ANNAMALAI UNIVERSITY

I YEAR B.E (ALL BRANCHES)

COURSE NAME: ENGINEERING GRAPHICS AND DRAFTING

SOLUTIONS

PLATE NO. 06 TO 10

ANNAMALAI UNIVERSITY

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE NAME: ENGINEERING GRAPHICS AND DRAFTING

SOLUTIONS

SIMPLE PROJECTION OF SOLIDS AND AUXILIARY PROJECTION OF SOLIDS

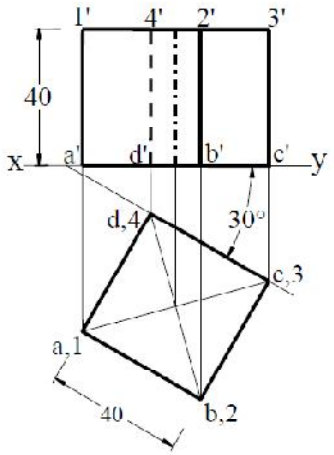
(PLATE NO. 06)

1.

Draw the projections of a cube of 40mm side when in each of the following positions:
a) Resting on HP on one of its faces with a vertical face inclined at 30° to VP.
b) Resting on HP on one of its faces with its vertical faces equally inclined to VP.

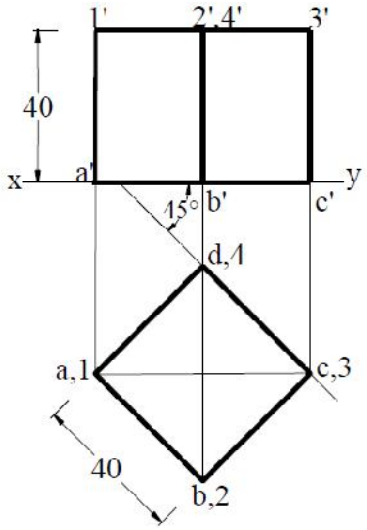
a)

1. Draw XY line
2. Draw a square of side 40 mm and one side "cd" inclined 30° to XY and name it abcd, 1234
3. Draw projectors from "abcd" and "1234"
4. Since cube is resting on HP the front elevation of "abcd" will lie on XY, and name it as "a'b'c'd'" respectively.
5. On the projectors drawn from "1234" measure out 40 mm from XY and mark "1'2'3'4'" which represent the elevation of top face of cube
6. Join the visible edges with thick continuous line and invisible edges with dotted line.
7. Represent the axis with dash dot line.
8. Give necessary dimensions and complete the solution.



b)

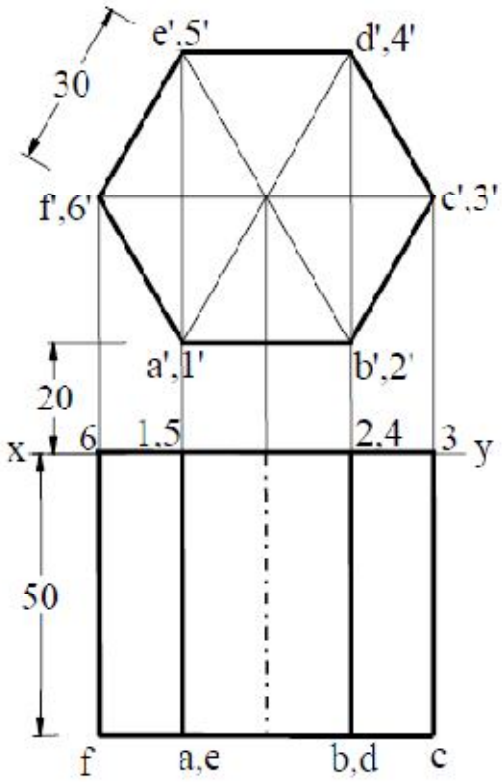
1. Draw XY line
2. Draw a square of side 40 mm and one side "cd" inclined 45^{o} to XY and name it abcd, 1234
3. Draw projectors from "abcd" and "1234"
4. Since cube is resting on HP the front elevation of "abcd" will lie on XY, and name it as "a'b'c'd'" respectively.
5. On the projectors drawn from "1234" measure out 40 mm from XY and mark "1'2'3'4'" which represent the elevation of top face of cube
6. Join the visible edges with thick continuous line and invisible edges with dotted line.
7. Represent the axis with dash dot line.
8. Give necessary dimensions and complete the solution.



2. A hexagonal prism base 30mm side and axis 50mm long is placed with its base on VP. Such that one of its base edges is parallel to and 20mm above HP. Draw its projections.

1. Draw XY line
2. Draw a hexagon of side 30 mm and one side "a'b'" parallel and 20 mm above XY and name it a'b'c'd'e'f', 1'2'3'4'5'6'(True shape of hexagonal prism will be seen in the front elevation since it is on VP
3. Draw projectors from "it a'b'c'd'e'f'" and " 1'2'3'4'5'6'"
4. Since hexagonal prism is resting on VP the plan of it will lie on XY, and name it as "123456'" respectively.
5. On the projectors drawn from "a'b'c'd'e'f" measure out 50 mm from XY and mark "abcdef" which represent the plan of front face of hexagonal prism
6. Join the visible edges with thick continuous line and invisible edges with dotted line.
7. Represent the axis with dash dot line.

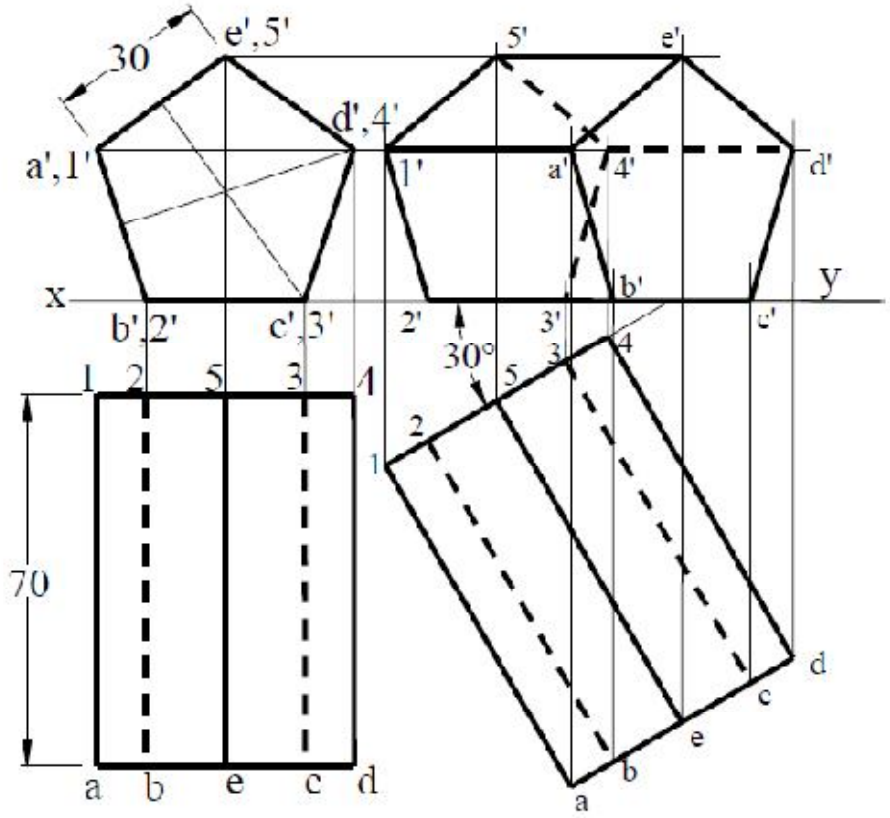
8. Give necessary dimensions and complete the solution.



3. A pentagonal prism of edge of base 30mm and axis 70mm long rests with one of its rectangular faces on HP and the ends inclined at 30° to VP. Draw its projections.

