MODULE-1

INTRODUCTION TO COMPUTER AIDED ENGINEERING GRAPHICS

1. 1 What is Drawing?

Drawing is a visual art that uses an instrument to mark paper or another two-dimensional surface. The instruments used to make a drawing are pencils, crayons, pens with inks, brushes with paints, or combinations of these. Drawing is one of the oldest forms of human expression within the visual arts. It is generally concerned with the marking of lines and areas of tone onto paper/other material, where the accurate representation of the visual world is expressed upon a plane surface.

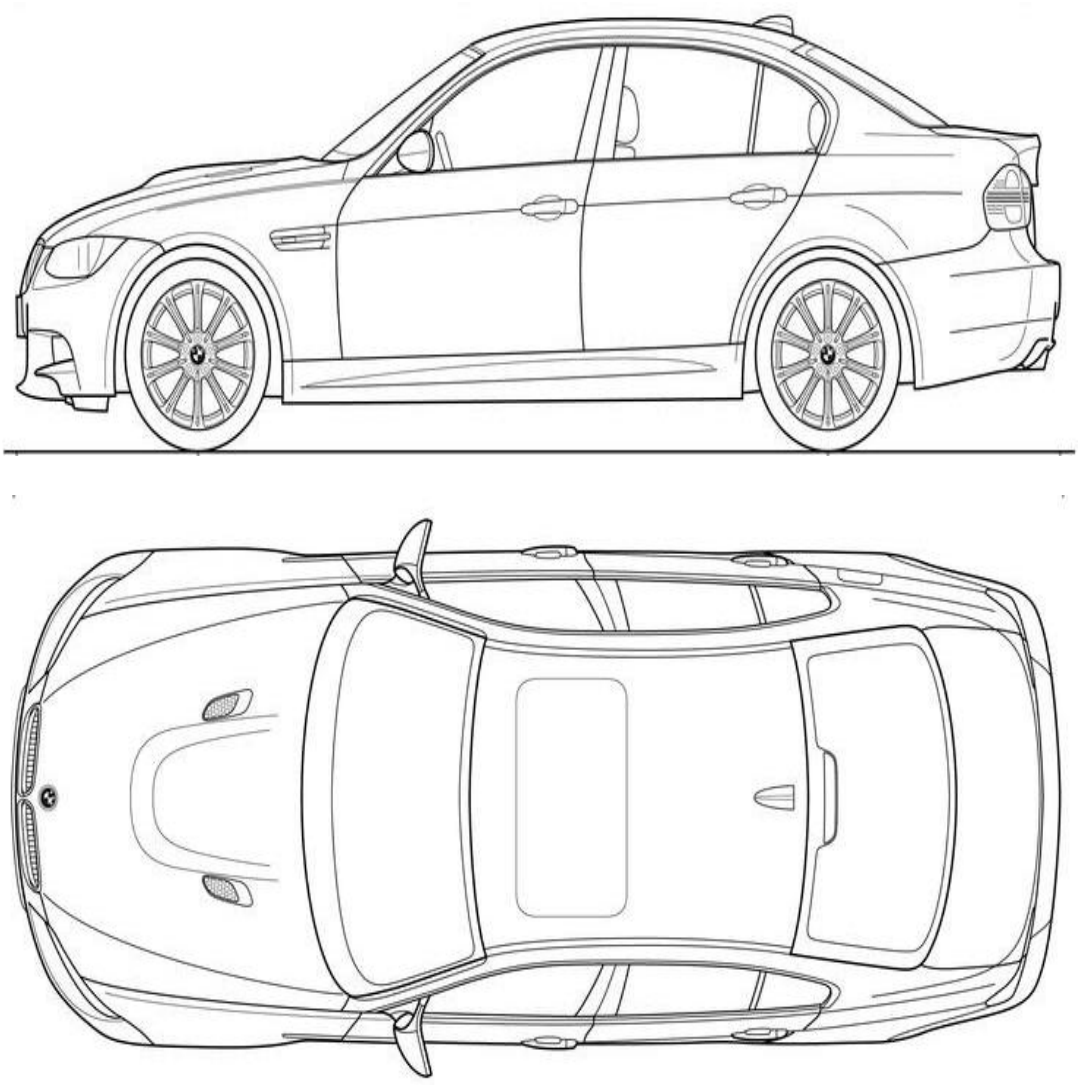


Fig 1.1 An example of a plane Drawing

1.2 What is an Engineering Drawing?

Engineering drawings are used to communicate design concepts and design intent using a standardized pictorial language comprised of lines, shapes, and symbols. They are sophisticated technical drawings that provide details on the geometry, dimensions, materials, and tolerances of an object.

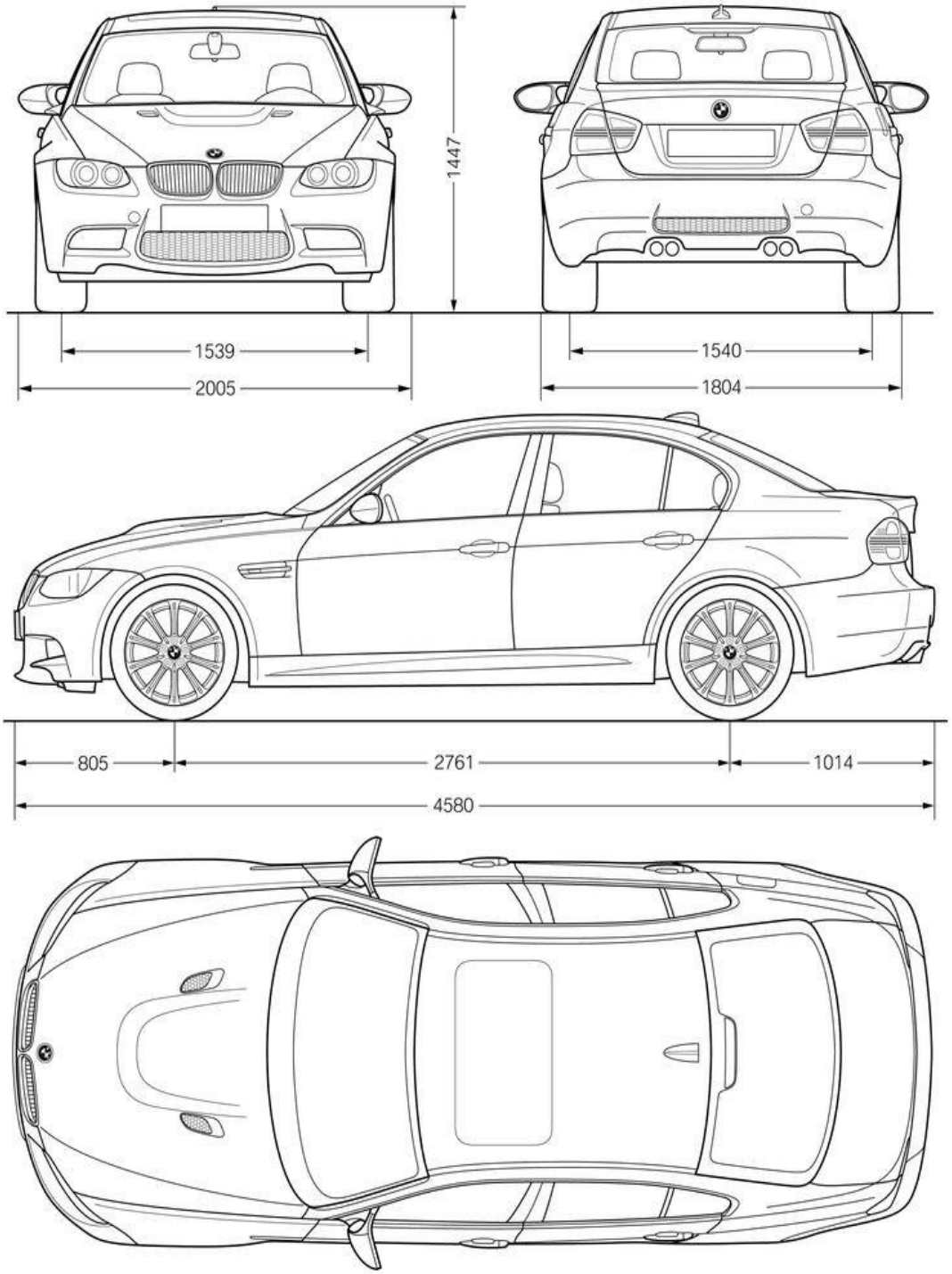


Fig1.2 An example of an Engineering Drawing

1.3 Drawing sheet

Drawing sheet is the medium on which drawings are prepared by means of pencils or pen. Drawing sheets are available in standard sizes as shown in Table 1.1.

Table 1.1 Standard sizes of drawing sheet

Designation	Size (mm)
A0	841 X 1189
A1	594 X 841
A2	420 X 594
A3	297 X 420
A4	210 X 297

1.4 Drawing Instruments

The various instruments, including drawing boards, drawing sheets, pencils, erasers, T-squares, set squares, French curves, Compasses, dividers, protractors, ad mini drafters, all play critical roles in the creation of technical drawings.

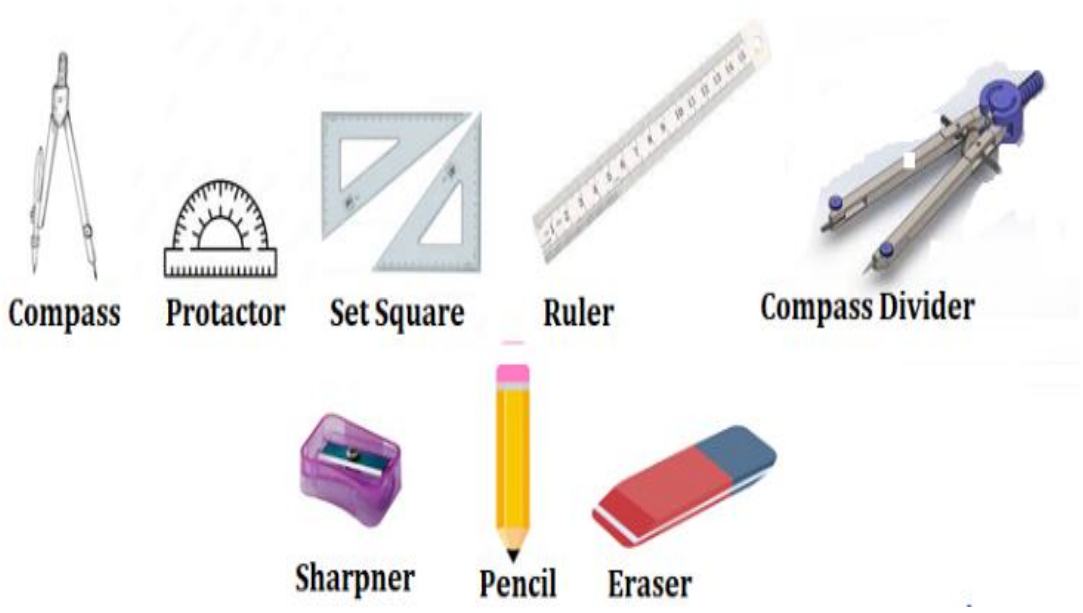


Fig 1.3 Engineering Drawing instruments

1.5 BIS Conventions of Engineering Drawing

BIS (Board of Indian Standards) defines dimension as a numerical value expressed in appropriate units of measurement and indicated graphically on technical drawings with lines, symbols and notes.

1.6 Free hand sketching of engineering drawing

Freehand sketching is the process of drawing without any measuring instruments and is accomplished via pencil and eraser only whereas technical drawing is drawing by use of drafting equipment including t-squared, drawing triangles, and French curves. Freehand drawing is the ability to draw something without depending on instruments or something else to draw. We guide the drawing process with only our hand, and it depends on our observational skills. Instead of tracing the likeness of a cat, or using instruments to do it for us, we draw it by hand

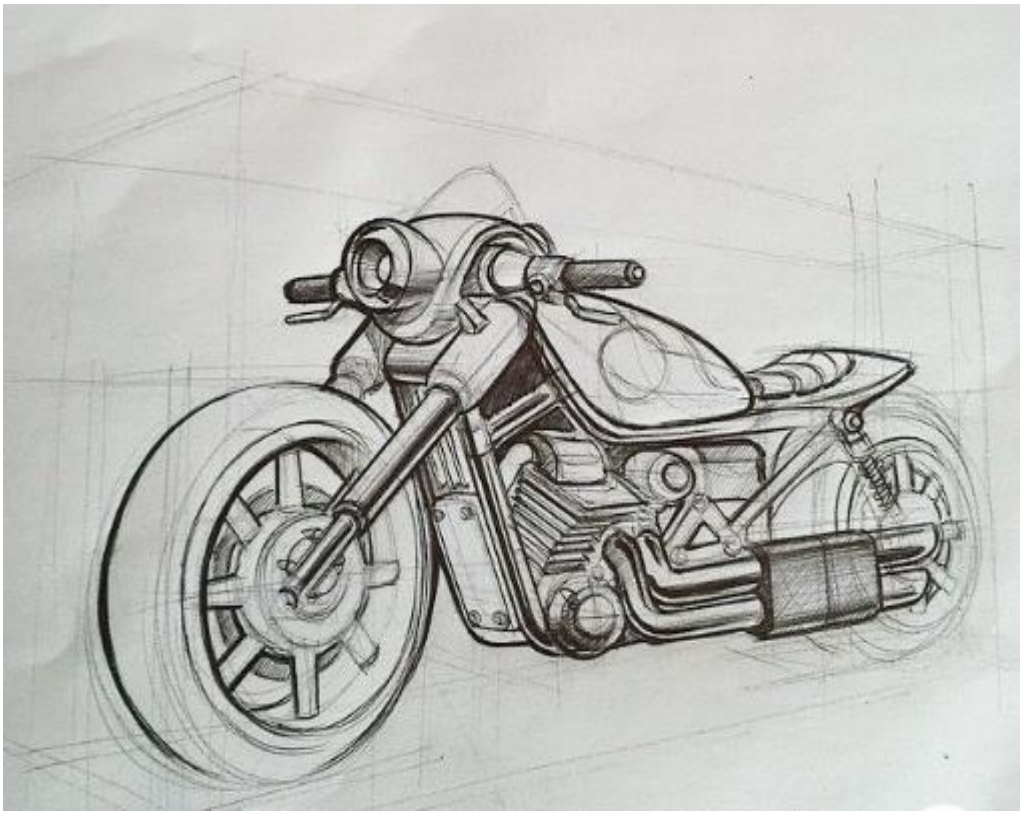
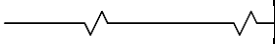


Fig 1.4 An example of Free hand sketching

1.7 Types of Lines

Line Type		Description	General Applications
A		Continuous thick or Continuous wide	Visible outlines, Visible edges, Main representations in diagrams, flow charts etc.,
B		Continuous thin (narrow)	Imaginary lines of intersection, Dimensions, Extension, Projection, Leader lines, Reference lines, Hatching, Construction lines, Outlines of revolved sections
C		Continuous thin (narrow) freehand	Limits of partial or interrupted views and sections, if the limit is not a chain thin line
D		Continuous thin (narrow) with zigzags	Long-break line
E		Dashed thick (wide)	Line showing permissible of surface treatment
F		Dashed thin (narrow)	Hidden outlines, hidden edges
G		Chain thin Long – dashed dotted	Centre lines, lines of symmetry, trajectories, Pitch circle of holes, Axes
H		Chain thin (narrow) with thick (wide) at the ends and at changing of the position	Cutting planes

- **Outlines (A):** Continuous thick or wide lines drawn to represent the visible edges and surface boundaries of the objects are called Outlines or Principal Lines.
- **Margin Lines (A):** They are continuous thick or wide lines along which the prints are trimmed
- **Dimension lines (B):** these lines are continuous thin lines that are terminated at the outer ends by pointed arrowheads touching the outlines, extension lines or centre lines.
- **Extension or Projection Lines (B):** These are also continuous thin lines that extend by about 3 mm beyond the dimension lines.
- **Construction Lines (B):** These continuous thin light lines used for constructing figures.
- **Hatching or Section Lines (B):** These are the continuous thin lines generally drawn at an angle of 45^0 to the main outline of the section and are uniformly spaced about 1mm to 2 mm apart. These are used to make the section evident.
- **Leader or pointer lines (B):** It is a continuous thin line drawn to connect a note with the feature to which it applies.
- **Border Lines (B):** Perfectly rectangular working space is determined by drawing the border lines.
- **Short- break lines (C):** These are continuous, thin and wavy lines drawn freehand and are used to show a short break or irregular boundaries.
- **Long-break lines (D):** These are thin ruled lines with short zigzags within them and

are drawn to show the long breaks.

- **Hidden or dotted lines (E/F):** Interior or hidden edges and surfaces are shown by hidden lines. They are also called as dotted lines.
- **Centre lines (G):** These are thin, long, chain lines composed of alternately long and dot lines drawn to indicate the axes of cylindrical, conical or spherical objects or details and also to show the centers of circles and arcs.
- **Cutting-plane lines (H):** The location of cutting plane is shown by this line. It is a long, thin, chain line, thick at ends only.

1.8 Scales

A scale drawing is an enlarged or reduced drawing that is proportional to the original object. This means that all of the ratios between the corresponding sides of the original figure and the drawing are equal. Scale drawings are used by architects, clothing designers, and map makers among others, we have the following scales: Full scale drawing, Reduced scale drawing, enlarged scale drawing.

1.9 Reference Planes

A reference plane is a plane in 3D space used as the workspace for drawing and the basis for other interactive actions. The initial reference plane is the XY plane (or ground plane).

1.9.1 Horizontal plane

A horizontal plane as any plane or surface which is parallel to the surface of the earth. or in other words we can also say that the plane which is at an angle of zero degree is known as the horizontal plane. The floor or celing is a perfect example of a horizontal plane or horizontal surface.

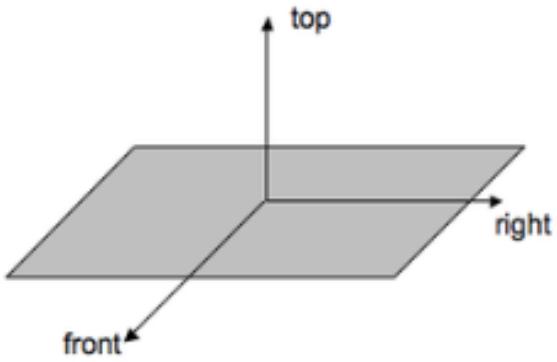


Fig 1.5 Horizontal plane (HP)

1.9.2 Vertical plane

Any plane which is perpendicular to the horizontal plane is known as the vertical plane. Perpendicular to the floor, the wall is a great example of a vertical plane.

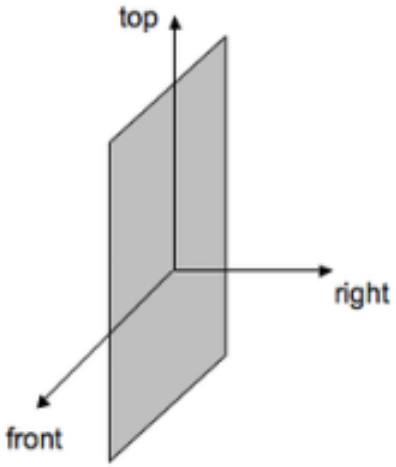


Fig 1.6 Vertical plane (VP)

1.9.3 Profile plane

A third plane perpendicular to both coordinate planes, and hence to the ground line, is called a profile plane. There are two types of profile planes. They are

a) Left profile plane (LPP)
b) Right profile plane (RPP)

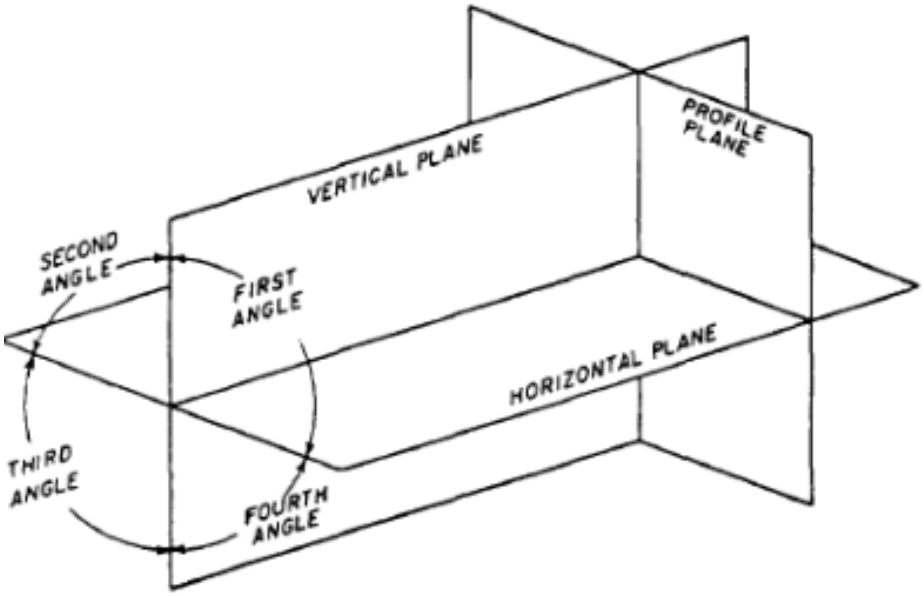


Fig 1.7 Profile plane (PP)

1.9.3.1 Left Profile plane & Right profile plane

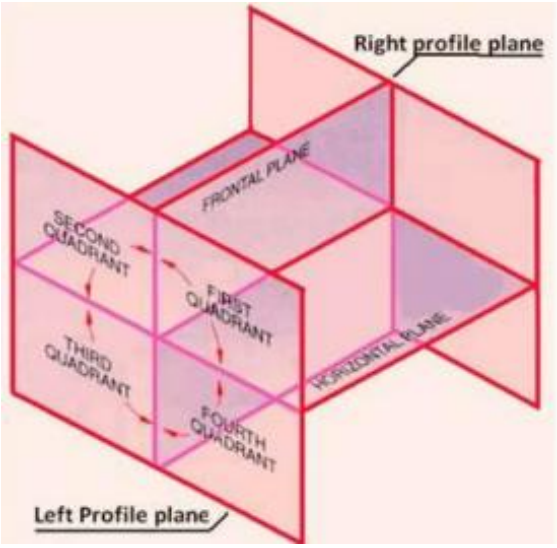


Fig 1.8 Left & Right Profile plane (LPP & RPP)

The right side view is projected onto the right profile plane of projection, which is a plane that is parallel to the right side of the object. However, you can also use the left side view if it is more descriptive and informative.

1.20 Quadrants

The entire space is divided into four rooms named as first quadrant, second quadrant, third quadrant and fourth quadrant respectively following an anticlockwise pattern. The division of the space is done by two planes commonly known as vertical plane (frontal plane) and horizontal plane bisecting each other. The line of intersection of these two planes is called reference line or XY line.

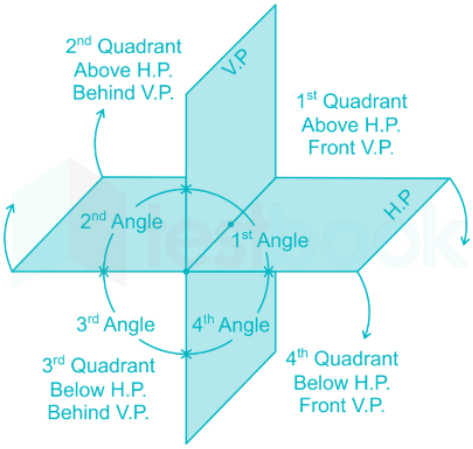


Fig 1.9 Quadrant Systems

The observer is assumed to be viewing the object from the right-hand side (depending upon the direction of view) of the quadrant system. His position being unaltered with respect to the object being placed in all the four different quadrants. In brief it can be concluded that the objects can be placed in any of the four quadrants, Also, when the plane of projection comes between the observer and the object as in the second and the third quadrant then the plane is assumed to be transparent. Universally, to obtain the 2D drawings of an object the horizontal plane is rotated clockwise.

When the Horizontal plane is rotated clockwise by 90 degrees about the reference line it is observed that for the second and the fourth quadrant, the vertical and the horizontal plane overlap with each other, at the same time even the two views individually obtained on each plane will be overwritten on each other which will lack clarity in understanding the drawing. Hence the first and the third quadrant is preferably chosen for projection named as First angle projection and Third angle projection respectively.

1.21 Plane of projections

The orthographic projection system is used to represent a 3D object in a 2D plane. The orthographic projection system utilizes parallel lines, to project 3D object views onto a 2D plane.

Types of Orthographic projection systems are first angle and third angle projection.

1.21.1 First Angle of Projection

In the first angle projection, the object is placed in the 1st quadrant. The object is positioned at the front of a vertical plane and top of the horizontal plane. First angle projection is widely used in India and European countries. The object is placed between the observer and projection planes. The plane of projection is taken solid in 1st angle projection.

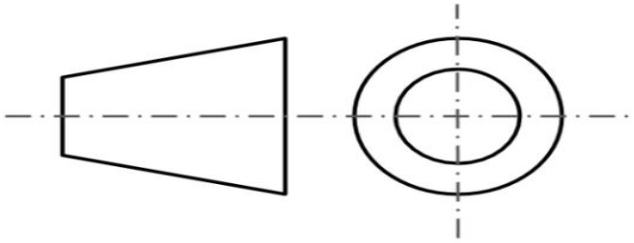


Fig: 1.10 Representation of First Angle of Projection

1.21.2 Third Angle of Projection

In the third angle projection, the object is placed in the third quadrant. The object is placed behind the vertical planes and bottom of the horizontal plane. Third angle projection is widely used in the United States. The projection planes come between the object and observer. The plane of projection is taken as transparent in 3rd angle projection.

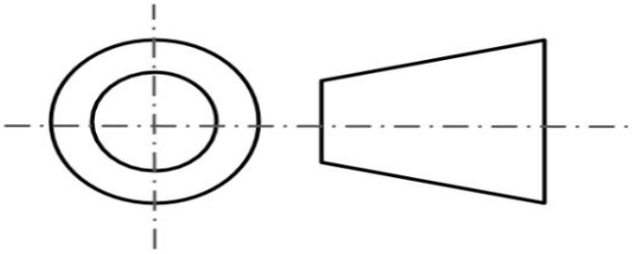


Fig: 1.11 Representation of Three Angle of Projection

Table: 1.2 Comparison of First and third angle projection

Sl No	First Angle Projection	Third Angle Projection
1	The object is placed in the first quadrant.	The object is placed in the third quadrant.
2	The object is placed between the plane of projection and observer.	The plane of projection is placed between the object and observer.
3	The plane of projection is opaque.	The plane of projection is transparent.
4	Front view is at the top of the horizontal axis.	Front view at the bottom of the horizontal axis.
5	Top view at the bottom of the horizontal axis.	Top view at the top of horizontal axis.
6	Right view is at the left side of vertical axis.	Right view is at the right side of vertical axis.
7	Left view is at the right side of vertical axis.	Left view is at the left side of vertical axis.
8	It is widely used in Europe, India, Canada.	It is widely used in United State and Australia.

1.22 Graphs and Charts

There are different types of graphs in mathematics and statistics which are used to represent data in a pictorial form. Among the various types of charts or graphs, the most common and widely

used ones are explained below. The four basic graphs used in statistics include bar, line, histogram and pie charts. These are explained here in brief.

1.22.1 Bar Graph

Bar graphs are the pictorial representation of grouped data in vertical or horizontal rectangular bars, where the length of bars is proportional to the measure of data. The chart's horizontal axis represents categorical data, whereas the chart's vertical axis defines discrete data.

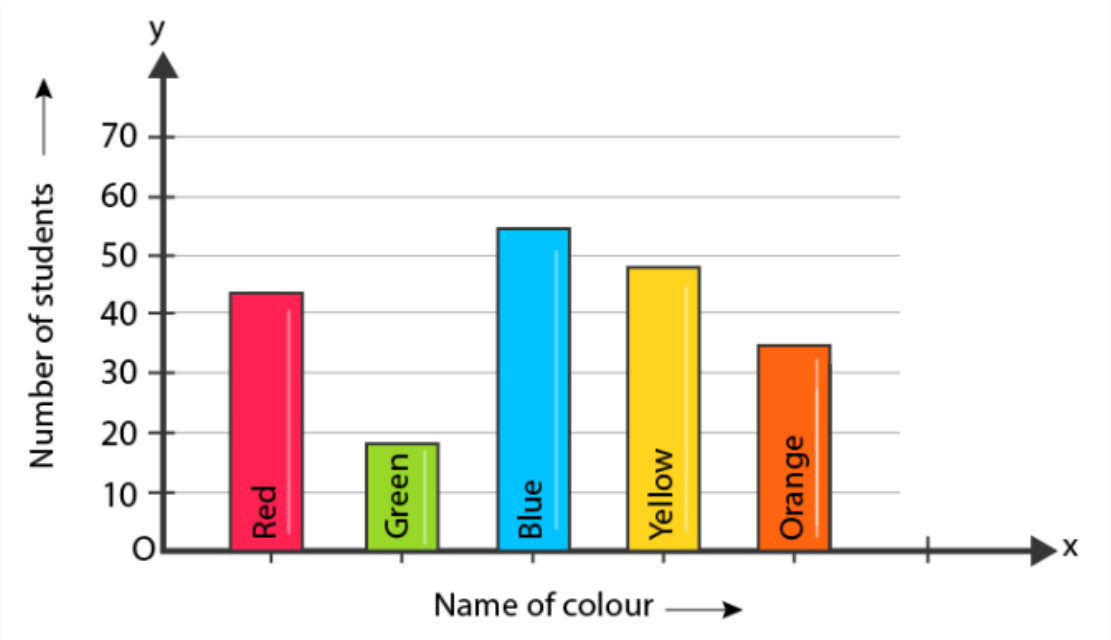


Fig: 1.12 Representation of bar graph

1.22.2 Line Graph

A graph that utilizes points and lines to represent change over time is defined as a line graph. In other words, it is a chart that shows a line joining several points or a line that shows the relation between the points. The diagram depicts quantitative data between two changing variables with a straight line or curve that joins a series of successive data points. Linear charts compare these two variables on a vertical and horizontal axis.

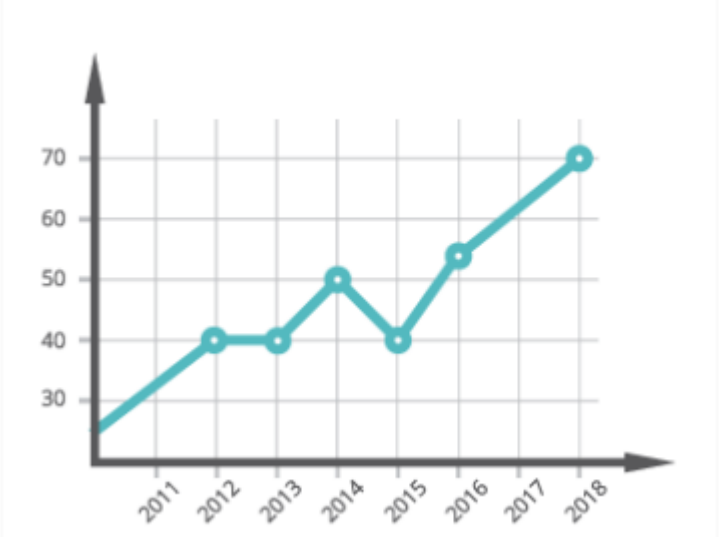


Fig 1.13 Representation of line graph

1.22.3 Histogram

A histogram chart displays the frequency of discrete and continuous data in a dataset using connected rectangular bars. Here, the number of observations that fall into a predefined class interval represented by a rectangular bar.

Fig: 1.14 Representation of Histogram chart

1.22.4 Pie Chart

A pie chart used to represent the numerical proportions of a dataset. This graph involves dividing a circle into various sectors, where each sector represents the proportion of a particular element as a whole. This is also called a circle chart or circle graph.

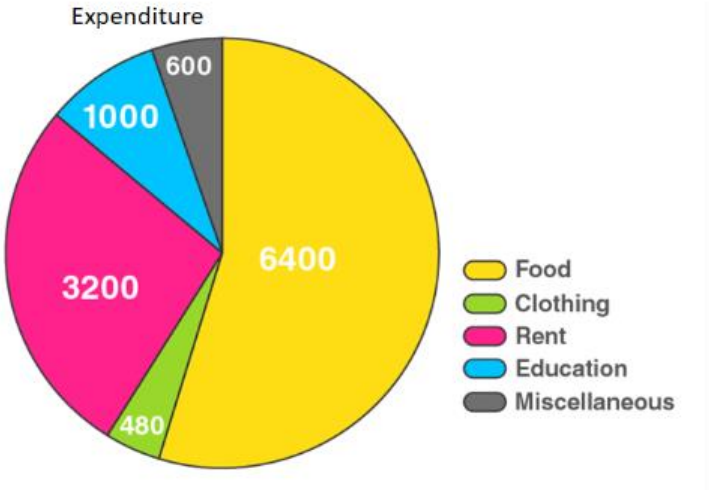


Fig: 1.15 Representation of pie chart

1.22.5 Gantt Chart

A Gantt chart is a project management tool that illustrates work completed over a period of time in relation to the time planned for the work. It typically includes two sections: the left side outlines a list of tasks, while the right side has a timeline with schedule bars that visualize work.

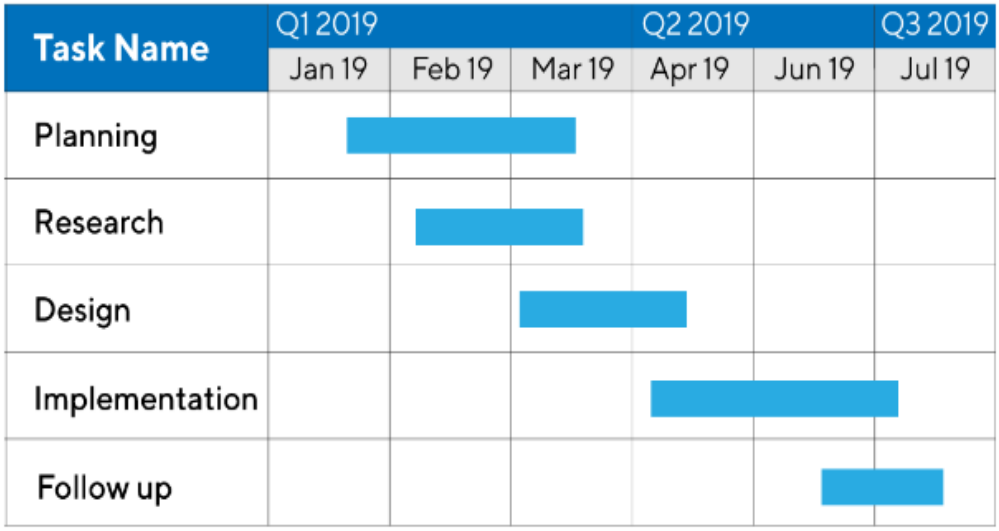


Fig: 1.16 Representation of Gantt Chart

1.23 Mechanism of Bicycle

The mechanism includes a crank lever, which when forced by the driver's legs, pushes a drive arm that, in turn, rotates a drive wheel. The rotation of the drive wheel transmits a torque to the bicycles rear wheel via a gearing mechanism

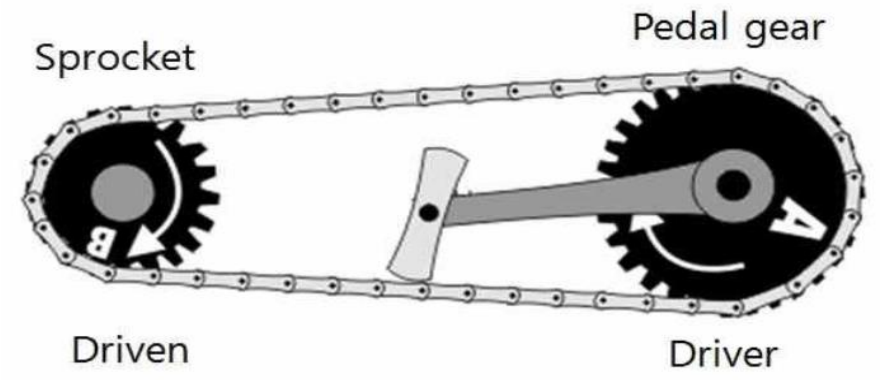


Fig: 1.17 Representation of Bicycle mechanism

1.24 Mechanism of Tricycle

Thinking about what is a tricycle, well these are three-wheeled vehicles that are designed to be operated by a rider sitting on a saddle or seat. It typically has two wheels in the back and one in the front, with pedals that allow the rider to generate power and move the vehicle forward

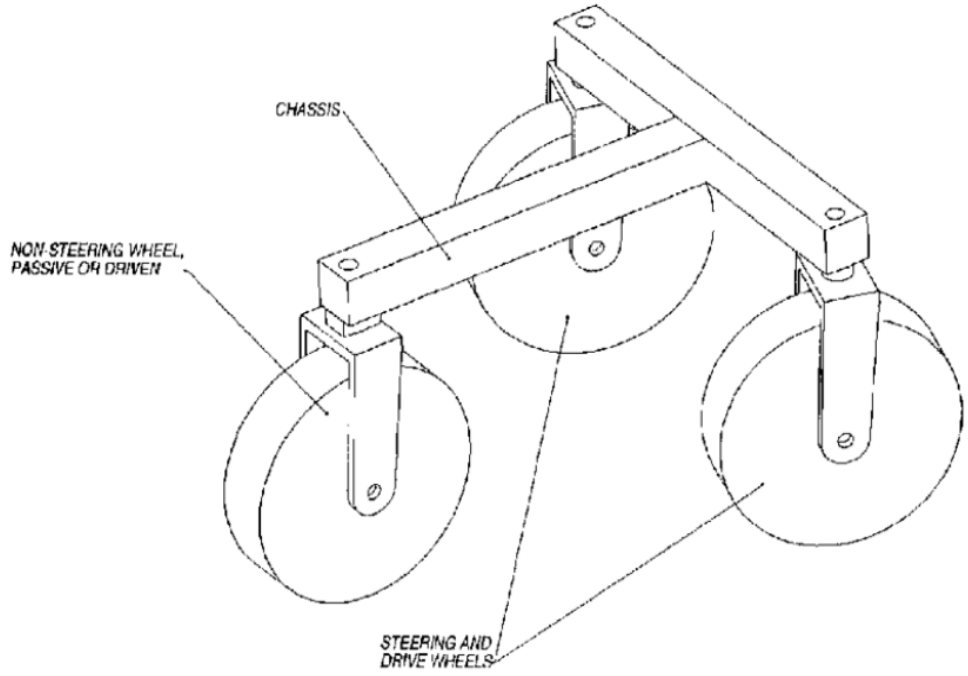


Fig 1.18 Representation of tricycle mechanism

1.25 Two wheeler cart

Fig 1.19 Representation of two-wheeler cart

Two-wheeled carts are simple transport devices. Their main purpose is to move goods or prepackaged products in production or industrial conditions. So, they are used in warehouse complexes, retail facilities (markets, etc.), enterprises, workshops and factories.

1.26 Four wheeler cart

A cart is an old-fashioned wooden vehicle that is used for transporting goods or people. Some carts are pulled by animals

Fig: 1.20 Representation of Four wheel cart

1.27 Simple residential house plan

simple residential house plan as shown in below figure. A simple residential house details in bedroom, kitchen, store, lawn & car park and dimension detail

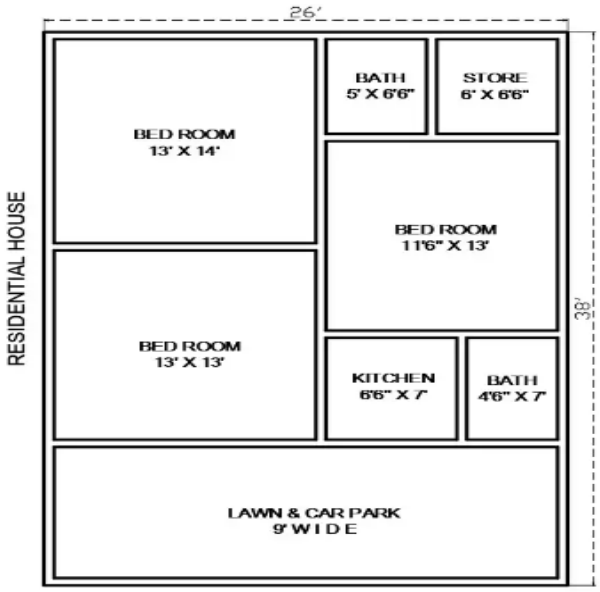


Fig: 1.21 Representation of simple residual house plan

1.28 Simple bridge plan

A steel truss bridge is shown in Figure. with straight truss at the center of the span and variable height near the column supports. The incremental height on the truss near the columns occurs due an increment axial stress in each truss member. The foundation, anchorage and check slab are made of reinforcement concrete; piers can be made of steel or reinforced concrete, depending the site characteristics.

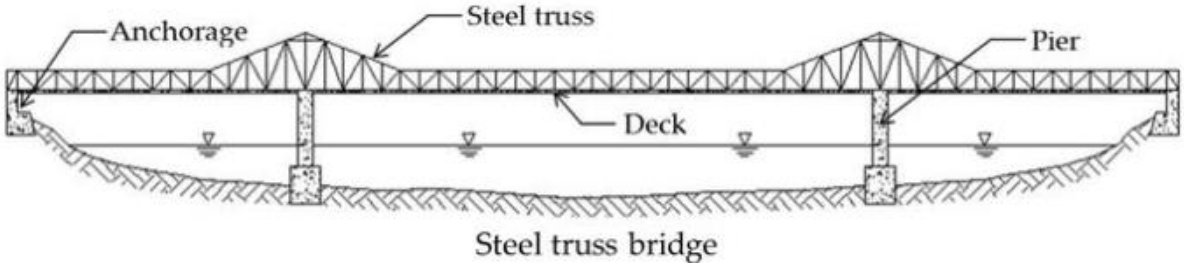


Fig 1.22 Representation of Simple bridge plan

1.29 Electric switchboard circuit diagram

A switchboard is a component of an electrical distribution system that divides an electrical power feed into branch circuits while providing a protective circuit breaker or fuse for each circuit in a common enclosure

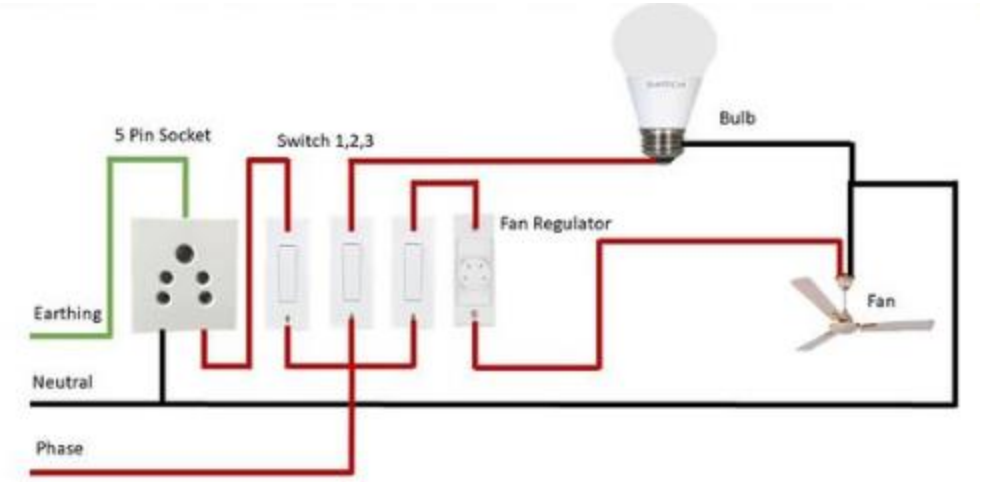


Fig 1.23 Electric switchboard circuit diagram

1.30 Simple Fire Alarm Circuit

A fire alarm is a critical safety device that alerts individuals of a potential fire in a building. A simple fire alarm circuit is an easy-to-build and cost-effective solution to detect the presence of smoke or heat. When a fire is detected, the circuit triggers an alarm, alerting everyone to evacuate or take action immediately. This circuit is an excellent choice for small homes, offices, and workshops where a more advanced fire alarm system is not required.

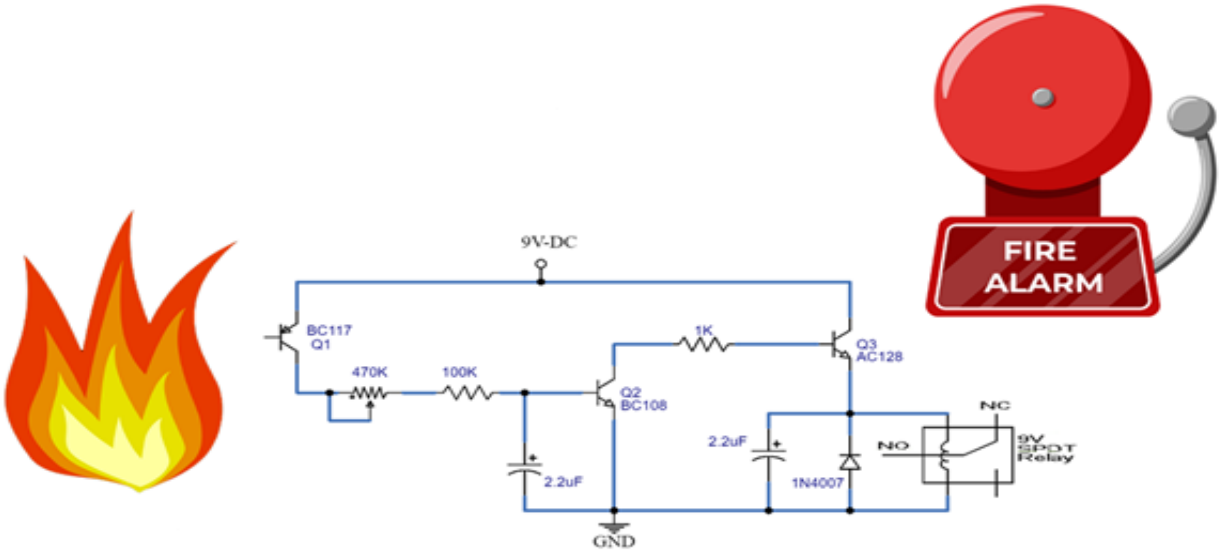


Fig 1.24 Fire alarm circuit

1.31 Off line UPS circuit diagram

The standby Uninterruptible Power Supply is also called as off line UPS, that is generally used for PCs. The block diagram of this UPS is shown below. This UPS includes a battery, an AC or DC

& DC or AC inverter, a static switch and a LPF which is used to decrease the switching frequency from the o/p voltage & a surge suppressor. The standby UPS system works with the switch arrangement to select the AC i/p as a primary power source, and interchanging to the battery & inverter as backup sources in case of primary power gets disrupted. The inverter normally relies on standby, only triggering when the power fails and the transfer switch routinely switches the load to the backup units. This kind of UPS system offers a small size, high degree of efficiency, & pretty low costs, making of this UPS is easy.

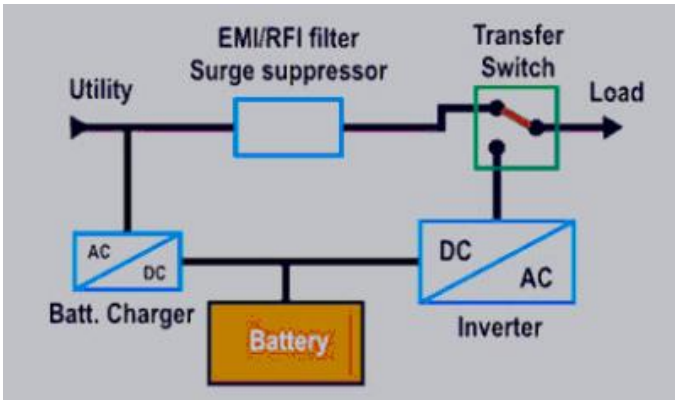


Fig 1.25: UPS circuit diagram

1.32 Home calling bell system

The voltage is stepped down to 5V which is then rectified by the diode bridge of 1N4007 and filtered by the capacitor 220µF. Because the minimum operating voltage of the IC is 4.5V DC, a Zener diode is used to further step down the voltage to 3.3V. The melody output generated at Pin 3 of IC is amplified through transistor 2N3904 to drive the Speaker. Resistors are used to limit the base current, and the capacitor is used to suppress the noise at the output.

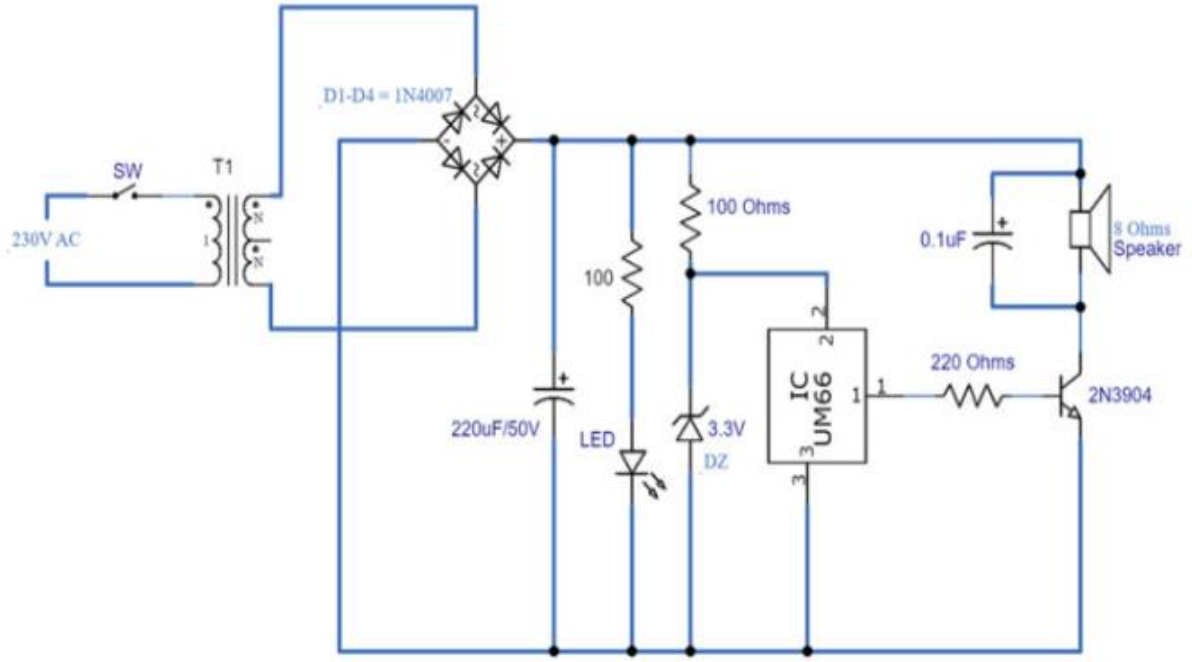
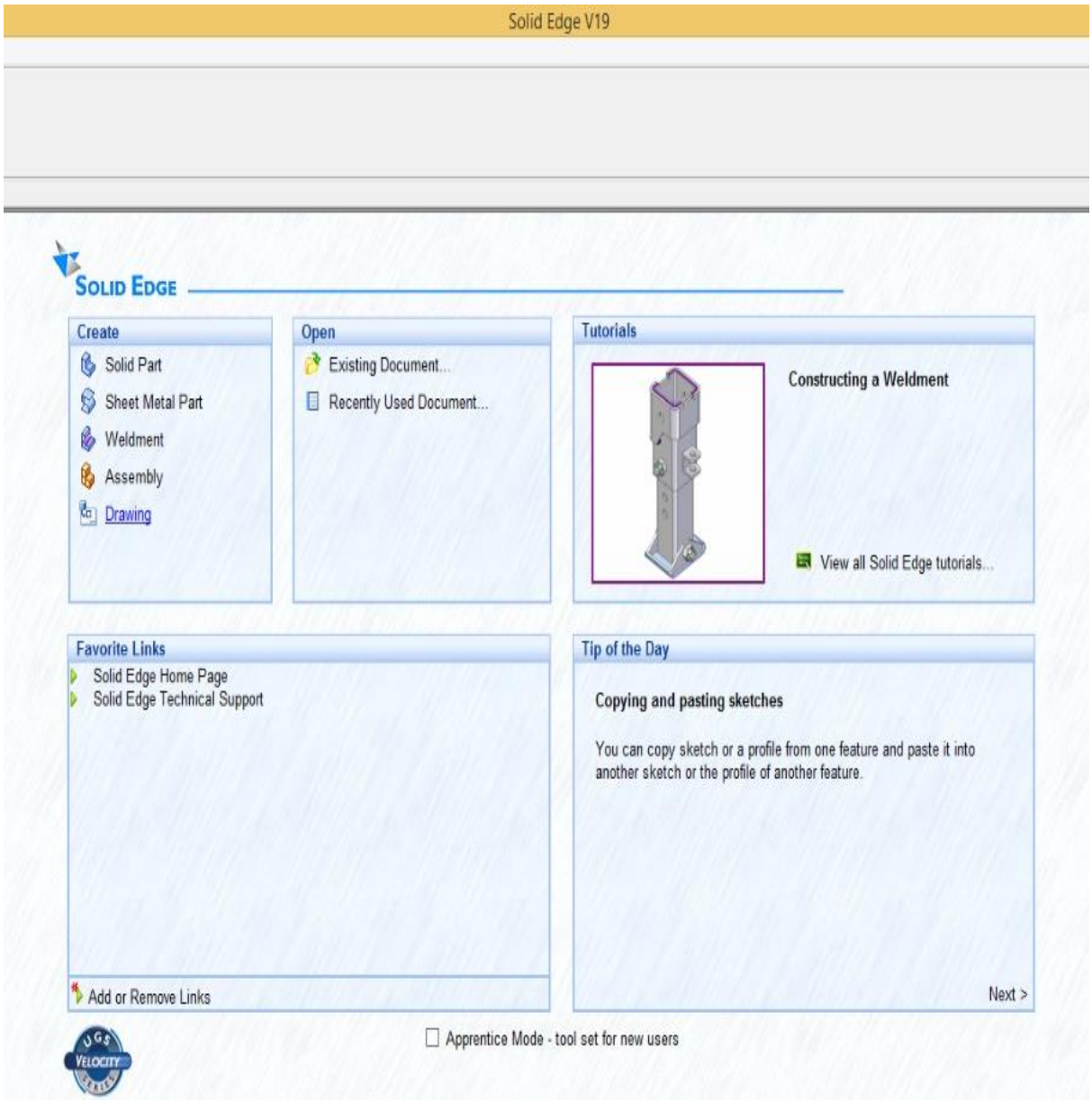


Fig 1.26 Calling bell circuit diagram

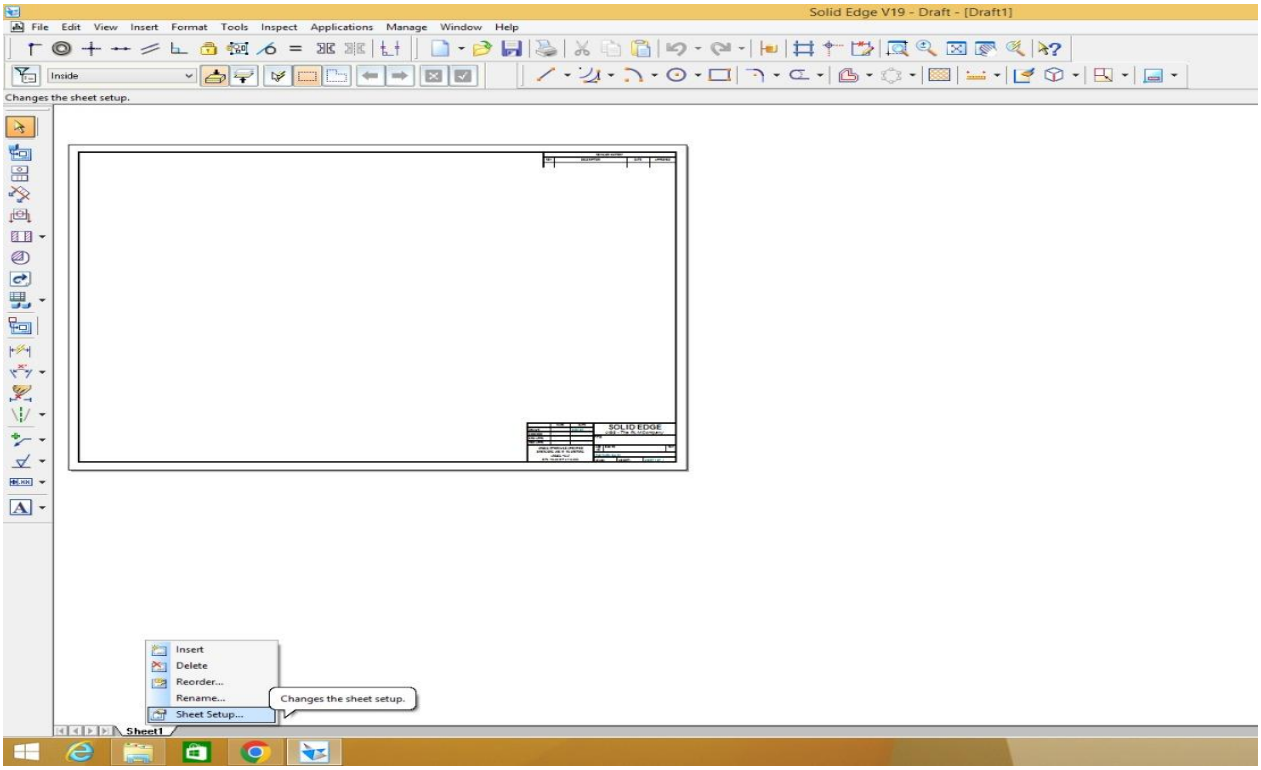
2.0 Introduction to Computer Aided Drafting Software

2.1 Sheet Setup

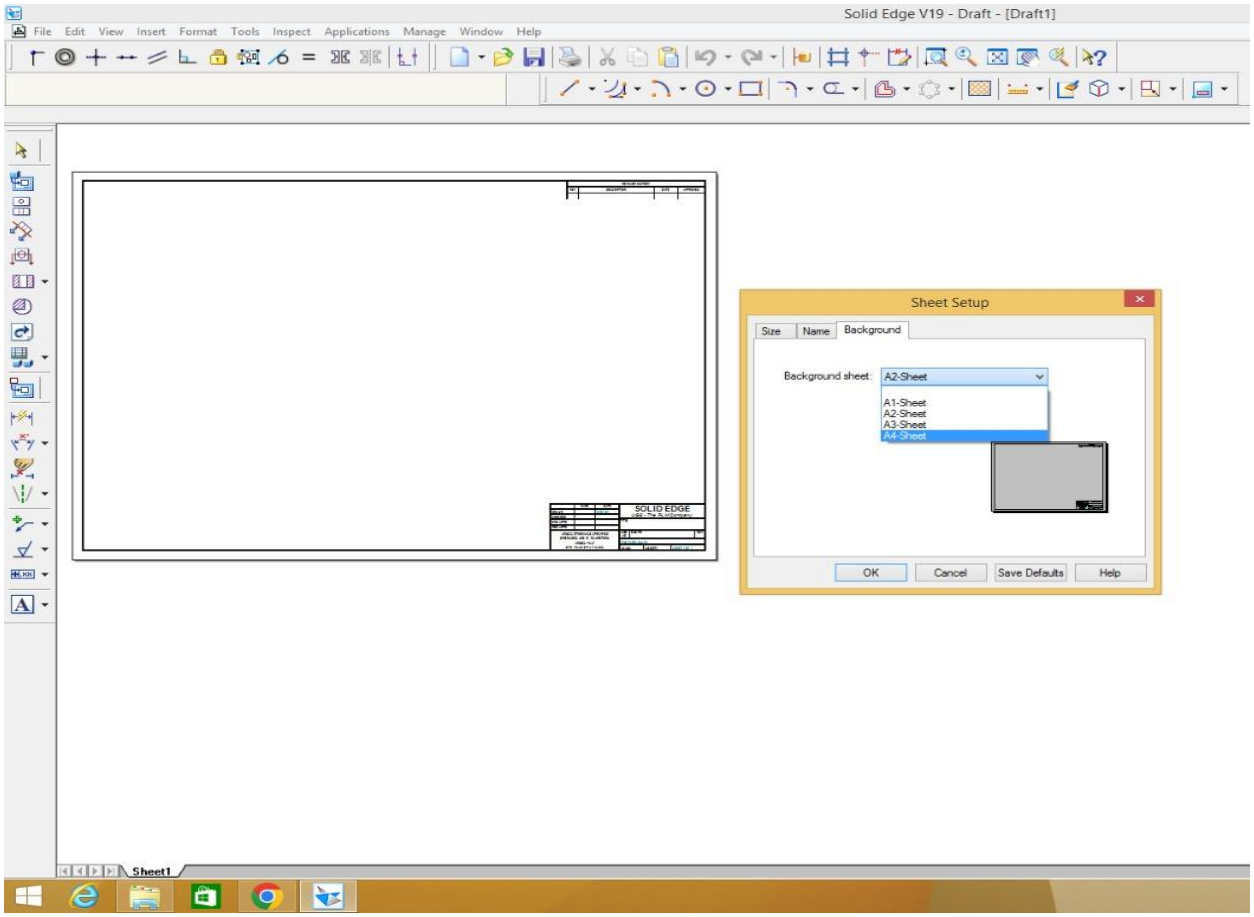
- Start Solid Edge V19 software
- Click "**Drawing**". A title block will display in the drawing area.



- Right-click on “Sheet” at the bottom of the screen. Select “Sheet Setup”.

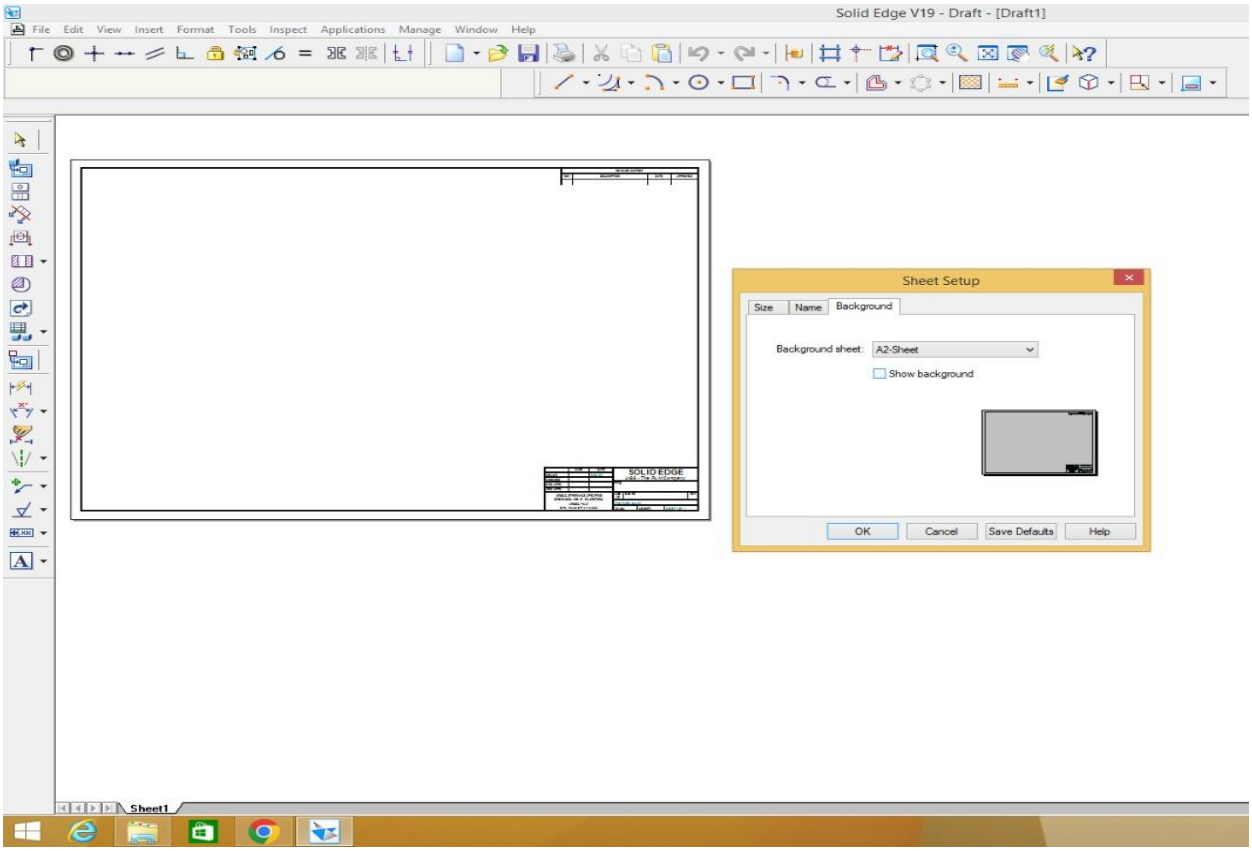


- Select “A4 Sheet” tab

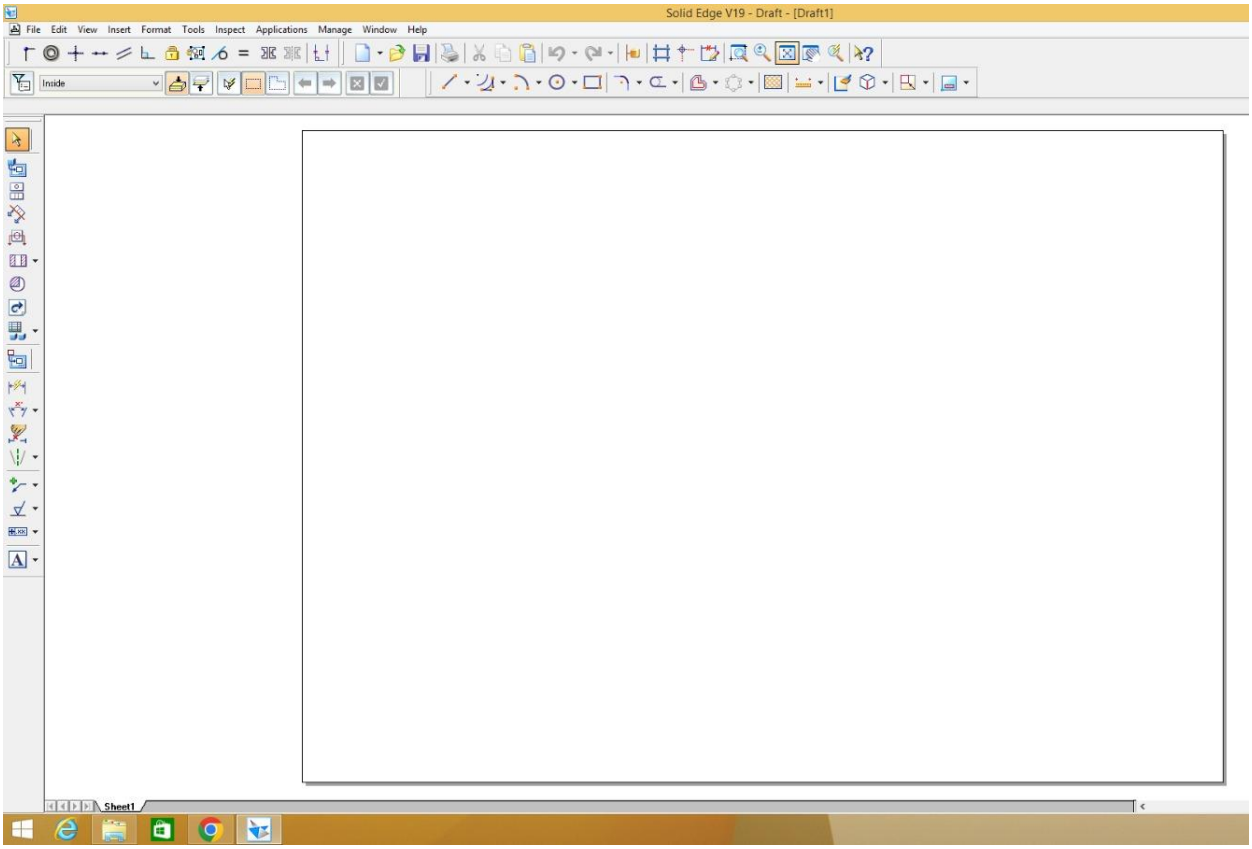


- Uncheck show background option

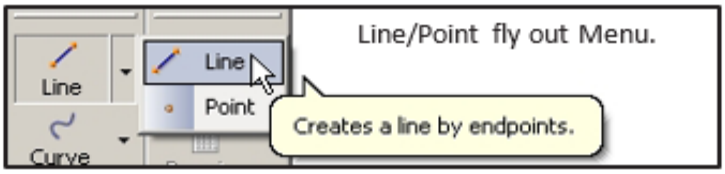
- Click “ok” button

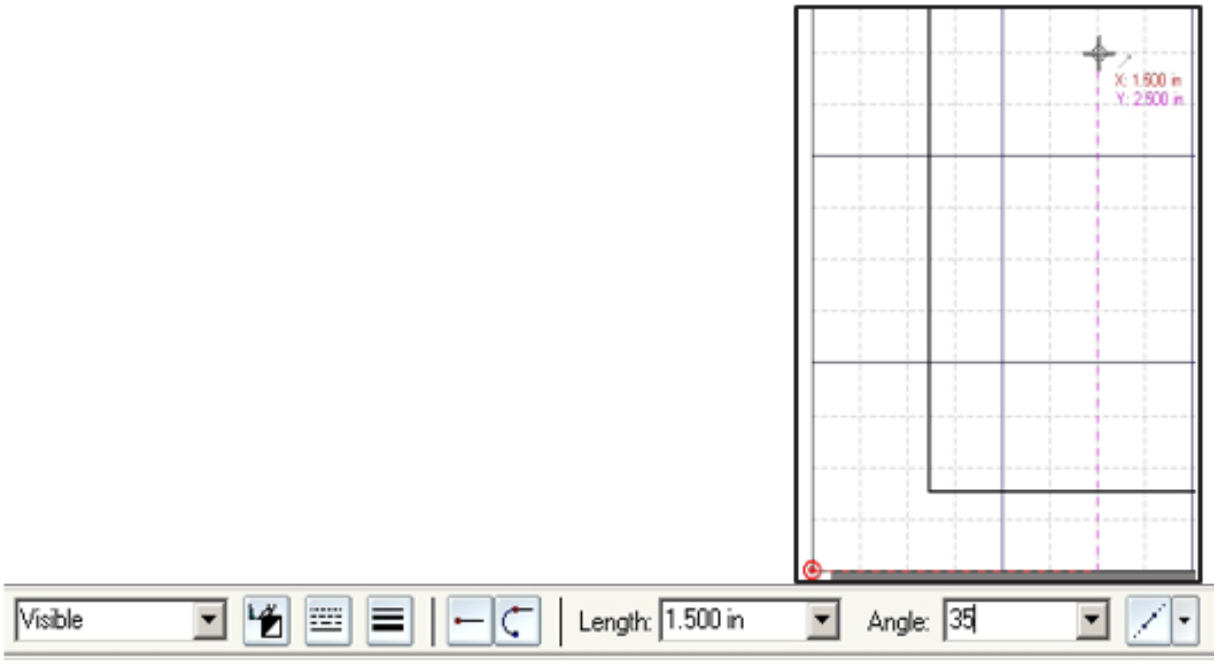


- Click on “Fit”



2.2 Point and Line construction





Point Command. The **ribbon bar** for placing points is shown above. At startup, the origin (X=0, Y=0) is at the lower corner of the ***paper.***

Not the title block lines). The origin may be moved to another location on the page using the **Set New Grid 0,0** icon command. The screen pointer displays the point location relative to the Grid 0,0 location. You can key in the X,Y offsets in the ribbon bar.

Line Command.

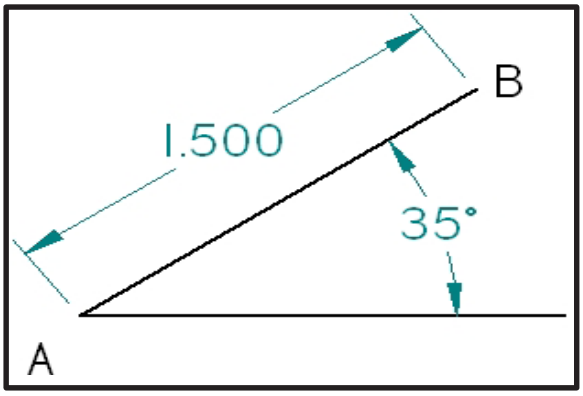
Options on the ribbon bar:

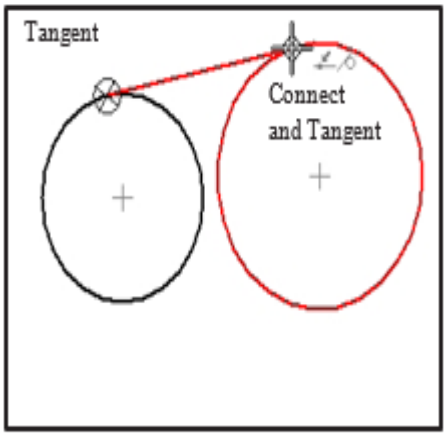
- Line color
- Line type
- Line thickness
- Line/Arc toggle
- Length
- Angle

▪ Line extension display

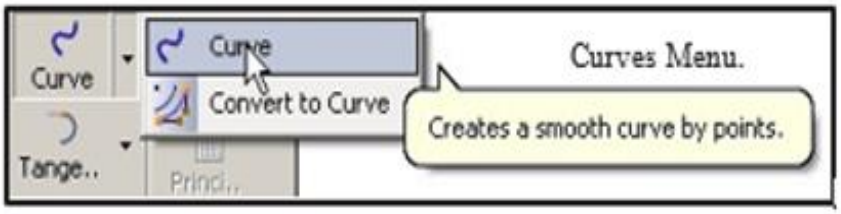
Angles for lines are measured from the horizontal as shown.

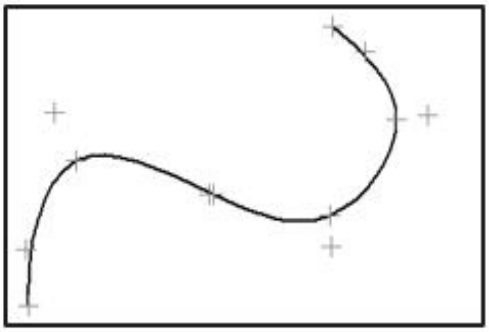
Lines may also be drawn using **Intelli sketch** geometry controls. (Connect, Tangent, etc.)





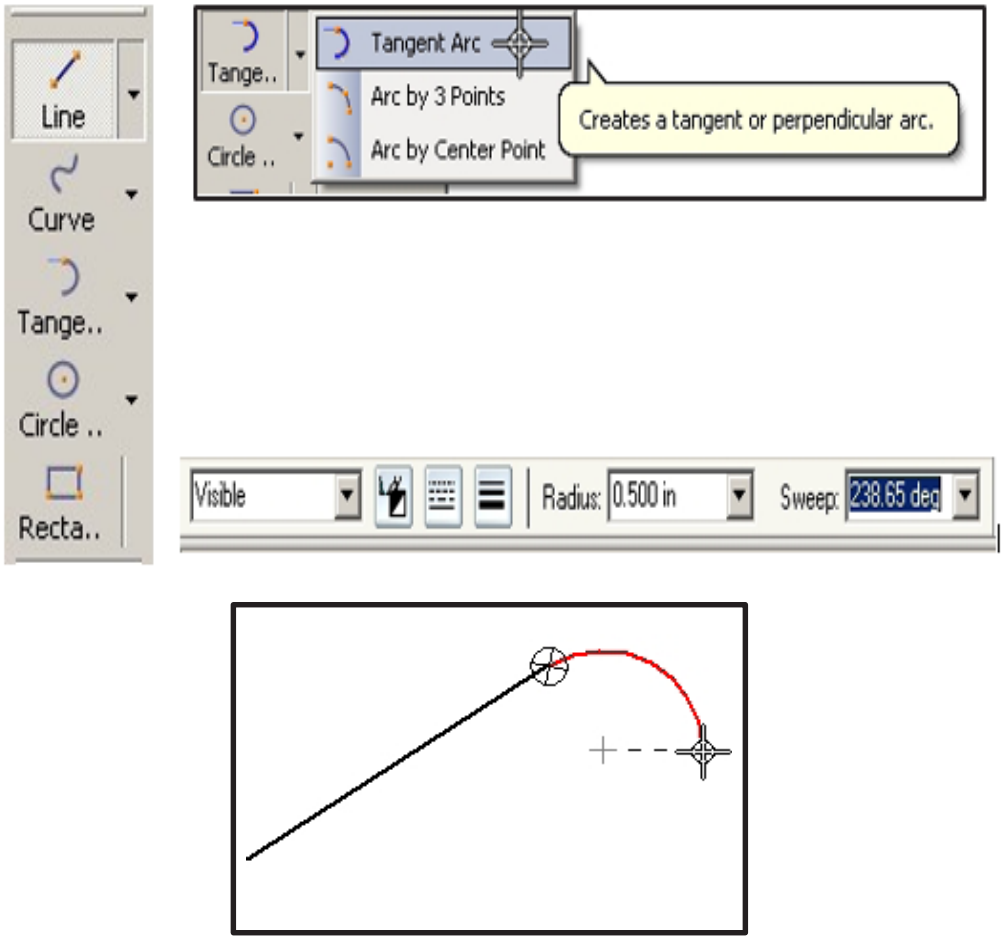
2.3 Construction of Curves



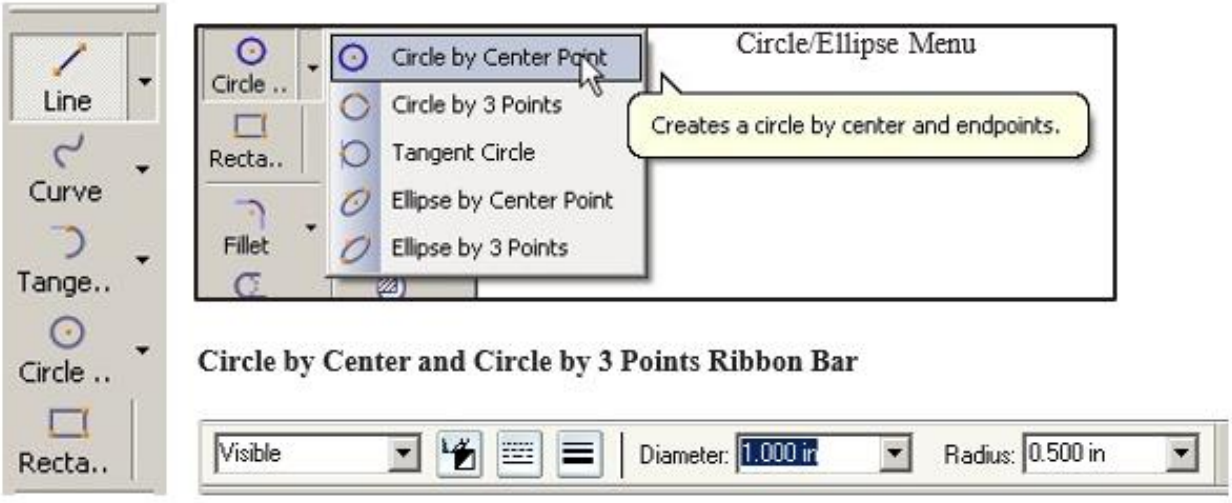


Points on curve are selected to control the shape. Points plotted using the **Point** command may be used to create accurate shapes

2.4 Construction of Arc

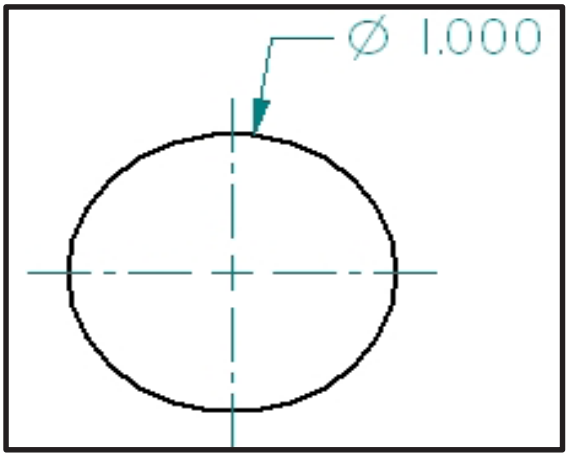


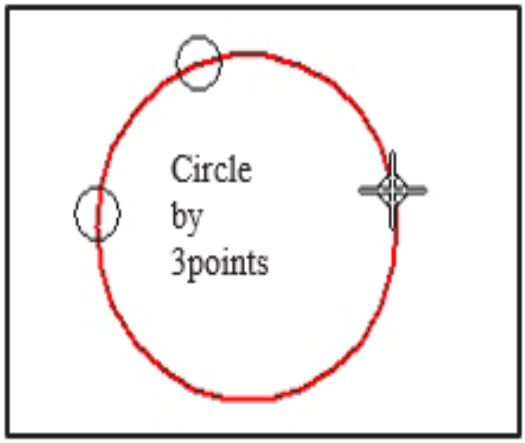
2.5 Construction of Circles



Circle by Center and Circle by 3 Points Ribbon Bar

- You can also place two points and input the diameter or the radius.



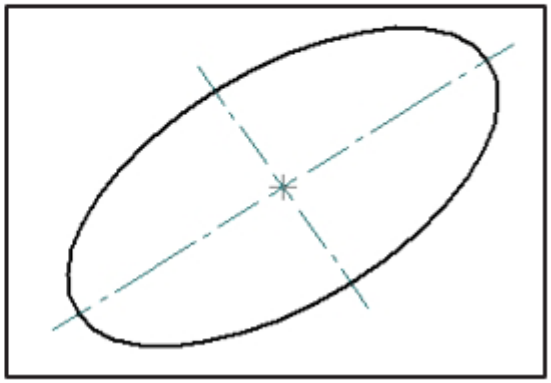


2.6 Construction of Ellipse

Click or input: center, major axis and minor axis

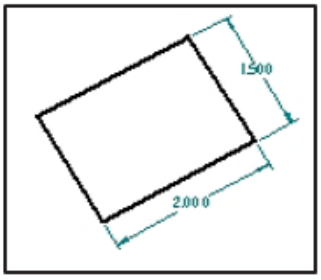
or

click center and 2 points on curve

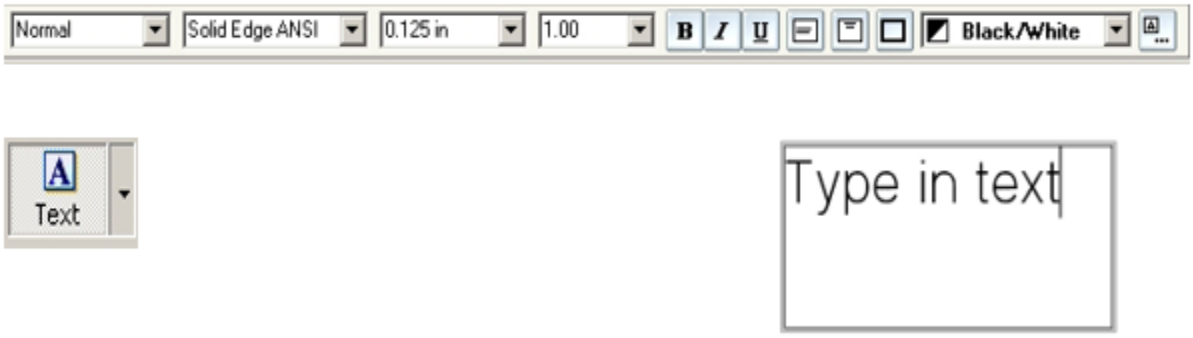


2.7 Construction of rectangles

Input Width, Height and Rotation Angle.

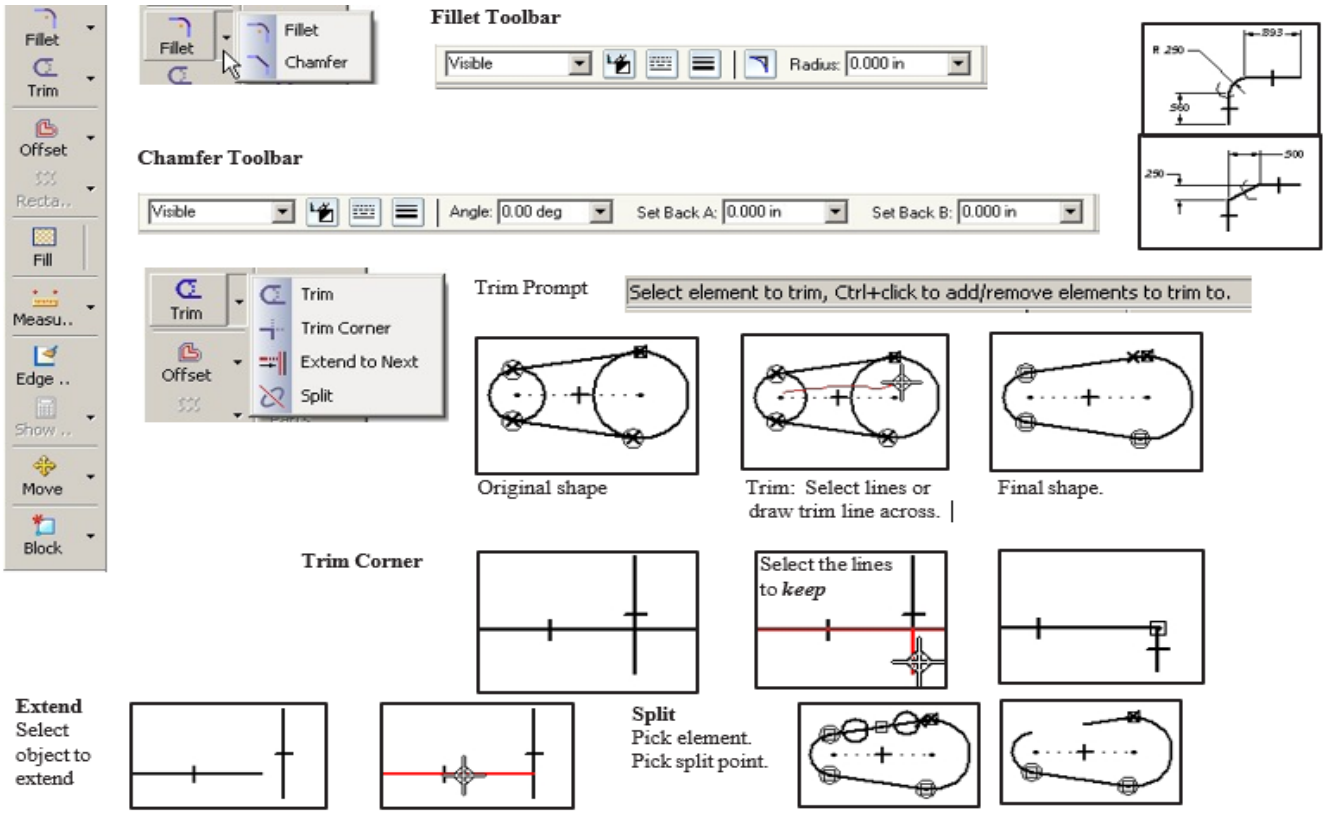


2.8 Text command



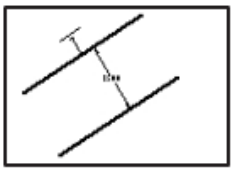
2.9 Editing Toolbar

Edits are used to change or adjust existing geometry. A shape with many rounded corners is easier to draw using square corners. Rounded corners are quickly added using the Fillet command

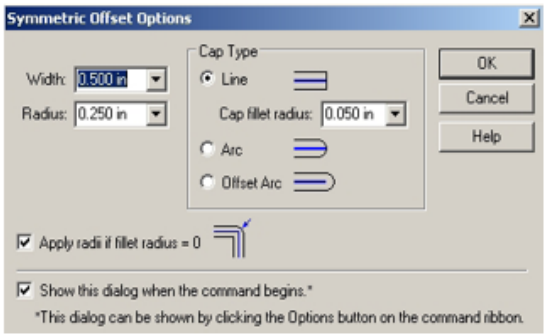


2.10 Offset toolbar

Offset. This is a "copy parallel" command.



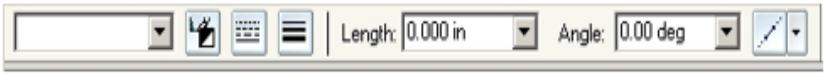
Select object to copy.
Select distance.
Select side.



2.11 Copy and Paste command

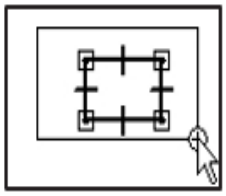
Copy and Paste are located on the **Edit** pop-down menu

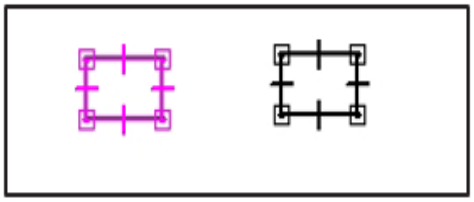
Paste Ribbon Bar



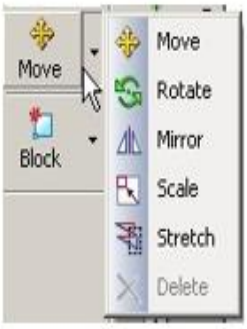
- Pick **Copy.**
- Use a **window** to select multiple items.
- Pick **Paste** to set 2nd item.

*If you Paste with no length, a 2nd item is pasted **on top of** the original item. Use Move to locate the 2nd item.*





2.12 Move command



Move ribbon bar

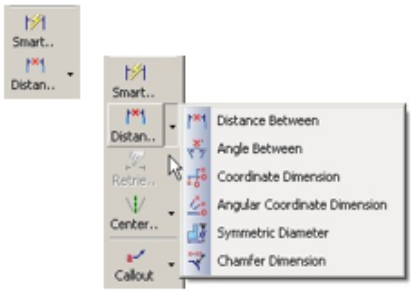
Click for the point to move from.

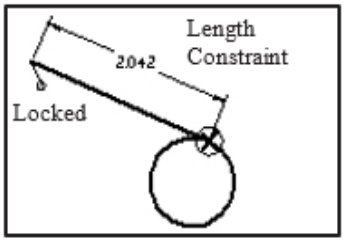
Click for the point to move the element to.

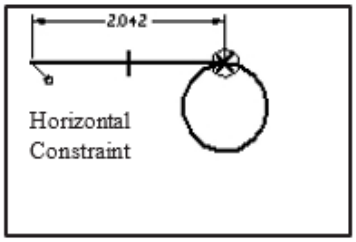
Note: Other commands work in a similar manner. Create small drawings and try each command.

2.13 Dimensions

Dimensions are Constraints. Dimensioning an entity will constrain its length, diameter, radius, location etc.







Notice the other dimension commands that display with the **Distance Between** fly out.

Smart Dimension works on one entity. ***Distance Between*** works on two entities.

MODULE-2

ORTHOGRAPHIC PROJECTIONS OF POINTS

A point is a dimensionless quantity that indicates a location in space or on a drawing. It has no width, height, or depth. A point is represented by the intersection of two lines.

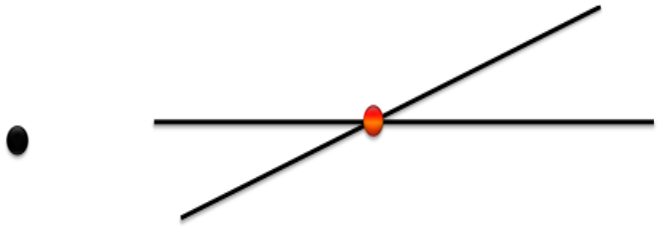


Fig. 2.1 Representation of a point

2.1 Representation point in different quadrants

- First Quadrants: Above HP and infront of VP
- Second Quadrants: Above HP and behind VP
- Third Quadrants: Below HP and behind VP
- Forth Quadrants: Below HP and in front of VP

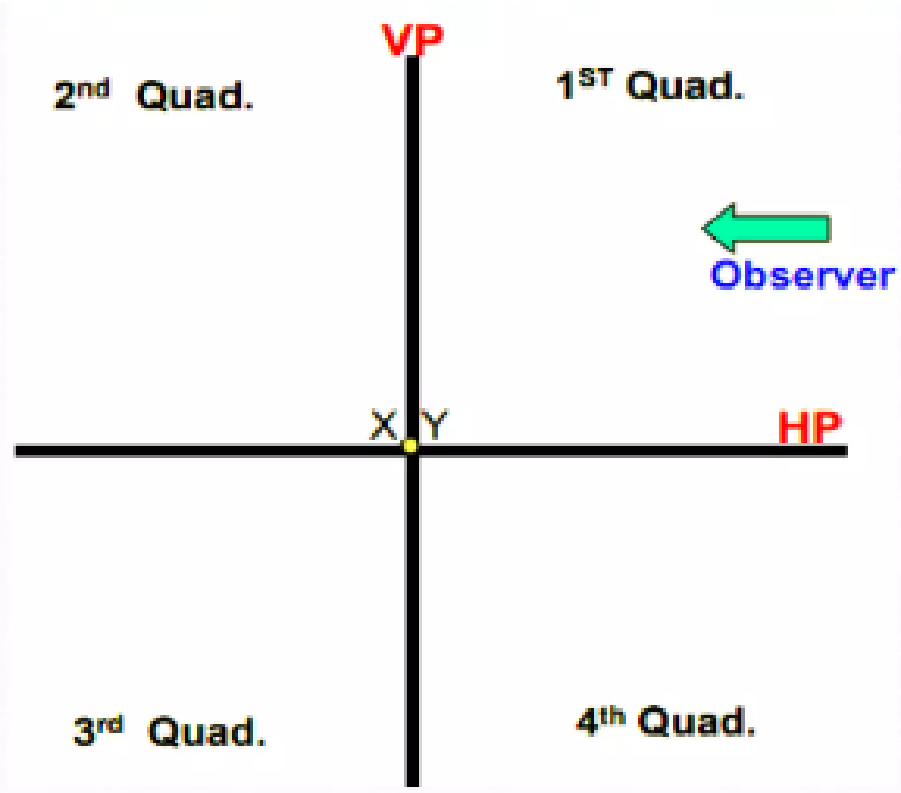
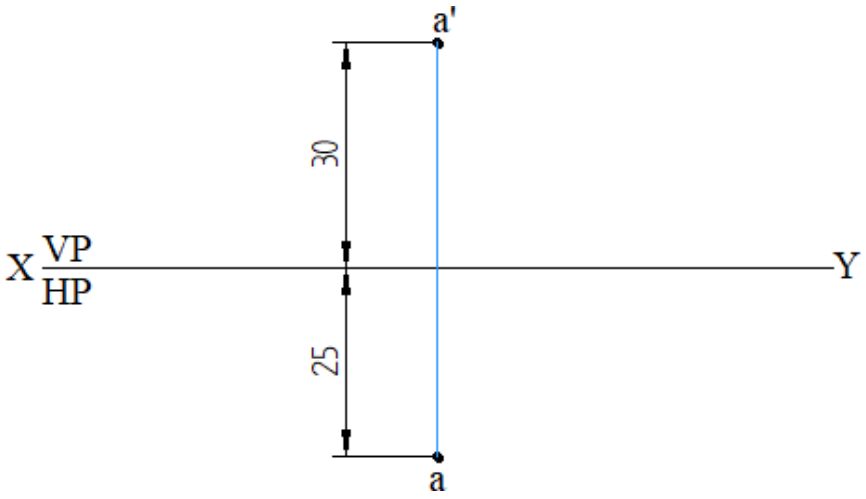


Fig. 2.2 Representation of point in quadrants

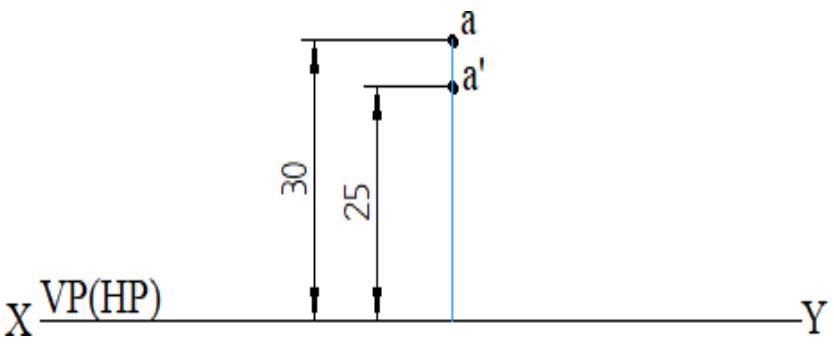
Q1. A Ping pong ball is 30 mm above HP and 25 mm in front of VP. Draw its projections and state the quadrant in which the Ping pong ball is situated.

Solution: Ping pong ball is situated in **FIRST** Quadrant



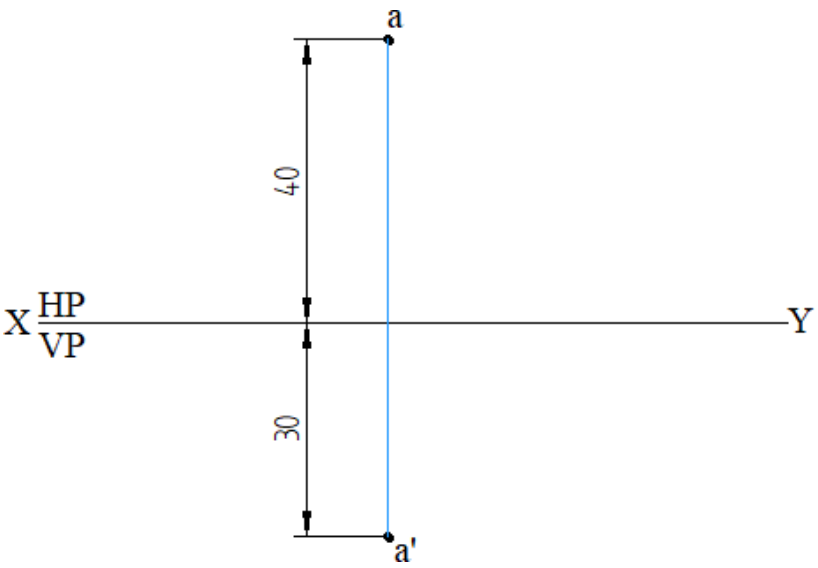
Q2. Point "A" is 30 mm above HP and 25mm behind VP. Draw its projections and state the quadrant in which the point is situated

Solution: Point "A" is situated in **SECOND** Quadrant



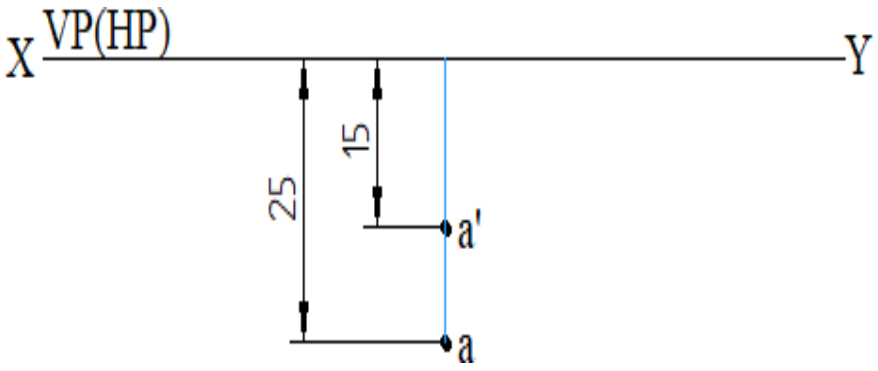
Q3. Point “A” is 30mm below HP and 40mm behind VP. Draw its projections and state the quadrant in which the point is situated.

Solution: Point “A” is situated in **THIRD** quadrant



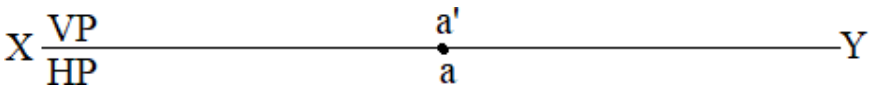
Q4. Point “A” is 15mm below HP and 25mm in front of VP. Draw its projections and state the quadrant in which the point is situated.

Solution: Point “A” is situated in **FOURTH** quadrant



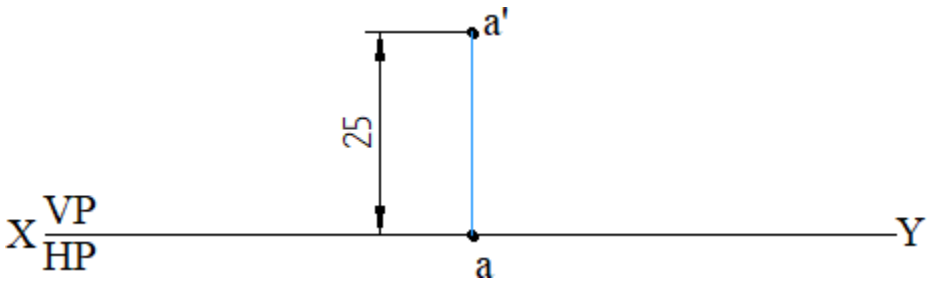
Q5. Point “A” is in both HP and VP. Draw its projections and state the quadrant in which the point is situated.

Solution: Point “A” is situated in **I, II, III and IV** quadrant.



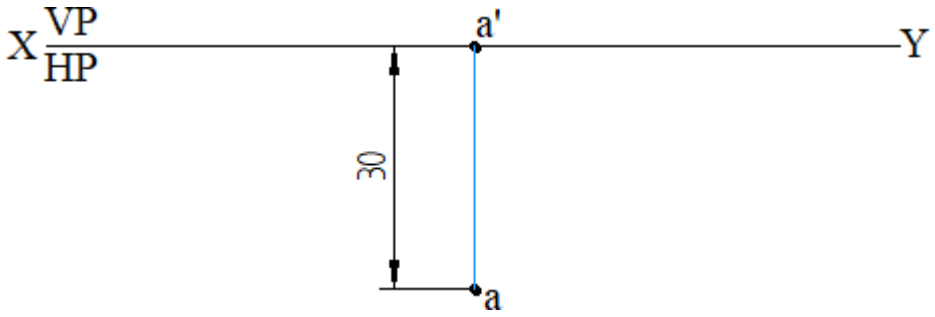
Q6. Point “A “is 25mm above HP and on VP. Draw its projections and state the quadrant in which the point is situated.

Solution: Point “A” is situated in **I as well as II** quadrant.



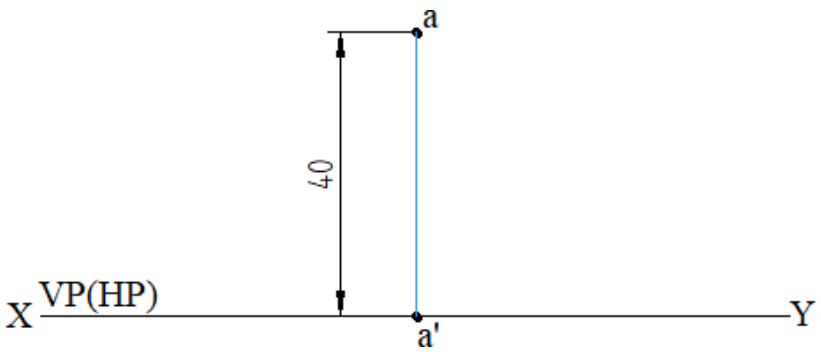
Q7. Point “A” is 30mm in front of VP and in the HP. Draw its projections and state the quadrant in which the point is situated.

Solution: Point “A” is situated in **I as well as IV** quadrant



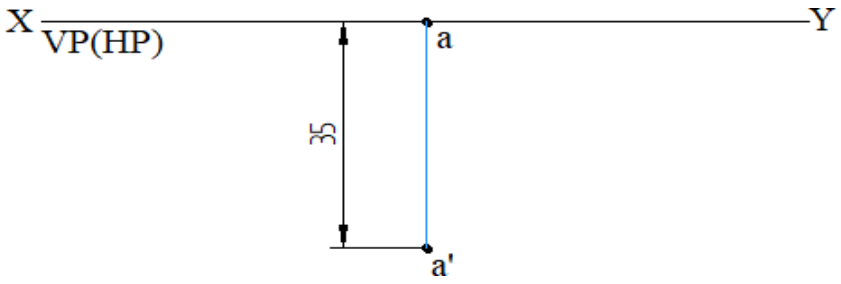
Q8. Point “A” is 40mm behind the VP and in HP. Draw its projections and state the quadrant in which the point is situated.

Solution: Point “A” is situated in **II as well as III** quadrant



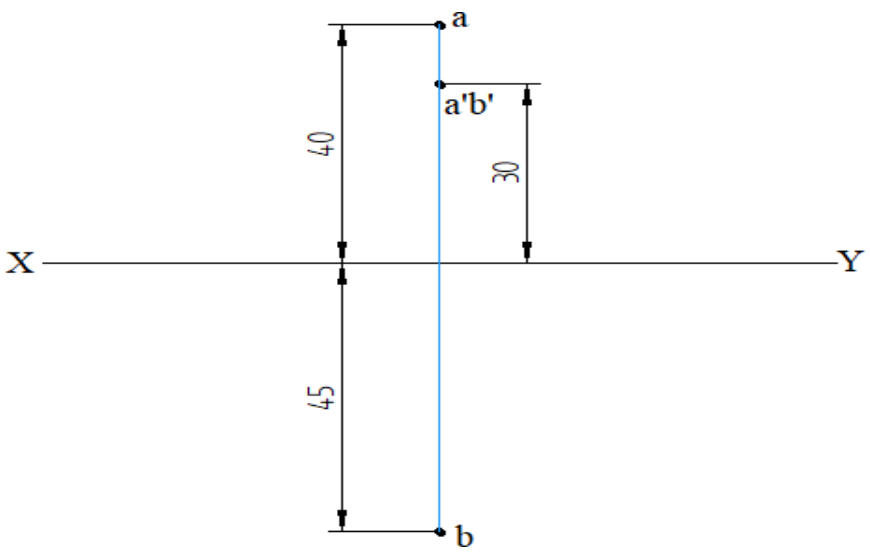
Q9. Point “A” is 35mm below HP and in the VP. Draw its projections and state the quadrant in which the point is situated.

Solution: Point “A” is situated in **III as well as IV** quadrant



Q10. A point 30mm above XY line is the front view of two points “a & b”. The top view of “a” is 40mm behind VP and Top view of “b” is 45mm in front of VP. Draw its projections and state the quadrant in which the point is situated.

Solution: Point “a” is situated in **II** quadrant and Point “b” is situated in **I** quadrant.



Q11. Draw the projections of the following Points on the same XY line, keeping convenient distance between each projector. Name the quadrants in which they lie.

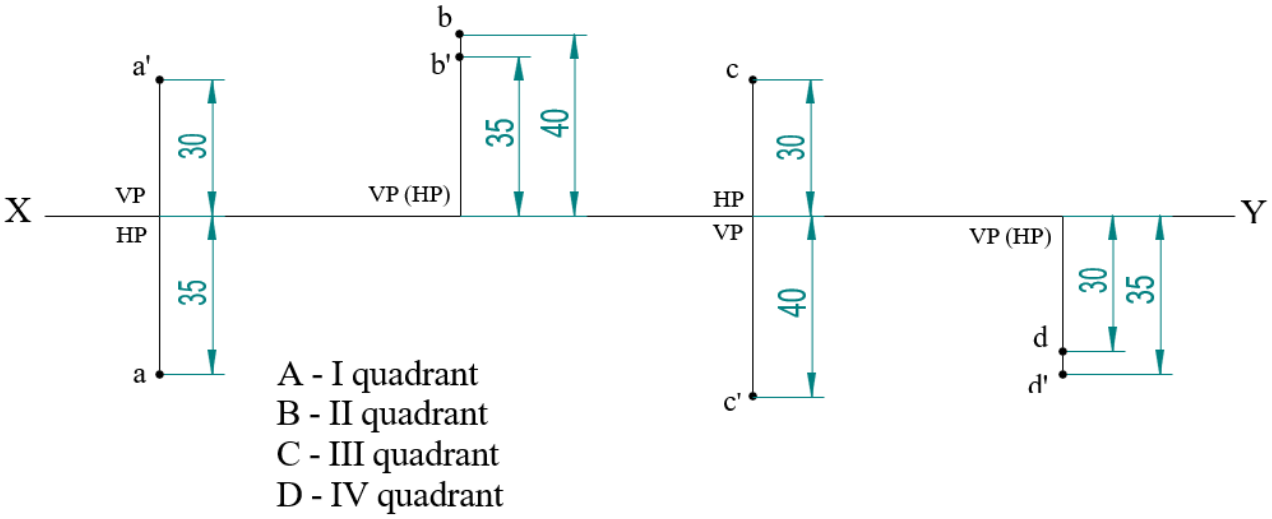
A - 30mm above HP and 35mm in front of VP.

B - 35mm above HP and 40mm behind VP.

C - 40mm below HP and 30mm behind VP.

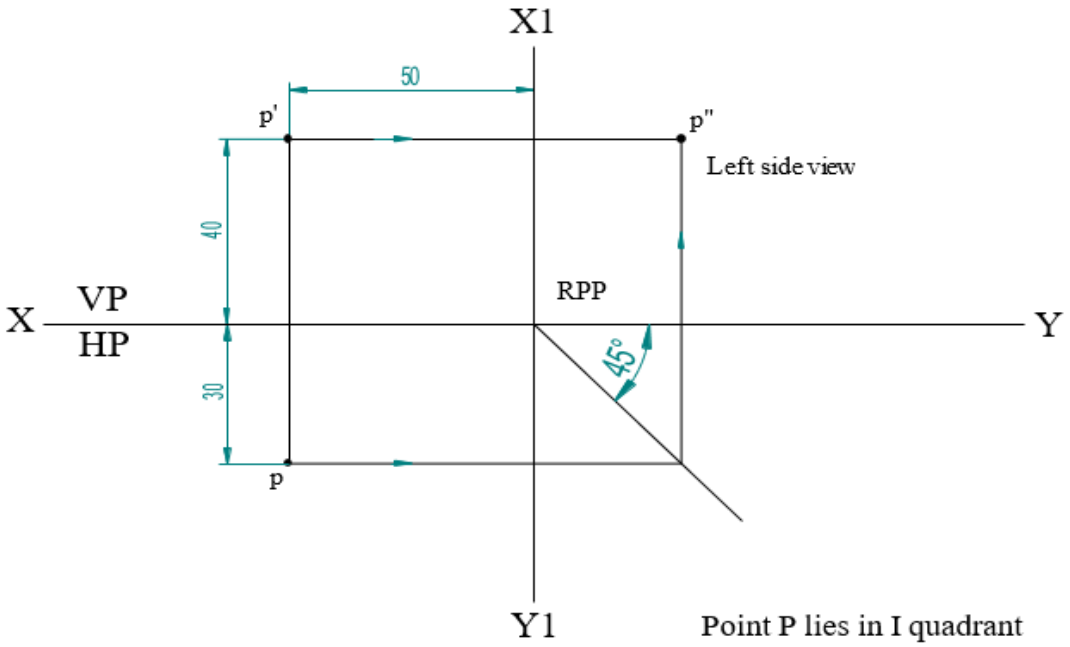
D - 35mm below HP and 30mm in front of VP.

Solution:



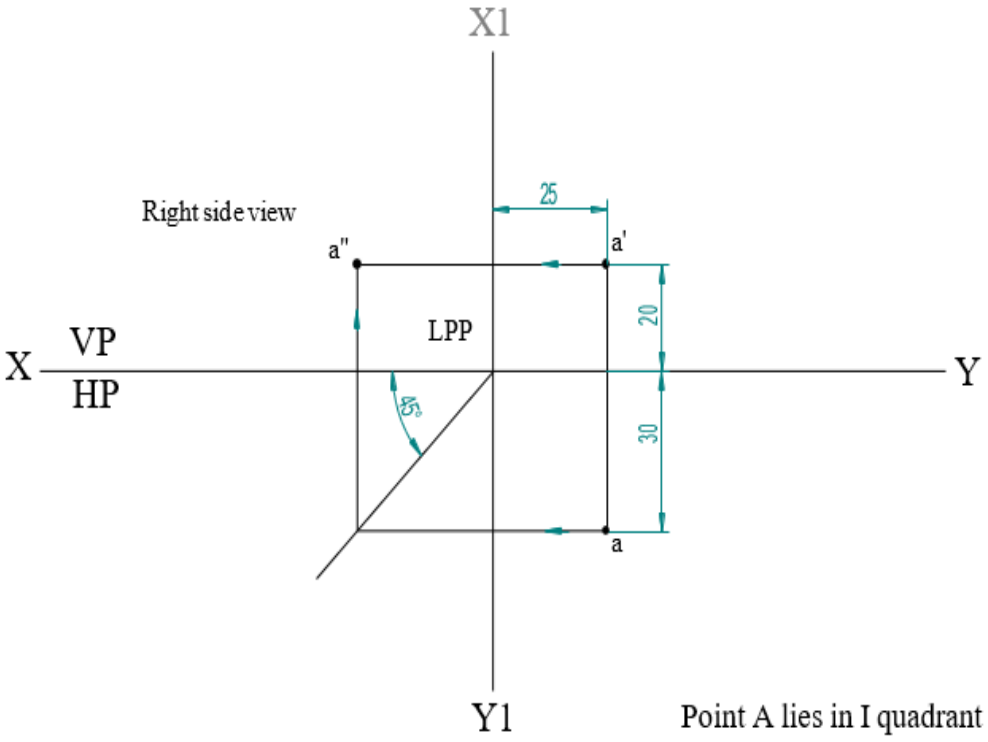
Q12. A point P is 30mm in front of VP, 40mm above HP and 50mm from RPP. Draw its projections and name the side view. Also state the quadrant in which it lies.

Solution:



Q13. Point 'A' is 30mm in front of VP, 20mm above HP and 25mm infront / behind / from LPP. Draw its projections and name the side view. Also state the quadrant in which it lies.

Solution:



ORTHOGRAPHIC PROJECTIONS OF LINES

The line is defined as a shortest distance between two points. It is a one dimensional quantity (Particular length) with negligible thickness.

Projection lines: Projection lines are extensions of lines that assist in 2D drawing. You can use projection lines to help you create new geometry, and any constraints you create with them remain active even after you turn projection lines off. For example, in a drawing, you can use projection lines on an auxiliary view to enable creation of additional views with proper alignment and size.

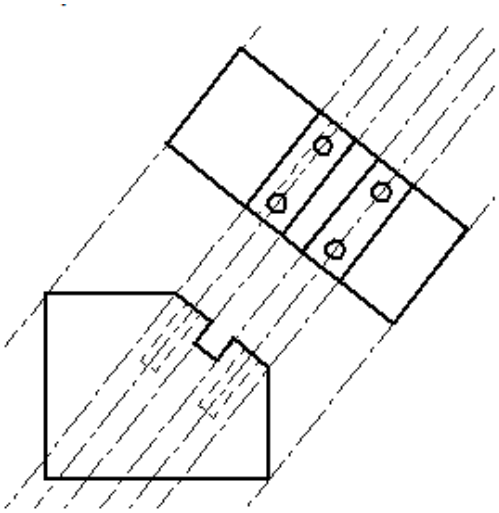
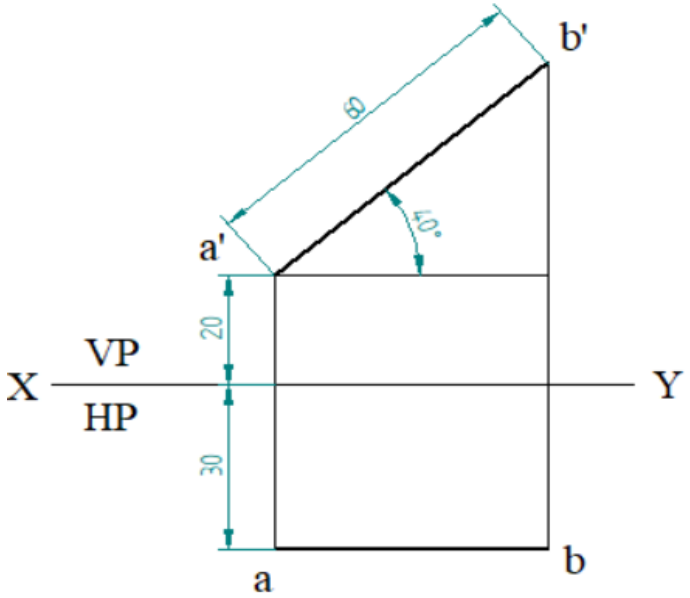


Fig. 2.2 Representation of projection lines

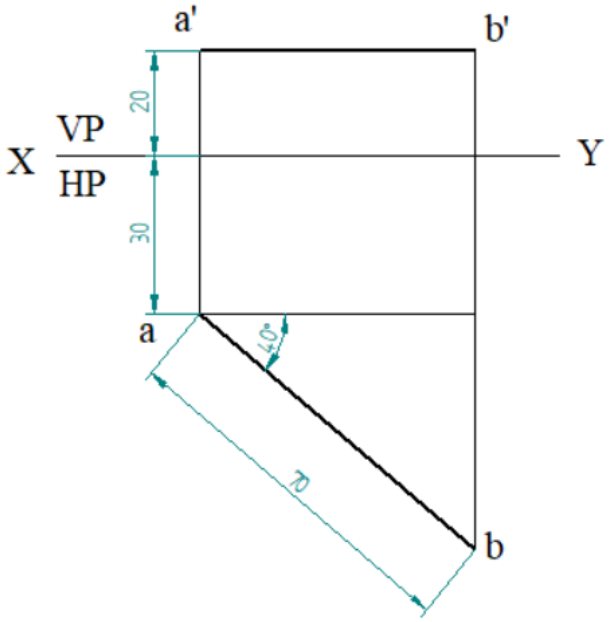
Q1. A lever AB 60mm long has its end "A" 20mm above HP and 30mm in front of VP. The lever is inclined at 40°to HP and parallel to VP. Draw its top and front views.

Solution:



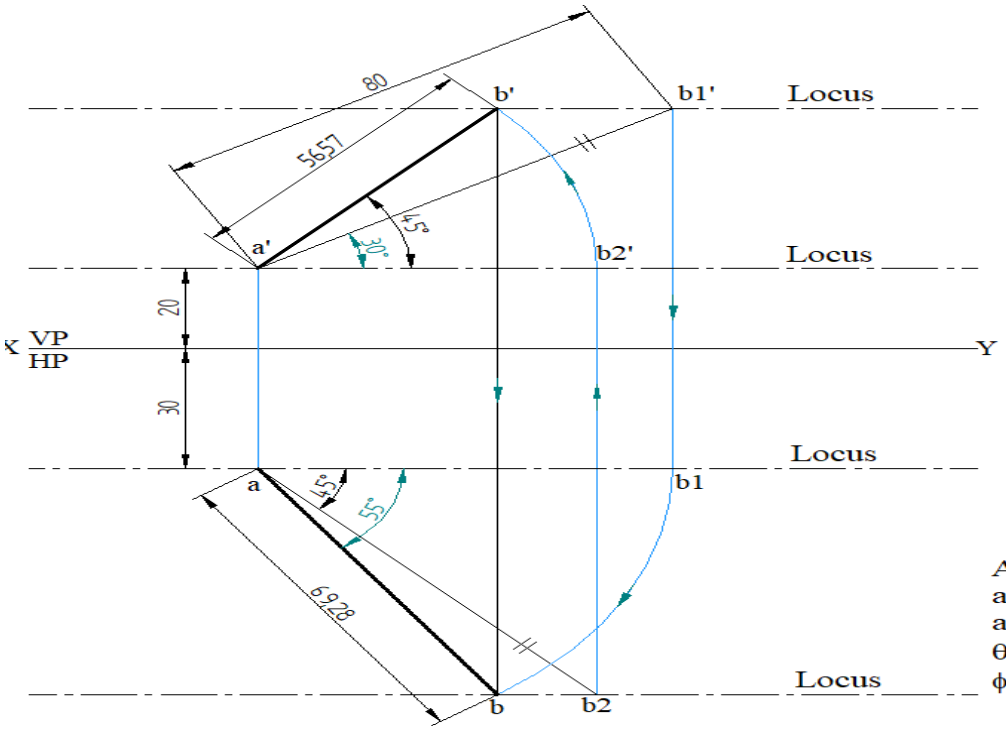
Q2. A Pen AB 70mm long has its end "A" 20mm above HP and 30mm in front of VP. The Pen is inclined at 40°to VP and parallel to HP. Draw its top and front views.

Solution:



Q3. A line AB 80mm long has its end "A" 20mm above the HP and 30mm in front of VP. It is inclined at 30°to HP and 45°toVP.Draw the projections of the line and find apparent lengths and apparent inclinations.

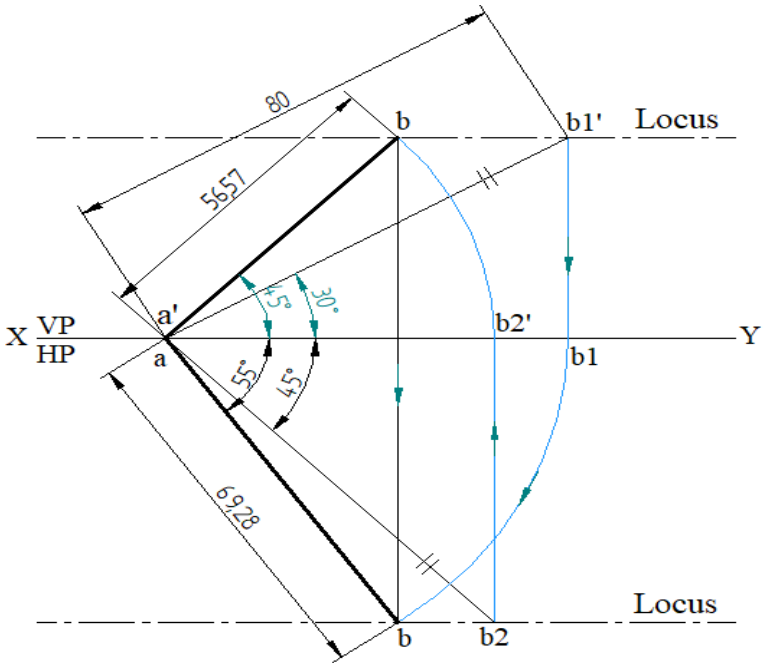
Solution:



Answers:
a'b'=56.57mm
ab=69.28mm
θ=45°
ϕ=55°

Q4. A line AB 80mm long is inclined to HP at 30°and VP at 45°. Draw front and top views of line and determine their lengths. Also measure the perpendicular distance of end B from both HP and VP.

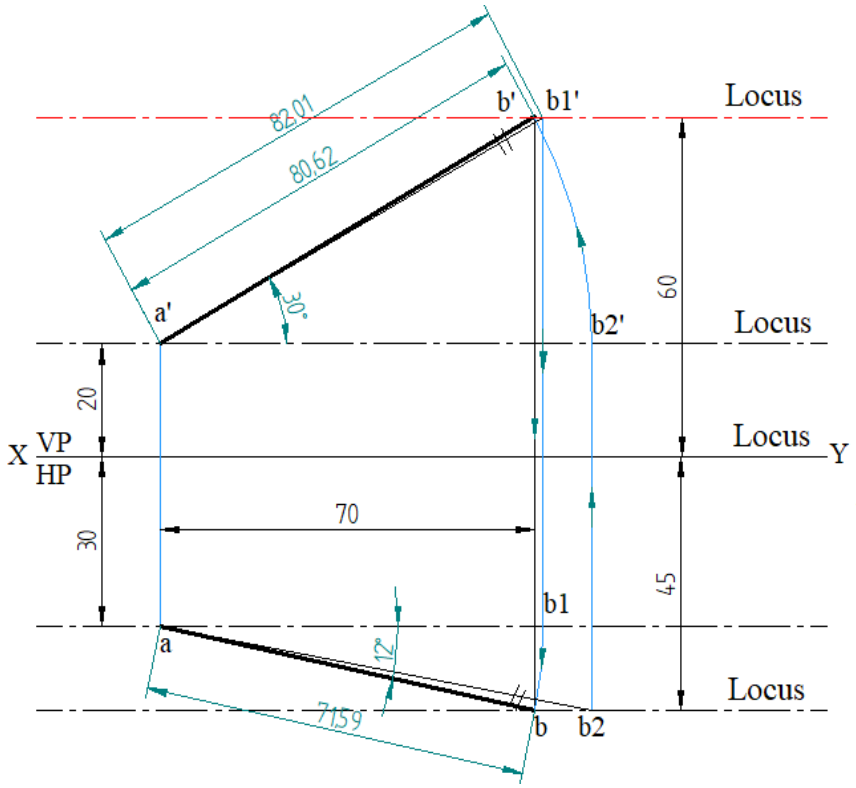
Solution:



Answers:
a'b'=56.57mm
ab=69.28mm
α=45°
β=55°

Q5. A line AB has its end "A" 20mm above HP and 30mm in front of VP. The other end of "B" is 60mmabove the HP and 45mm in front of VP. The distance between end projectors is 70mm. Draw its projections and determine the true lengths and apparent inclinations.

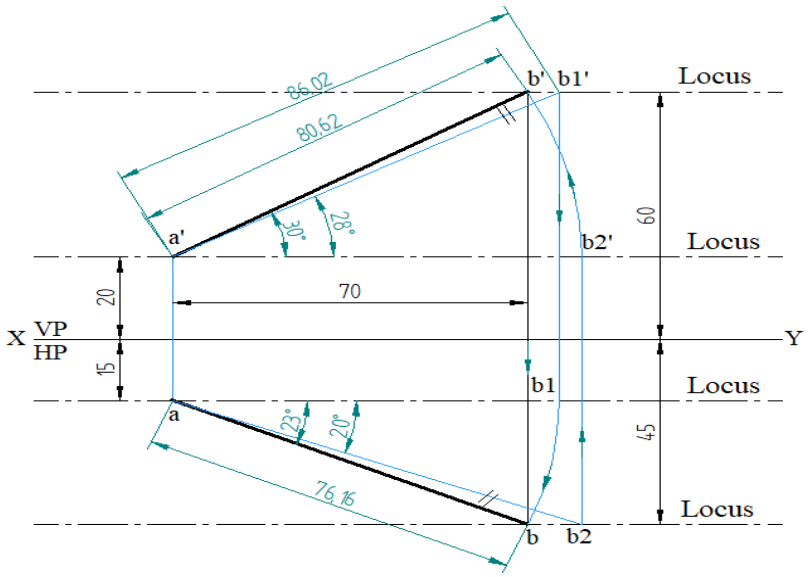
Solution:



Answers:
a'b1'=82.01mm
a'b'=80.62mm
ab=69.28mm
α=30°
β=12°

Q6. A line AB has its end "A" 20mm above the HP and 15mm in front of the VP. The other end "B" is 60mm above the HP and 45mm in front of the VP. The distance between the end projectors is 70mm. Draw its projections. Determine the true length and true inclination. Also determine the apparent lengths and inclinations.

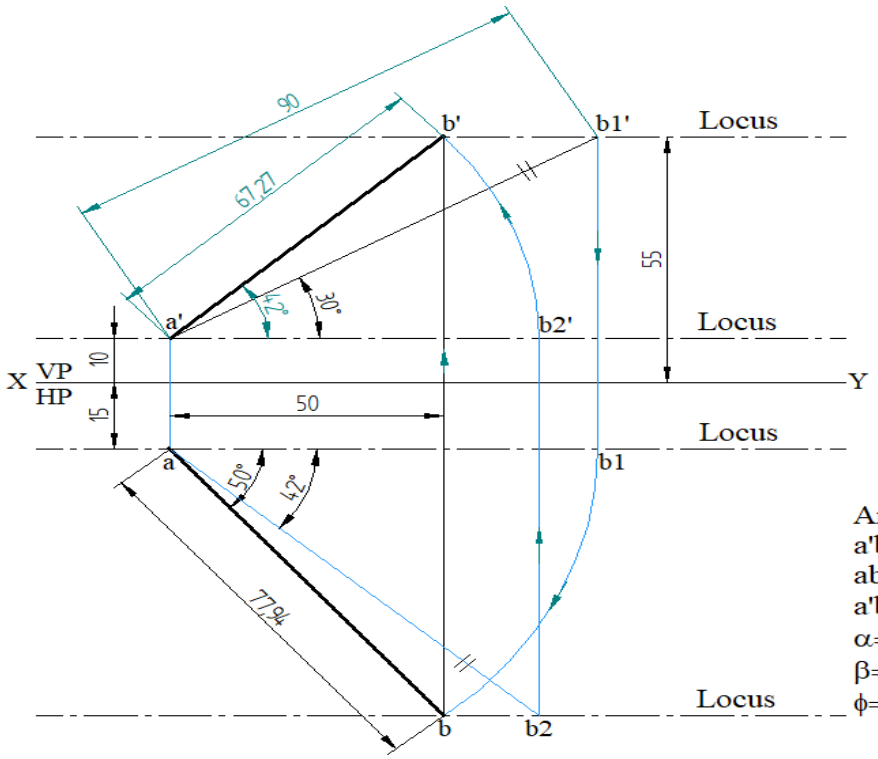
Solution:



Answers:
a'b1'=86.02mm
a'b'=80.62mm
ab=76.16mm
α=30°, θ=28°
β=23°, ϕ= 20°

Q7. A line has its end "A"10mm above HP and15mm in front of VP. The end "B" is 55mm above HP and line is inclined at 30°to HP. The distance between the end projectors is 50mm. Draw the projections of the line. Determine the true length of the line and its inclination with VP.

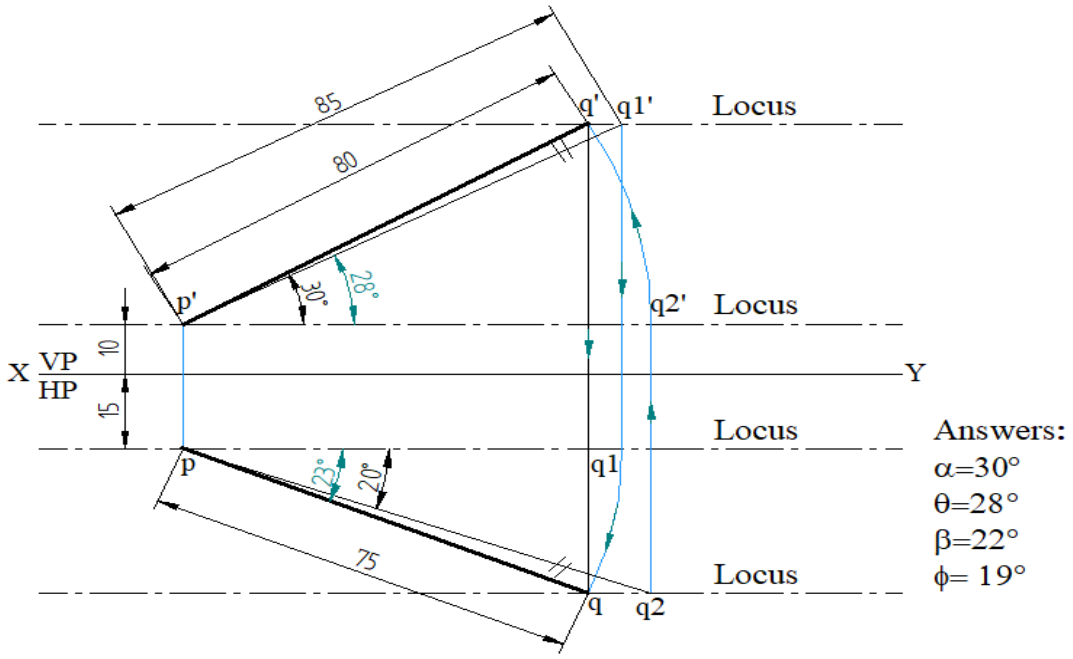
Solution:



Answers:
a'b'=67.27mm
ab=77.94mm
a'b1'=90mm
α=42°
β=50°
ϕ=42°

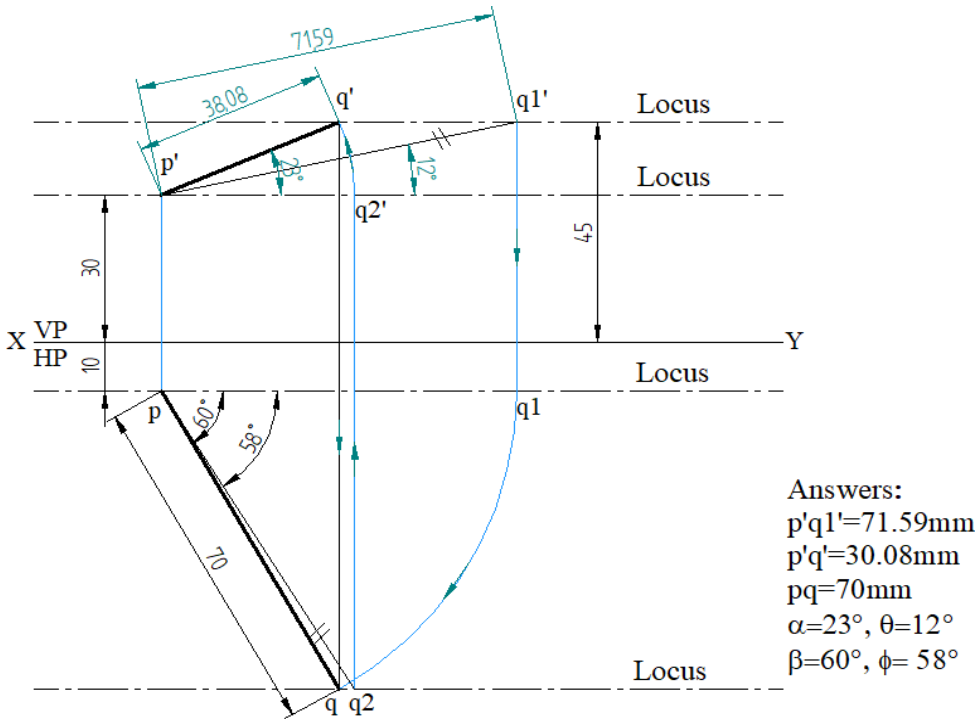
Q8. A line PQ 85mm long has its end "P"10mm above HPand15mm in front of VP. The top view and front view of line PQ are 75mm and 80 mm respectively. Draw its projections and also determine the true and apparent inclinations of the line to the reference planes.

Solution:



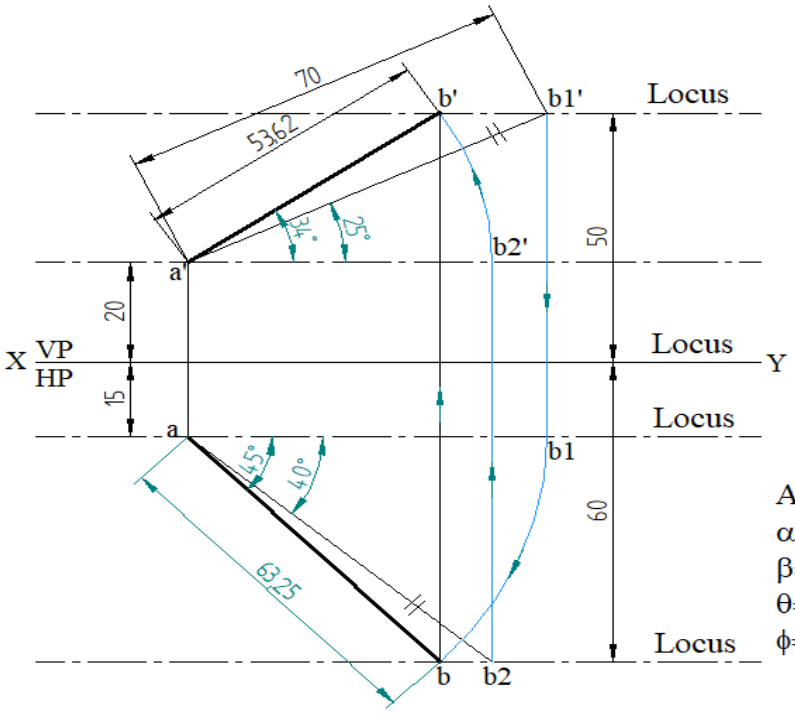
Q9. The top view PQ of a straight line is 70mm and makes an angle of 60° with XY line. The end "Q" is 10mm in front of VP and 30mm above HP. The difference between the distances of "P" and "Q" above HP is 45mm. Draw the projections. Determine its true length and true inclinations with HP and VP.

Solution:



Q10. A line AB measuring 70mm has its end "A"15mm in front of VP and 20mm above HP and the other end "B" is 60mm in front of VP and 50mm above HP. Draw the projections of the line and find the inclinations of the line with both the reference planes of projection.

Solution:



ORTHOGRAPHIC PROJECTIONS OF PLANES

Plane is a two dimensional figure with particular length and width with negligible thickness it also known as lamina.

Example: Sheet of a paper, Plate with negligible thickness

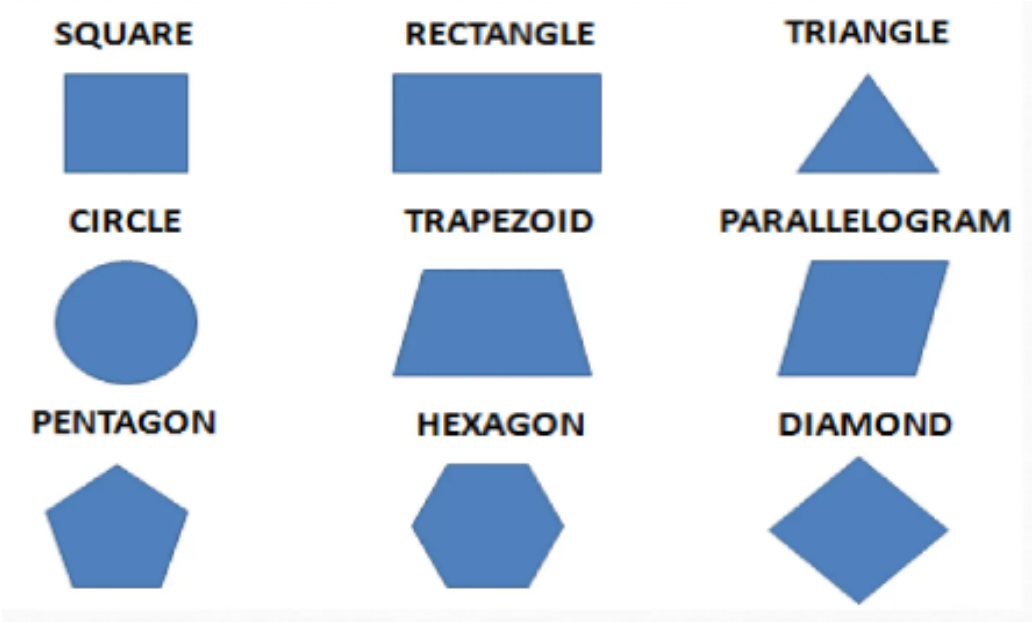
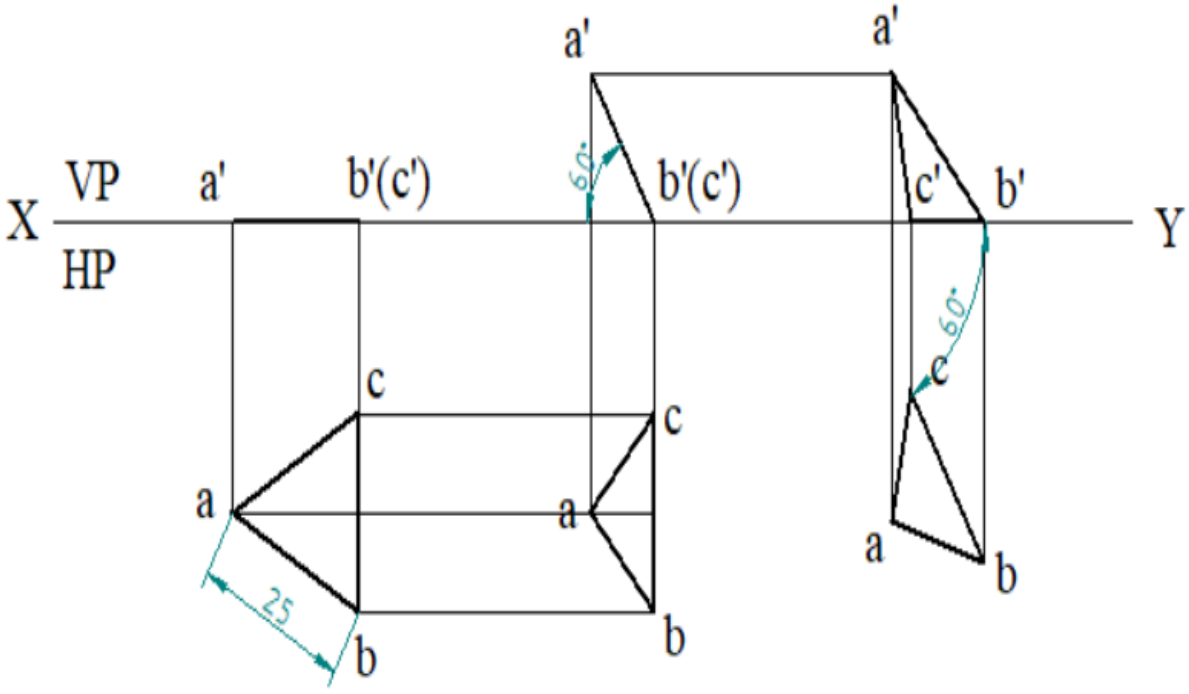


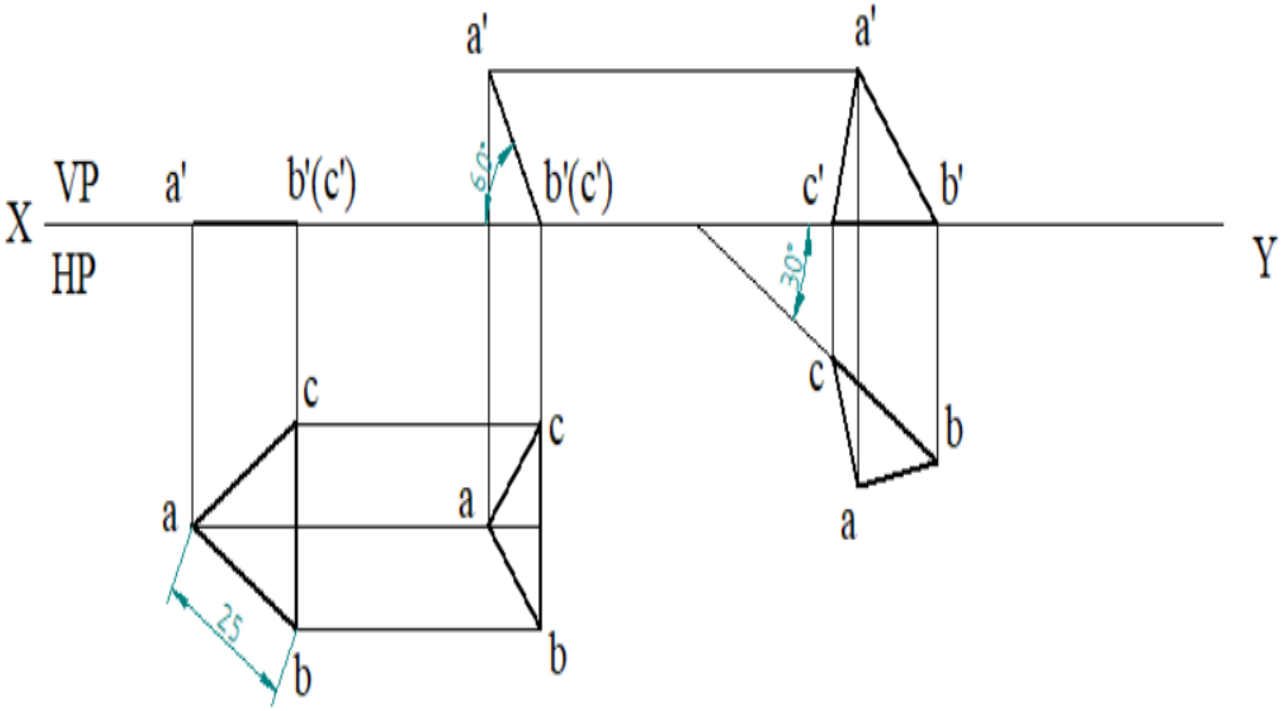
Fig. 2.3 Types of lamina

Q1. An equilateral triangular lamina of 25 mm sides lies with one of its edges on HP such that the surface of the lamina is inclined to HP at 60 deg. The edge on which it rests is inclined to VP at 60 deg. Draw its projections.

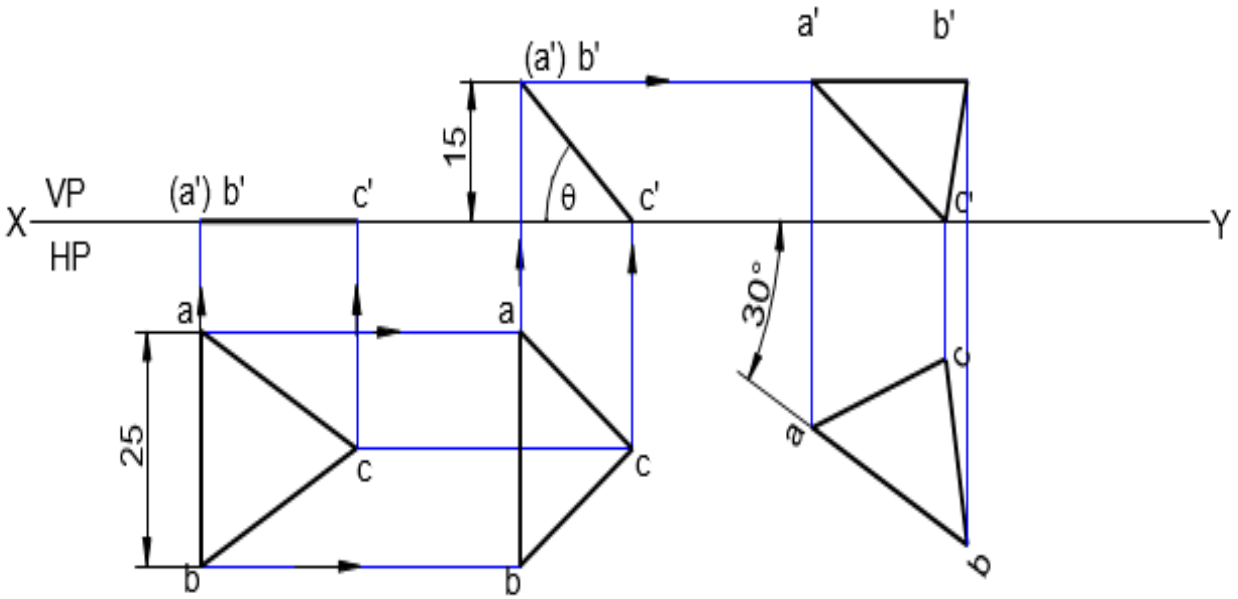


Q2. An equilateral triangular lamina of 25mm side rests one of its edges on HP such that the surface of the lamina is inclined to HP at 60°.The edge on which it rests is inclined to VP at 30°. Draw its projections.

Solution:

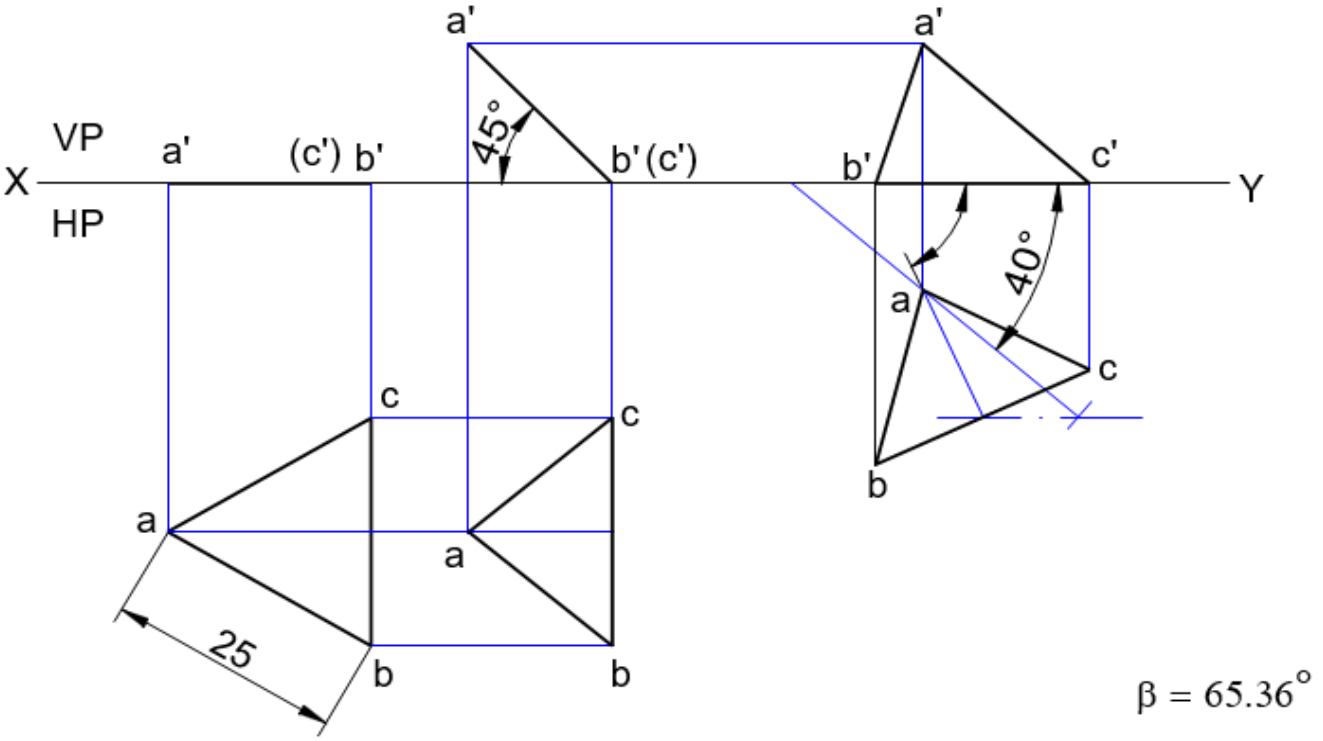


Q3. A triangular plane lamina of sides 25 mm is resting on HP with one of its corners touching it,such that the side opposite to the corner on which it rests is 15 mm above HP and make an angle of 30 deg. with VP. Draw the top and front views in this position. Also determine the inclination of the lamina to the reference plane.



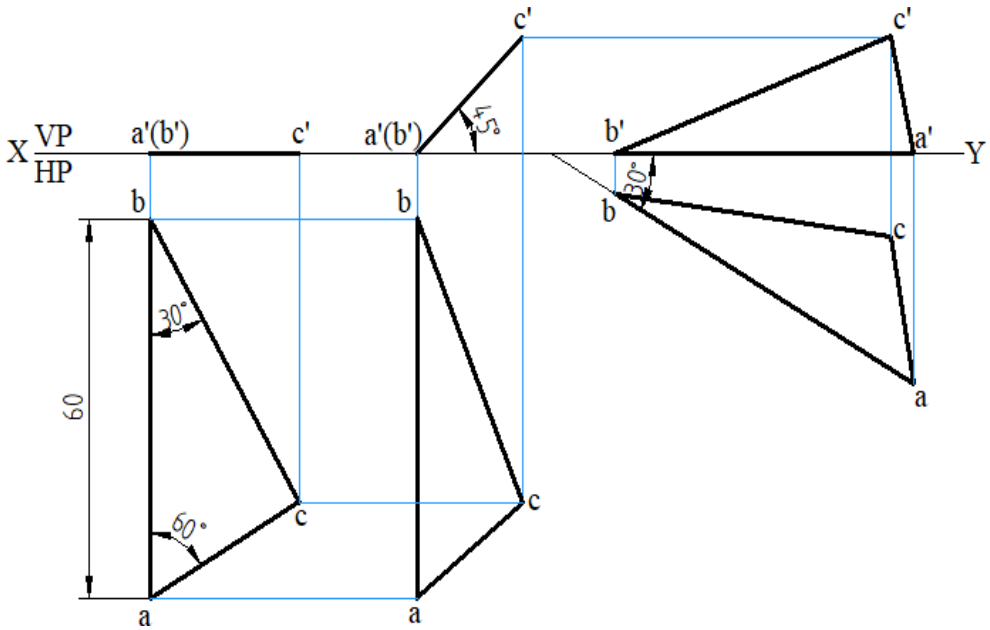
$\theta = 43.86^{\circ}$

Q4. An equilateral triangular lamina of 25 mm sides lies on one of its sides on HP. The lamina makes 45 deg. with HP and one of its medians is inclined at 40 deg. to VP. Draw the projections.

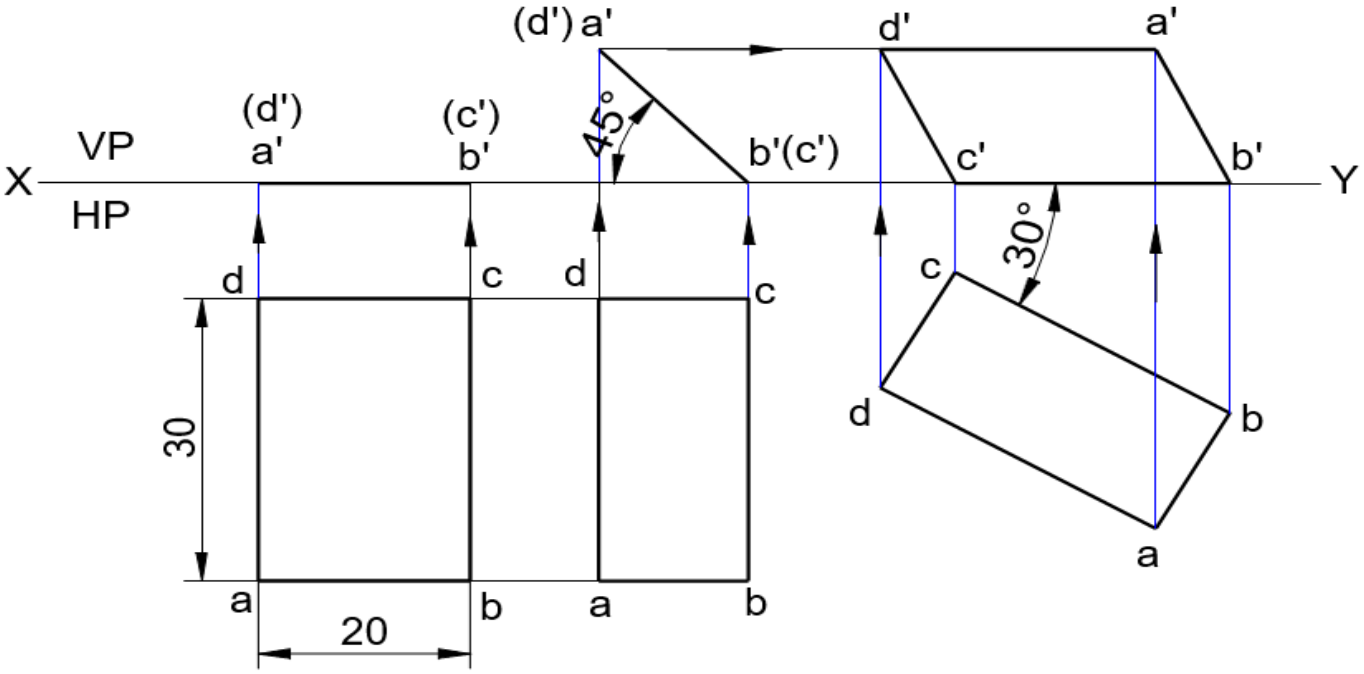


Q5. A 30°-60°set square of 60mm longest side is so kept such that the longest side is in HP, making an angle of 30° with VP. The setsquare itself is inclined at 45° to HP. Draw the projections of the setsquare.

Solution:

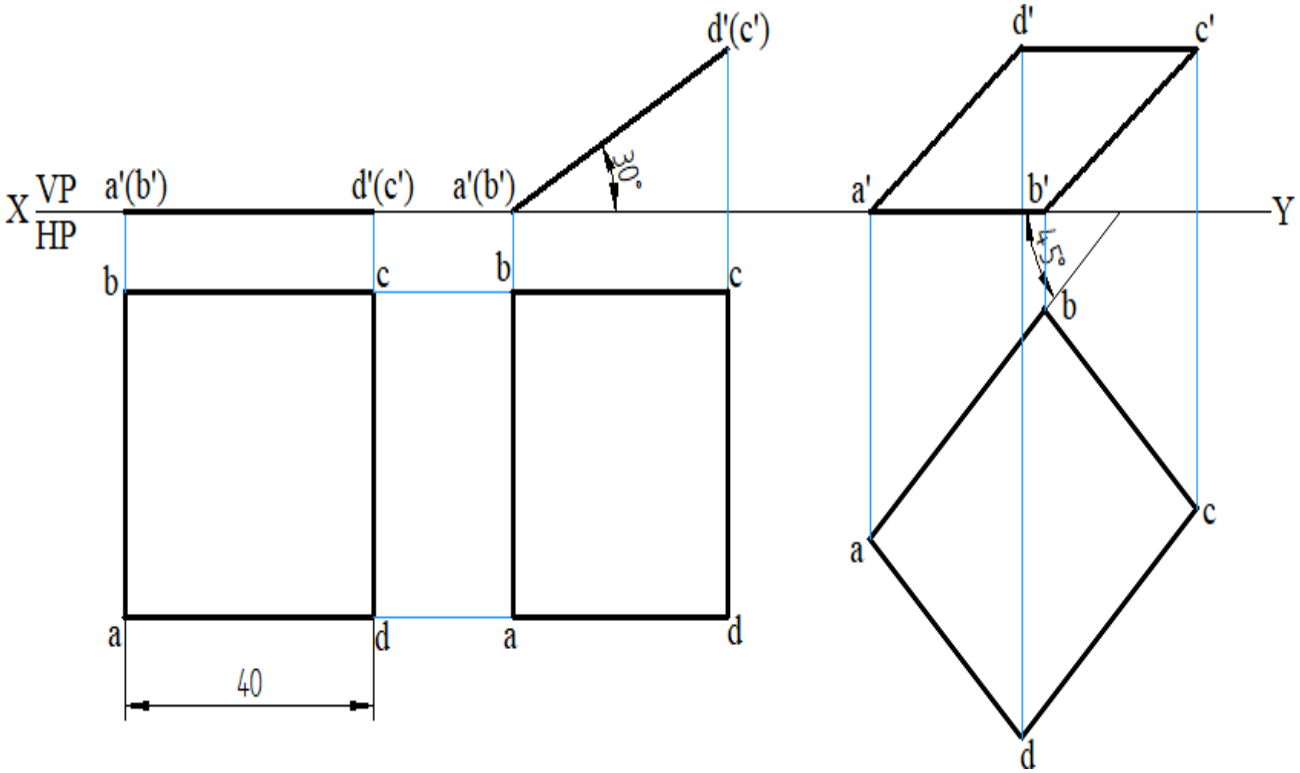


Q6. A rectangular marble (Negligible thickness) of sides 20 mm X 30 mm rests on HP on one of its longer edges. The marble is tilted about the edge on which it rests till its plane surface is inclined to HP at 45 deg. The edge on which it rests is inclined at 30 deg. to VP. Draw its projections of the marble.



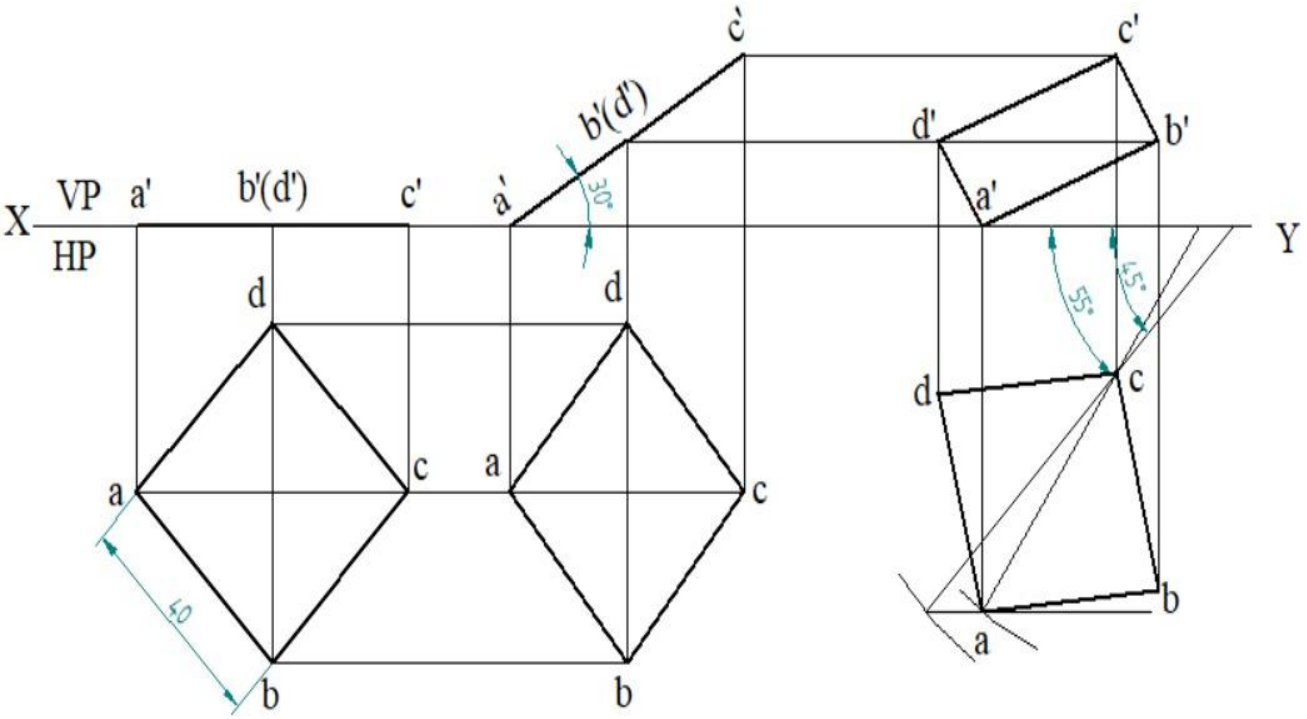
Q7. A square kite of 40mm side rests on one of its sides on HP. The kite makes 30°to HP and the side on which it rests makes 45°to VP. Draw its projections

Solution:



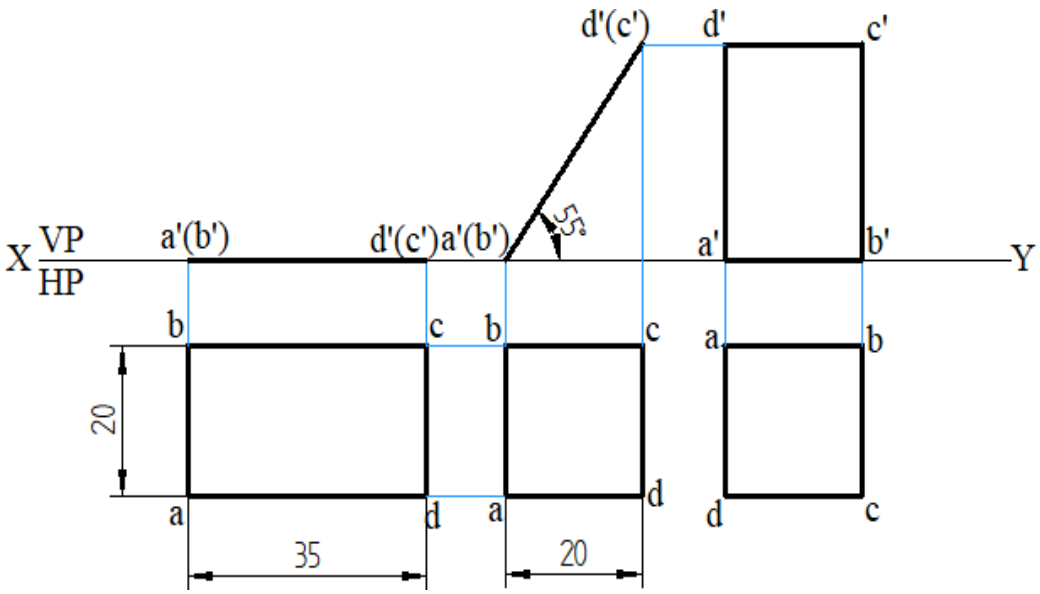
Q8. A square plate of 40 mm sides rests on HP such that one of the diagonals is inclined at 30° to HP and 45°to VP. Draw its projections

Solution:



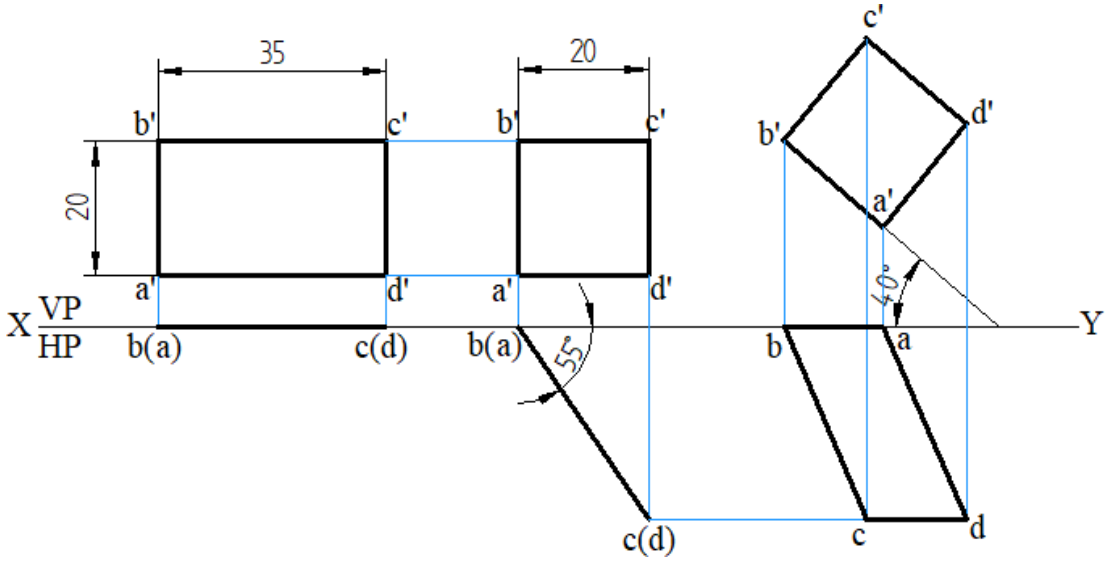
Q 9. A rectangular lamina of side 35mmx20mm rests on HP on one of its shorter edges. The lamina is rotated about the edge on which it rests till it appears as a square in the top view. The edge on which the lamina rests being parallel to both HP and VP. Draw its projections and find its inclinations to HP and VP

Solution:



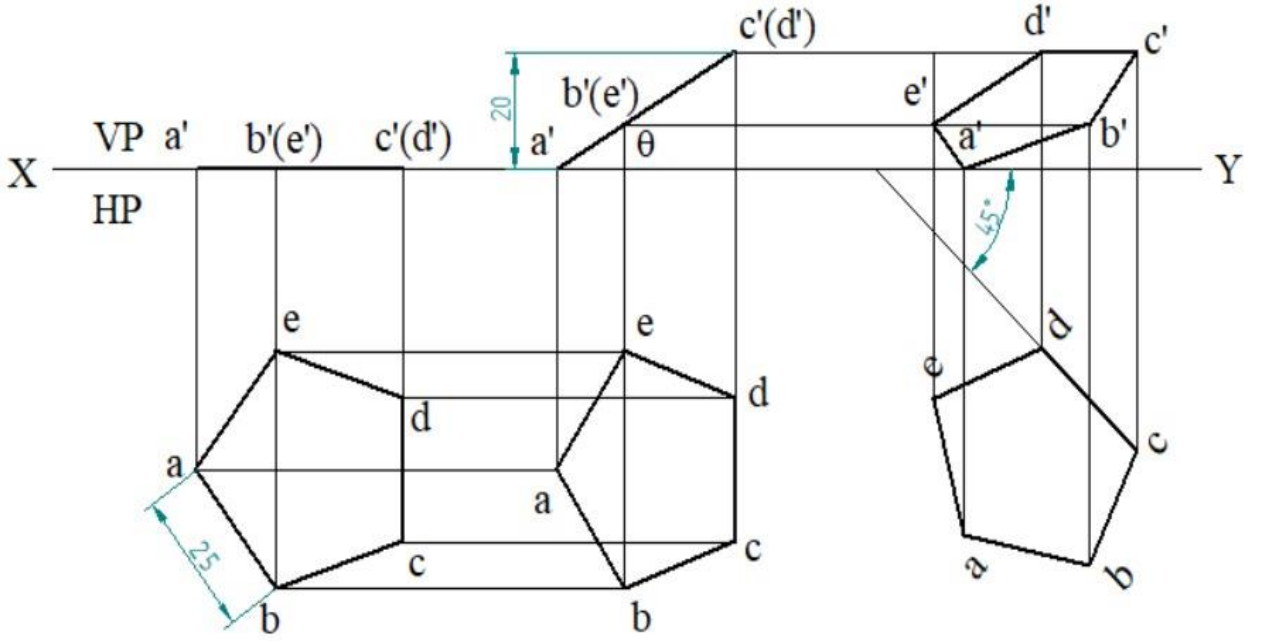
Q 10. A rectangular plate of negligible thickness of size 35x20mm has one of its shorter edges in VP with that edge inclined at 40°to HP. Draw the top view if its front view is a square of side 20mm.

Solution:



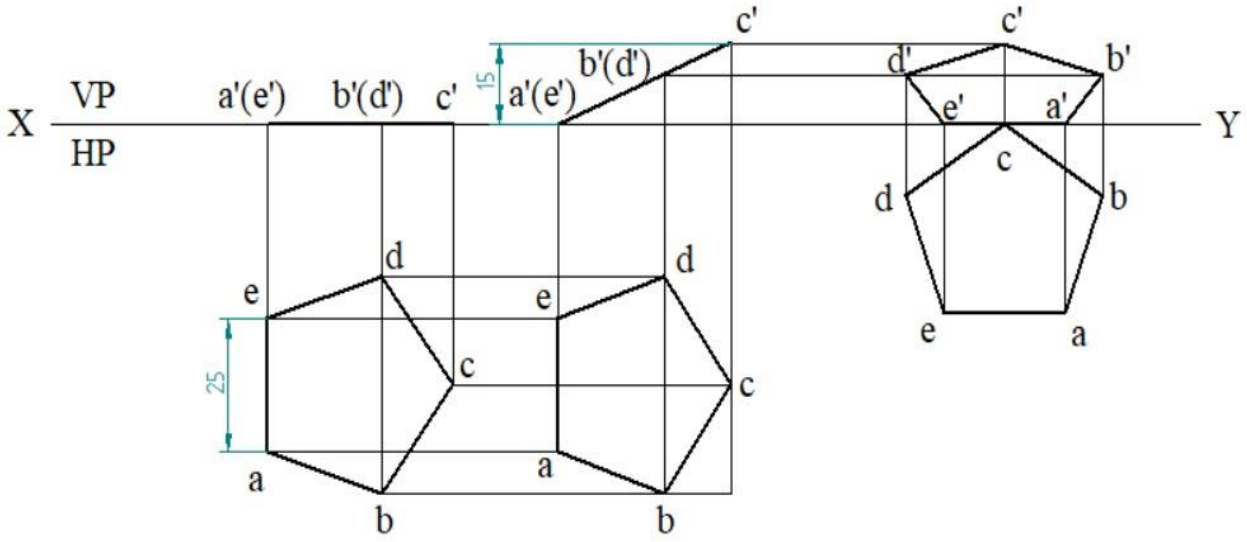
Q 11. A pentagonal lamina of edges 25mm is resting on HP with one of its corners such that the edge opposite to this is 20mm above HP and makes an angle of 45° with VP. Draw the top and front views of the plane lamina in this position. Determine the inclination of the lamina with HP

Solution:



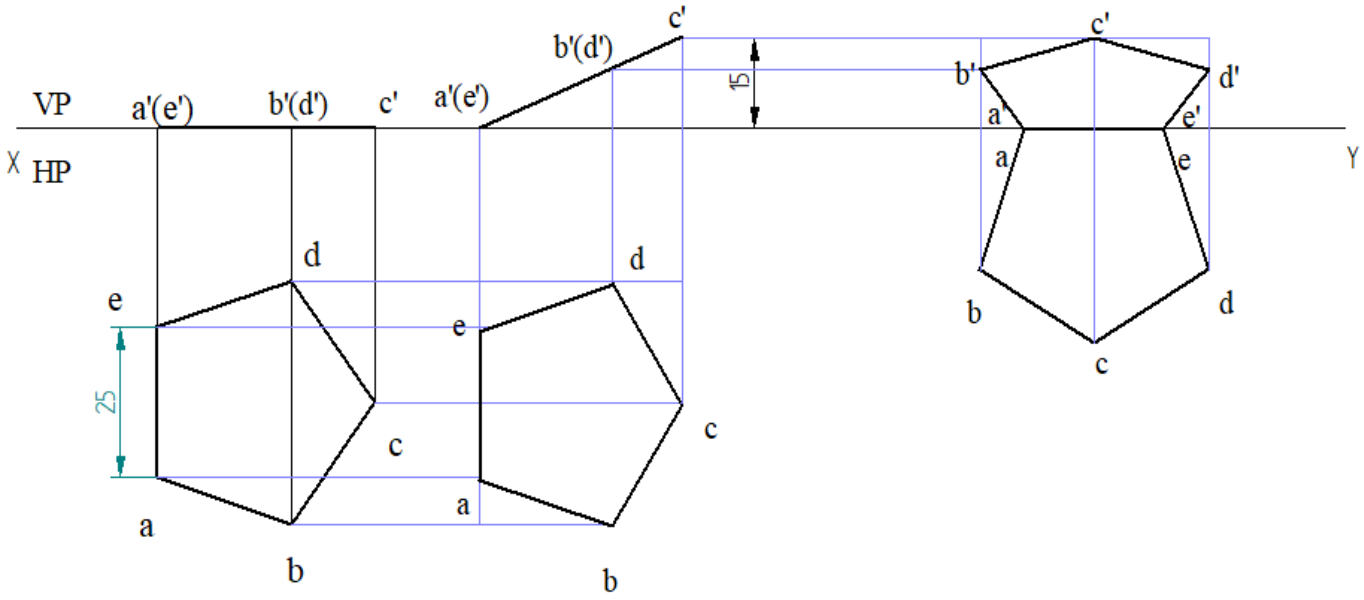
Q 12. A pentagonal lamina of sides 25mm is resting on one of its edges on HP with the corner opposite to that edge touching VP. This edge is parallel to VP and the corner, which touches VP, is at a height of 15mm above HP. Draw the projections of the lamina and determine the inclinations of the lamina with HP and VP and the distance at which the parallel edge lies from VP.

Solution:



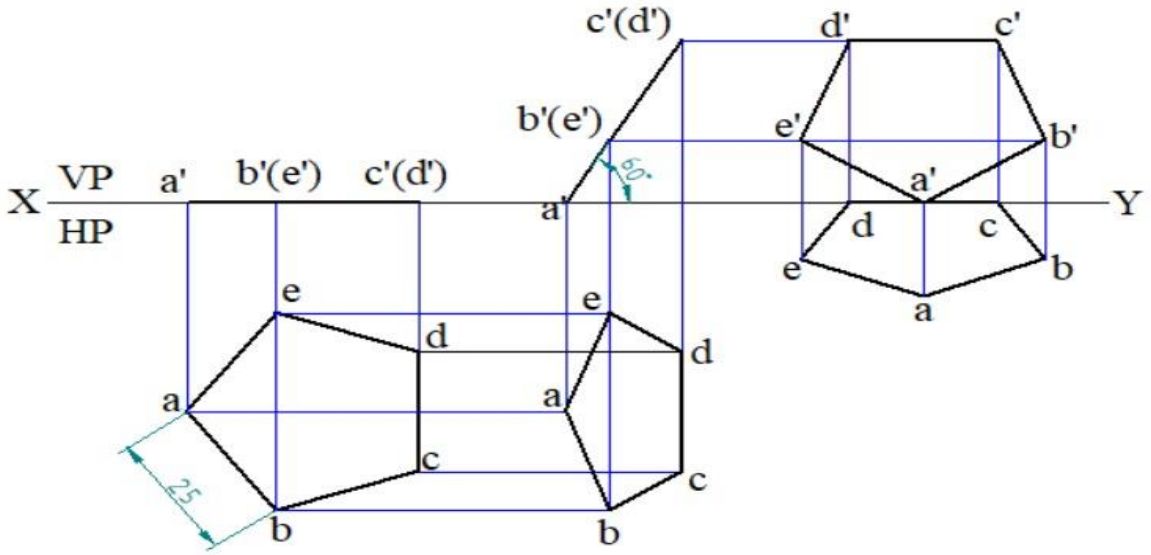
Q 13. A pentagonal lamina of sides 25mm is having a side both on HP and VP. The corner opposite to the side on which it rests is 15mm above HP. Draw the top and front views of the lamina.

Solution:



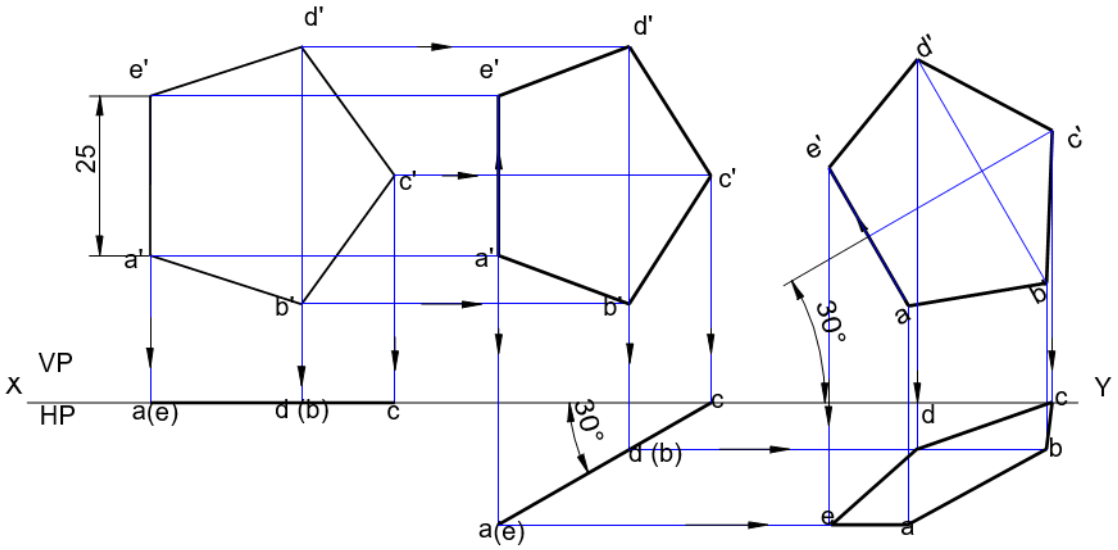
Q 14. A regular pentagonal lamina of 25mm side is resting on one of its corners on HP while the side opposite to this corner touches VP. If the lamina makesanangleof60°with HP, draw the projections of the lamina

Solution:



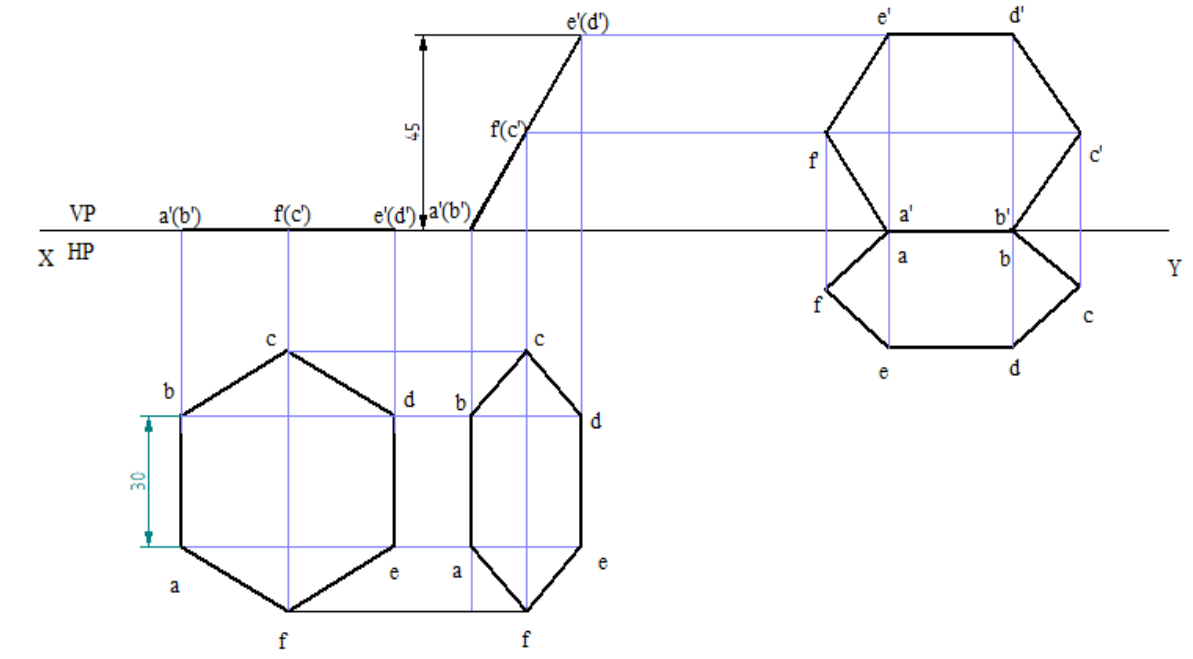
Q15. A pentagonal lamina having edges 25 mm is placed on one of its corners on VP such thatthe surface makes an angle of 30 deg. with VP and perpendicular bisector of the edge passing through the corner on which the lamina rests appears to be inclined at 30 deg. to HP. Draw the top and front views of the lamina.

Solution:



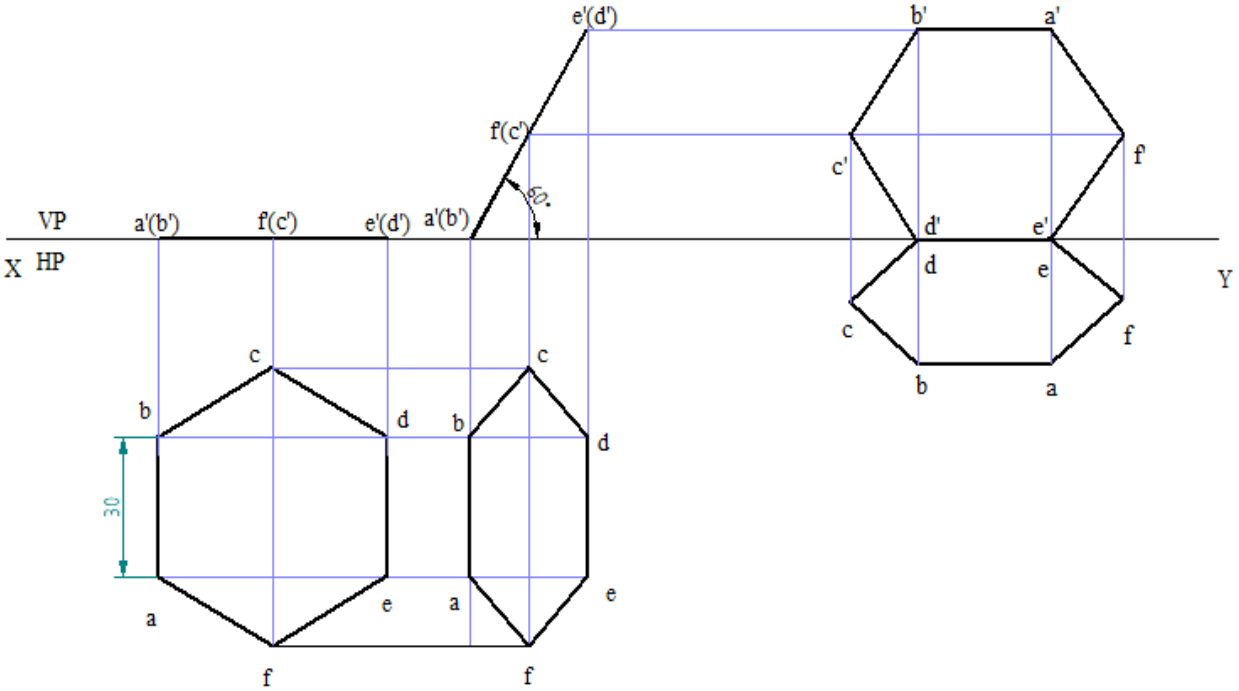
Q16.A regular hexagonal lamina of side 30mm is lying in such a way that one of its sides touches both the reference planes. If the side opposite to the side on which it rests is 45mm above HP. Draw the projections of the lamina.

Solution:



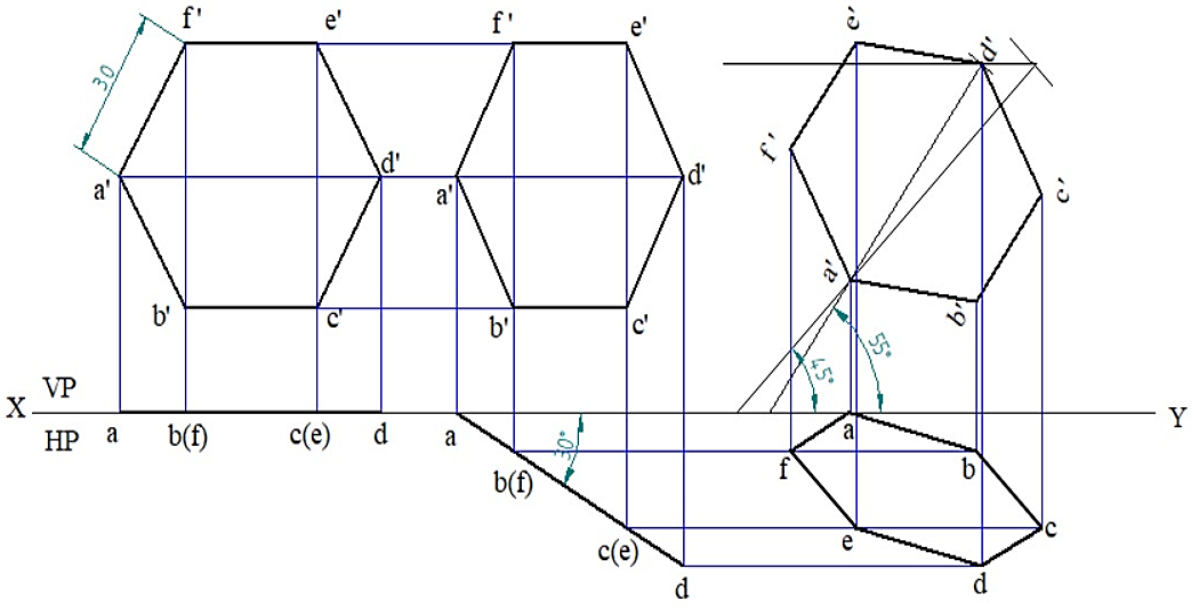
Q17. A regular hexagonal lamina of sides 30 mm is lying in such a way that one of its sides on HP while the side opposite to the side on which it rests is on VP. If the lamina makes 60° to HP draw the projections of the lamina.

Solution:



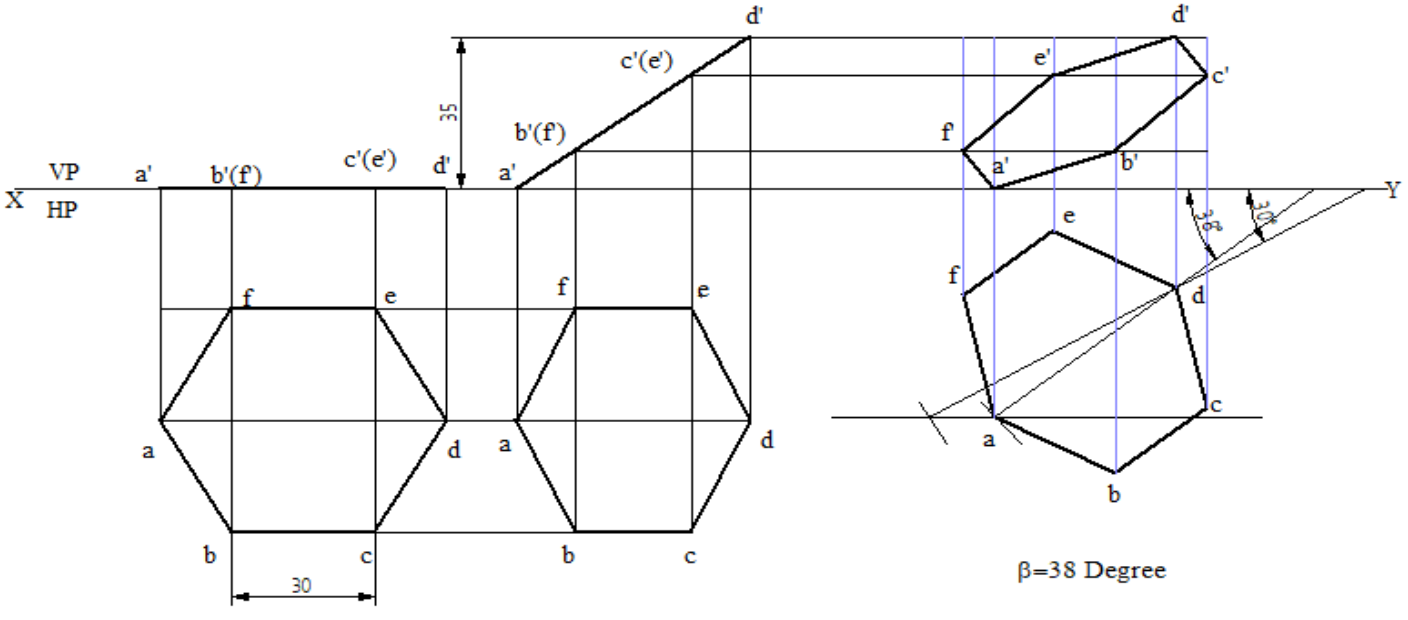
Q18. A hexagonal lamina of sides 30 mm is resting with one of its corners on VP and its surface inclined at an angle of 30° with VP. The diagonal passing through the corner which is in VP is inclined at 45°to HP. Draw the projections of the lamina.

Solution:



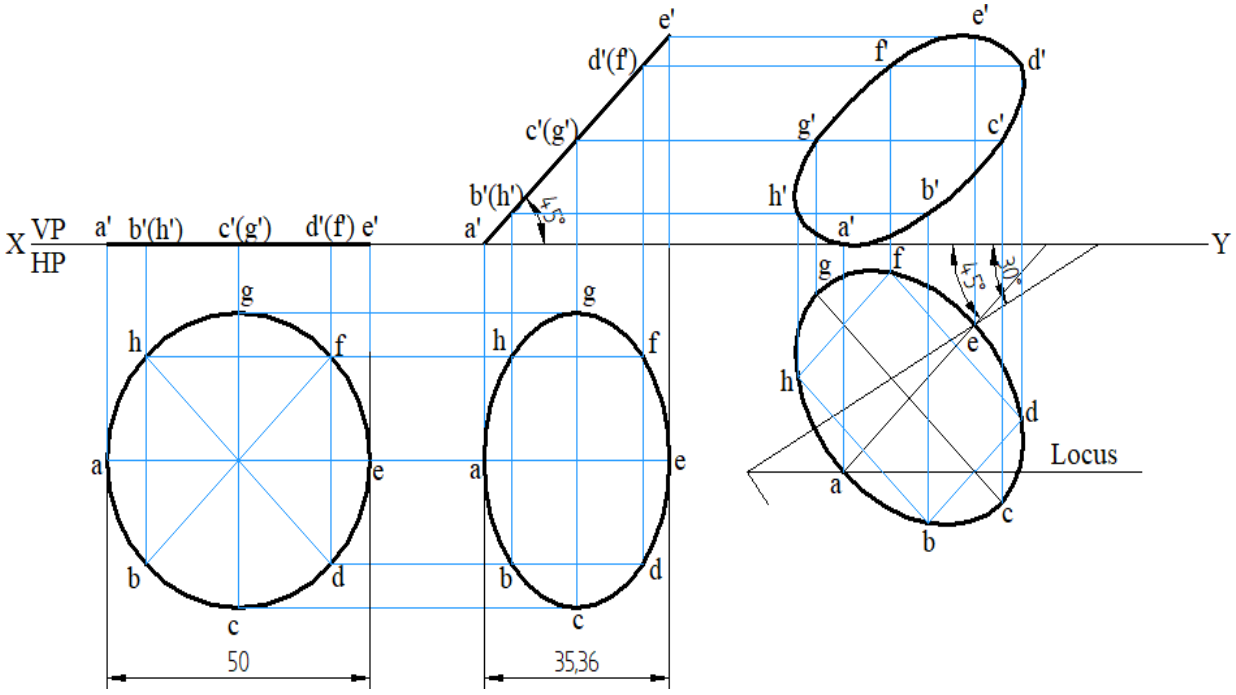
Q19.A hexagonal lamina of sides 25mm rests on one of its corners on HP. The corner opposite to the corner on which it rests is 35mmabove HP and the diagonal passing through the corner on which it rests is inclined at 30° to VP. Draw its projections. Find the inclinations of the surface with HP

Solution:



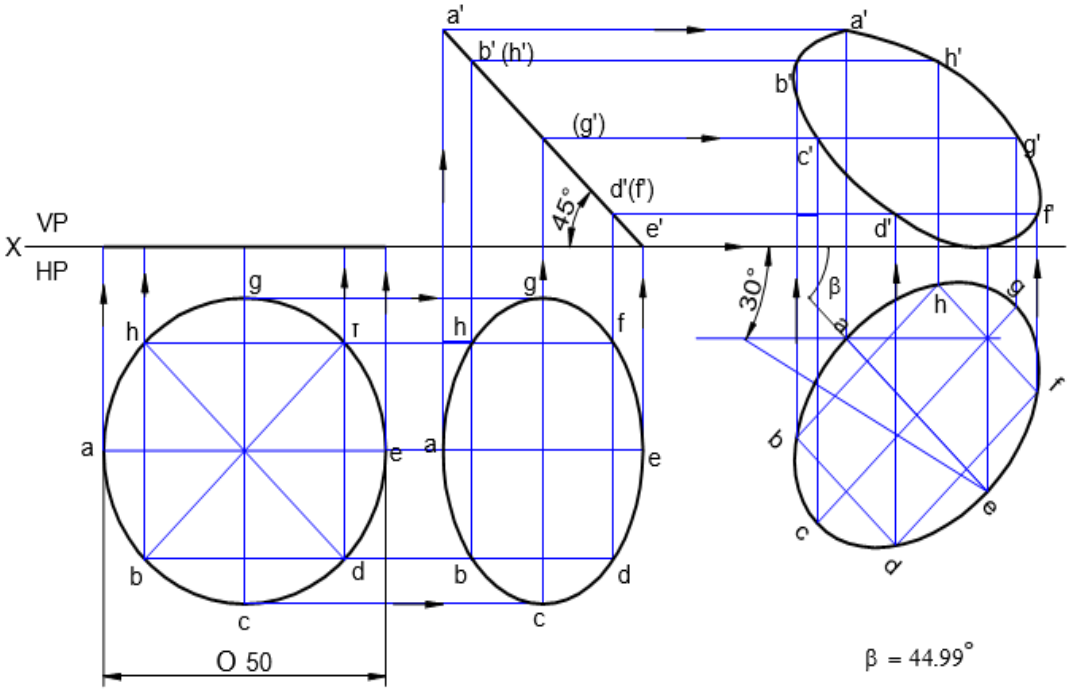
Q 20. A circular lamina of 50mm diameter rests on HP such that one of its diameters is inclined at 30°to VP and 45°to HP. Draw its top and front views in this position

Solution:



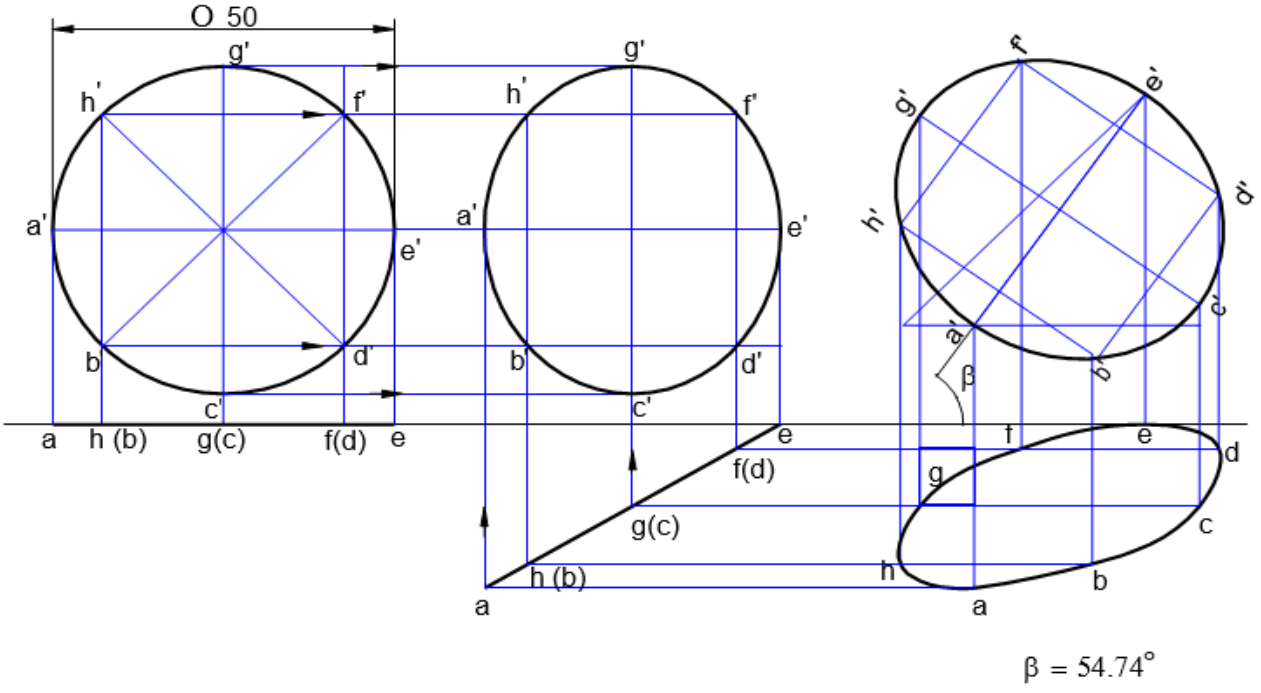
Q21. A circular lamina of 50 mm diameter rests on HP such that one of its diameter is inclined at30 deg. to VP and 45 deg. to HP. Draw its top and front views in this position.

Solution:



Q22.A circular lamina of 30 mm diameter rests on VP such that one of its diameter is inclined at30 deg. to VP and 45 deg. to HP. Draw its top and front views in this position.

Solution:



β = 54.74°

MODULE-3

ORTHOGRAPHIC PROJECTION OF SOLIDS

An object having three dimensions, i.e., length, breadth and height or thickness is called a SOLID. To represent a solid in the orthographic projection, at least two views are necessary; one view to represent length and height, called FRONT VIEW and the other view to represent length and breadth, called TOP VIEW

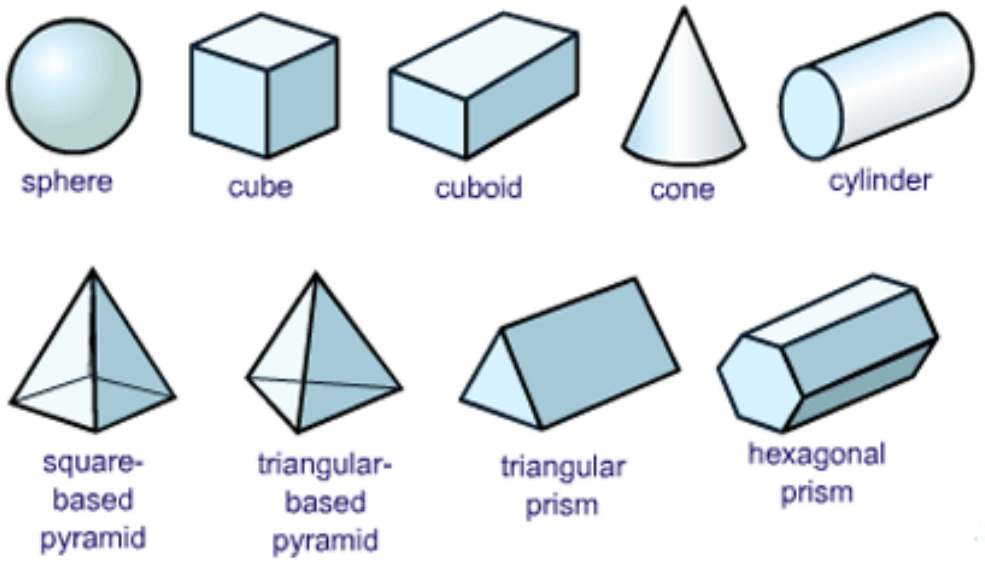


Fig 3.1 Types of solids

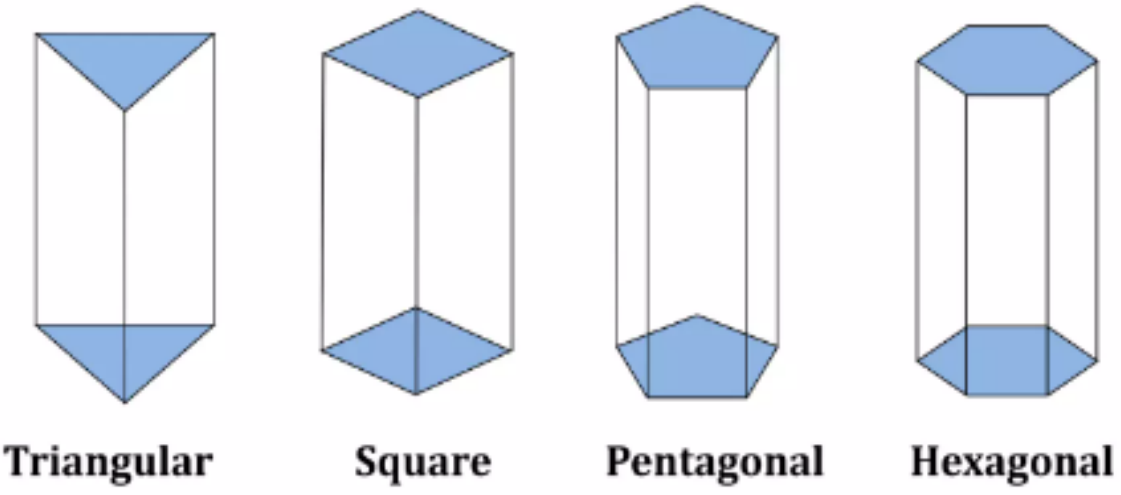


Fig 3.2 Types of prism

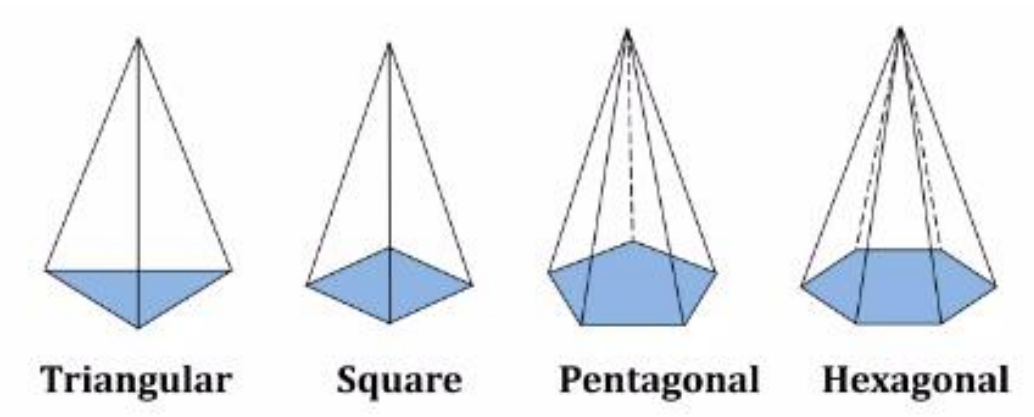


Fig 3.3 Types of pyramid

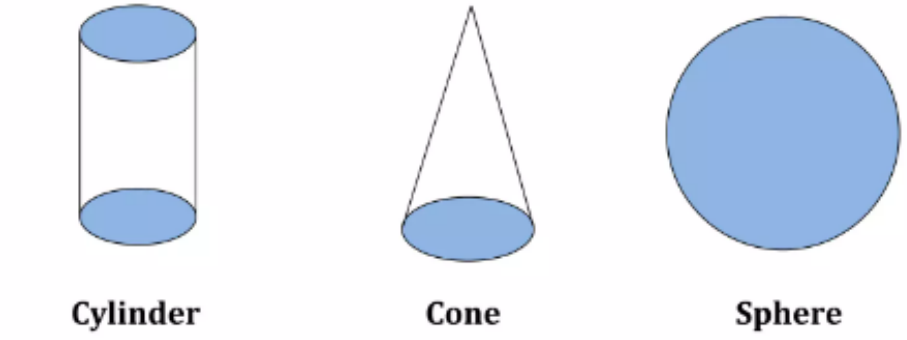


Fig 3.4 Solids of revolution

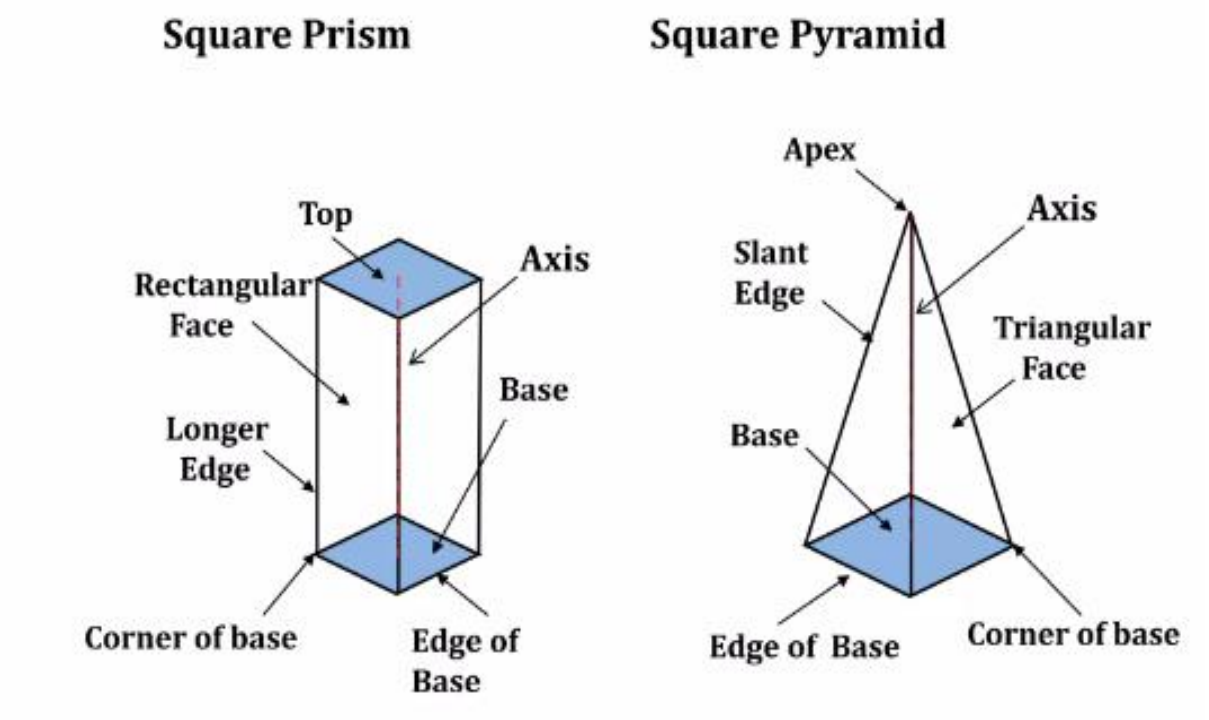
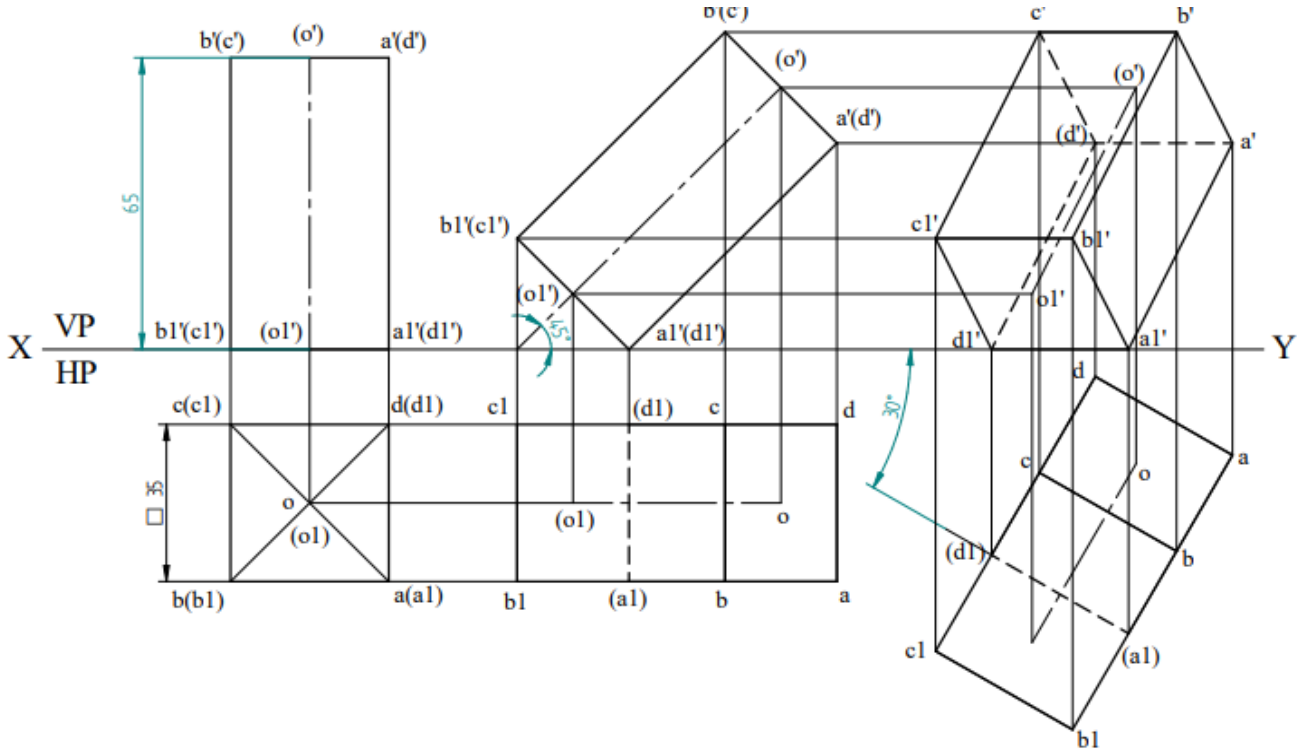


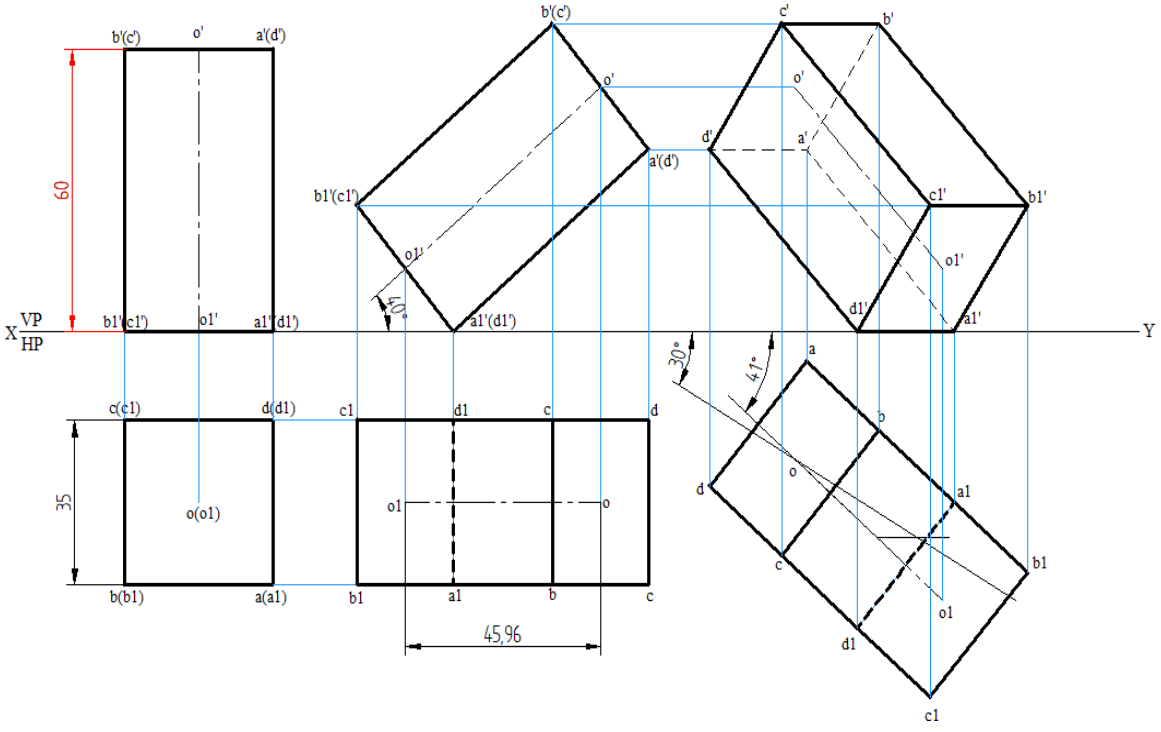
Fig 3.5 Nomenclature of Solids

Q 1. A square prism 35mm sides of base and 65mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30 degrees. Draw the projections of the prism when the axis is inclined to HP at 45 degree



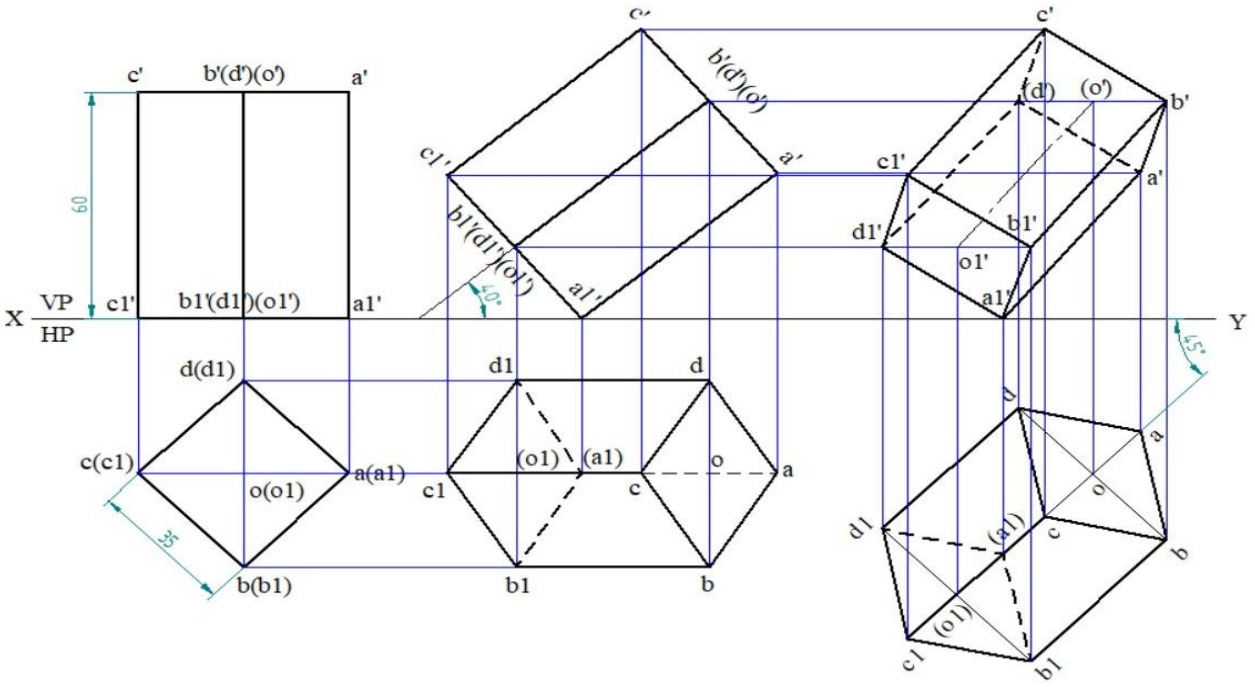
Q 2. A square prism35mm sides of base and 60mm axis length rests on HP on one of its edges of the bases. Draw the projection of the prism when the axis of the prism is inclined to HP at 45degree and to VP at 30 degrees.

Solution:



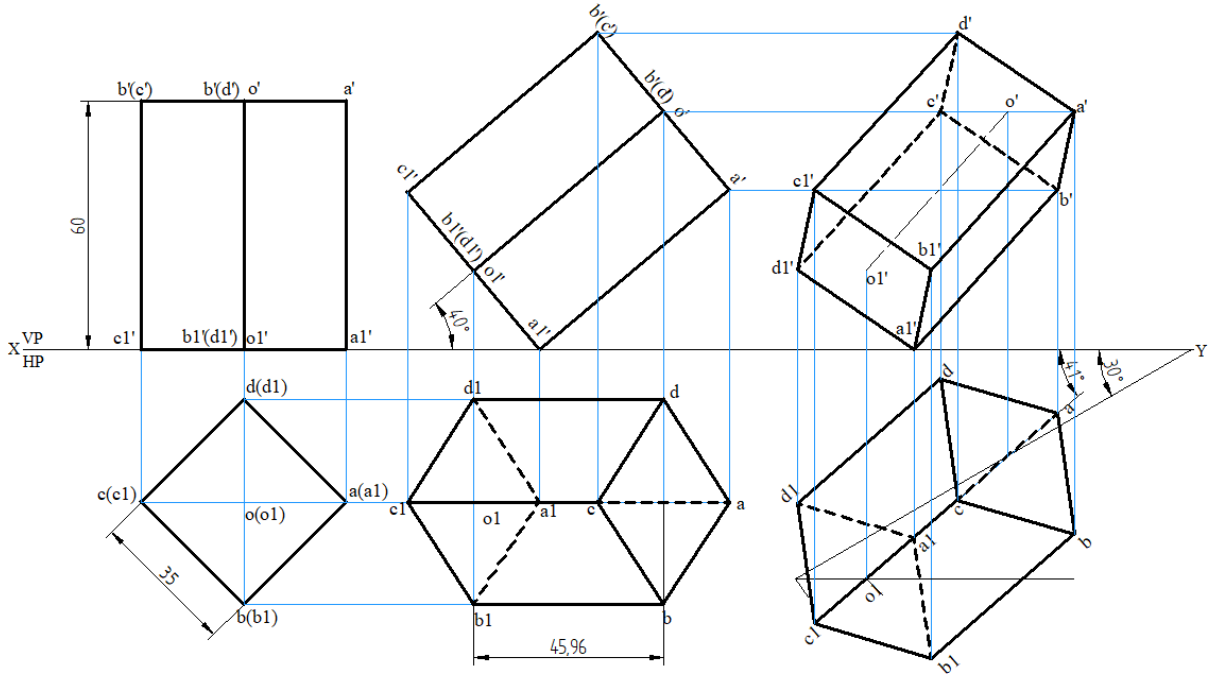
Q 3. A square prism 35mm sides of base and 60mm axis length rests on HP on one of its corner of the base such that the two base edges containing the corner on which it rests makes equal inclinations with HP. Draw the projections of the prism when the axis of the prism axis is inclined to HP at 40 degrees and appears to be inclined to VP at 45 degrees.

Solution:

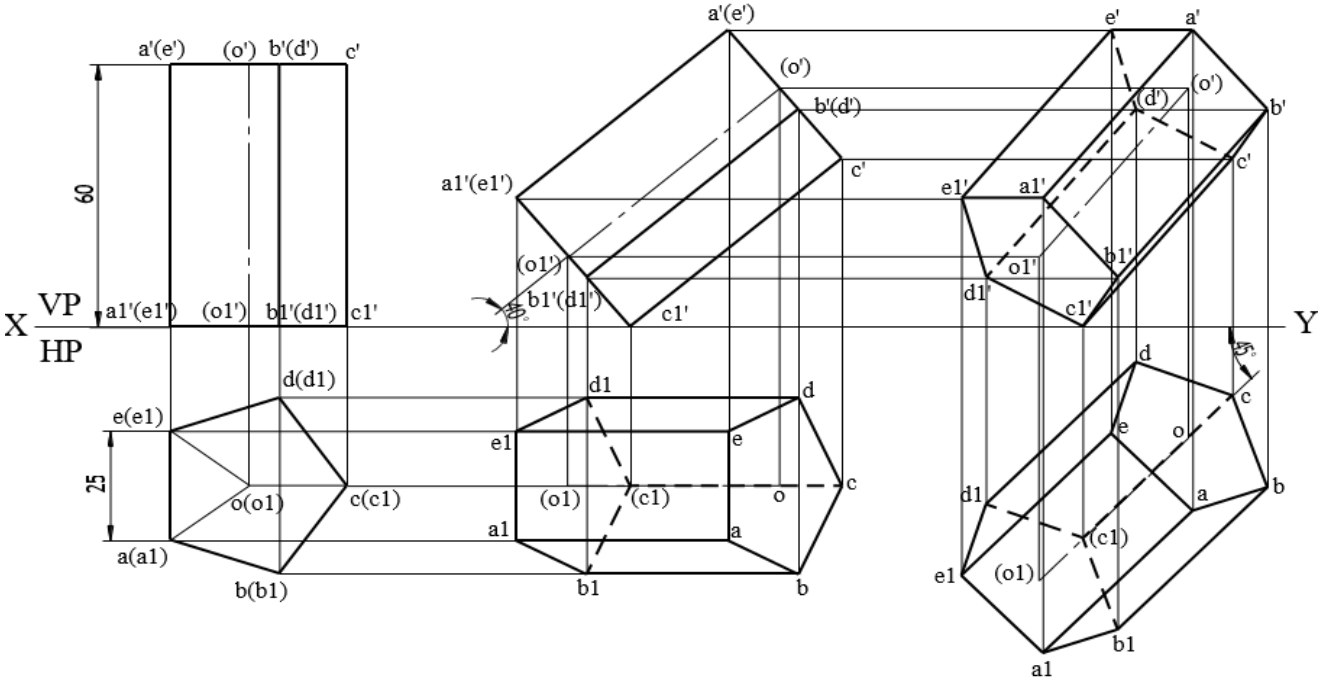


Q 4. A square prism 35mm sides of base and 60mm axis length rests on HP on one of its base corners. Draw the projection of the prism when the axis of the prism is inclined to HP at 40 degrees and to VP at 30 degrees.

