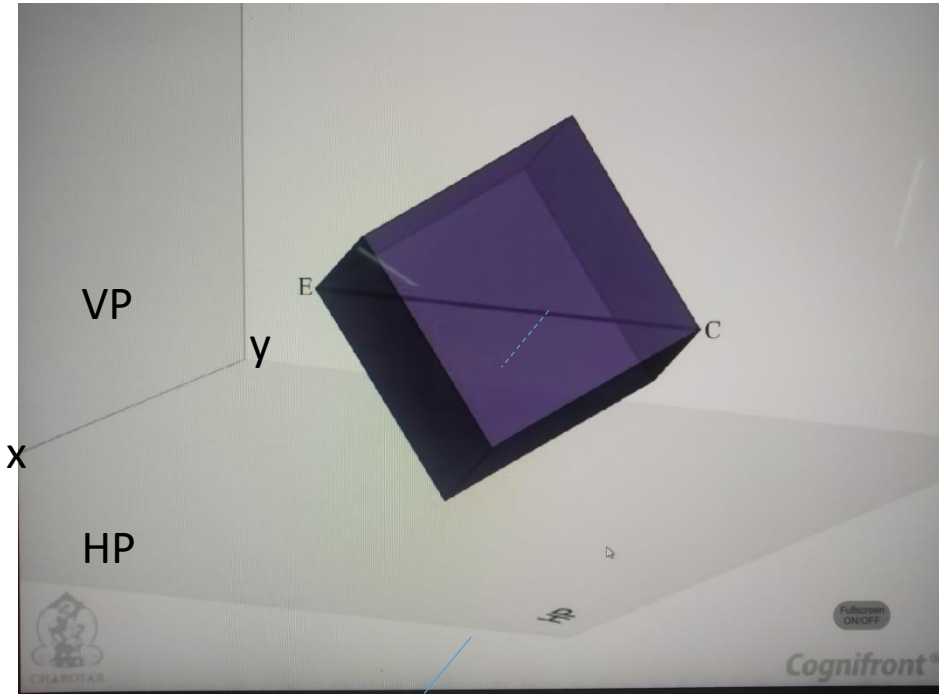
Lecture - 7

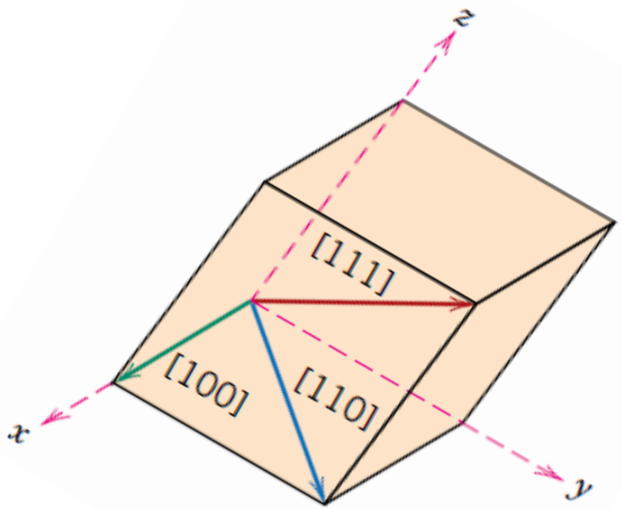
Isometric Projection

ME119, 2021-2

1. Isometric Projection of a Cube

A cube of side ‘a’ rests on the ground on one of its corners with its sides equally inclined to the V.P., and one of the body diagonals parallel to the H.P. and perpendicular to the V.P. Draw the front and top views of the cube.





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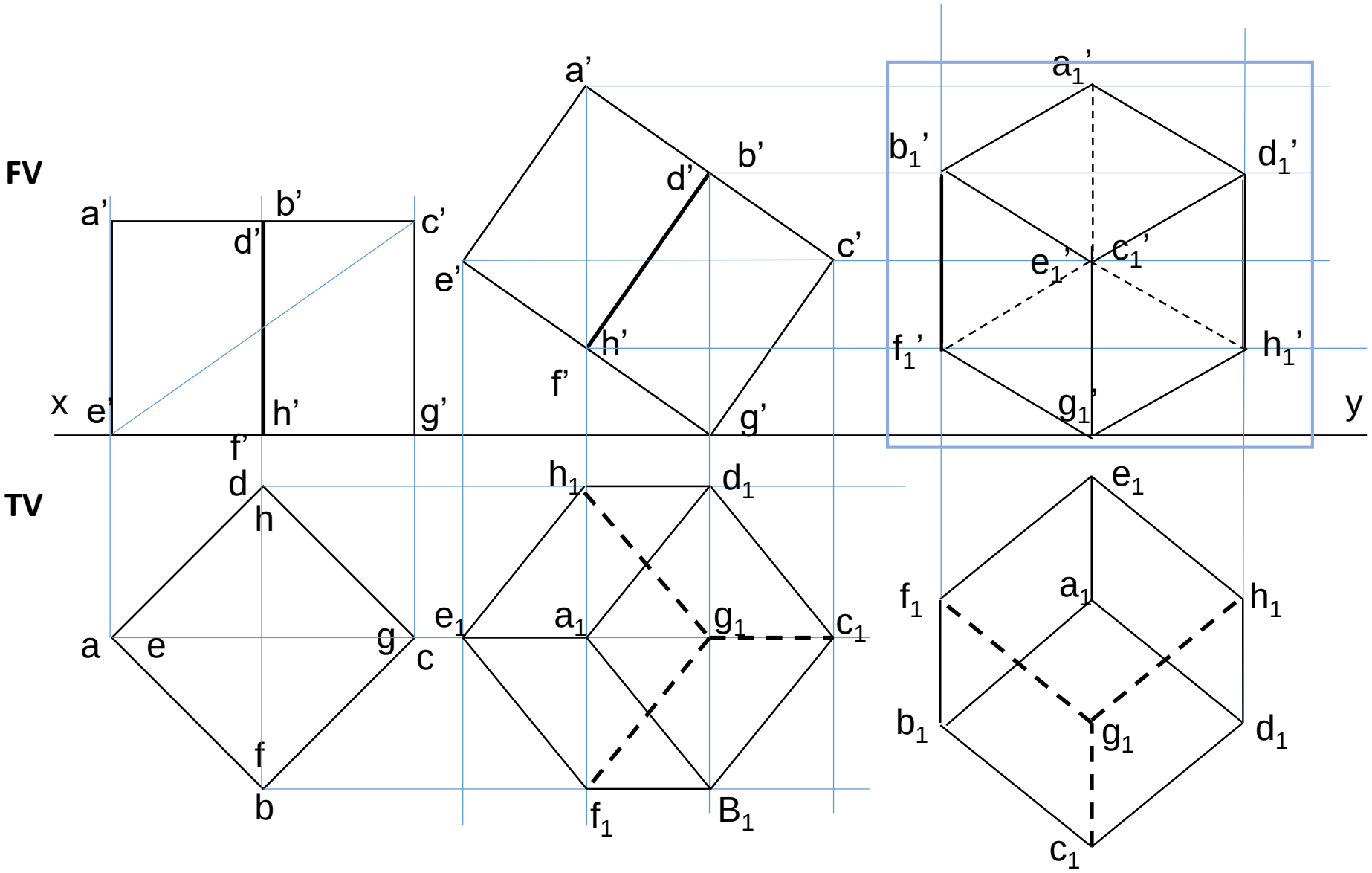


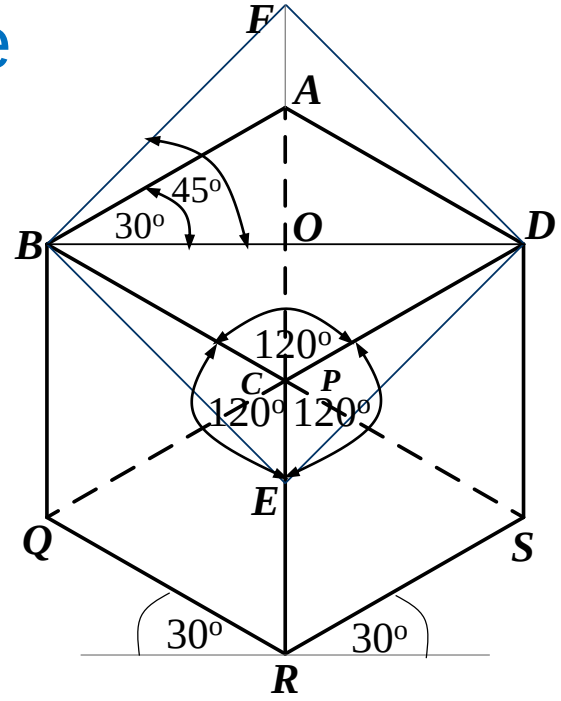
An isometric projection of a cube is found by constructing a view where one of the diagonals of the cube appears as a point

In the front view, the lengths of all the sides have decreased (foreshortened) *equally*

The top view is NOT an isometric projection because the lengths of all the edges are not foreshortened equally

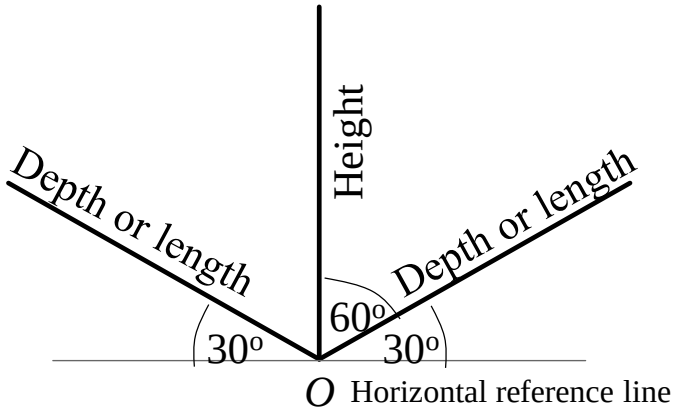
Isometric projection of cube

- All faces of the cube are equally inclined to V.P. and are seen as rhombuses
- All sides/ edges are equally shortened w.r.t original dimensions
- Hence isometric projection is smaller than the object



BEDF: Square with true edge length

- **Isometric axes**: The three lines CD, CB & CR meeting at C and making an angle of 120° w.r.t each other
- **Isometric lines**: Lines ‖ isometric axes. Also referred to as iso-lines
- **Non-Isometric lines**: Lines not ‖ isometric axes. Also referred to as non-isolines
- **Isometric planes**: Planes representing faces of cube as well as other planes ‖ to these planes
- **Non-Isometric planes**: Planes not ‖ to isometric planes
- **Origin or Pole point**: Point on which a given object is supposed to be resting on H.P such that the three isometric axes originating from that point make equal angles to plane of projection

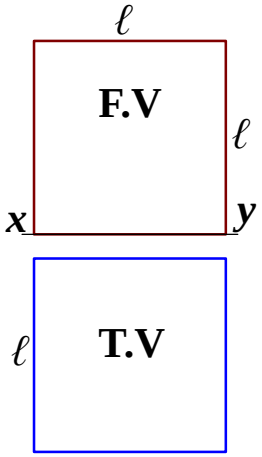


Relation between true length and isometric length

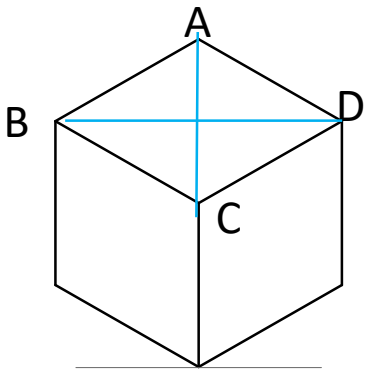
$$AB = \frac{BO}{cos30} = \frac{BFcos45}{cos30} = \frac{l/\sqrt{2}}{\sqrt{3}/2} = l\sqrt{\frac{2}{3}} \text{ or, } \frac{isometric\ length}{true\ length} = \sqrt{\frac{2}{3}} \approx 0.82$$

- All isolines are reduced in the same ratio
- Non-isolines are not reduced in any fixed ratio

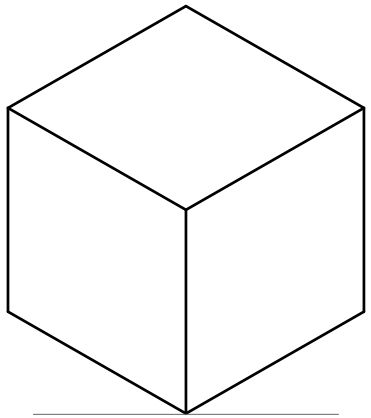
$$\frac{\text{Isometric length of AC}}{\text{True length of AC}} = \frac{1}{\sqrt{3}} \qquad \frac{\text{Isometric length of BD}}{\text{True length of BD}} = 1$$



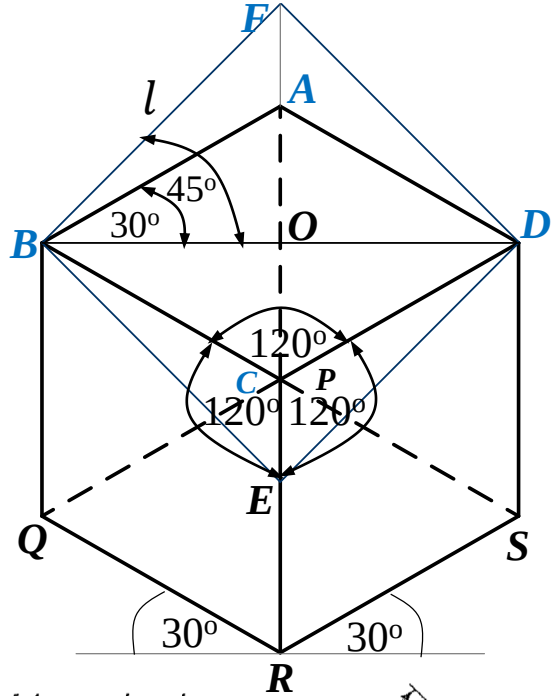
Orthographic projection of cube



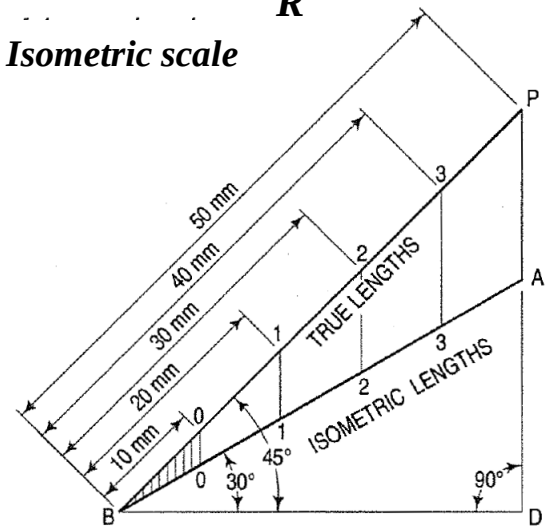
Isometric projection of cube **(drawn with isometric length for isolines)**



Isometric drawing/view of cube **(drawn with true length for isolines)**



Isometric scale



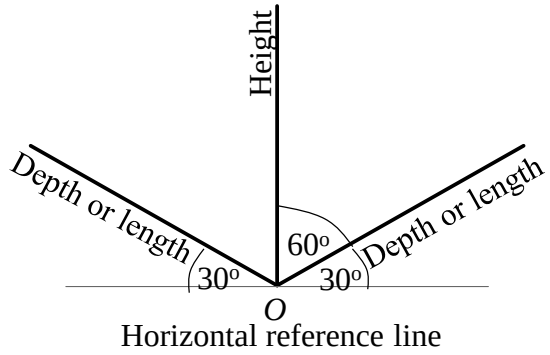
Source: N.D. Bhatt

Advantages of isometric view:

- Ease in construction
- Directly infer dimensions of isolines from the drawing

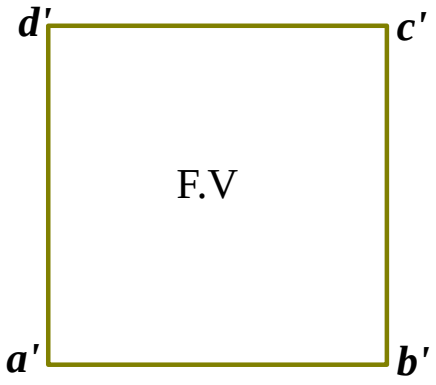
Lines in isometric view, isometric projection:

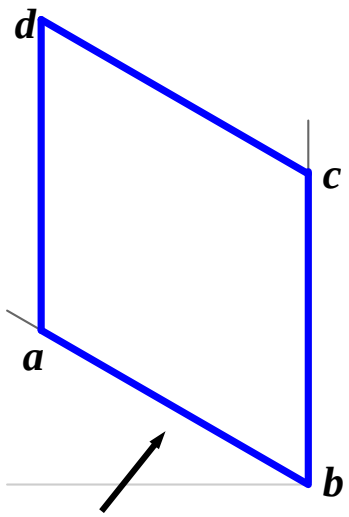
- Lines || on object are || in the drawing
- Vertical lines on object appear vertical in projection
- Horizontal lines on object are drawn at an angle of 30° w.r.t horizontal reference line in isometric projection
- Non-isometric lines are drawn by locating positions of their ends on isometric planes and joining them
- Hidden lines are usually not shown

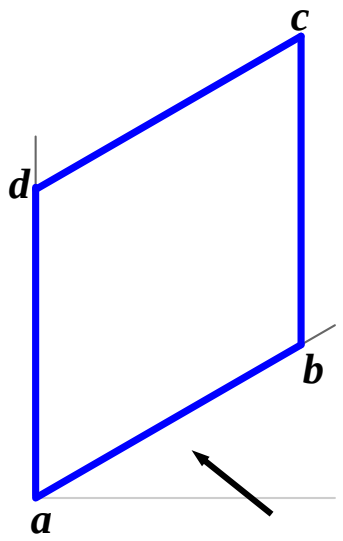


Isometric drawing of plane figures

Square in V.P

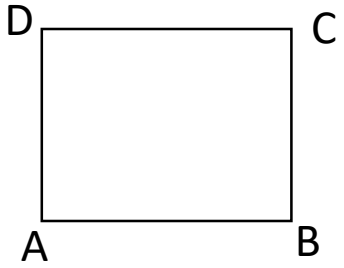


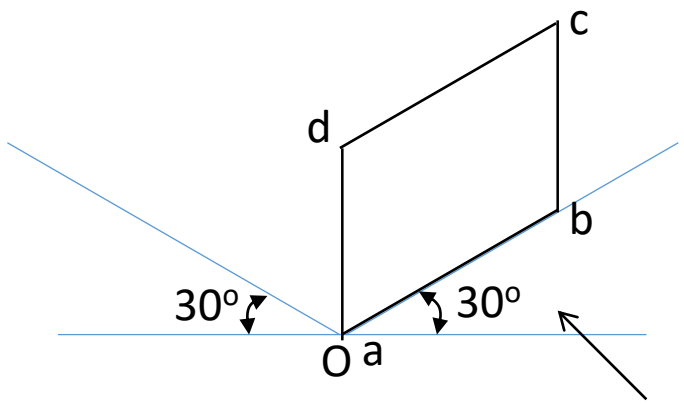




Isometric Drawing of a Plane

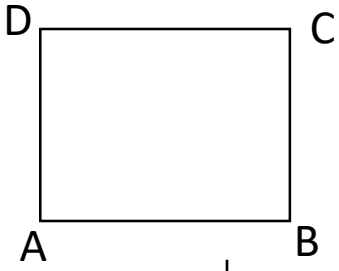
Front view of a plane which is parallel to the V.P. is shown below. Draw its isometric view

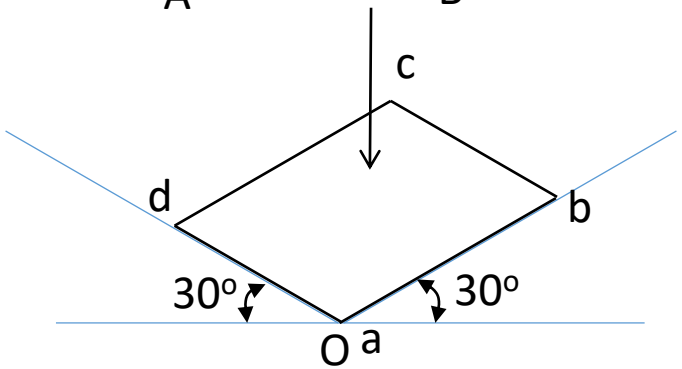




l(AB) = l(ab), l(BC) = l(bc),
l(DC) = l(dc), l(AD) = l(ad)

Top view of a plane which is parallel to the H.P. is shown below. Draw its isometric view





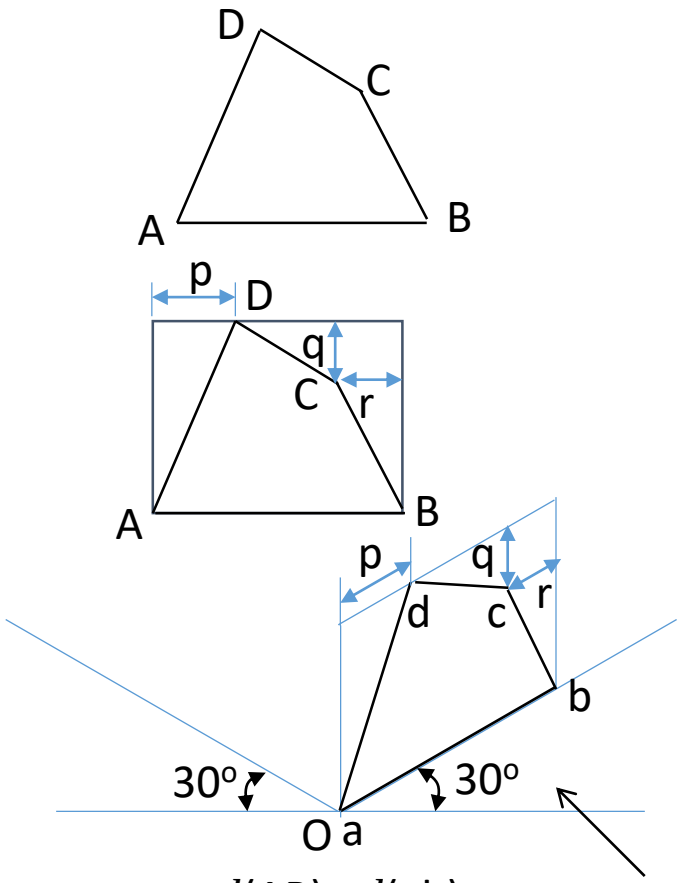
l(AB) = l(ab), l(BC) = l(bc),
l(DC) = l(dc), l(AD) = l(ad)

Measurements in the horizontal and the vertical directions in the front view are perpendicular to the P.P. and the H.P., respectively

Measurements in the horizontal and the vertical directions in the top view are perpendicular to the P.P. and the V.P., respectively

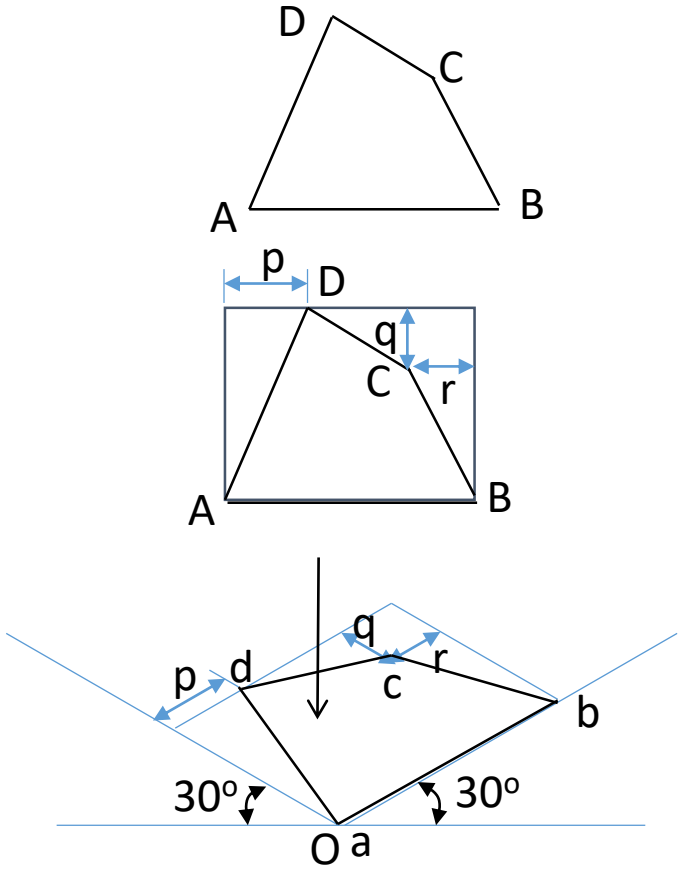
Isometric Drawing of a Plane with Sides not Parallel to the Coordinate Axes

Front view of a plane which is parallel to the V.P. is shown below. Draw its isometric view



l(AB) = l(ab)

Top view of a plane which is parallel to the H.P. is shown below. Draw its isometric view

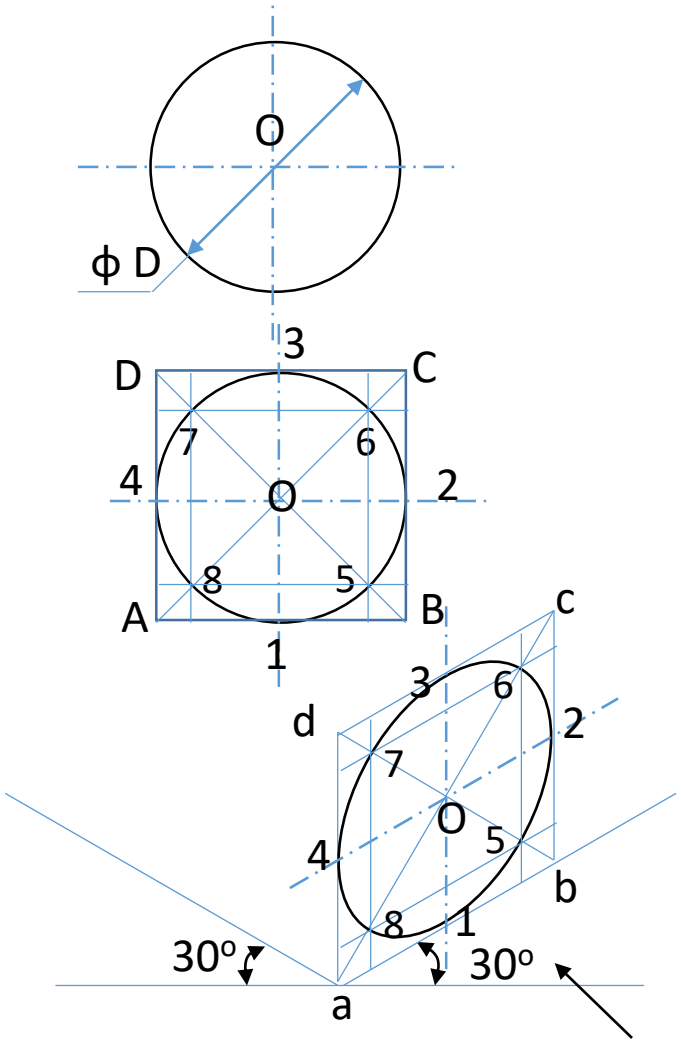


l(AB) = l(ab)

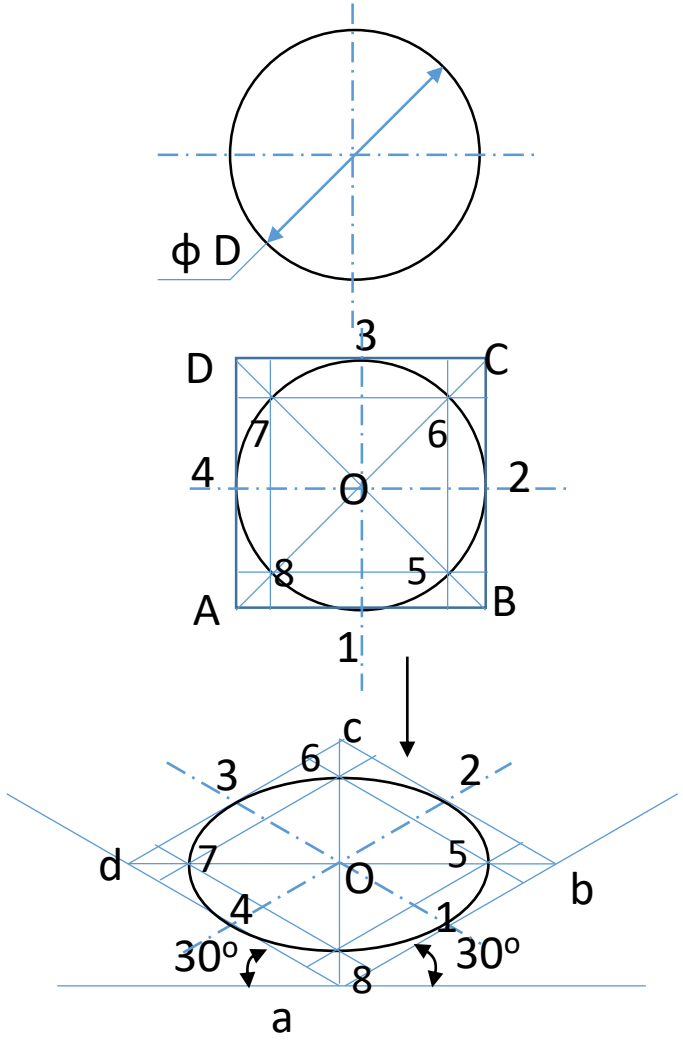
Non-isometric lines are drawn by locating the position of their extremities on isometric planes and then connecting them

Isometric Drawing of a Circle

Front view of a circle which is parallel to the V.P. is shown below. Draw its isometric view



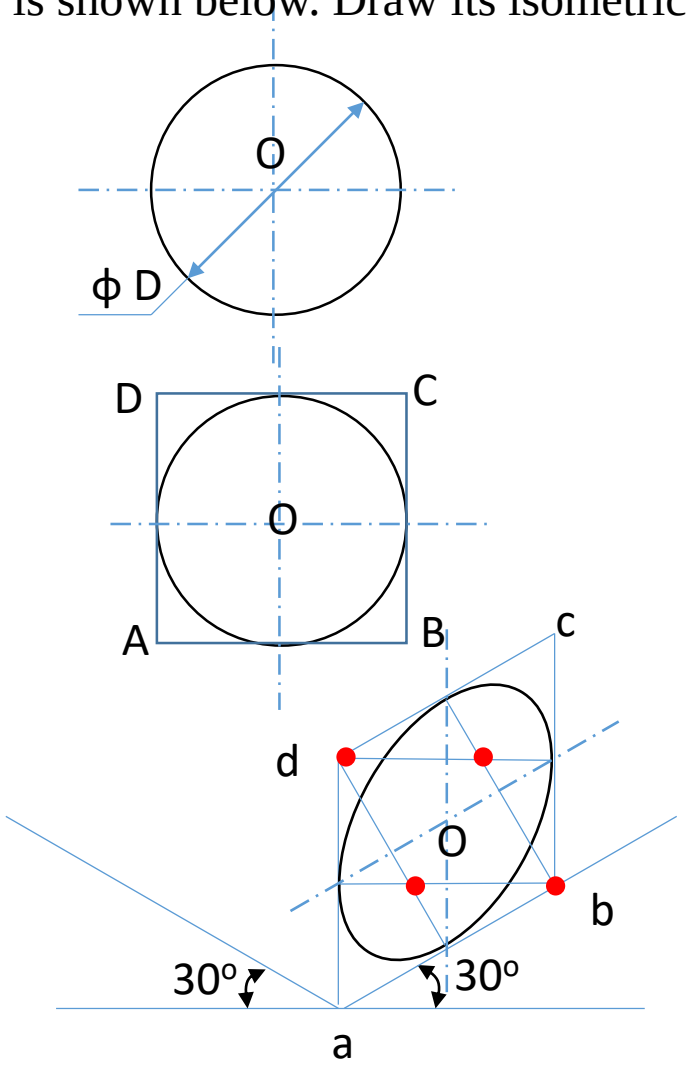
Top view of a circle which is parallel to the H.P. is shown below. Draw its isometric view



The length of the major axis is greater than the true diameter of the circle

Isometric Drawing of a Circle – Four Center Method

Front view of a circle which is parallel to the V.P. is shown below. Draw its isometric view.



The ellipse is *assumed* to be made up of arcs of four circles.

-Assume that a square circumscribes the circle in the orthographic projection

-In the isometric view, the square becomes a rhombus and the circle becomes an ellipse which is tangent to the rhombus at the midpoints of the sides

-Draw the bisectors of the sides of the rhombus

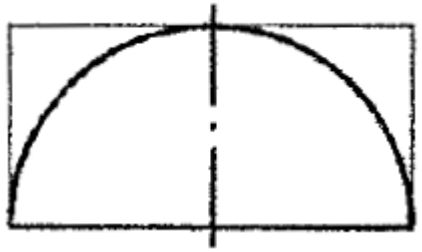
-The points of intersection of the four bisectors are centers of the arcs of the center (red dots)

-The two centers that lie at the corner of the rhombus are centers of the larger arcs, while the remaining intersections are centers of the smaller arcs

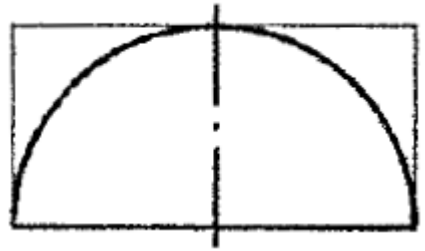
However, the 4-centre method does not give a true ellipse. It only approximates the true ellipse, but simplifies the drawing of it compared to free-hand drawing.