1. Draw XY line
2. Draw a hexagon of side 30 mm and one side "b'c'" on XY and name it a'b'c'd'e', 1'2'3'4'5'(True shape of pentagonal prism will be seen in the front elevation since it is resting on HP with a rectangular face
3. Draw projectors from "it a'b'c'd'e'" and " 1'2'3'4'5'"
4. Since pentagonal prism is resting on HP the plan of it will lie below XY, and name it as "12345" respectively.
5. On the projectors drawn from "a'b'c'd'e'" measure out 70 mm from XY and mark "abcde" which represent the plan of front face of pentagonal prism
6. Join the visible edges with thick continuous line and invisible edges with dotted line.
7. Represent the axis with dash dot line.
8. Give necessary dimensions and complete the simple projection.
9. Draw a 30° degree line to XY

10. Reproduce the rectangle plan with edges “12345” on 30^{o} line
11. Draw projectors from “12345” and “abcde”
12. Draw line parallel to XY from “a’b’c’d’e’” to intersect the projector from “abcde” and name it “a’b’c’d’e’” in the tilted projection
13. Draw line parallel to XY from “1’2’3’4’5’” to intersect the projector from “12345” and name it “1’2’3’4’5’” in the tilted projection.
14. Join the visible edges and invisible edges as per convention and complete the view.



4.

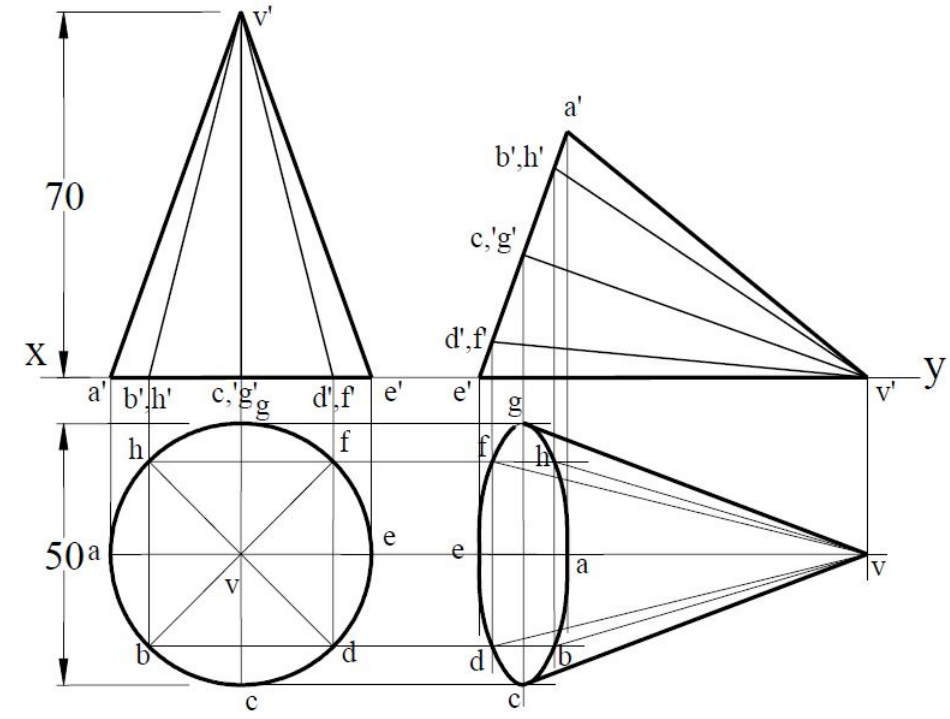
. The diameter of base of a cone is 50mm and the height is 70mm. Draw its projections when in each of the following positions:

a) resting on one of its generators with the axis parallel to VP.

1. Draw XY line
2. Draw a circle of 50 mm diameter below XY at some distance and divide it into eight equal parts and name it as ”abcdefgh”. This will be the plan of the cone. Fix the centre of the circle and name it as “v”. Draw projectors from “abcdefgh” and from “v”
3. Mark the front elevation of the base of cone “a’b’c’d’e’f’g’h’” on XY since it is resting on HP in simple position.

4. On the projector drawn from “v” measure out 70 mm from XY and mark “v’” which is the front elevation of vertex “v”
5. Join all points “a’b’c’d’e’f’g’h’” with “v’” which will be the front elevation of generators. “a’v’ & e’v’ “ are the two end generators of the cone.
6. The cone to be tilted such that one of its end generators is on XY. So to the right side of the elevation extend XY and on it Draw the front elevation triangle “ a’f’v’” so that “e’v’ “ on XY.
7. Draw projectors from “a’b’c’d’e’f’g’h’” and “v’” in the tilted position.
8. Draw lines from “abcdefgh” & “v” to intersect the projectors from the tilted position and name the points appropriately.
9. Join the base points of the cone by smooth curve and generators with straight line. And complete the view. Give the required dimensions

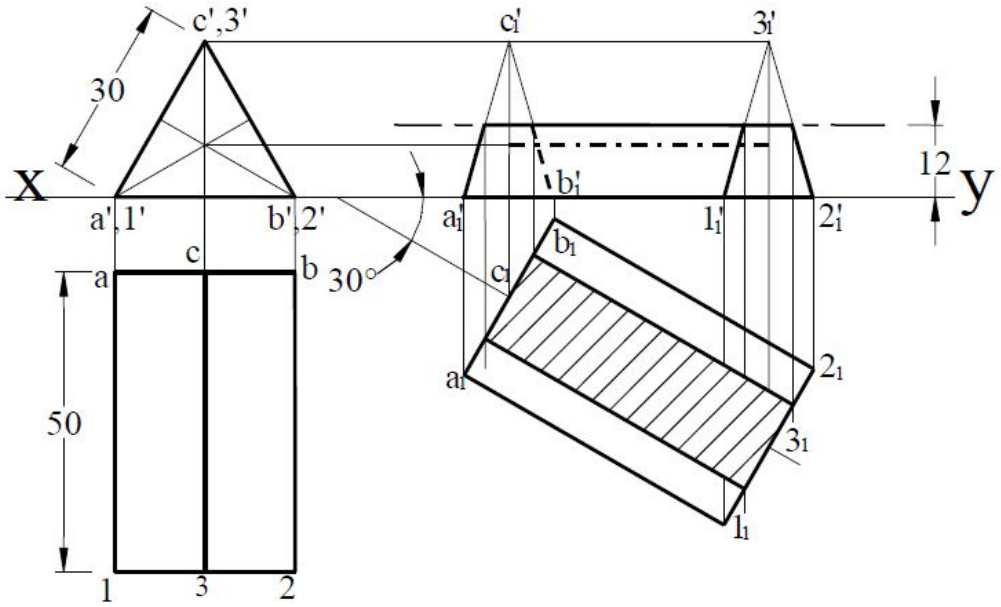
a)



SECTIONS OF SOLIDS

(PLATE NO. 07)

1) A triangular prism edge of base 30mm and axis 50mm long is lying on HP on one of its rectangular faces with its axis inclined at 30o to VP. It is cut by a horizontal plane at a distance of 12mm above HP. Draw its elevation and sectional plan.



(1) Draw the triangular prism in the simple position as shown above
(2) Draw the solid in the tilted position also
(3) The section plane is 12 above HP, so draw the section plane line above XY at a distance of 12 mm in the tilted elevation
(4) The section plane cuts the solid at 4 points on edges $a_1'c_1'$,$b_1'c_1'$, $1_1'3_1'$ & $2_1'3_1'$
(5) Draw projectors from $a_1'c_1'$,$b_1'c_1'$, $1_1'3_1'$ & $2_1'3_1'$ and get the corresponding points in the tilted plan. Join the points appropriately and shade the sectional plan.

2) A square pyramid base 40mm side and axis 65mm long has its base on HP and all the edges of the base are equally inclined to VP. It is cut by a section plane perpendicular to VP and inclined at 45^o to HP and bisecting the axis. Draw its sectional plan, sectional end elevation and true shape of the section.