Solution:

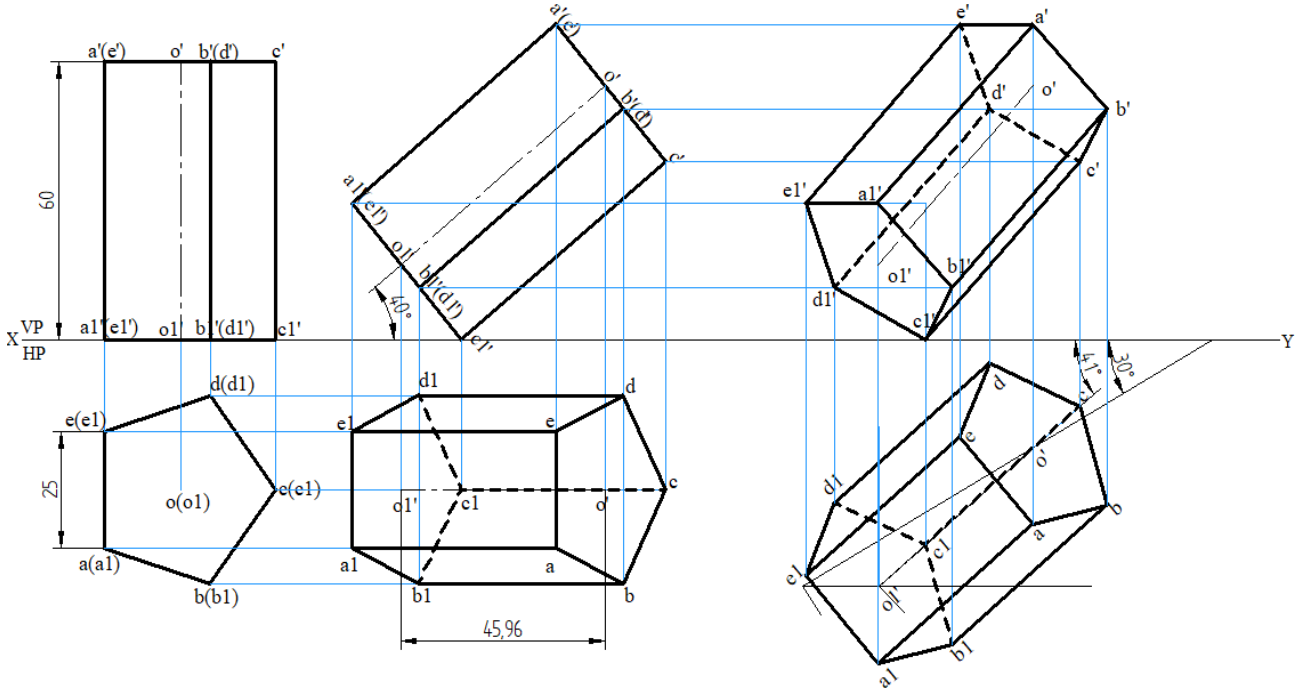


Q 5. A pentagonal prism 25mm sides of base and 60mm axis length rests on HP on one of its corner of the base such that the two base edges containing the corner on which it rests makes equal inclinations with HP. Draw the projections of the prism when the axis of the prism axis is inclined to HP at 40 degrees and appears to be inclined to VP at 45 degrees.

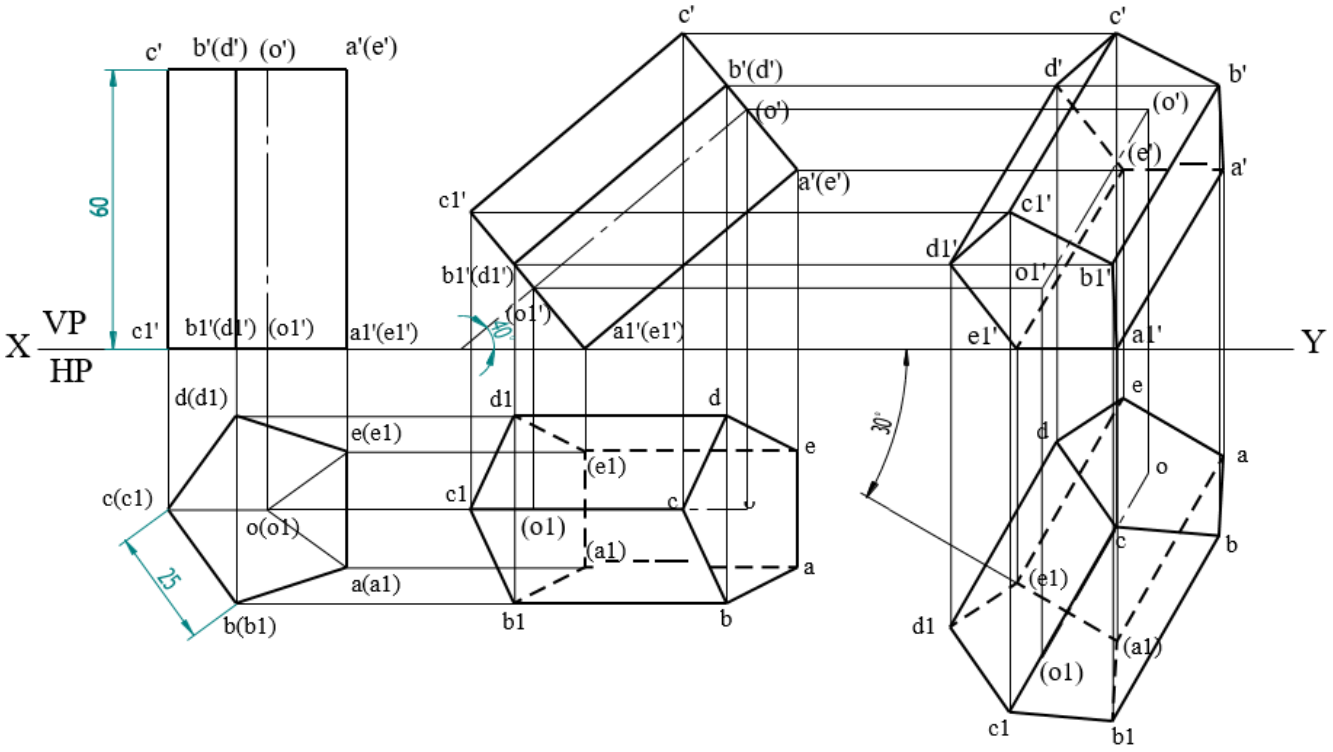


Q 6. A pentagonal prism 25mm sides of base and 60mm axis length rests on HP on one of its base corners. Draw the projection of the prism when the axis of the prism is inclined to HP at 40 degrees and to VP at 30degree.

Solution:

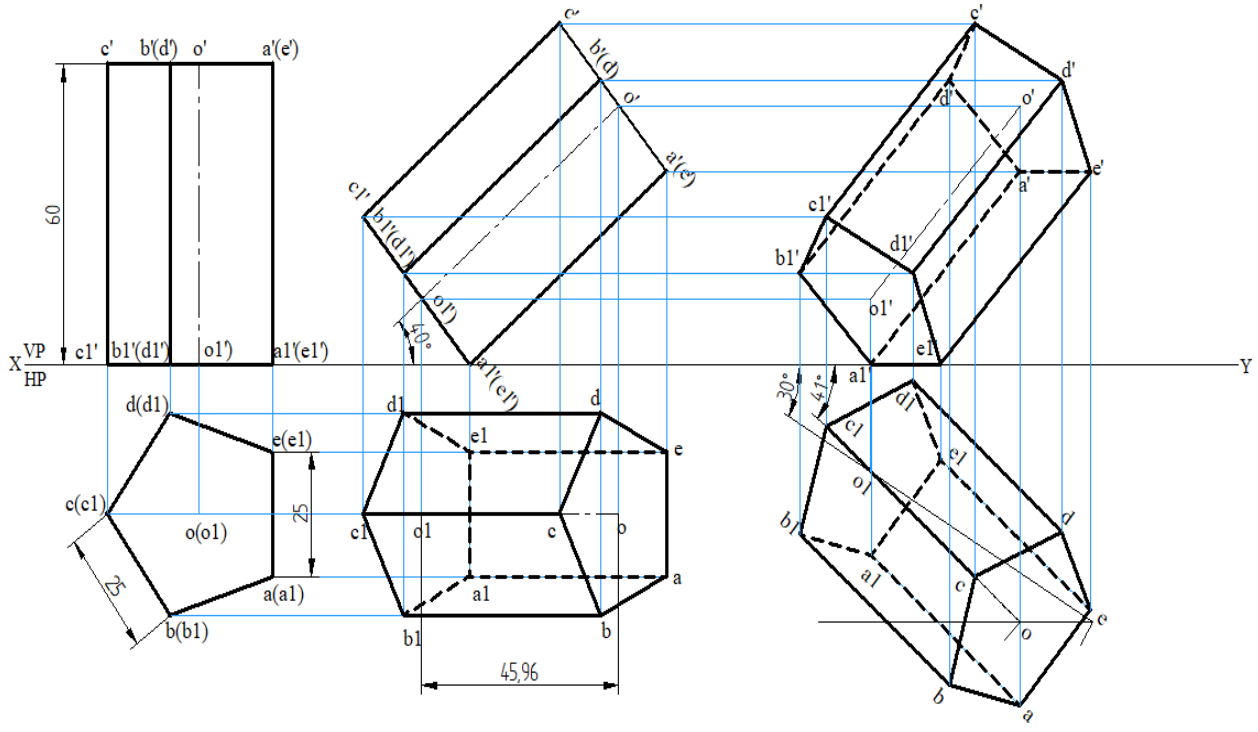


Q 7. A pentagonal prism 25mm sides of base and 60mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30 degrees. Draw the projections of the prism when the axis is inclined to HP at 40 degrees.

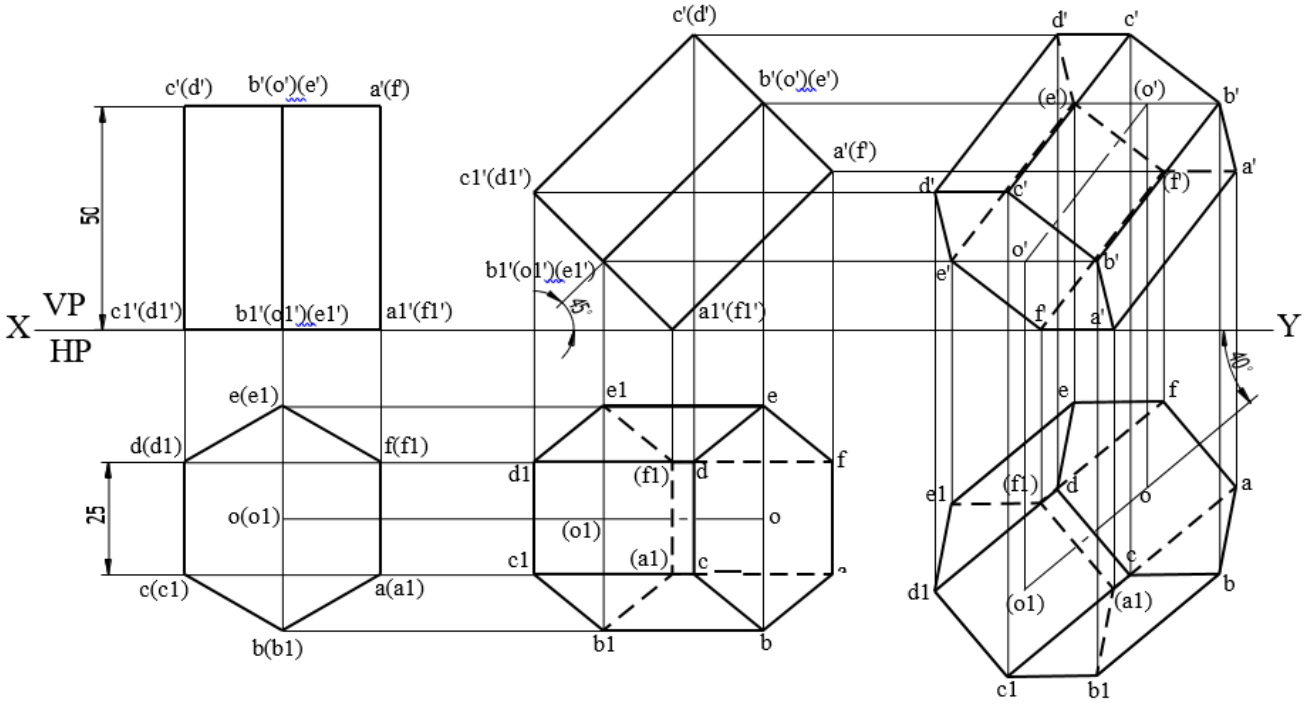


Q 8. A pentagonalprism25mm sides of base and 60mm axis length rests on HP on one of its edges of the base. Draw the projection of the prism when the axis is inclined to HP at 40 degree and VP at 30 degrees.

Solution:

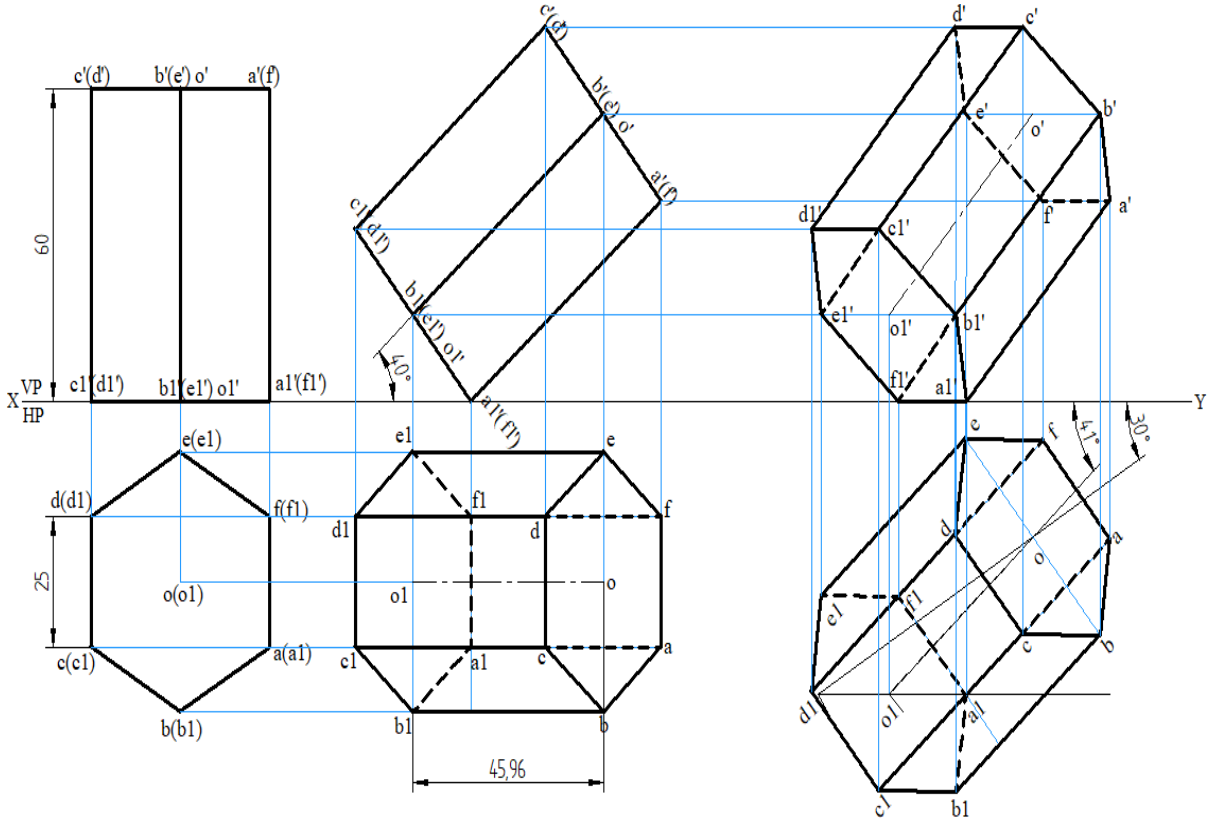


Q 9. A hexagonal prism 25mm sides of base and 50mm axis length rests on HP on one of its edges. Draw the projections of the prism when the axis is inclined to HP at 45 degrees and appears to be inclined to VP at 40 degrees.



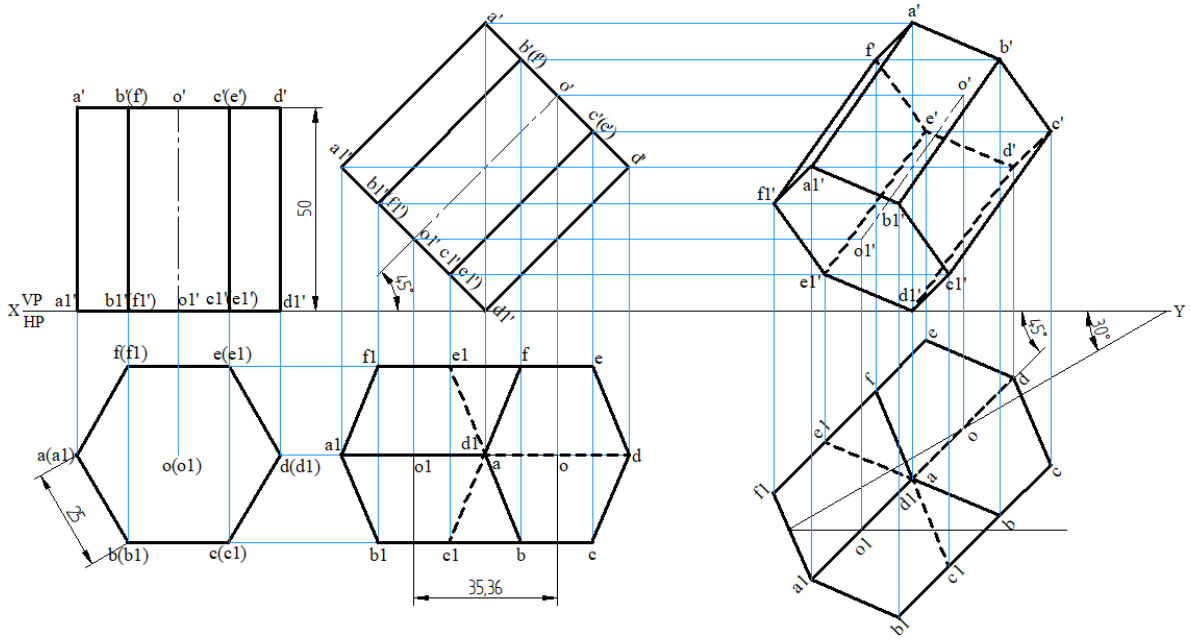
Q 10. A hexagonal prism 25mm sides of base and 60mm axis length rests on HP on one of its edges of the base. Draw the projection of the prism when the axis is inclined to HP at 40 degrees and to VP at 30 degree.

Solution:

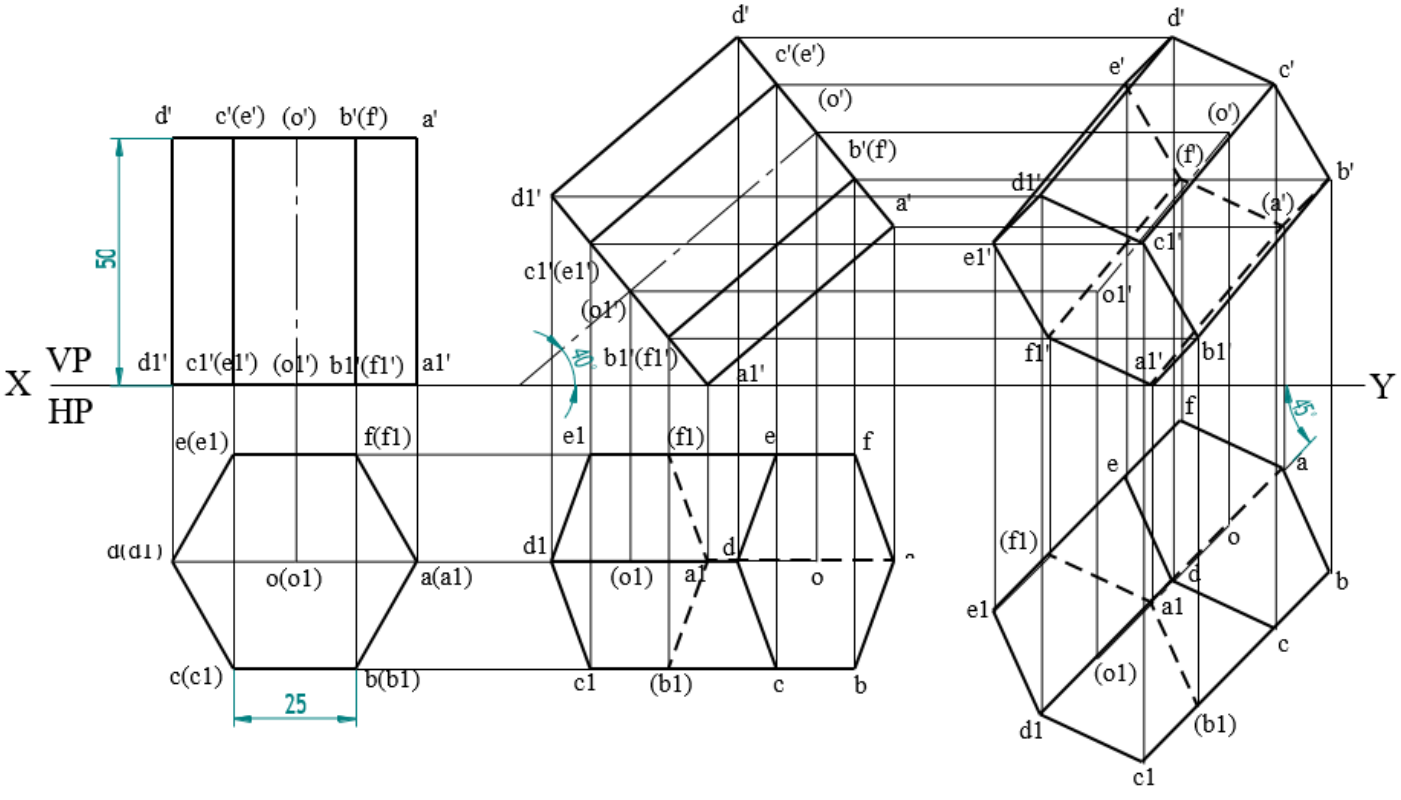


Q 11. A hexagonal prism 25mm sides of base and 50mm axis length rests on HP on one of its base corners. Draw the projection of the prism when the axis of the prism is inclined to HP at 45 degrees and to VP at 30degree.

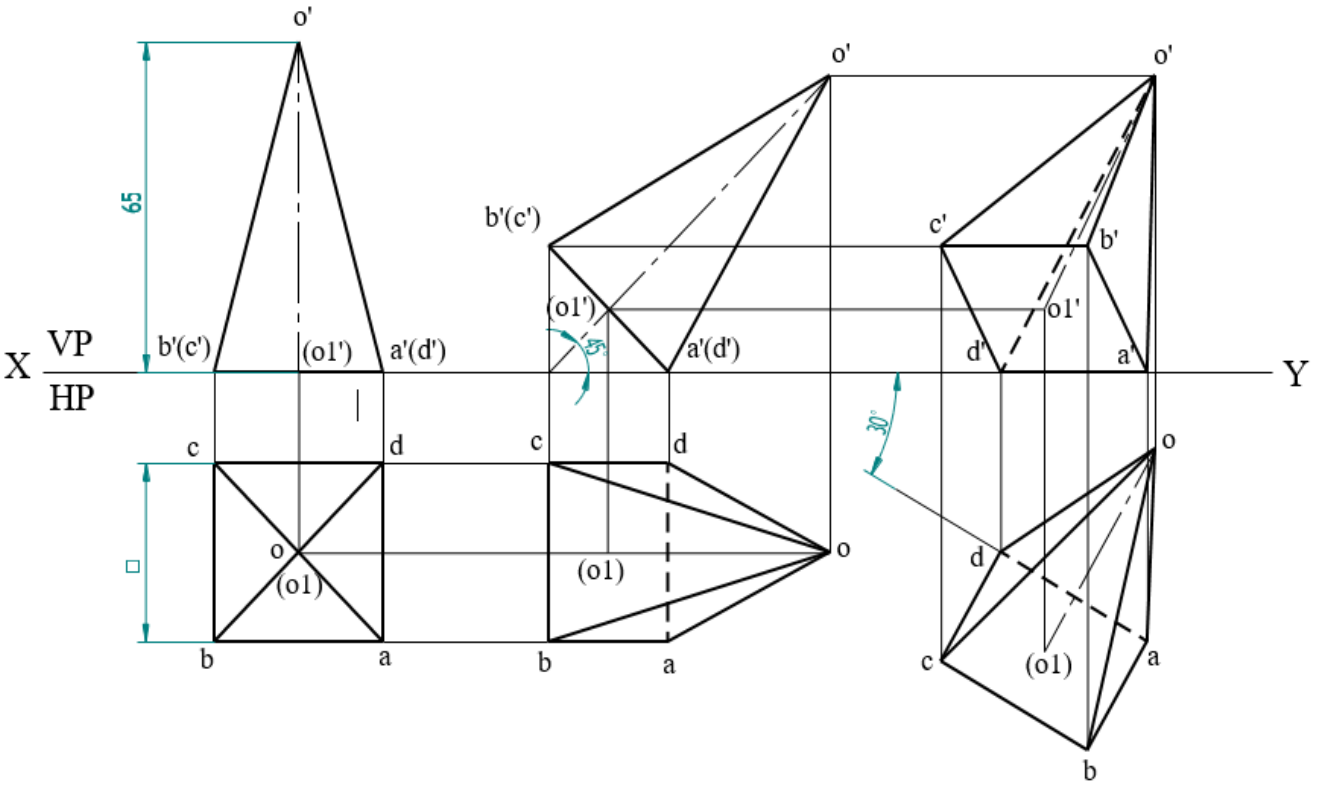
Solution:



Q 12. A hexagonal prism 25mm sides of base and 50mm axis length rests on HP on one of its corner of the base such that the two base edges containing the corner on which it rests makes equal inclinations with HP. Draw the projections of the prism when the axis of the prism axis is inclined to HP at 40 degrees and appears to be inclined to VP at 45 degrees.

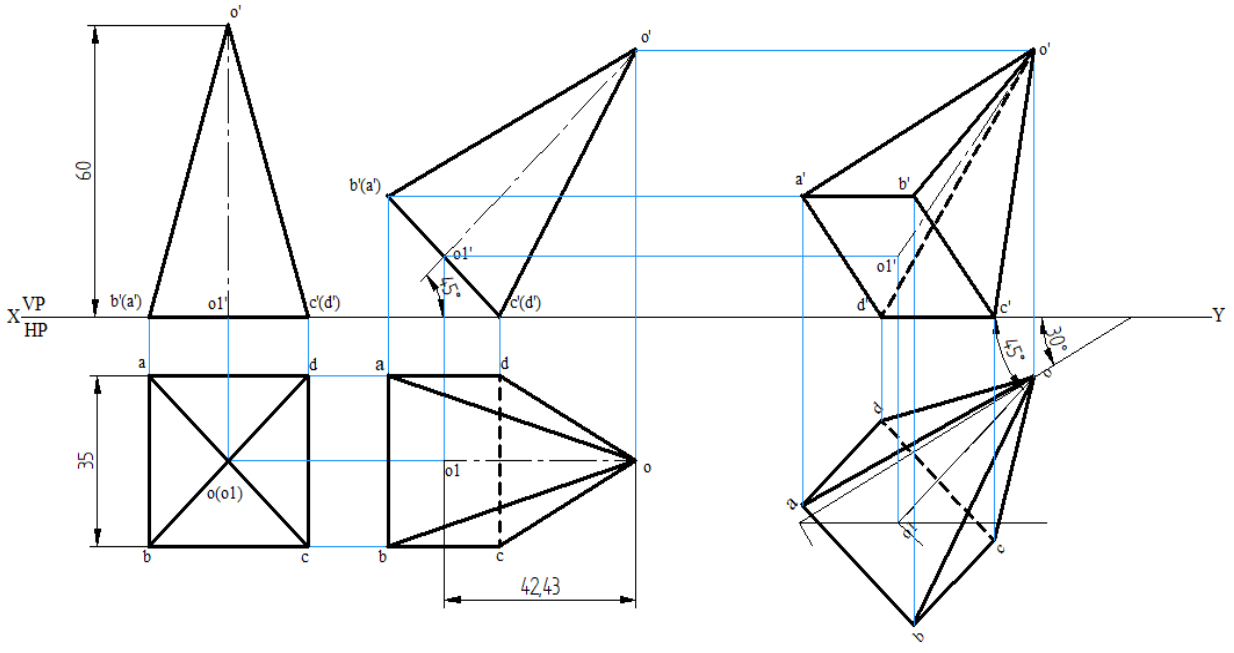


Q 13. A square pyramid 35mm sides of base and 65mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30 degrees. Draw the projections of the pyramid when the axis is inclined to HP at 45 degrees.

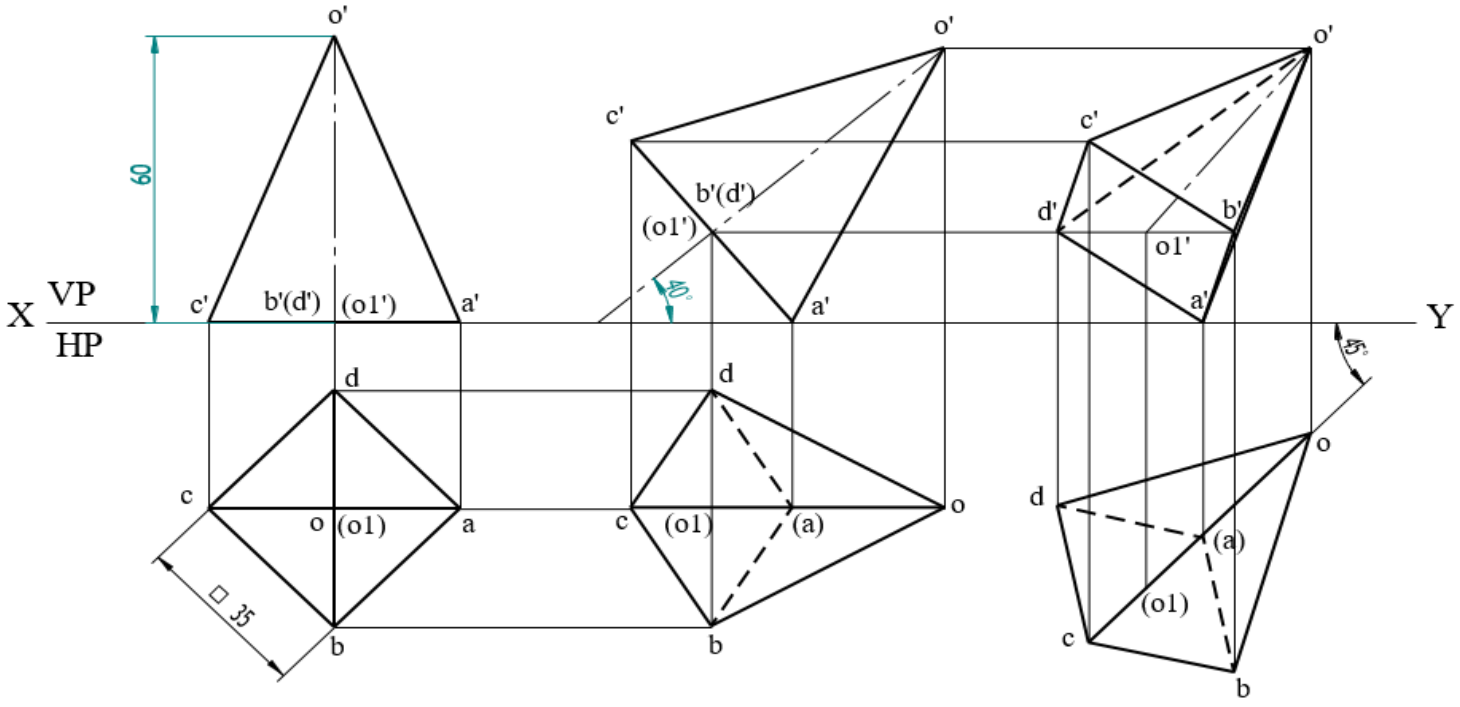


Q 14. A square pyramid 35mm sides of base and 60mm axis length rests on HP on one of its edges of the base. Draw the projection of the pyramid when the axis is inclined to HP at 45 degree and to VP at 30 degrees.

Solution:

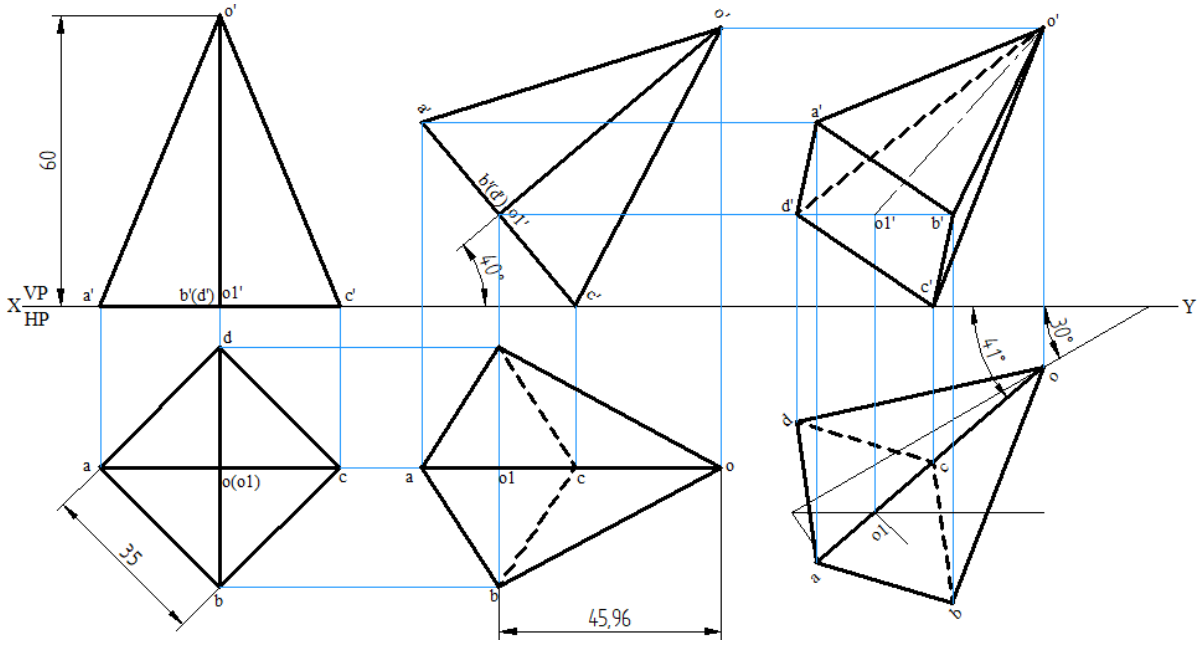


Q 15. A square pyramid 35mm sides of base and 60mm axis length rests on HP on one of its corner of the base such that the two base edges containing the corner on which it rests makes equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40 degrees and appears to be inclined to VP at 45 degrees.

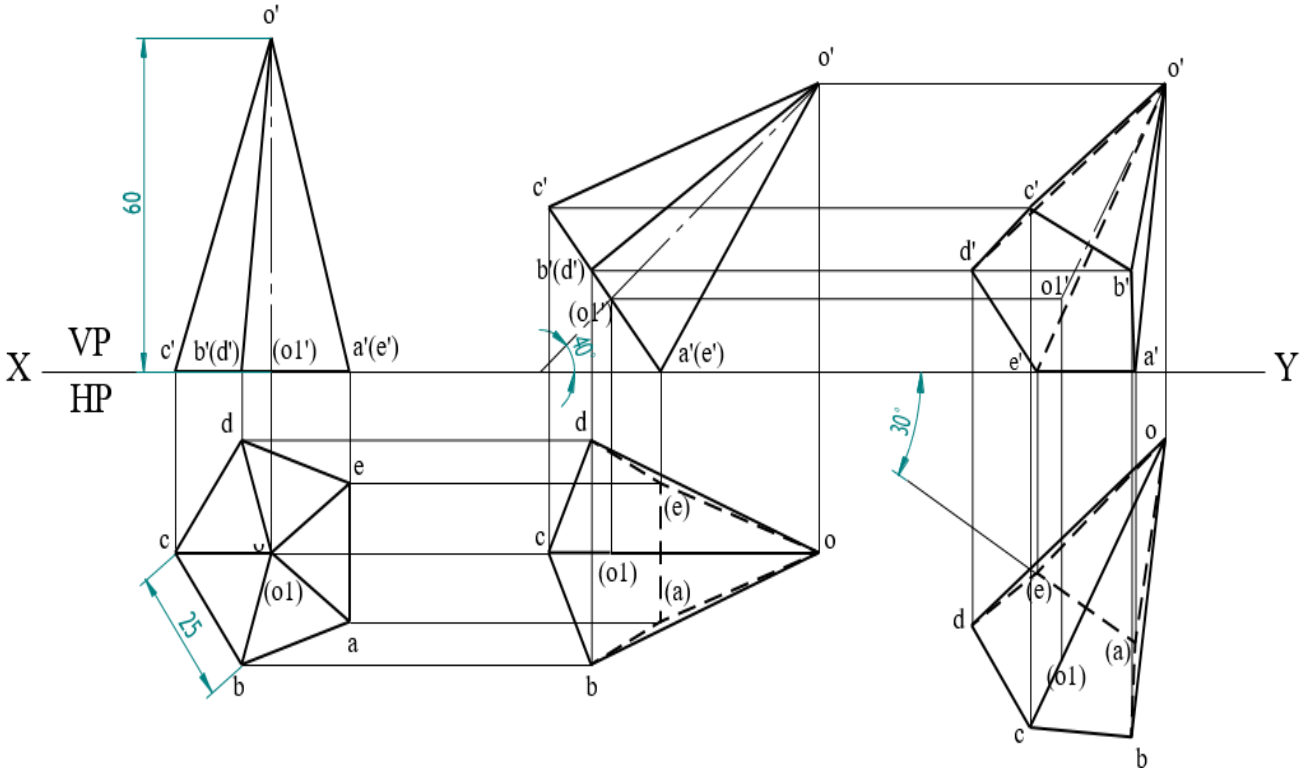


Q16. A square pyramid 35mm sides of base and 60mm axis length rests on HP on one of its corners of the base. Draw the projection of the pyramid when the axis of the pyramid is inclined to HP at 40degree and to VP at 30degree.

Solution:

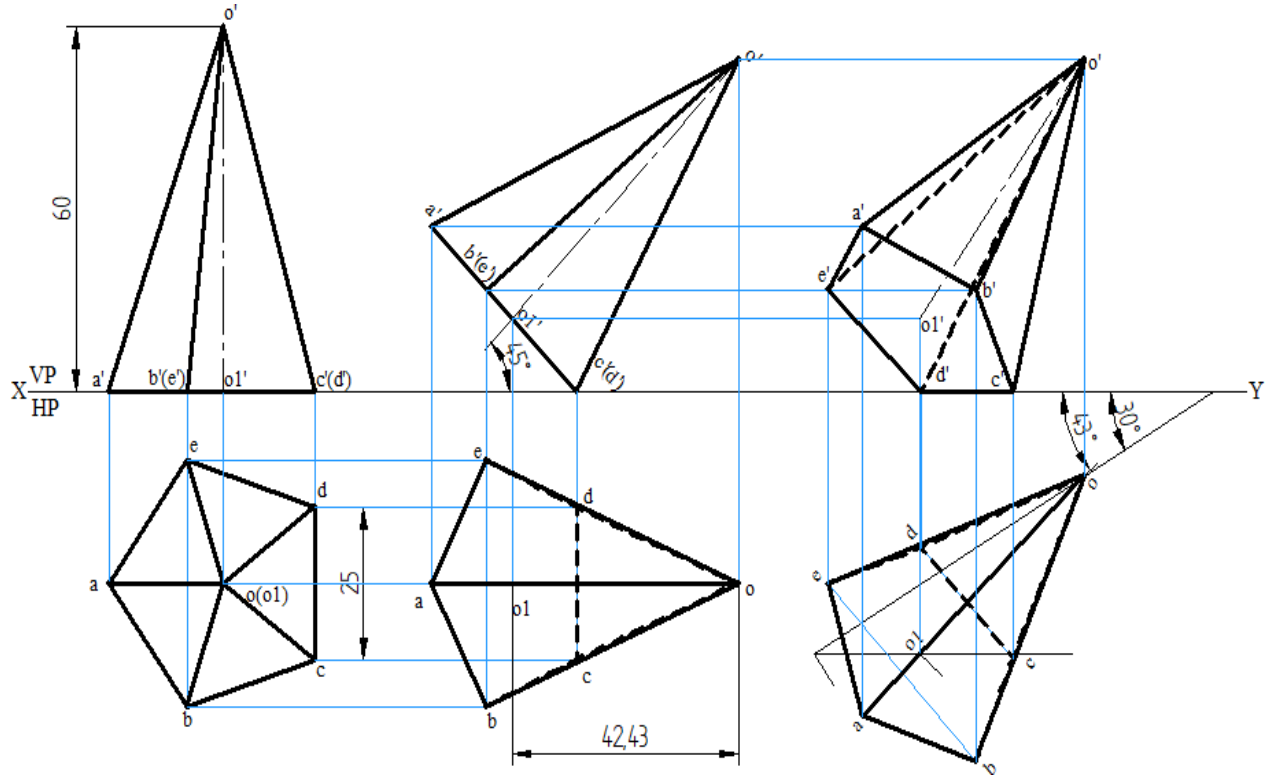


Q 17. A pentagonal pyramid 25mm sides of base and 60 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30 degrees. Draw the projections of the pyramid when the axis is inclined to HP at 40 degree

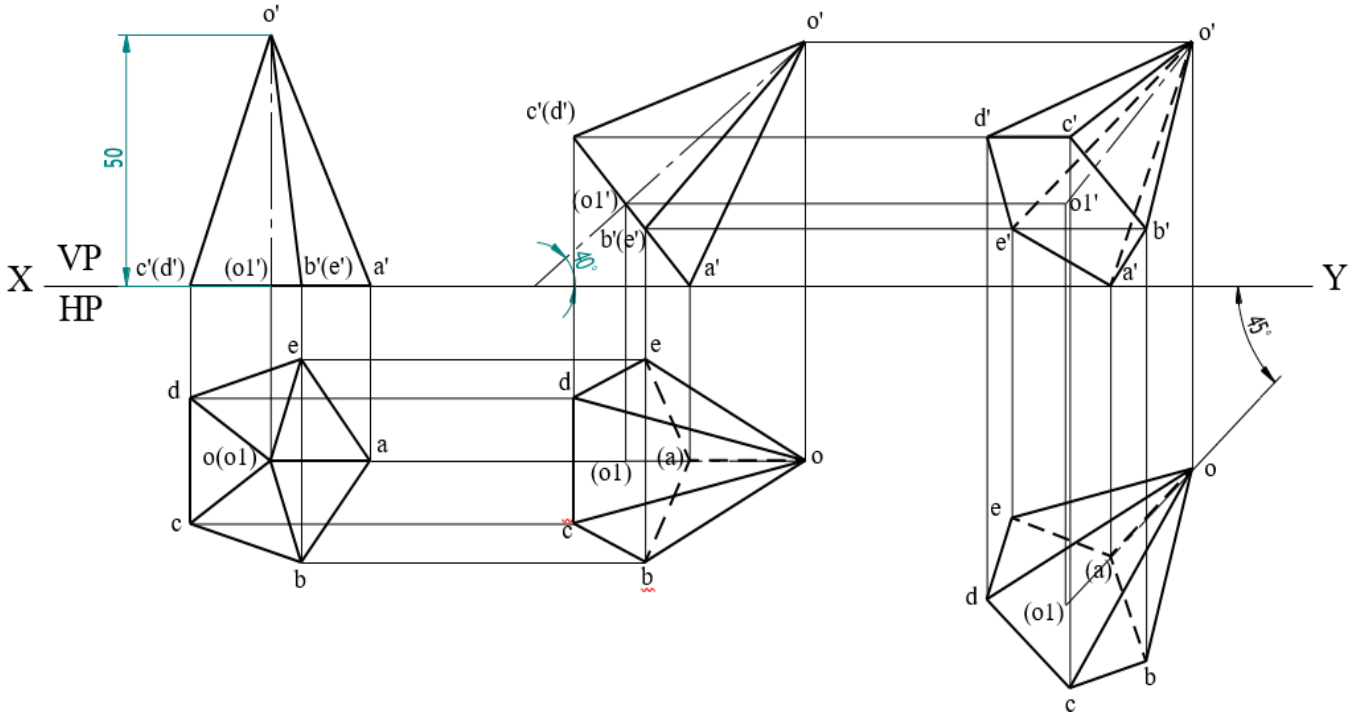


Q 18. A pentagonal pyramid 25mm sides of base and 60mm axis length rests on HP on one of its edges of the base. Draw the projection of the pyramid when the axis is inclined to HP at 45degree and to VP at 30degree.

Solution:

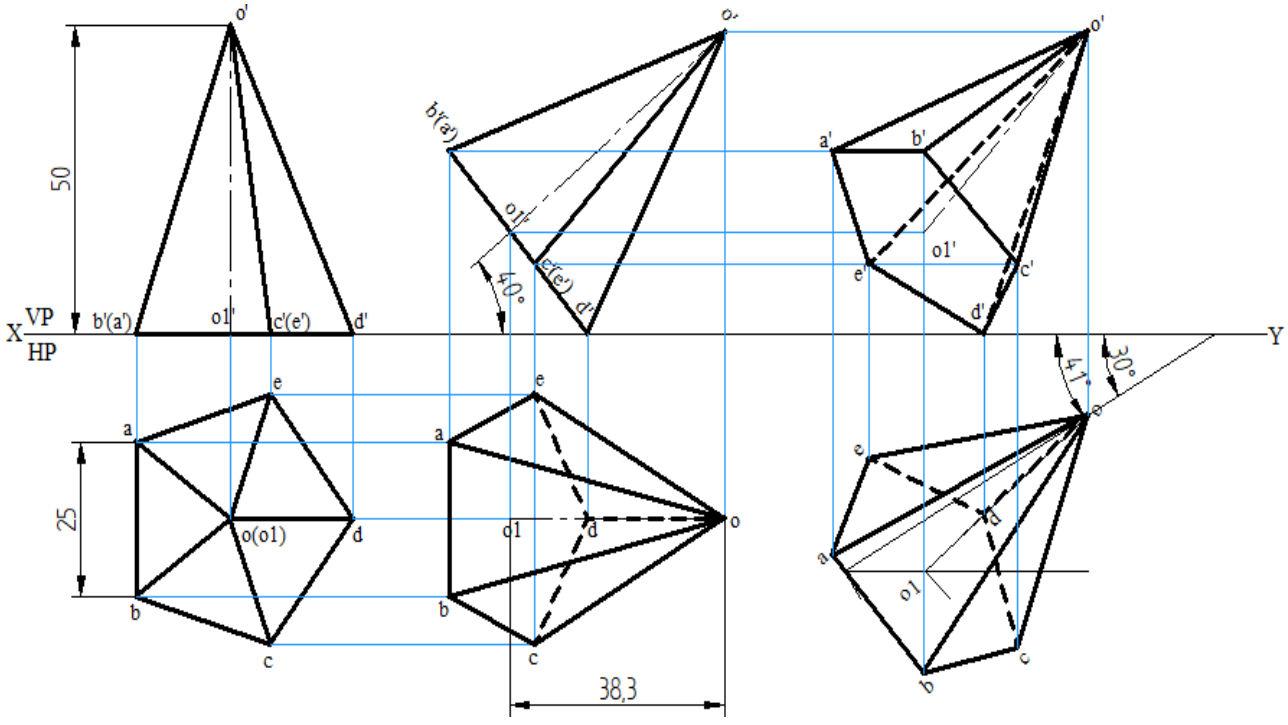


Q 19. A pentagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its corner of the base such that the two base edges containing the corner on which it rests makes equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40 degrees and appears to be inclined to VP at 45 degrees.



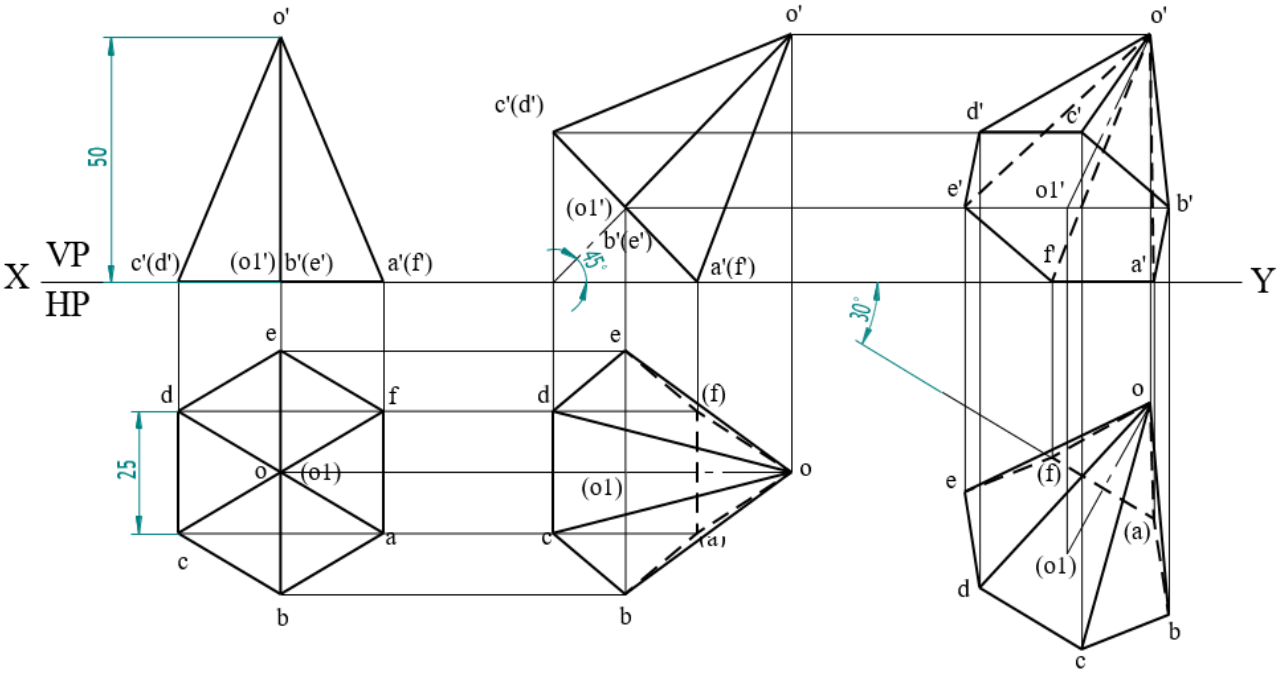
Q 20. A pentagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its corners of the base. Draw the projection of the pyramid when the axis of the pyramid is inclined to HP at 40degree and to VP at 30degree.

Solution:

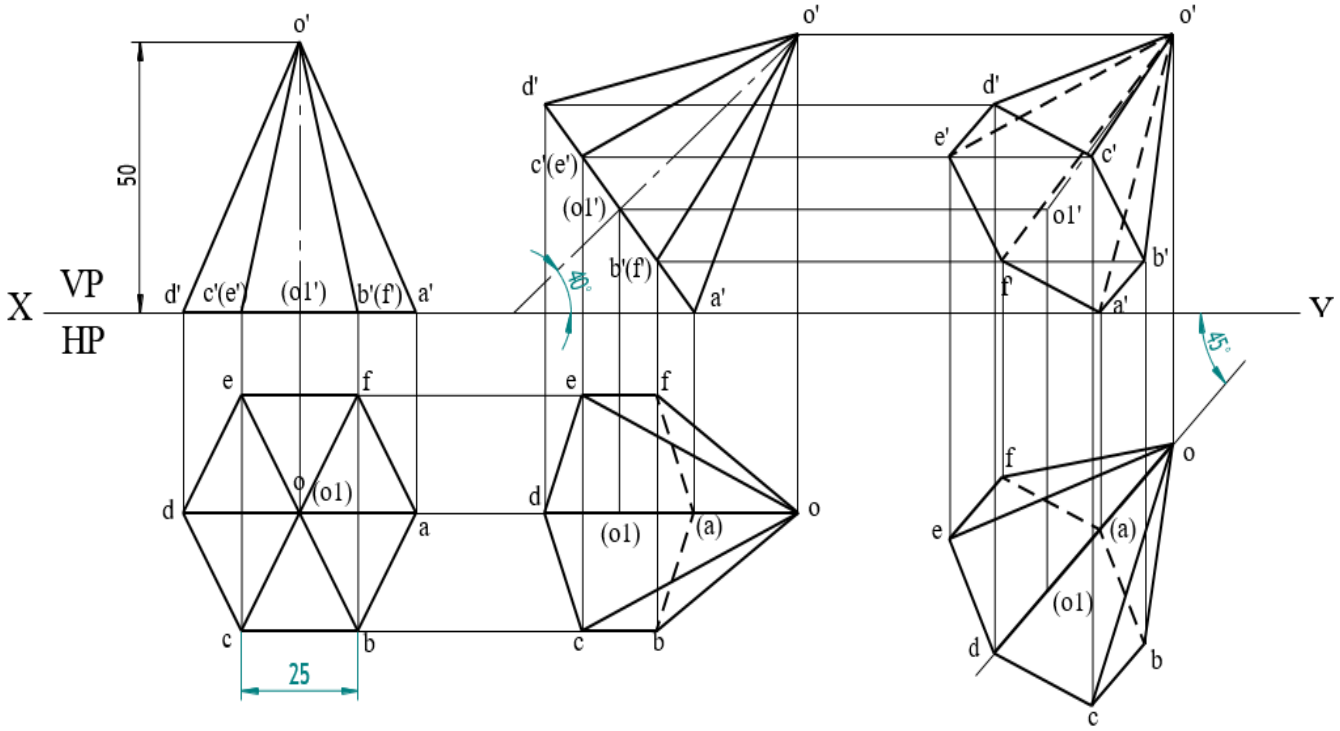


Q 21. A hexagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30 degrees. Draw the projections of the pyramid when the axis is inclined to HP at 45 degrees.

Solution:

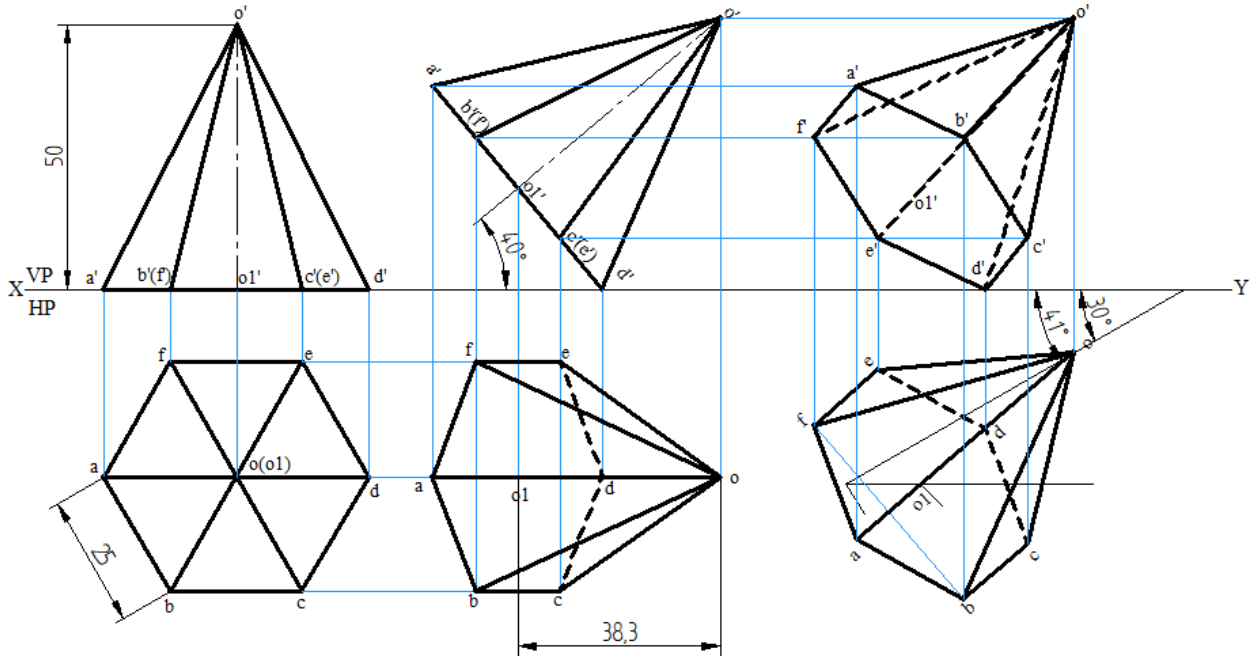


Q 23. A hexagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its corner of the base such that the two base edges containing the corner on which it rests makes equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40 degrees and appears to be inclined to VP at 45 degrees.



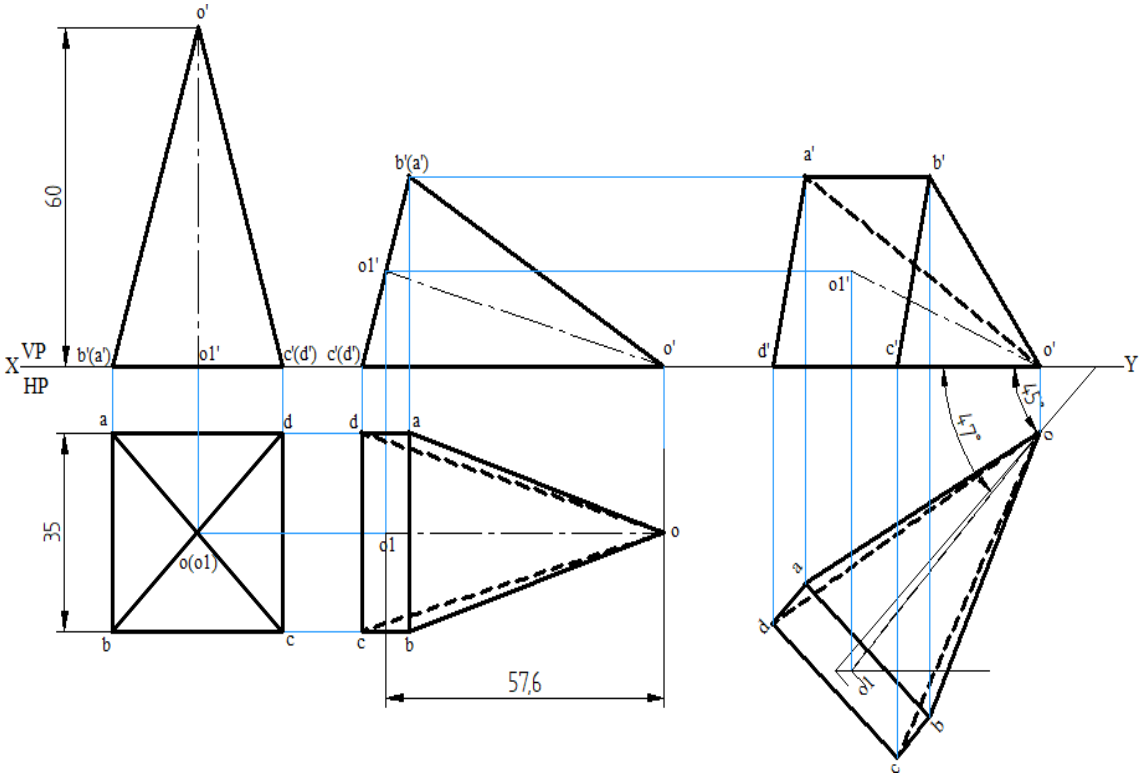
Q 24. A hexagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its corners of the base. Draw the projection of the pyramid when the axis of the pyramid is inclined to HP at 40degree and to VP at 30 degrees.

Solution:



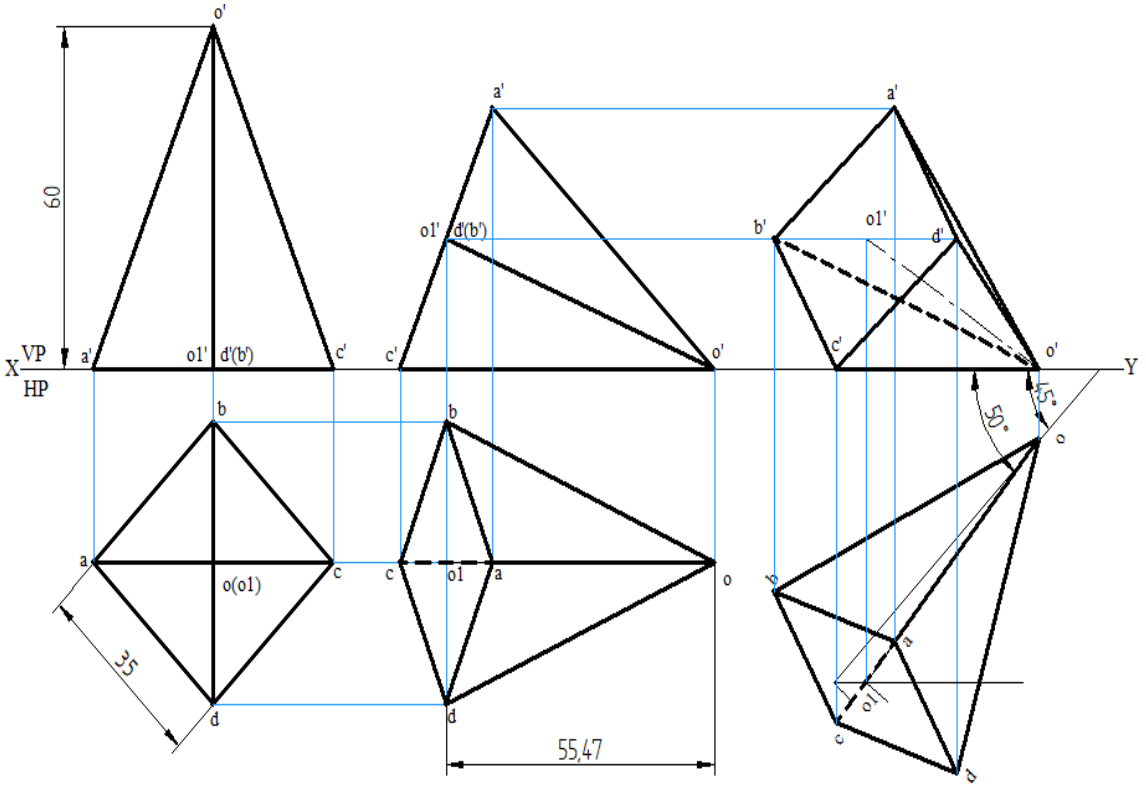
Q 25. A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its slant triangular faces. Draw the projection of the pyramid when the axis is inclined to VP at 45 degrees.

Solution:



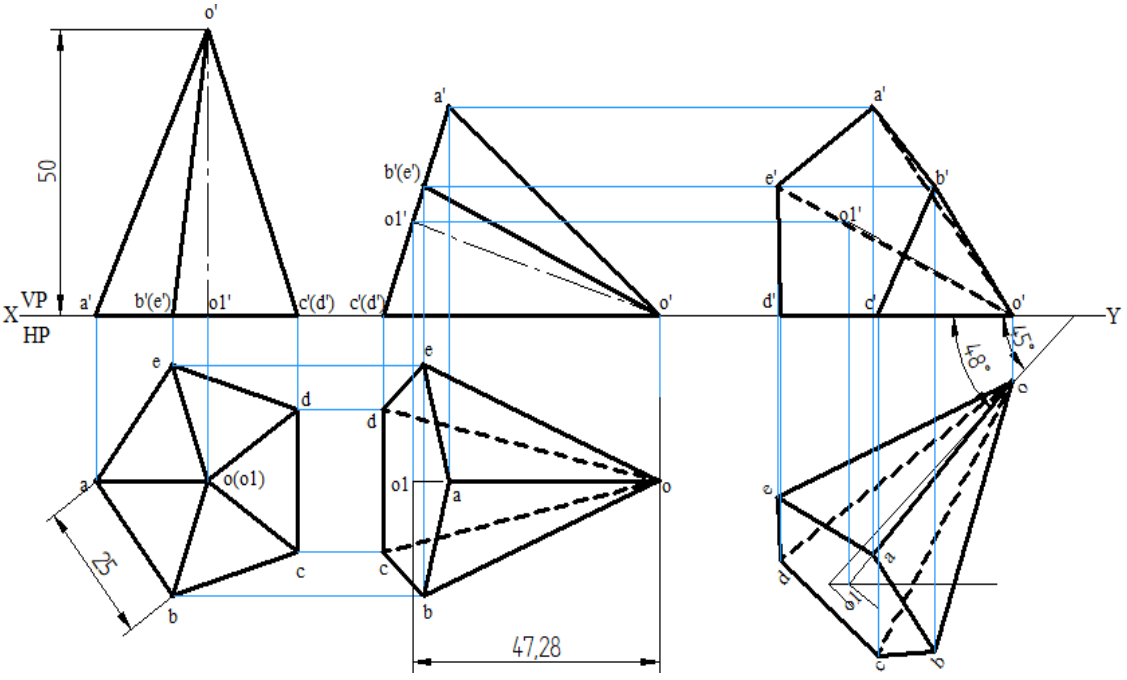
Q 26. A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its slant edge. Draw the projection of the pyramid when the axis is inclined to VP at 45 degrees.

Solution:



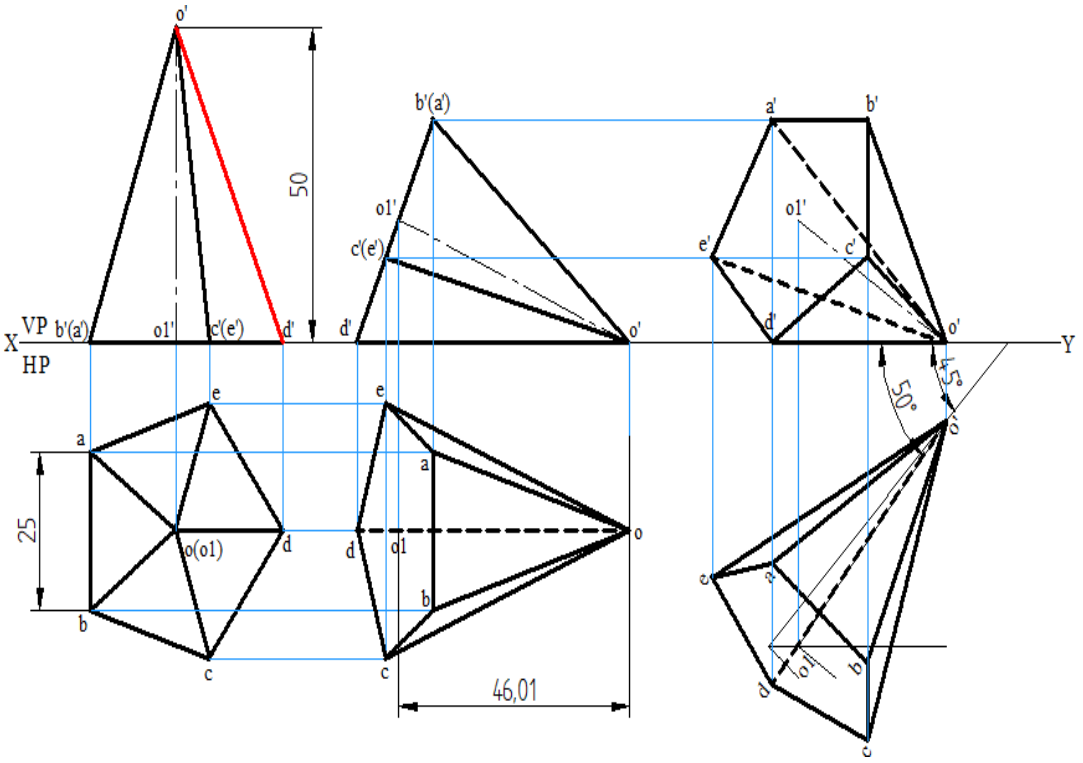
Q 27. A pentagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its slant triangular face. Draw the projection of the pyramid when the axis is inclined to VP at 45 degrees.

Solution:



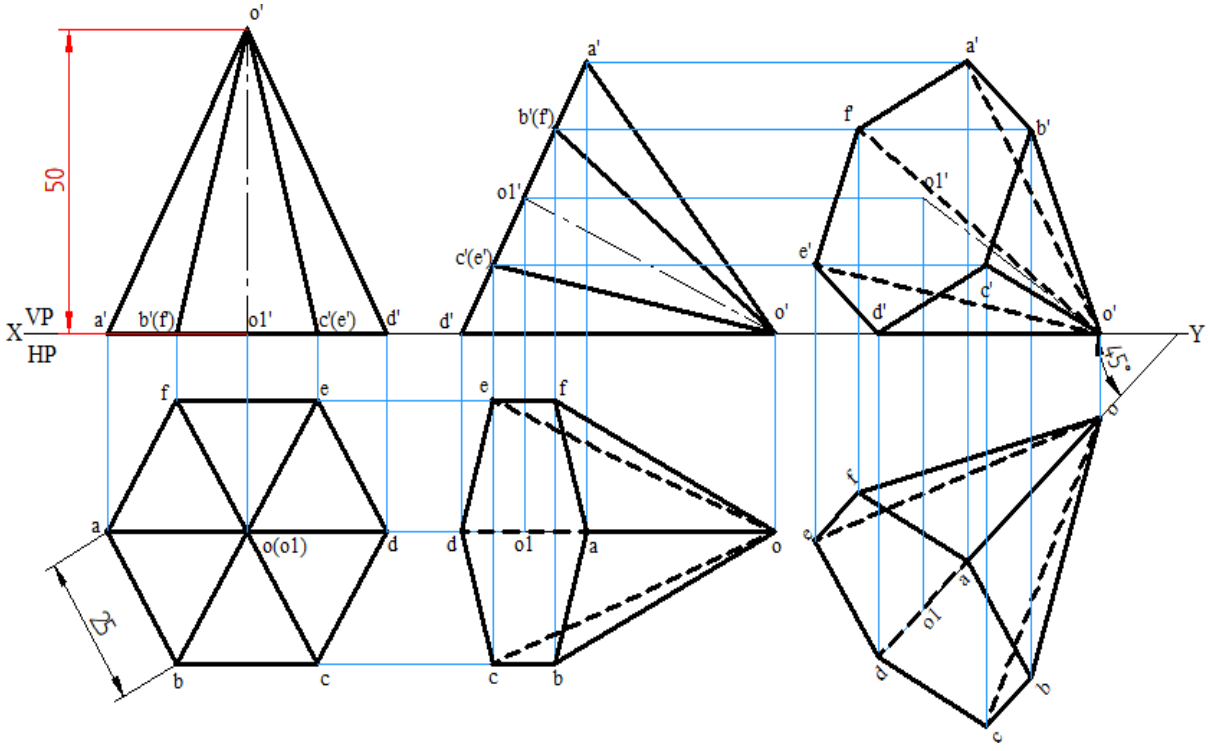
Q 28. A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant edges. Draw the projection of the pyramid when the axis is inclined to VP at 45 degrees.

Solution:



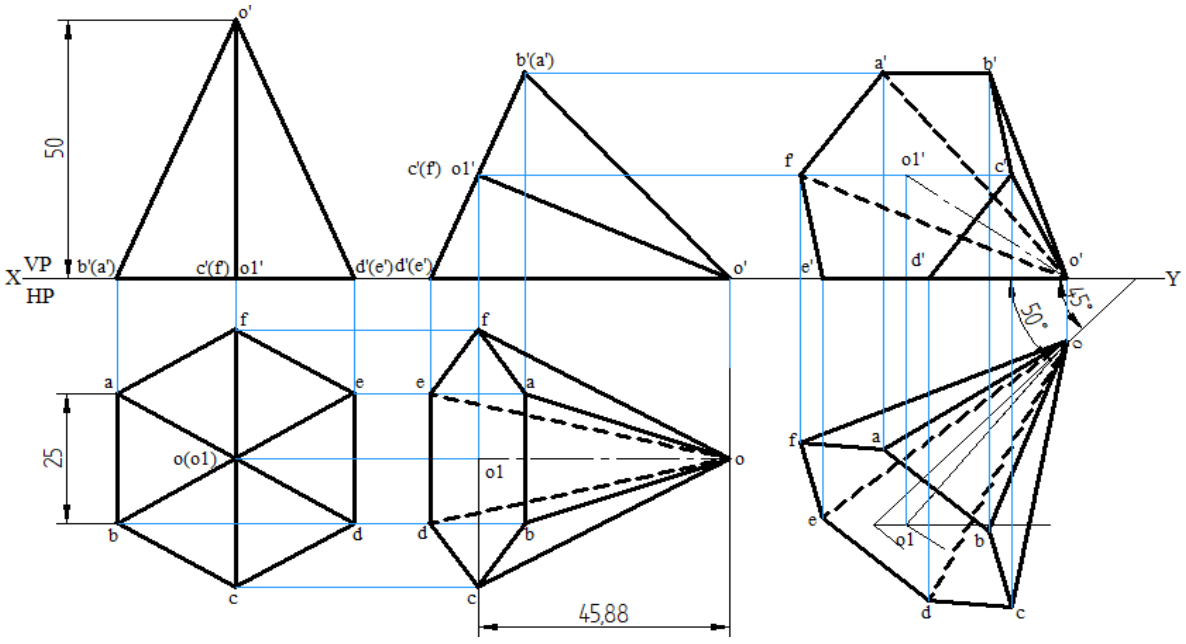
Q 29.A hexagonal pyramid 25mm sides of base and 50mmaxis length rests on HP on one of its slant edges. Draw the projection of the pyramid when the axis appears to be inclined to VP at 45 degrees.

Solution:



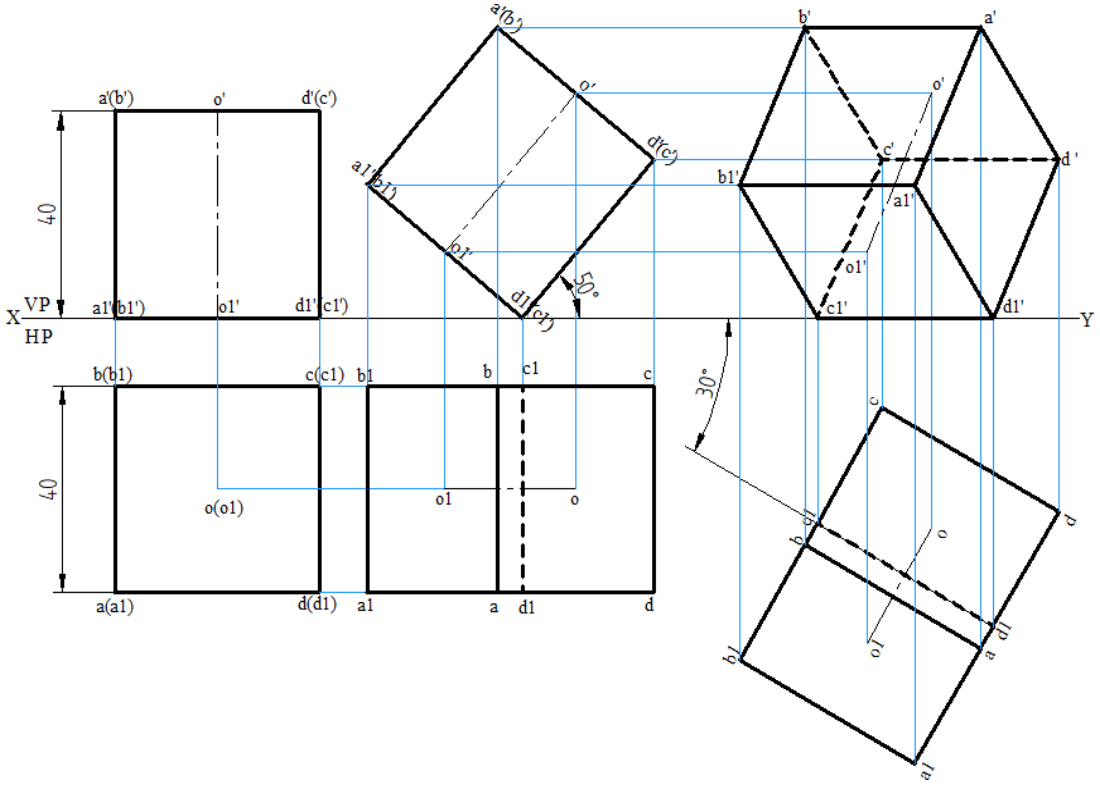
Q 30. A hexagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its slant triangular faces. Draw the projection of the pyramid when the axis is inclined to VP at 45 degrees.

Solution:



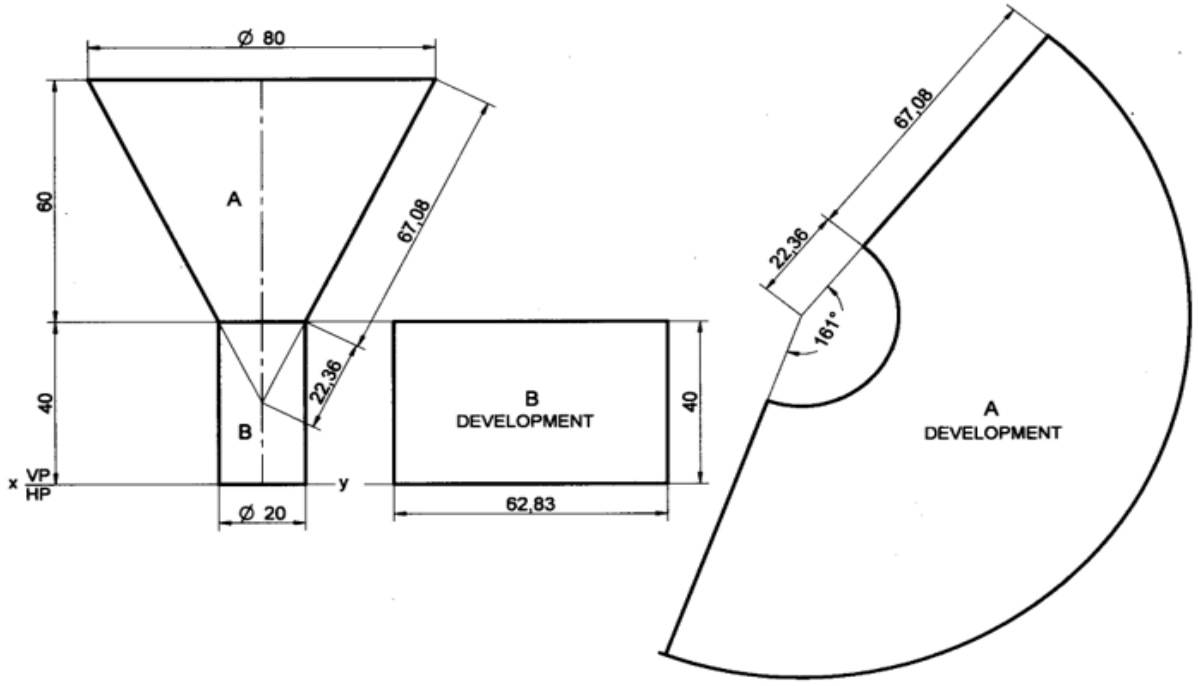
Q 31. A cube of 40mm sides rests on HP on an edge which is inclined to VP at 30 degrees. Draw the projection when the lateral square face containing the edge on which it rests makes an angle of 50 degrees to HP.

Solution:

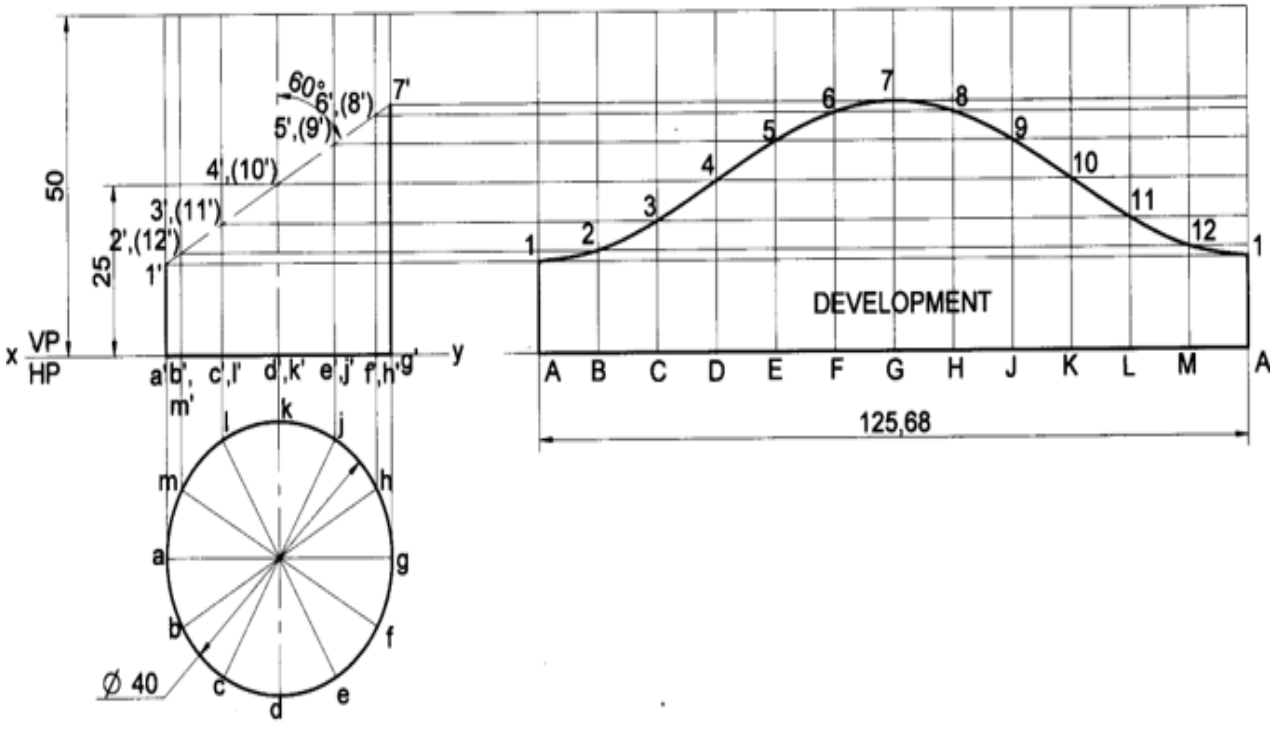


Module-4
Development of Lateral Surfaces of solid

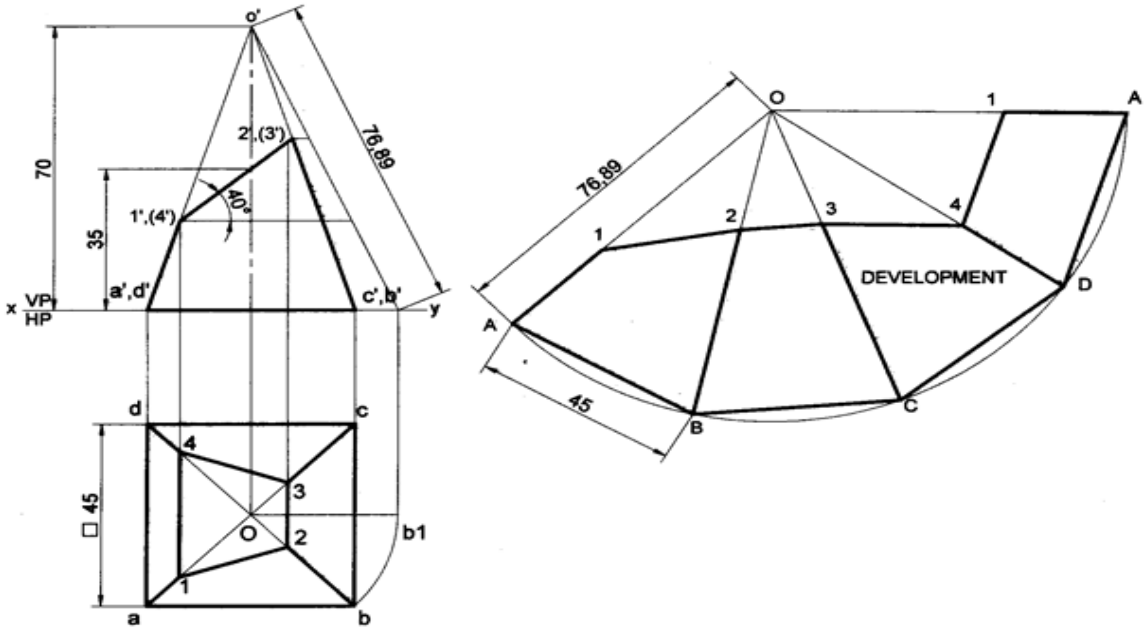
Q1. Draw the development of the lateral surface of a funnel consisting of a cylinder and a frustum of a cone. The diameter of the cylinder is 20mm and top face diameter of the funnel is 80mm. The height of frustum and cylinder are equal to 60mm and 40mm respectively



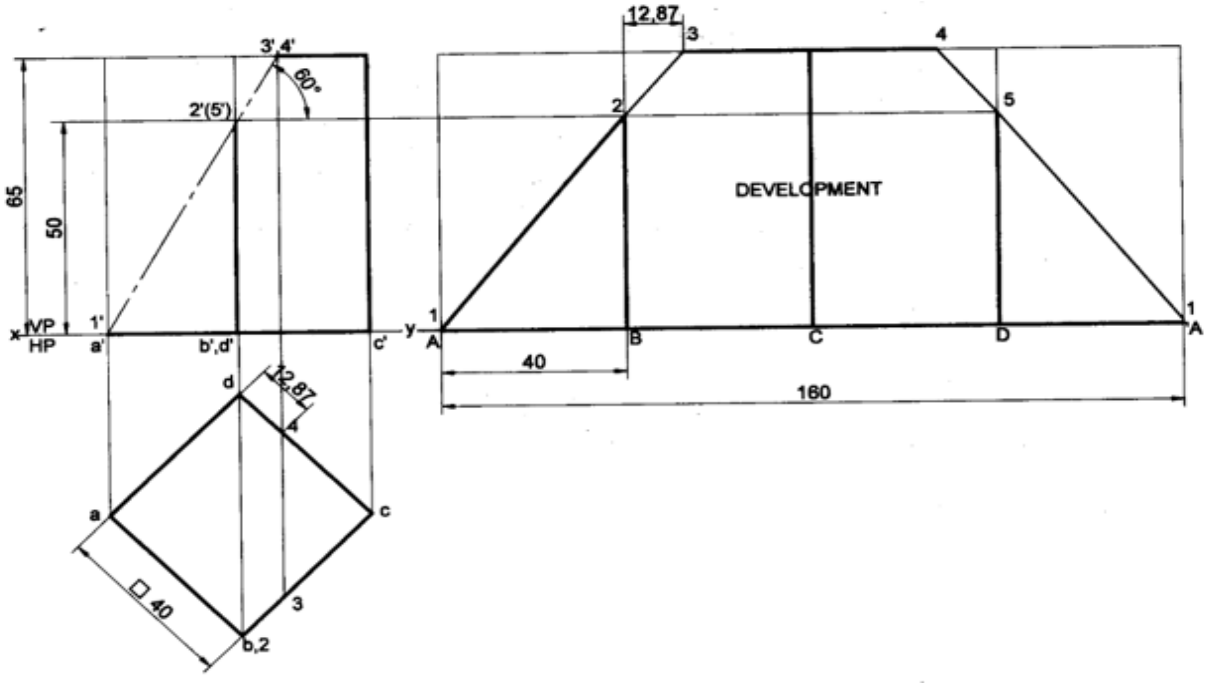
Q2. Draw the development of the lateral surface of a truncated vertical cylinder, 40mm diameter of base and height 50mm, the truncated flat surface of the cylinder bisects the axis at 60° to it.



