

6.0 Isometric Projections (Using Solidworks)

SEMESTER: I/II

**COURSE TITLE: COMPUTER AIDED ENGINEERING
GRAPHICS**

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Solution Manual

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What Is Isometric Projection?

- Isometric drawing, also commonly called isometric projection, is a method of graphic representation of three-dimensional objects through drawing.
- In isometric projection, the plan shows the three visible sides of the object from the same angle to each other. Hence, the isometric projection shows the sides of the object at an angle of 120° to each other. These lines of the object are called isometric axes.
- In isometric projection, two isometric axes are held at an angle of 30° with the horizontal plane. While the third axis forms an angle of 90° with the horizontal plane.
- Graphic representations of three-dimensional objects used by engineers, technical illustrators, and architects are made using the Isometric projection.

Isometric Scale

An isometric projection is formed using an isometric scale. Using this scale, the actual dimensions of the object are converted to isometric dimensions.

In the fig 1, line DP the line shows the true scale, while the line DA gives the isometric length.

From the similar triangles DPO and DAO, OD is the common side which may be written as $DP \cos 45^\circ = DA \cos 30^\circ$

$$DP \times \frac{1}{\sqrt{2}} = DA \times \frac{\sqrt{3}}{2} \Rightarrow DA = \left[\frac{2}{\sqrt{2} \times \sqrt{3}} \right] DP = \sqrt{\frac{2}{3}} \times DP = 0.816 \times DP$$

$$\text{Isometric length} = 0.816 \times \text{True length} \approx 0.82 \times \text{True length}$$

Fig 2 shows the graphical method to obtain isometric length from true lengths, which is based on the above relationship.

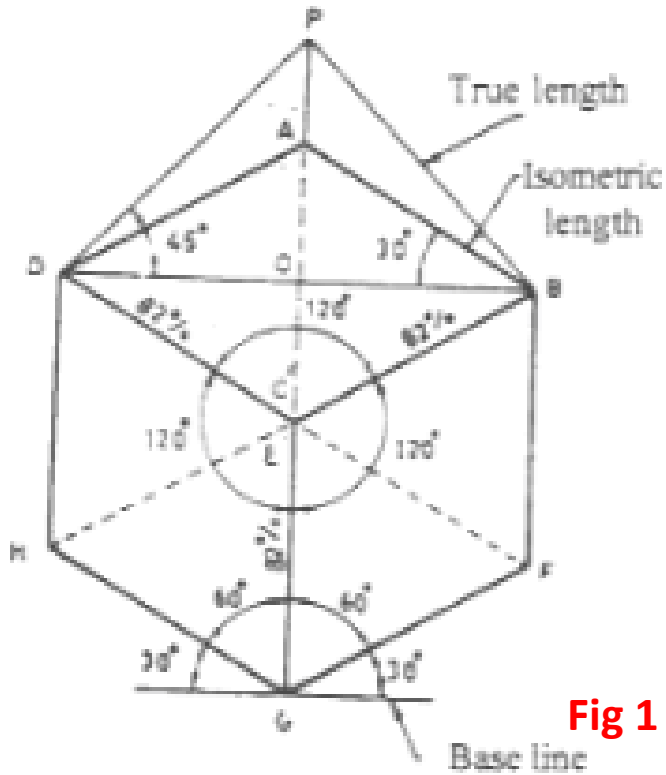


Fig 1

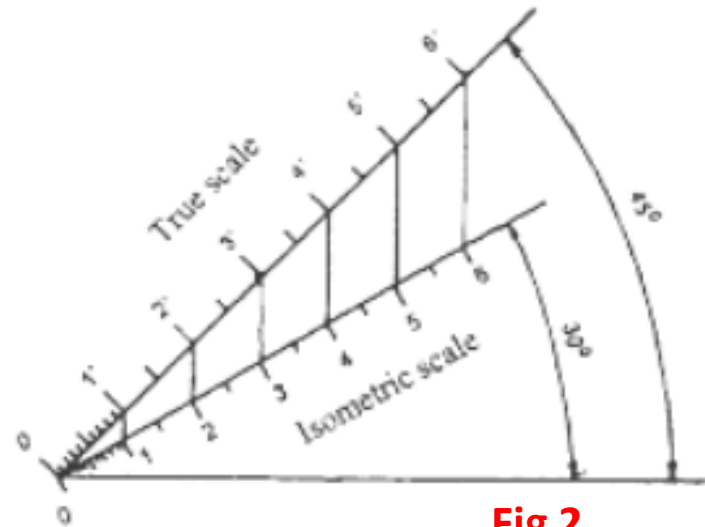
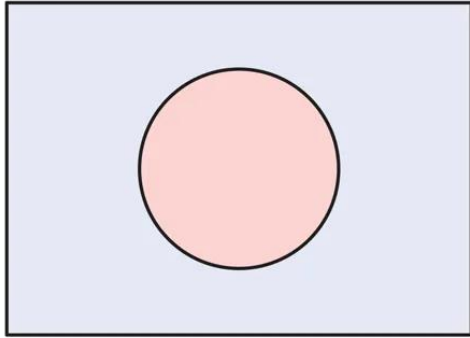


Fig 2

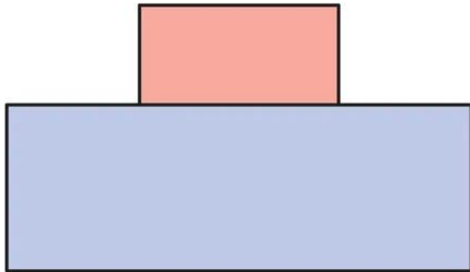
Lines in Isometric Projection

- A line drawn parallel to the isometric axis of the object is called the **isometric line** and its length is reduced by 82%.
- A line in isometric drawing that is not parallel to the isometric axis is called a **non-isometric line**.
- Vertical lines on an object are also vertical in isometric projection, while the horizontal lines on an object are drawn at an angle of 30° with the horizontal in isometric projection.
- *The main difference between orthographic and isometric projection is that the orthographic drawing represents a two-dimensional view of the object, while isometric drawing represents three-dimensional views of the same object.*

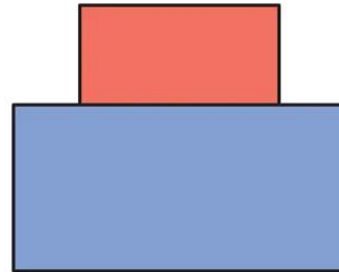
Orthographic and isometric projections of an object



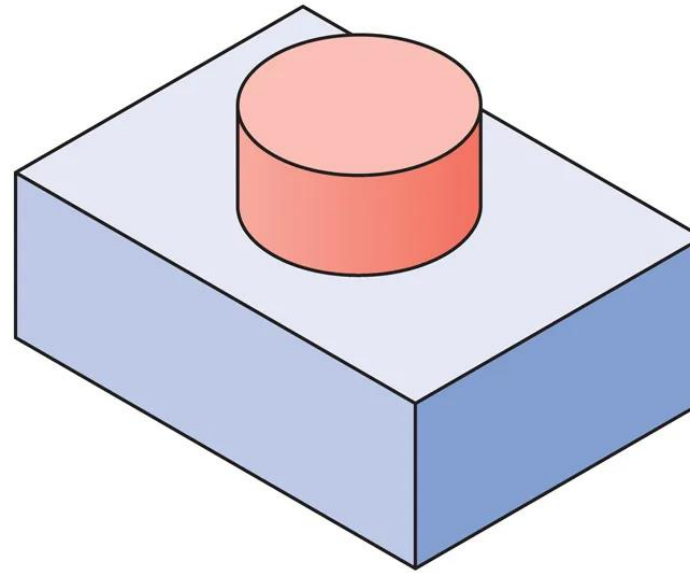
top view



front view



side view



3-dimensional isometric projection

Isometric Projection of circle.

The isometric projection of a circle is an ellipse, whose major axis is equal to the actual diameter of the circle.

The term "isometric" comes from the Greek for "equal measure", reflecting that the scale along each axis of the projection is the same.

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

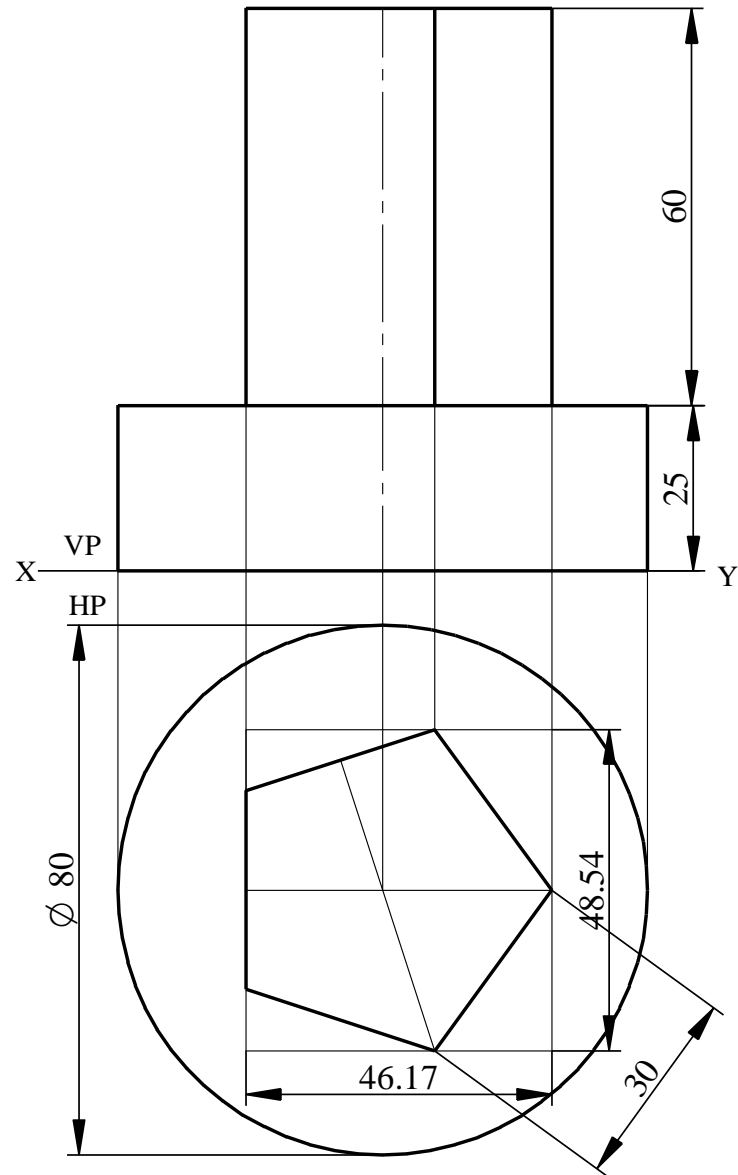
Solution:

1. Draw the orthographic projections of the cylinder and pentagonal prism co axial with it.
2. Enclose the pentagonal prism in a rectangle (in top view) touching all corners and outer edges. This is to obtain box which will be a rectangular prism whose height is equal to the length of axis of the prism.
3. However, the enclosure for a cylinder need not be shown as it will be a square prism with base side equal to diameter of cylinder and height equal to length of axis of cylindrical block.
4. Obtain the isometric projection of cylindrical block using 4 center approximate method (to obtain elliptical shape of the top & bottom faces in isometric projection)
5. Obtain the isometric projection of pentagonal prism by marking the corners of the pentagon w.r.t the corners of the rectangular box and place it coaxially with the cylinder.

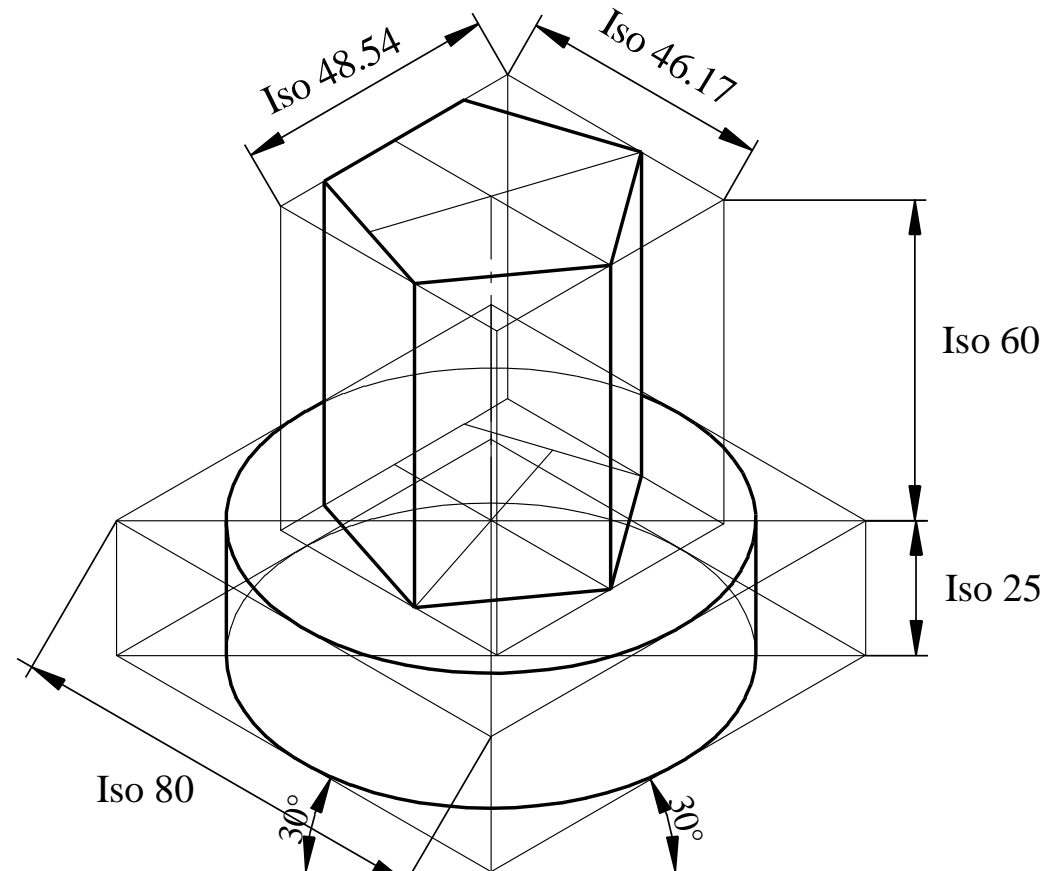
Note:

- To obtain isometric projection, enclose the given object in a box and tip the box on a corner such that the horizontal edges of the box are at 30° and the vertical edges of the box remain vertical, but the dimensions will be 82% of the true dimensions (Scale ratio 0.816 can be used in solidworks). The corners of the object must be marked w.r.t corners of the box.

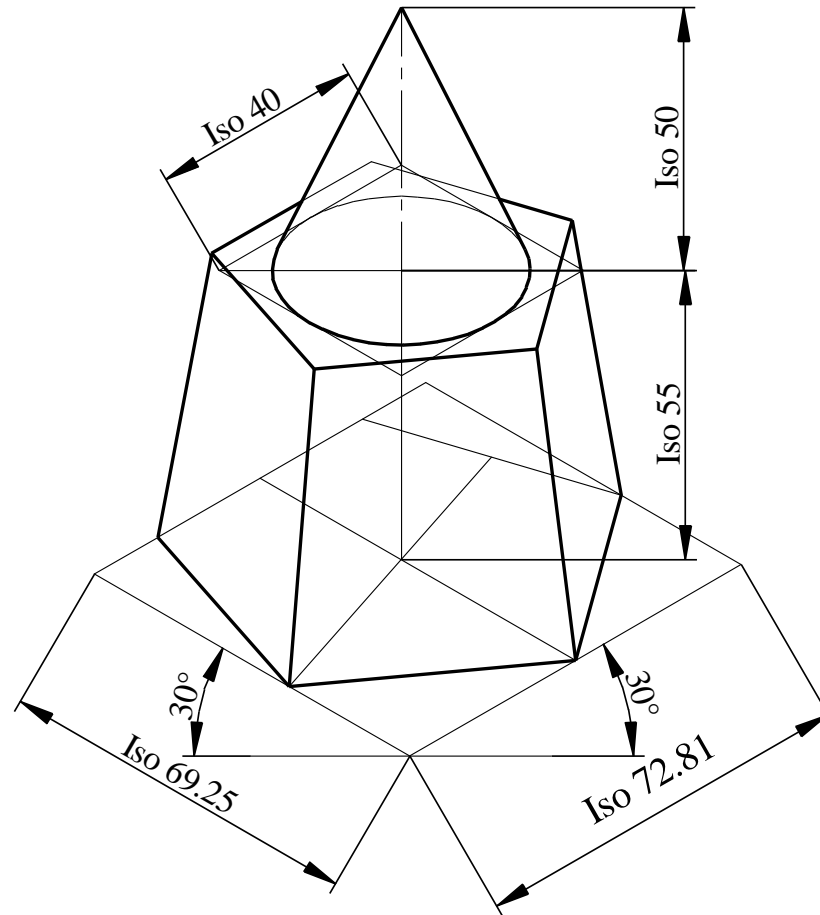
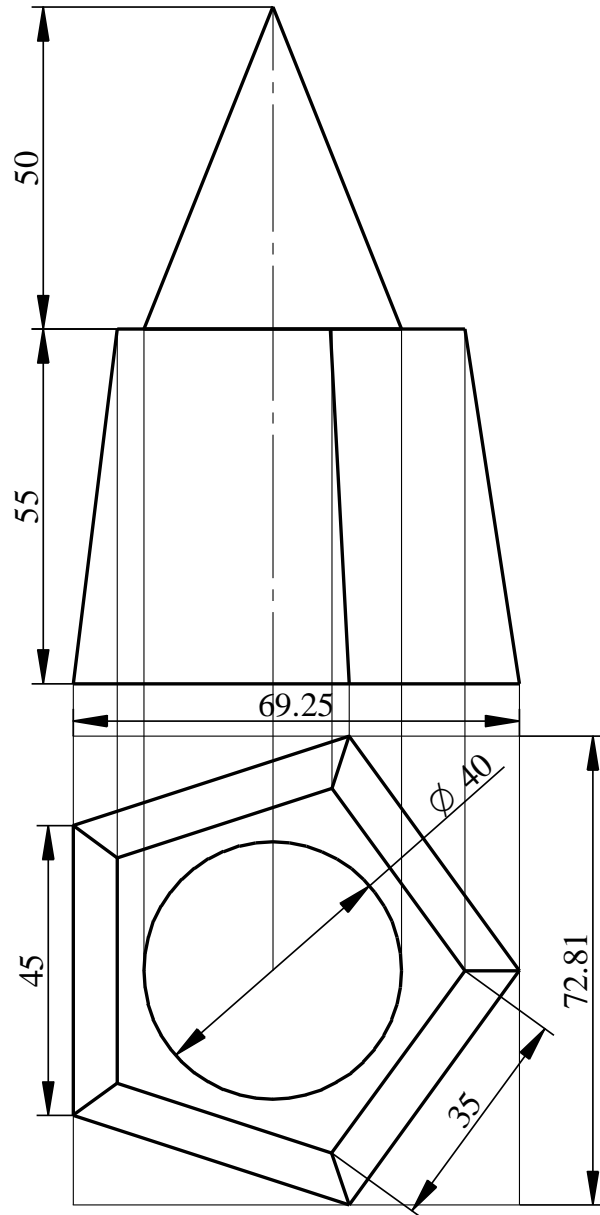
6.1 A regular pentagonal prism of base edge 30 mm and axis 60mm is mounted centrally over a cylindrical block of 80 mm diameter and 25mm thick. Draw isometric projection of the combined solids.



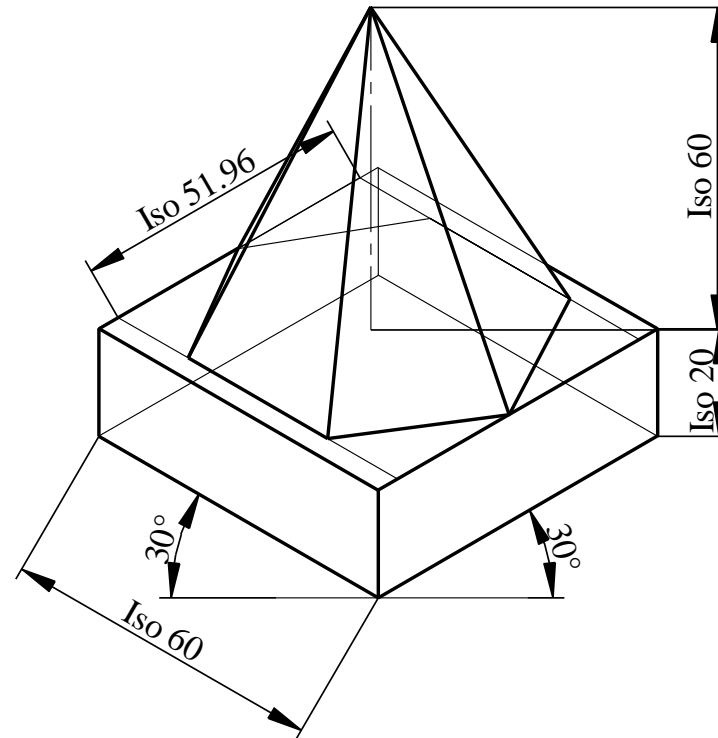
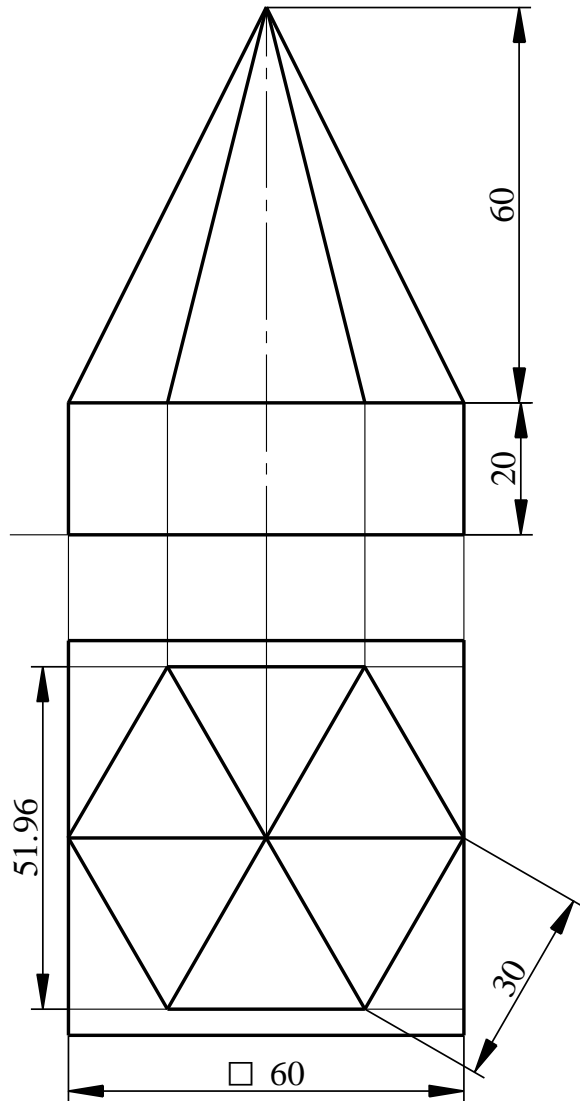
- Note:**
1. In isometric projections, outer visible edges must be thick, and the hidden lines /curves must be thin.
 2. *Iso 80 means Isometric length of 80 = $(0.816 \times 80) = 65.28$ mm and so on.*



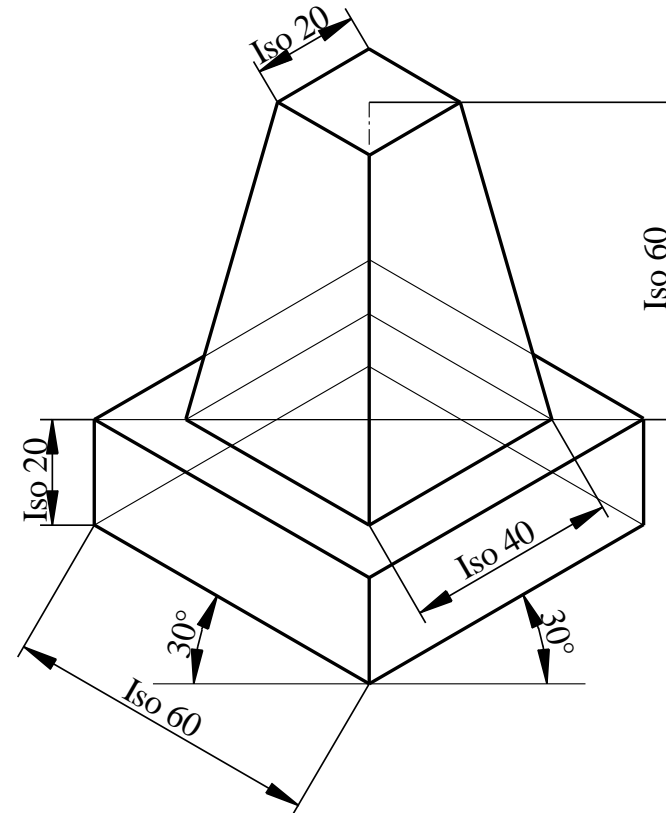
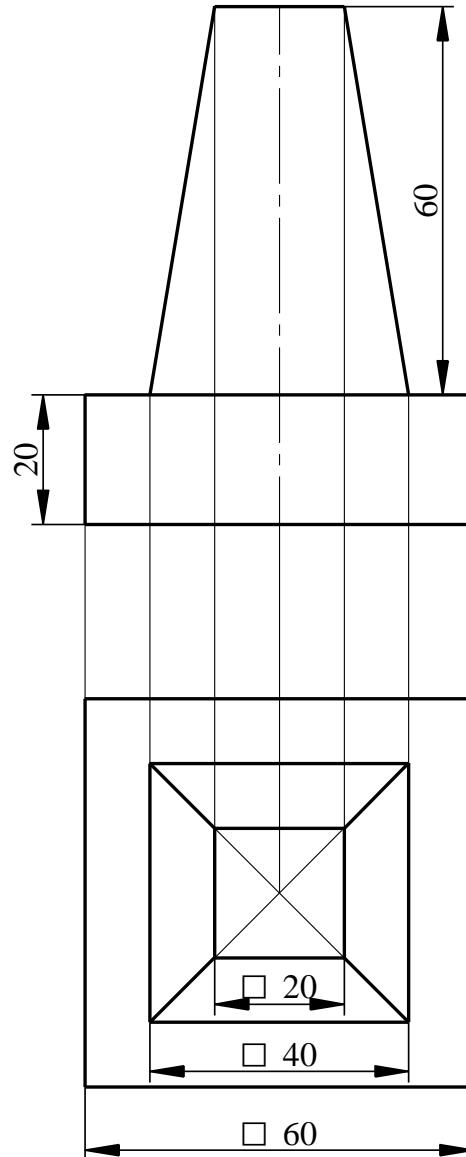
Q 6.2 A cone of base diameter 40mm and height 50mm rests centrally over a frustrum of a pentagonal pyramid of base side 45mm, top side 35 mm and height 55 mm. Draw isometric projections of the combination of solids.

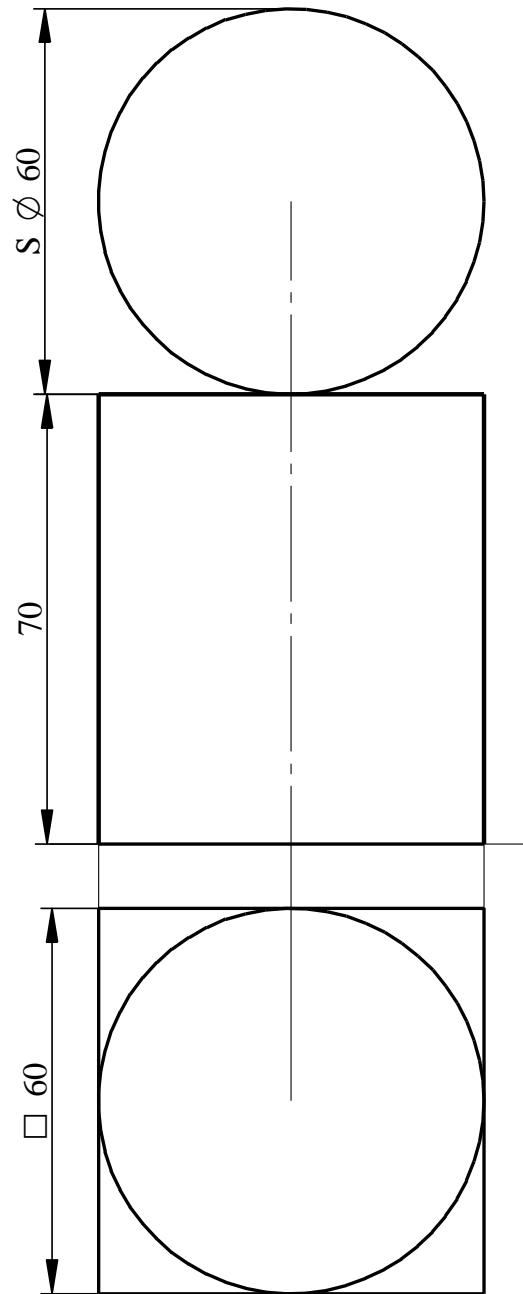


Q 6.3 A hexagonal pyramid 30mm side and height 60mm rests on the center of the top of a square block of side 60mm and height 20mm. The base edge of the pyramid is parallel to the top edge of the square block. Draw the isometric projection of the combination of the solids.



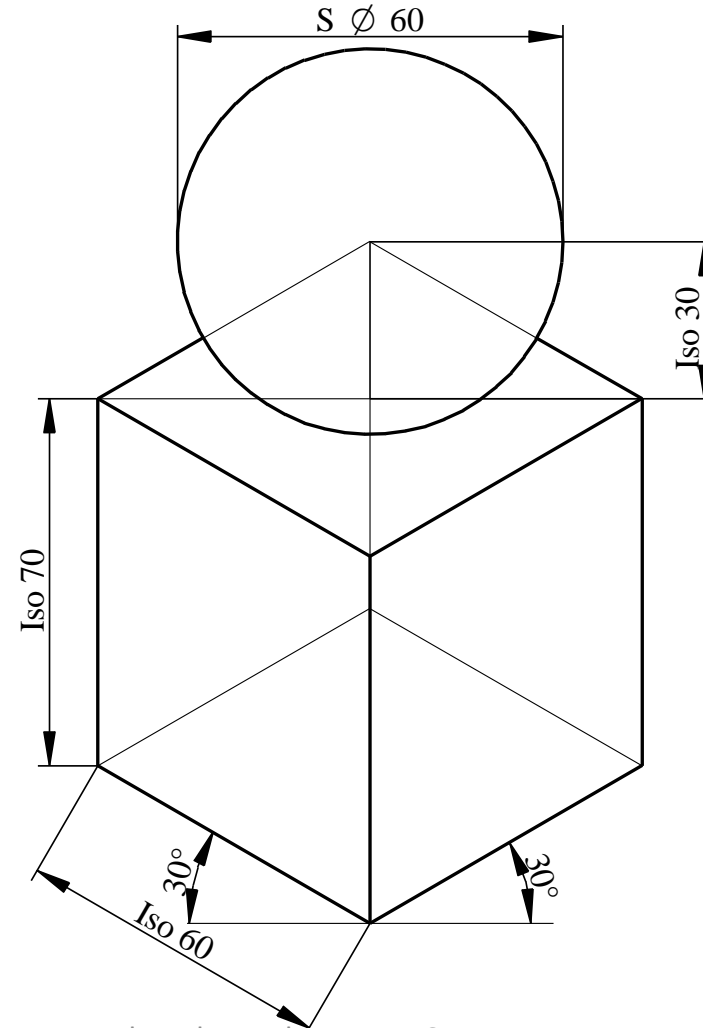
6.4 The frustum of a square pyramid of sides of top face 20mm, bottom face 40mm and height 60mm rests centrally on top of a square block of side 60mm and height 20mm. The base edges of the pyramid are parallel to the top edges of the square block. Draw the isometric projection of combination of solids.

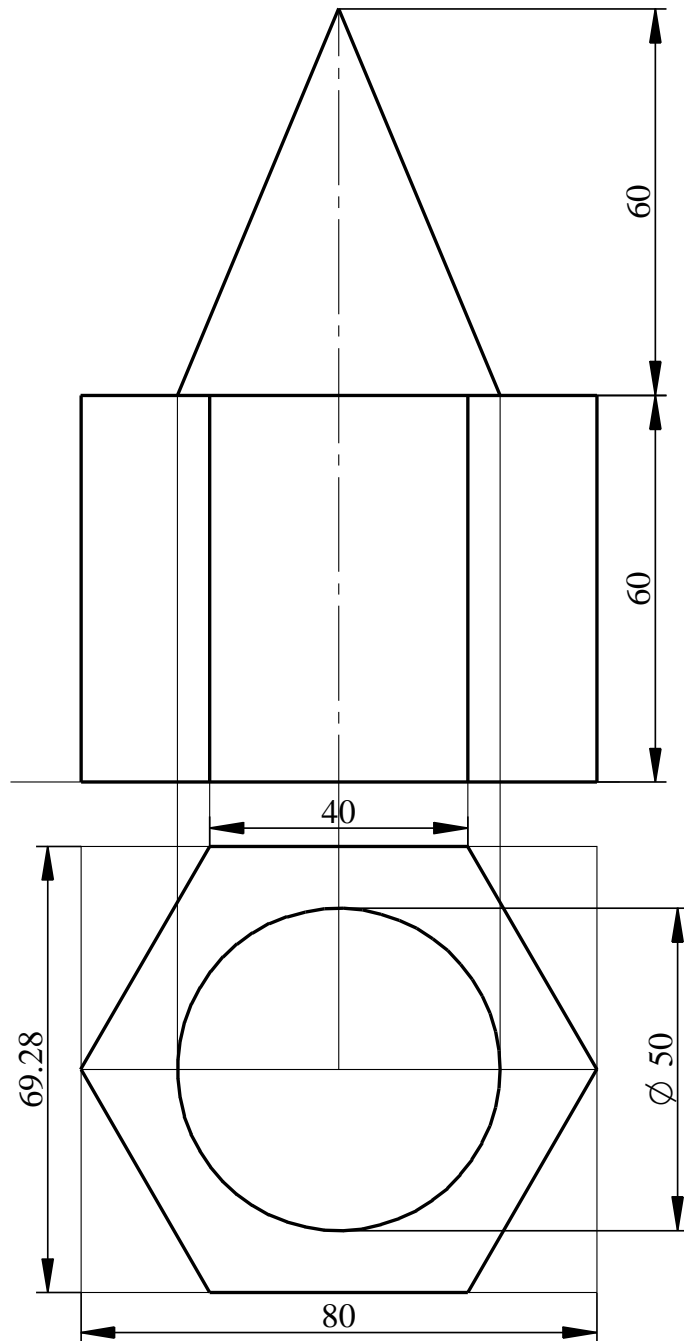




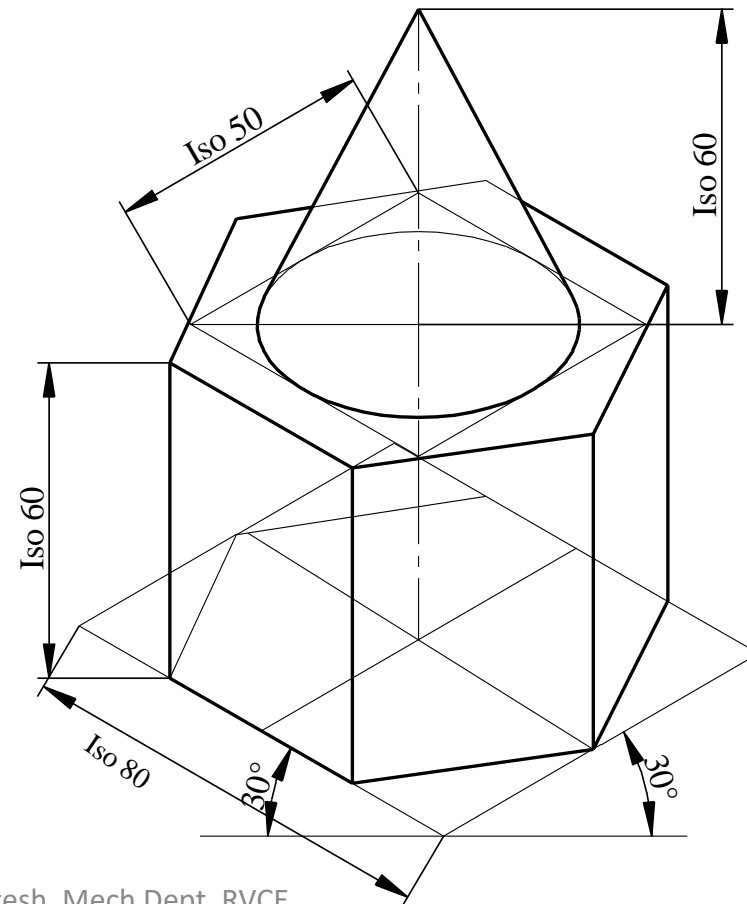
Q 6.5 A sphere of diameter 60mm is placed centrally on the top face of a square prism side 60mm and height 70mm. Draw the isometric projection of the combination.

A sphere, will appear as a circle of actual radius when looked at any angle, and hence isometric projection of a sphere will be a circle. However, the center to center height will be a vertical dimension and hence it will be isometric length of the radius of sphere.





Q 6.6 Draw the isometric projection of a hexagonal prism of side of base 40mm and height 60mm with a right circular cone of base 50mm diameter and height 60mm, resting on its top such that the axes are collinear.



Q 6.7 Draw the isometric projection of the combination of solids shown in Figure 6.1.

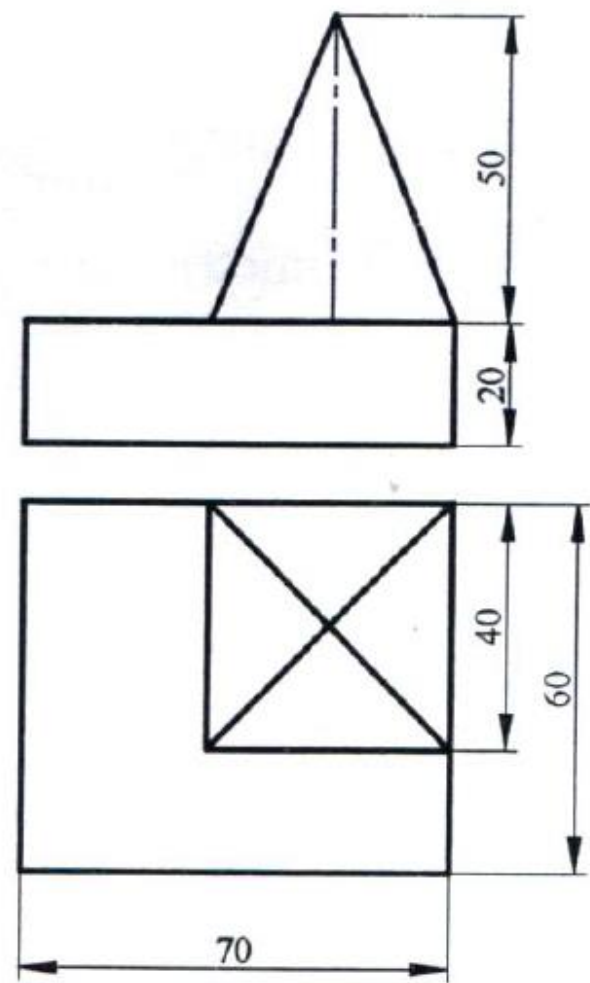


Figure 6.1