1) Draw the square pyramid in the simple position as shown below
2) Draw the section plane inclined at an angle 45^o to XY and passing through the centre of the axis (i.e., 32.5 mm from XY).
3) The section plane cuts the solid at four points s_1 in the edge AV, s_2 at BV,s_3 at CV and s_4 at DV
4) Draw the projectors from s_1,s_2,s_3,& s_4 and get the corresponding points in the respective edges in the plan viz., s_1,s_2,s_3,& s_4

5) The section Point s2 & s4 are in the line perpendicular to XY. To transfer them take those points to the any one of the extreme edge" c'v' " (or a'v') and project it on "cv " (or av) and transfer that to points to the respective edges "bv " and "dv"

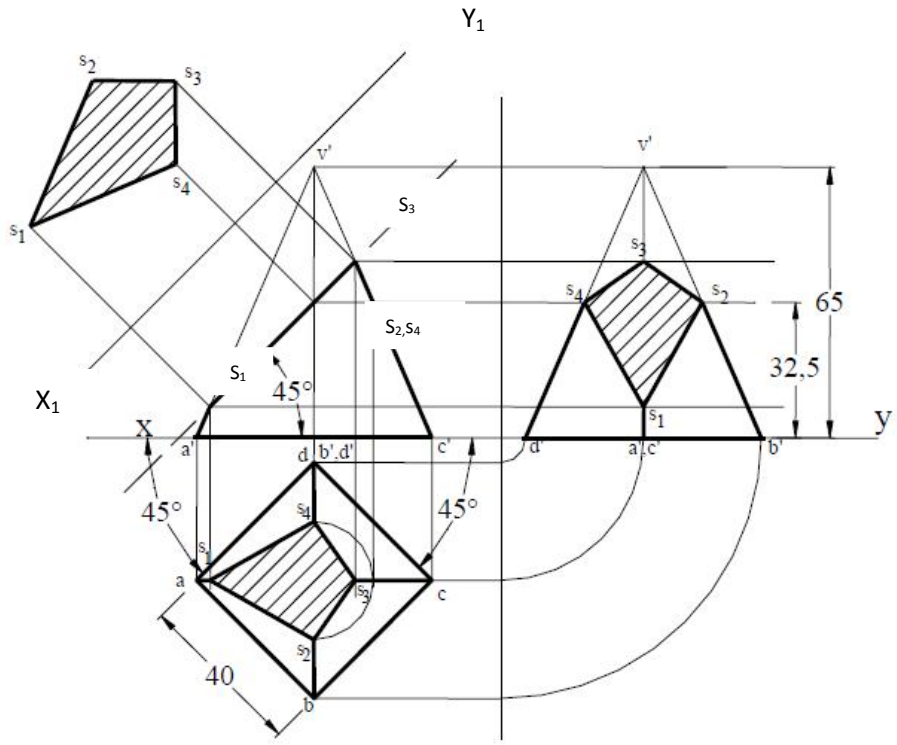
6) Join the points $s_1,s_2,s_3,$& s_4 in cyclic order and hatch the portion to show it as sectional plan.

7) To get true shape of section

(a) Draw a line parallel to section plane in the front elevation at a suitable distance

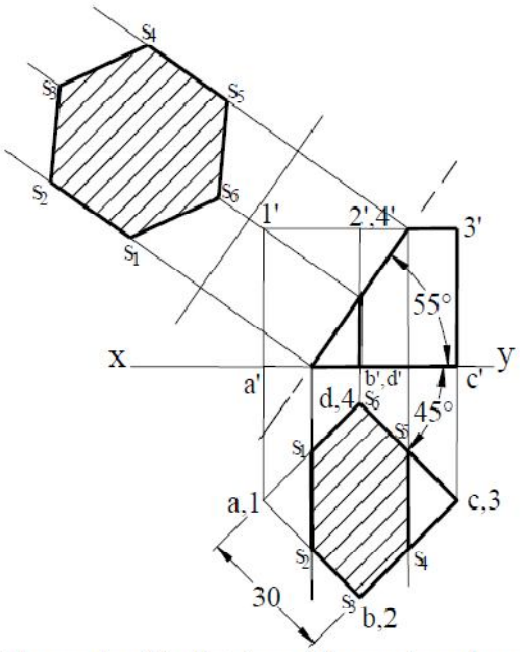
(b) Draw projectors $s_1,s_2,s_3,$& s_4 perpendicular to X_1Y_1

(c) Measure the distance of $s_1,s_2,s_3,$& s_4 from XY in the plan and mark that distance in the respective projectors drawn perpendicular to X_1Y_1 and get the points $s_1,s_2,s_3,$& s_4. Join the points in the cyclic order and hatch the portion.



3) A hexahedron of 30mm edge is cut by a section plane such that the true shape of the section is a regular hexagon. Draw the projections of the cube determine the angle of inclination of the section plane with the HP and the inclination of the base edge with VP.

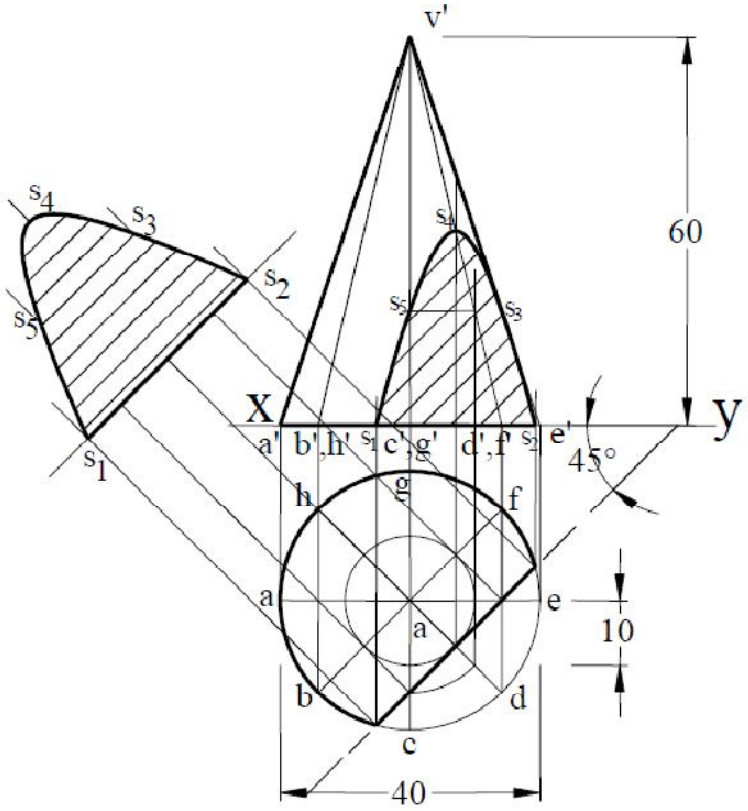
1) Draw the cube in the simple position as shown below
2) Draw the section plane inclined at an angle 55° to XY and passing through the midpoint of the edges “a’b’”, “b’2’” & “2’3’”
3) The section plane will cut the solid at six points s_1,s_2,s_3,s_4 ,s_5, & s_6
4) Get the section plan and true shape of section as explained in the previous problem.



The angle of inclination of the section plane with the HP is 55°
The inclination of the base edge with VP is 45°

4) A right circular cone of 40mm diameter of the base and 60mm altitude stands on HP. A plane normal to HP and inclined at 45O to VP cuts the cone at a distance of 10mm from its axis. Draw the sectional elevation and true shape of the section.

1) Draw the cone in the simple position as shown below
2) Draw the section plane inclined at an angle 45^{o} to XY and passing at a distance of 10 mm from the centre of circle. With vertex v as centre and 10 mm as radius draw a circle and the section plane should be drawn as tangent to the circle.
3) The section plane will cut the base and generators of cone at points s_1,s_2,s_3,s_4 ,&s_5 as shown in the figure.
4) Get the section plan and true shape of section as explained in the previous problem.

