

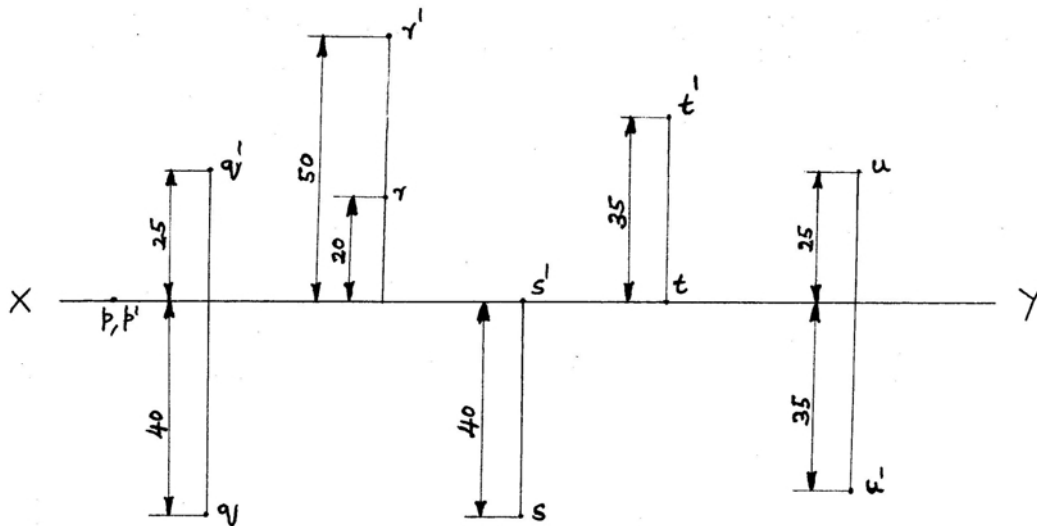
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Unit II

Projections of Points, Lines and Plane surfaces

Projections of Points:

01. Mark the projections of the following points on a common reference line:
- (i) P, 35 mm behind the VP and 20 mm below the HP.
 - (ii) Q, 40 mm in front of the VP and 30 mm above the HP
 - (iii) R, 50 mm behind the VP and 15 mm above the HP
 - (iv) S, 40 mm below the HP and in the VP
 - (v) T, 30 mm in front of the VP and 50 mm below the HP
 - (vi) U, 35 mm behind the VP and in the HP.
02. The projections of different points are shown in the following figure. Define the position of the points in relation to the reference planes. The distances marked are in millimetres.



Projections of Lines :

01. A line PQ, 50 mm long is perpendicular to the HP and 15 mm in front of the VP. The end P, nearer to the HP is 20 mm above it. Draw the projections of the line.
02. A line PQ, 70 mm long is parallel to the HP and inclined at 30° to the VP. The end P is 25 mm above the HP and 40 mm in front of the VP. Draw the projections of the straight line.
03. A line MN, 70 mm long lies in the VP and has the end M in both the HP and the VP. It is inclined at 35° to the HP. Draw the projections of the line.
04. A line PQ, 60 mm long has one end P, 20 mm above the HP and 35 mm in front of the VP. The line is parallel to the HP. The front view has a length of 50 mm. Find its true inclination with the VP.

GE2111 Engineering Graphics I Year Chemical

05. One end P of a line PQ is in the HP and 20 mm in front of the VP. The line is parallel to the VP and inclined at 40° to the HP. The length of the top view is 40 mm. Find the true length of the line.
01. A straight line 85 mm long has one end 15 mm in front of VP and 10 mm above HP, while the other end is 50 mm in front of VP and 45 mm above HP. Draw the plan and elevation of the line. Determine the inclinations of the line to HP and VP.
02. The distance between the projectors of two points A and B is 70 mm. Point A is 15 mm above HP and 20 mm in front of VP. Point B is 55 mm above HP and 45 mm in front of VP. Find the shortest distance between A and B and the true inclinations of the line AB with VP and HP.
03. A line EF, 85 mm long has its end E, 25 mm above the HP and 20 mm in front of the VP. The top and front views of the line have lengths of 55 mm and 70 mm respectively. Draw the projections of the line and find its true inclinations with the VP and the HP.
04. A line measuring 75 mm long has one of its ends 50 mm in front of VP and 15 mm above HP. The top view of the line is 50 mm long. Draw its projections and measure the front view. The other end is 15 mm in front of VP and is above HP.
05. A line 100 mm long has one of its ends 50 mm in front of VP and 20 mm above HP. The other end is 20 mm in front of VP and above HP. The length of the top view of the line measures 80 mm. Draw the projections and find the inclinations of the line to HP & VP.
06. The top view of a line is 65 mm long and is inclined at 30° to the reference line. One end is 20 mm above the HP and 10 mm in front of VP. The other end is 60 mm above HP and is in front of VP. Draw the projections and find the true length of the line and its inclinations to HP and VP.
07. The top view of a line PQ makes an angle of 30° with the horizontal and has a length of 100 mm. The end Q is in the HP and P is in the VP and 65 mm above the HP. Draw the projections of the line and find its true length and true inclinations with the reference planes.
08. The end P of a line PQ is 30 mm above HP and 35 mm in front of VP. The line is inclined at 35° to the HP. Its top view is 70 mm long and inclined at 40° to XY. Draw the projections of the straight line. Find the true length and inclination of the line with the VP.
09. The front view of a line 90 mm long is inclined at 45° to XY line. $a'b' = 65$ mm long, a' is 15 mm above XY. The point A is in VP. Draw the projections and find its true inclinations.
10. The plan and elevation of a line are inclined at 35° and 50° respectively to the XY. One end of the line is touching both HP and VP. The other end is 50 mm above HP. Draw the projections, find true length and true inclinations.

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11. A straight line AB has its end A 10 mm above the HP and end B 50 mm in front of VP. Draw the projections of line AB if it is inclined at 30^0 to the HP and 45^0 to the VP, and it is 50 mm long.
12. A line AB 80 mm long has its end A 60 mm in front of VP and 15 mm above HP. The line is inclined at 50^0 to HP and 40^0 to VP. Draw the projections of the line.
13. A line PQ, 65 mm long has its end P, 15 mm above the HP and 15 mm in front of the VP. It is inclined at 55^0 to the HP and 35^0 to the VP. Draw its projections.
14. Draw the projections of a straight line AB of 100 mm long when one of its ends is touching the VP and the other end touching HP. The angle of inclination with VP and HP are 40^0 and 50^0 respectively.
15. The mid-point of a straight line AB is 60 mm above HP and 50 mm in front of VP. The line measures 80 mm long and inclined at 30^0 to HP and 45^0 to VP. Draw its projections.
16. The mid point of a line AB 80 mm long, is 30 mm above HP and 45 mm in front of VP. It is inclined at 35^0 to HP and 55^0 to VP. Draw the projections.
17. The projections of a line measure 80 mm in the top view and 70 mm in the front view. The mid point of the line is 45 mm in front of VP and 35 mm above HP. One end is 10 mm in front of VP and nearer to it. The other end is nearer to HP. Draw the projections of the line, find the true length and true inclinations with the reference planes.

Projections of Planes :

01. A square lamina of side 35 mm is parallel to the HP with one of its sides inclined at 30^0 to the VP. The lamina is 20 mm above the HP. Draw its top and front views.
02. A hexagonal plate of side 35 mm rests on the HP on one of its sides perpendicular to the VP. Draw its projections when its surface is inclined at 50^0 to the HP.
03. A circular lamina of diameter 60 mm is held vertical with its surface inclined at 45^0 to the VP. Its centre is 40 mm above the HP and 30 mm in front of the VP. Draw its top and front views.
01. A triangle PQR has sides PQ = 70 mm, QR = 55 mm and PR = 40 mm. The side PQ is in the VP and inclined at 30^0 to the HP. Its surface is inclined at 45^0 to the VP. Draw the top and front views of the triangle.
02. A rectangular plate 70 x 40 mm has one of its shorter edges in the VP inclined at 40^0 to the HP. Draw its top view if its front view is a square of side 40 mm.

GE2111 Engineering Graphics I Year Chemical

03. A square lamina PQRS of side 40 mm rests on the ground on its corner P in such a way that the diagonal PR is inclined at 45° to the HP and apparently inclined at 30° to the VP. Draw its projections.
04. The diagonal PR of a square plate PQRS of side 45 mm is inclined at 40° to the HP. The diagonal QS is inclined at 35° to the VP and is parallel to the HP. Draw its projections.
05. A regular pentagonal lamina of 30 mm sides has one edge in HP and inclined at an angle of 30° to VP. Draw its projections when its surface is inclined at 45° to HP.
06. A pentagon of side 30 mm rests on the ground on one of its corners with the sides containing that corner being equally inclined to the ground. The side opposite to the corner on which it rests is inclined at 30° to the VP and is parallel to the HP. The surface of the pentagon makes 50° with the ground. Draw the top and front views of the pentagon.
07. A thin pentagonal lamina of 60 mm long edges rests on one of its corners in HP. Draw its projections when the surface of the lamina makes 45° with HP and the top view of the line joining the centre and that corner in HP, is inclined at 30° to VP.
08. Draw the projections of a hexagon of side 30 mm having one of its sides in HP and inclined at 60° to VP and the surface inclined at 35° to HP.
09. A circular plate of diameter 70 mm has the end P of the diameter PQ in the HP and the plate is inclined at 40° to the HP. Draw its projections when:
(i) the diameter PQ appears to be inclined at 45° to the VP in the top view. (ii) the diameter PQ makes 45° with the VP.
10. A circular lamina of diameter 60 mm has the end P of the diameter PQ in the HP and the end Q in the VP. Draw its projections when its surface is inclined at 60° to the HP and 30° to the VP.
11. A Square lamina of side 30 mm has one side in the HP and the opposite side in the VP. Draw its projections when its surface is inclined at 60° to the HP and 30° to the VP.

Unit III Projections of solids

Projections of solids:

01. Draw the projections of a cube (hexahedron) of side 40 mm when it rests on one of its corners with a diagonal of the solid vertical.
02. Draw the projections of a triangular prism of base side 30 mm and axis 50 mm resting on HP on one of its base sides with the axis inclined at 45° to HP and parallel to VP.

GE2111 Engineering Graphics I Year Chemical

03. A square prism of base side 30 mm and axis 50 mm rests on the HP on one of its rectangular faces with its axis inclined at 30^0 to the VP. Draw its plan and elevation.
04. A square prism of base side 35 mm and axis length 60 mm rests on one of its base edges on the HP with its axis inclined at 30^0 to the HP and parallel to the VP. Draw its top and front views.
05. A pentagonal prism, side of base 25 mm and axis 50 mm long, rests with one of its shorter edges on HP such that the base containing that edge makes an angle of 30^0 to HP and its axis is parallel to VP. Draw its projections.
06. A hexagonal prism, side of base 25 mm and axis 50 mm long rests with one of its base corners on HP such that its base makes an angle of 60^0 to HP and its axis is parallel to VP. Draw its projections.
07. Draw the projections of a hexagonal prism of base side 20 mm and axis 50 mm resting on a corner of its base on HP with the axis inclined at 45^0 to HP and parallel to VP.
08. A hexagonal prism of base edge 35 mm, axis 50 mm rests on one corner of its base on HP with the solid diagonal through that corner perpendicular to HP. Draw the plan and elevation.
09. A hexagonal prism of base edge 35 mm, axis 50 mm rests on one corner of its base on HP with the solid diagonal parallel to both HP and VP. Draw the projections.
10. Draw the projections of hexagonal prism of base side 20 mm and axis length 50 mm when it rests on the ground on one of the edges of the base and the axis inclined at 35^0 to the ground and parallel to the VP.
11. Draw the projections of a hexagonal prism of base side 20 mm and axis length 50 mm when it is lying on the ground on one of its rectangular faces and the axis is inclined at 35^0 to the VP.
12. A square pyramid of base side 30 mm and height 40 mm rests on the HP on one of its base edges with its axis inclined at 45^0 to the HP and parallel to the VP. Draw its projections.
13. A square pyramid of base side 60 mm and altitude 100 mm lies on the HP on one of its triangular faces with its axis parallel to the VP. Draw its projections.
14. A square pyramid, side of base 50 mm and altitude 75 mm long, is lying on one of its lateral faces on HP. The projection of the axis on HP in this position is parallel to the reference line. Draw the front view and top view of the pyramid.
15. Draw the projections of a square pyramid of base side 20 mm and altitude 50 mm when:
 - (i) it lies on the ground on one of its triangular faces and the axis is parallel to the VP.
 - (ii) it lies on the ground on one of its slant edges with the axis parallel to the VP

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- (iii) it rests on the ground on one of its base edges perpendicular to the VP and the triangular face containing the resting edge perpendicular to the VP and the HP.
16. A pentagonal pyramid, side of base 25 mm and axis 55 mm long, lies with one of its slant edges on HP such that its axis is parallel to VP. Draw its projections.
 17. Draw the projections of a pentagonal pyramid of base side 30 mm and altitude 60 mm when it rests on the ground on one of its base edges with the axis inclined at 30° to the ground and parallel to the VP.
 18. A pentagonal pyramid of base edge 25 mm and axis length 60 mm rests on one base side on HP such that the highest base corner is 20 mm above HP. Its axis is parallel to the VP. Draw its top and front views.
 19. A hexagonal pyramid of base edge 40 mm and altitude 80 mm rests on one of its base edges on the HP with its axis inclined at 30° to the HP and parallel to the VP. Draw its top and front views.
 20. Draw the projections of a hexagonal pyramid of base side 20 mm and axis 60 mm when it rests on one of its triangular faces on HP with its axis parallel to VP.
 21. A cone of base diameter 40 mm and altitude 80 mm rests on the HP with its axis inclined at 30° to the HP and parallel to the VP. Draw its projections.
 22. Draw the projections of a cone of base diameter 50 mm and axis length 70 mm when it lies on the ground on one of its generators with the axis parallel to the VP.
 23. A cylinder of diameter 30 mm and axis length 50 mm is resting on the HP on a point so that its axis is inclined at 45° to the HP and parallel to the VP. Draw its top and front views.
 24. Draw the projections of a cylinder 40 mm diameter and 60 mm long, lying on the HP with its axis inclined at 45° to the VP and parallel to the HP.
 25. A hexagonal prism of 30 mm base sides and axis 70 mm long is suspended freely from one of its base corners. Draw its front view and top view, when the vertical plane containing the axis, and the point of suspension is parallel to VP.
 26. A solid pentagonal pyramid of base side 25 mm and 60 mm height is suspended from a string attached to one corner of the base of the pyramid. The string is held such that the apex of the pyramid is just touching the HP. The axis of the pyramid is parallel to the VP. Draw the projections of the pyramid.
 27. A pentagonal pyramid of base side 20 mm and axis 60 mm long is freely suspended from one of its base corners, such that the axis is parallel to VP. Draw the front view and the top view of the solid in the above position.

GE2111 Engineering Graphics I Year Chemical

28. A cone of diameter 40 mm and height 60 mm is freely suspended from one of its base points such that the axis is parallel to VP. Draw the projections.

Unit IV Section of Solids and Development of surfaces

Section of solids:

01. A cube of 45 mm side rests with a face on HP such that one of its vertical face is inclined at 30° to VP. A section plane parallel to VP cuts the cube at a distance of 15 mm from the vertical edge nearer to the observer. Draw its top and sectional views.
02. A cube of side 30 mm is resting on the ground on one of its faces with base edges equally inclined to the VP. Find the position of the cutting plane so that the true shape of section is a regular hexagon.
03. A square pyramid of base 30 mm and axis 60 mm long is standing on the HP with its base edges equally inclined to VP. It is cut by a section plane perpendicular to the VP and inclined at 30° to HP meeting the axis at 30 mm above the HP (bisecting the axis). Draw the sectional top view and the true shape of the section, if the upper portion is removed.
04. A square pyramid of base side 30 mm and axis 50 mm lies on the HP on its base with its base edges equally inclined to VP. It is cut by a plane perpendicular to VP and inclined to HP cuts the base also, such that the true shape is an isosceles triangle of base side 20 mm and altitude 45 mm. Draw the projections and find the inclination of the section plane.
05. A square pyramid of base side 40 mm and axis 65 mm rests on its base on HP. A cutting plane inclined to HP and perpendicular to VP cuts the pyramid in such a way that the true shape of the section is a trapezium of parallel sides measuring 30 mm and 20 mm. Draw its sectional top view and the true shape of the section. Also find the inclination of the cutting plane to the HP.
06. A pentagonal pyramid of base side 20 mm and altitude 55 mm rests on its base on the HP with one of the base edges perpendicular to the VP. It is cut by a plane inclined at 50° to the base. The cutting plane meets the axis at 15 mm above the base. Draw the front view, sectional top view and the true shape of the section.
07. A pentagonal pyramid of 20 mm edge of base and axis 40 mm long stands vertically with its base on HP and an edge parallel to VP. It is cut by a vertical section plane inclined at 30° to VP and located at a distance of 5 mm from the axis (and in front of it). Draw the sectional front view and the top view. Also draw the true shape of the cut portion.

GE2111 Engineering Graphics I Year Chemical

08. A hexagonal pyramid of base side 25 mm and axis 55 mm rests on its base on the HP with two base edges perpendicular to the VP. It is cut by a plane perpendicular to the VP and inclined at 30^0 to the HP meeting the axis at 20 mm from the vertex (meeting the axis at a point 35 mm from the base). Draw the front view, sectional top view and the true shape of the section.
09. A hexagonal pyramid of base side 20 mm and axis 55 mm rests on the HP on its base with two edges parallel to the VP (with a base edge parallel to the VP). It is cut by a vertical plane inclined at 30^0 to the VP and cutting the pyramid at 5 mm from the top view of the axis. Draw the top view, sectional front view and the true shape of the section.
10. A cone of base diameter 50 mm and axis 60 mm is resting on the HP on its base. It is cut by a plane perpendicular to the VP and inclined at 75^0 to the HP and passes through the apex. Draw the sectional plan and true shape of the section.
11. A cone of base diameter 65 mm and axis 80 mm stands vertically with its base on HP. The vertical trace of a section plane perpendicular to VP and parallel to one of the end generators of the cone, passes at a distance of 15 mm from it. Draw the sectional top view and true shape of the section. Name the curve of the true shape of section.
12. A cylinder of diameter 40 mm and height 50 mm rests on its base on the HP. It is cut by a plane perpendicular to the VP and inclined at 50^0 to the HP. The cutting plane meets the axis at a distance of 15 mm from the top. Draw the front view, sectional top view and the true shape of the section.
13. A Solid is half pyramidal and half conical. The pyramidal portion has a base of three sides of size 20 mm each. The axis length is 50 mm. The solid rests on the HP on its base with a side of the pyramidal base perpendicular to the VP. It is cut by a plane perpendicular to the VP and inclined at 45^0 to the HP. The plane cuts the axis at 22 mm above base. Draw the front view, sectional top view and the true shape of the section.
14. A hexagonal pyramid of base side 20 mm and altitude 50 mm rests on its base on the HP with two base edges parallel to the VP. It is cut by a horizontal plane perpendicular to the VP meeting the axis of the pyramid at 30 mm from the vertex. Another plane perpendicular to the VP and inclined at 40^0 to the HP also cuts the solid meeting the axis at the point where the horizontal plane meets the axis. Draw the front view, sectional top view and the true shape of the section.

Development of lateral surfaces of simple and truncated solids :

01. A cylinder of diameter 40 mm and height 50 mm is resting vertically on one of its ends on the HP. It is cut by a plane perpendicular to the VP and inclined at 30^0 to the HP. The plane meets the axis at a point 30 mm from the base. Draw the development of the lateral surface of the lower portion of the truncated cylinder.

GE2111 Engineering Graphics I Year Chemical

02. Draw the development of the lateral surface of the right portion of the cylinder of diameter 50 mm and height 65 mm cut by a plane inclined at 30° to the axis and passing through the axis at a height of 40 mm above the base.
03. A cylinder of diameter 40 mm, height 75 mm is cut by a plane perpendicular to VP and inclined at 55° to HP meeting the axis at top face. Draw the lateral development of the solid.
04. A vertical chimney of 40 cm diameter joins a roof sloping at an angle of 35° with the horizontal. The shortest portion over the roof is 30 cm. Determine the shape of the sheet metal from which the chimney can be fabricated. Take a scale of 1 : 10.
05. A cylinder of base diameter 60 mm and height 80 mm is cut by a cutting plane perpendicular to the VP and inclined at 45° to the HP meeting the axis at the midpoint. Another plane perpendicular to the VP and inclined at 45° to the HP also bisects the axis such that the included angle between the two cutting planes is 90° . Both the cutting planes are to the right. Draw the development of the lateral surface of the cylinder.
06. A square prism of base side 35 mm and height 70 mm rests on one of its ends on the HP with a rectangular face inclined at 30° to the VP. The positions of two points A and B on the surface of the prism are given. A string is to be tied connecting A and B in the anti clockwise direction along the surface of the prism. Find the shortest length of the string and also show the string in the front view. Point A is 8 mm and B is 55 mm above the HP. The top view of A is at 17 mm and that of B is at 23 mm from the far left corner in the top view on adjacent sides. A is visible and B is invisible from the front.
07. A hexagonal prism of base side 25 mm and height 60 mm is standing vertically with one of its rectangular faces inclined at 20° to the VP. Draw the development of the lateral surfaces of the truncated hexagonal prism and also the elevation showing the line joining any two points along the surface of the solid by the shortest distance. The cutting plane is perpendicular to VP and inclined at 45° to HP and passing through the top right corner of the prism.
08. A pentagonal pyramid of base side 30 mm and axis 70 mm is lying on the ground on its base with a base edge perpendicular to the VP. It is cut by a section plane, perpendicular to the VP, inclined at 60° to the HP and bisects the axis. Draw the development of the lateral surfaces of the truncated pyramid.
09. A hexagonal pyramid of base side 25 mm and altitude 50 mm is resting vertically on its base on the ground with two of the sides of the base perpendicular to the VP. It is cut by a plane perpendicular to the VP and inclined at 50° to the axis. The plane bisects the axis of the pyramid. Draw the development of the lateral surfaces of the pyramid.
10. A hexagonal pyramid of base side 25 mm and altitude 60 mm rests on its base on the HP with two base edges parallel to the VP. It is cut by a horizontal plane perpendicular to the VP meeting the axis of the pyramid at 35 mm from the vertex. Another plane perpendicular to the VP and inclined at 60° to the

GE2111 Engineering Graphics I Year Chemical

HP also cuts the solid meeting the axis at the point where the horizontal plane meets the axis. Draw the development of the lateral surfaces of the truncated hexagonal pyramid.

11. A square pyramid of base side 35 mm and axis 60 mm rests on its base on the ground with one of the sides of the base inclined at 30° to the VP. A string is wound round the surfaces of the pyramid starting from left extreme point on the base and ending at the same point. Find the shortest length of the string required. Also trace the path of the string in the front and top views.
12. A right circular cone of base diameter 60 mm and height 70 mm is resting on its base on the ground. It is cut by a plane perpendicular to the VP and inclined at 60° to the axis. The cutting plane bisects the axis of the cone. Draw the development of the lateral surface of the truncated cone.
13. A right circular cone of base diameter 70 mm and axis length 90 mm rests on its base on the HP. A cutting plane perpendicular to the VP and inclined to the HP cuts the cone and passes through left extreme base point of the cone and the mid point of the axis. Draw the development of the lateral surface of the truncated cone.
14. A cone of base diameter 60 mm and altitude 70 mm rests on its base on the HP. It is cut by a plane perpendicular to both the HP and the VP and passing through the cone 10 mm to the left of the axis of the cone. Draw the development of the lateral surface of the right portion of the cut cone.
15. A lamp shade is formed by cutting a cone of base 144 mm diameter and 174 mm height by a horizontal plane at a distance of 72 mm from the apex and another plane inclined at 30° to HP passing through one extremity of the base. Draw the development of the shade.
16. A cone of base 54 mm diameter and height 72 mm rests with its base on HP. A section plane perpendicular to HP and inclined at 25° to VP cuts the cone at a distance of 13.5 mm from the axis. Draw the sectional front view and develop the lateral surface of the remaining portion of the cone.
17. A cone of base 50 mm diameter and 60 mm height, rests with its base on HP. It is cut by a section plane perpendicular to VP, parallel to one of the end generators and passing through a point on the axis at a distance of 22 mm from the apex. Draw the sectional top view and develop the lateral surface of the remaining portion of the cone.
18. Draw the development of a cone of base diameter 30 mm and height 50 mm and show the shortest path starting from a point on the circumference of the base and moving around the cone returning to the same point by the shortest distance.

OR

A cone of base diameter 30 mm and height 50 mm rests vertically on its base on the ground. A string is wound round the curved surface of the cone starting from left extreme point on the base and ending at the same point. Find the shortest length of the string required. Also, trace the path of the string in the front and the top views.

GE2111 Engineering Graphics I Year Chemical

OR

The vertical section of a right circular cone through the axis is an isosceles triangle of 30 mm base and 50 mm height. A fly sits on the extreme left end of the base and walks around the surface of the cone and returns to the starting point. Find geometrically the length of the shortest path the fly can take. Show the path in front and top views.

19. A bucket made of G.I. sheet has its top 30 cm diameter and bottom 18 cm diameter with a circular ring 6 cm wide at the bottom. The total height of the bucket is 38.5 cm. Develop the complete surface of the bucket. Adopt a scale of 1 : 5.

OR

A bucket made of thin sheet metal is in the form of an inverted frustum of a cone. Its top is 300 mm diameter and bottom 180 mm diameter & its height is 325 mm. A circular ring of 180 mm diameter and 60 mm height is attached to the frustum at the bottom. Draw the development of the lateral surface of the bucket, including the bottom ring. Adopt a scale of 1 : 5.

20. Draw the development of a hopper which consists of :
- i) a cylinder of diameter 60 mm and height 10 mm
 - ii) an inverted frustum of a cone of base diameter 60 mm and height 50 mm and
 - iii) a cylinder of diameter 20 mm and height 30 mm.

Development of lateral surfaces of solids with cylindrical cut-outs :

01. A round hole of 30 mm diameter is drilled through a right square prism of base side 40 mm and height of axis 60 mm at mid height. The axis of the hole intersects the axis of the prism at right angles and is running through the diagonally opposite long edges. Develop the lateral surface of the prism.
02. A hexagonal prism of base edge 25 mm and height 60 mm rests on one of its ends on the HP with a vertical face parallel to the VP. A horizontal hole of diameter 36 mm is drilled centrally right through the prism with its axis perpendicular to the VP. Draw the development of the lateral surfaces of the prism with the hole.
03. A pentagonal prism of base side 25 mm and height 60 mm stands on one of its ends on the HP with a rectangular face parallel to the VP. A hole of diameter 30 mm is drilled right (centrally) through the prism in such a way that the axis of the hole bisects the axis of the prism at right angles. The axis of the hole is perpendicular to the VP. Draw the development of the lateral surfaces of the prism.
04. A square prism of base side 25 mm and height 50 mm rests on the ground on its base with base edges equally inclined to the VP. A circular hole of diameter 28 mm is drilled through the prism. The axis of the hole is perpendicular to the VP, 25 mm above the base and 8 mm to the left of the axis of the prism. Draw the development of the lateral surfaces of the square prism.

GE2111 Engineering Graphics I Year Chemical

05. A circular hole of diameter 30 mm is drilled through a vertical cylinder of diameter 50 mm and height 65 mm. The axis of the hole is perpendicular to the VP and meets the axis of the cylinder at right angles at a height of 30 mm above the base. Draw the development of the lateral surface of the cylinder.
06. A hexagonal pyramid of base side 20 mm and altitude 55 mm stands on its base on the HP with a base edge parallel to the VP. A circular hole of diameter 20 mm is drilled right through the pyramid with the axis of the hole perpendicular to the VP and meeting the axis of the pyramid at 20 mm above the base. Draw the development of the pyramid with the hole.
07. A cone of base diameter 40 mm and height 50 mm stands on its base on the HP. A cylindrical hole of diameter 20 mm is drilled right through the cone. The axis of the hole is perpendicular to the VP and meets the axis of the cone at 15 mm above the base of the cone. Draw the development of the lateral surface of the cone with the hole.
08. A right circular cone of base 60 mm diameter and 60 mm height stands vertically with its base on HP. A semi-circular hole of 36 mm diameter is cut through the cone such that the axis of the hole is parallel to HP, perpendicular to VP and intersecting the axis of the cone 20 mm above the base. The flat surface of the hole is parallel to HP and perpendicular to VP. Draw the development of the lateral surface of the cone with the hole.

Unit V Isometric and Perspective projections

Isometric projection

01. Draw the **isometric view** of a square prism of base side 20 mm and height 30 mm (i) When the prism is resting on one of its ends (ii) When the prism is lying on one of its longer sides (rectangular face).
02. Draw the **isometric view** of a triangular prism of base side 30 mm and height 60 mm when it rests on one of its triangular faces on HP and an edge of base is parallel to VP.
03. Draw the **isometric view** of a hexagonal prism of base side 15 mm and height 35 mm :
 - i) When it rests on one of its ends on the HP with two of its base sides parallel to the VP.
 - ii) When it rests on one of its rectangular faces with its axis horizontal.
04. A glass table weight is in the form of a triangular prism with a central cylindrical hole passing through the triangular ends. The sides of the triangular ends are 50 mm and the height of the table weight is 100 mm. The diameter of the circular hole is 25 mm. Draw the **isometric projection** of the table weight.

GE2111 Engineering Graphics I Year Chemical

05. A hexagonal prism of base side 20 mm and height 45 mm has a square hole of side 16 mm at the centre. The axes of the square and hexagon coincide. One of the faces of the square hole is parallel to a face of the hexagon. Draw the **isometric projection** of the prism with hole.
06. Draw the **isometric view** of a cylinder of diameter 40 mm and height 60 mm:
i) When it rests on one of its ends on the HP.
ii) When it rests on one of its generators on the HP (i.e. with its axis horizontal and ends vertical).
07. A square prism of base 20 mm side and height 40 mm rests on one of its ends on the HP. All the base sides of the prism are equally inclined to the VP. It is cut by a plane, perpendicular to the VP and inclined at 45° to the axis, passing through a point on the axis 7 mm from the top. Draw the **isometric projection** of the prism.
08. Draw the **isometric projection** of a pentagonal prism of side of base 30 mm and height 60 mm, resting on its pentagonal base with one rectangular face parallel to VP which is sectioned by a cutting plane inclined at 50° to the axis and passing through the axis at a height of 40 mm from the base.
09. A hexagonal prism, side of base 25 mm and height 50 mm rests on HP and one of the edges of its base is parallel to VP. A section plane perpendicular to VP and inclined at 45° to HP bisects the axis of the prism. Draw the **isometric projection** of the truncated portion of the prism, clearly showing the cut surface.
10. Draw the **isometric projection** of a cylinder of diameter 46 mm and height 60 mm when it is resting on one of its ends on the HP. It is cut by a plane perpendicular to the VP and inclined at 45° to the HP. The plane passes through a point on the axis located at 15 mm from the top.
11. Draw the **isometric view** of the triangular pyramid of side of base 30 mm and height 60 mm such that it rests on its triangular base on HP and an edge of base is parallel to VP.
12. Draw the three different **isometric views** of a pentagonal pyramid of side of base 20 mm and axis 65 mm.
13. Draw the **isometric view** of a hexagonal pyramid of base of side 15 mm and height 55 mm :
i) When it rests on its base on the HP with two sides of the base parallel to the VP.
ii) When its axis is horizontal and base vertical.
14. Draw the **isometric view** of a right circular cone of base diameter 34 mm and height 60 mm :
i) When it is resting on its base on the HP.
ii) When its axis is horizontal and base vertical.

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15. A pentagonal pyramid, 20 mm edge of base and 60 mm height, stands on HP, such that an edge of the base is parallel to VP and the corner opposite to that edge is nearer to VP. A section plane perpendicular to VP and inclined at 45° to HP cuts the pyramid passing through a point on the axis at a height of 33 mm from the apex. Draw the **isometric projection** of the truncated pyramid, showing the cut surface.
16. A pentagonal pyramid of 30 mm base and 60 mm axis rests on its base on HP with one of its base edges perpendicular to VP. A section plane perpendicular to VP and inclined at 30° to HP bisects the axis. Draw the **isometric projection** of the solid.
17. A cone of base diameter 50 mm and height 55 mm is resting on its base on the HP. It is cut by a plane perpendicular to the VP and inclined at 60° to the axis. The plane meets the axis at a distance of 25 mm from the apex. Draw the **isometric projection** of the truncated cone showing the cut surface.
18. A dust bin is in the form of a frustum of a hollow square pyramid with the base dimensions of 20 mm sides and the top open surface of 45 mm sides. Draw the **isometric projection** of the hollow dust bin, if its height is 50 mm and the wall thickness is negligible.
19. Draw the **isometric projection** of the frustum of a pentagonal pyramid of base 30 mm side and top 15 mm side. The height of the solid is 40 mm.
20. A pentagonal pyramid, base 30 mm and axis 65 mm long, rests with its base on HP. An edge of the base is parallel to VP and nearer to it. A horizontal section plane cuts the pyramid and passes through a point on the axis at a distance of 25 mm from the apex. Draw the **isometric projection** of the frustum of the pyramid.
21. Draw the **isometric projection** of a frustum of a hexagonal pyramid when it is resting on its base on the HP with two sides of the base parallel to the VP. The base side is 20 mm and top face side is 8 mm. The height of the frustum is 55 mm.
22. A frustum of a square pyramid of bottom edge 40 mm, top edge 26 mm and height 40 mm lies on the HP on one of its trapezoidal faces such that its axis is parallel to the VP. Draw the **isometric projection** of the frustum in this position.
23. Draw the **isometric projection** of a frustum of a cone of height 30 mm, base diameter 34 mm, top diameter 20 mm when it is centrally placed over a square slab of side 50 mm and thickness 10 mm.
24. A cylinder of base diameter 30 mm and axis 50 mm is placed on its base centrally on the top of a square slab of side 50 mm and thickness 20 mm. Draw the **isometric projection** of the combination of solids.

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25. A square pyramid of base side 30 mm and axis 50 mm is placed centrally on top of a cylindrical slab of 60 mm diameter and 35 mm thick. Draw the **isometric projection**.
26. A cone (50 mm diameter and 40 mm axis) is placed centrally over a cylindrical slab (50 mm diameter and 35 mm axis). The axes of the solids coincide and vertically positioned. Draw the **isometric projection**.
27. Draw the **isometric view** of a sphere of diameter 16 mm kept centrally over a frustum of a square pyramid of height 25 mm. The frustum has a base of side 35 mm and top of side 20 mm.

(OR)

Draw the **isometric projection** of a frustum of a square pyramid of height 25 mm surmounting a sphere of diameter 16 mm. The frustum has a base of side 35 mm and top of side 20 mm.

Perspective Projection

01. A square pyramid of base edge 20 mm and altitude 40 mm rests on its base on the ground with a base edge parallel to the picture plane. The axis of the pyramid is 25 mm behind the PP and 25 mm to the right of the eye. The eye is 50 mm in front of the PP and 50 mm above the ground. Draw its perspective projection.
02. A square pyramid of side of base 40 mm and axis 50 mm long, rests with its base on the ground plane such that all the edges of the base are equally inclined to the PP. One of the corners of the base is touching the PP. The station point is 60 mm in front of the PP, 80 mm above the ground plane and lies in a central plane which passes through the axis of the pyramid. Draw the perspective projection.
03. A square pyramid of base side 30 mm and axis length 55 mm rests on its base on the ground with a base corner touching the picture plane and the base edges equally inclined to the PP and behind it. The station point is 50 mm in front of the PP and 60 mm above the ground. The central plane is 15 mm to the left of the axis of the solid. Draw the perspective view of the pyramid.
04. A square pyramid of base side 30 mm and altitude 40 mm rests on its base on the ground such that one of its base sides is parallel to the picture plane and 10 mm in front of it. The station point is 50 mm in front of the picture plane, 25 mm to the left of the axis of the pyramid and 55 mm above the ground. Draw the perspective projection of the pyramid.
05. A square pyramid 45 mm base 50 mm axis rests on its base on the ground such that two parallel base edges recede at 30° to left of PP with the nearest corner base 10 mm behind PP. The station point is 45 mm in front of PP and 70 mm above ground and 10 mm to the right of the nearest corner. Draw the perspective view of solid.

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06. A rectangular pyramid of sides of base 50 mm and 40 mm and height 60 mm rests with its base on ground such that one of the longer base edges is parallel to the picture plane and 25 mm behind it. The station point is 50 mm in front of the picture plane, 40 mm to the left of the axis of the pyramid and 70 mm above the ground. Draw the perspective projection of the pyramid.
07. A rectangular pyramid of base 30 mm x 20 mm sides and height 40 mm rests on its base on the ground such that one of its base corner is touching the picture plane and the shorter edge of the base through this corner is inclined at 30° to PP. The station point is 30 mm in front of PP and 50 mm above the ground and 30 mm to the left of the axis of the pyramid. Draw the perspective projection of the solid.
08. A pentagonal pyramid, side of base 30 mm and height 50 mm rests with its base on the ground plane such that one of its base edges is inclined at 45° to PP and the base corner nearer to PP is 10 mm behind it. The station point is 45 mm in front of the picture plane, 70 mm above the ground plane and lies in a central plane which is 15 mm to the left of the base corner nearer to PP. Draw the perspective projection.
09. A regular hexagonal pyramid of base edge 20 mm and height 35 mm rests on its base on the ground plane with one of its base edges touching the picture plane. The station point is 30 mm above the ground plane and 40 mm in front of the PP. The central plane is 30 mm to the right of the axis. Draw the perspective view of the pyramid.
10. A square prism of base 25 x 25 mm and height 40 mm rests on the GP with the edges of the base making 45° with PP (with the edges of the base equally inclined to PP). The corner nearest to the PP is 25 mm to the right of the station point and 25 mm behind the PP. The station point is 55 mm above the GP and 70 mm in front of the PP. Draw the perspective projection of the square prism.

(OR)

A square prism of base 25 x 25 mm and height 40 mm rests on the GP on one of its ends with a rectangular face receding away from the PP towards right making 45° with PP. The corner nearest to the PP is 25 mm to the right of the station point and 25 mm behind the PP. The station point is 55 mm above the GP and 70 mm in front of the PP. Draw the perspective drawing of the prism.

11. Draw the perspective projection of a square prism of base side 20 mm and height 35 mm resting on an end (resting on one of its square faces) on the ground with a rectangular face parallel to the picture plane. The axis of the prism is 25 mm behind the PP and 25 mm to the right of the eye. The eye is 50 mm in front of the PP and 50 mm above the ground.

(OR)

A square prism, side of base 20 mm and height 35 mm rests with its base on the ground such that one of its rectangular faces is parallel to and 15 mm behind the picture plane. The station point is 50 mm in front of PP, 50 mm above the ground plane and lies in a central plane 25 mm to the left of the centre of the prism. Draw the perspective view.

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12. A triangular prism having an equilateral triangular base of sides 30 mm and height 40 mm rests on its base on the ground with one of its vertical edges 10 mm behind the PP. One of the rectangular faces containing that edge is inclined at 40° to the PP and is behind the PP. The station point is 50 mm in front of the PP and 50 mm above the ground. The station point is 15 mm to the right of the edge nearest to the PP. Draw the perspective view of the prism.
13. A triangular prism whose base is an isosceles triangle of sides 40 mm x 30 mm x 30 mm and axis 50 mm long rests with its base on the ground plane such that one of its vertical edges is 10 mm in front of the PP. One of the rectangular faces containing that edge is inclined at 45° to PP and in front of it. The station point is 80 mm in front of PP, 60 mm above the ground plane and lies in a central plane which is at 10 mm to the left of the centre of the prism. Draw the perspective projection.
14. A rectangular prism 40 x 30 x 15 mm rests on the ground on one of its ends with one of the longest edges touching the PP and the shortest edges receding to the left at an angle of 40° to the PP. The nearest vertical edge is 15 mm to the left of the station point which is at a distance of 55 mm in front of the PP and 30 mm above the ground. Draw the perspective drawing of the prism.
- (OR)**
- A rectangular prism 15 x 30 x 40 mm is placed on the ground behind the picture plane with the longest edges vertical and shortest edges receding to the left at an angle of 40° to the PP. The nearest vertical edge is touching the PP and 15 mm to the left of the observer who is at a distance of 55 mm in front of PP. The height of the observer above the ground is 30 mm. Draw the perspective projection of the prism.
15. A rectangular prism, sides of base 50 mm x 30 mm and height 55 mm, rests with its base on the ground plane. A vertical edge is in the picture plane and one of the longer edges of its base is inclined at 45° to PP and behind it. The station point is 50 mm in front of PP, 75 mm above the ground plane and lies in a central plane which passes through the centre of the prism. Draw the perspective projection.
16. Draw the perspective projection of a pentagonal prism of base side 20 mm and height 40 mm when it rests on its base on the ground plane with one of its rectangular faces parallel to and 20 mm behind the picture plane. The station point is 45 mm in front of the PP and 60 mm above the GP. The observer is 20 mm to the left of the axis.
17. A pentagonal prism, side of base 30 mm and height 50 mm rests with its base on the ground plane such that one of its rectangular faces is inclined at 45° to PP and the vertical edge nearer to PP is 10 mm behind it. The station point is 45 mm in front of the picture plane, 90 mm above the ground plane and lies in a central plane which is 15 mm to the left of the vertical edge nearer to PP. Draw the perspective projection.
18. A hexagonal prism of base side 20 mm and height 40 mm stands on its base on the ground with a base side parallel to the PP and 15 mm behind the PP. The observer's eye is 75 mm above the ground and 60 mm in front of the PP. The

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eye is located at 30 mm to the right of right extreme corner of the prism. Draw the perspective drawing of the prism.

19. A hexagonal prism, side of base 25 mm and height 50 mm rests with its base on the ground plane such that one of its rectangular faces is inclined at 30° to the picture plane and the vertical edge nearer to the picture plane is 10 mm behind it. The station point is 45 mm in front of the picture plane, 90 mm above the ground plane and lies in a central plane which is 15 mm to the left of the vertical edge nearer to the picture plane. Draw the perspective projection of the prism.
20. A cube of side 25 mm rests on one of its faces on the ground, the nearest vertical edge being 20 mm behind the picture plane and 40 mm to the left of the station point. A face containing the nearest vertical edge is inclined at 60° to the PP. The station point is 40 mm above the ground and 60 mm in front of the PP. Draw the perspective projection of the cube.
21. A cube of 35 mm long edges rests with a square face on the ground plane such that one of the vertical edges of the cube is 8 mm in front of the picture plane and a vertical face containing that edge is inclined at 30° to PP. The station point is 40 mm in front of the PP, 70 mm above the ground plane and lies in a central plane which is 45 mm to the left of the centre of the cube. Draw the perspective projection.
22. A cube of 35 mm edge lies with a face on the ground and an edge on the picture plane. All the vertical faces are equally inclined to PP. The edge of the cube in contact with the picture plane is situated 10 mm to the right of the station point (The station point lies in a central plane which is 10 mm to the left of the centre of the cube). Draw the perspective drawing of the cube, if the distance of station point from PP is 80 mm and its height from the ground is 60 mm.
23. A cylinder of diameter 40 mm and height 40 mm rests on the GP on one of its ends with its axis 35 mm behind the picture plane. The station point is 45 mm to the right of the axis. The station point is 65 mm above the GP and 40 mm in front of the PP. Draw the perspective projection of the cylinder.
24. A cylinder of 50 mm diameter and 70 mm long lies with its generator on the ground. The point on the circumference nearest to PP is 30 mm to the left of the eye and 15 mm behind the PP. The length of the cylinder recede at 45° to PP towards right. The distance of eye from PP is 50 mm and its height from the ground is 60 mm. Draw the perspective projection of the prism.
25. A cylinder 30 mm diameter and 40 mm long is lying on the ground with its axis perpendicular to the picture plane. The nearest point of contact with the ground is 60 mm on the left of the station point and 10 mm from the PP. The station point is 40 mm above the ground and 60 mm in front of the PP. Draw the perspective projection of the cylinder.
26. A frustum of a square pyramid of base edge 26 mm, top edge 20 mm and height 35 mm rests on its base on the ground with base edges equally inclined to the PP. The axis of the frustum is 30 mm to the right of the eye. The eye is

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45 mm in front of the PP and 50 mm above the ground. The nearest base corner is 10 mm behind the PP. Draw the perspective view of the frustum.

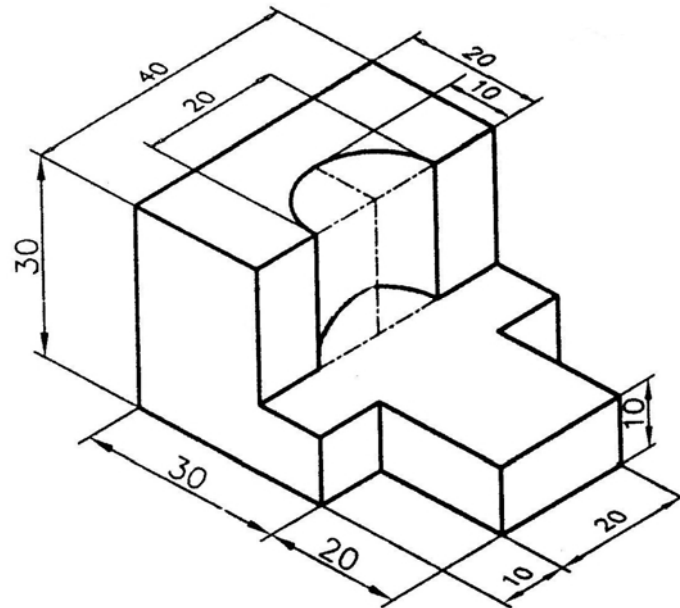
27. A frustum of a square pyramid of bottom base side 40 mm and top face side 20 mm and height 40 mm is lying on the ground vertically, with its base edges equally inclined to the PP. The nearest base edge corner is 10 mm in front of PP. The station point is 60 mm in front of PP and 90 mm above the ground and lies in a central plane, passing through a point 20 mm to the left of the axis. Draw the perspective view of the solid.
28. A frustum of a hexagonal pyramid of base edge 24 mm, top edge 12 mm and height 45 mm is placed on the ground with a base edge parallel to the picture plane and 10 mm behind the picture plane. The observer's eye is 50 mm in front of the PP and 75 mm above the ground. The eye lies in a central plane that passes through the centre of gravity of the frustum. Draw the perspective projection of the frustum.
29. Draw the perspective view of a hexagonal prism lying on the ground plane on one of its longer edges such that one of its rectangular faces is perpendicular to the ground plane. The axis is inclined at 30° to the picture plane and an edge of the base is touching the picture plane. The station point is 110 mm in front of the PP, 95 mm above the ground plane and lies in a central plane which bisects the axis. For the prism, side of base is 25 mm and height 75 mm. Use reduced scale 1 : 2.
30. A hexagonal prism of base side 20 mm and axis length 50 mm rests on the ground plane on one of its rectangular faces with its axis inclined at 30° to the picture plane receding to the right. A corner of the base (hexagonal face) is touching the PP. The station point is 60 mm in front of the PP and lies in a central plane that bisects the axis. The station point is 40 mm above the ground plane. Draw the perspective projection of the prism.
31. A hexagonal prism, side of base 30 mm length 90 mm lies with a rectangular face on the ground, so that the corner of that face nearest to the picture plane is 30 mm to the left of the eye and 15 mm behind the picture plane. The longer edges of the prism recede at 45° to the picture plane towards right. The distance of eye from picture plane is 130 mm and its height from the ground is 75 mm. Draw the perspective projection of the prism.

Unit I Plane curves and Free hand sketching

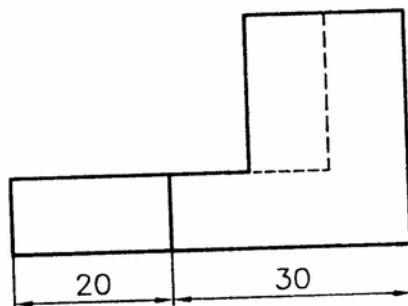
Free hand sketching :

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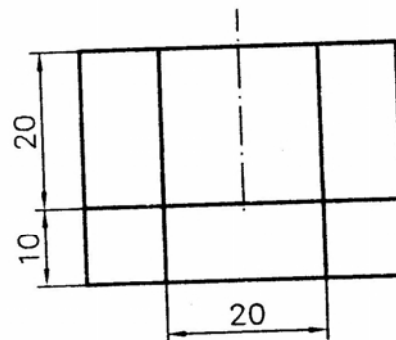
01. Draw three views of the block given below.



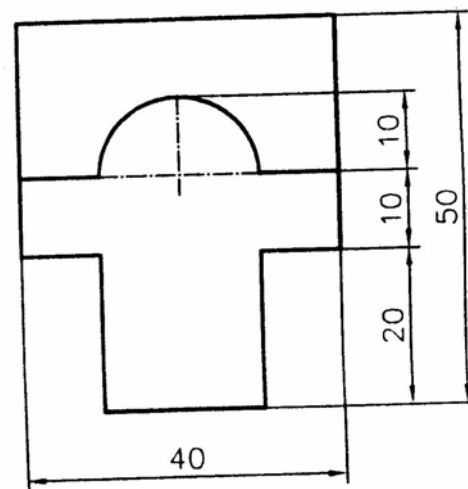
Solution :



R.S. VIEW

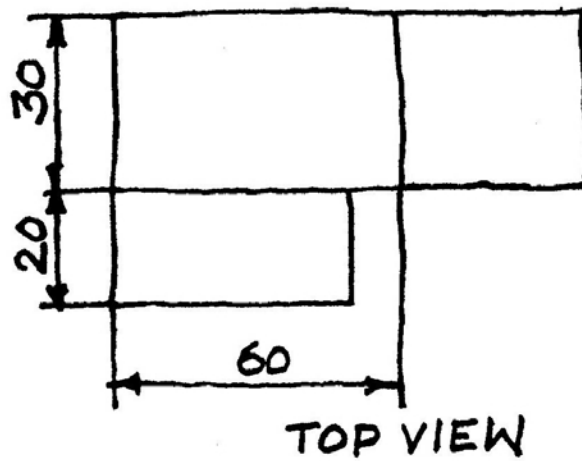
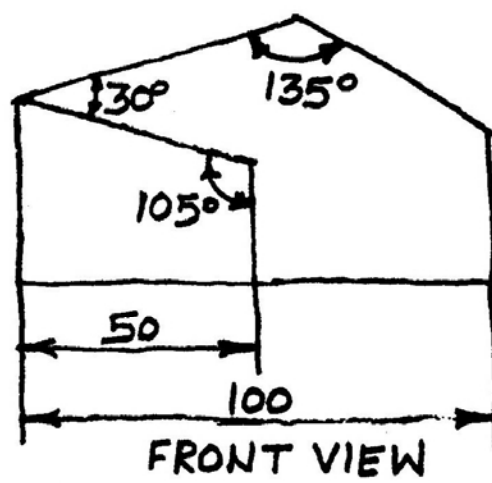
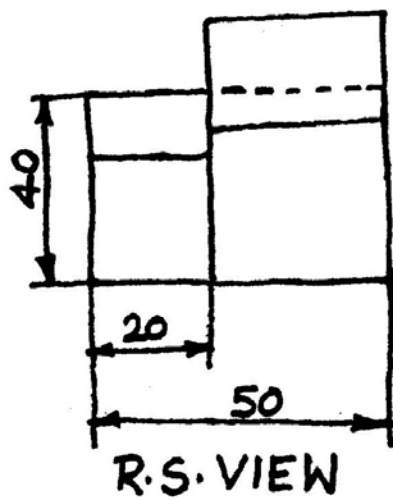
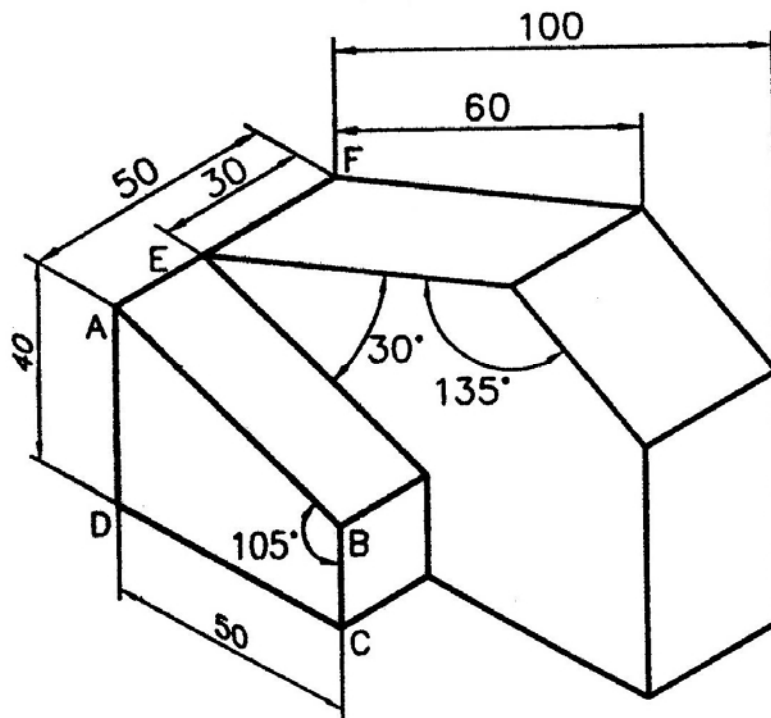


FRONT VIEW



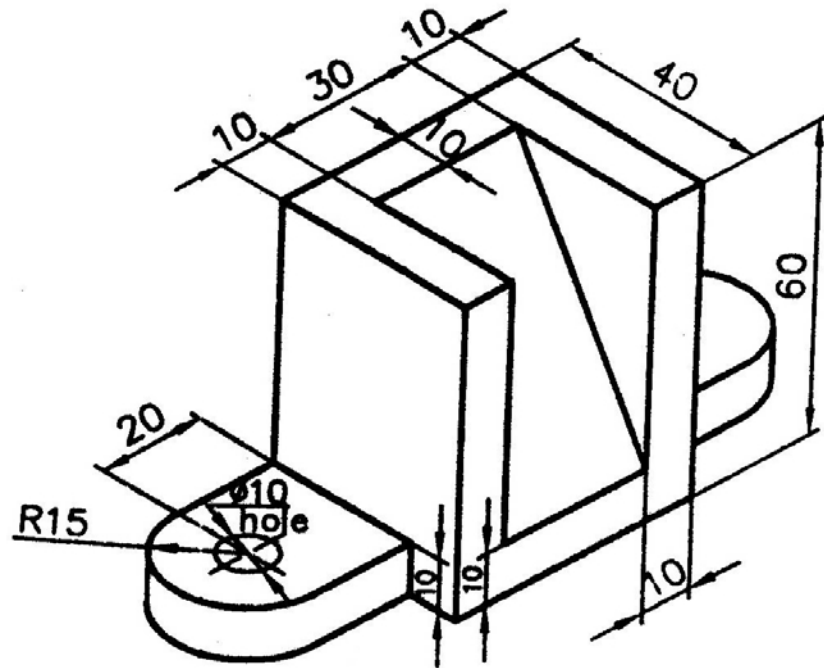
TOP VIEW

02. Make free-hand sketches of front, top and right side views of the pictorial view shown below.

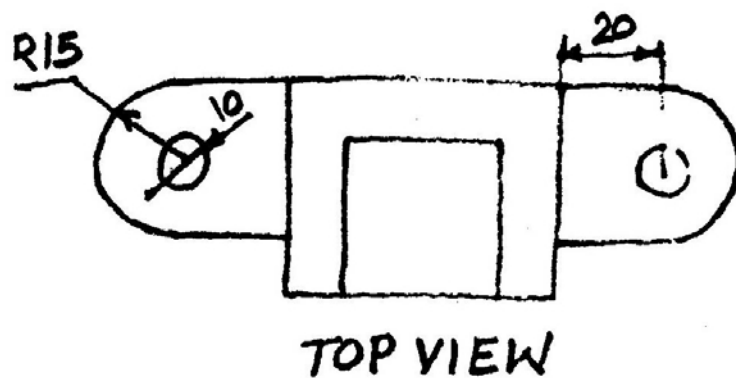
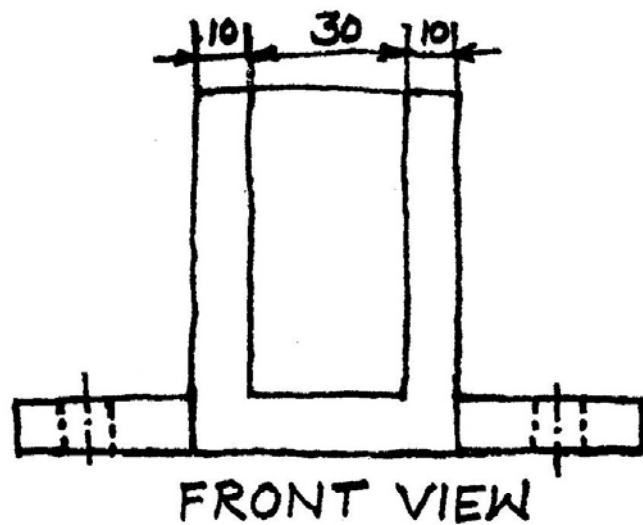
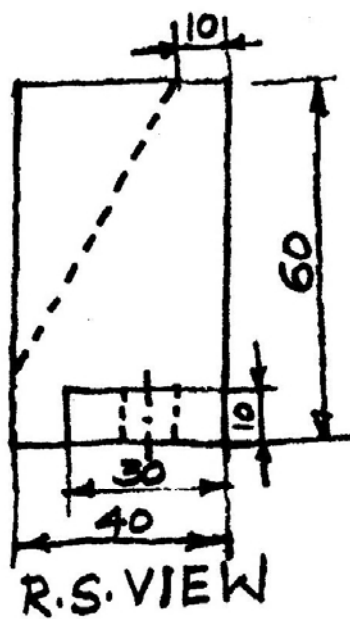


- 03. Make free-hand sketches of front, top and right side views of the pictorial view shown below.**

Compiled by : **Mr. B.Ramesh**, M.E., (Ph.D.), Associate Professor of Mechanical Engineering. 21



Solution :



04. Draw the front view, top view and right side view of the component shown below.

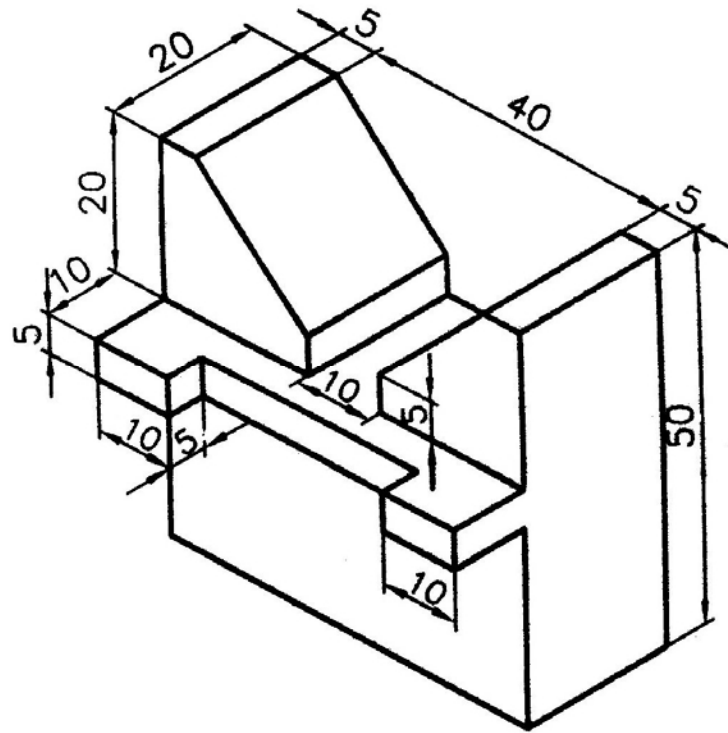
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Solution :

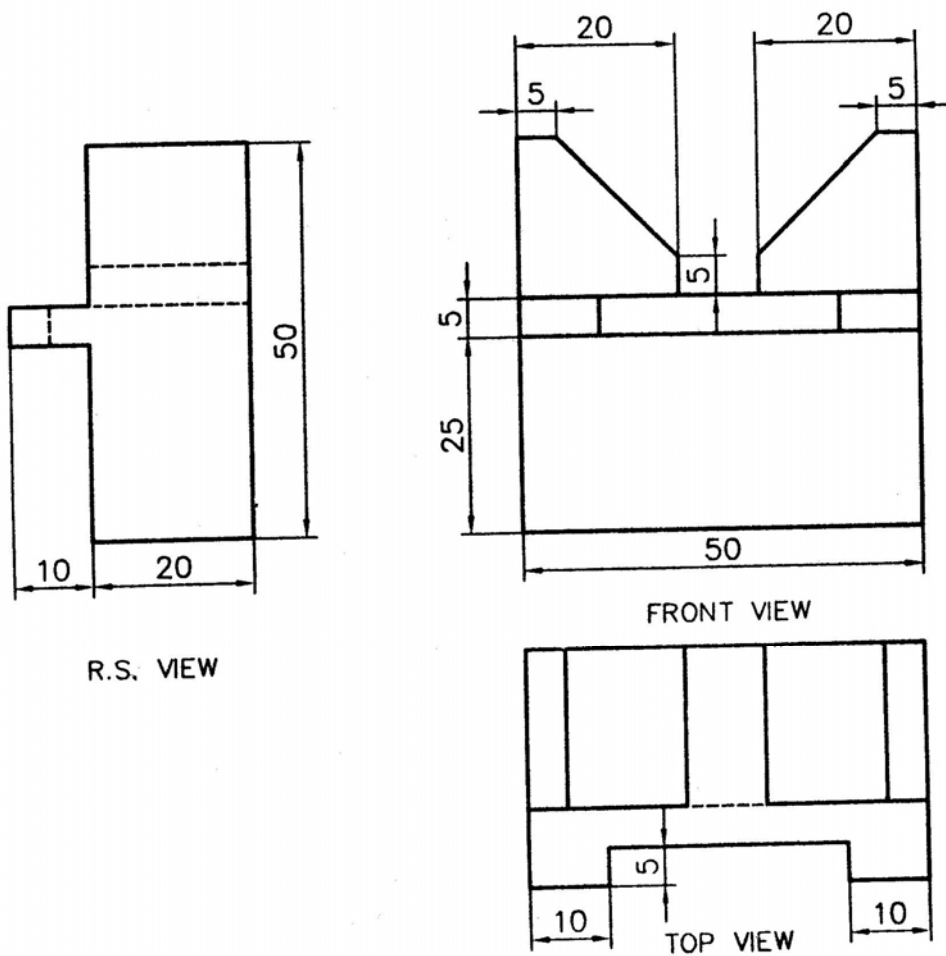
05. Draw the top, front and right side views of the object shown below.

Compiled by : **Mr. B.Ramesh**, M.E., (Ph.D.), Associate Professor of Mechanical Engineering.

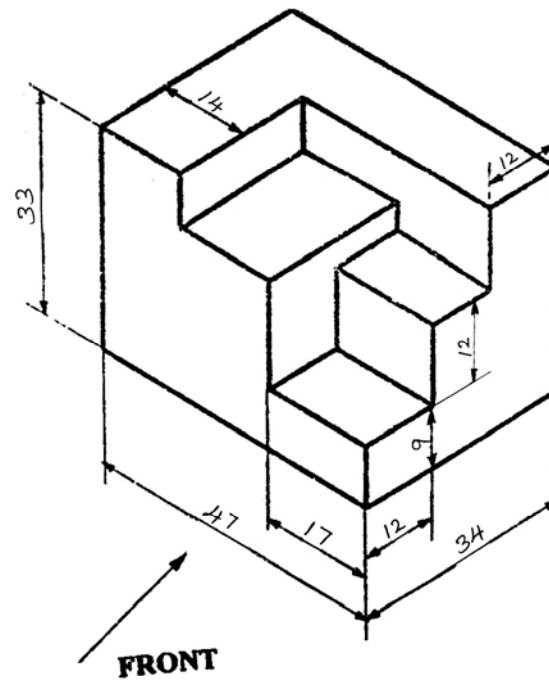
23



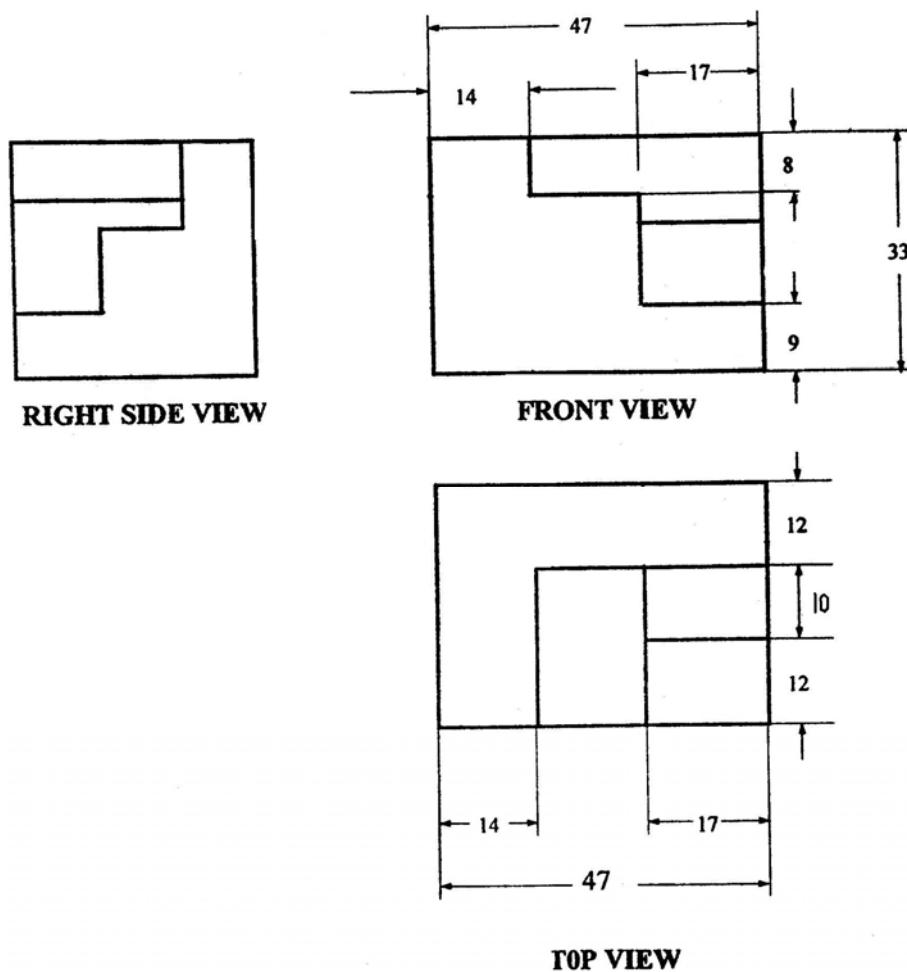
Solution :



06. Draw the front view, top view and right side view of the component shown below.



Solution :



07. Draw the top view, front view and right side view of the object shown below.