Half circle problems

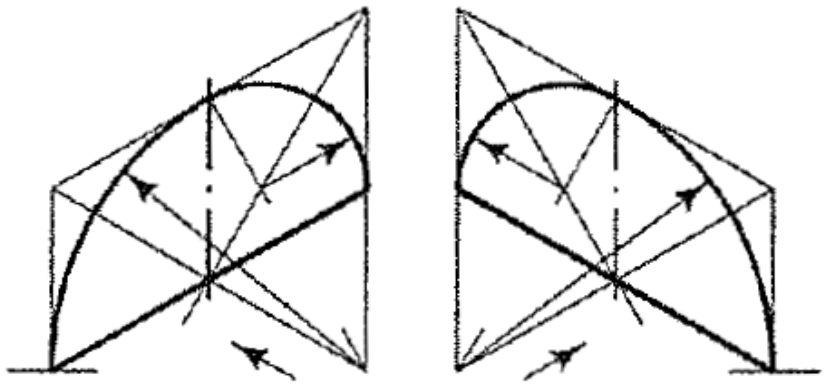
VP

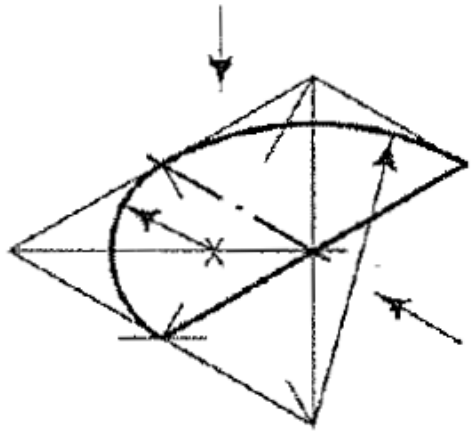


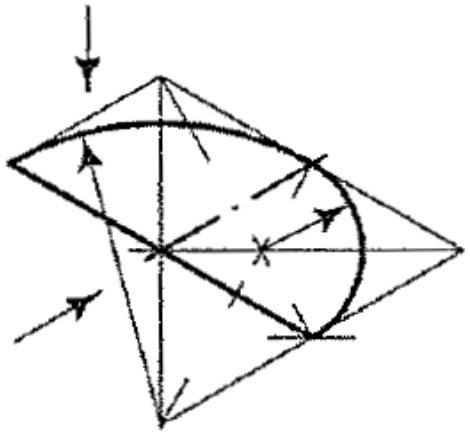
HP



Isometric view

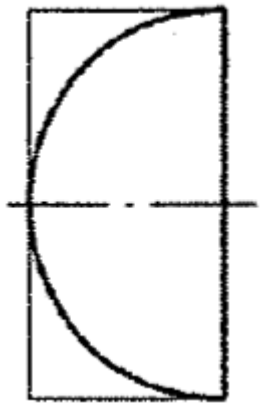


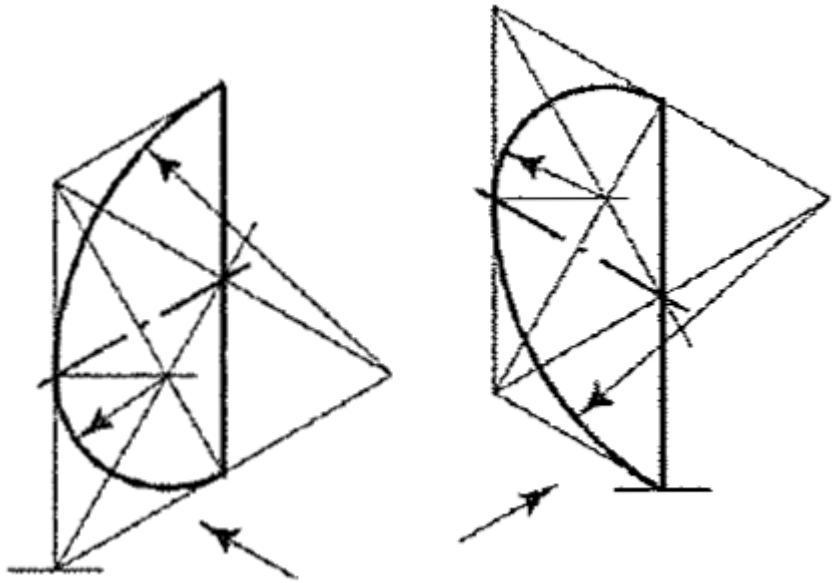




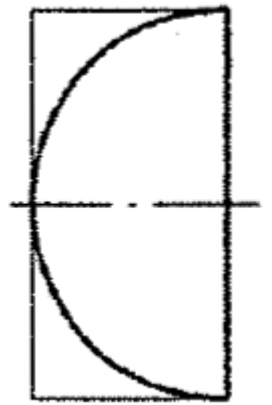
Half circle (oriented)

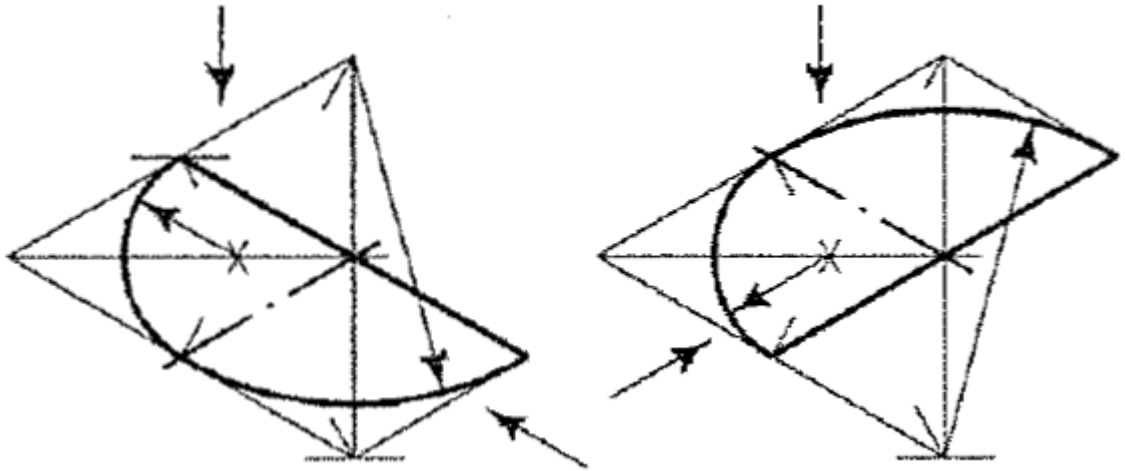
FV





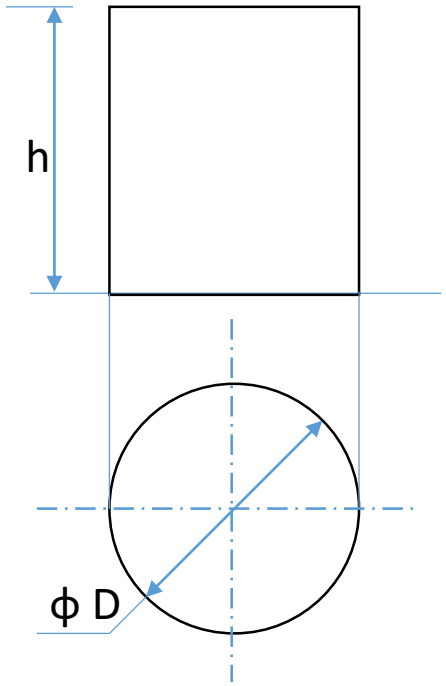
TV

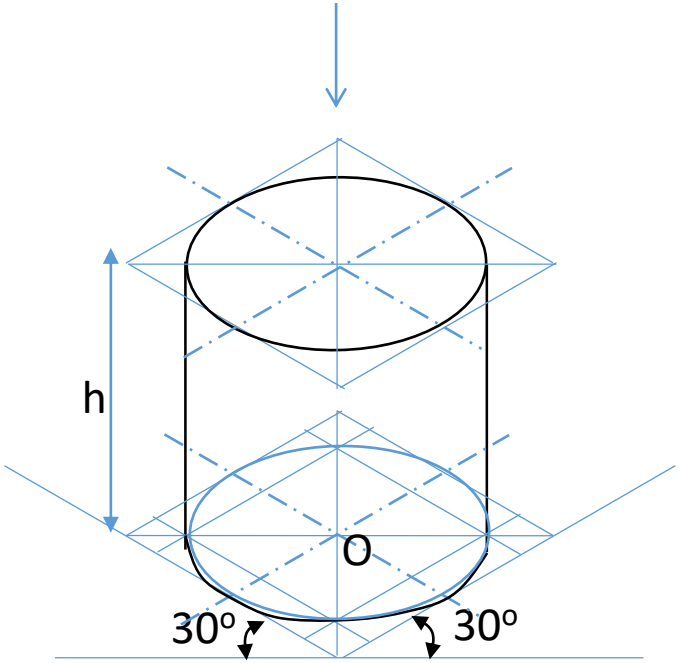




Isometric Drawing of a Cylinder

The front and the top view of a cylinder which is resting on the H.P. is shown below. Draw its isometric view

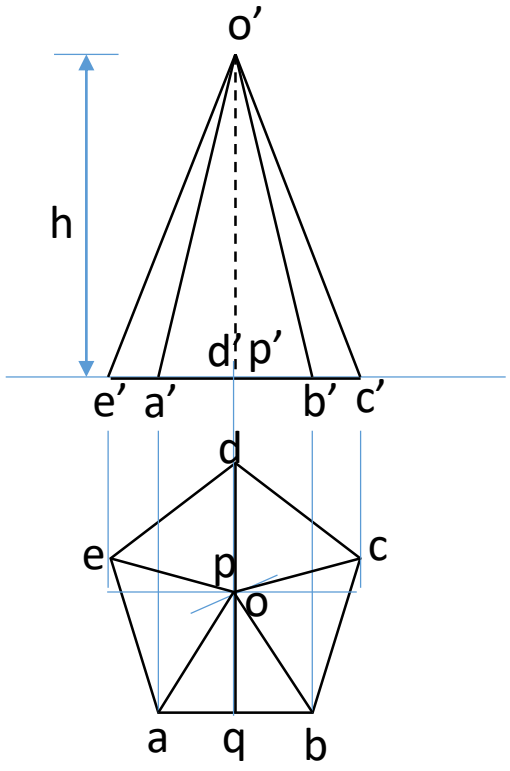




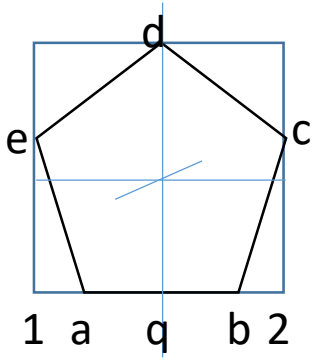
Hidden lines are not shown in isometric views. (for the labs, keep construction lines)

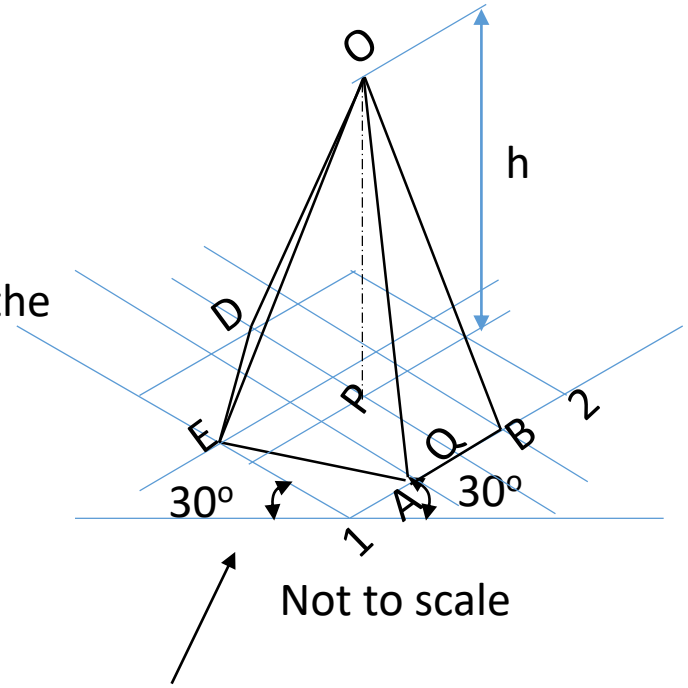
Isometric Drawing of a Pentagonal Pyramid

The front and the top view of a right pentagonal pyramid which is resting on the H.P. is shown below. Draw its isometric view



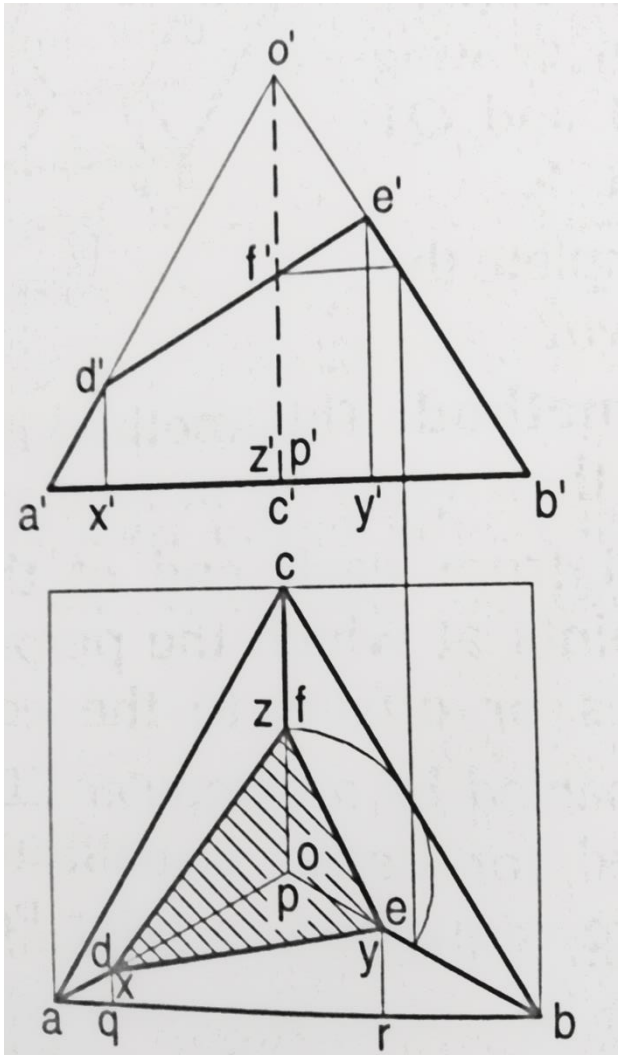
Circumscribe a rectangle around the pentagon.

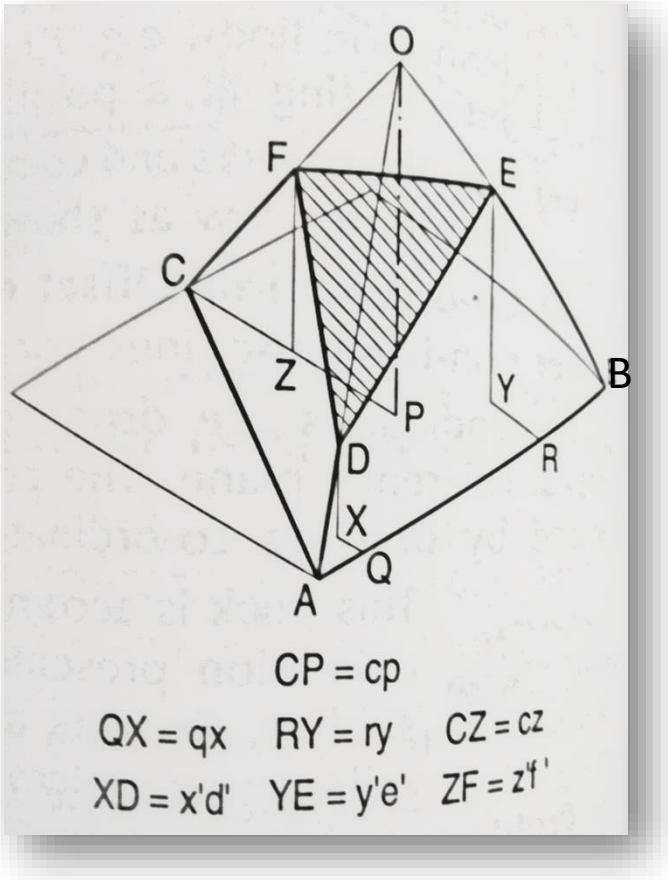




Isometric Drawing of a Truncated Pyramid

The front and the top view of a truncated right triangular pyramid which is resting on the H.P. is shown below. Draw its isometric view



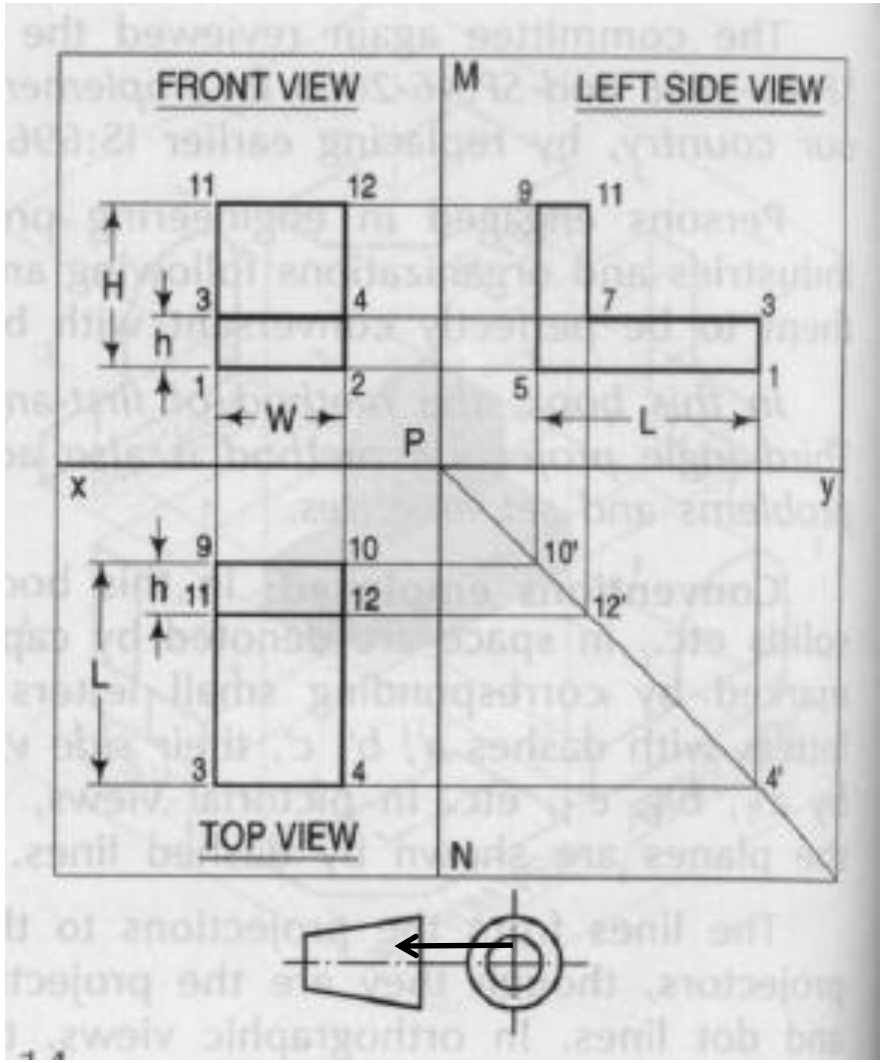


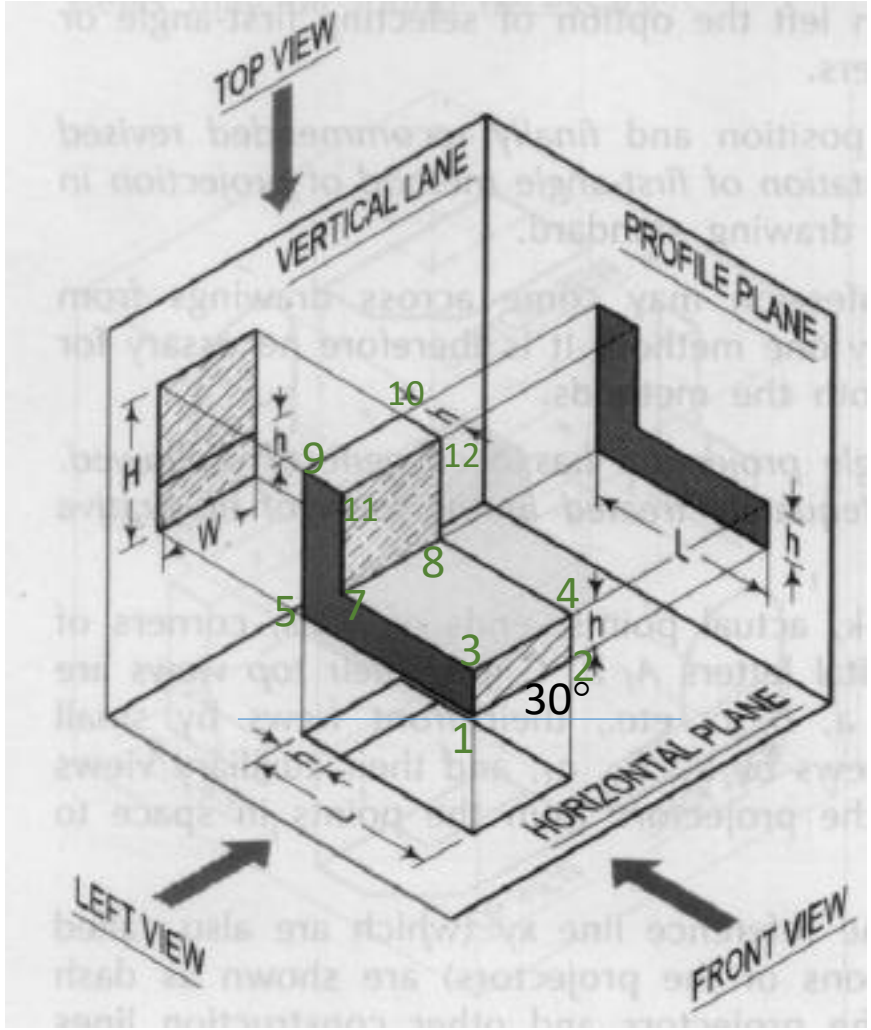
Construction lines can be drawn by lighter pencil ('H' type) and to be retained. Lines and points which are hidden are not be shown.

N. D. Bhat – pg 428

Isometric Drawing of a Typical Solid - 1

Draw the isometric drawing of the solid whose orthographic projection is as shown below

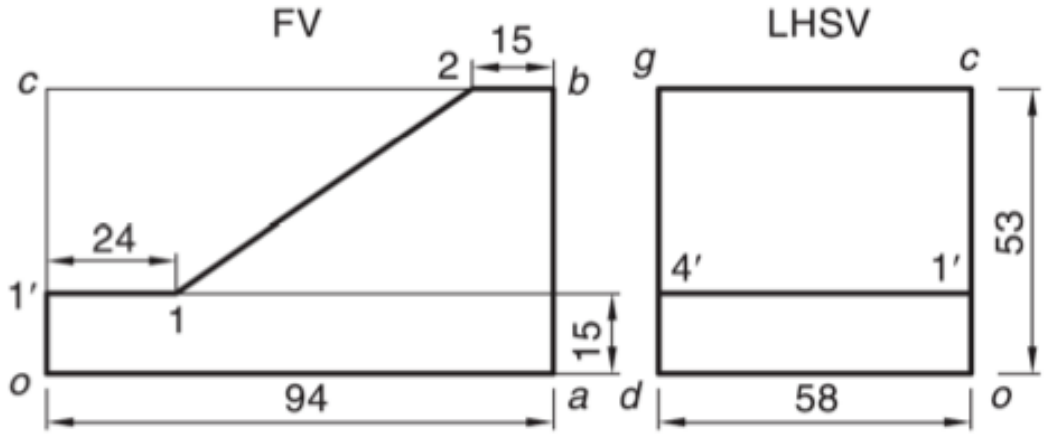


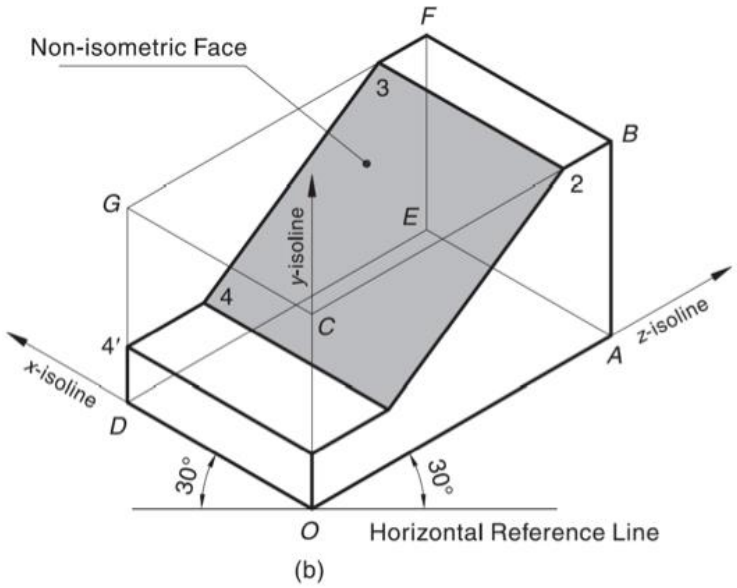


Ref: Engineering Drawing by N. D. Bhatt et. al

Isometric Drawing of a Typical Solid - 2

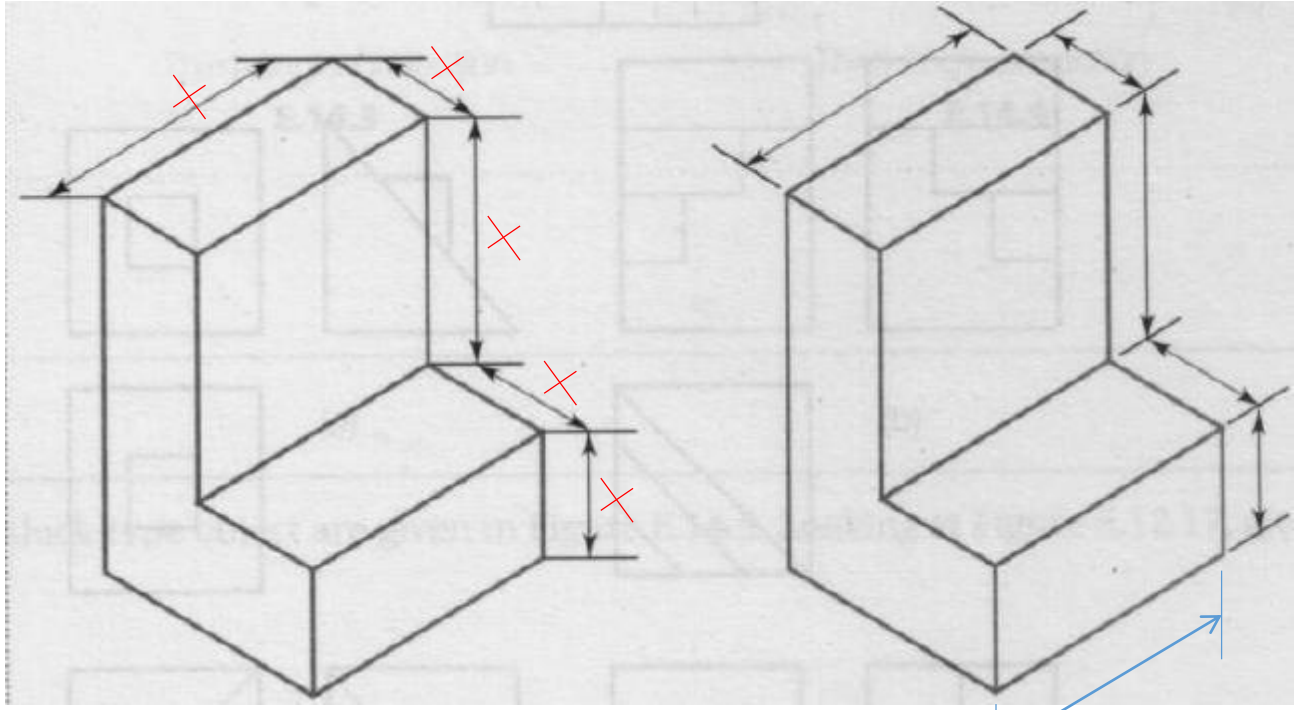
Draw the isometric drawing of the solid whose orthographic projection is as shown below





(b)

Dimensioning conventions



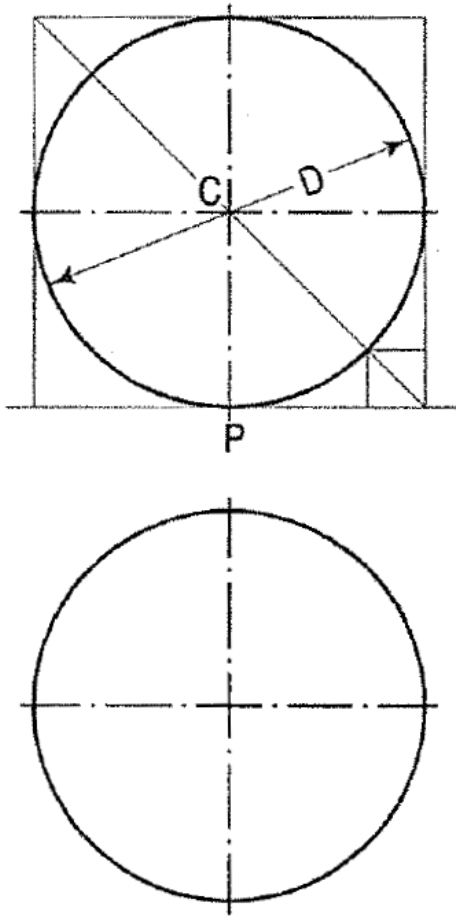
Incorrect

Correct

Engineering Drawing, Shah and Rana

Problem: Isometric projection of a sphere

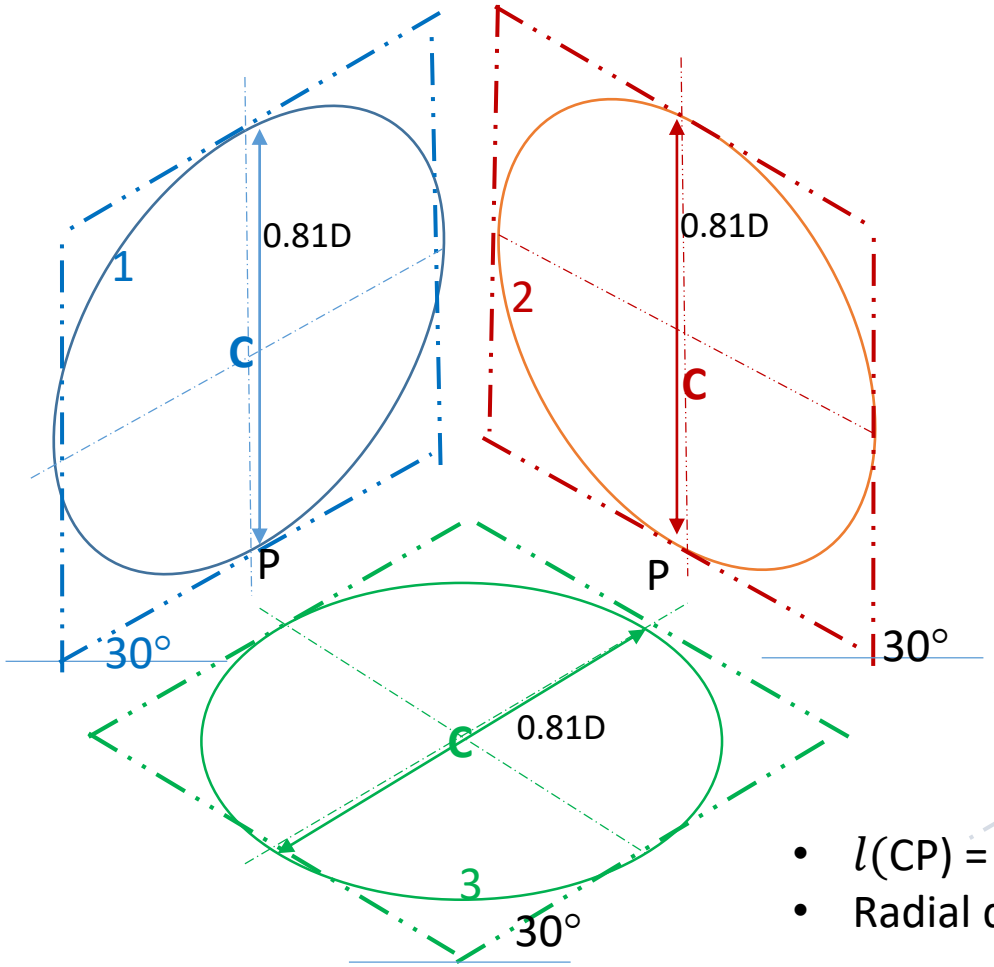
- The orthographic projection of a sphere seen from any direction is a circle of diameter equal to the diameter of the sphere. Hence, the isometric projection of a sphere is also a circle of the same diameter (no foreshortening).
- But other dimensions, like the distance of the centre from the base plane will be foreshortened

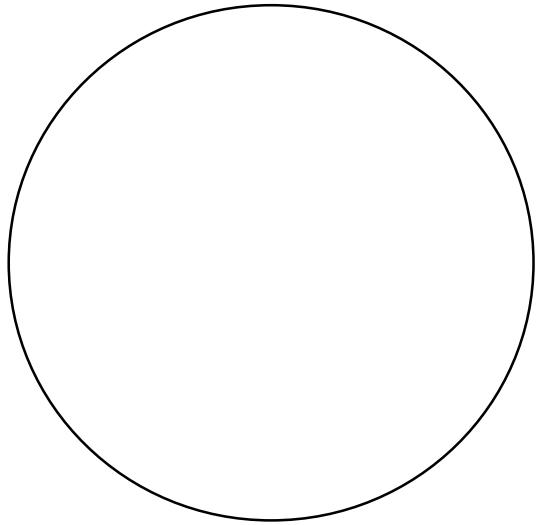


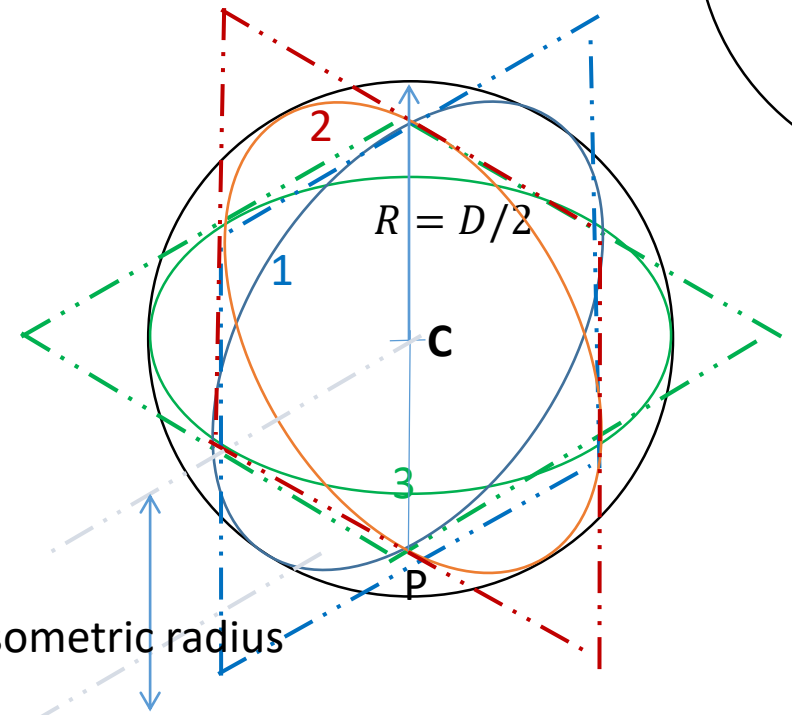
Because the sphere dimensions do not get foreshortened, but other associated distances or dimensions of other objects associated with the sphere get foreshortened, we will draw isometric projections (not views or drawings).

Constructing the isometric *projection* of a sphere

Draw circles in three usual isometric planes (as ellipses).
Superimpose and circumscribe with a circle





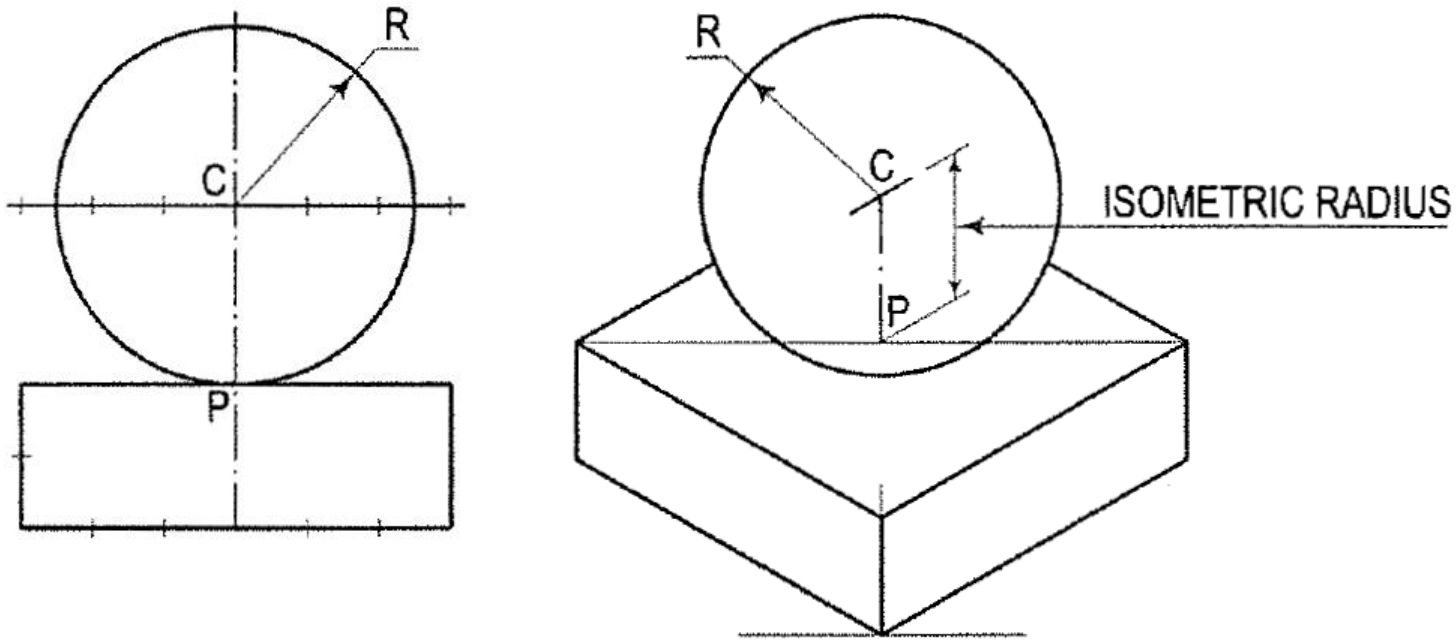


- l(CP) = 0.81 R (usual foreshortening) is called the **isometric radius** of the sphere
- Radial directions will be foreshortened

Isometric projection of a sphere is a circle whose diameter is equal to the true diameter of the sphere

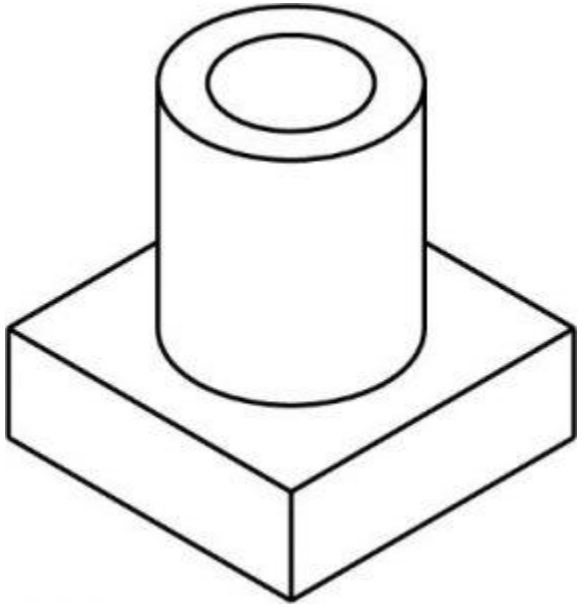
Isometric scale must be used while drawing isometric projections of solids in conjunction with spheres or spherical parts

Sphere resting on square prism

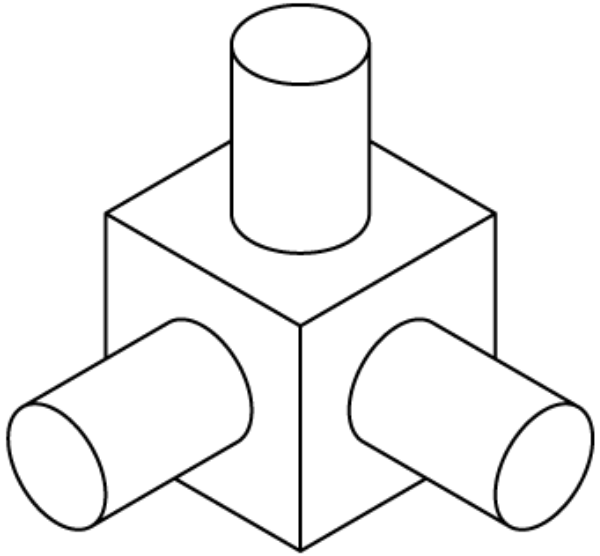


- Draw the isometric projection (using isometric scale) of the square prism and locate the centre *P* of its top surface
- Draw a vertical at *P* and mark a point C on it, such that *PC* = the *isometric radius* of the sphere $\cong 0.82R$
- With C as centre and *radius equal to the radius of the sphere,* draw a circle which will be the isometric projection of the sphere

Standard shapes for reference

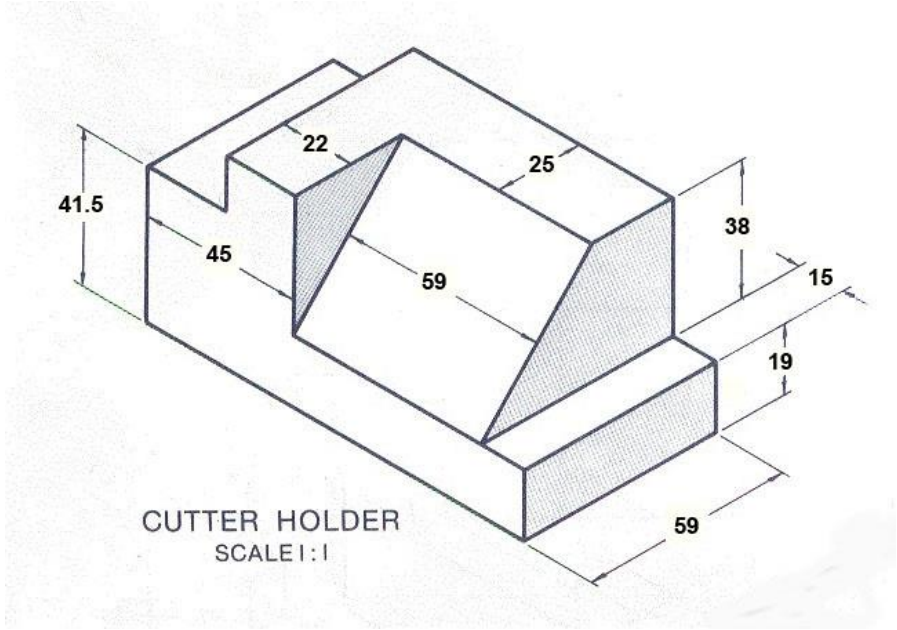


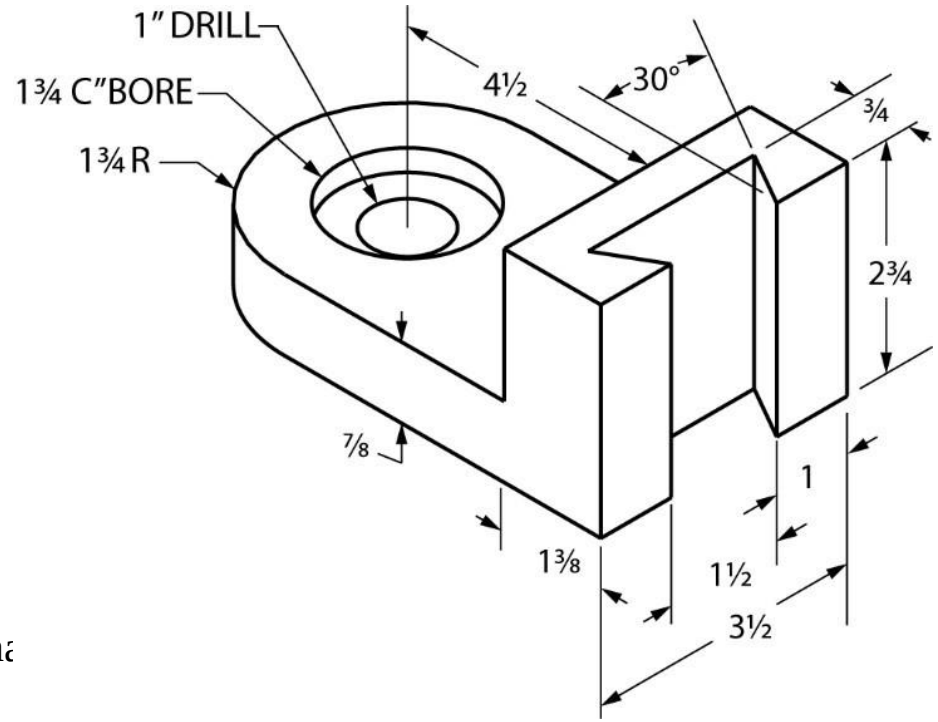
Hollow cylinder resting on solid block



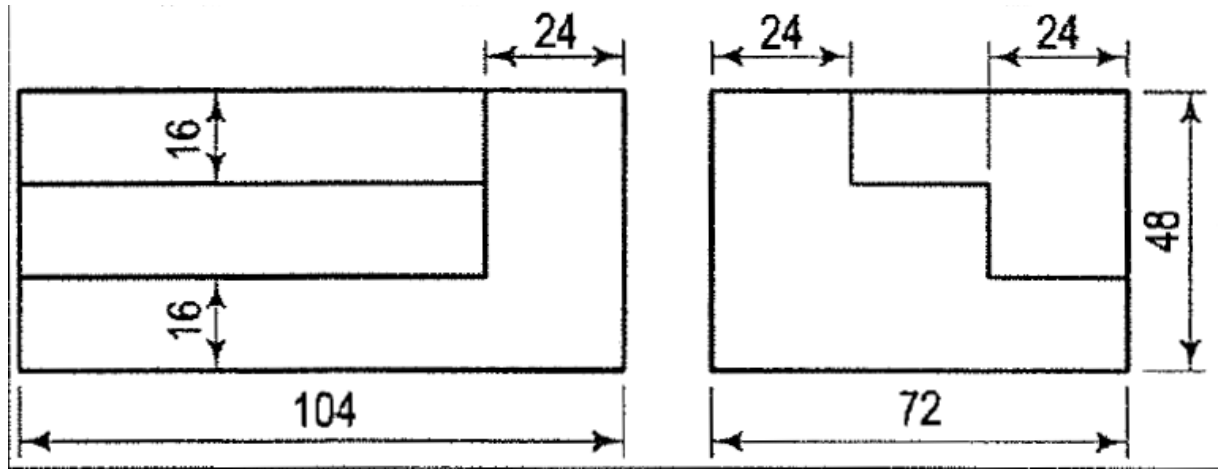
Cylindrical bosses on the faces of cube

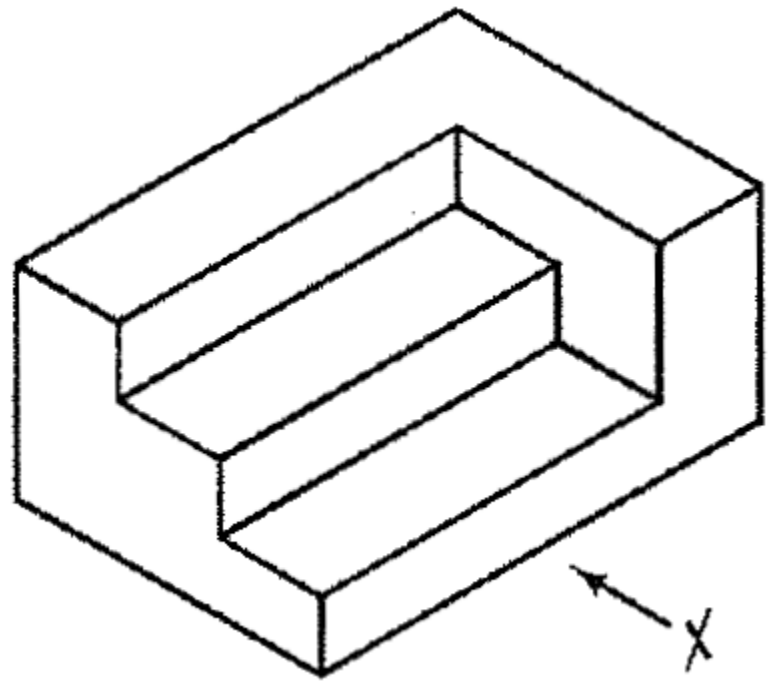
Dimensioning conventions



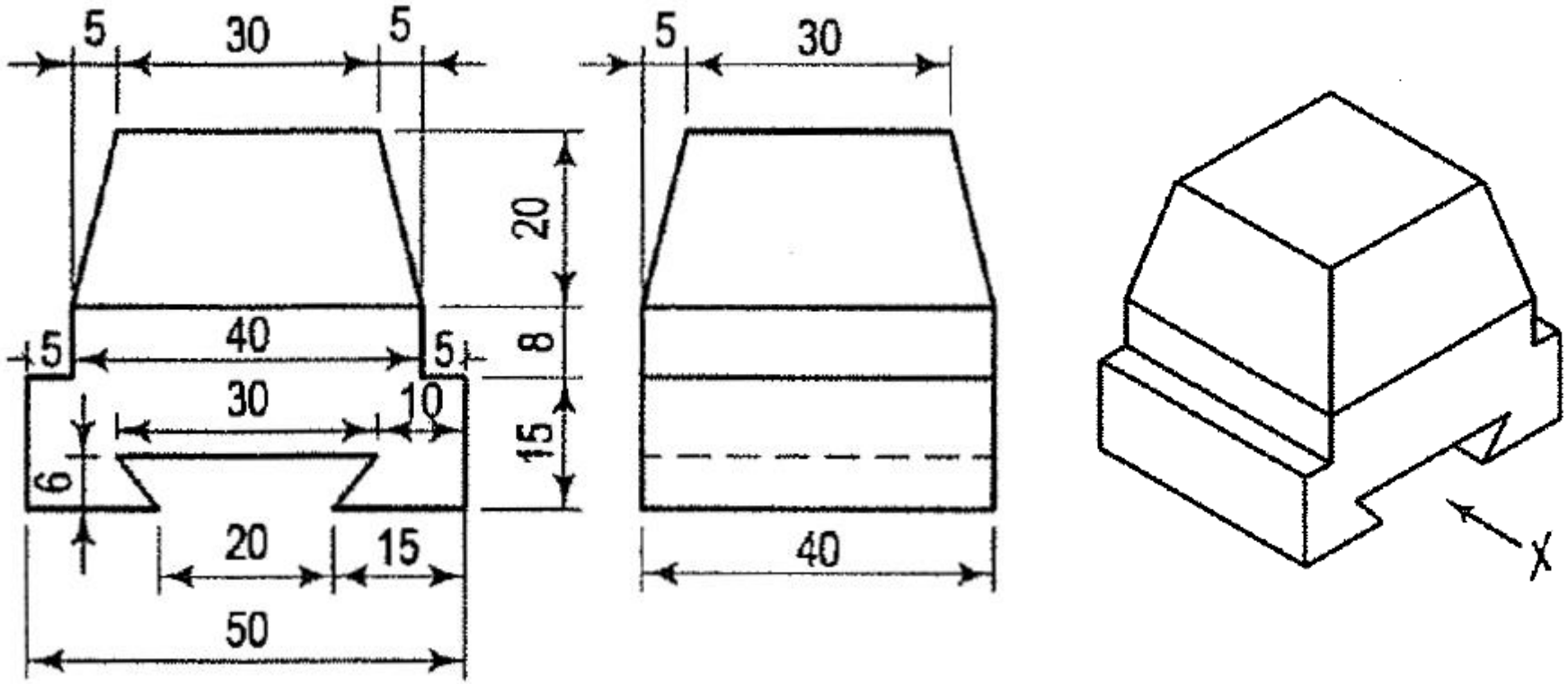


- Dimensions are applicable to isometric lines or circles.
- The extension lines are parallel to isometric lines (except while showing angles)
- The numbers and angles can be straight-up, but progress at +30° or -30° for slanted iso-lines or horizontally for vertical lines.
- Different styles exist but good to stick to one style and be self consistent.





Solution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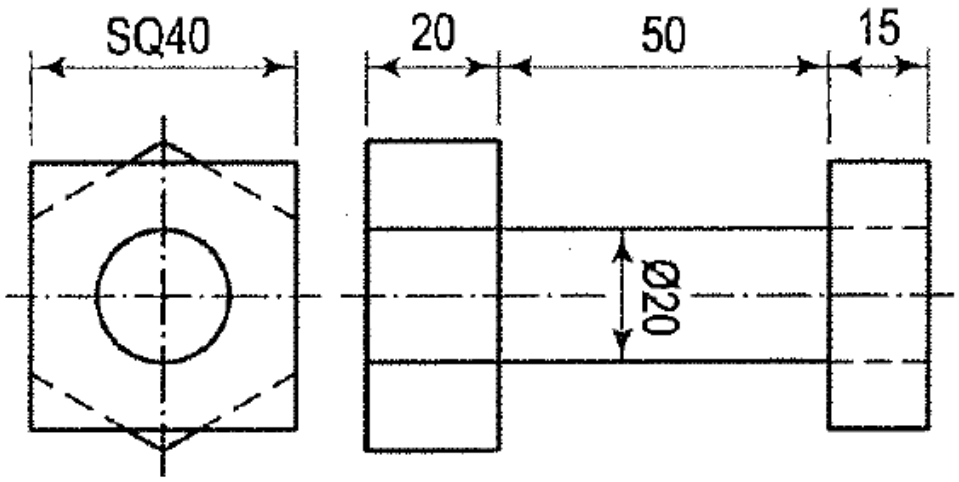
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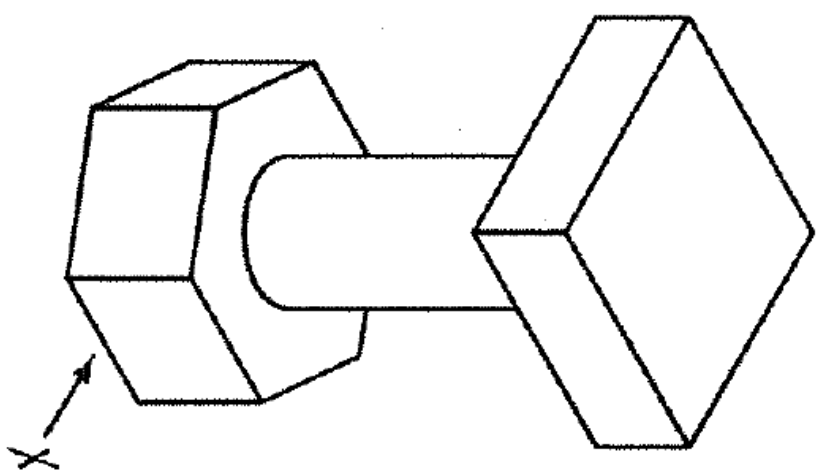
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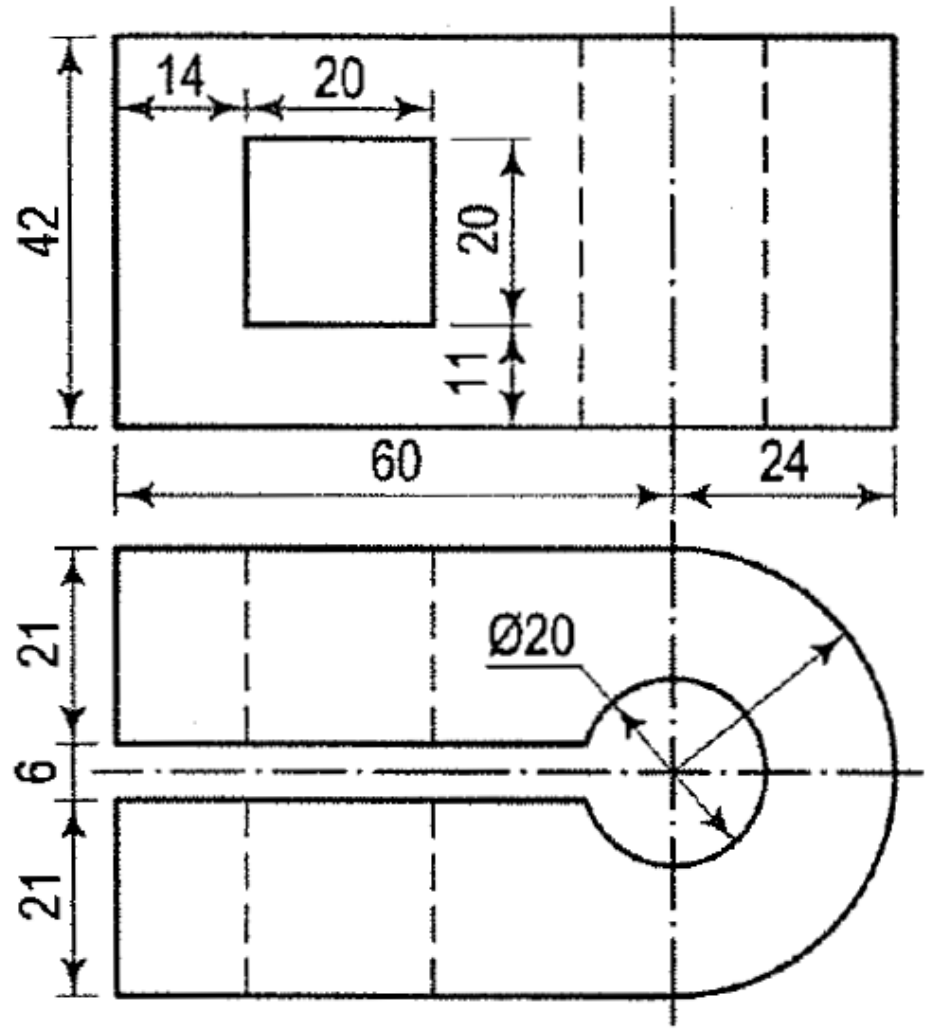
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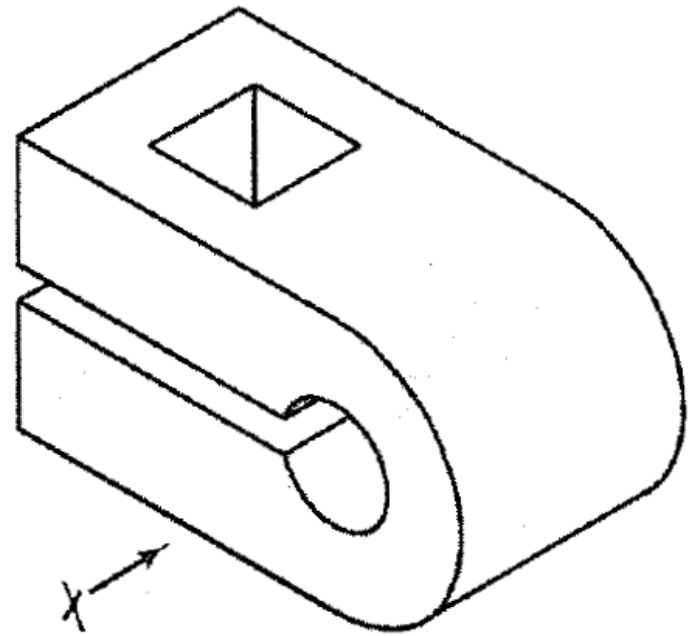
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Thank you