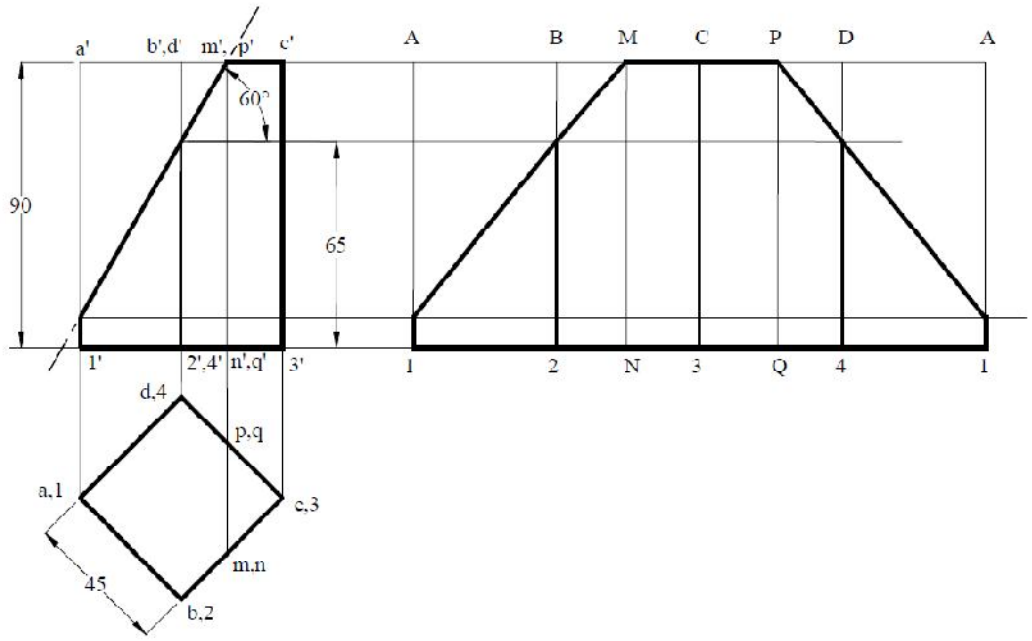


DEVELOPMENT OF SOLID SURFACES

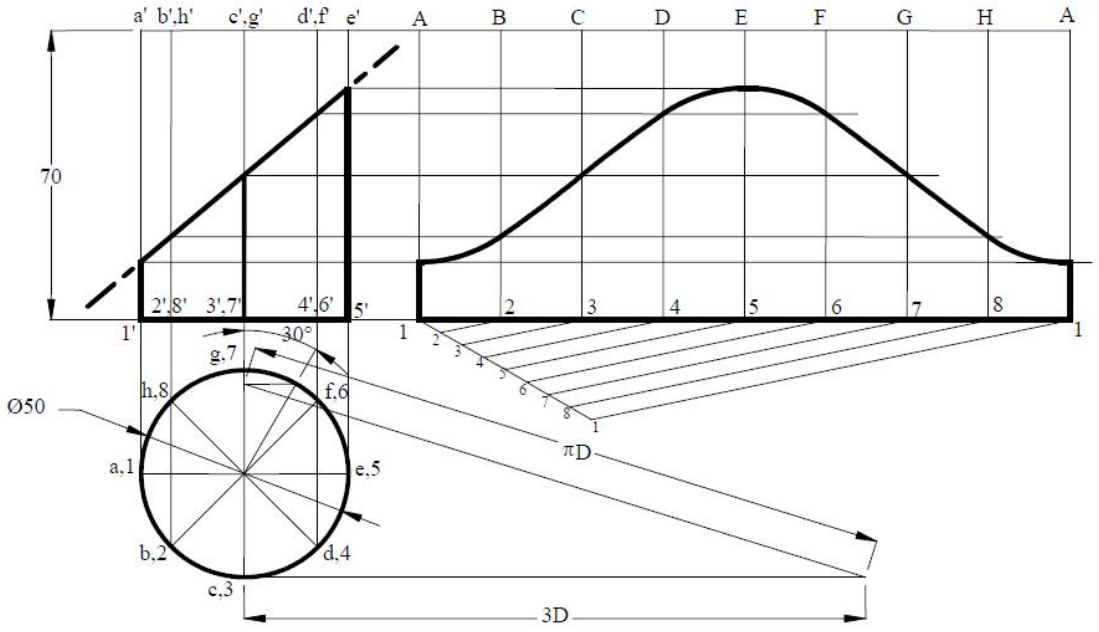
(PLATE NO. 08)

1. A square prism of edge of base 45mm and axis 90mm long has its base on HP and its faces are equally inclined to VP. It is cut by a plane perpendicular to VP, inclined at 60o to the HP and passing through a point on the axis 65mm above the base. Draw the development of the lower portion of the lateral surface.

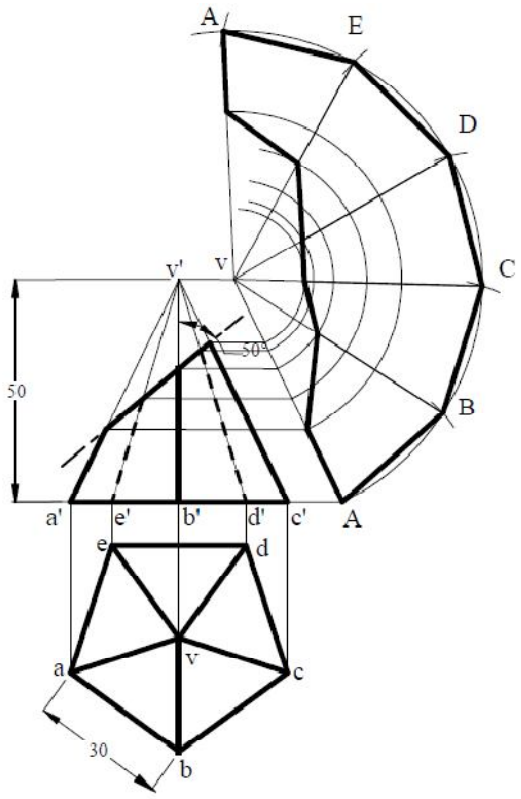
    1. Draw the square prism in the simple position as shown below
    2. Draw the section plane inclined at an angle 60^{o} to XY and passing at a distance of 65 mm above XY and get the section points
    3. To the right side of elevation draw the development of square prism as shown in the figure. 1-2, 2-3, 3-4, 4-1 is equal to the side of square and 1-A is equal to the height of prism
    4. From each section points in the elevation draw lines parallel to XY to cut the corresponding edges in the development. Join the points in the order and completes the view



2. Draw the development of the lateral surface of the lower portion of a cylinder of diameter 50mm and altitude 70mm when it is cut by a plane perpendicular to VP and inclined at 40^{o} to HP and passing through the midpoint of the axis.
    1. Draw the cylinder in the simple position as shown below
    2. Divide the circle (plan of cylinder) into 8 equal parts and name it as “1 to 8” to represent the plan of the base of the cylinder and “a to h” to represent the plan of the top of the cylinder.
    3. Draw the section plane inclined at an angle 40^{o} to XY and passing at a distance of 35 mm above XY(midpoint of the axis) in the front elevation and get the section points.
    4. To the right side of elevation draw the development of cylinder as shown in the figure. The rectangle 1AA1 is the development of the lateral surface of the cylinder.
    5. 1A is equal to the axis length or height of the cylinder and 11 or AA is equal to the circumference of the cylinder.
    6. Divide the rectangle (1AA1) into 8 equal parts and draw the generators 1A,2B,3C … 1A as shown in the fig
    7. From each section points in the elevation draw lines parallel to XY to intersect the corresponding generators in the development.
    8. Join all the points in the development with a smooth curve,
    9. Give necessary dimensions to finish the solution.



3. A pentagonal pyramid edge of base 30mm and height 50mm stands on its base on HP with an edge of base parallel to VP. A section plane cuts the pyramid at a point 30mm above the base and makes an angle of 50^{o} with axis. Draw the development of the truncated pyramid.
    1. Draw the pentagonal pyramid in the simple position as shown below
    2. Draw the section plane inclined at an angle 50^{o} to axis and passing at a distance of 30 mm above XY (from the base) in the front elevation and get the section points.
    3. To the right side of elevation draw the development of pyramid as shown in the figure.
    4. Draw a line "VA" parallel and equal to " v'c' " the slant length of the pyramid.
    5. With "v" as centre and " VA " as radius draw an arc and step off 30 mm from the point A 5 times to get the points B,C,D,E,A. Join all the points with "V" to get the slant edges of the pyramid in the development.
    6. Take all section points to the extreme slat edge (" v'c' " and transfer all the points to the corresponding edges in the development.
    7. Join all the points and complete the development.
    8. Give necessary dimensions and finish the solution.



