

# 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.)

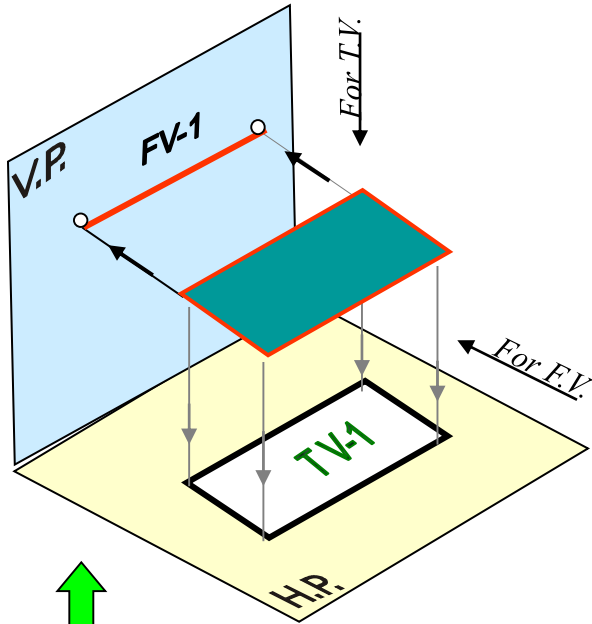
Study the illustration showing  
surface & side inclination given on next page.



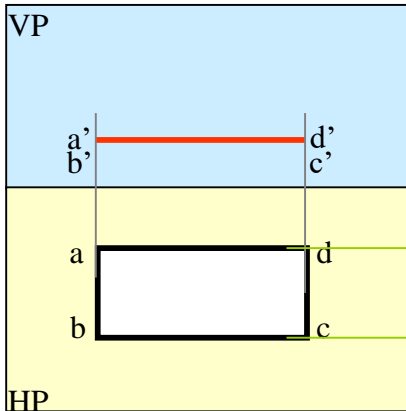
# CASE OF A RECTANGLE – OBSERVE AND NOTE ALL STEPS.



**SURFACE PARALLEL TO HP**  
PICTORIAL PRESENTATION

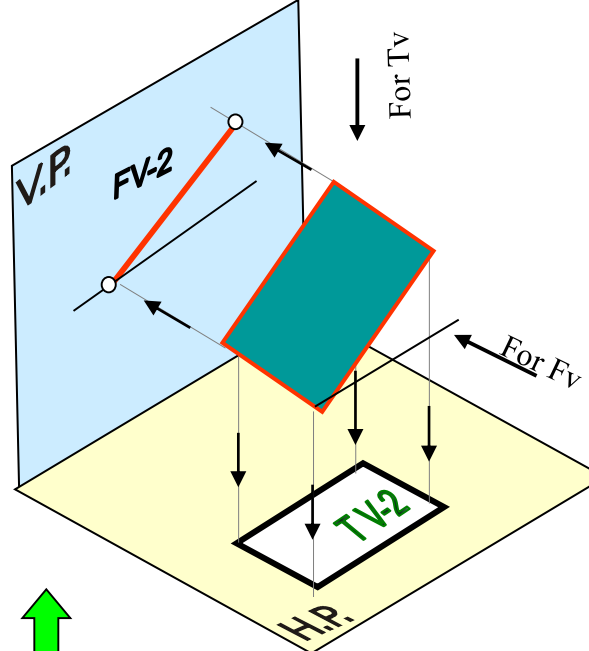


**ORTHOGRAPHIC**  
TV-True Shape  
FV- Line // to xy

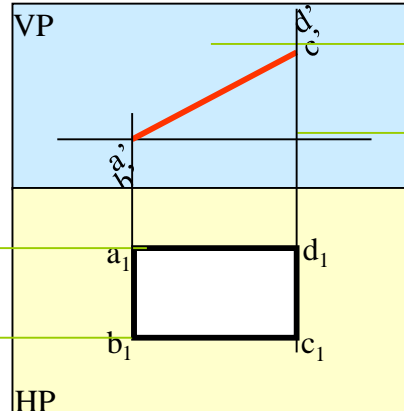


**A**

**SURFACE INCLINED TO HP**  
PICTORIAL PRESENTATION

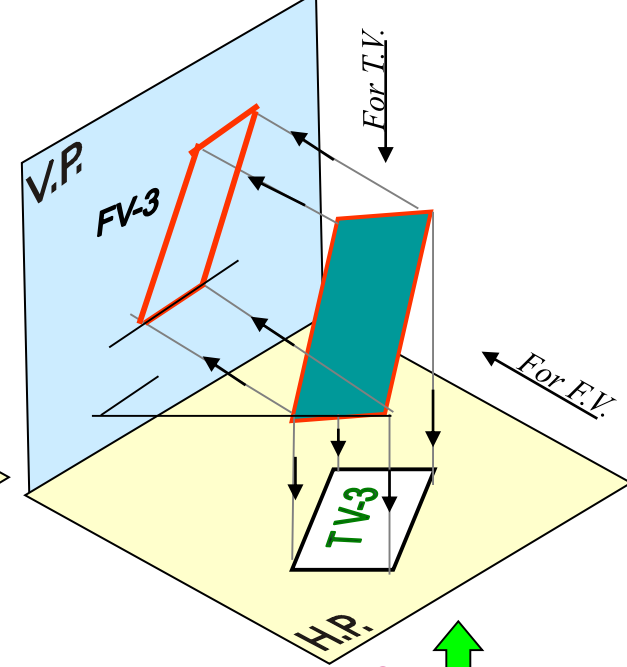


**ORTHOGRAPHIC**  
FV- Inclined to XY  
TV- Reduced Shape

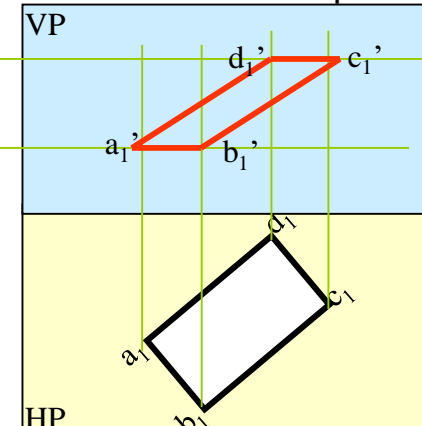


**B**

**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 2<sup>nd</sup> Fv & Tv.

**STEP 3.** After this, consider side/edge inclination and draw 3<sup>rd</sup> ( 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 ).

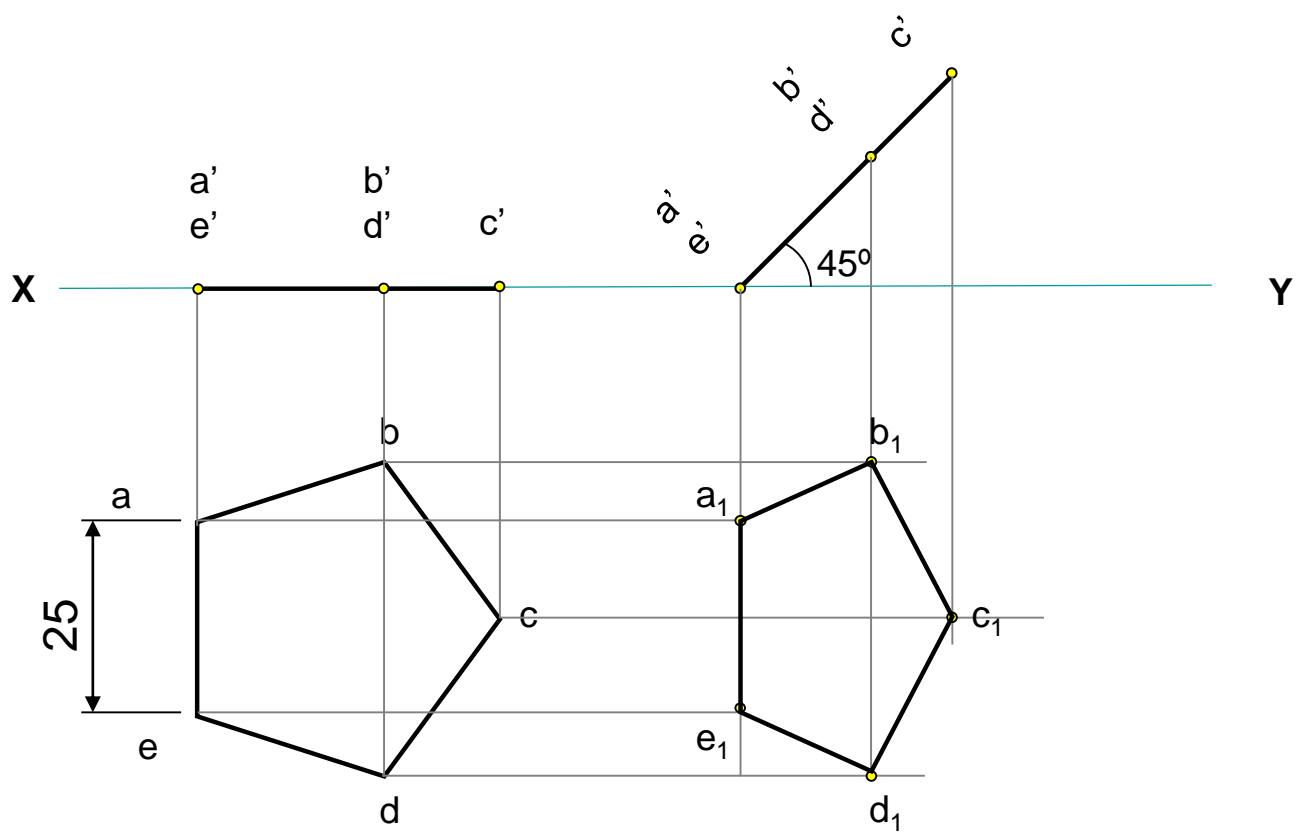
**Now Complete STEP 2. By making surface inclined to the resp plane & project it's other view.  
(Ref. 2<sup>nd</sup> pair **B** on previous page illustration )**

