S.RAMANATHAN ASST PROF MVSREC
Ph: 9989717732 rama_bhp@yahoo.com

Combination of Solids

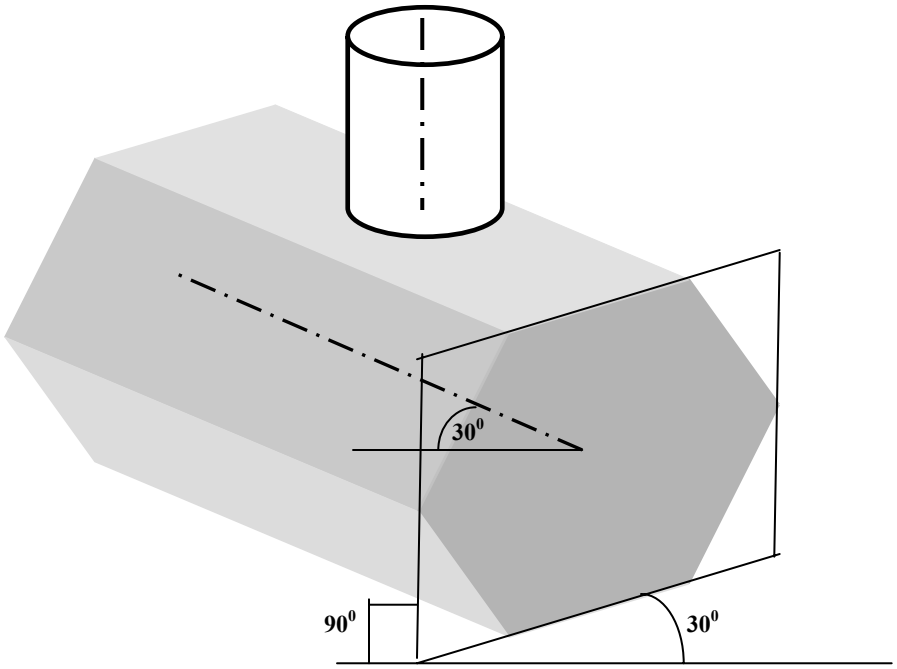
In combination of solids, 2 or more solids are usually placed one upon the other centrally with their vertical axes coinciding.

To draw their isometric projections, we start with the base solid (1st solid) and then after completely drawing the 1st solid, the 2nd solid is drawn upon it at the centre.

→ Usually, the axes of both the solids are taken as vertical.
→ Sometimes, it will be mentioned that the axis is horizontal & in that case, the solid is drawn by drawing the box at 30^0-90^0 & then, the 2nd solid is drawn on it.

E.g. ***This question was asked in Nov-Dec-2009, supplementary examination.***
→ ***A hexagonal prism of base 40 mm sides & axis 65 mm long is resting on one of its rectangular faces on the ground. A vertical cylinder of base 30 mm diameter & axis 50 mm long rests centrally upon it. Draw the isometric projection of the combination of the solids.***

Here, the hexagonal prism is resting on its rectangular faces on the ground & hence, its axis is horizontal. The cylinder is vertical.
Hence, the 1st solid is drawn at 30^0-90^0 & the 2nd solid is drawn at 30^0-30^0.



S.RAMANATHAN ASST PROF MVSREC
Ph: 9989717732 rama_bhp@yahoo.com

Combination of Solids

1) Draw the isometric projection of a sphere of 40 mm diameter resting centrally on the top of a square prism of side 50 mm and height 25 mm.

Sol) Given data:

No.of solids:→ 2 (1st (base)→ Square prism; 2nd (top) → Sphere)

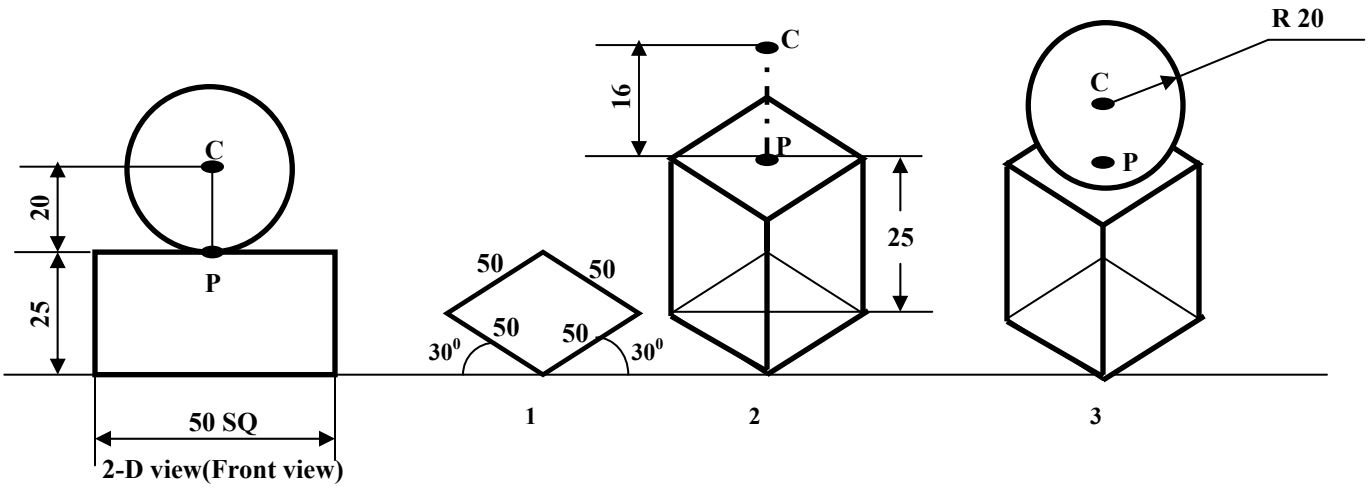
Axes condition→ Vertical (box to be drawn at 30^0-30^0 & height (axis) at 90^0)

Base dimensions→ (i) Square prism of 50 mm sides & height 25 mm
(ii) Sphere of 40 mm diameter.

Steps:

(i) Draw the base solid (square prism) with axis in vertical position.
(ii) Base box of 50 mm sides is drawn at 30^0-30^0 & axis of 25 mm at 90^0.
(iii) Locate the center of the top face of the prism (P) & from P, mark the centre of the sphere C at CP= ***isometric radius of the sphere*** (CP= 0.8 x R), where R is the radius of the sphere.
(iv) R = 25 mm & hence CP= 0.8 * 20 = 16 mm.
(v) With C as center & Radius = 20, draw a circle to get the sphere in 3-D.

Draw the 2-d view if asked for in the question.



S.RAMANATHAN ASST PROF MVSREC
Ph: 9989717732. rama_bhp@yahoo.com

2) A sphere of 40 mm diameter is centrally placed over a frustum of cone of bottom diameter 60 mm, top diameter 40 mm & 60 mm height. Draw the isometric view of the arrangement.

(Sol) Given solids:

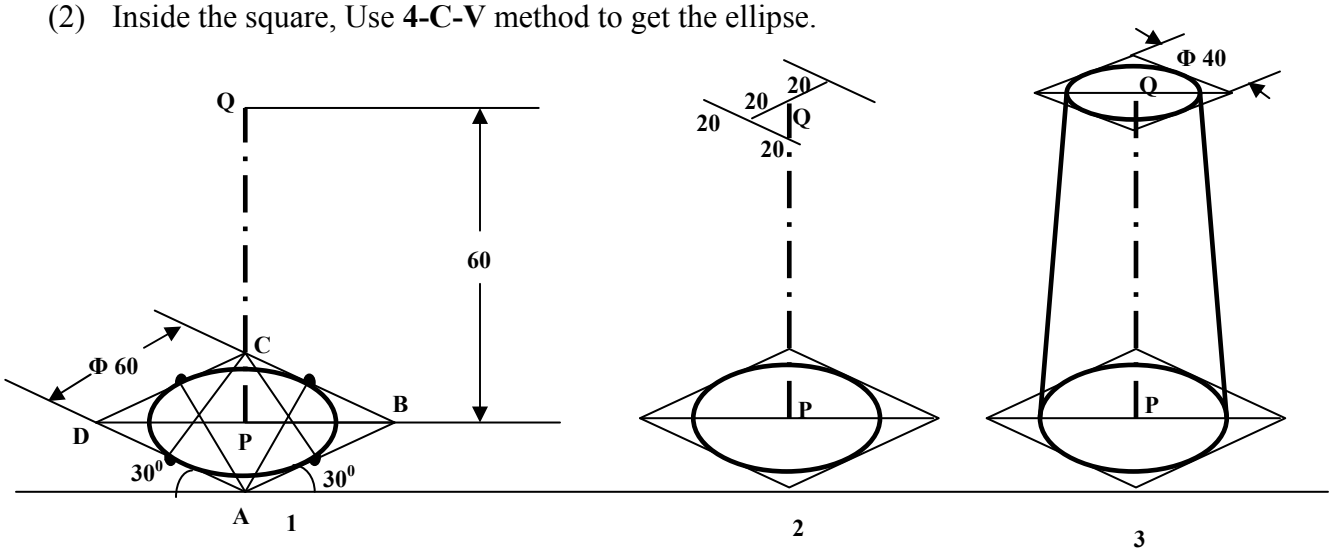
(1) **Base→Frustum of Cone;** Dimensions: Base Diameter =60, Top dia = 40, Ht =60.

(2) **Top →Sphere (Diameter = 40mm)**

Logic:
(i) Draw the Frustum of Cone by using 4-C-V method as discussed earlier.
(ii) Locate Centre of cone (P) at top & from P, mark the center of sphere (C) at Isometric radius. (CP = 0.8 * Radius of sphere) (CP = 16 mm)
(iii) At C, draw the circle of 20 mm radius to get the sphere.

Steps: Part 1: ***Drawing the Isometric Projection of the Frustum***

(1) On a horizontal line, draw the base box ABCD of 60 mm sides at 30^0- 30^0.
(2) Inside the square, Use **4-C-V** method to get the ellipse.



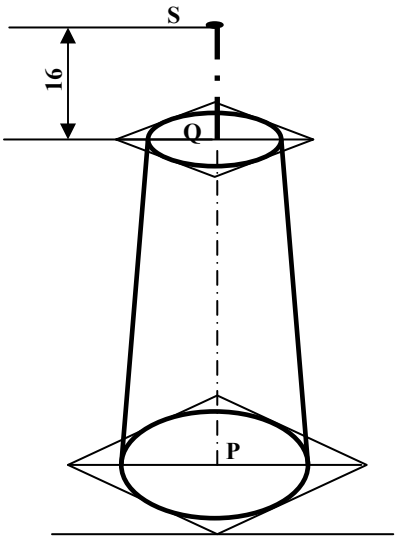
(3) Locate the center of the box & mark axis of 60 mm at 90^0 from the center of base.
(4) At the top, draw lines of 20 mm each parallel to AB & AD from the center Q.
(5) Complete the box of 40 mm at top part Q and inside it, draw an ellipse by using ***4-C-V*** *method*.

Part 2: ***Drawing the sphere on top of the frustum***

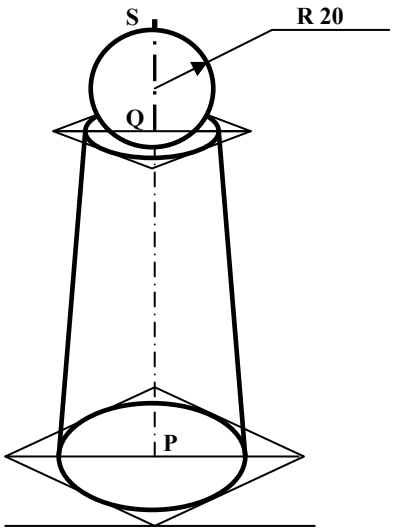
(1) From **Q,** the top of the frustum, mark center of Sphere **S** at **isometric radius**; **QS= 0.8 * 20=16 mm**.
(2) With **S** as center & **radius** = **true radius**, **20** mm, draw a **circle** to get the sphere.

S.RAMANATHAN ASST PROF MVSREC
Ph: 9989717732 rama_bhp@yahoo.com

4



5



Sphere mounted centrally on a frustum of Cone

(3) Cylinder resting centrally on a Square Prism (Cube or slab)

Case 1: ***The dimensions of the Cylinder and the Square Prism are equal***:

Logic: → The isometric view of cylinder is by **4-C-V method** which requires a box to be constructed.

→ Since the dimensions of the cylinder and square are same, there is no need to construct a box separately for the base of the cylinder. Directly by 4-C-V method, the ellipse can be drawn on the top of the square prism.

→ But for the top part of cylinder, a box must be drawn and ellipse drawn to complete the cylinder.

Q) ***A cylinder of base 50 mm diameter & axis 70 mm long is resting centrally upon a square prism of base 50 mm sides and height 30 mm with their axes coinciding with each other. Draw the isometric projection of the combination of the solids.***

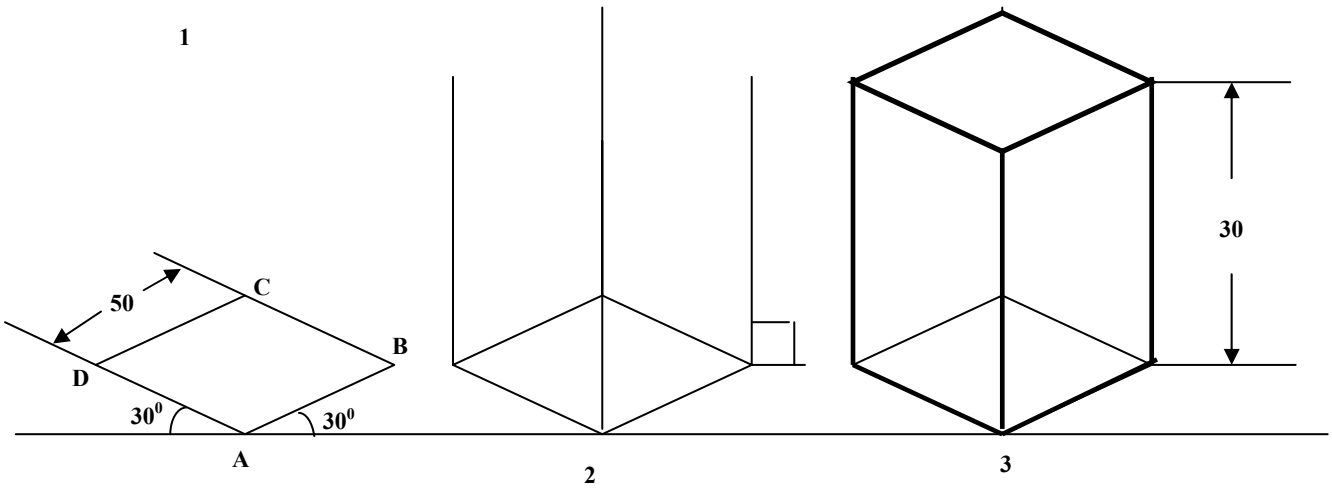
Sol) Given solids:

(1) **Base** → **Square Prism;** Dimensions: Base = 50, Height = 30.

(2) **Top** → **Cylinder;** Base Diameter = 50mm; Height = 70 mm

Steps: Part 1: ***Drawing the Isometric Projection of the Square Prism***

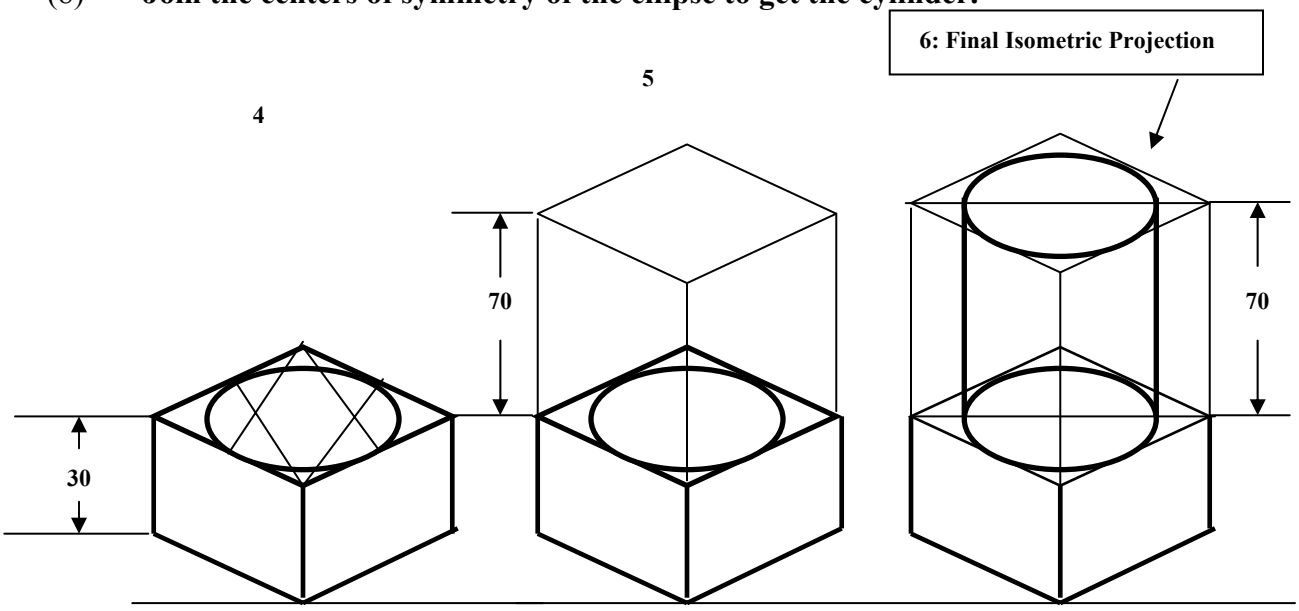
(1) On a horizontal line, draw the base box ABCD of 50 mm sides at 30^0- 30^0.
(2) From all corners of the box, draw axis of 30 mm at 90^0 to Horizontal.
(3) Join all the corners at the top to get the square prism.



Base Solid→ Square Prism

Part 2: ***Drawing the Isometric Projection of the Cylinder at the top***

(4) On the top of the square prism, by **4-C-V method, draw an ellipse.**
(5) From all corners of the box at the top, draw axis of 70 mm at 90^0 to Horizontal.
(6) Join all the corners at the top to get the box.
(7) Inside the box, draw an ellipse by **4-C-V method.**
(8) **Join the centers of symmetry of the ellipse to get the cylinder.**



S.RAMANATHAN ASST PROF MVSREC
Ph: 9989717732 rama_bhp@yahoo.com

(3) Cylinder resting centrally on a Square Prism (Cube or slab)

Case 2: ***The dimensions of the Cylinder and the Square Prism are unequal***:

Logic: → The isometric view of cylinder is by **4-C-V method** which requires a box to be constructed.

→ Since the dimensions of the cylinder and square are not the same, **a box is drawn separately at the top of the square prism for the base of the cylinder**.
→ The cylinder is drawn by **4-C-V method.**
→ **The box for the cylinder should be parallel to the box of the square prism.**

Q) ***A cylinder of base 50 mm diameter & axis 70 mm long is resting centrally upon a square prism of base 65 mm sides and height 30 mm with their axes coinciding with each other. Draw the isometric projection of the combination of the solids.***

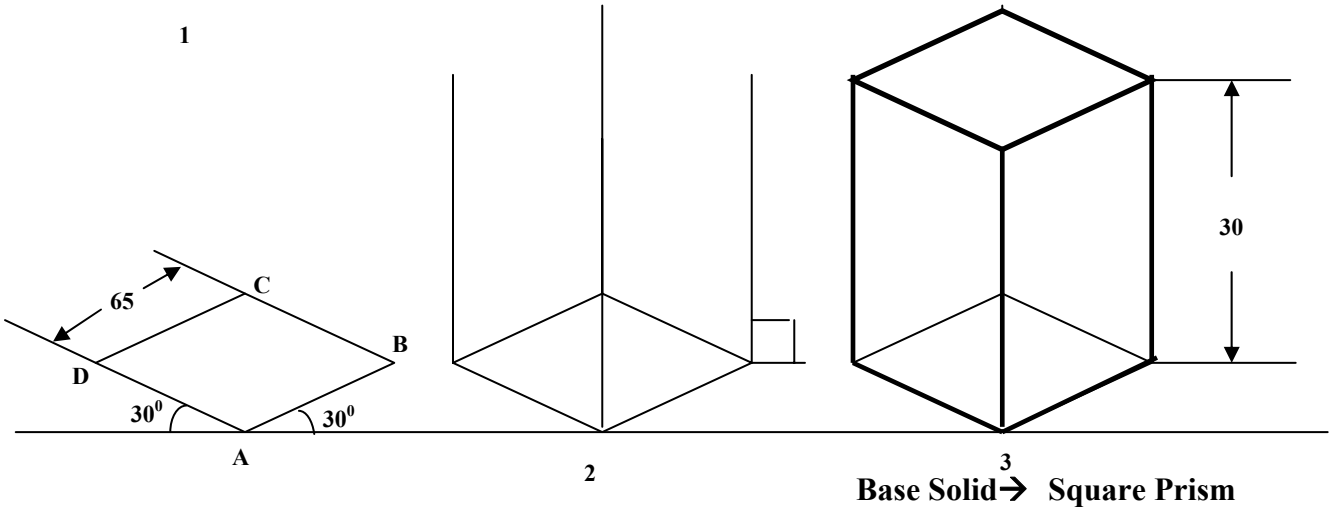
Sol) Given solids:

(1) **Base** → **Square Prism;** Dimensions: Base = 65, Height = 30.

(2) **Top** → **Cylinder;** Base Diameter = 50mm; Height = 70 mm

Steps: **Part 1:** ***Drawing the Isometric Projection of the Square Prism***

(1) On a horizontal line, draw the base box ABCD of 65 mm sides at 30^0- 30^0.
(2) From all corners of the box, draw axis of 30 mm at 90^0 to the horizontal.
(3) Join all the corners at the top to get the square prism.

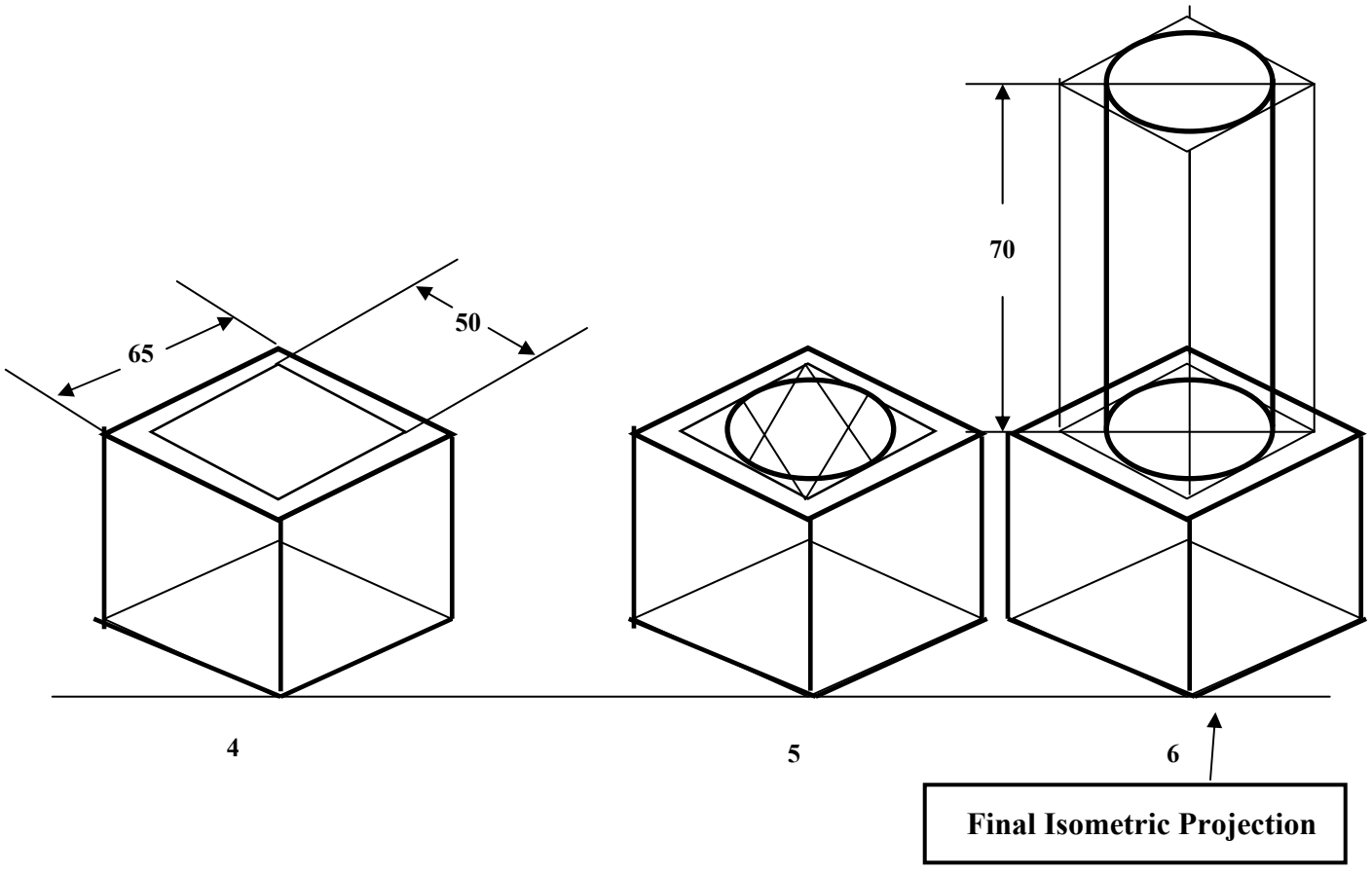


Base Solid→ Square Prism

S.RAMANATHAN ASST PROF MVSREC
Ph: 9989717732 rama_bhp@yahoo.com

Part 2: ***Drawing the Isometric Projection of the Cylinder at the top***

(4) On the top of the square prism, draw another box inside it of sides 50 mm.
(5) Inside this box of 50 mm, use **4-C-V method & draw an ellipse.**
(6) From all corners of the box at the top, draw axis of 70 mm at 90^0 to Horizontal.
(7) Join all the corners at the top to get the box.
(8) Inside the box, draw the second ellipse by **4-C-V method.**
(9) **Join the centers of symmetry of the ellipse to get the cylinder.**



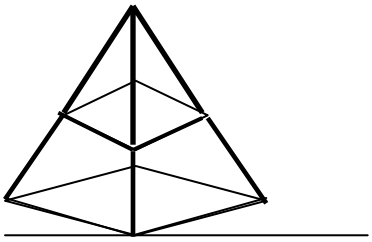
(4) Solids resting centrally on Frustums (square or cone frustum)

→ **In this case, the base solid is a frustum of cone or a square. As such, we need to draw the frustum first.**

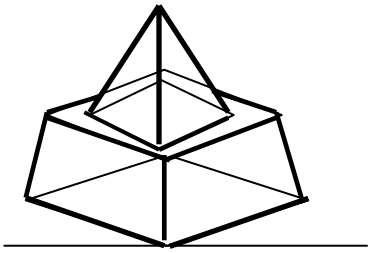
→ **Then, there are 2 cases for the solid which is on top of the frustum. It may be of same dimension as that of the top of frustum or different. Depending on the case, we draw the 2nd solid.**

Following are the cases which are possible:

(i) Square pyramid resting centrally on top of a square frustum

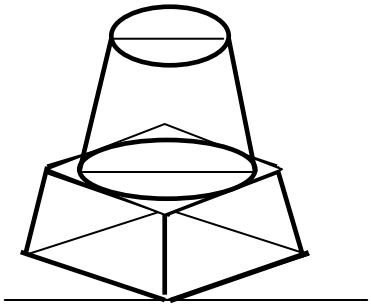


Case 1: Top dimensions same

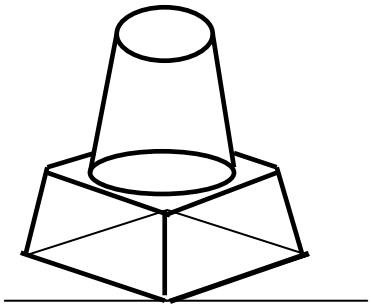


Case 2: Top dimensions different

(ii) *Cone frustum resting centrally on a square frustum*.

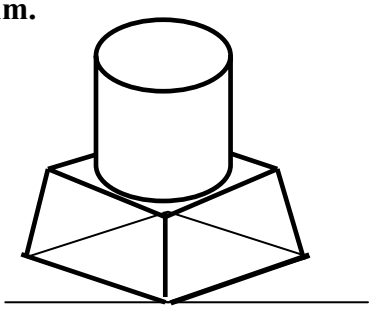


Case 1: Top dimensions same



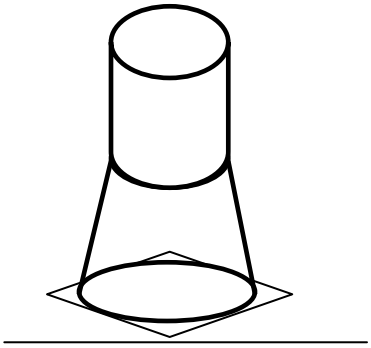
Case 2: Top dimensions different

(iii) Cylinder resting centrally on a square frustum.

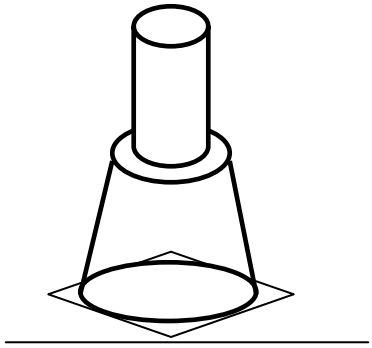


S.RAMANATHAN ASST PROF MVSREC
Ph: 9989717732 rama_bhp@yahoo.com

(iv) Cylinder resting centrally on a cone frustum.



Case 1: Top dimensions same



Case 2: Top dimensions different

Solutions to the above Problems:

Steps:

(i) *For all the above problems, the base is a frustum of square or cone. Hence the first step is to draw the frustum of square at the base. For cone, the extra effort is to draw the* ***ellipses*** *inside the box* ***by 4-C-V method.***

(ii) *For the top solid which rests centrally on the base solid, identify if the dimensions at the* ***top*** *of the* ***1st solid*** *&* ***base of the 2nd solid*** *are the same or different.*

(iii) *If the dimensions are same, then the 2nd solid can be directly drawn on the 1st solid's box.*

(iv) *If the dimensions are different, then a separate box of the given dimensions should be drawn for the 2nd solid and the given 2nd solid is to be constructed in it.*

Here, one sample will be shown for each case and the rest of them, can be constructed similarly.

For Frustums, always remember the concept that the top part is to be drawn by first selecting mid point and then extending the sides by half each at 30^0-30^0, parallel to base.

E.g.: If top of frustum is 50 mm, then draw 25mm-25mm about the mid point, keeping the sides ∥ to the base sides which are at 30^0-30^0.

S.RAMANATHAN ASST PROF MVSREC
Ph: 9989717732 rama_bhp@yahoo.com

Q) ***A square pyramid of base 50 mm & axis 70 mm long is resting centrally upon a frustum of a square pyramid of base 65 mm sides, top 50 mm sides & height 40 mm with their axes coinciding with each other. Draw the isometric projection of the combination of the solids.***

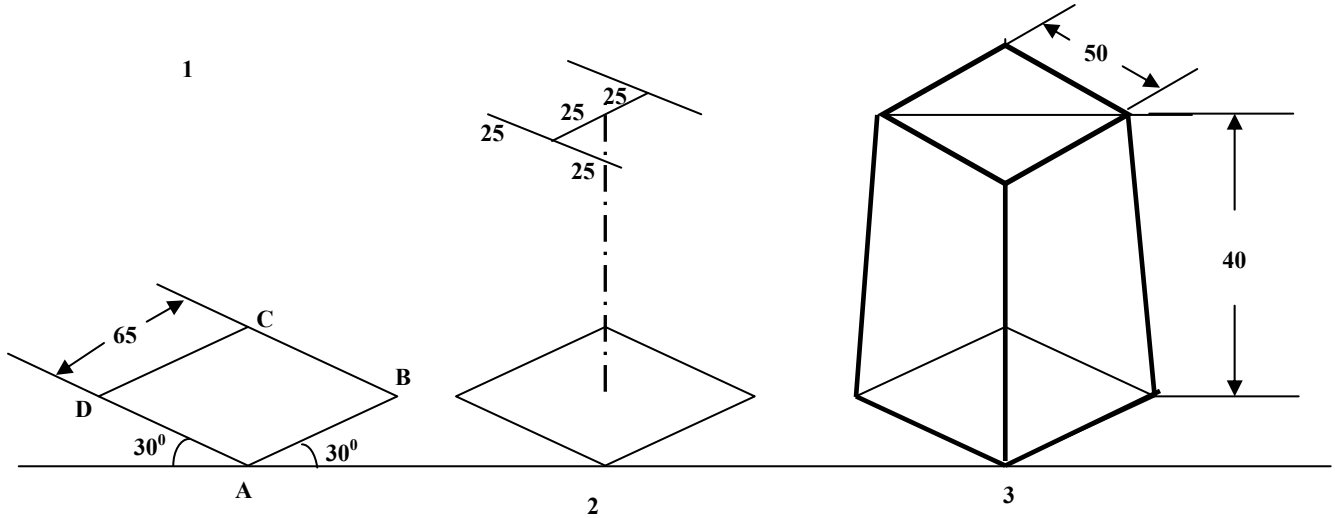
Sol) Given solids:

(1) **Base** → **Frustum of Square Pyramid;** Base = 65, Top = 50 & Height = 40.

(2) **Top** → **Square pyramid;** Base = 50mm; Height = 70 mm

Steps: Part 1: ***Drawing the Isometric Projection of the frustum of Square Pyramid***

(1) On a horizontal line, draw the base box ABCD of 65 mm sides at 30^0- 30^0.
(2) From the centre of base, mark axis at 40 mm & draw a small box around the centre of top. The box is drawn by keeping drafter ‖ to AB & drawing 25 mm-25 mm from mid point
(3) Join all the corners at the top to get the frustum of square pyramid.



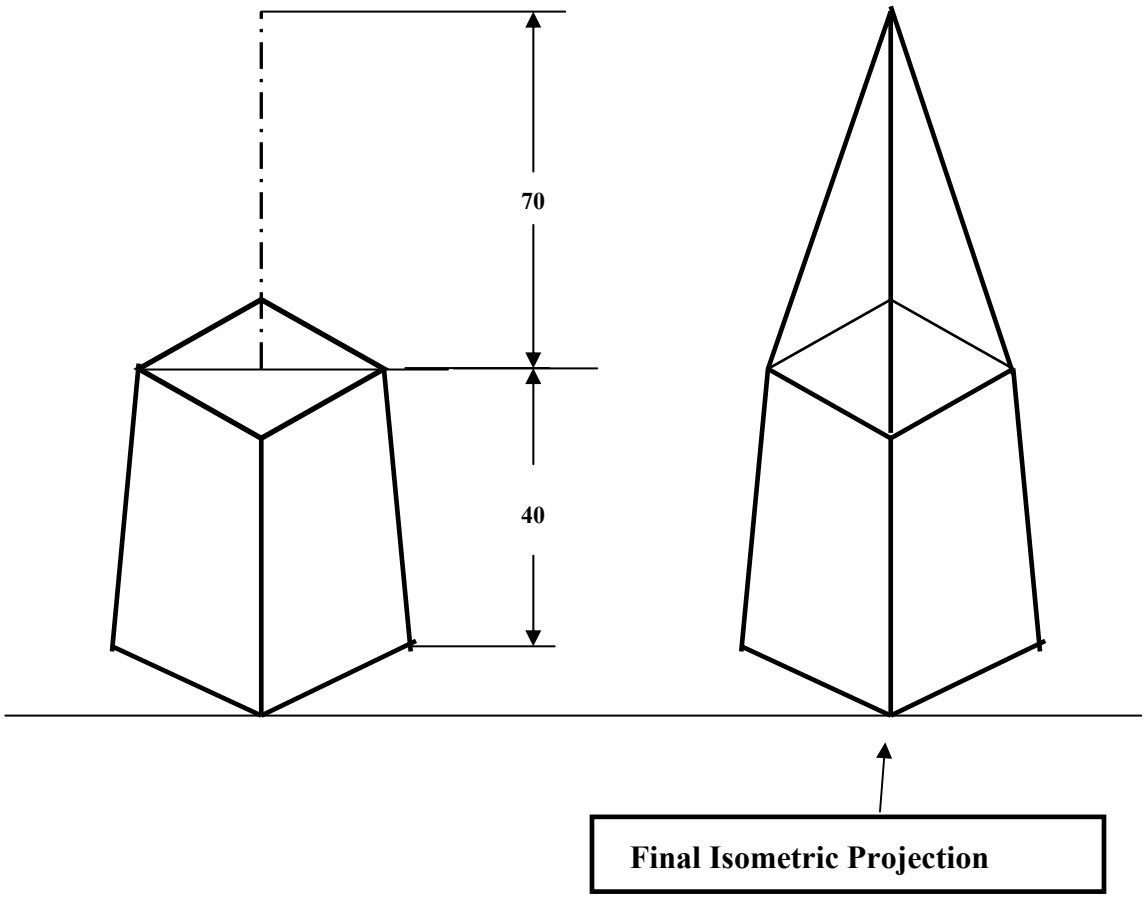
Base Solid→ Frustum of Square Pyramid

Part 2: ***Drawing the Isometric Projection of the Square pyramid at the top***

4) On the top of the square frustum, mark the center & draw apex of 70 mm at 90^0.
5) Join the corners of frustum to the apex point to get the square pyramid.

Note: Here, there is no need to draw another box for the 2nd solid since it has same dimensions as the 1st solid at the top.

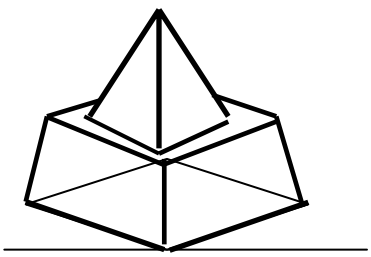
S.RAMANATHAN ASST PROF MVSREC
Ph: 9989717732 rama_bhp@yahoo.com



Q) ***A square pyramid of base 40 mm & axis 70 mm long is resting centrally upon a frustum of a square pyramid of base 65 mm sides, top 50 mm sides & height 40 mm with their axes coinciding with each other. Draw the isometric projection of the combination of the solids.***

(Sol) Here the dimension of the 2nd pyramid is different from the top of the 1st solid. Hence a box of 40 mm is to be drawn inside the box of 50 mm at the top of the 1st solid and then pyramid is drawn.

Steps are similar to the earlier problem discussed.



S.RAMANATHAN ASST PROF MVSREC
Ph: 9989717732 rama_bhp@yahoo.com

Cone resting centrally upon a frustum of square pyramid:

When such a problem is given, then, in the above problem, instead of a square pyramid, a cone is to be drawn by using 4-C-V method at the top of the frustum.

Frustum of Cone resting centrally upon a frustum of square pyramid:

→ In this case, 2 frustums have to be drawn.
→ 1st is the base frustum of a square pyramid.
→ 2nd is the top frustum of a cone, as discussed earlier.
→ Only complexity here is that 4 boxes have to be drawn, 2 for the square frustum & 2 for the cone.

Cylinder resting centrally upon a frustum of cone or frustum of square pyramid:

→ In such cases, the base frustum is drawn using the procedure discussed earlier.
→ Then, on the top of the frustum, a cylinder is drawn by using the usual **4-C-V method** by drawing a box of given dimensions of cylinder.

→ If the cylinder dimension is different from the dimension at the top of the frustum, another box is drawn inside the top of the frustum and the cylinder is drawn.

For practice of the above problems, take suitable data for the 1st & 2nd solids & practice them on A4 sheets.