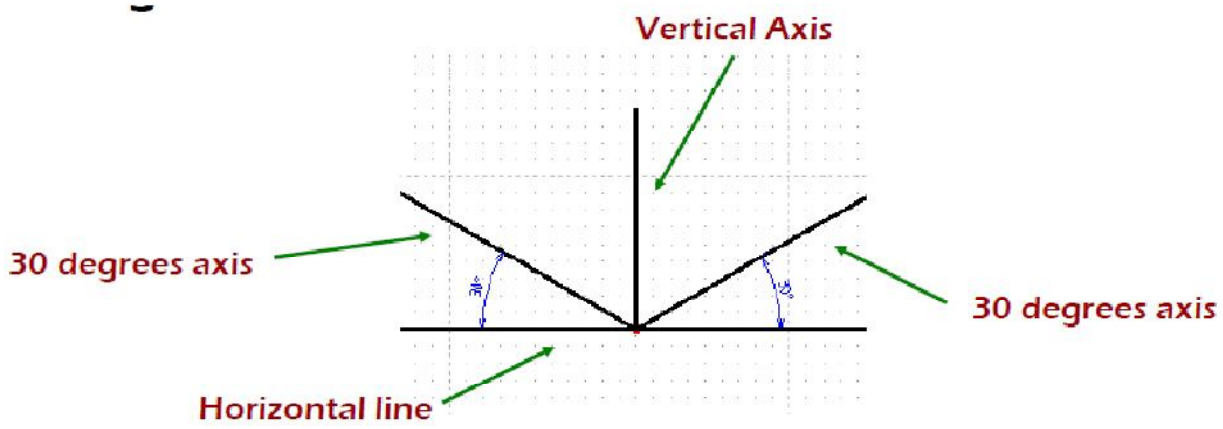
ISOMETRIC PROJECTIONS

(PLATE NO. 09)

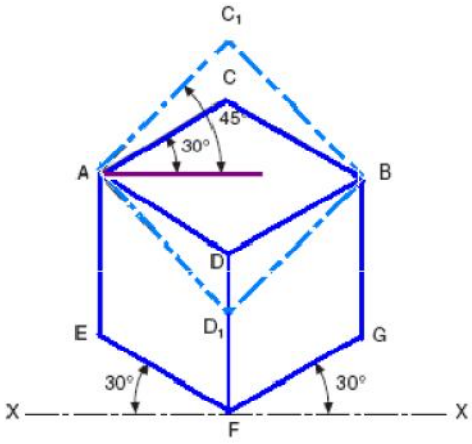
INTRODUCTION

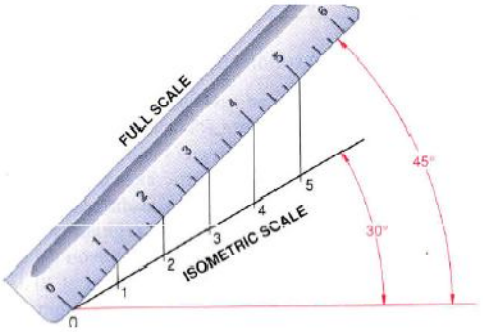
- Isometric drawing method shows the drawing in 3-D
- The real shape of an object can be easily interpreted by using isometric drawing
- The construction of an isometric drawing can be made by viewing the object from certain angle and directions.

Isometric drawing is built on 3 main axis namely the vertical axis and two 30 degrees axis from a horizontal line to the left and right of the vertical axis



Isometric scale is produced by positioning a regular scale at 45° to the horizontal and projecting lines vertically to a 30° line.





$$\text{Isometric scale} = (\text{Isometric length/True length}) = \frac{\cos 45^\circ}{\cos 30^\circ} = \frac{1}{\sqrt{2}} \div \frac{\sqrt{3}}{2} = \frac{\sqrt{2}}{\sqrt{3}} = 0.8165$$

$$= 82\% \text{ (approximately)}$$

Isometric length = 0.82* True length

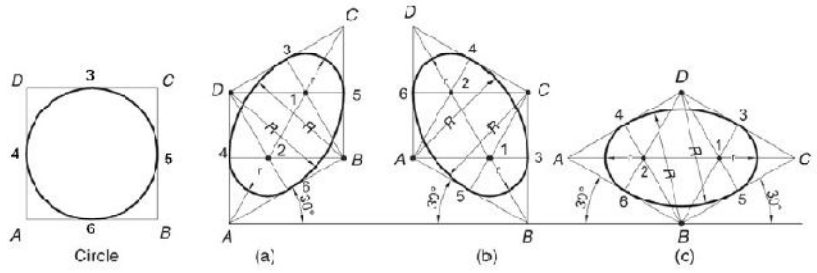
CIRCLE IN ISOMETRIC

In isometric drawing, a circle appears as an ellipse.

Four-center method is usually used when drawn an isometric ellipse with drawing instrument.

The isometric view or isometric projection of a circle is an ellipse. It is obtained by using four-centre method explained below.

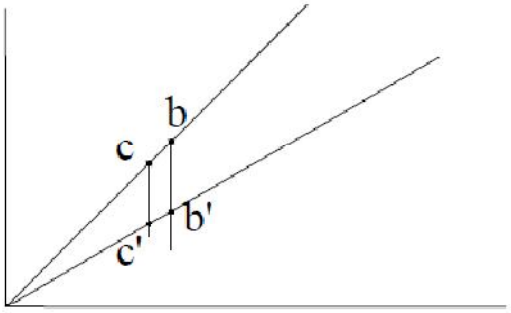
Four-Centre Method : First, enclose the given circle into a square *ABCD*. Draw rhombus *ABCD* as an isometric view of the square. Join the farthest corners of the rhombus, i.e., *A* and *C*. Obtain midpoints 3 and 4 of sides *CD* and *AD* respectively. Locate points 1 and 2 at the intersection of *AC* with *B*–3 and *B*–4 respectively. Now with 1 as a centre and radius 1–3, draw a small arc 3–5. Draw another arc 4–6 with same radius but 2 as a centre. With *B* as a centre and radius *B*–3, draw an arc 3–4. Draw another arc 5–6 with same radius but with *D* as a centre.



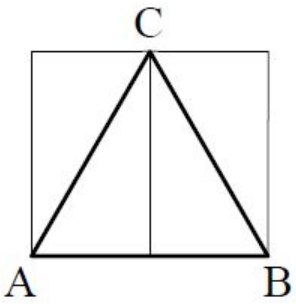
Taken from Dhananjay A Jolhe, Engg. Drawing, MGH

Draw the isometric projections of the following.

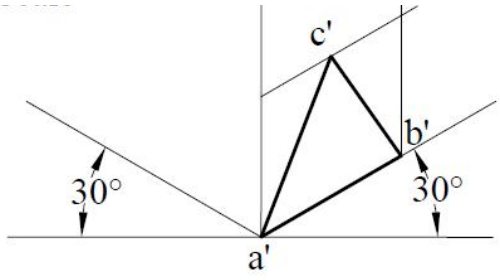
a) An equilateral triangle of 40 mm side when it is placed with its surface vertical and a side horizontal.



Isometric Scale

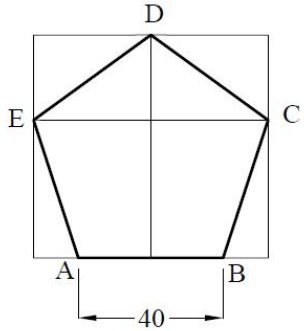


Projection

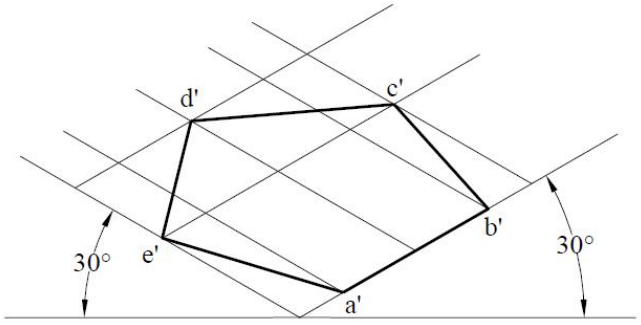


Isometric Projection

b) A regular pentagon of 40 mm side when it is placed with its surface horizontal and a side parallel to VP.

