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1) Draw the isometric projections of a square prism of base 40 mm sides & axis 60 mm long when its axis is (i) Vertical & (ii) Horizontal

Sol) Shape → Square Prism
Base → 40 mm
Axis → 60 mm

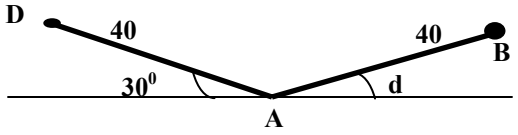
(i) ***When Axis is vertical***:

Base (box) angles → 30^0-30^0
Axis angle → 90^0

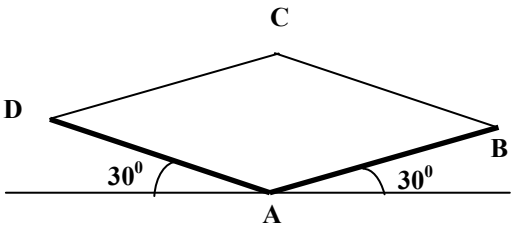
Steps:

(i) Draw a horizontal line and on it mark A on it.

(ii) From A, draw 2 lines of 40 mm each at 30^0 to the right & left, to get AB & AD.

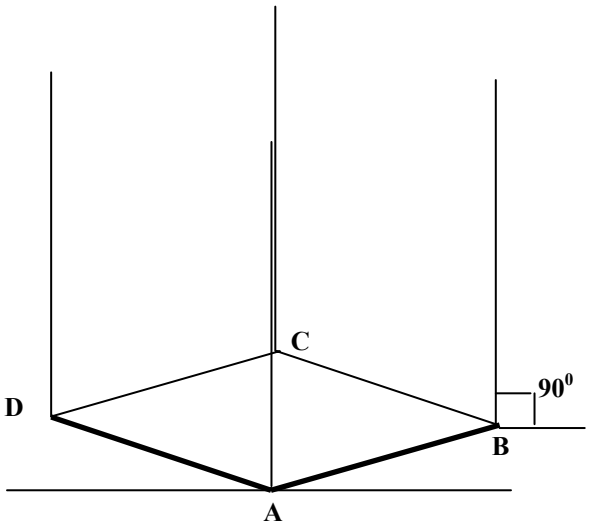


(iii) On D, draw a line of 40 mm ‖ to AB & on B, draw a line ‖ to AD. The intersection of the sides gives C. ABCD is the required base of the solid.

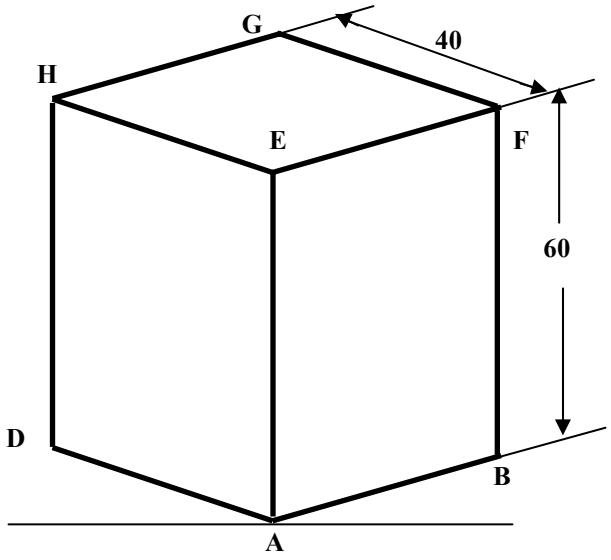


CD & BC are shown light as they will be invisible when the final solid is constructed.

(iv) On each corners, A, B, C & D, draw a vertical line (axis) at 90^0 to the horizontal of length 60 mm. Join all the points at the top to get the required square prism.



→ Since BC, CD & CG will be invisible in the 3-D view, they are erased and not shown in the final figure.



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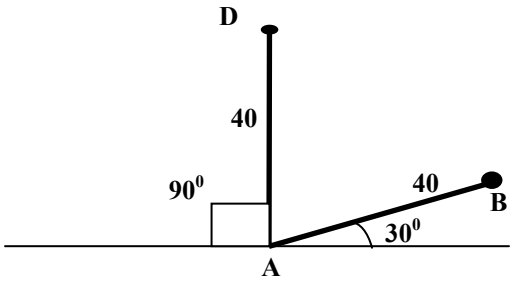
(ii) ***When Axis is horizontal***:

Base (box) angles → 30^0-90^0
Axis angle → 30^0

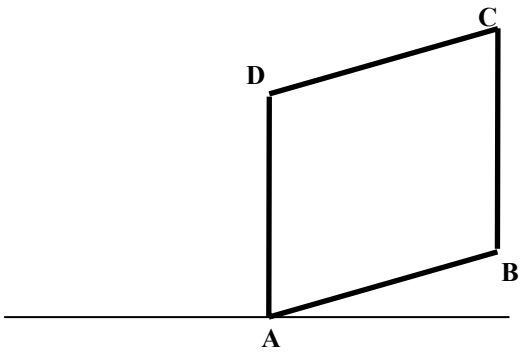
Steps:

(i) Draw a horizontal line and on it mark A on it.

(ii) From A, draw 2 lines of 40 mm each at 30^0 to the right of A & 90^0 on A (vertical) to get B & D. Choice of right or left is ours.

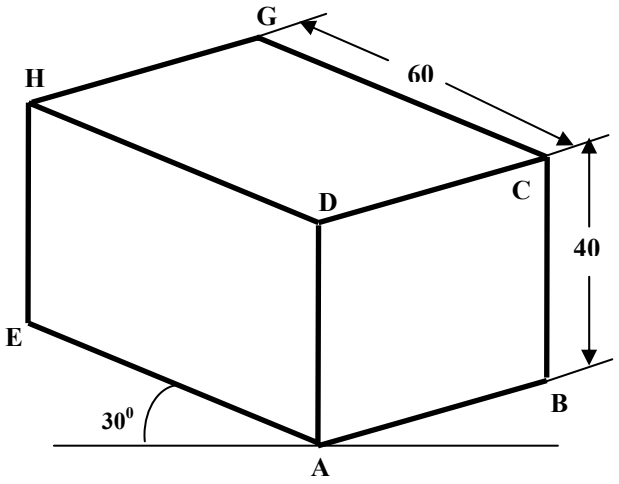


(iii) On D, draw a line of 40 mm ‖ to AB & on B, draw a line ‖ to AD. The intersection of the sides gives C. ABCD is the required base of the solid.



Here, all the sides will be visible in the final isometric view & hence ABCD is shown as thick visible lines.

(iv) On each corners, A, B, C & D, draw a line (axis) at left, at an angle of 30^0 to the horizontal & of length 60 mm. Join all the points at the end to get the required square prism.



Since the sides EF, FG & BG are not visible, they are not shown here. Alternatively, they can be shown as thin light lines if they are not erased.

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2) Draw the isometric projections of a square pyramid of base 40 mm sides & axis 60 mm when its axis is (i) Vertical & (ii) Horizontal

(iv)

Sol) Shape → Square Pyramid
Base → 40 mm
Axis → 60 mm

(v)

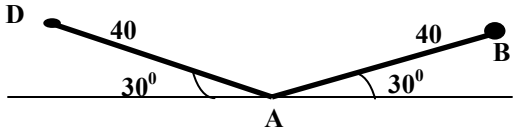
(iii) ***When Axis is vertical***:

Base (box) angles → 30^0-30^0
Axis angle → 90^0

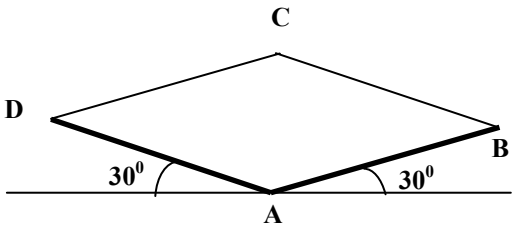
Steps:

(iv) Draw a horizontal line and on it mark A on it.

(v) From A, draw 2 lines of 40 mm each at 30^0 to the right & left, to get AB & AD.



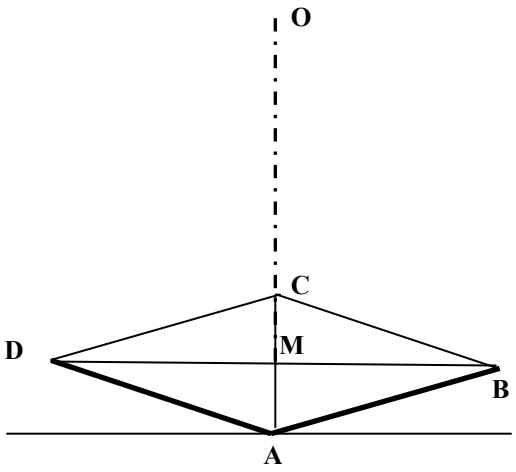
(vi) On D, draw a line of 40 mm ‖ to AB & on B, draw a line ‖ to AD. The intersection of the sides gives C. ABCD is the required base of the solid.

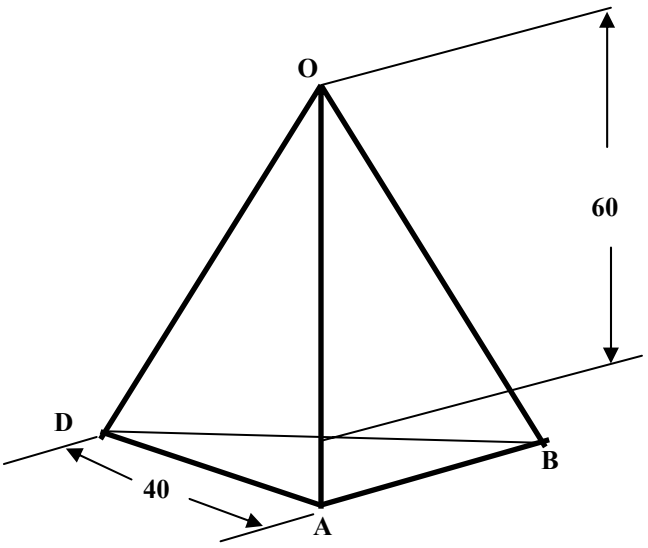


CD & BC are shown light as they will be invisible when the final solid is constructed.

(iv) Locate the mid point M of the base ABCD by joining the diagonals AC & BD.

On M, draw a vertical line MO (axis) at 90^0 to the horizontal of length 60 mm. Join all the points at the base ABCD to the apex O to get the required square pyramid.





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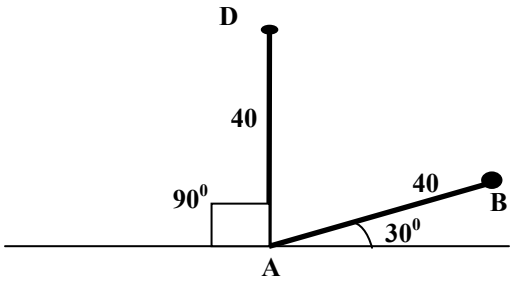
(vi) ***When Axis is horizontal***:

Base (box) angles → 30^0-90^0
Axis angle → 30^0 (vii)

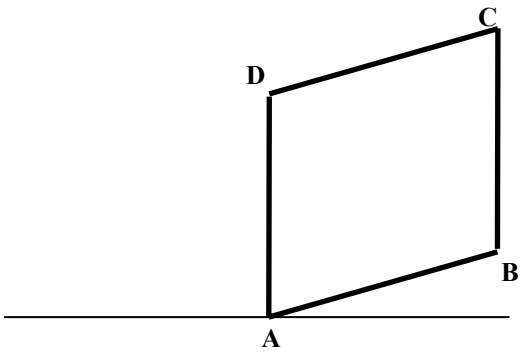
Steps:

(iv) Draw a horizontal line and on it mark A on it.

(v) From A, draw 2 lines of 40 mm each at 30^0 to the right of A & 90^0 on A (vertical) to get B & D. Choice of right or left is ours.



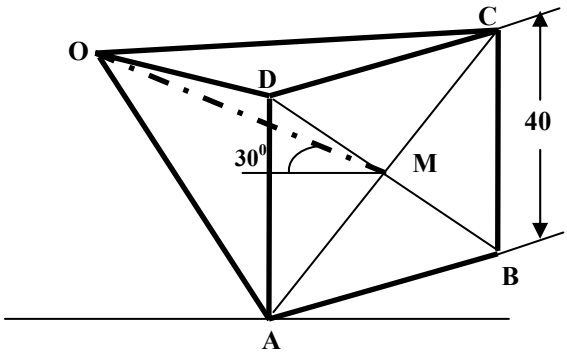
(vi) On D, draw a line of 40 mm ‖ to AB & on B, draw a line ‖ to AD. The intersection of the sides gives C. ABCD is the required base of the solid.



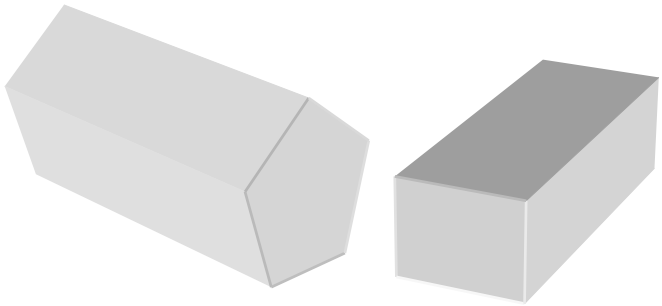
Here, all the sides will be visible in the final isometric view & hence ABCD is shown as thick visible lines.

(iv) Locate the mid point M of the base ABCD by joining the diagonals AC & BD.

On M, draw a line MO (axis) at 30^0 to the horizontal to the left side, length = 60 mm. Join all the points at the base ABCD to the apex O to get the required square pyramid.



Since the edge BO is not visible, it is not shown here. Alternatively, they can be shown as thin light lines if they are not erased.



Pentagonal prism Square Prism

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3) **Draw** the isometric projections of a **pentagonal prism** of base 25 mm sides and axis 65 mm long when the axis is (i) **Vertical** & (ii) **Horizointal.**

Sol) Whenever polygons other than square are given, we have to use the box method to construct the isometric view of the polygon.

Box Method for polygons :

(i) The box method consists of drawing a box (square or rectangle) around the given polygon such that it touches all the corners of the polygon.

(ii) In the isometric view, draw this box dimensions either at 30^0-30^0 or 30^0-90^0 depending on axis position.

(iii) After drawing the box, mark the points of the polygon in this box by measuring distances of the corners of polygon from corners of the box.

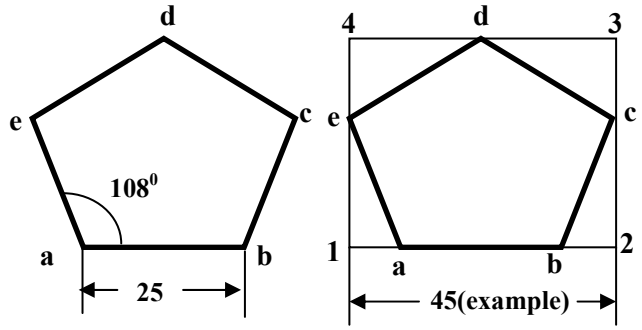
(iv) Always note that the true shape is not drawn in the isometric box as it always shows the reduced shape only.

The box method is explained in the following stages:

(i) Draw the regular pentagon of base 25 mm with sides at angle of 108^0 to each other. Mark it as abcde.

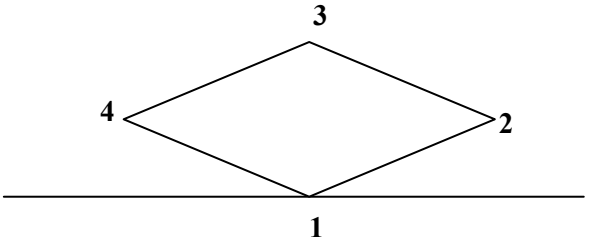
(ii) Around abcde, draw a box such that the box touches all corners a, b, c, d & e. Mark the box as 1234.

(iii) Measure 1234 & reproduce it in isometric.



(iv) After drawing the box 1234 at 30^0-30^0, mark the point '**A' by measuring distance of 'a' from 1 in the poygon inside the box 1234 in (iii)**

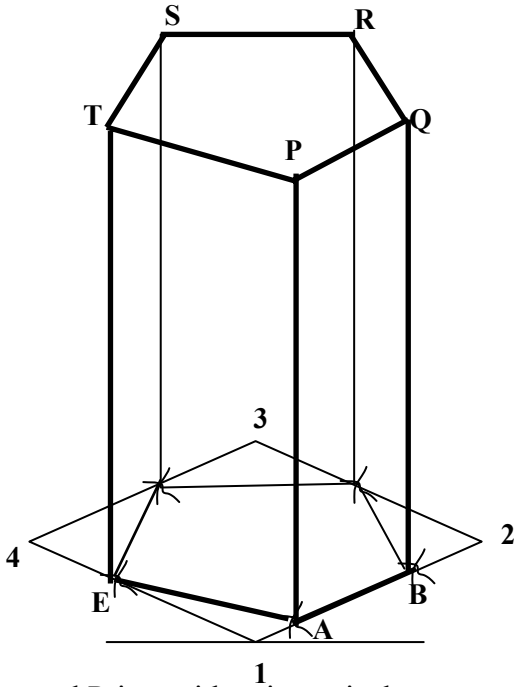
(v) Similarly, mark points B at given distance from 2 ; C is marked at given distance from 3 or 2.



(vii) Points 'D' & 'E' are marked at their distances from corners 3 or 4.

(viii) Join all the points inside the box to get the required pentagon.

(ix) Draw axis 65 mm vertically at 90^0 from each vertex A, B, C, D, E & join them in sequence to get the required pentagonal prism.



Pentagonal Prism with axis vertical

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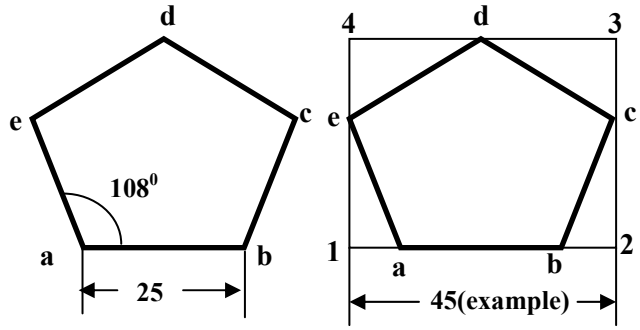
Pentagonal Prism with axis horizontal:

(i) Draw the regular pentagon of base 25 mm with sides at angle of 108^0 to each other. Mark it as abcde.

(ii) Around abcde, draw a box such that the box touches all corners a, b, c, d & e. Mark the box as 1234.

(iii) Measure 1234 & reproduce it in isometric.



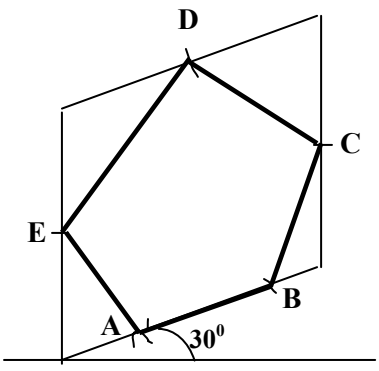
(iv) The box 1234 is to be drawn at 30^0-90^0.

After drawing the box 1234 at 30^0-90^0, mark the point '**A' by measuring distance of 'a' from 1 in the polygon inside the box 1234 in (iii)**

(v) Similarly, mark points B at given distance from 2, C is marked at given distance from 3 or 2.

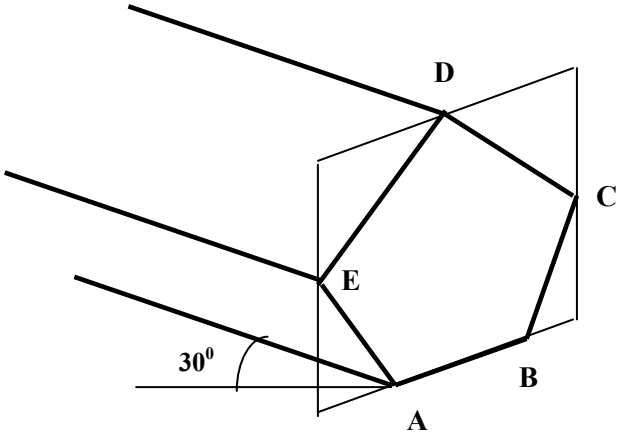
(vi) Points 'D' & 'E' are marked at their distances from corners 3 or 4.

Join all the points inside the box to get the required pentagon.

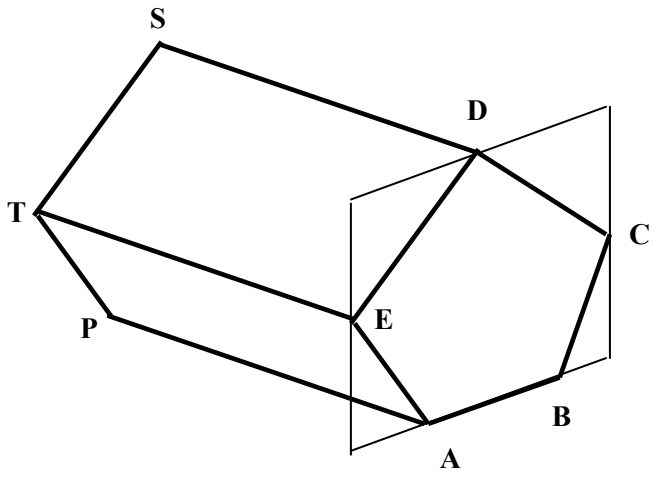


(vii) Now, since the axis is horizontal, the axis is to be drawn at 30^0 to the left as the base angle of 30^0 has been drawn to the right.

From all the visible corners A, E & D, draw lines of length = 65 mm at 30^0 with the horizontal & join the end points P, S & T in the same sequence as ABCDE. PQRST is the other side of pentagon.



Since Q & R are not visible, they are not shown in the final isometric drawing.



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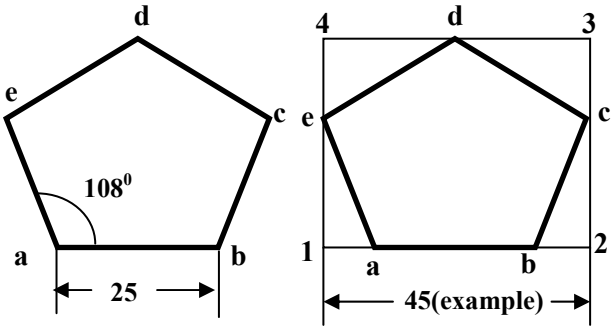
Hexagonal Prism with axis horizontal/ vertical

The isometric projection for this solid can be obtained by the same way as obtained for the pentagonal prism by box method discussed in the earlier problem.



Pentagonal Pyramid with axis vertical:

(4) ***Draw*** *the isometric projections of a* ***pentagonal pyramid*** *with base 30 mm sides and axis 60 mm long when its* ***axis*** *is (i)* ***Vertical*** *& (ii)* ***Horizontal.***

(Sol) Base → 30 mm
Axis → 60 mm

Logic: (i) Draw the pentagon & a box around it.

(ii)Turn the box by 30^0-30^0 or 30^0-90^0 depending on axis position as vertical or horizontal.

(iii) Locate the centre of the polygon and then draw the axis to get apex point. The axis can be drawn either at 90^0 or 30^0 depending on position.

(iv) Join all the corners of the pentagon to the apex point O to get the pentagonal pyramid.

Steps:

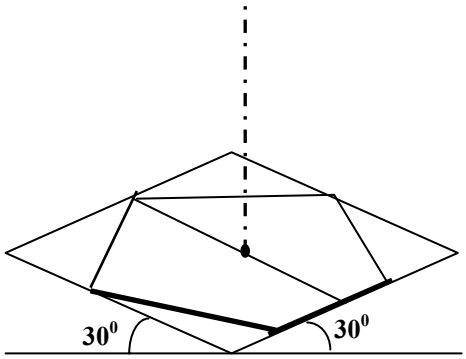
(i) Draw the regular pentagon of base 30 mm with sides at angle of 108^0 to each other. Mark it as abcde.

(ii) Around abcde, draw a box such that the box touches all corners a, b, c, d & e. Mark the box as 1234.

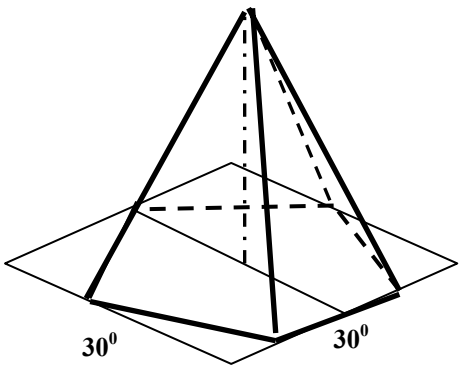
(iii) Measure 1234 & reproduce it in isometric.

(iv) Turn the box by 30^0-30^0 & inside it, draw the pentagon by box method as earlier.

(v) Locate the centre of the pentagon by joining a corner point and mid point of the base & mark a point at half of this length to get the center.



(vii)



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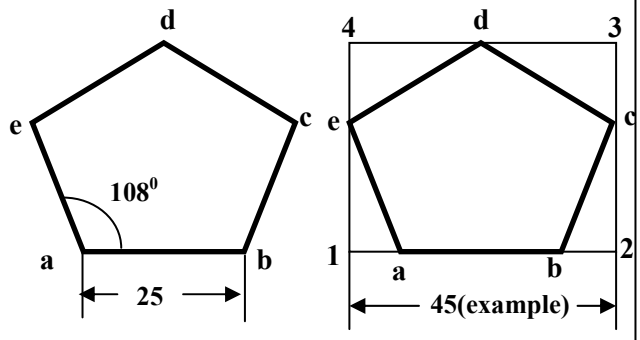
(ii)Pentagonal Pyramid with axis horizontal:

(i) Draw the regular pentagon of base 25 mm with sides at angle of 108^0 to each other. Mark it as abcde.

(ii) Around abcde, draw a box such that the box touches all corners a, b, c, d & e. Mark the box as 1234.

(iii) Measure 1234 & reproduce it in isometric.

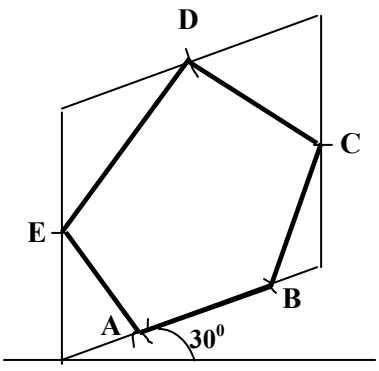


(vii) The box 1234 is to be drawn at 30^0-90^0.

After drawing the box 1234 at 30^0-90^0, mark the point '**A' by measuring distance of 'a' from 1 in the polygon inside the box 1234 in (iii)**

(viii) Similarly, mark points B at given distance from 2, C is marked at given distance from 3 or 2.
(ix) Points 'D' & 'E' are marked at their distances from corners 3 or 4.

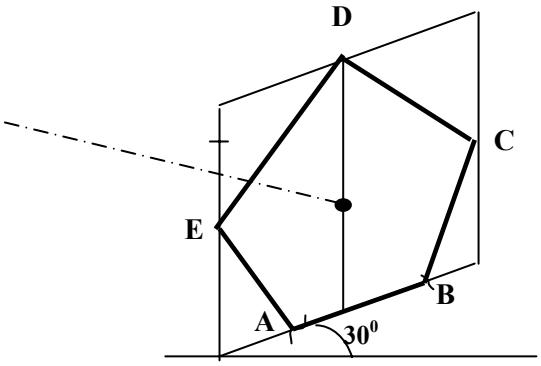
Join all the points inside the box to get the required pentagon.

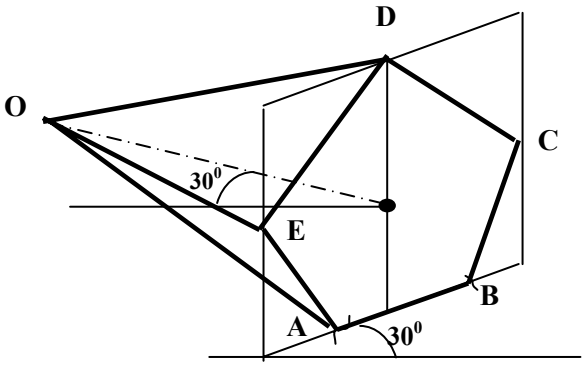


(vii) Now, since the axis is horizontal, the axis is to be drawn at 30^0 to the left as the base angle of 30^0 has been drawn to the right.

Join all the visible corners A, B, C, D & E to the center of the pyramid, O.

Draw the axis of length = 65 mm and obtain the pentagonal pyramid.





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Isometric Projections of Cones & Cylinders

The base shape of these solids is a circle and will be seen as an ellipse in the 3-D view when it is rotated by the isometric angles of 30^0-30^0-90^0 and lifted up.

The ellipse is drawn by ***4-center-V method.***

Isometric views of a cone:

(5) Draw the Isometric projections of a **Cone** having its base **diameter 50 mm** & **height 75**mm when its **axis is**
(i) Vertical & (ii) **Horizontal**

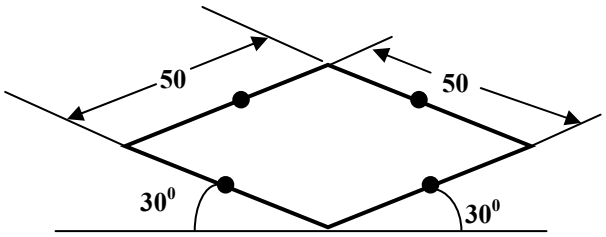
(Sol) The first step is to draw a box around the circle and then turn the box by 30^0-30^0 for vertical axis & 30^0-90^0 for horizontal axis position.

Since it is known that the box around a circle will always be a square, we directly begin our isometric projections by drawing the square taking the side as equal to the diameter of circle.

(i) ***Axis is Vertical*** (*box (square)* → **30^0-30^0**)

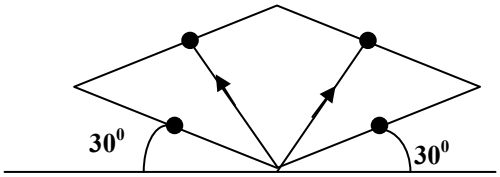
Steps:

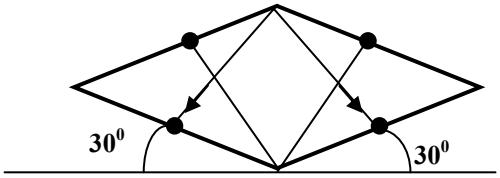
(1) Draw a horizontal line and on it, draw a square with sides = 50 mm at 30^0-30^0.



(2) Mark 4 centers on the 4 sides of the square.

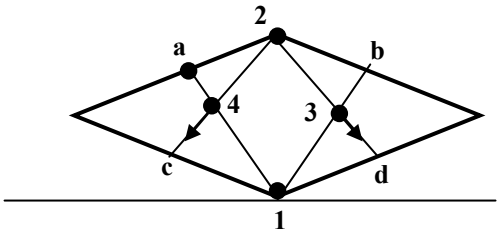
(3) Form a **'V'** shape by joining the corners of the square to the centers of opposite sides.



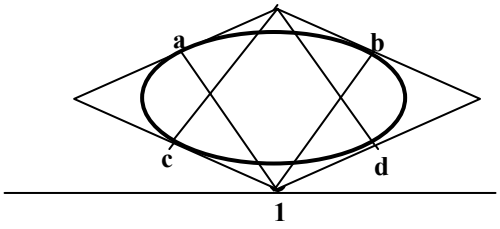


(4) Identify the ***4 centers*** now for drawing arcs to get the ellipse in 4 parts. The 4 centers of V's are 1, 2, 3 & 4 as shown below.

Note: (c, d) = (a, b)



(5) With 1 as center and Radius = (1-a) or (1-b), draw an arc passing through (a, b).
(6) With 2 as center and same radius (1-a), draw an arc passing through (c, d).
(7) With 3 & 4 as centers & radius = (4-a) or (4-c), draw arcs to through (a-c) & (b-d).



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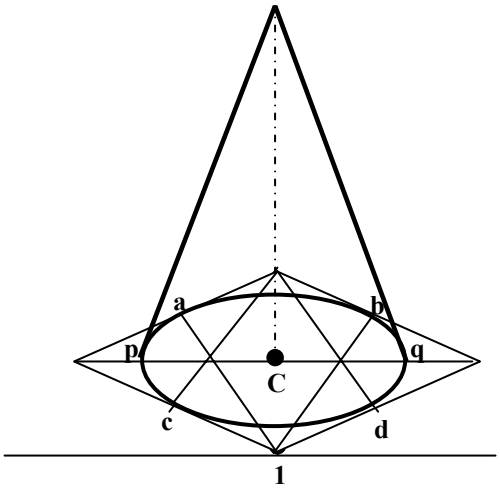
(8) Join the centers of the square to get C. (viii)

(9) From O, mark apex O at 90^0 and of length 75 mm.

(10) Join the centers of the base ellipse with O to get the final view of the cone.



Since the inner part of the cone is invisible, it can be shown as hidden lines or can be erased.

The portion p-a-b-q can be erased or shown as dotted to explain that it is invisible.

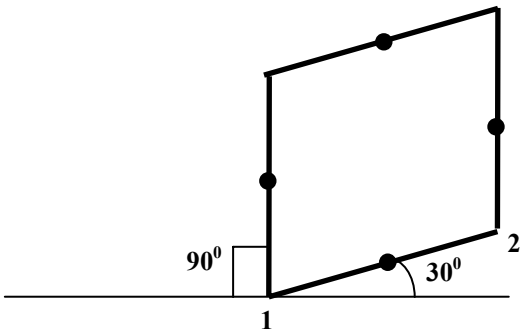
When Axis is horizontal:

Base (box) angles → 30^0-90^0
Axis angle → 30^0

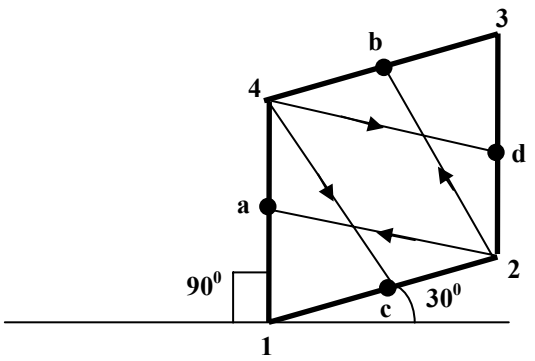
Steps:

(1) Draw a horizontal line and on it, draw a square with sides = 50 mm at 30^0-90^0.

(2) Mark 4 centers on the 4 sides of the square.



3) In 30^0-90^0, the '**V**' formation starts from corner **2** of the square **instead of 1.**



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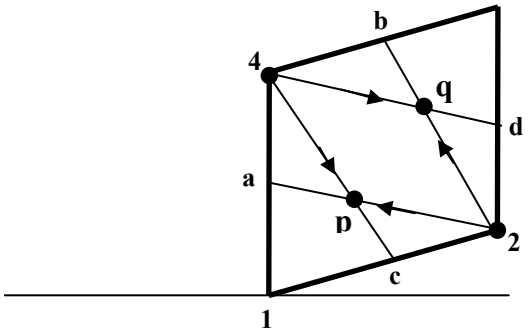
(4) Identify the ***4 centers*** now for drawing arcs to get the ellipse in 4 parts. The 4 centers of V's are 2, 4, p & q as shown below.

Note: (c, d) = (a, b)



(5) With 2 as center & Radius = (2-a) or (2-b), draw an arc passing through (a, b).

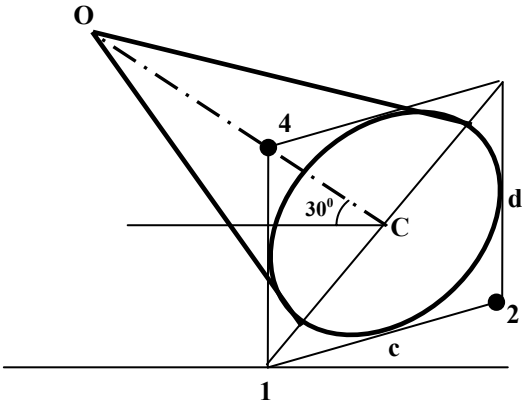
(6) With 4 as center and same radius (2-a), draw an arc passing through (c, d).

(7) With p & q as centers & radius = (p-a) or (q-b), draw arcs to through (a-c) & (b-d).

(8) On completion of arcs, an ellipse is obtained, which is completely visible.

(9) Mark the center of the square C and draw the axis of length = 75 at 30^0 to the left, with respect to the horizontal to get apex O.

(10) Join the centers of symmetry of the ellipse to O to get the cone.



Isometric Projection of a cone
Axis →Horizontal

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Isometric projections of a Cylinder:

In Isometric projections of a cylinder, 2 ellipses are seen at the base and top which are again drawn by using 4-center V method as discussed for cones.

The only variation is that after drawing the ellipse at the base, another box (square) is to be drawn at the top (axis) in which the top ellipse is inscribed.

(6) Draw the Isometric projections of a **Cylinder** having its base **diameter 50 mm** & **height 75**mm when its **axis is**
(i) Vertical & (ii) **Horizontal**

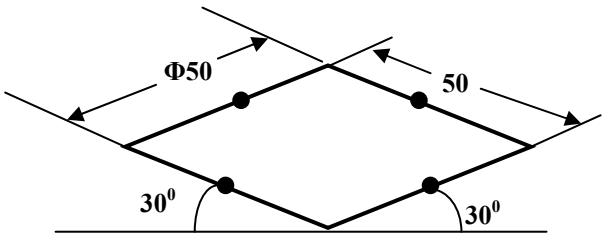
(Sol) The first step is to draw a box around the circle and then turn the box by 30^0-30^0 for vertical axis & 30^0-90^0 for horizontal axis position.

Since it is known that the box around a circle will always be a square, we directly begin our isometric projections by drawing the square taking the side as equal to the diameter of circle.

(i) ***Axis is Vertical*** (*box (square)* → **30^0-30^0**)

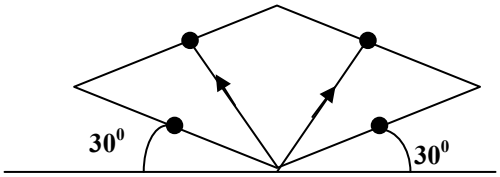
Steps:

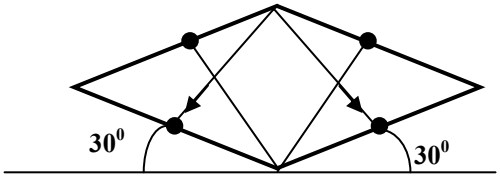
(1) Draw a horizontal line and on it, draw a square with sides = 50 mm at 30^0-30^0.



(2) Mark 4 centers on the 4 sides of the square.

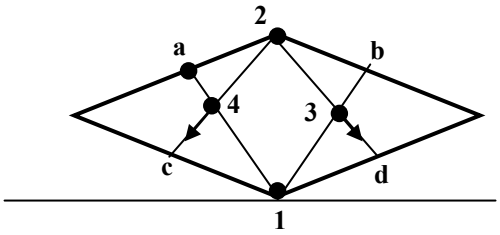
(3) Form a **'V'** shape by joining the corners of the square to the centers of opposite sides.



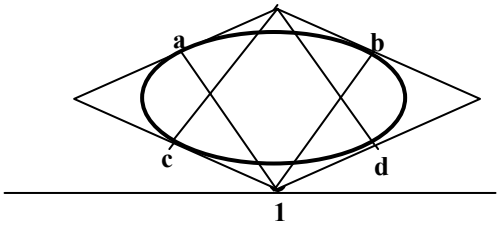


(4) Identify the ***4 centers*** now for drawing arcs to get the ellipse in 4 parts. The 4 centers of V's are 1, 2, 3 & 4 as shown below.

Note: (c, d) = (a, b)



(5) With 1 as center and Radius = (1-a) or (1-b), draw an arc passing through (a, b).
(6) With 2 as center and same radius (1-a), draw an arc passing through (c, d).
(7) With 3 & 4 as centers & radius = (4-a) or (4-c), draw arcs to through (a-c) & (b-d).



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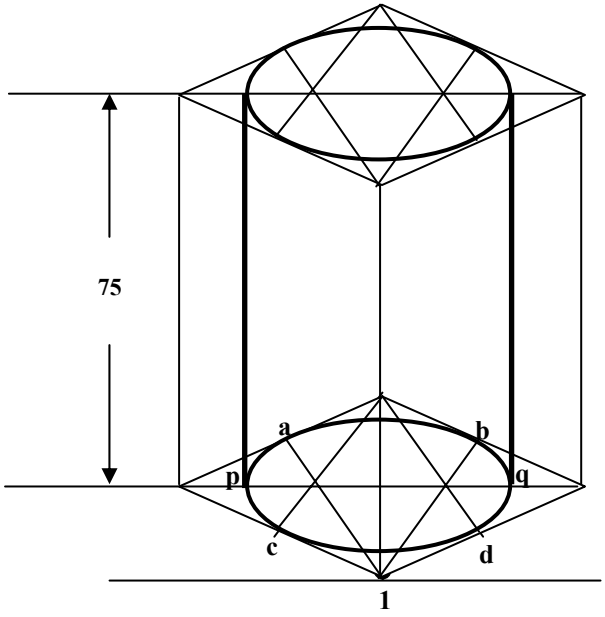
(8) Join the centers of the square to get C. (ix)

(9) From each of the corners of the square, draw axis at 90^0 & of length 75 mm.

(11) Join all the top points to get another square of 50 mm at the top.

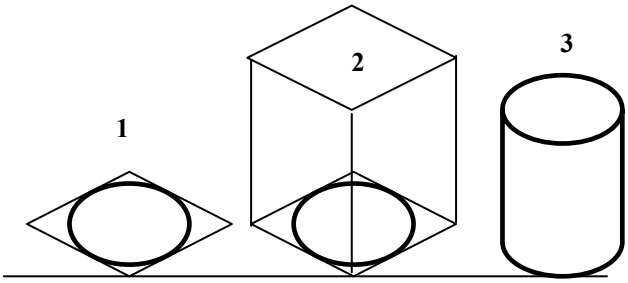
(12) In this square, again using 4-C-V method, draw an ellipse.

(13) Join the centers of symmetry of the base ellipse with the centers of the symmetry at the top to get the final view of the cylinder.



Since the inner part of the cylinder is invisible, it can be shown as hidden lines or can be erased.
The portion p-a-b-q can be erased or shown as dotted to explain that it is invisible.

3 stages showing the construction of a cylinder.



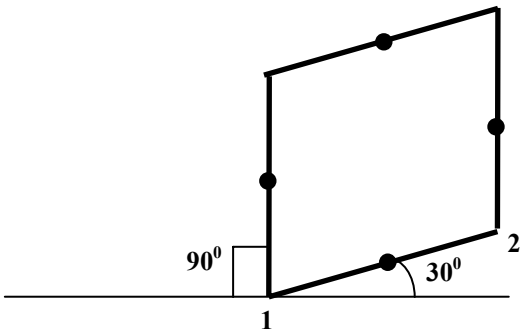
When Axis is horizontal:

Base (box) angles → 30^0-90^0
Axis angle → 30^0

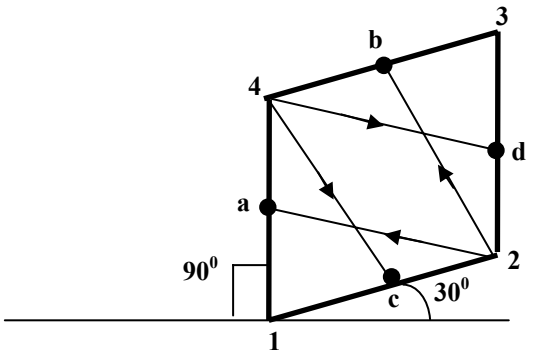
Steps:

(1) Draw a horizontal line and on it, draw a square with sides = 50 mm at 30^0-90^0.

(2) Mark 4 centers on the 4 sides of the square.



3) In 30^0-90^0, the '**V**' formation starts from corner **2** of the square **instead of 1.**



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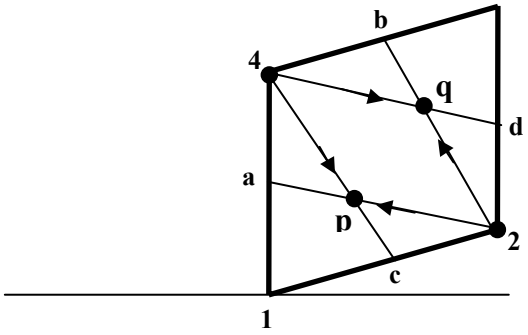
(4) Identify the ***4 centers*** now for drawing arcs to get the ellipse in 4 parts. The 4 centers of V's are 2, 4, p & q as shown below.

Note: (c, d) = (a, b)

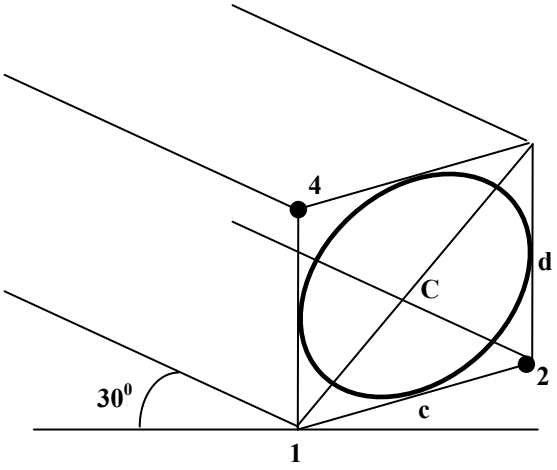


(5) With 2 as center & Radius = (2-a) or (2-b), draw an arc passing through (a, b).

(6) With 4 as center and same radius (2-a), draw an arc passing through (c, d).

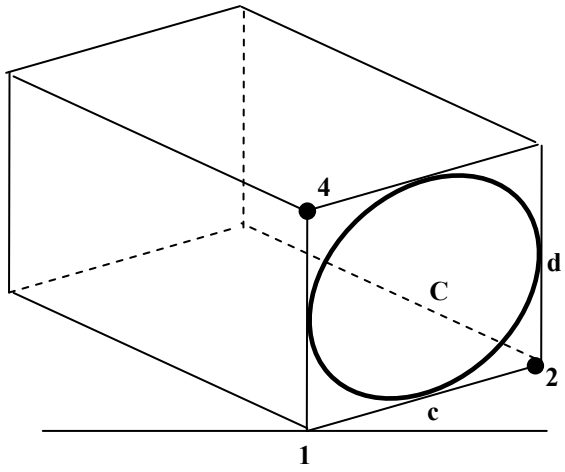
(7) With p & q as centers & radius = (p-a) or (q-b), draw arcs to through (a-c) & (b-d).

(8) On completion of arcs, an ellipse is obtained, which is completely visible.



(9) At 30^0 to the left, from each corner of the square, draw axis of length 75 mm & join at the ends to get another square.

(10) In this square, draw an ellipse by using 4-C-V method as described earlier.



11) After drawing the ellipses, join the centers of symmetry to get the final projection of the cylinder.