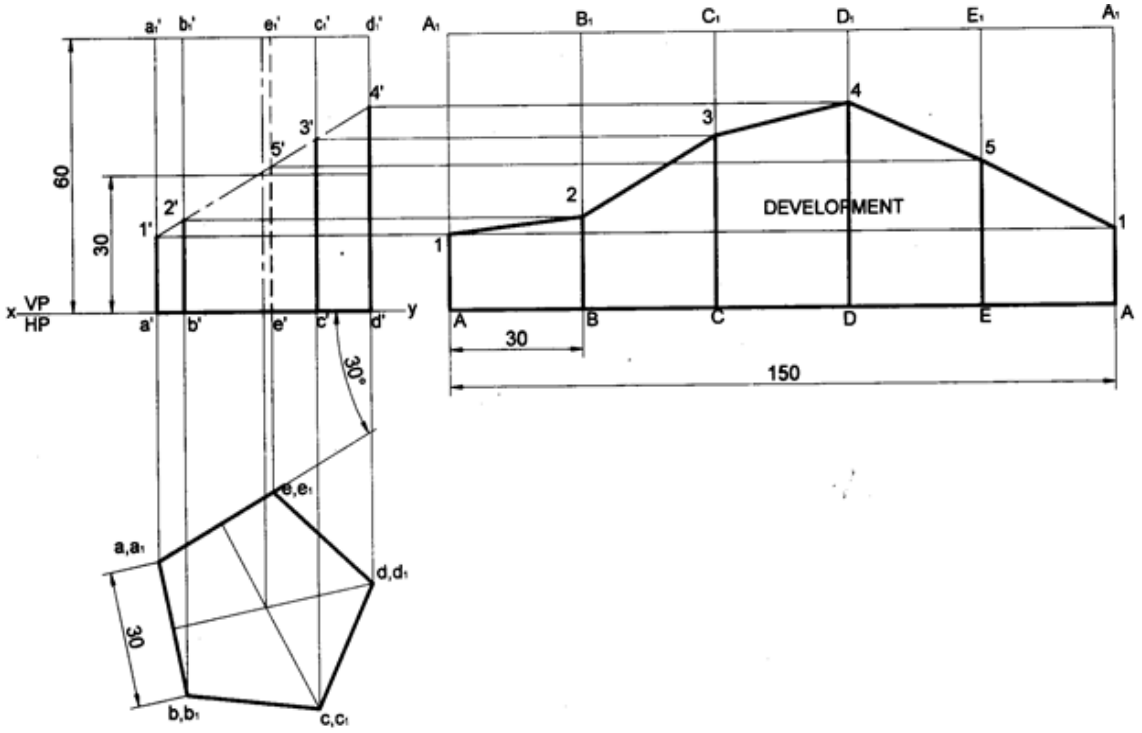
Q 3. A square pyramid of side of base 45mm, altitude 70mm is resting with its base on HP with two sides of the base parallel to VP. The pyramid is cut by a section plane which is perpendicular to the VP and inclined at 40° to the HP. The cutting plane bisects the axis of the pyramid. Obtain the development of the lateral surfaces the truncated pyramid.



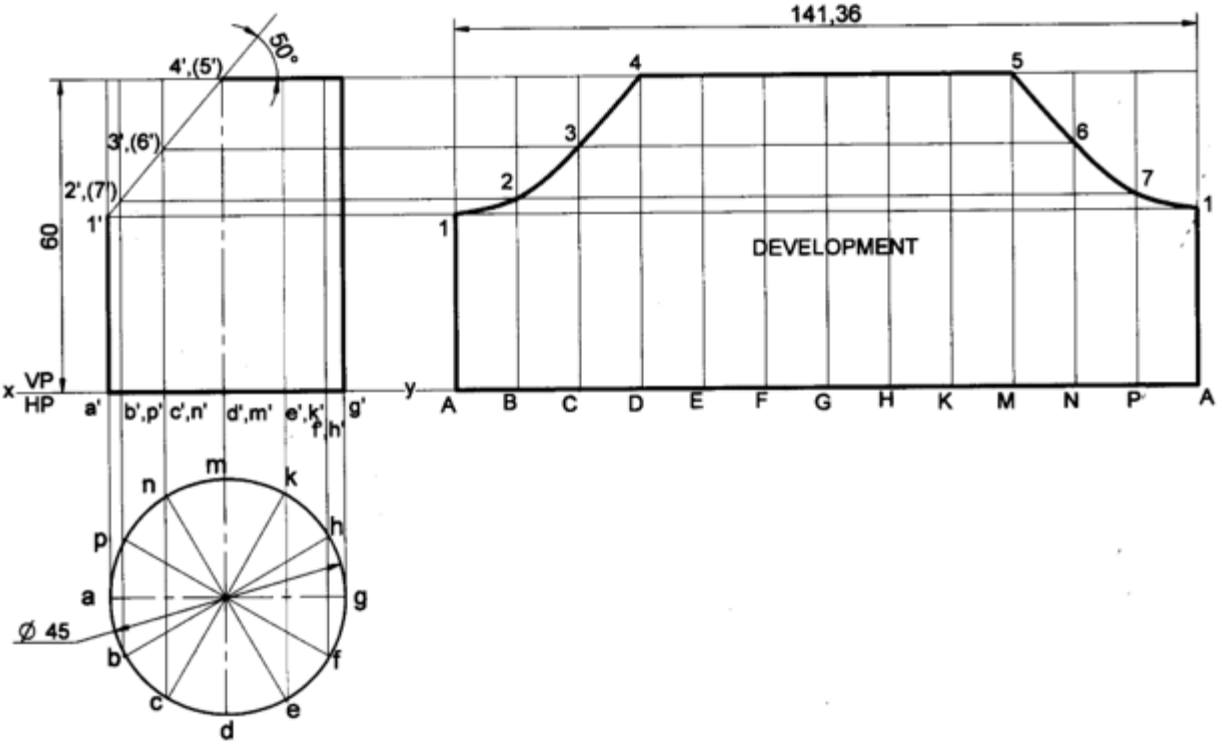
Q4. A square prism of base side 40mm and axis length 65mm is resting on HP on its base with all the vertical faces being equally inclined to VP. It is cut by an inclined plane 60° to HP and perpendicular to VP and is passing through a point on the axis at a distance 15mm from the top face. Draw the development of the lower portion of the prism.



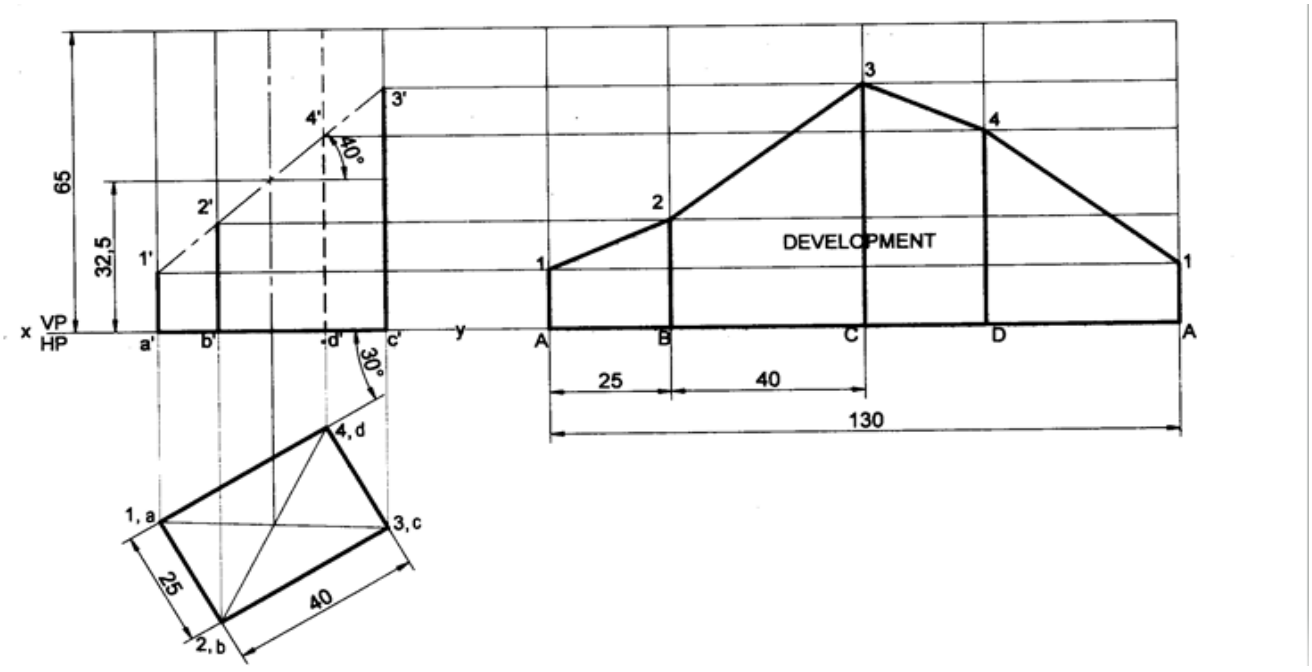
Q 5. A regular pentagonal prism of height 60mm and base edge 30mm rests with its base on HP. The vertical face closest to VP is 30° to it. Draw the development of the truncated prism with its truncated surface inclined at 60° to its axis and bisecting it.



Q 6. A vertical cylinder of base diameter 45mm and axis length 60mm is cut by a plane perpendicular to VP and inclined at 50° to HP, is passing through the center point of the top face. Draw the development of the lateral surface of the cylinder.

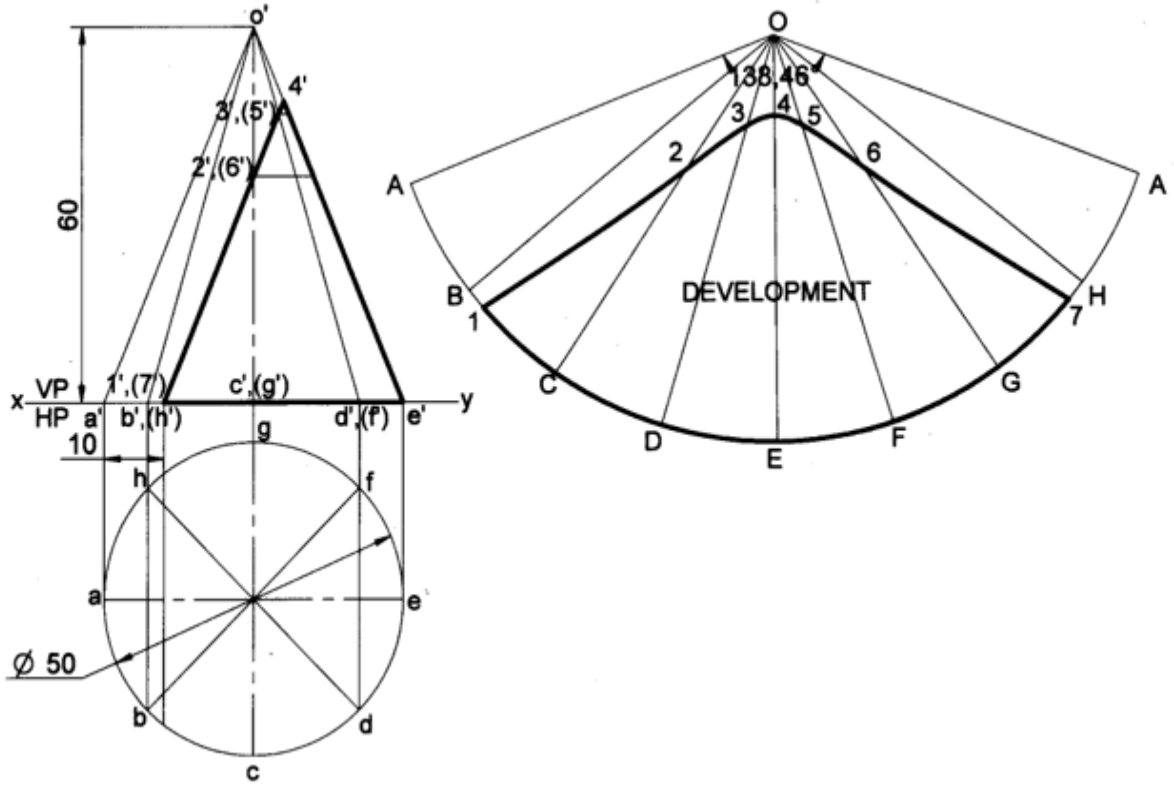


Q7. A rectangular prism of base 40mm x 25mm and height 65mm rests on HP on its base with the longer base side inclined at 30° to VP. It is cut by a plane inclined at 40° to HP, perpendicular to VP cuts the axis at its mid height. Draw the development of the remaining portion of the prism.



Q 8. A cone of base diameter 50mm and height 60mm is resting with its base on HP. It is cut, as shown in the following front view of which is as shown in figure. Draw the development of the lateral surface of it.

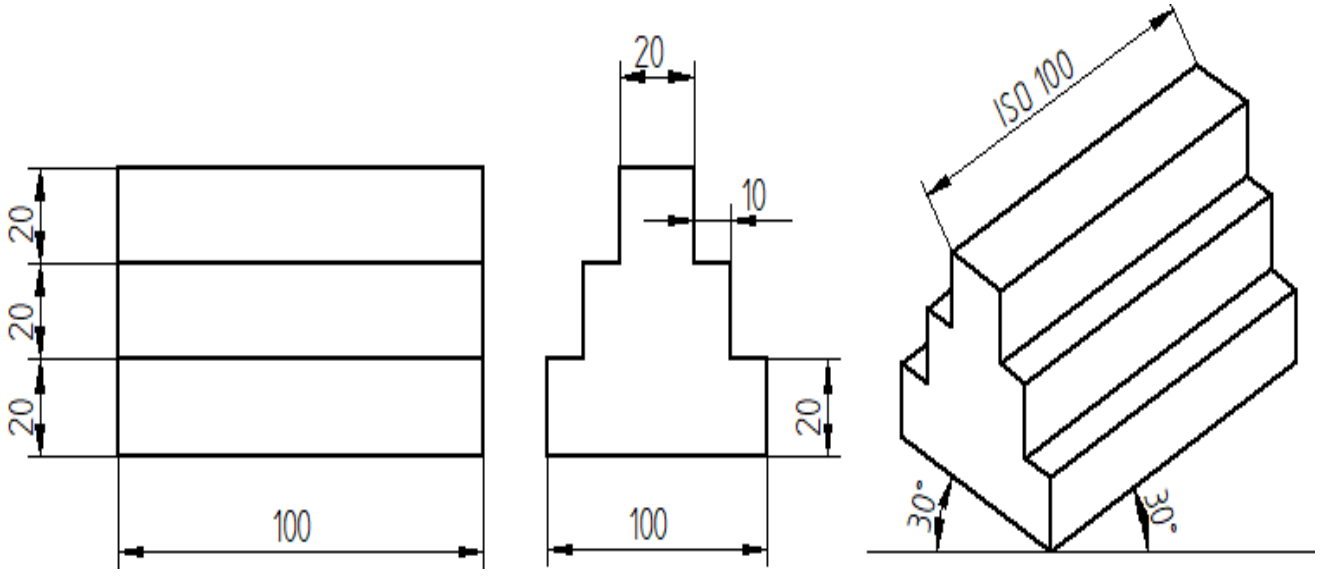
Solution



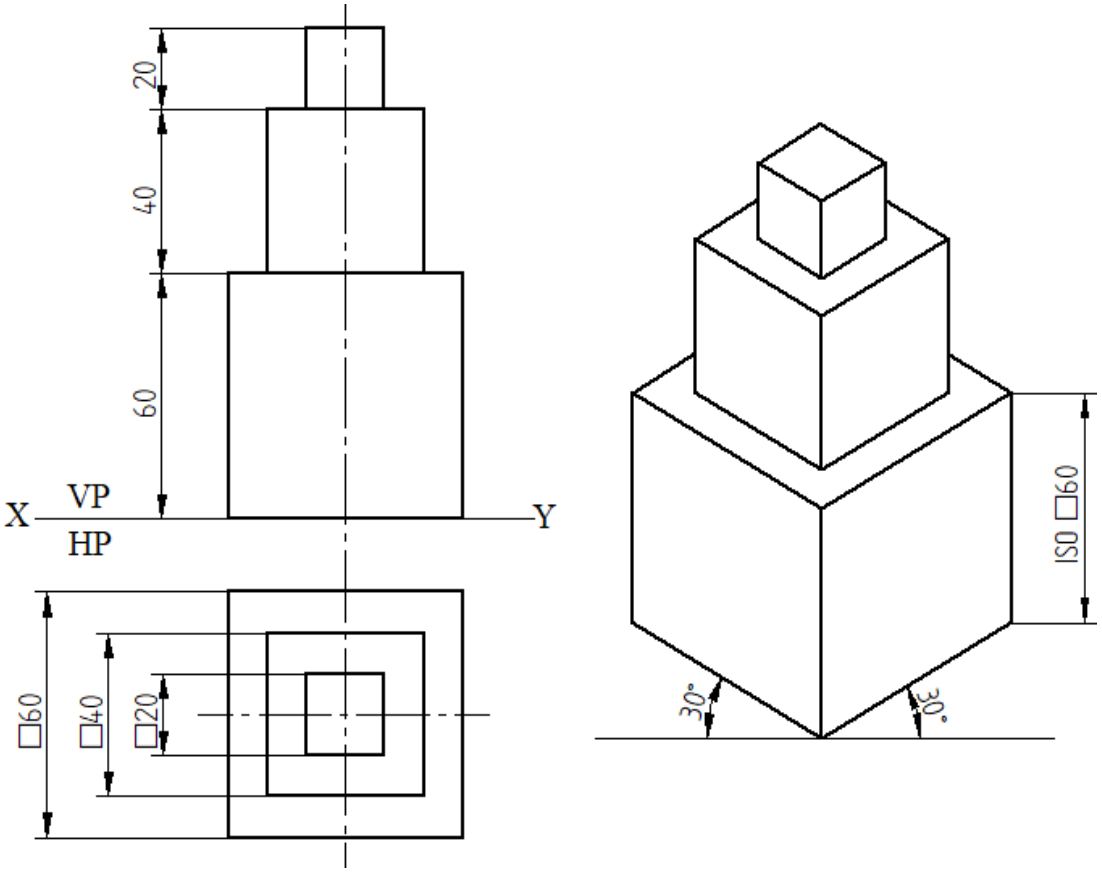
Module-5

ISOMETRIC PROJECTIONS

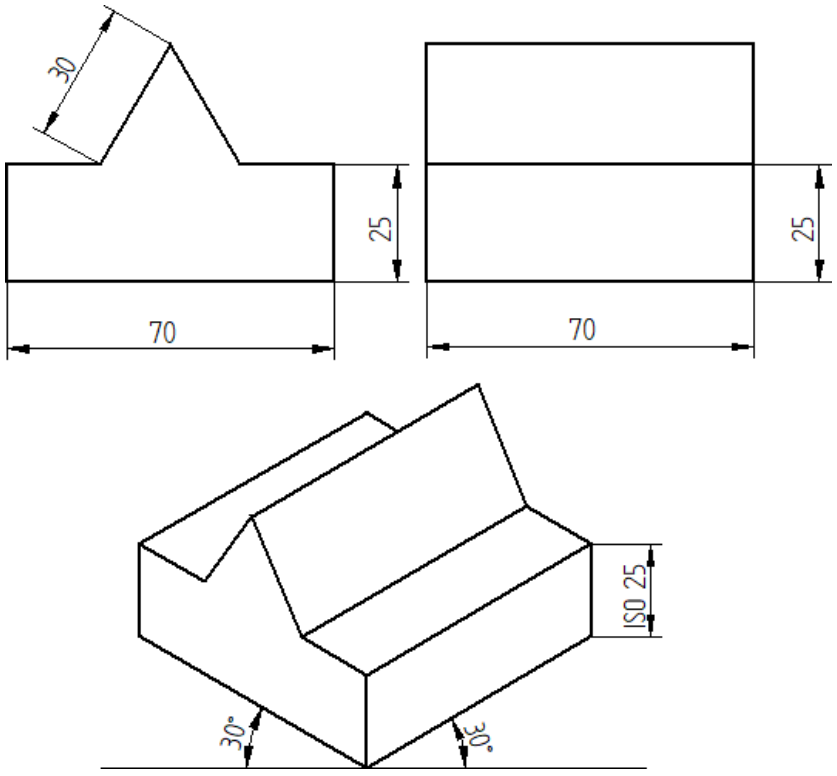
Q 1. Three rectangular slabs (l x b x h) 100mm x 60mm x 20mm, 100mmx40mmx20mm and 100mmx20mmx20mm are placed one above the other in the descending order of their width-b, such that their longer axes are coplanar. Draw the isometric projection of the combination.



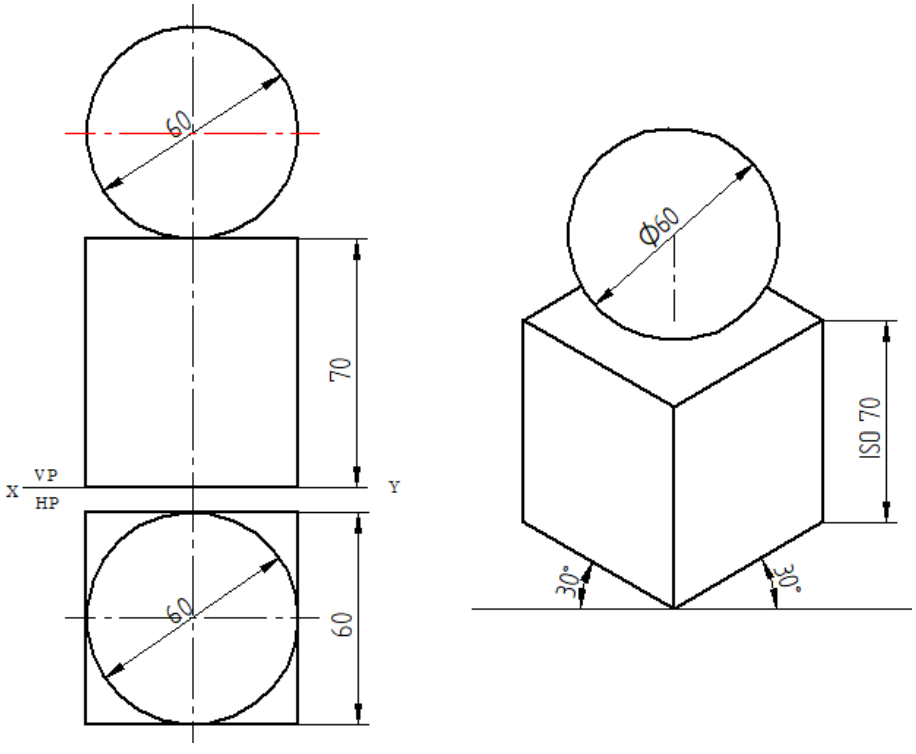
Q 2. Three cubes of sides 60mm, 40mm and 20mm are placed centrally one above the other in the descending order of their side. Draw the isometric projection of the combination.



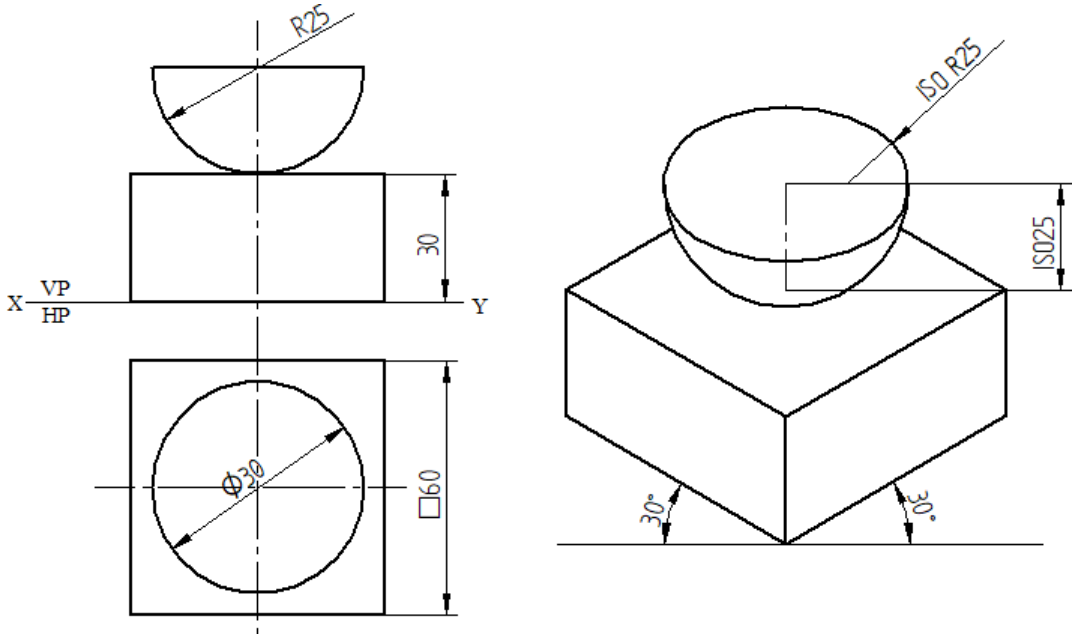
Q 3. A triangular prism base side 30mm and length 70mm is resting on its rectangular face on top of a square slab side 70mm and 25mm thick. Draw the isometric projection of the combination.



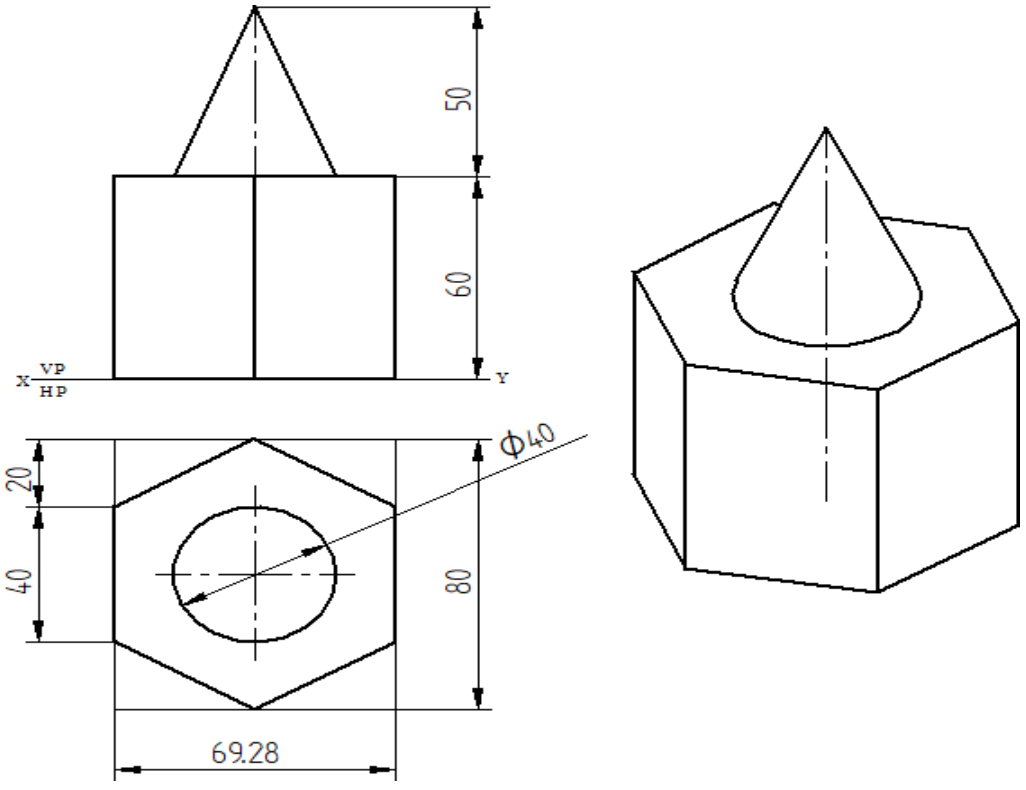
Q 4. A sphere of diameter 60 mm is placed centrally on the top face of a square prism side 60mm and height 70mm. draw the isometric projection of the combination



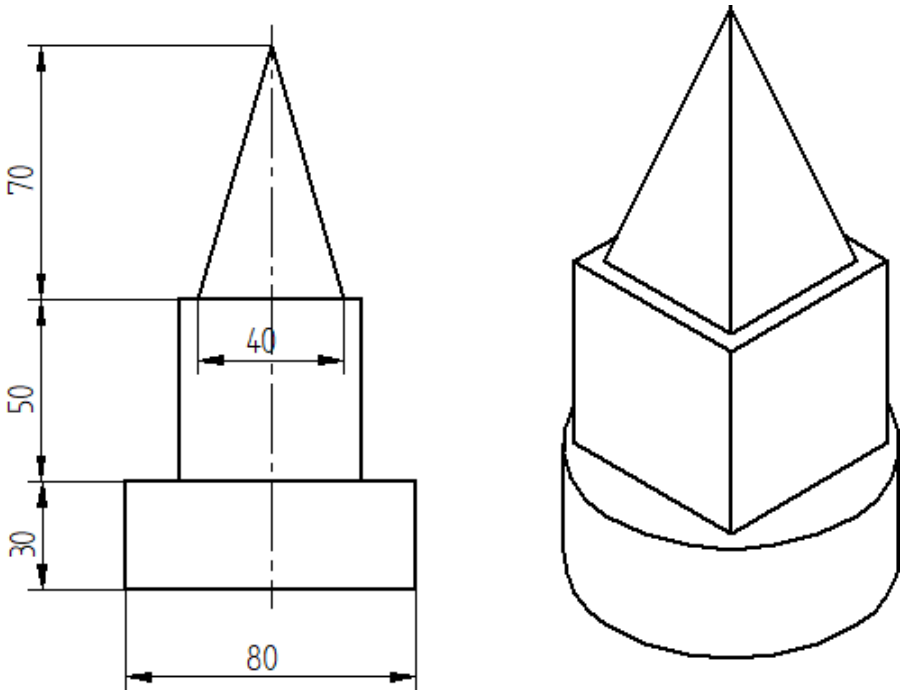
Q 5. A hemisphere of diameter 50mm is centrally resting on top of a square prism of base side 60mm and height 30mm such that the curved surface of hemisphere is touching the top face of the prism. Draw its isometric projections



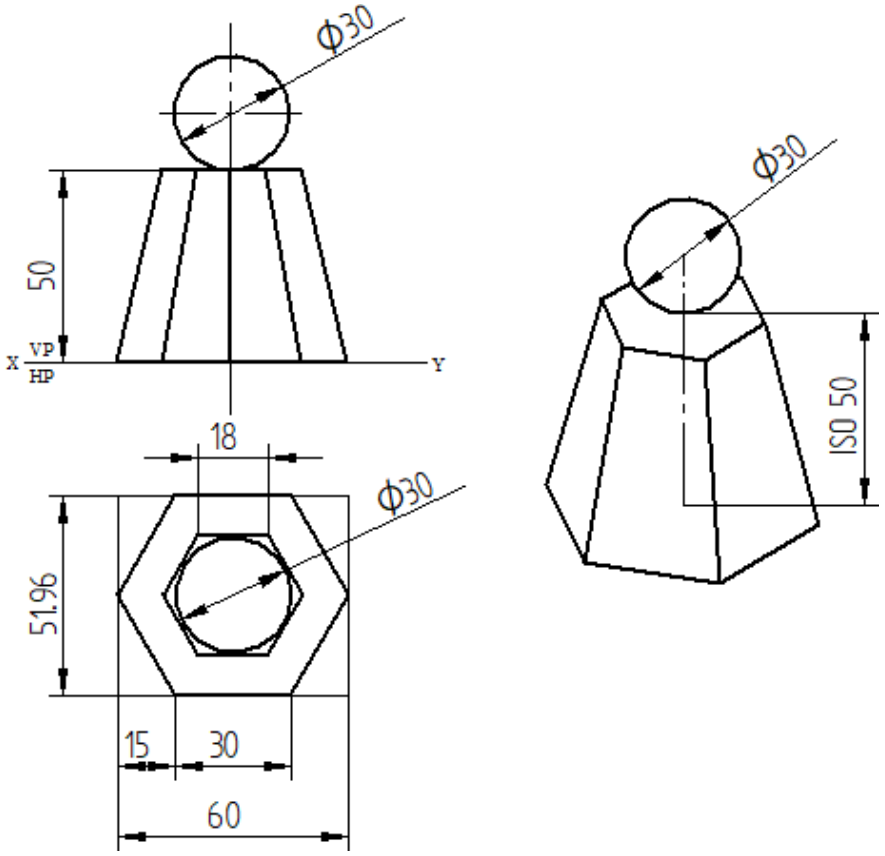
Q 6. Draw the isometric projection of a hexagonal prism of side of base 40mm and height 60mm with a right circular cone of base 40 mm diameter and altitude 50mm, resting on its top such that the axes of both the sides are collinear



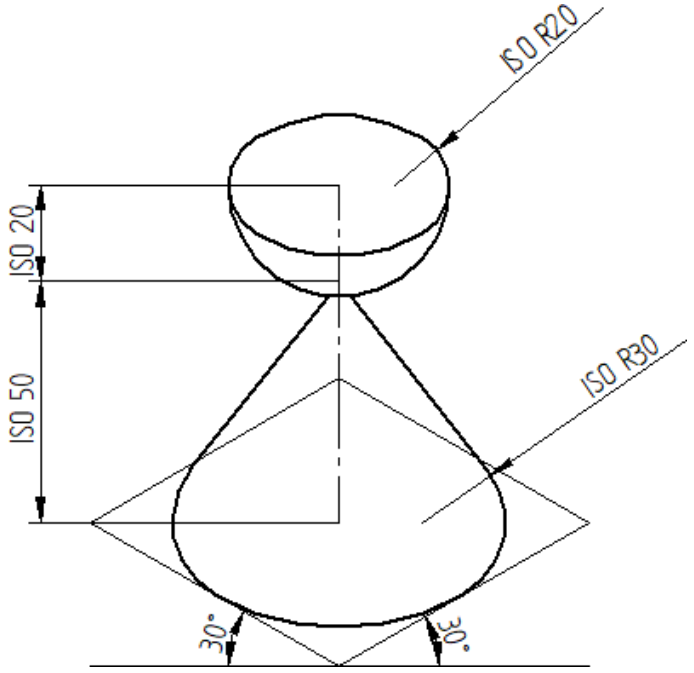
Q 7. A square pyramid of base side 40mm and height 70mm rests symmetrically on a cube of side 50mm, which itself is placed on a cylinder of diameter 80mm and thickness 30mm. Draw the isometric projection of the solids, if the axes of the three solids are in common line.



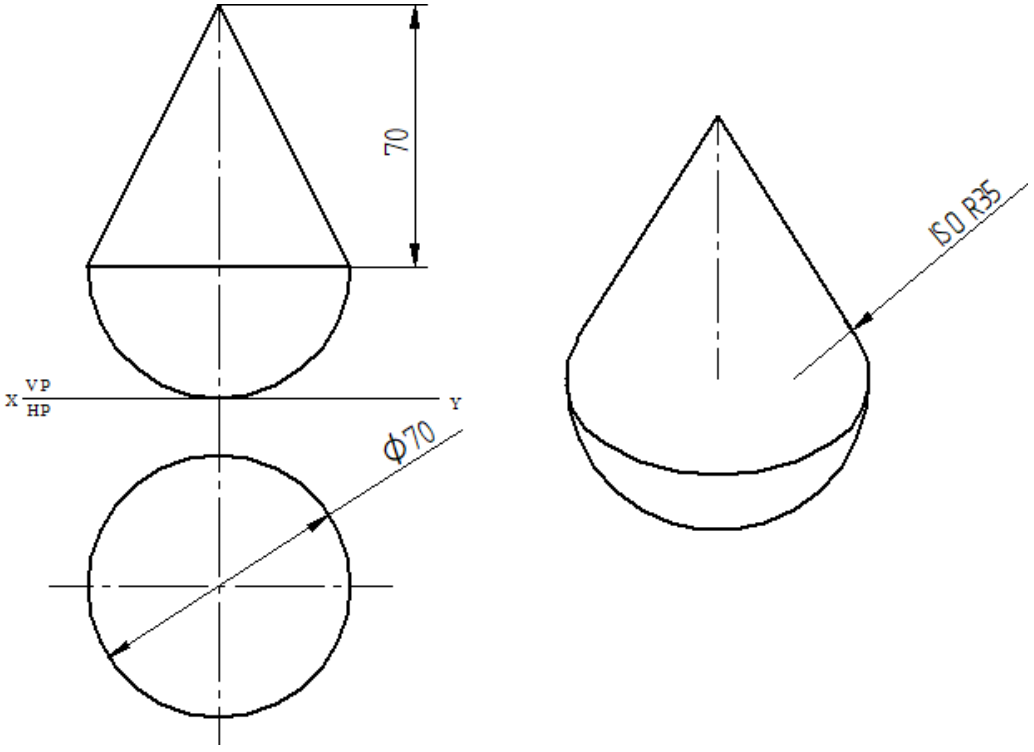
Q 8. A sphere of diameter 30mm rests on the frustum of a hexagonal pyramid of base 30 mm, top face 18mm side and height 50mm, such that their axes coincide. Draw the isometric projection of the combined solids



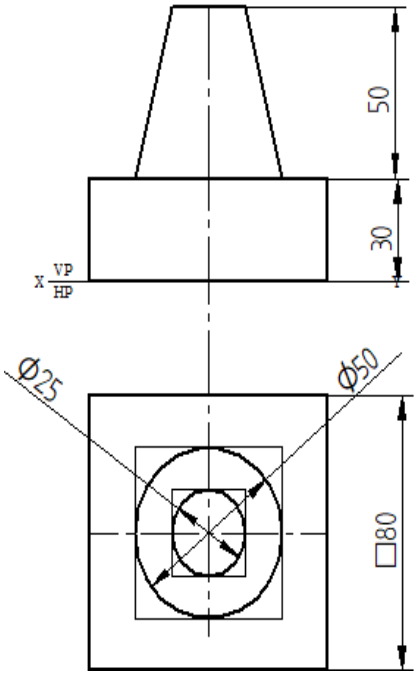
Q 9. A hemisphere of 40mm diameter is supported co-axially on the vertex of a cone of base diameter 60mm and axis length 50mm. The flat circular face of the hemisphere is facing upside. Draw the isometric projection of the combination of solids.

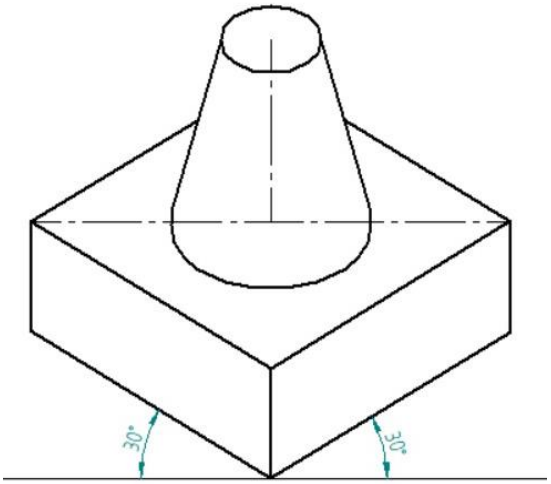


Q10. A hemisphere diameter 70mm is placed on the ground on its curved surface. A cone base diameter 70mm and height 70mm is placed centrally on it. Draw the isometric projection of the combination

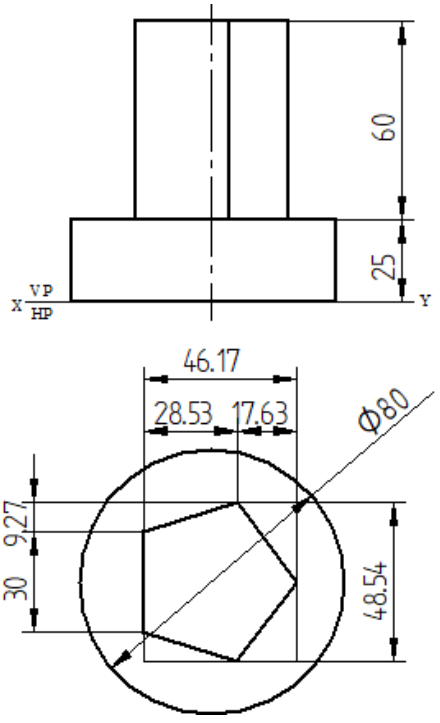


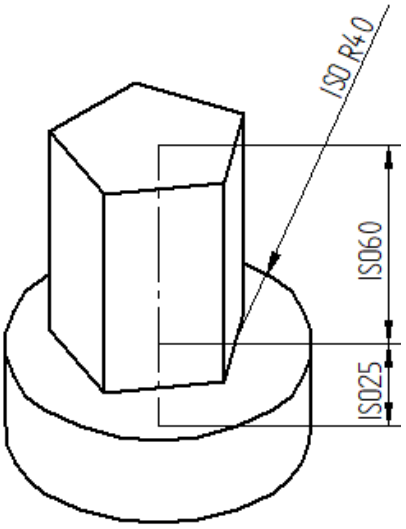
Q 11. A frustum of cone base diameter 50 mm, top diameter 25 mm and height 50 mm is placed centrally on a square slab side 80mm and thickness 30mm. Draw the isometric projection



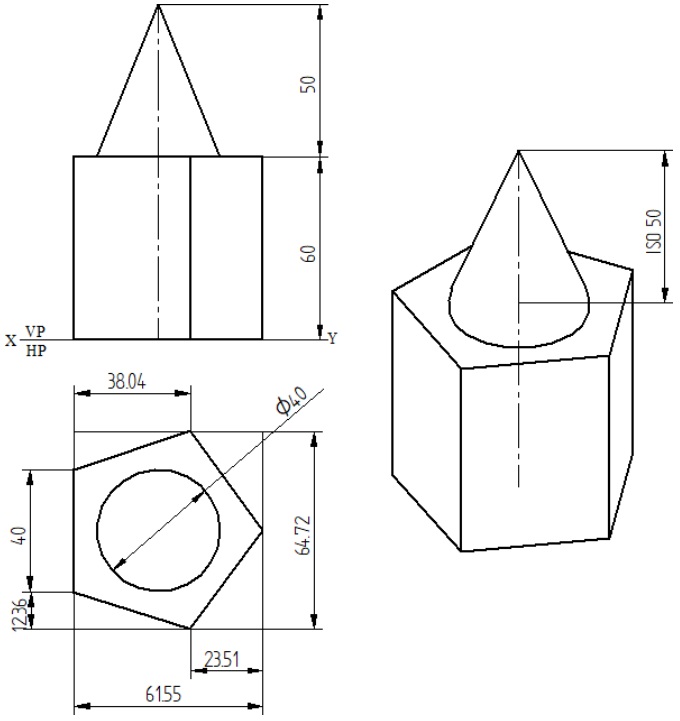


Q12.A regular pentagonal prism of base edge 30mm and axis 60mm is mounted centrally over a cylindrical block of 80mm diameter and 25mm thick. Draw isometric projection of the combined solids.

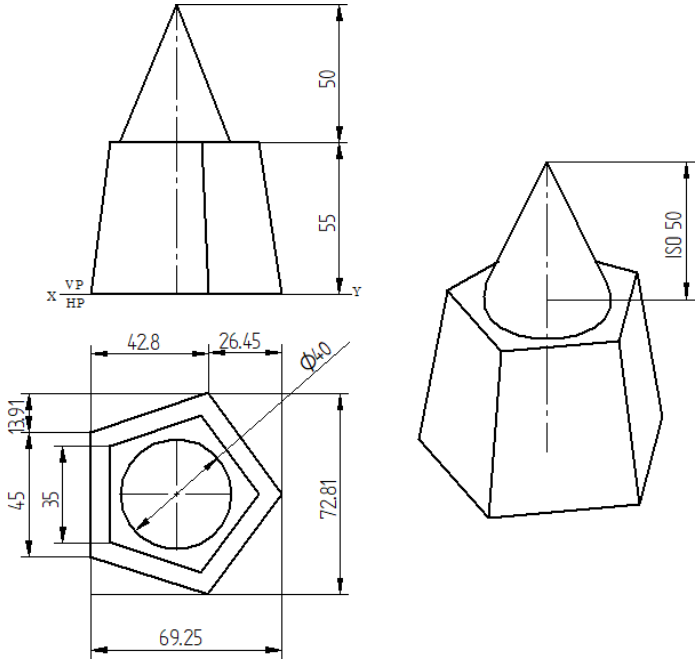




Q13.Draw isometric projections of a pentagonal prism of sides of base 40mm and height 60mm with a right circular cone of base 40mm as diameter and altitude 50mm, resting on its top such that the axes of both the solids are collinear.



Q14. A cone of base diameter 40mm and height 50mm rests centrally over a frustum of a pentagonal pyramid of base side 45mm and top side 35mmand height 55mm. Draw its isometric projections.



Q15.A sphere of diameter 45 mm rests centrally over a frustum of cone of base diameter 60 mm, top diameter 40mm and height 60mm. Draw its isometric projections.