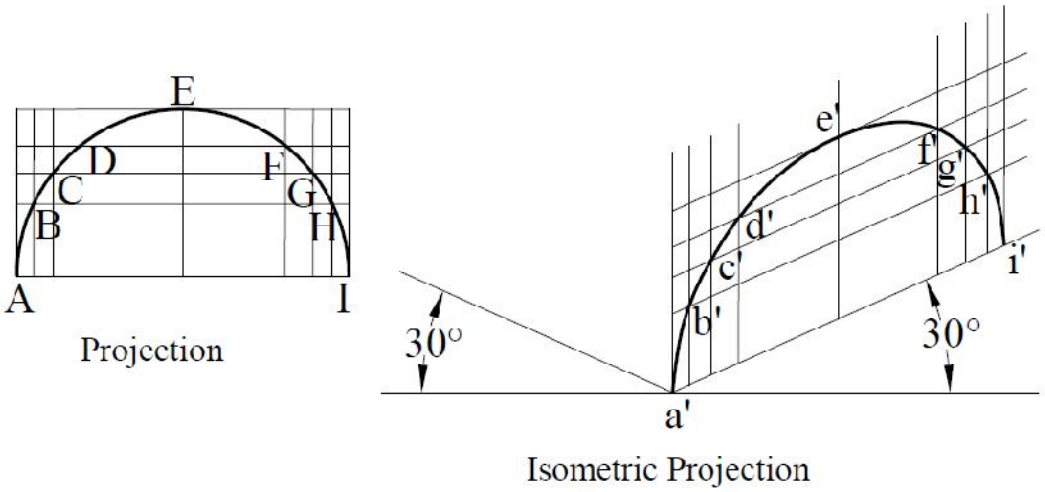


Projection

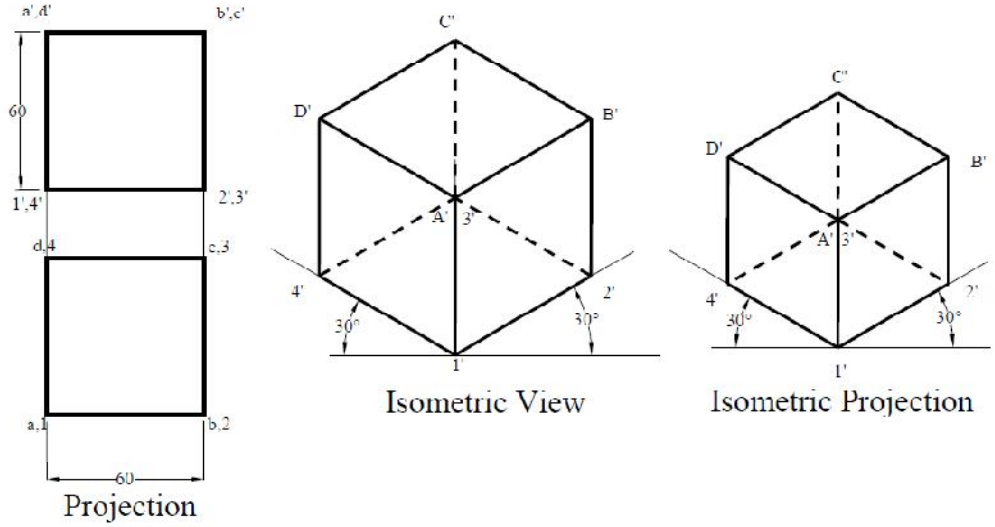


Isometric Projection

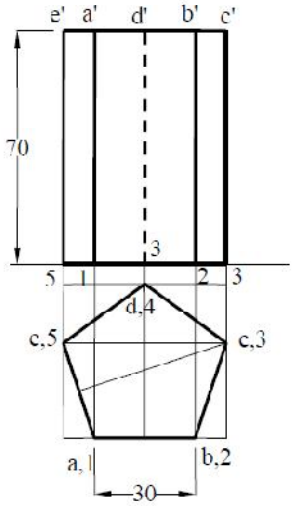
c) A semi – circular lamina of 60 mm diameter when it is standing on its diameter with its surface vertical.



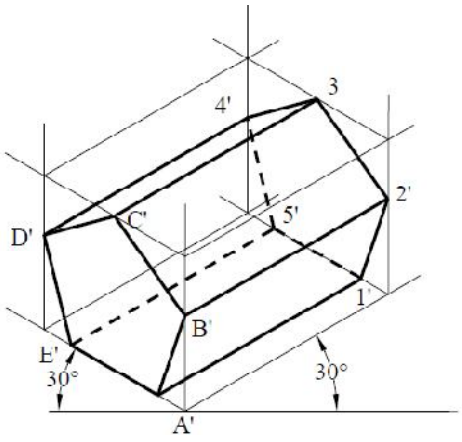
Draw the isometric projection and isometric view of a cube of edge 60 mm.



1. Draw the isometric projection of a pentagonal prism of edge of base 30 mm and axis 70 mm long when the axis is horizontal.
    1. Draw the pentagonal prism in the simple position as shown below
    2. To the right side of elevation draw iso axis as shown below
    3. Enclose the pentagon in the plan in a square.
    4. Get the corresponding box of length equal to iso-scale of 70 mm, width equal to iso-scale of “5-3” in the plan and height of the box equal to iso-scale of height of rectangle in the plan
    5. Complete the pentagon in the front and back of the rectangular box in the isometric projection
    6. Join all the visible edges with continuous line and invisible edges with dotted lines to complete the isometric projection.



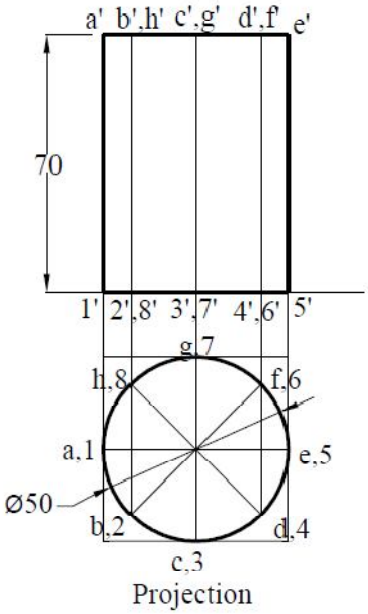
Projectio



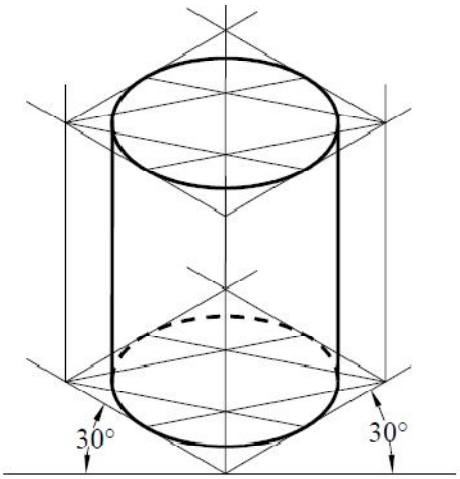
Isometric Projection

2. Draw the isometric projection of a cylinder of diameter 50 mm and axis 70 mm long when the axis is vertical.

    1. Draw the cylinder in the simple position as shown below
    2. To the right side of elevation draw iso axis as shown below
    3. Inscribe the circle in the plan in a square.
    4. Get the corresponding box of height equal to iso-scale of 70 mm, width and breath equal to iso-scale of side of the square
    5. Complete the ellipse in the top and bottom of the rectangular box in the isometric projection as explained by four center method
    6. Join the top and bottom of the ellipse by straight line as shown below and rear part of the bottom face of the cylinder by dotted line as it will not be visible to complete the isometric projection.



Projection

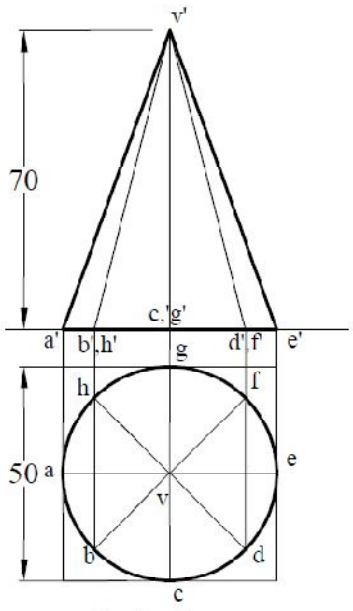


Isometric Projection

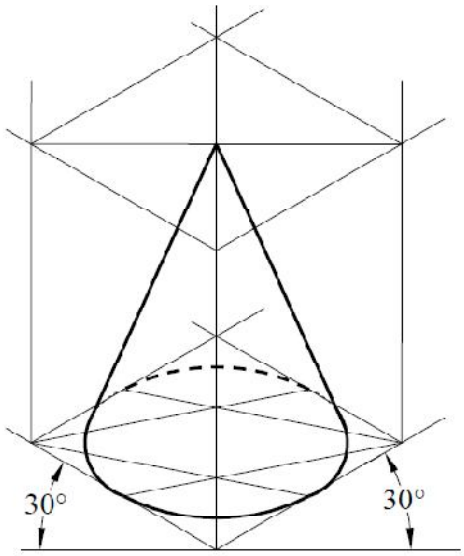
3. Draw the isometric view of a cone of base diameter 50 mm and altitude 70 mm when the base is on HP.