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

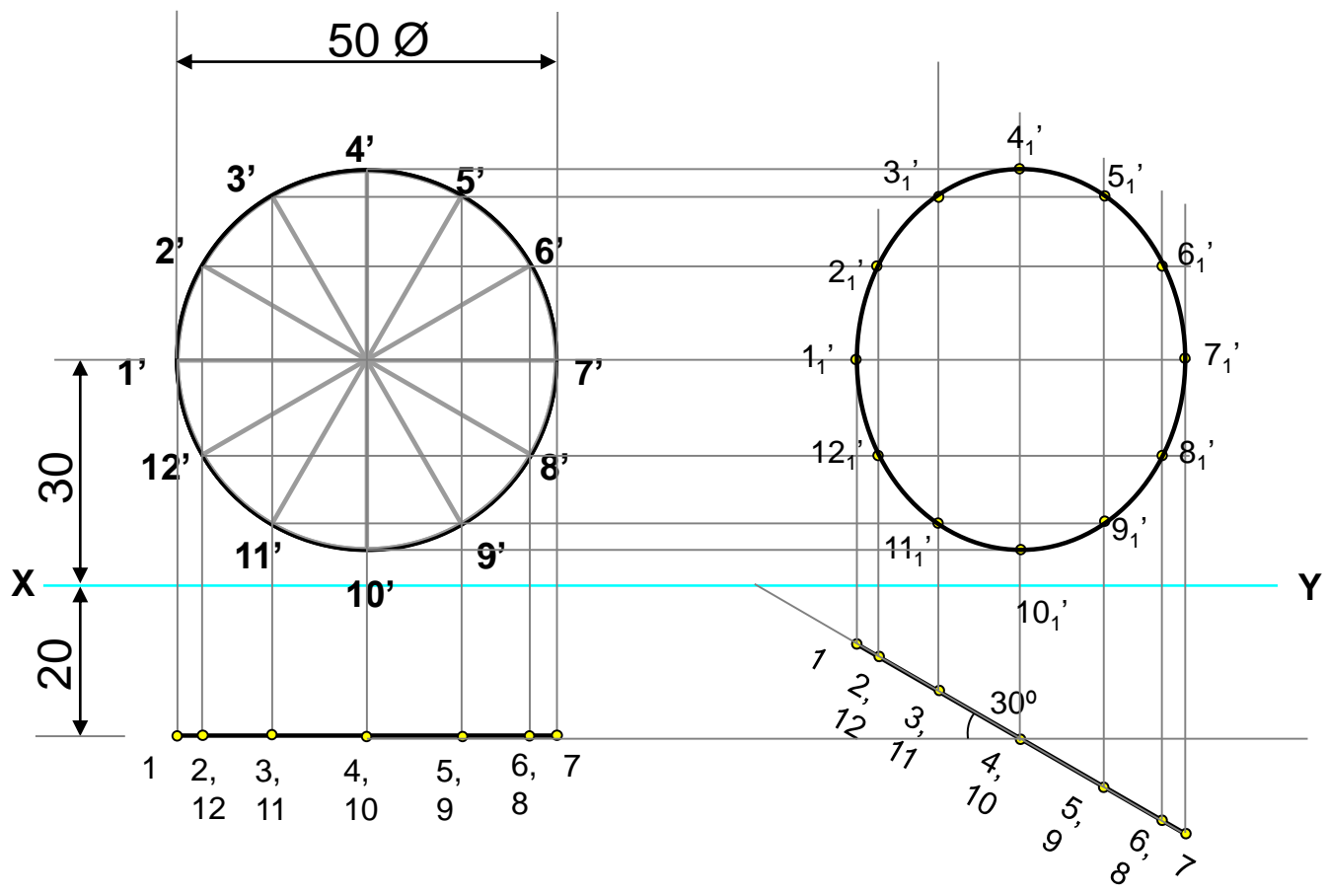
**APPLY SAME STEPS TO SOLVE NEXT *ELEVEN* PROBLEMS**

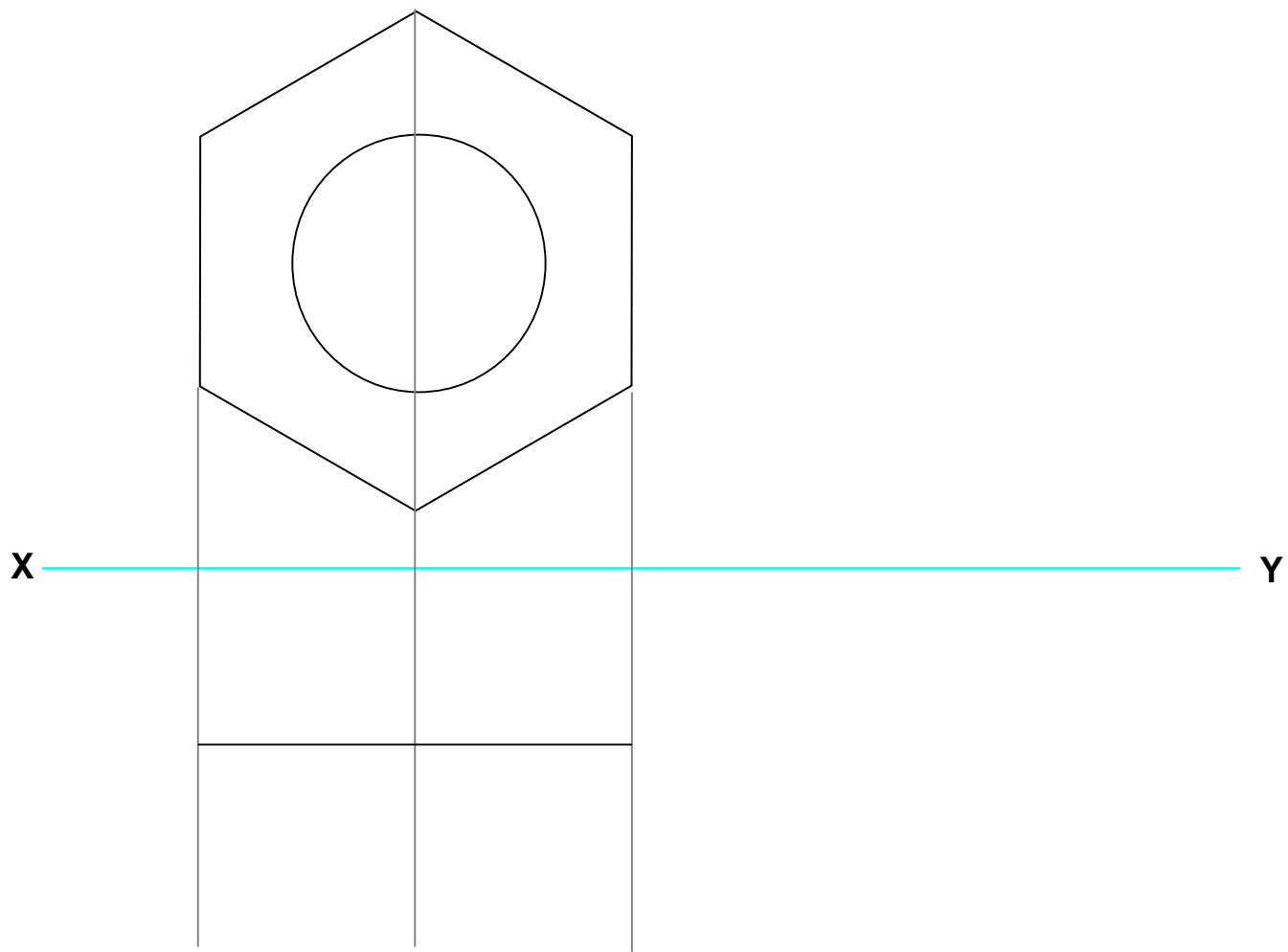
**Q12.4: A regular pentagon of 25mm side has one side on the ground. Its plane is inclined at  $45^\circ$  to the HP and perpendicular to the VP. Draw its projections and show its traces**

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

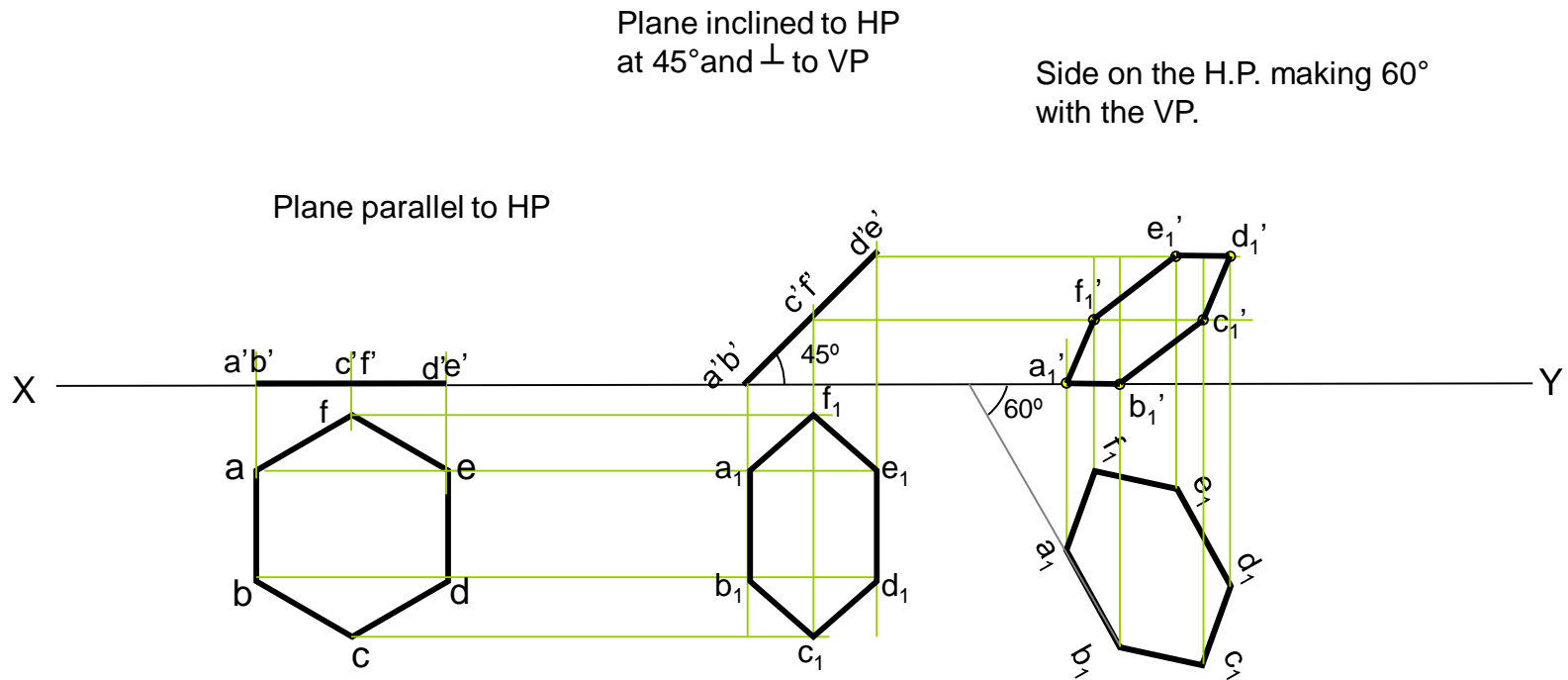


**Q.12.5: Draw the projections of a circle of 5 cm diameter having its plane vertical and inclined at 30° to the V.P. Its centre is 3cm above the H.P. and 2cm in front of the V.P. Show also its traces**





**Q12.7: Draw the projections of a regular hexagon of 25mm sides, having one of its side in the H.P. and inclined at  $60^\circ$  to the V.P. and its surface making an angle of  $45^\circ$  with the H.P.**

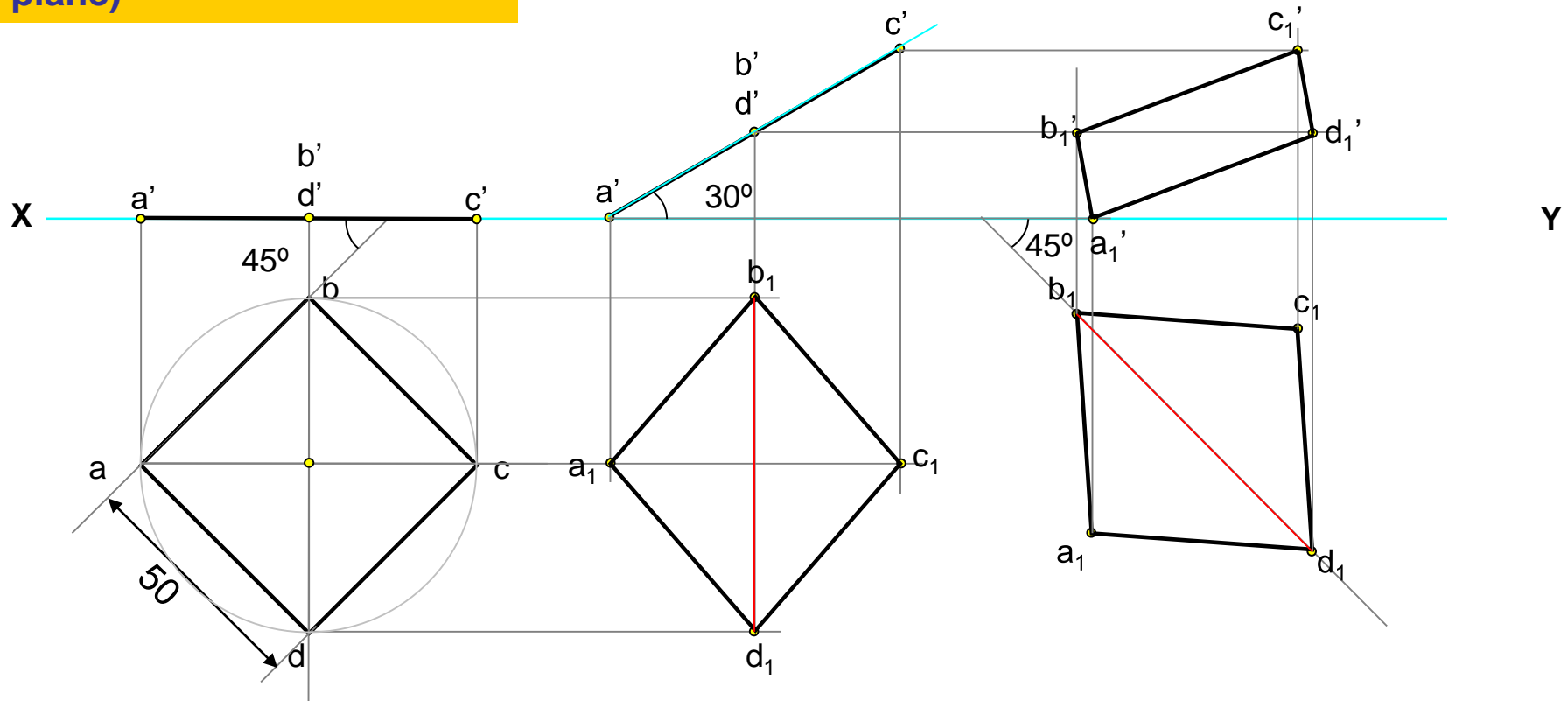


**Q12.6: A square ABCD of 50 mm side has its corner A in the H.P., its diagonal AC inclined at  $30^\circ$  to the H.P. and the diagonal BD inclined at  $45^\circ$  to the V.P. and parallel to the H.P. Draw its projections.**

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

Incline AC at  $30^\circ$  to the H.P.  
i.e. incline the edge view (FV) at  $30^\circ$  to the HP

Incline BD at  $45^\circ$  to the V.P.



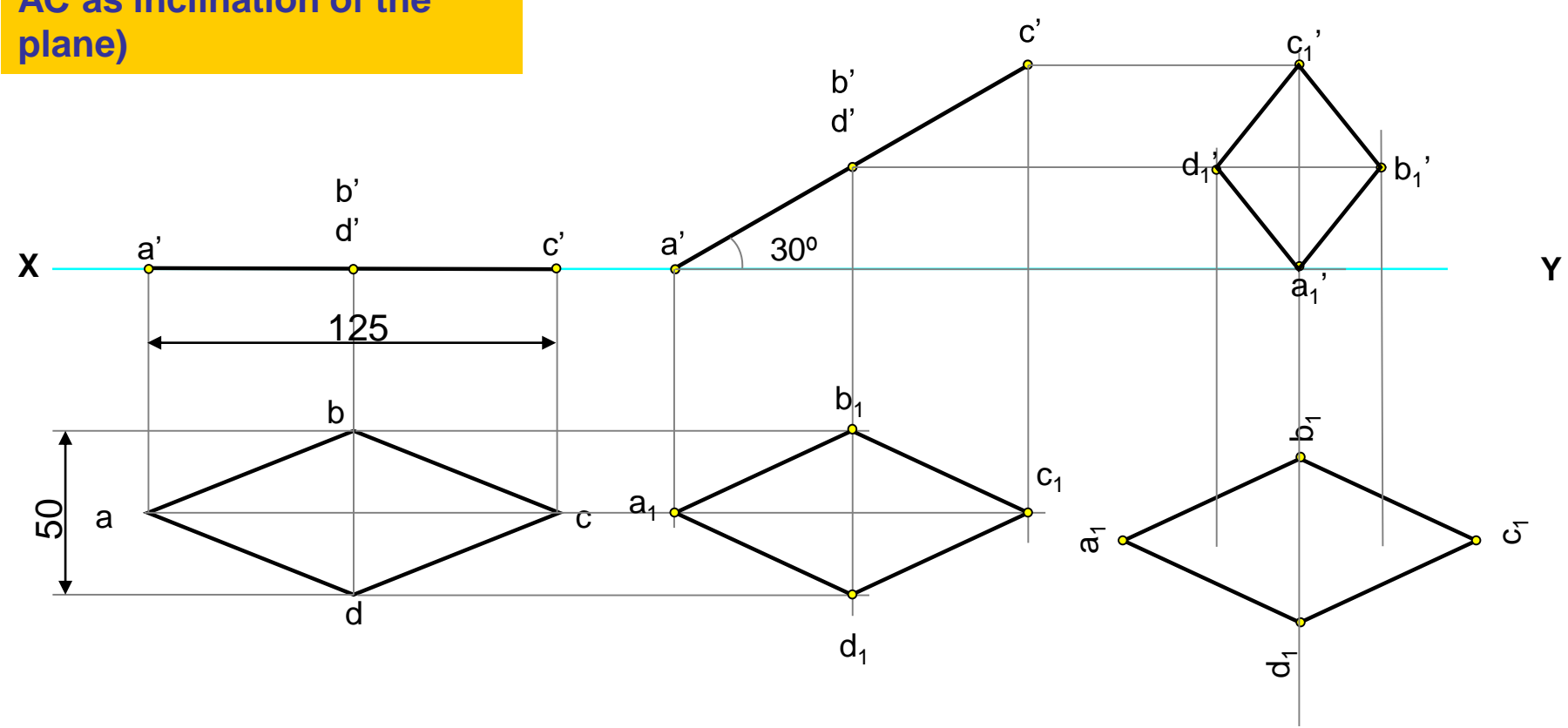


**Q4: Draw projections of a rhombus having diagonals 125 mm and 50 mm long, the smaller diagonal of which is parallel to both the principal planes, while the other is inclined at 30° to the H.P.**

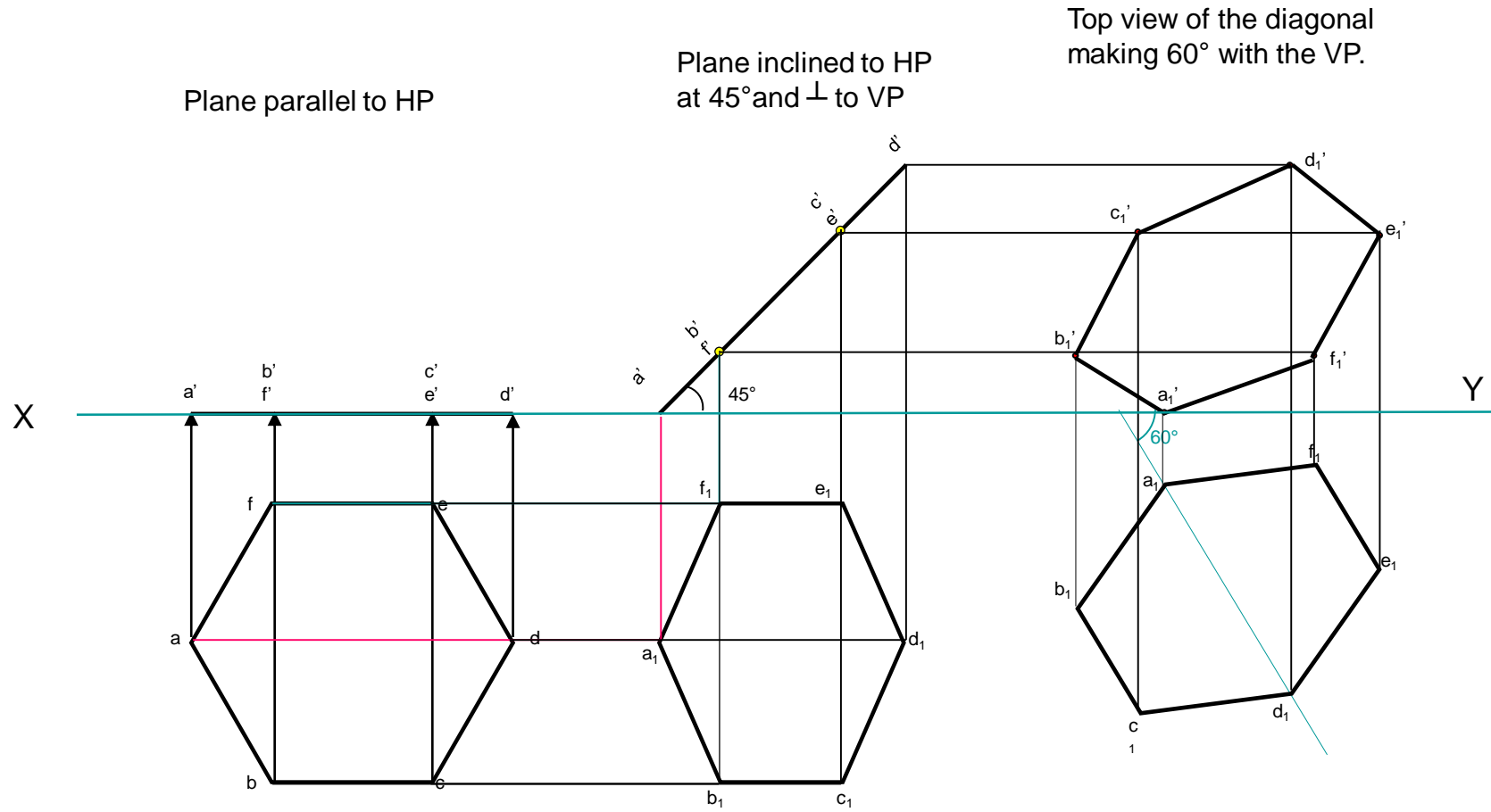
Keep AC parallel to the H.P. & BD perpendicular to V.P. (considering inclination of AC as inclination of the plane)

Incline AC at 30° to the H.P.

Make BD parallel to XY



**Q 2: A regular hexagon of 40mm side has a corner in the HP. Its surface inclined at  $45^\circ$  to the HP and the top view of the diagonal through the corner which is in the HP makes an angle of  $60^\circ$  with the VP. Draw its projections.**

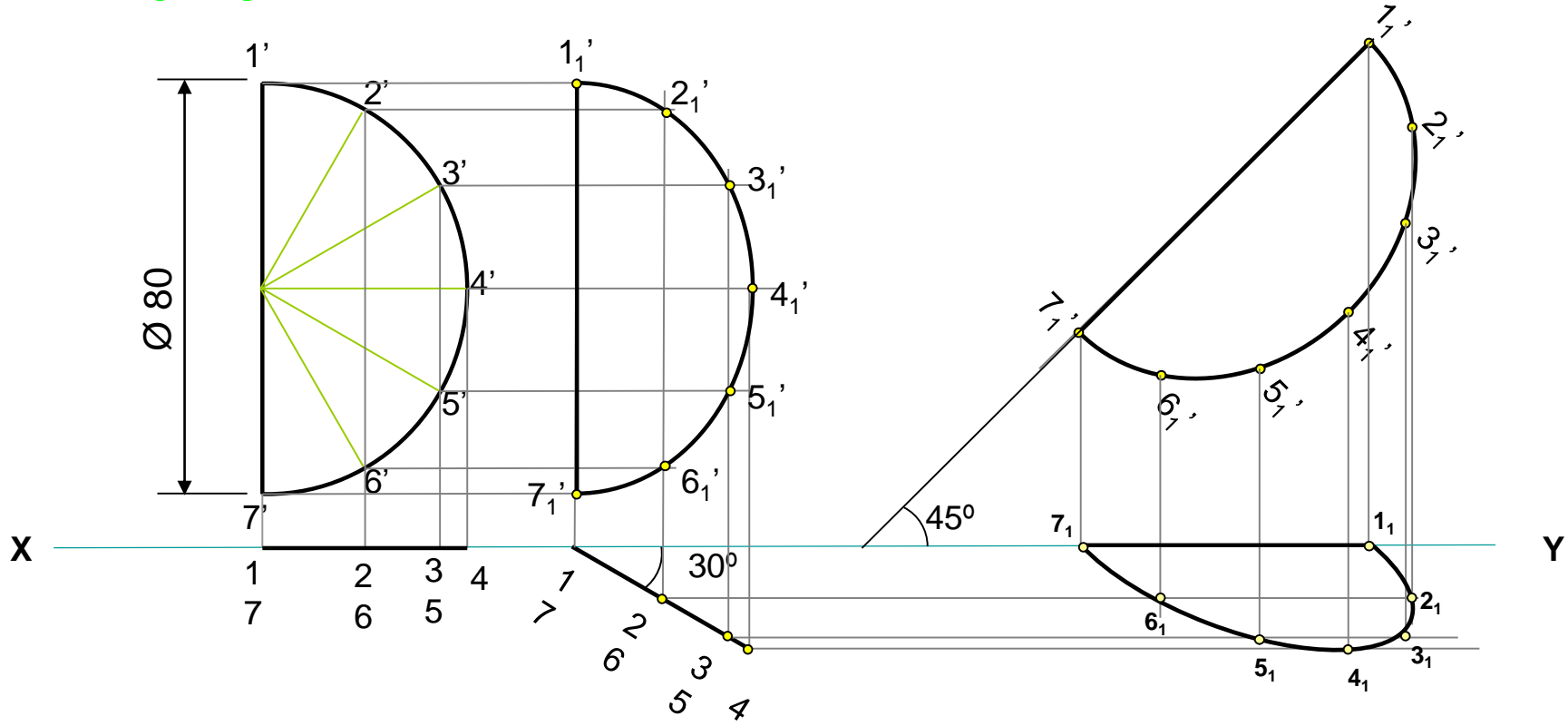


**Q7:**A semicircular plate of 80mm diameter has its straight edge in the VP and inclined at 45° to HP. The surface of the plate makes an angle of 30° with the VP. Draw its projections.

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.

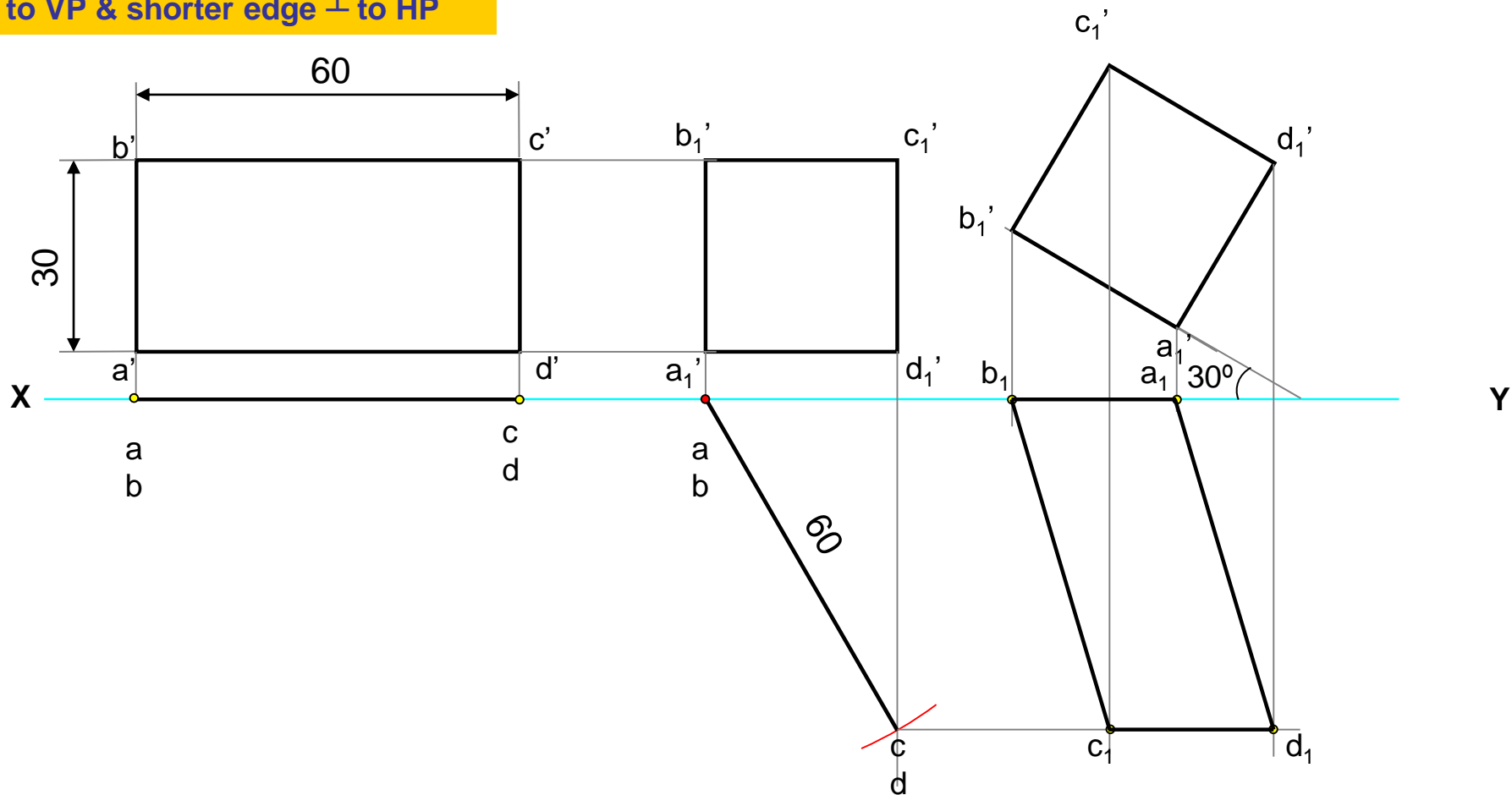


**Q12.10: A thin rectangular plate of sides 60 mm X 30 mm has its shorter side in the V.P. and inclined at 30° to the H.P. Project its top view if its front view is a square of 30 mm long sides**

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 ⊥ to HP

F.V. (square) is drawn first

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

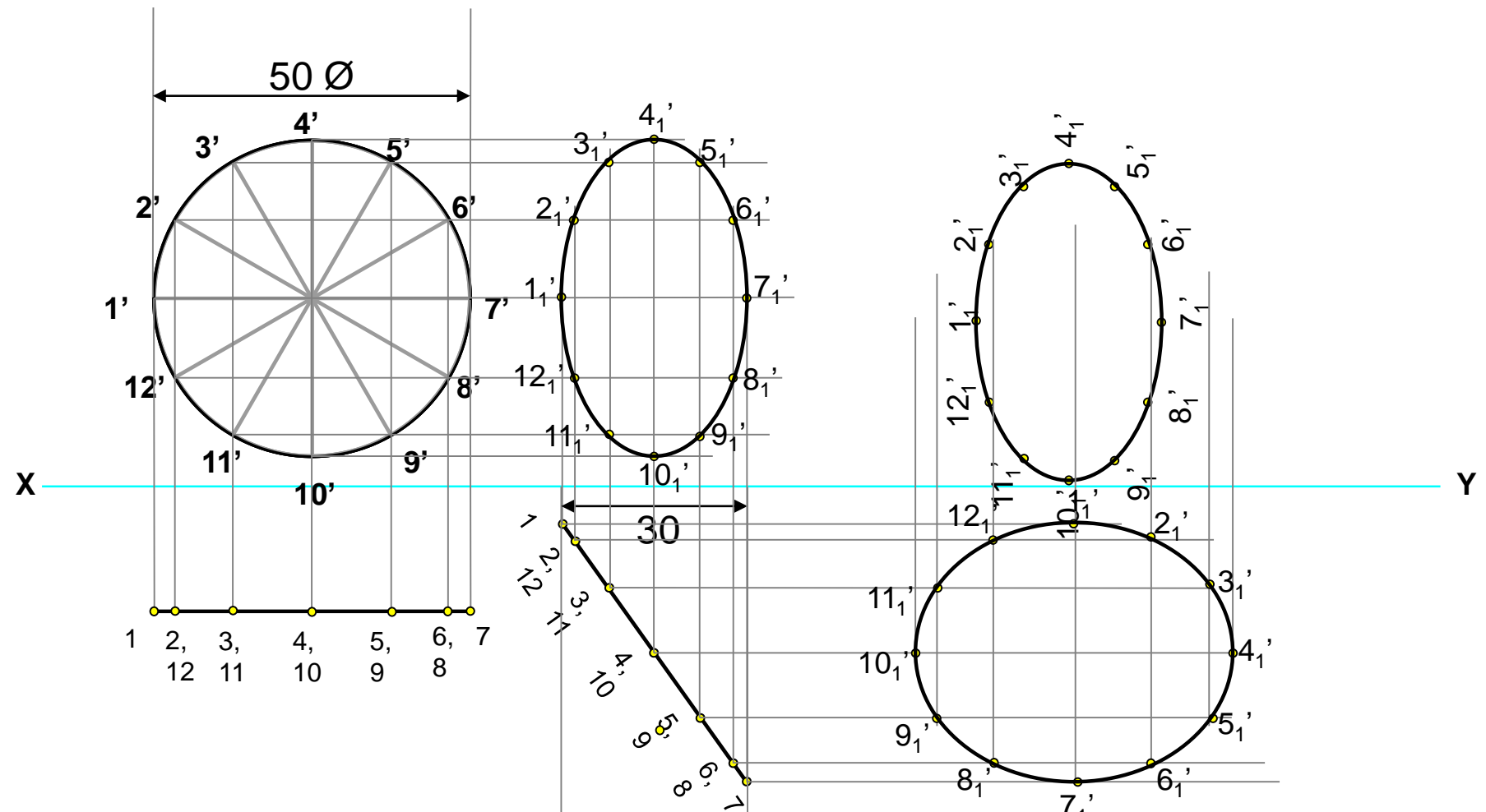


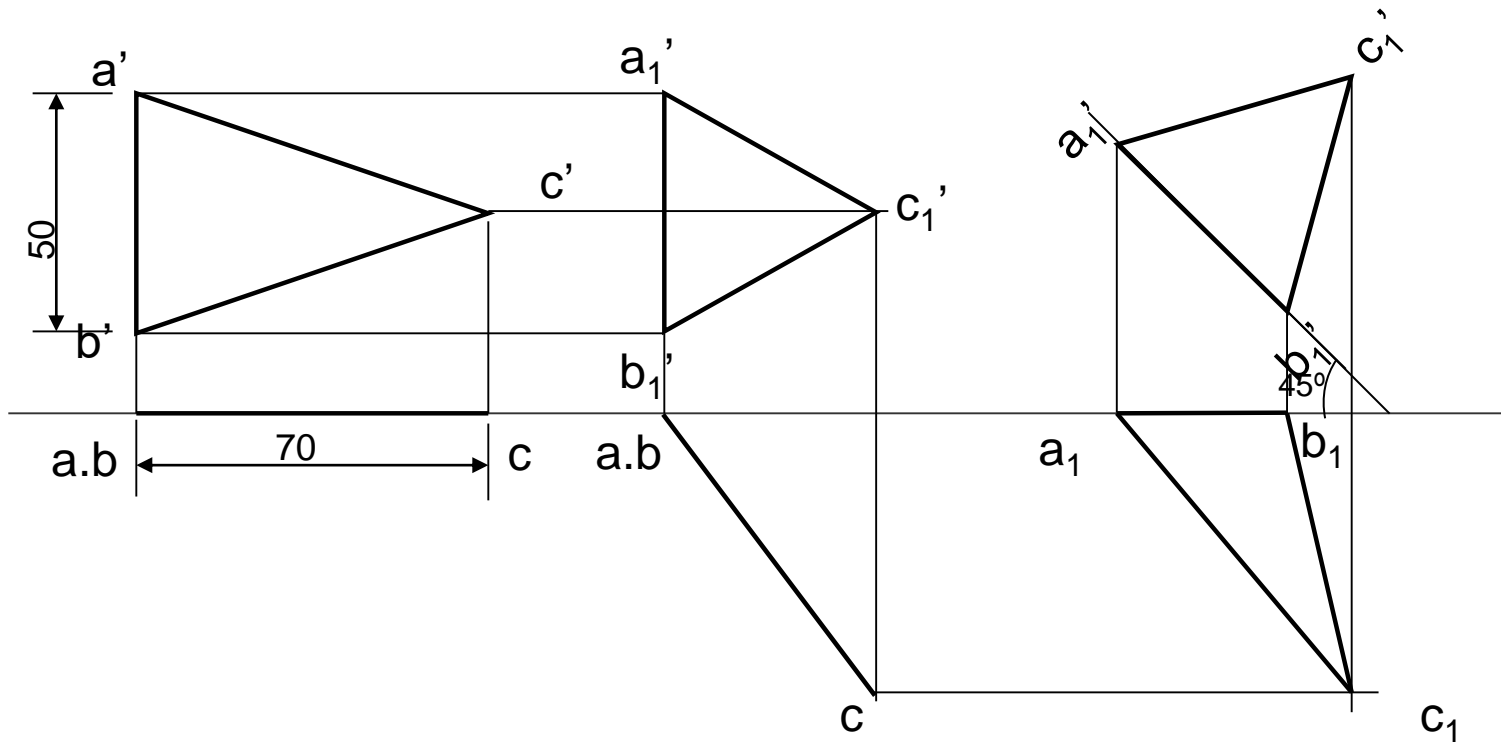
**Q12.11: A circular plate of negligible thickness and 50 mm diameter appears as an ellipse in the front view, having its major axis 50 mm long and minor axis 30 mm long. Draw its top view when the major axis of the ellipse is horizontal.**

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





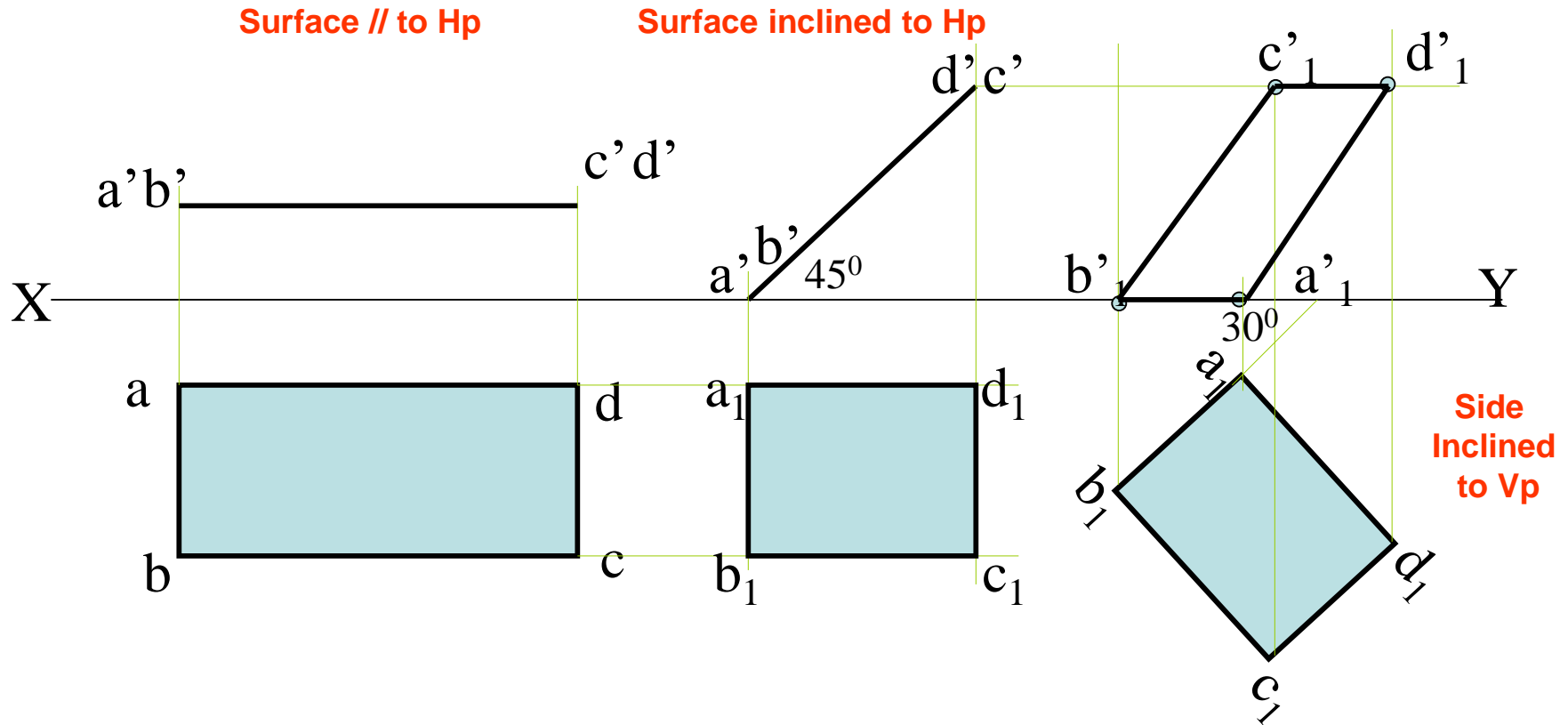
### Problem 1:

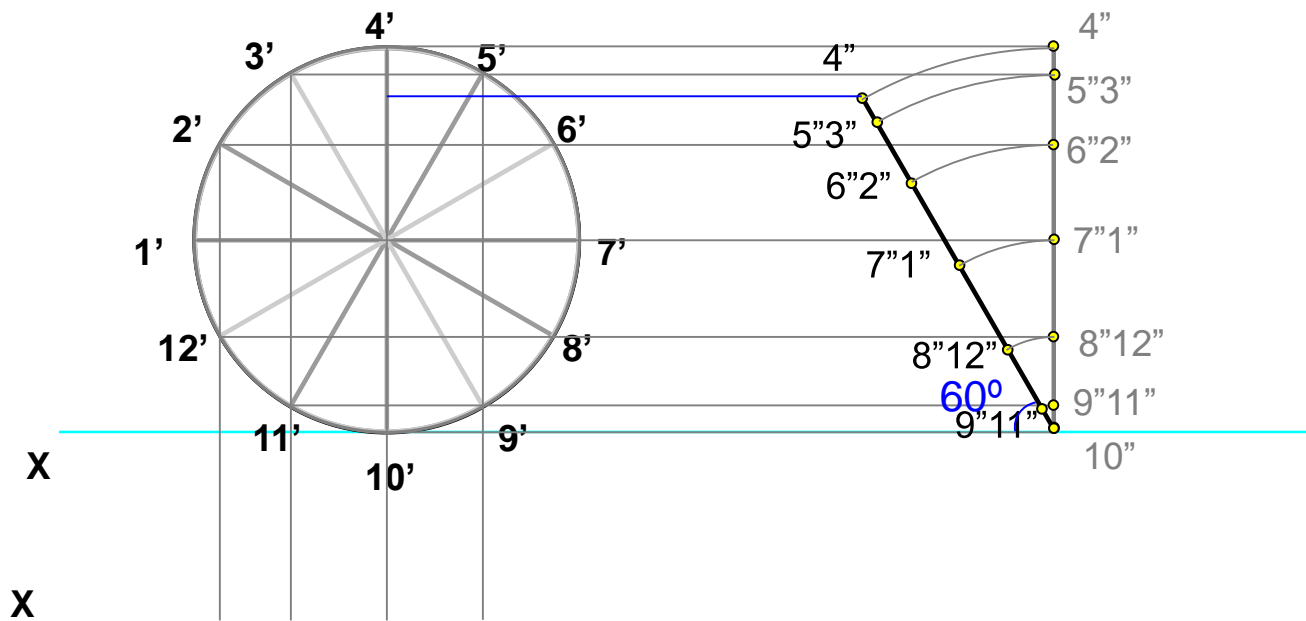
Rectangle 30mm and 50mm sides is resting on HP on one small side which is  $30^\circ$  inclined to VP, while the surface of the plane makes  $45^\circ$  inclination with HP. Draw its projections.

### 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.**





Y



### Problem 12.9:

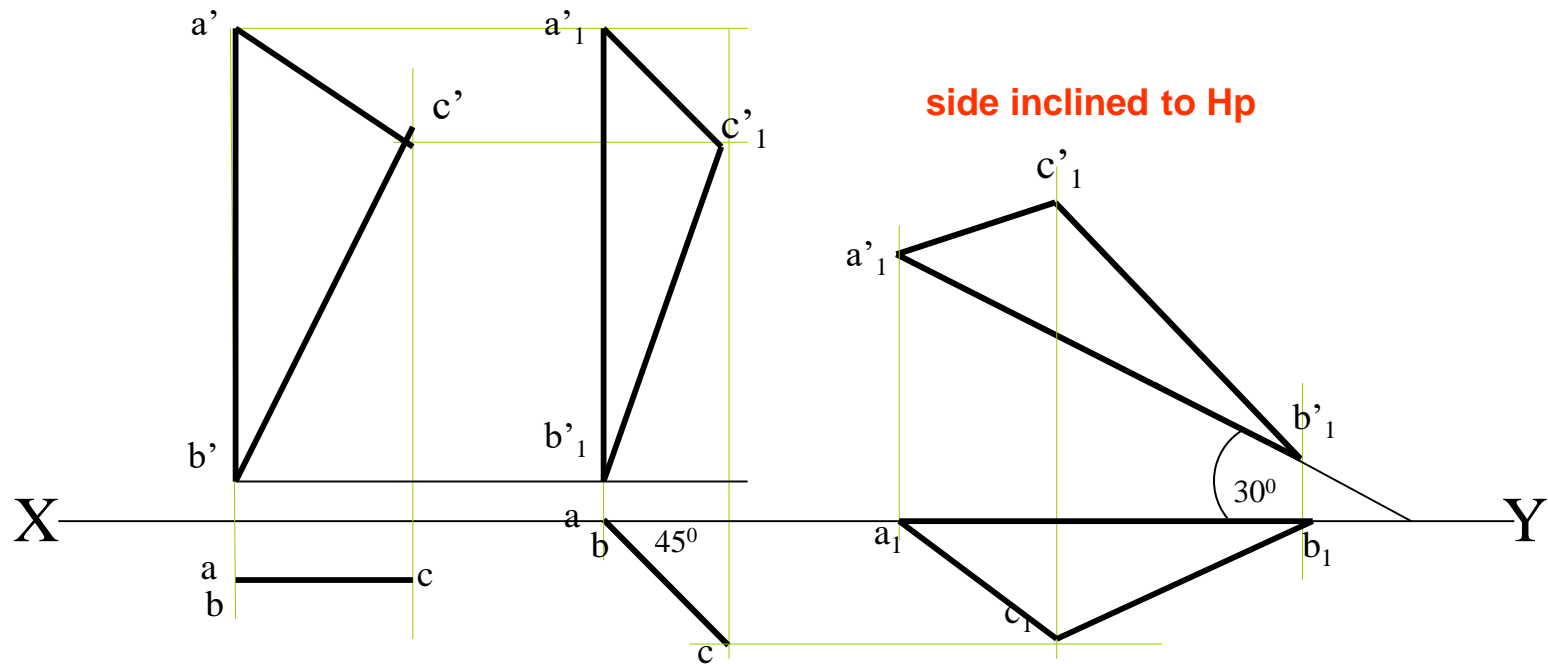
A  $30^\circ - 60^\circ$  set square of longest side 100 mm long, is in VP and  $30^\circ$  inclined to HP while it's surface is  $45^\circ$  inclined to VP. Draw its projections

(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.**



**Surface // to Vp    Surface inclined to Vp**

### Problem 3:

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

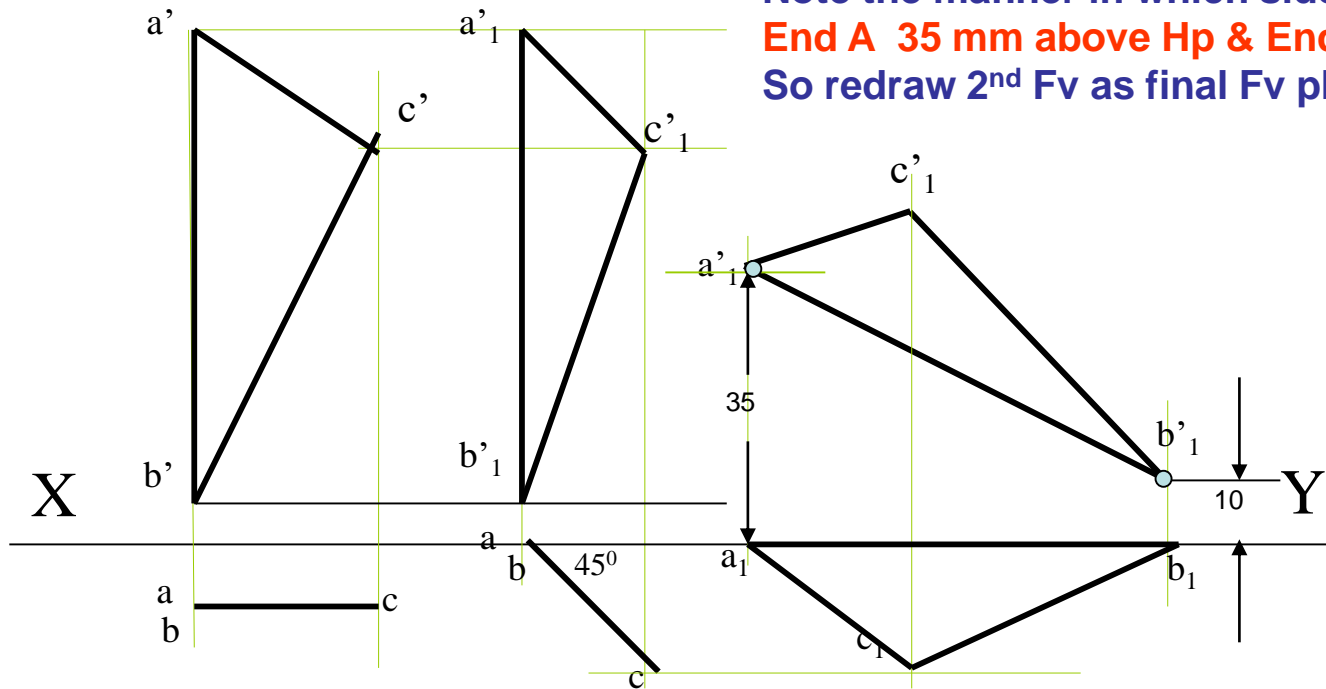
(Surface inclination directly given.  
Side inclination indirectly given)

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 2<sup>nd</sup> 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  $45^\circ$  inclined to HP.

Draw its projections when the side in HP makes  $30^\circ$  angle with VP

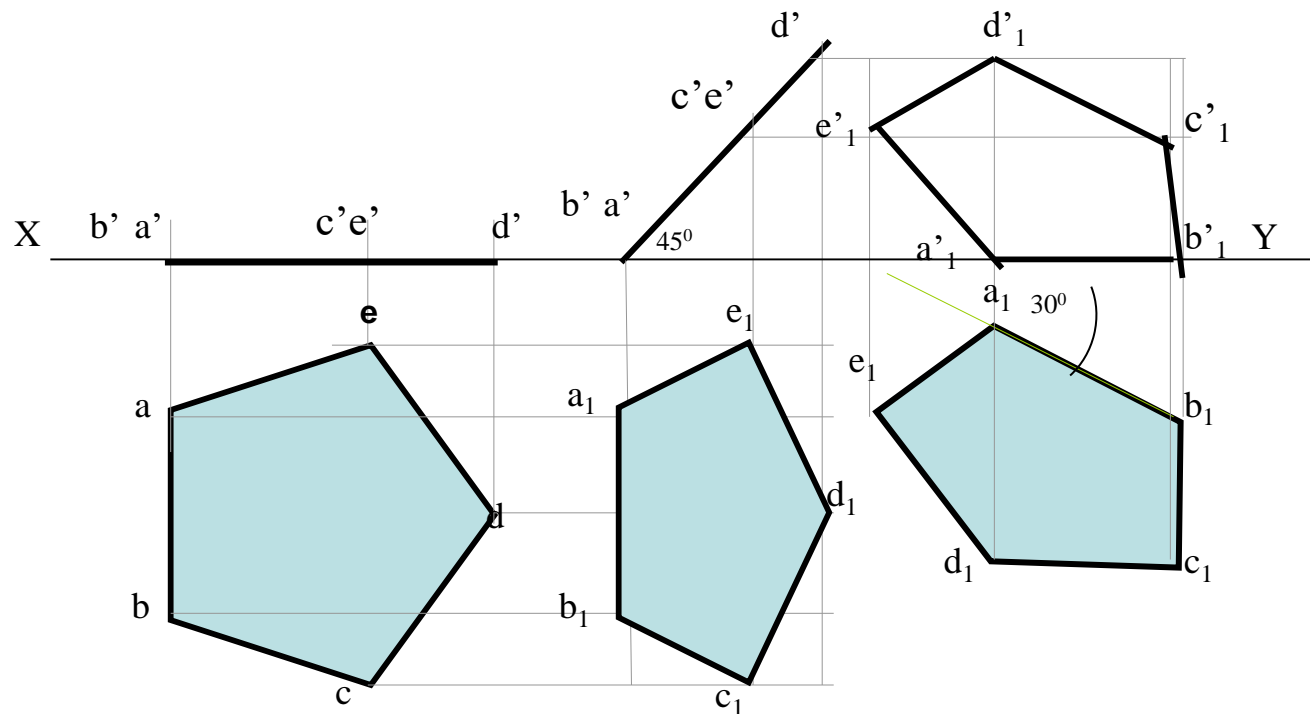
**SURFACE AND SIDE INCLINATIONS  
ARE DIRECTLY GIVEN.**

### 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  $30^\circ$  inclined to VP.

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

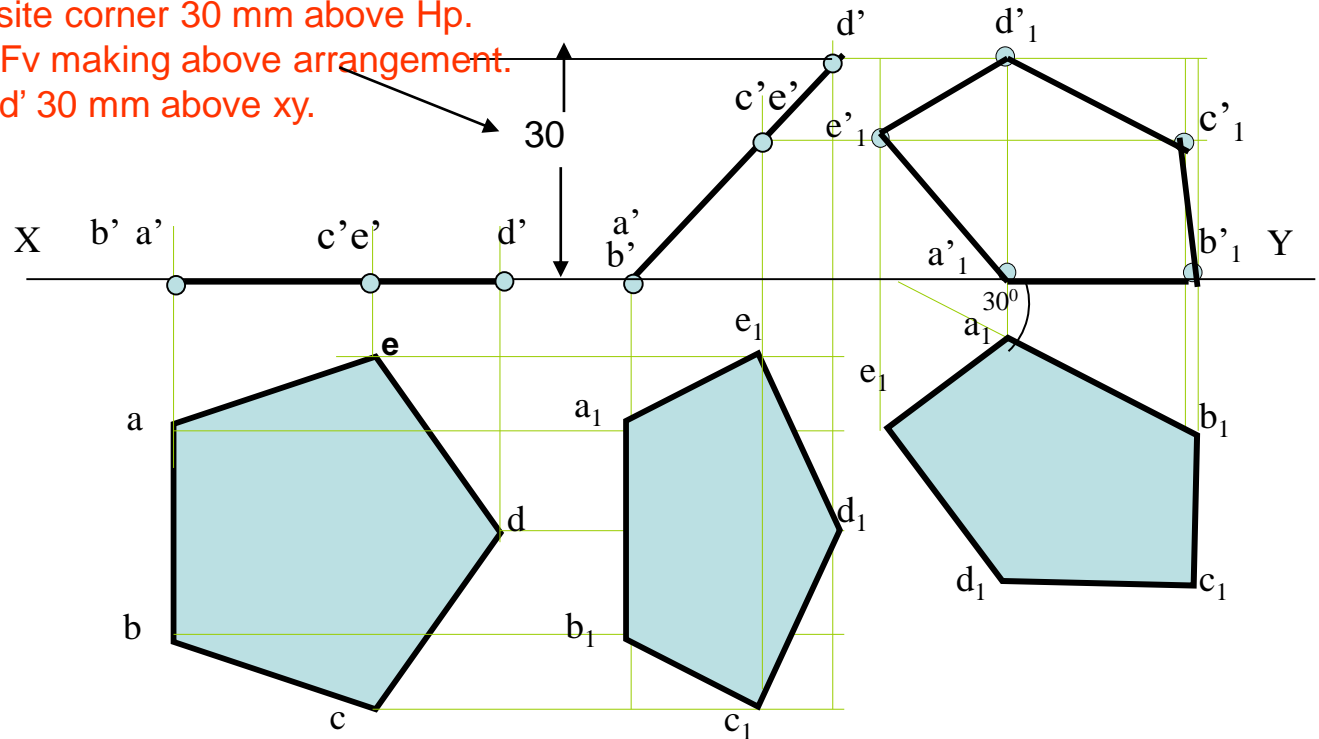
ONLY CHANGE is

the manner in which surface inclination is described:

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

Hence redraw 1<sup>st</sup> Fv as a 2<sup>nd</sup> Fv making above arrangement.

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



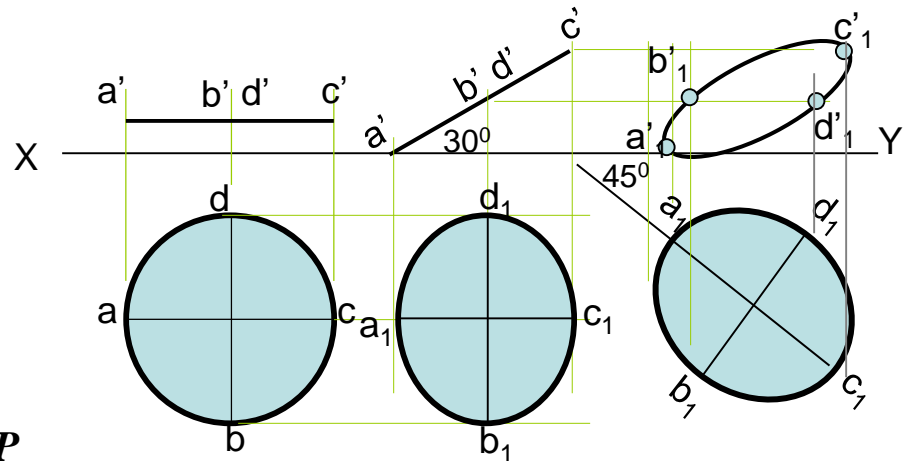
Read problem and answer following questions

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.**

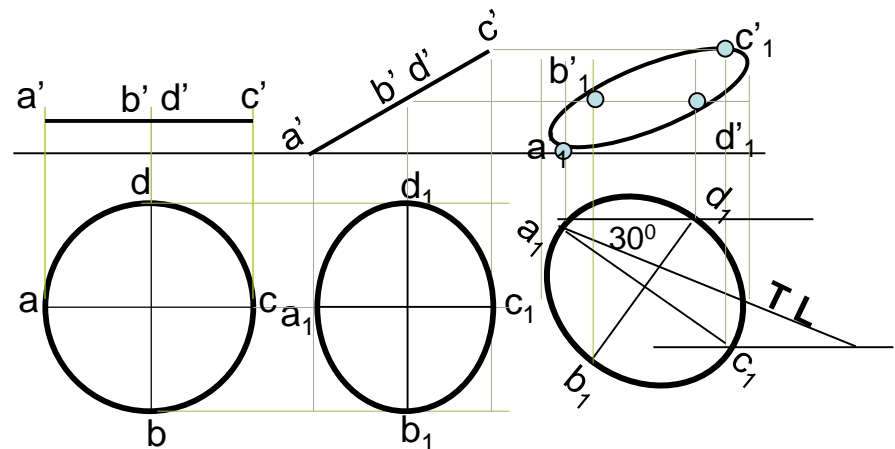
**Hence begin with TV, draw pentagon below**

**X-Y line, taking one side vertical.**

**Problem 8:** A circle of 50 mm diameter is resting on Hp on end A of it's diameter AC which is  $30^\circ$  inclined to Hp while it's Tv is  $45^\circ$  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 3<sup>rd</sup> 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  $30^\circ$  inclined to Hp while it makes  $45^\circ$  inclined to Vp. Draw it's projections.

**Note the difference in construction of 3<sup>rd</sup> step in both solutions.**

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.

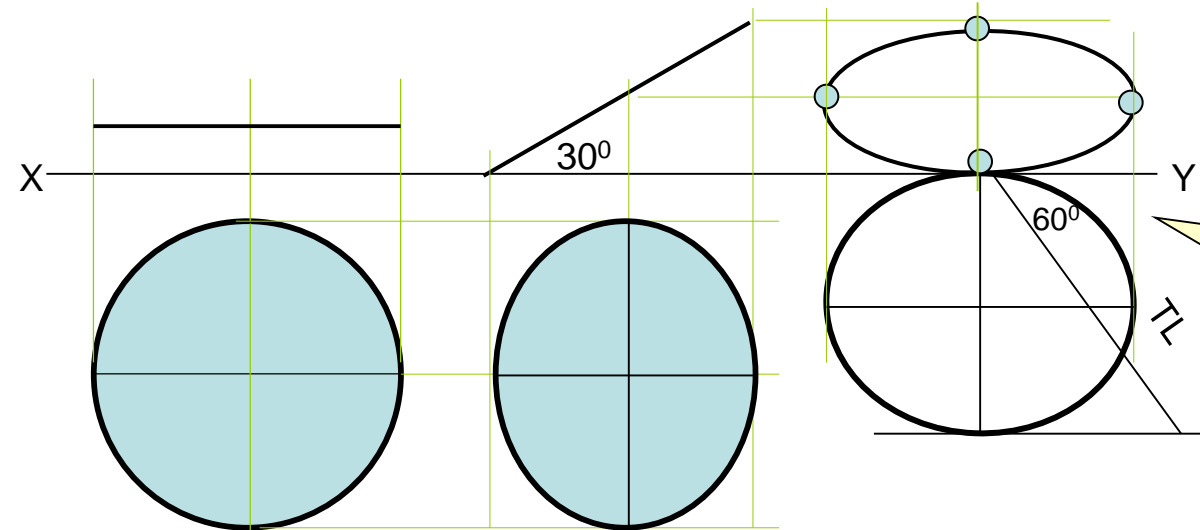
But in the 3<sup>rd</sup> step there is one more change.

Like 9<sup>th</sup> 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 11:

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.

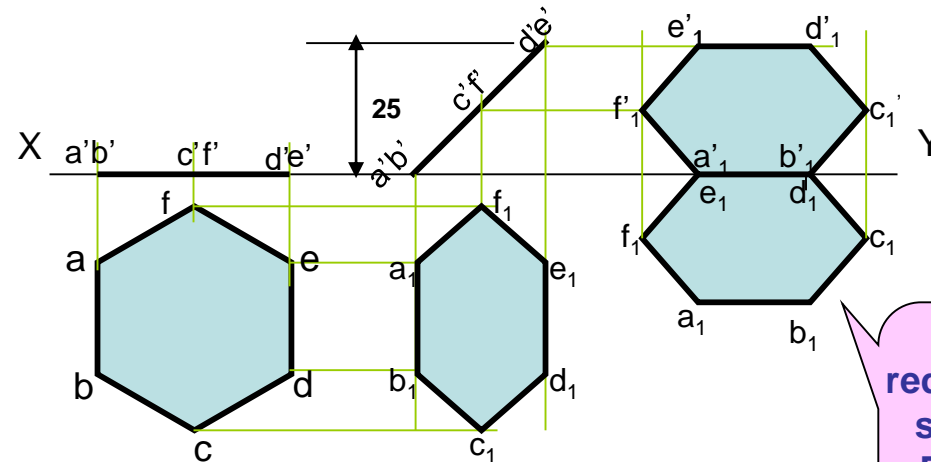
ONLY CHANGE is the manner in which surface inclination is described:

One side on Hp & its opposite side 25 mm above Hp.  
Hence redraw 1<sup>st</sup> Fv as a 2<sup>nd</sup> 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 3<sup>rd</sup> step  
redraw 2<sup>nd</sup> Tv keeping  
side DE on xy line.  
Because it is in VP  
as said in problem.

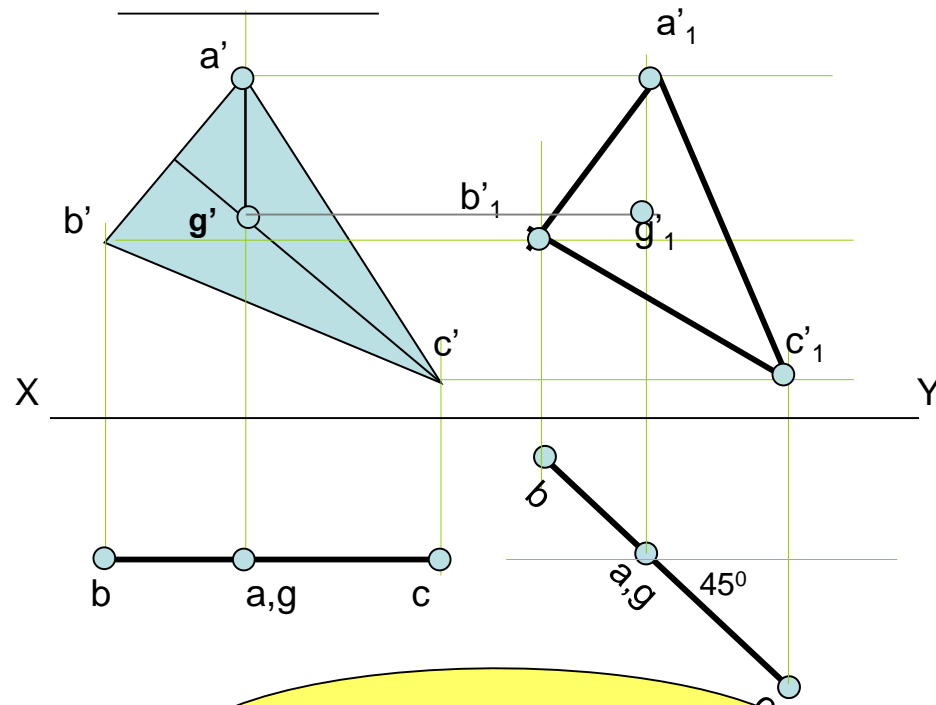
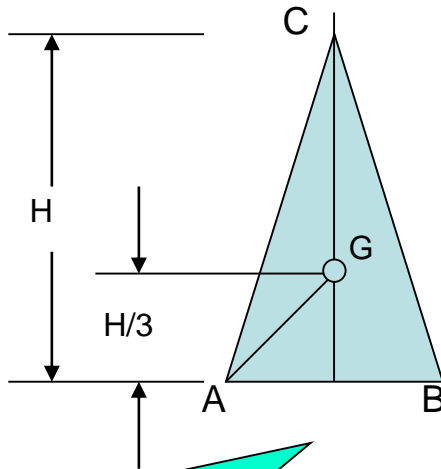
# FREELY SUSPENDED CASES.

## IMPORTANT POINTS

### Problem 12:

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  $45^\circ$  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 1<sup>st</sup> 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



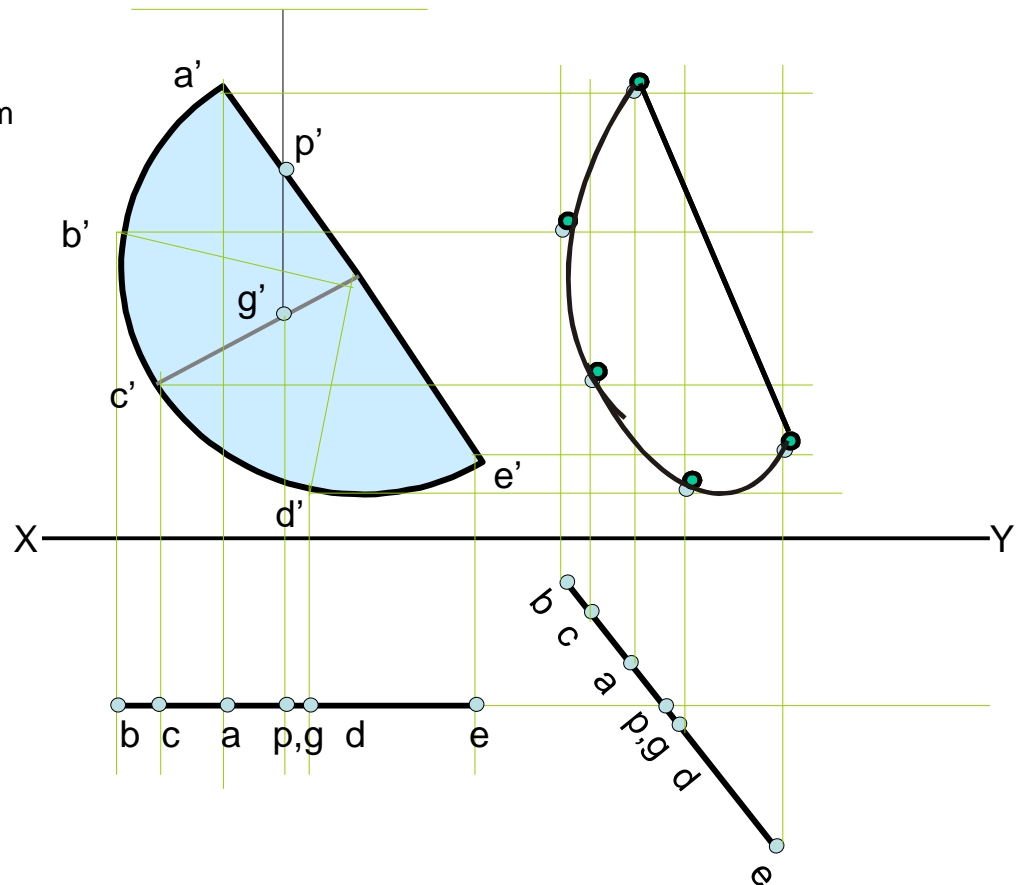
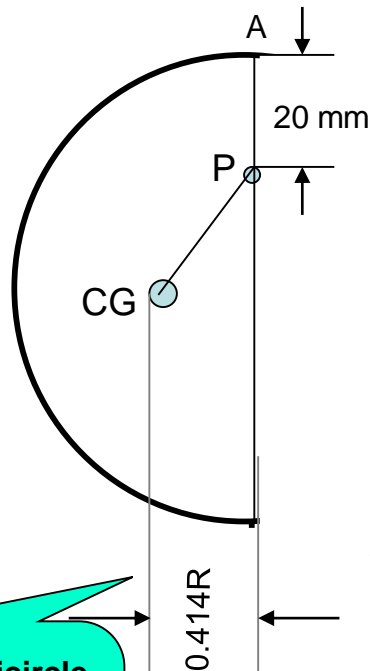
# IMPORTANT POINTS



## Problem 13

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  $45^\circ$  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 1<sup>st</sup> 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 AND THEN IT'S OTHER VIEW WILL SHOW TRUE SHAPE:**

NOW FINAL VIEWS ARE ALWAYS SOME SHAPE, NOT LINE VIEWS:  
SO APPLYING ABOVE METHOD:

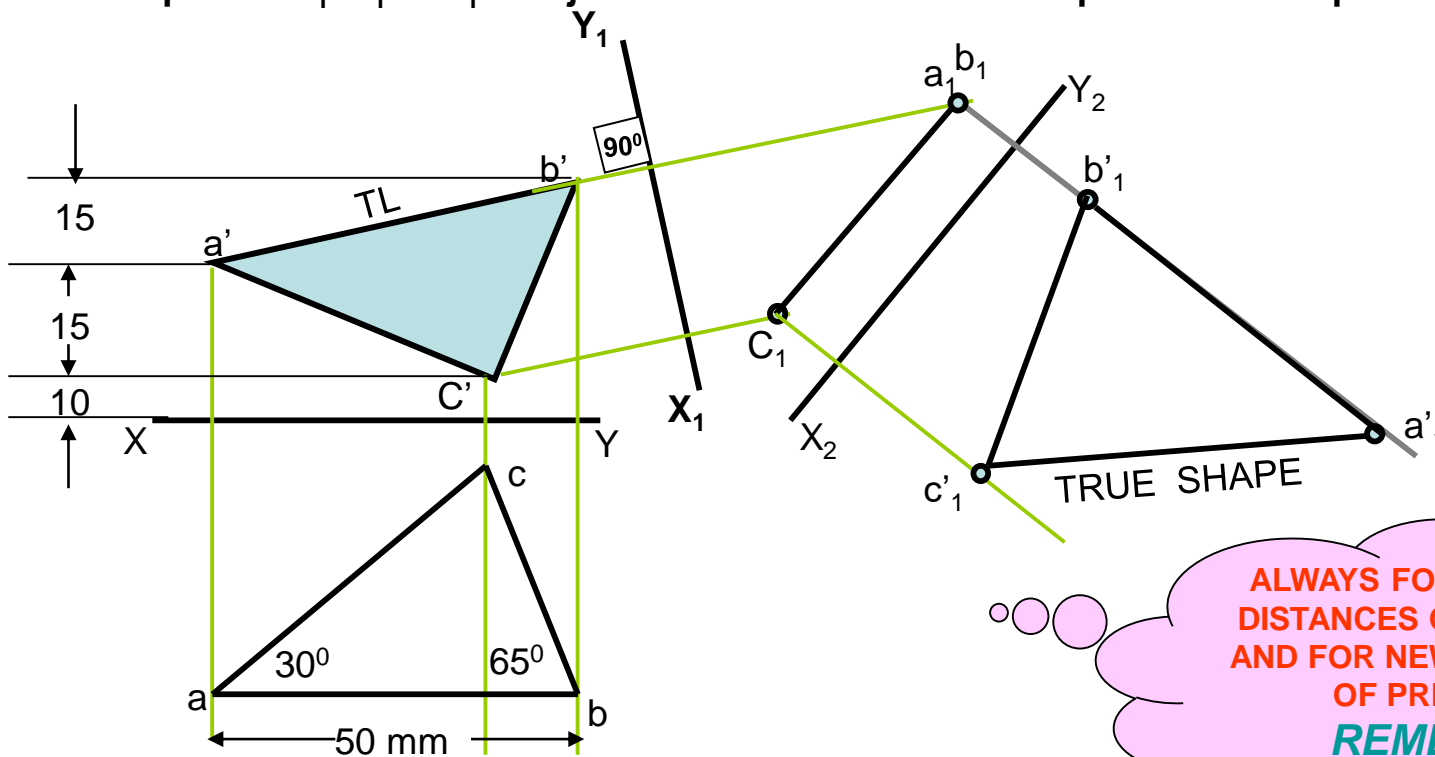
WE FIRST CONVERT ONE VIEW IN INCLINED LINE VIEW .(By using  $x_1y_1$  aux.plane)  
THEN BY MAKING IT // TO  $x_2-y_2$  WE GET TRUE SHAPE.

**Study Next  
Four Cases**

**Problem 14** Tv is a triangle abc. Ab is 50 mm long, angle cab is  $30^\circ$  and angle cba is  $65^\circ$ . 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  $a_1b_1$  &  $c_1$ .
  - 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 15:** Fv & Tv of a triangular plate are shown.  
Determine it's true shape.

USE SAME PROCEDURE STEPS  
OF PREVIOUS PROBLEM:

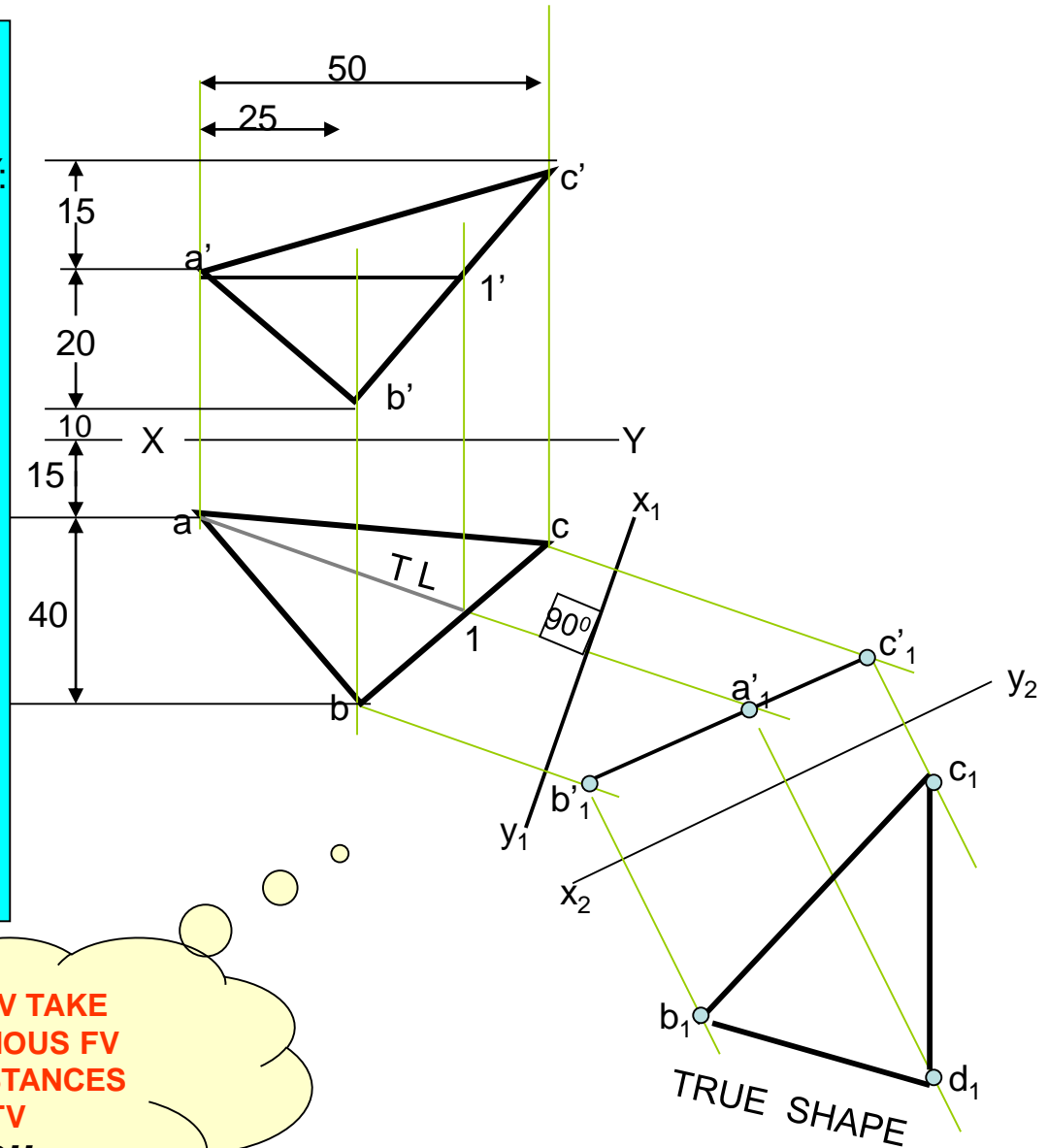
**BUT THERE IS ONE DIFFICULTY:**

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!!**

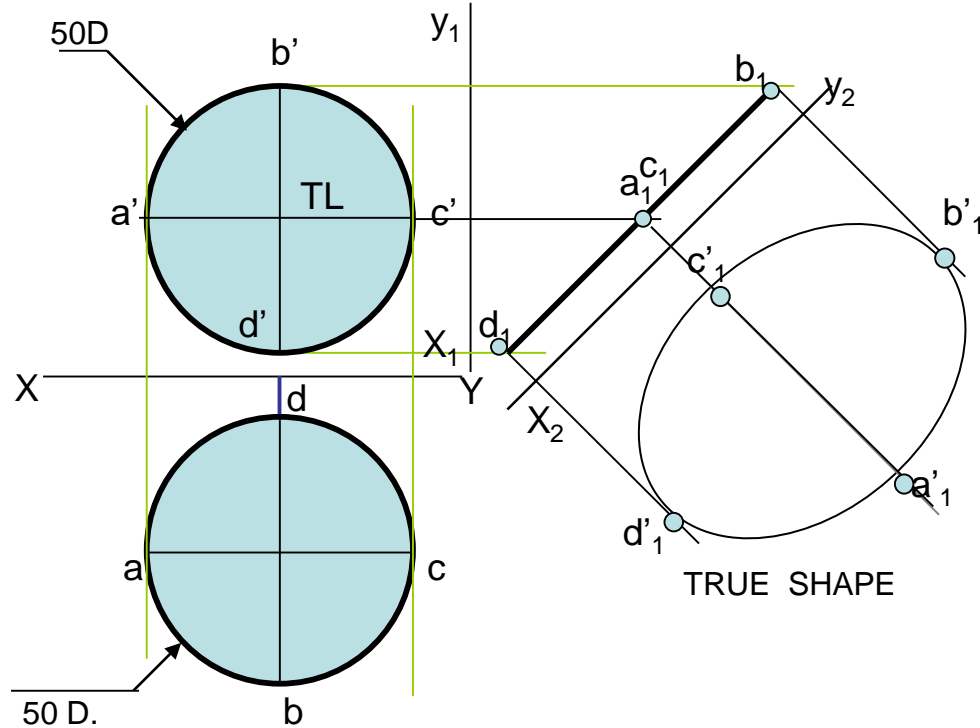
**PROBLEM 16:** Fv & Tv both are circles of 50 mm diameter. Determine true shape of an elliptical plate.

**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!!**



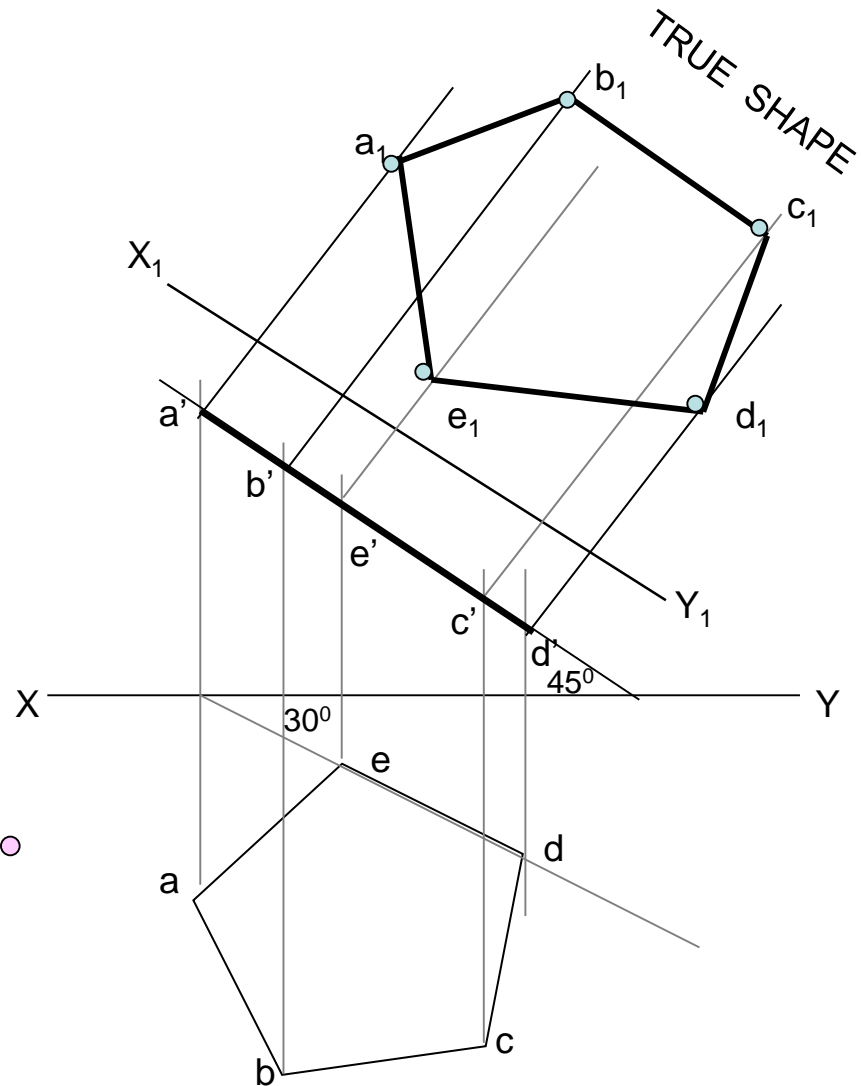
**Problem 17 :** Draw a regular pentagon of 30 mm sides with one side  $30^\circ$  inclined to xy. This figure is Tv of some plane whose Fv is A line  $45^\circ$  inclined to xy. Determine its true shape.

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!!**



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