semicircle of 100 mm diameter is suspended from a point on its straight edge 30 mm from the midpoint of that edge so that the surface makes an angle of 45° with VP. Draw its projections.

1. In this case the plane of the figure always remains *perpendicular to Hp*.
2. It may remain parallel or inclined to Vp.
3. Hence **TV** in this case will be always a **LINE view**.
4. Assuming surface // to Vp, draw true shape in suspended position as FV. (Here keep *line joining point of contact & centroid of fig. vertical*)
5. Always begin with FV as a True Shape but in a suspended position. AS shown in 1st FV.



First draw a given semicircle
With given diameter,
Locate it's centroid position
And
join it with point of suspension.

To determine true shape of plane figure when it's projections are given. BY USING AUXILIARY PLANE METHOD

WHAT WILL BE THE PROBLEM?

Description of final Fv & Tv will be given.

You are supposed to determine true shape of that plane figure.

Follow the below given steps:

1. Draw the given Fv & Tv as per the given information in problem.
2. Then among all lines of Fv & Tv select a line showing True Length (T.L.)
(It's other view must be // to xy)
3. Draw x_1-y_1 perpendicular to this line showing T.L.
4. Project view on x_1-y_1 (it must be a line view)
5. Draw x_2-y_2 // to this line view & project new view on it.

It will be the required answer i.e. True Shape.

The facts you must know:-

If you carefully study and observe the solutions of all previous problems,
You will find

**IF ONE VIEW IS A LINE VIEW & THAT TOO PARALLEL TO XY LINE,
THEN IT'S OTHER VIEW WILL SHOW TRUE SHAPE:**

NOW FINAL VIEWS ARE ALWAYS SOME SHAPE, NOT LINE VIEWS:

SO APPLYING ABOVE METHOD:

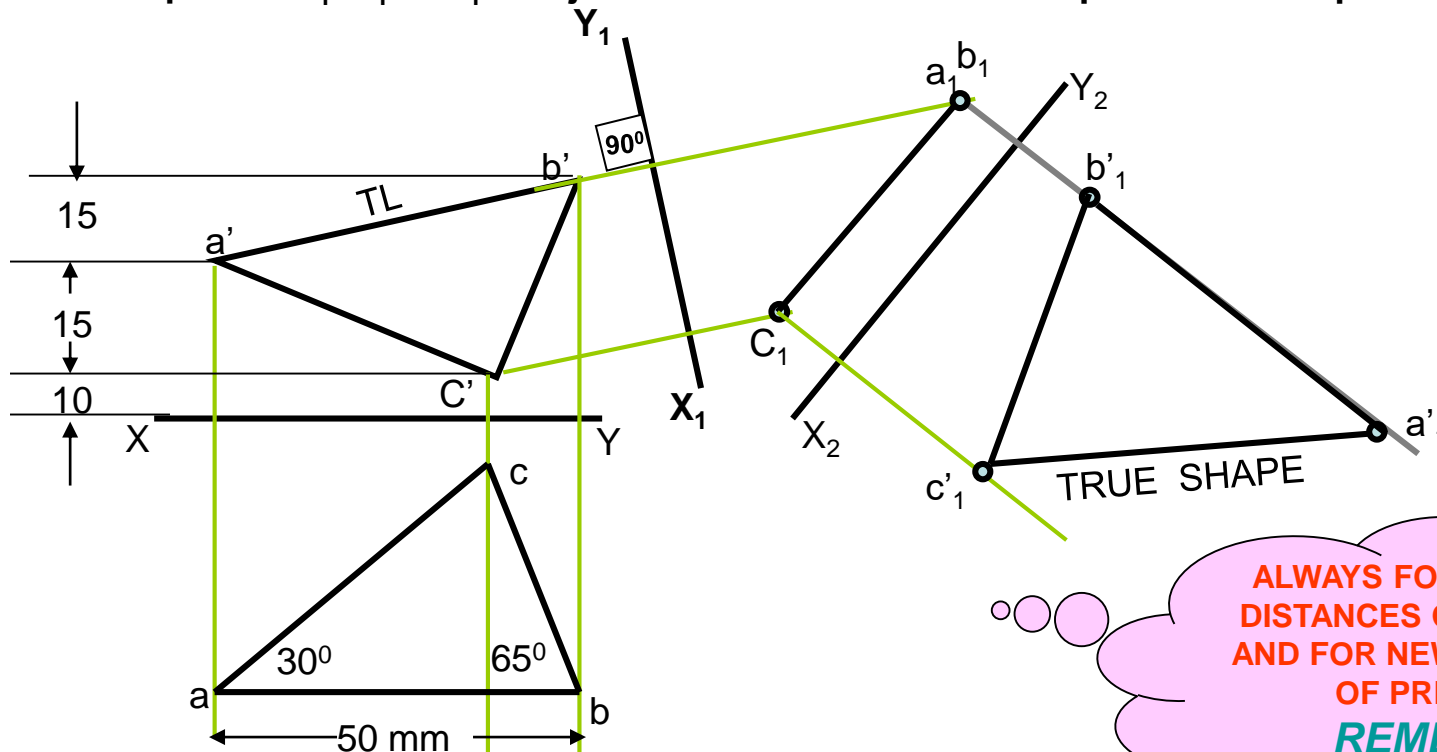
WE FIRST CONVERT ONE VIEW IN INCLINED LINE VIEW .(By using x_1y_1 aux.plane)
THEN BY MAKING IT // TO x_2-y_2 WE GET TRUE SHAPE.

**Study Next
Four Cases**

Problem 12: Tv is a triangle abc. Ab is 50 mm long, angle cab is 30° and angle cba is 65° . a'b'c' is a Fv. a' is 25 mm, b' is 40 mm and c' is 10 mm above Hp respectively. Draw projections of that figure and find its true shape.

As per the procedure-

1. First draw Fv & Tv as per the data.
2. In Tv line ab is // to xy hence its other view a'b' is TL. So draw x_1y_1 perpendicular to it.
3. Project view on x_1y_1 .
 - a) First draw projectors from a'b' & c' on x_1y_1 .
 - b) from xy take distances of a, b & c (Tv) mark on these projectors from x_1y_1 . Name points a₁b₁ & c₁.
 - c) This line view is an Aux. Tv. Draw x_2y_2 // to this line view and project Aux. Fv on it.
for that from x_1y_1 take distances of a'b' & c' and mark from x_2y_2 on new projectors.
4. Name points a'₁, b'₁ & c'₁ and join them. This will be the required true shape.



ALWAYS FOR NEW FV TAKE
DISTANCES OF PREVIOUS FV
AND FOR NEW TV, DISTANCES
OF PREVIOUS TV
REMEMBER!!

Problem 13: Fv & Tv of a triangular plate are shown.
Determine it's true shape.

USE SAME PROCEDURE STEPS
OF PREVIOUS PROBLEM:

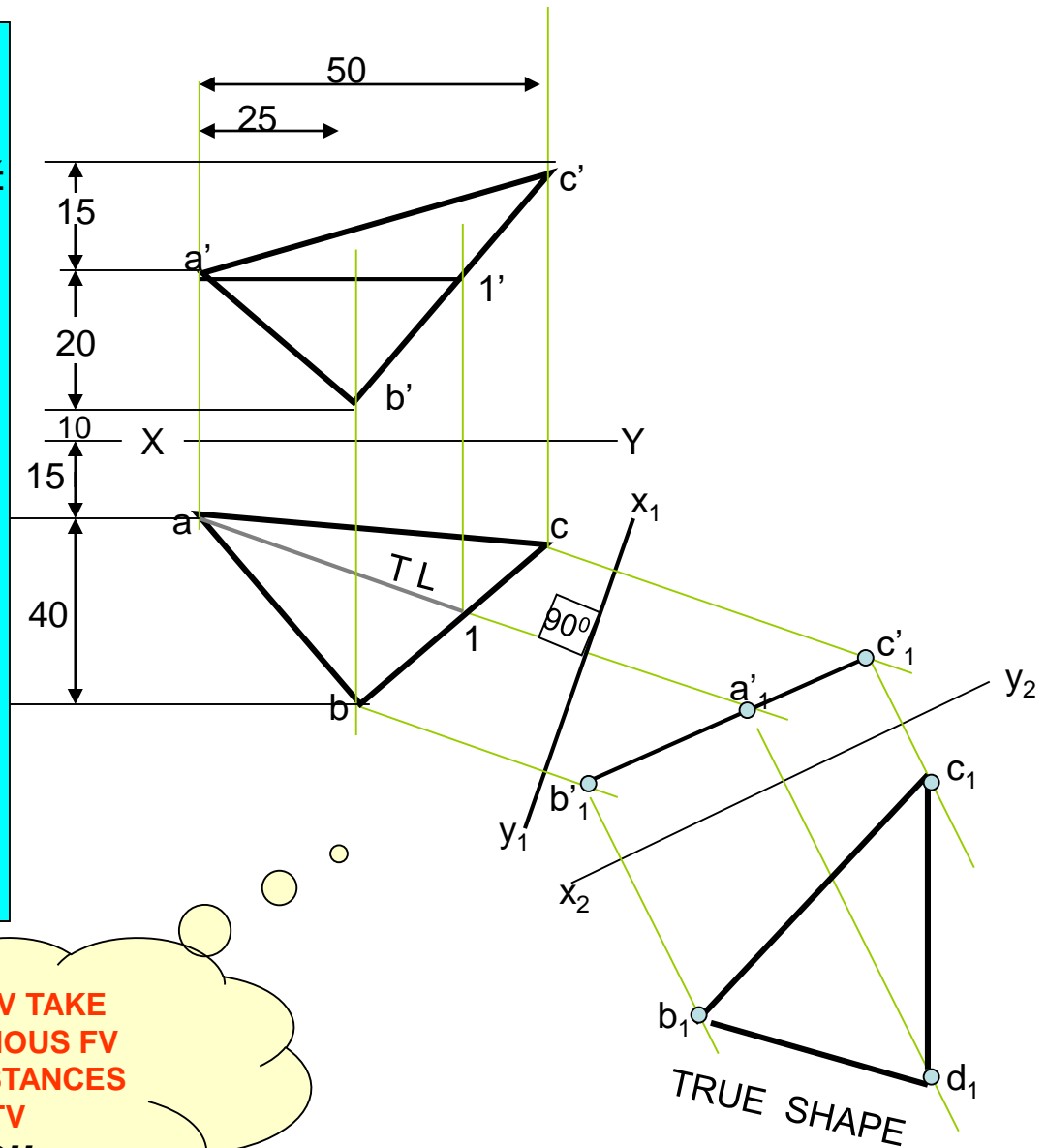
BUT THERE IS ONE DIFFICULTY:

NO LINE IS // TO XY IN ANY VIEW.
MEANS NO TL IS AVAILABLE.

IN SUCH CASES DRAW ONE LINE
// TO XY IN ANY VIEW & IT'S OTHER
VIEW CAN BE CONSIDERED AS TL
FOR THE PURPOSE.

HERE $a' 1'$ line in Fv is drawn // to xy.
HENCE it's Tv $a-1$ becomes TL.

THEN FOLLOW SAME STEPS AND
DETERMINE TRUE SHAPE.
(STUDY THE ILLUSTRATION)



ALWAYS FOR NEW FV TAKE
DISTANCES OF PREVIOUS FV
AND FOR NEW TV, DISTANCES
OF PREVIOUS TV
REMEMBER!!

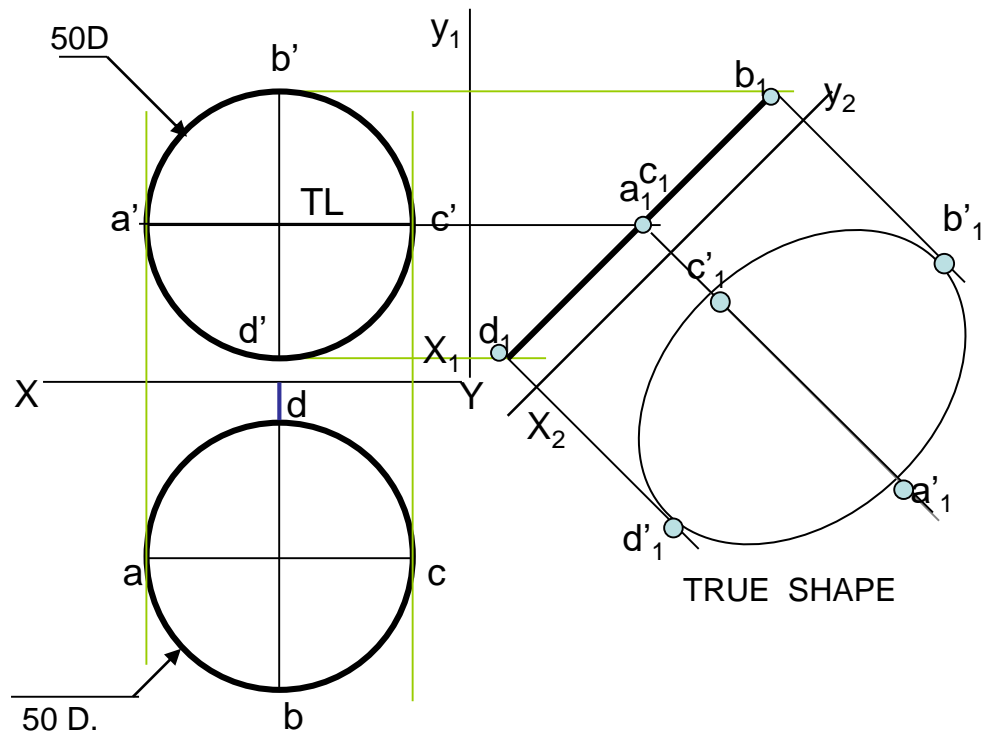
PROBLEM 14: Fv & Tv both are circles of 50 mm diameter. Determine true shape of an elliptical plate.

ADOPT SAME PROCEDURE.

a c is considered as line // to xy.
Then a'c' becomes TL for the purpose.
Using steps properly true shape can be Easily determined.

Study the illustration.

ALWAYS, FOR NEW FV
TAKE DISTANCES OF
PREVIOUS FV AND
FOR NEW TV, DISTANCES
OF PREVIOUS TV
REMEMBER!!



Problem 15 : Draw a regular pentagon of 30 mm sides with one side 30° inclined to xy. This figure is Tv of some plane whose Fv is A line 45° inclined to xy. Determine its true shape.

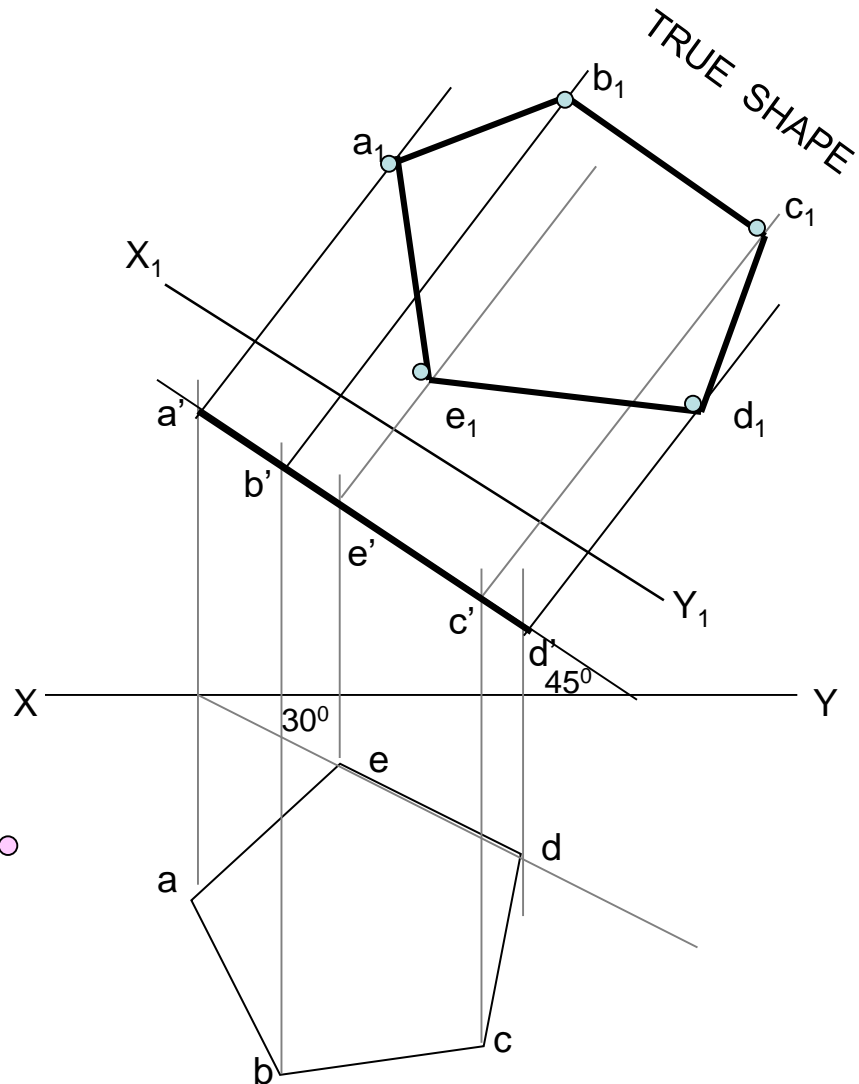
IN THIS CASE ALSO TRUE LENGTH IS NOT AVAILABLE IN ANY VIEW.

BUT ACTUALLY WE DONOT REQUIRE TL TO FIND IT'S TRUE SHAPE, AS ONE VIEW (FV) IS ALREADY A LINE VIEW. SO JUST BY DRAWING $X_1Y_1 \parallel$ TO THIS VIEW WE CAN PROJECT VIEW ON IT AND GET TRUE SHAPE:

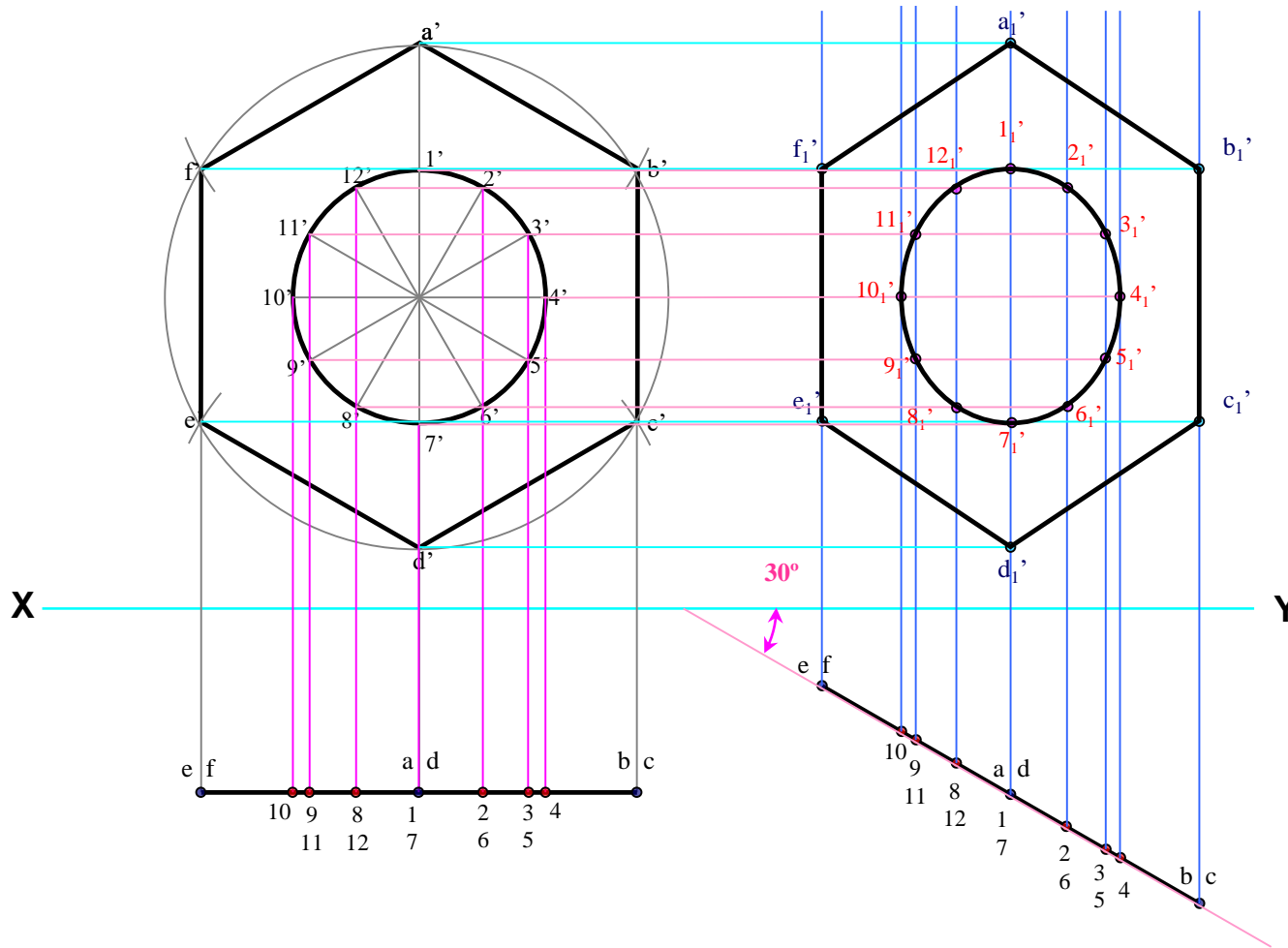
STUDY THE ILLUSTRATION..

ALWAYS FOR NEW FV
TAKE DISTANCES OF
PREVIOUS FV AND FOR
NEW TV, DISTANCES OF
PREVIOUS TV

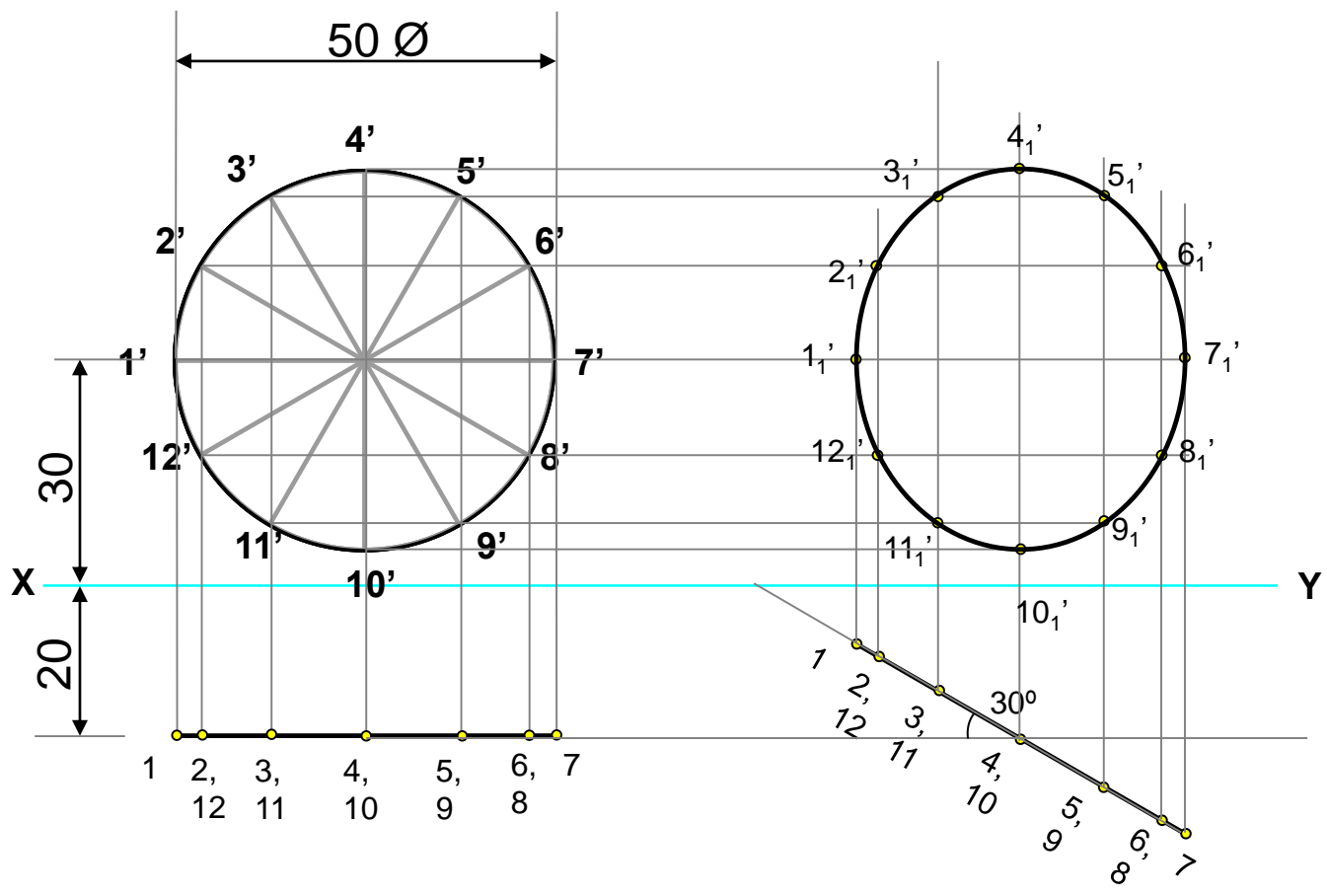
REMEMBER!!



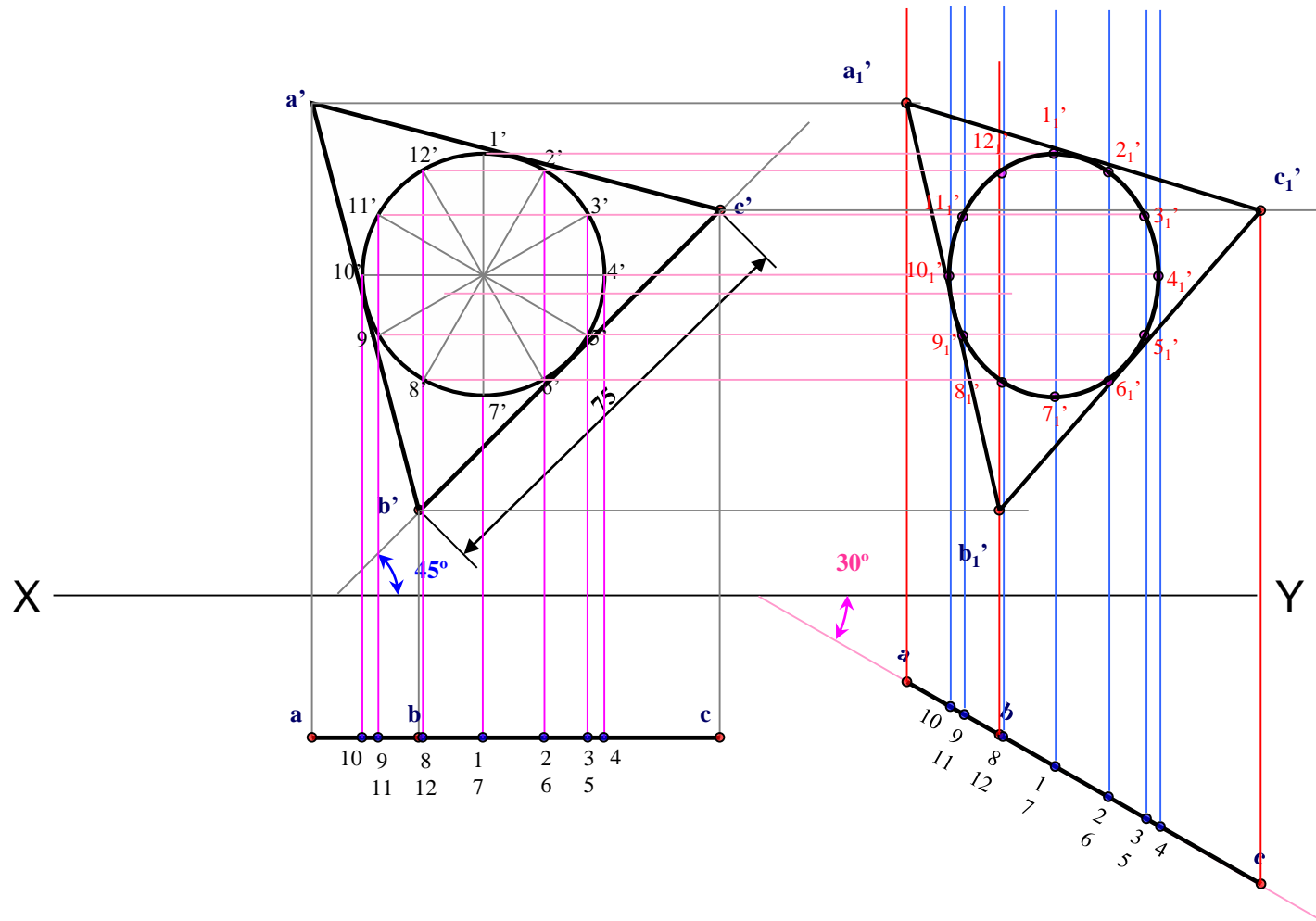
Problem 16 : draw a regular hexagon of 40 mm sides, with its two sides vertical. Draw a circle of 40 mm diameter in its centre. The figure represents a hexagonal plate with a hole in it and having its surface parallel to the VP. Draw its projections when the surface is vertical and inclined at 30° to the VP.



Problem 17: Draw the projections of a circle of 5 cm diameter having its plane vertical and inclined at 30° to the V.P. Its centre is 3cm above the H.P. and 2cm in front of the V.P. Show also its traces



Problem 18 : Draw an equilateral triangle of 75 mm sides and inscribe a circle in it. Draw the projections of the figure, when its plane is vertical and inclined at 30° to the VP and one of the sides of the triangle is inclined at 45° to the HP.

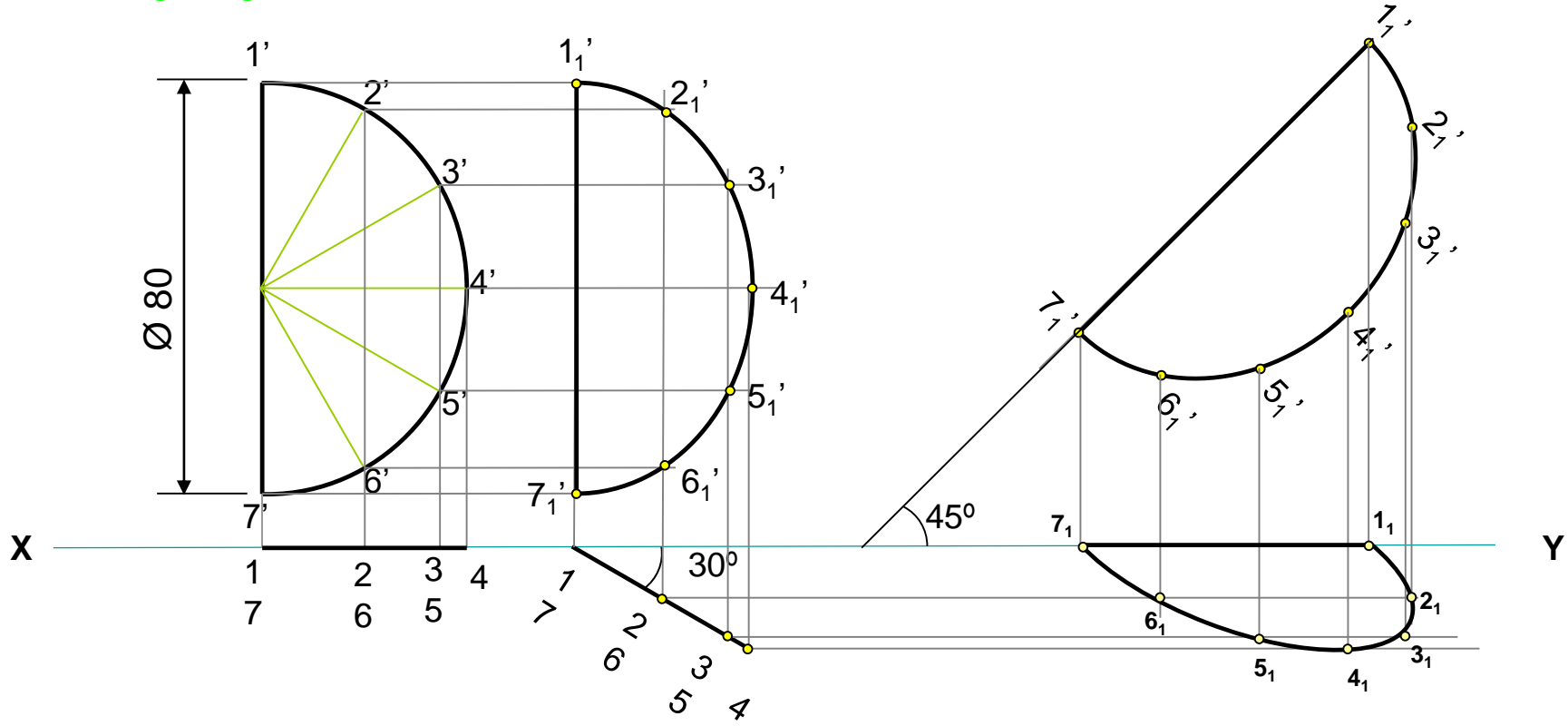


P 19: A semicircular plate of 80mm diameter has its straight edge in the VP and inclined at 45 to HP. The surface of the plate makes an angle of 30 with the VP. Draw its projections.

Plane in the V.P. with
straight edge \perp to H.P

Plane inclined at 30° to the V.P.
and straight edge in the H.P.

St. edge in V.P. and
inclined at 45° to the H.P.

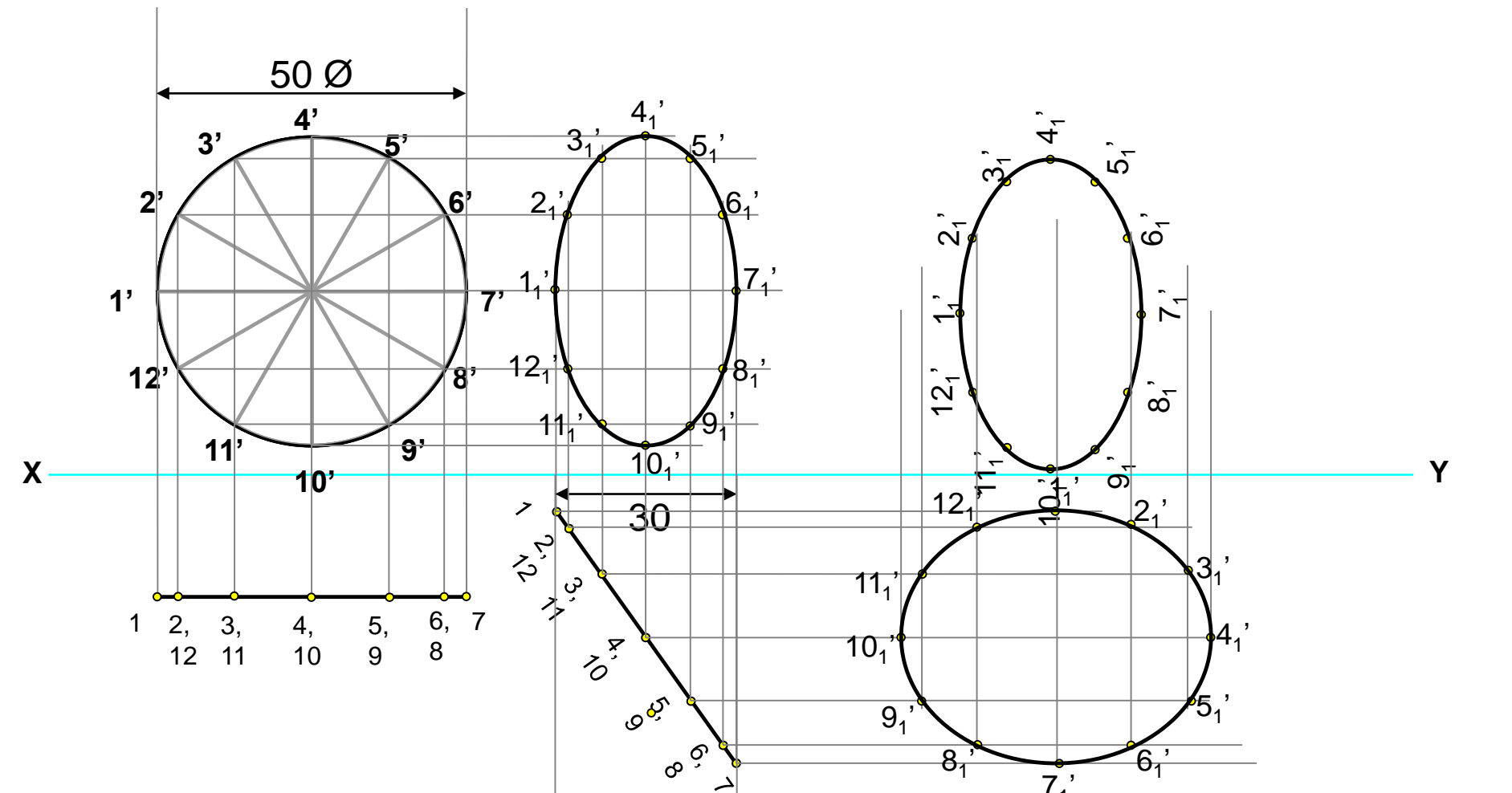


Problem 20: A circular plate of negligible thickness and 50 mm diameter appears as an ellipse in the front view, having its major axis 50 mm long and minor axis 30 mm long. Draw its top view when the major axis of the ellipse is horizontal.

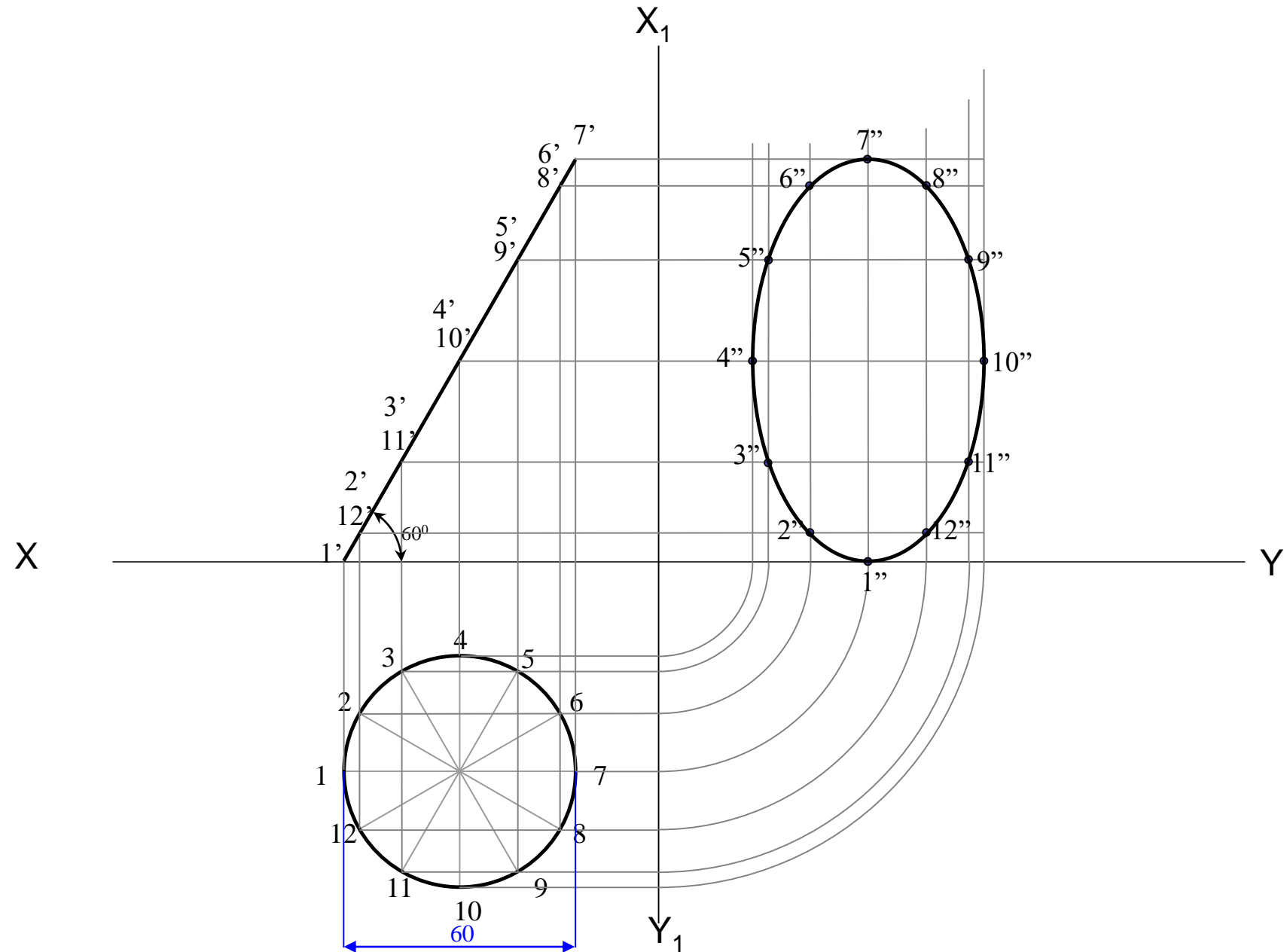
A circle can be seen as a ellipse in the F.V. only when its surface is inclined to VP. So for the first view keep the plane // to VP.

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

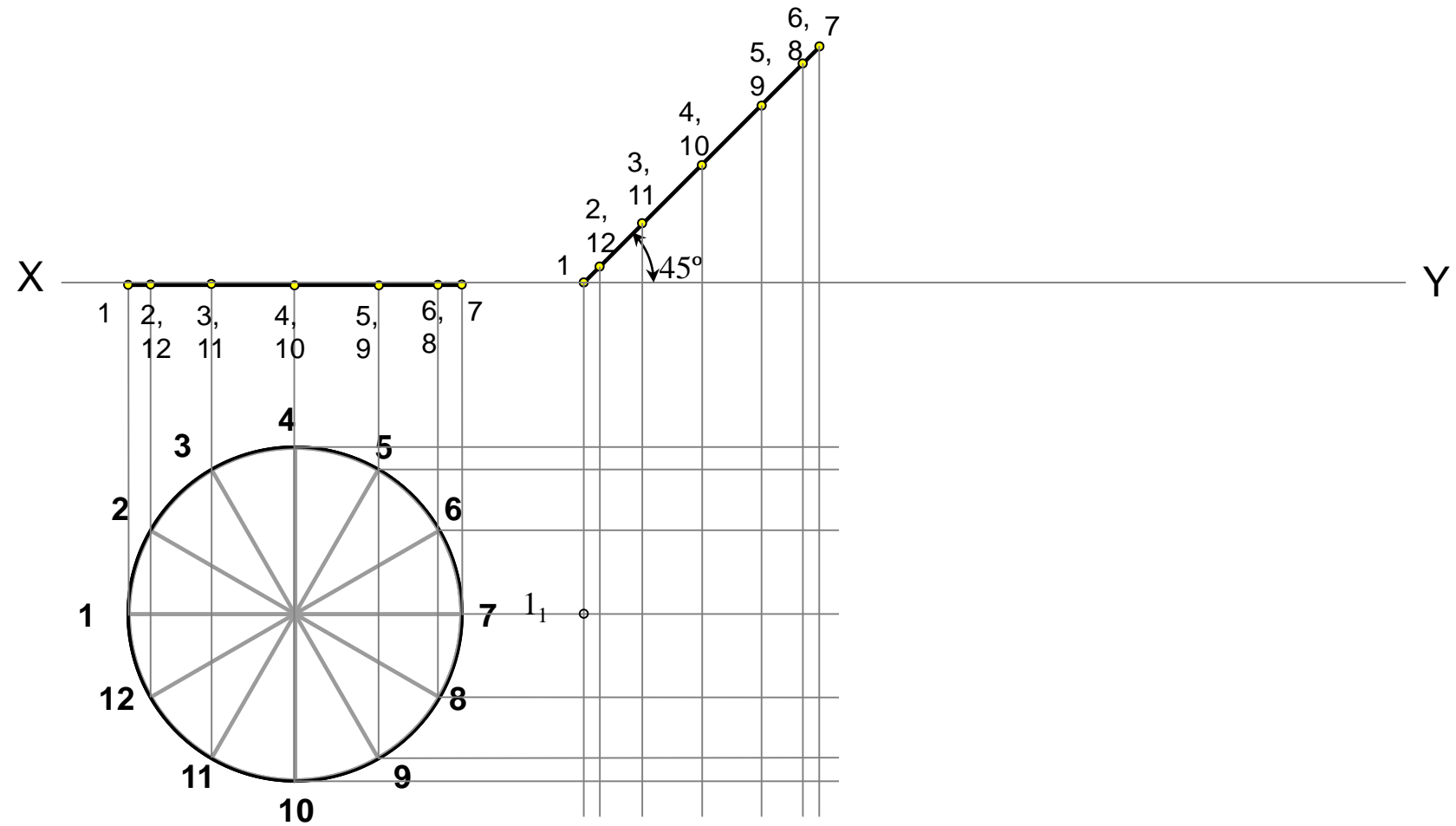
Incline the F.V. till the major axis becomes horizontal



Problem 21: The top view of a plate, the surface of which is inclined at 60° to the HP is a circle of 60 mm diameter. Draw its three views.



Problem 22 : Draw the projections of a circle of 50 mm diameter resting on the HP on point A on the circumference. Its plane inclined at 45° to the HP and (a) The top view of the diameter AB making 30° angle with the VP (b) The the diameter AB making 30° angle with the VP



Thank You