In Isometric view actual dimension should be used

1. Draw the cone in the simple position as shown below
2. To the right side of elevation draw iso axis as shown below
3. Inscribe the circle in the plan in a square.
4. Get the corresponding box of height equal to 70 mm, width and breath equal to side of the square
5. Complete the ellipse in the bottom of the rectangular box in the isometric view as explained by four center method
6. Get the centre of the top face of the rectangular box to get the vertex point.
7. Join the bottom of the ellipse with the vertex by straight line as shown below and rear part of the bottom face of the cone by dotted line as it will not be visible to complete the isometric view.



Projection

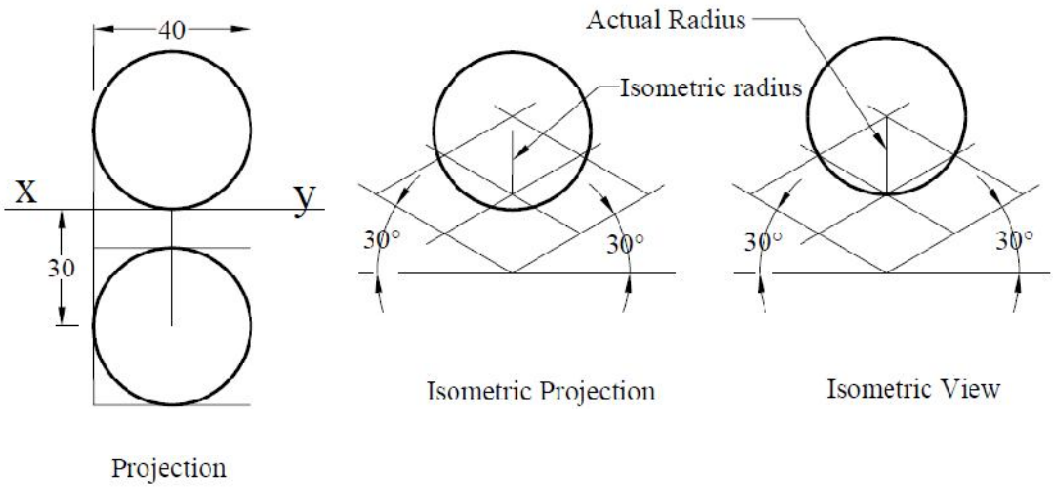


Isometric Projection

4. Draw the isometric projection and isometric view of a sphere of diameter 40 mm and mark the lowest point on its surface.

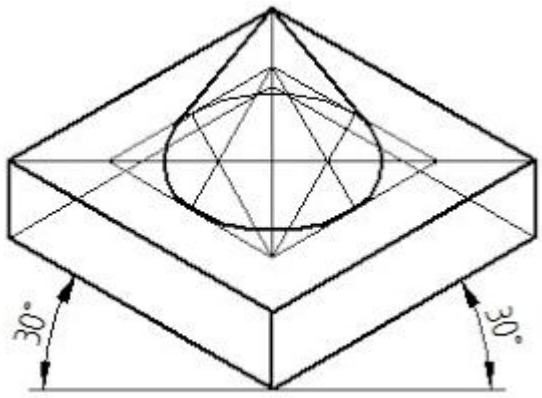
The isometric projection of the sphere is a circle whose diameter is (3/2) times that of the actual diameter of the sphere. The isometric projection view of the sphere is simply a circle whose diameter is equal to the true diameter of the sphere.

1. Draw the sphere in the simple position as shown below
2. To the right side of elevation draw iso axis as shown below
3. Inscribe the circle in the plan in a square.
4. Get the rhombus corresponding to iso-scale of square in the plan
5. Fix the centre of the rhombus and fix the centre of the circle equal to iso scale of radius of the sphere. With that centre and radius equal to isometric radius draw a circle.
6. Repeat the above procedure only with a difference that the radius of the circle is equal to actual radius of sphere to get isometric view of sphere.



5. A cone of base diameter 40 mm and axis length 50 mm is mounted centrally on the top of a square slab of side 60 mm and thickness 15 mm. Draw the isometric projection of the solids.

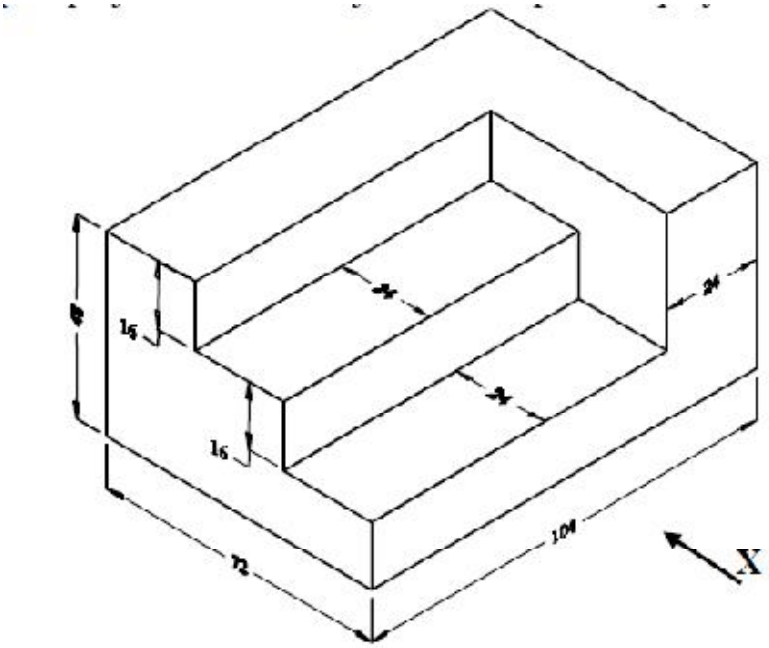
    1. Draw the isometric projection of square slab as shown below (only representation of view)
    2. Fix the centre of the top face of the square slab and fix it as centre for the cone.
    3. Draw the isometric projection of cone as described in problem 3 and completes the problem.



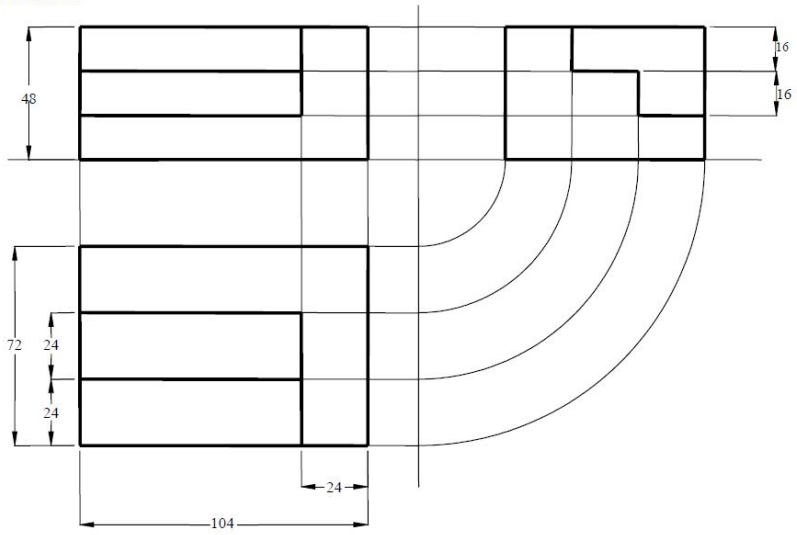
CONVERSION OF PICTORIAL PROJECTIONS TO ORTHOGRAPHIC PROJECTIONS

(PLATE NO. 10)

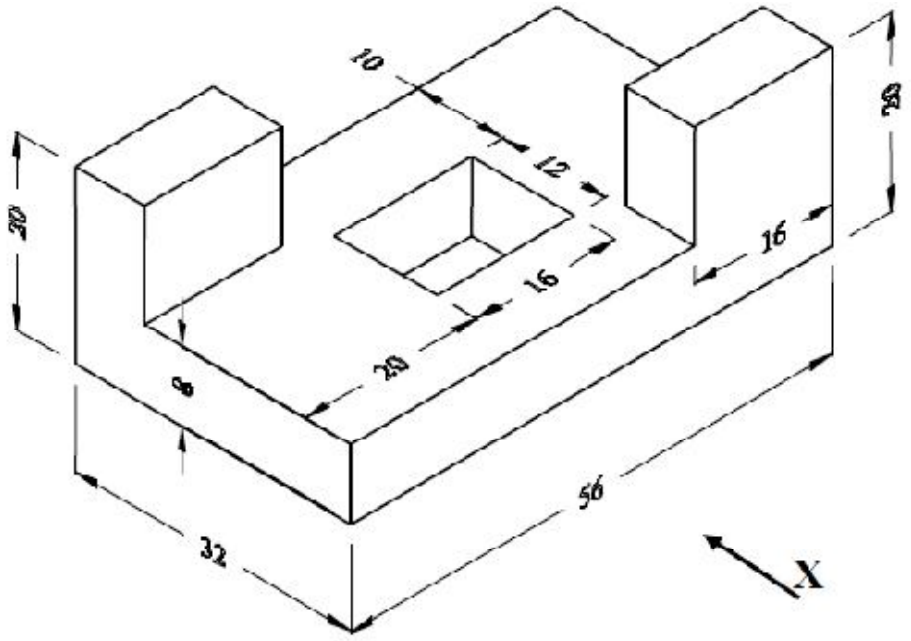
1. Draw the orthographic projections of the objects, whose pictorial projection is given as



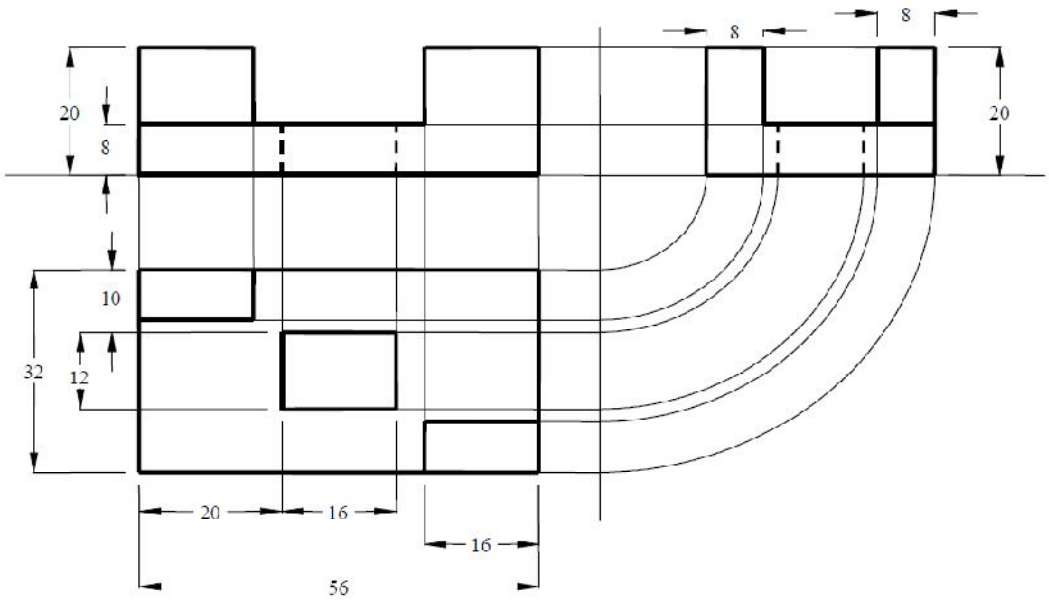
Solution:



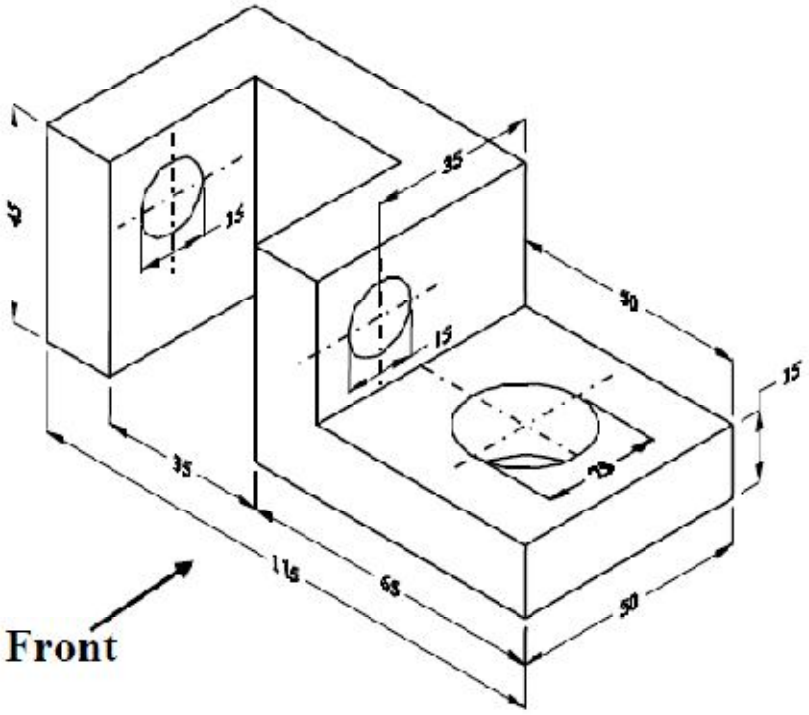
2. Draw the orthographic projections of the objects, whose pictorial projection is given as



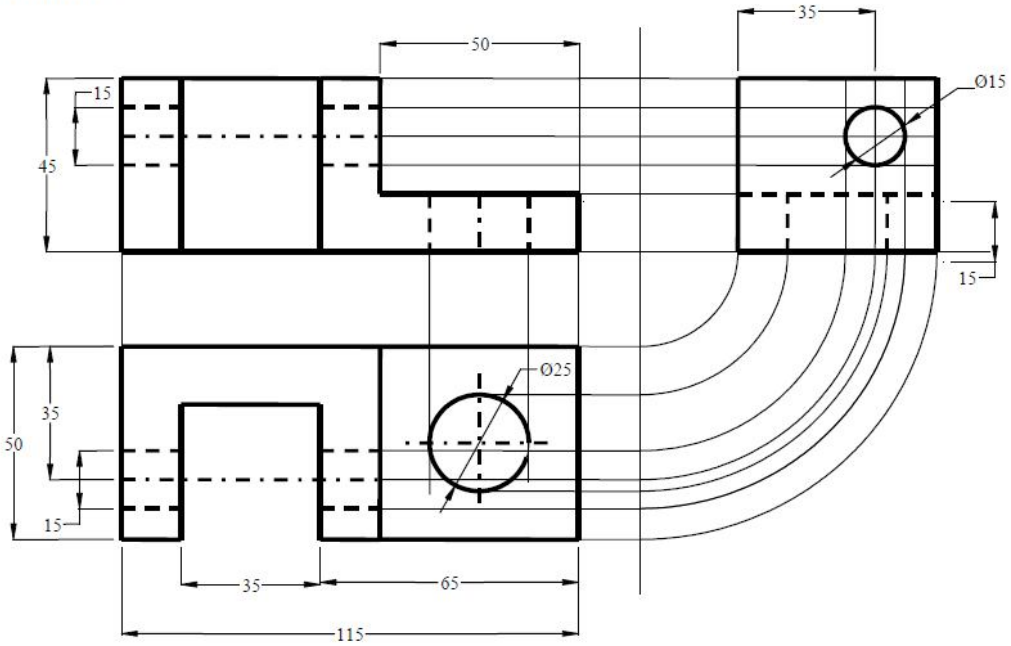
Solution:



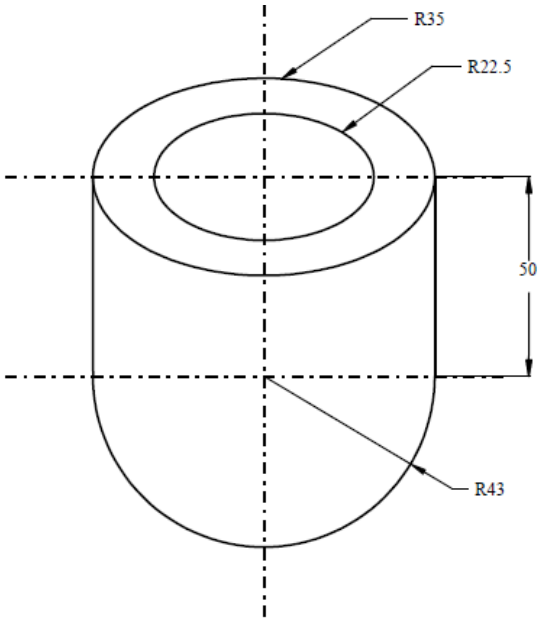
3. Draw the orthographic projections of the objects, whose pictorial projection is given as



Solution:



4. Draw the orthographic projections of the objects, whose pictorial projection is given as



Solution: