Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi

An Institution of National Importance, Government of India

Engineering Graphics (ME121)

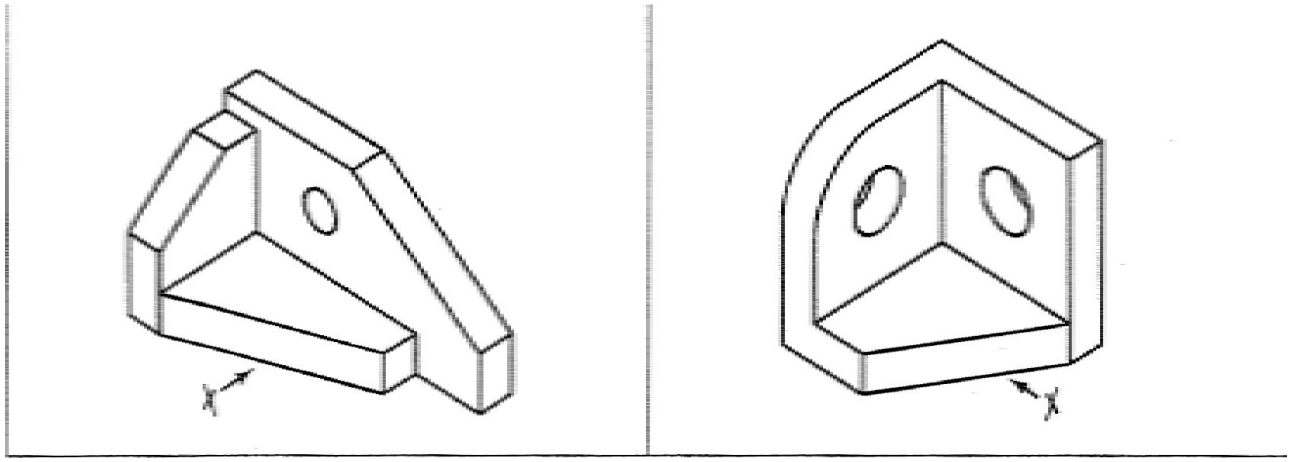
Course Content

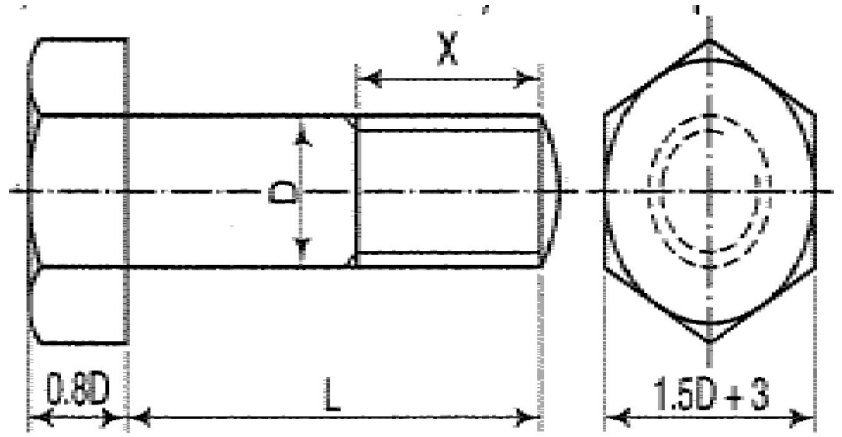
Corse Credit-03

1. Introduction to Engineering Graphics
2. Geometric Construction
3. Projection of Points and Lines
4. First Angle and Third Angle Projection
5. Orthographic and Isometric Projections
6. Oblique and Perspective Projections
7. Machine Drawing and CAD Modelling

What is Engineering Graphics??

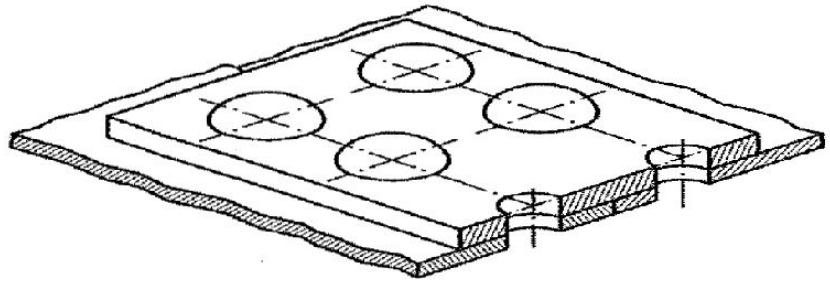
- This is language of engineers and creating pictorial view of engineering structure.

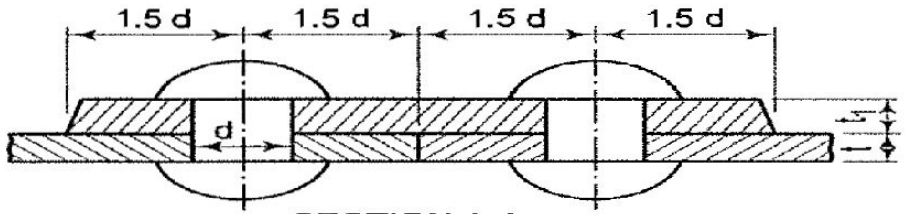




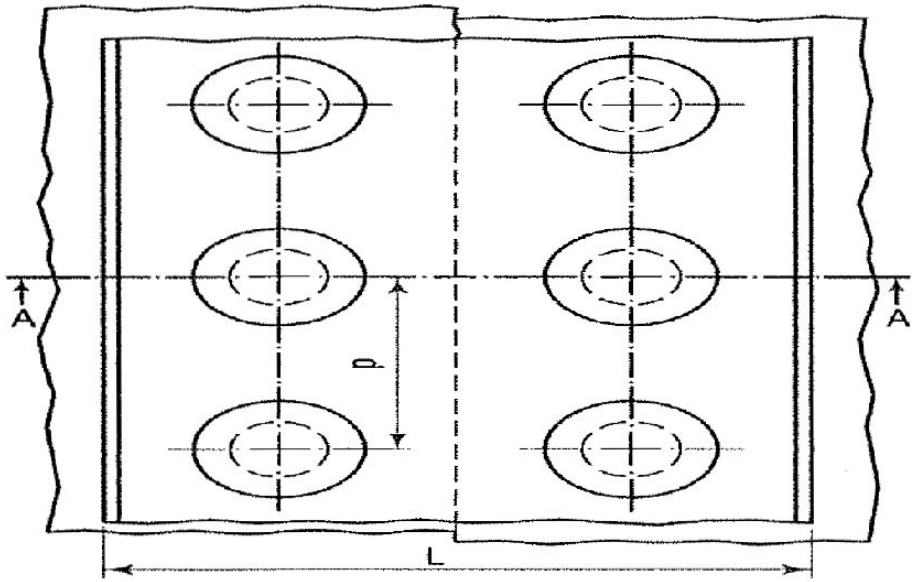
Its Importance.....

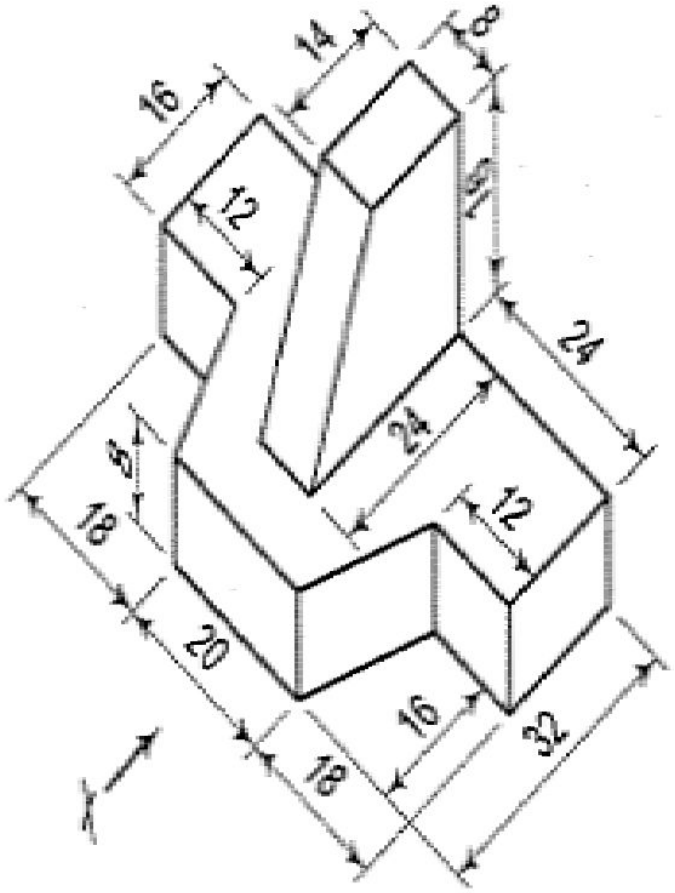
- Engineering drawings are essential for providing other engineers and machinists with relevant information.
- Permit the readers to imagine the suggested product in their minds.
- Give details on the product's measurements and the materials that went into making it.
- Provide views from the top, the side, and the front

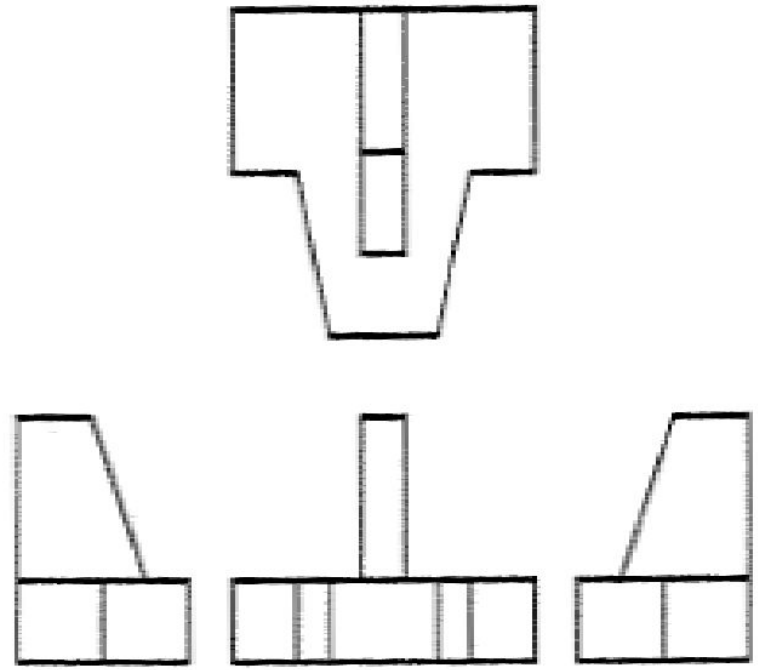


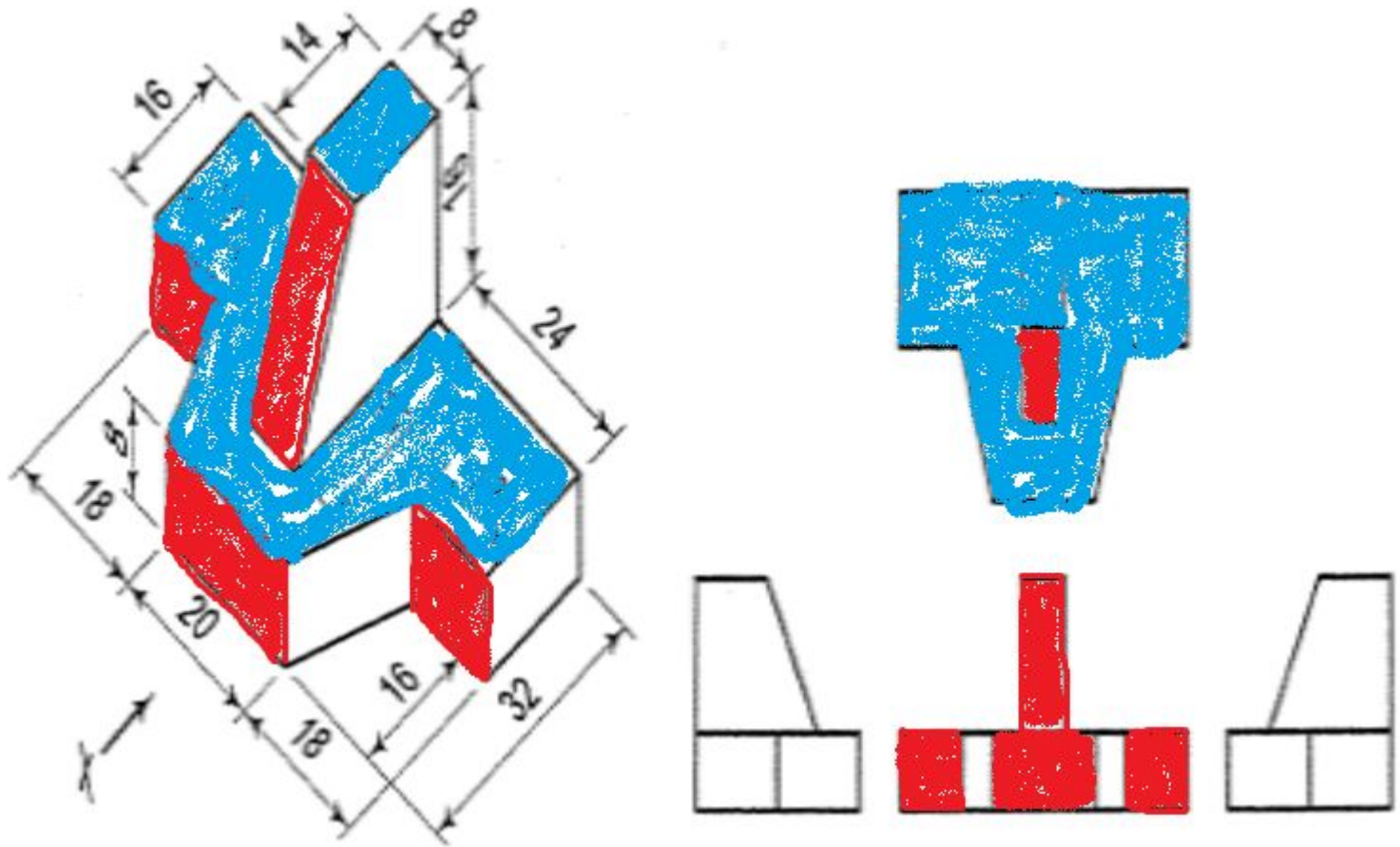


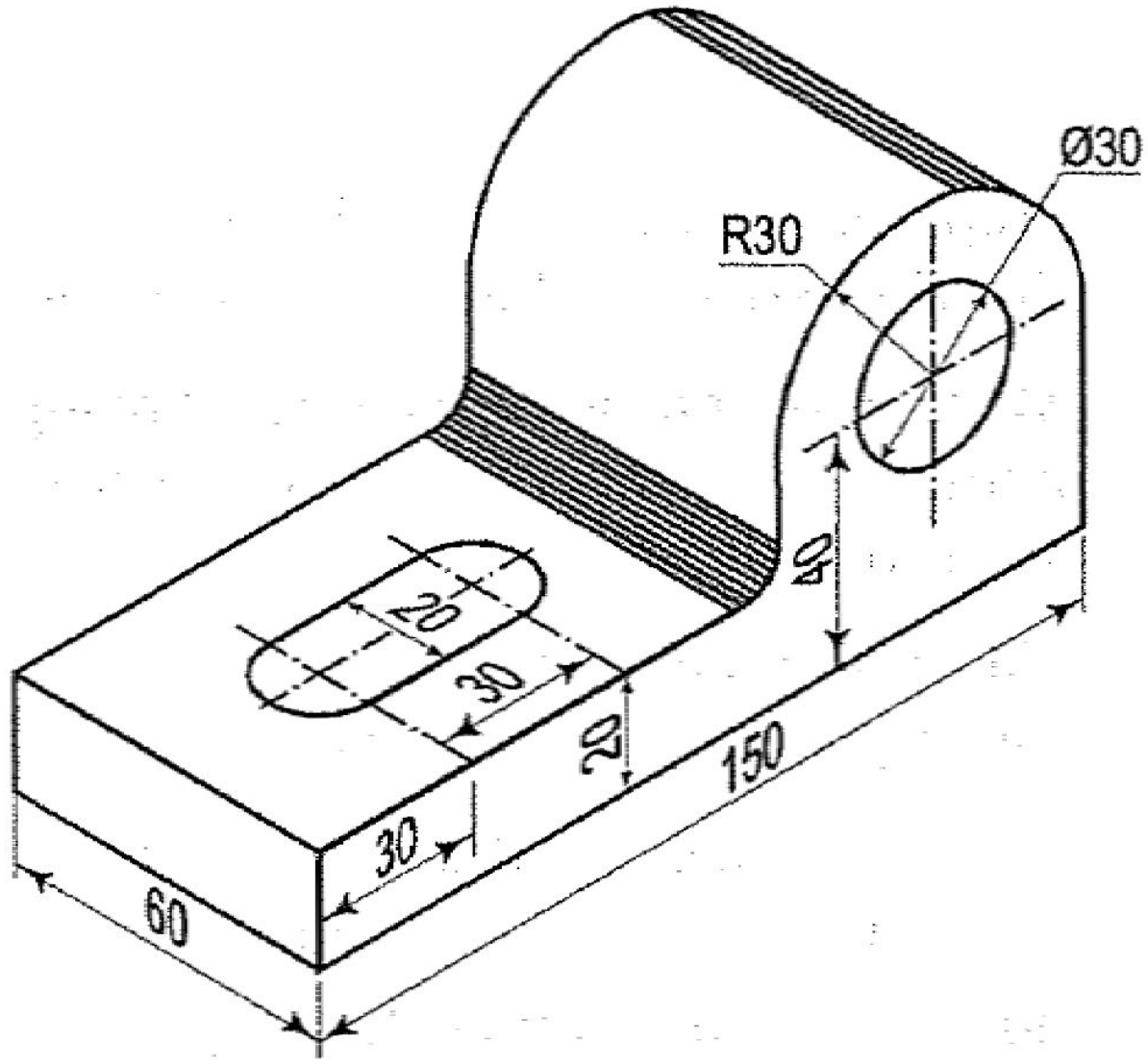
SECTION A-A

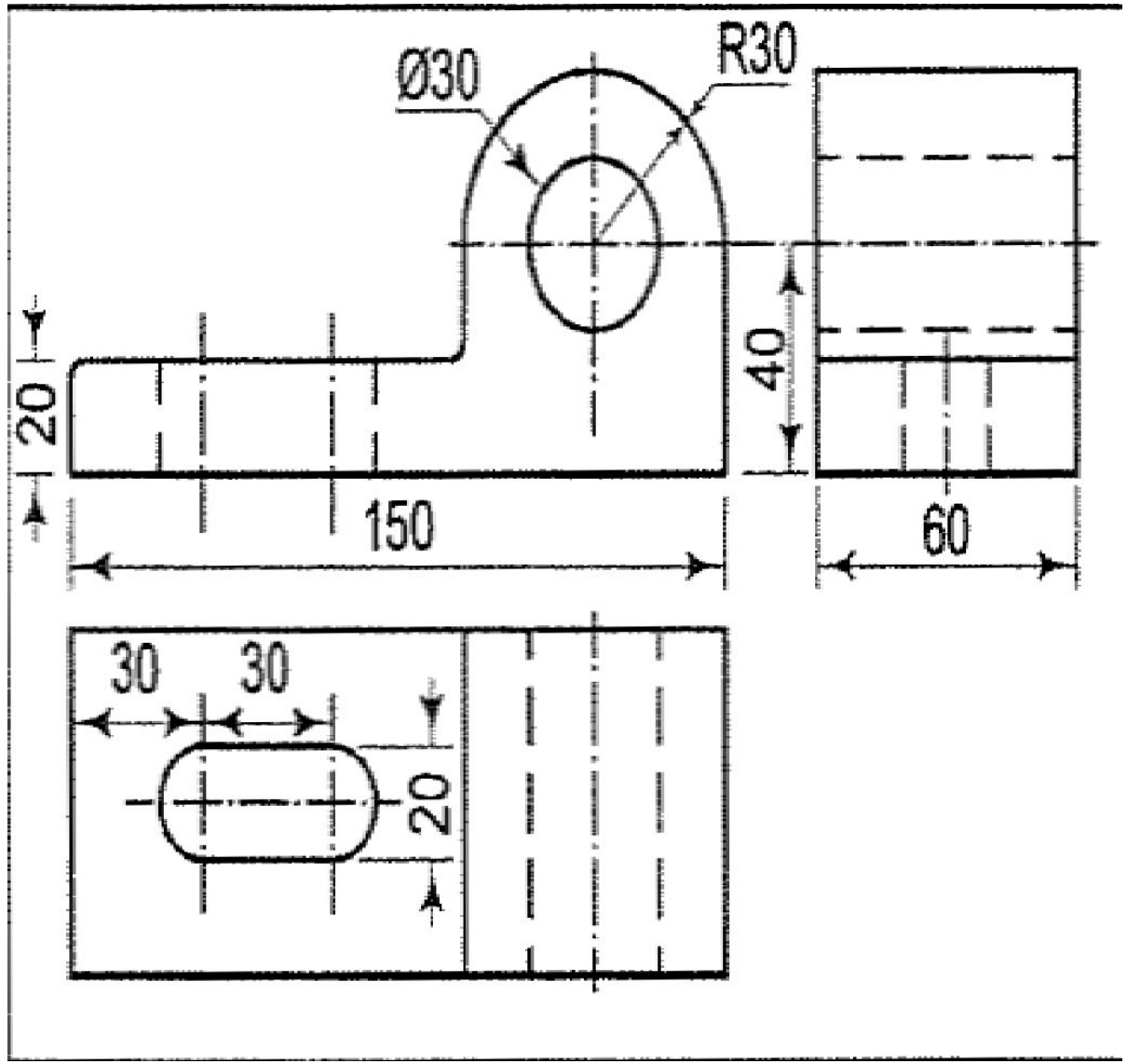



14
8
16
12
40
24
24
8
12
18
20
16
18
32




16
14
8
40
24
8
18
20
18
16
32


Ø30
R30
20
30
40
20
150
30
60


Ø30
R30
20
40
150
60
30
30
20

Types of Drawings and standards

- **Engineering drawing (a) part (b) assembly**
- **Civil drawing**
- **Electrical drawing**

- American Society of Mechanical Engineers (ASME)(3rd angle projection)
- International standard (ISO)(1st angle projection)
- Bureau of Indian Standards (BIS)

Scale

- It is defined as ratio of liner dimension of element of object as represented in drawing to the actual dimension of object it is also known as representative fraction (RF)
- $RF = \frac{Length\ of\ Drawing}{Actual\ length\ of\ object}$
- Three type of scale are used in drawing

(a) Reducing Scale 1:2, 1:50

(b) Enlarging Scale 2:1, 50:1

(c) Full Scale 1:1

Type of Scale

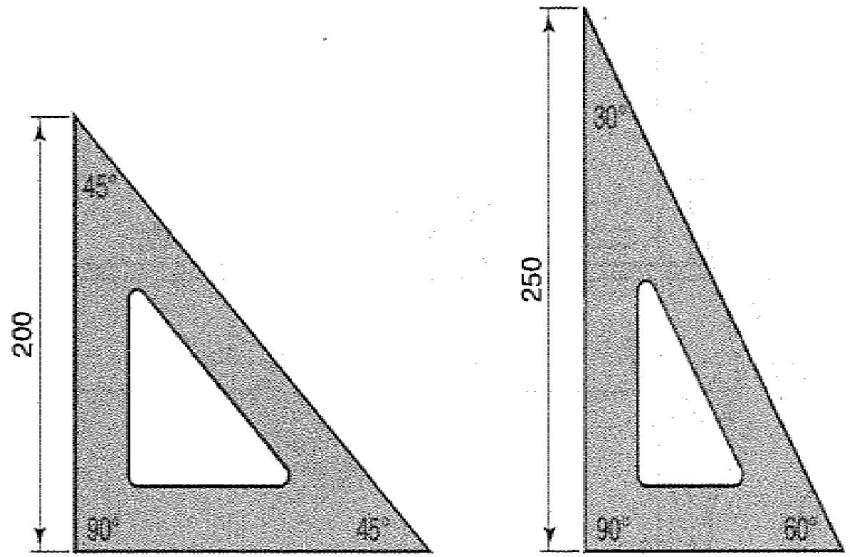
- Plain Scale
- Diagonal Scale
- Comparative Scale
- Vernier Scale

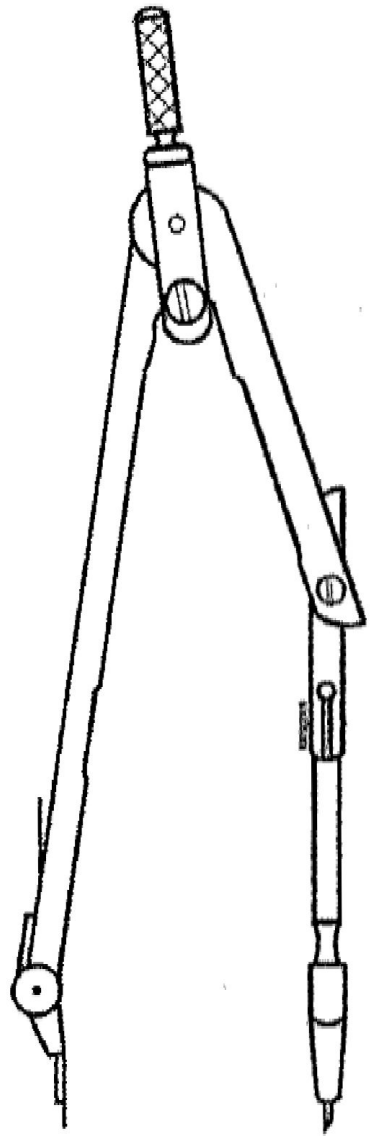
$$Length\ of\ scale = RF \times maximum\ length$$

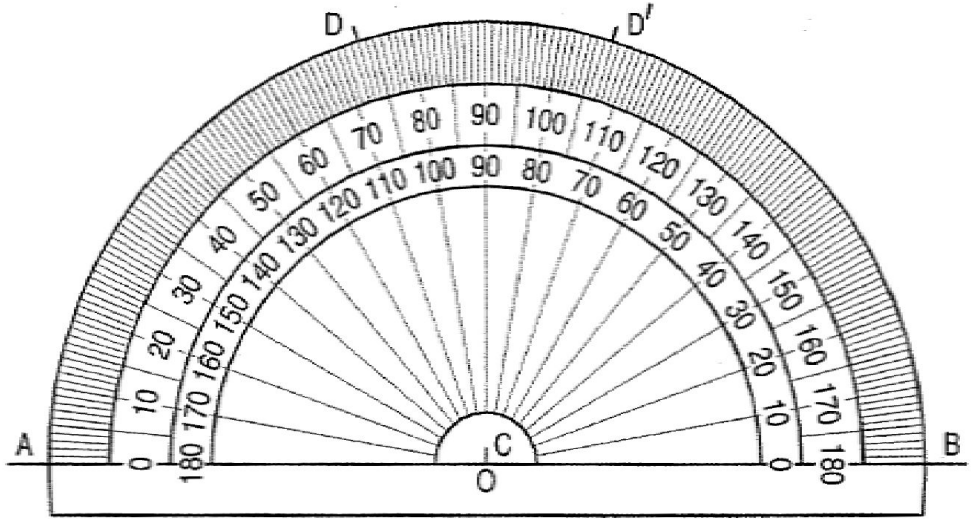
Exercise

1. Construct a scale of 1:4 to show centimetres and long enough to measure up to 5 decimetres and mark 3.8 dm. (Plain Scale)
2. Construct a scale of 1:60 to show meters and decimetres and long enough to measure up to 6 meters.(plain Scale)
3. Construct diagonal scale of 3:200 showing meters, decimetres and centimetres and measure up to 6 meter and mark 4.56 m

Instruments







Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi
An Institution of National Importance, Government of India

Engineering Graphics (ME121)

Geometrical Construction-1

Topics

1. Lines
2. Arc
3. Circle
4. polygons

Types of Lines

1. Outlines : lines drawn to represent visible edges(continuous thick)
2. Dimension line: to represent dimension (continuous thin line)
3. Extension or projection line: continuous thin line
4. Hidden Line: hidden edges and hidden surface and short dashes and medium thickness
5. Center Line: for indication of center of axis of object and thin and long chain composed of alternate long and dot
6. Cutting plane line: location of cutting plane and it is a long, thin, chain line, thick at ends

Exercise

1. Draw a line AB 75 mm long. At B, erect a perpendicular BC 100 mm long. Draw a line joining A and C, and measure its length and construct a square on each line as side.
2. Draw a line PQ 100 mm long. At any point near its center, erect a perpendicular OA 65 mm long. Through A, draw a line parallel to PQ.
3. Draw two lines AB and AC making an angle of 75° , draw a circle of 25 mm radius touching them
4. The distance between the centers of two circles of 65 mm and 90 mm diameters is 120 mm. draw an internal and external common tangents to the two circles.
5. Construct a regular pentagon of 30 mm side.

Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi
An Institution of National Importance, Government of India

Engineering Graphics (ME121)

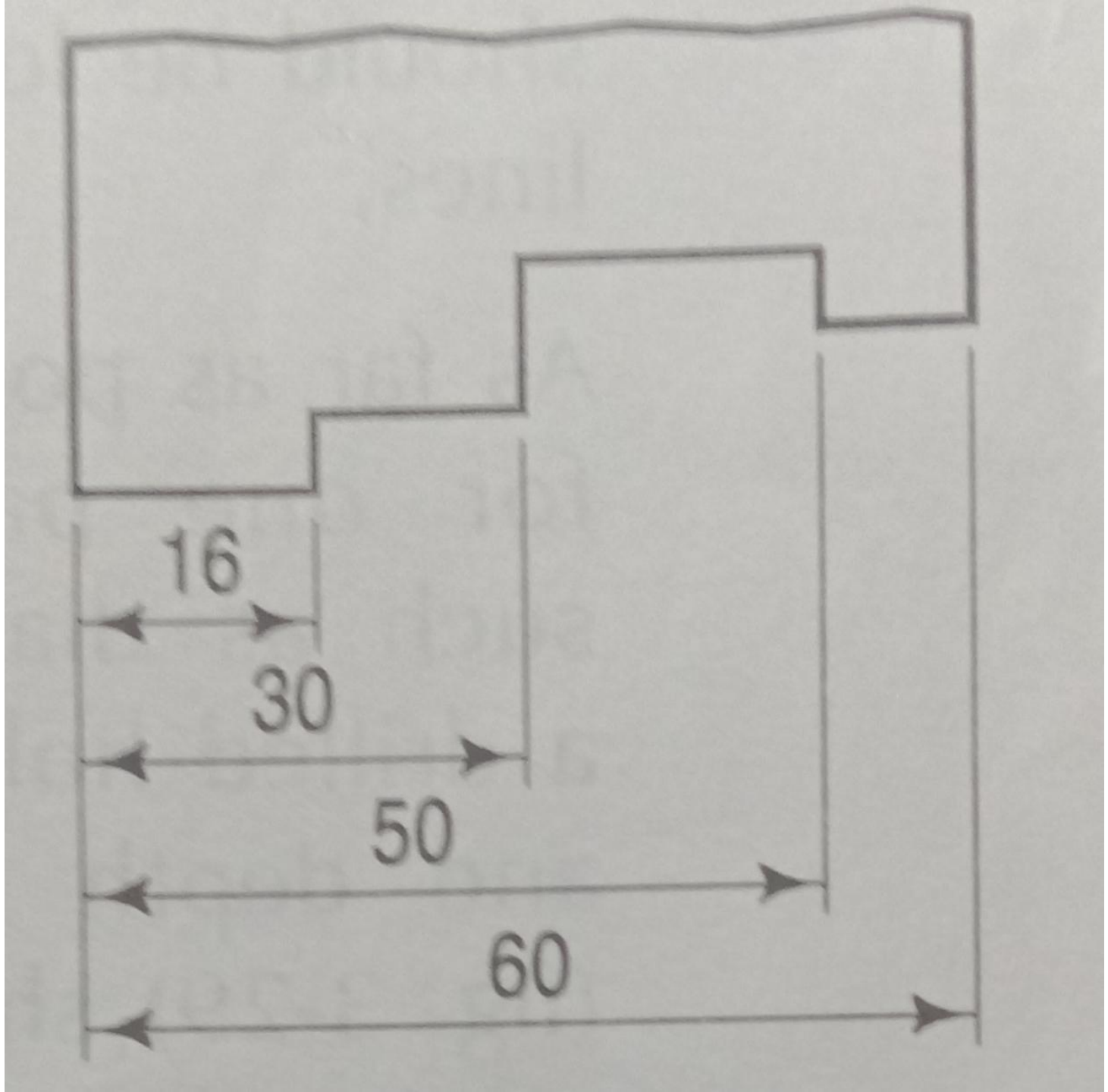
Geometrical Construction-2

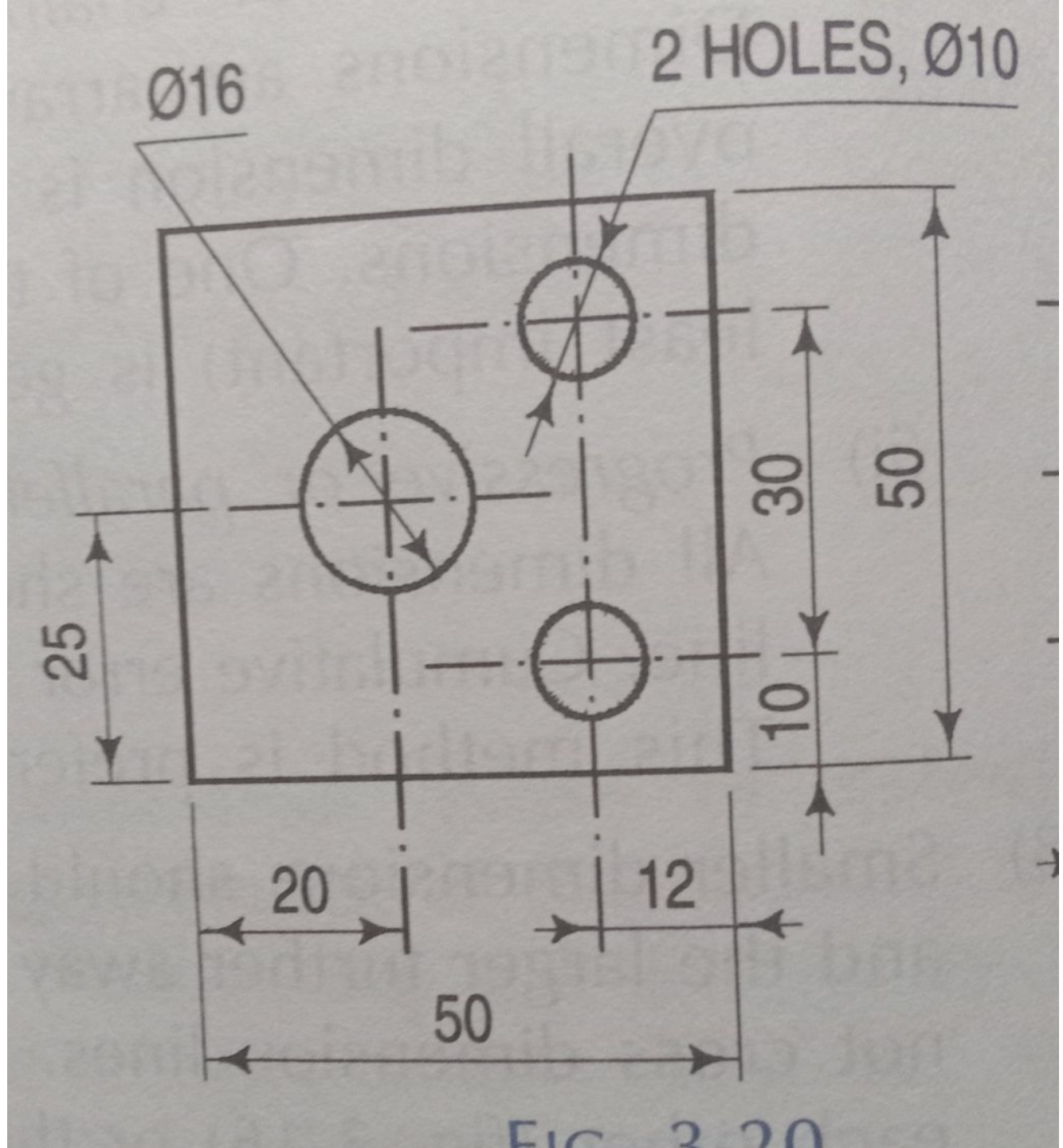
Topics

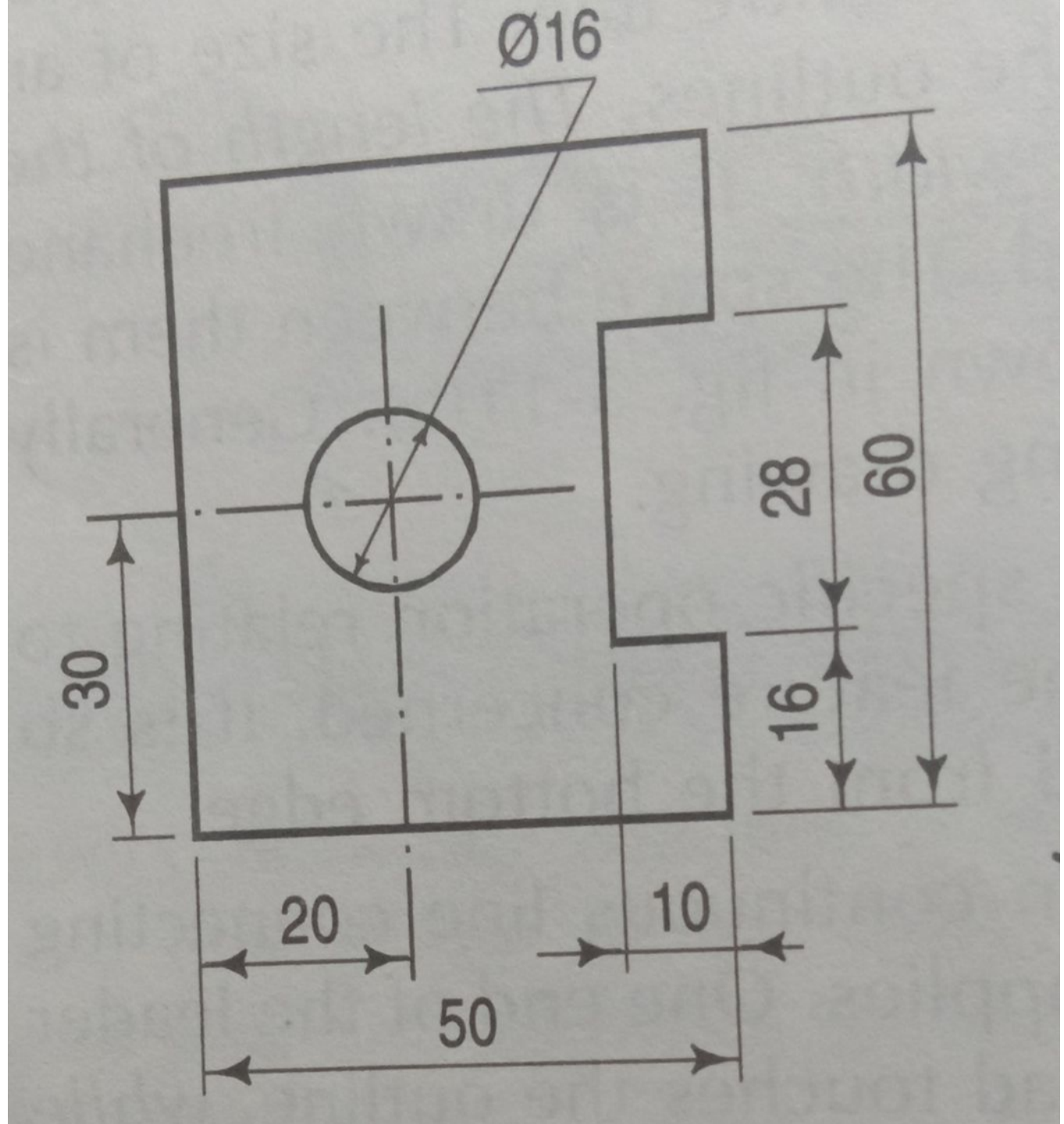
1. Tangents
2. Arcs
3. exercise

Exercise

1. Draw an arc of 30 mm radius and measure its cord length
2. Draw a regular hexagon with 30 mm side.
3. Draw the given figures


16
30
50
60


Ø16
2 HOLES, Ø10
30
50
25
10
20
12
50


Ø16
28
60
30
16
20
10
50

Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi
An Institution of National Importance, Government of India

Engineering Graphics (ME121)

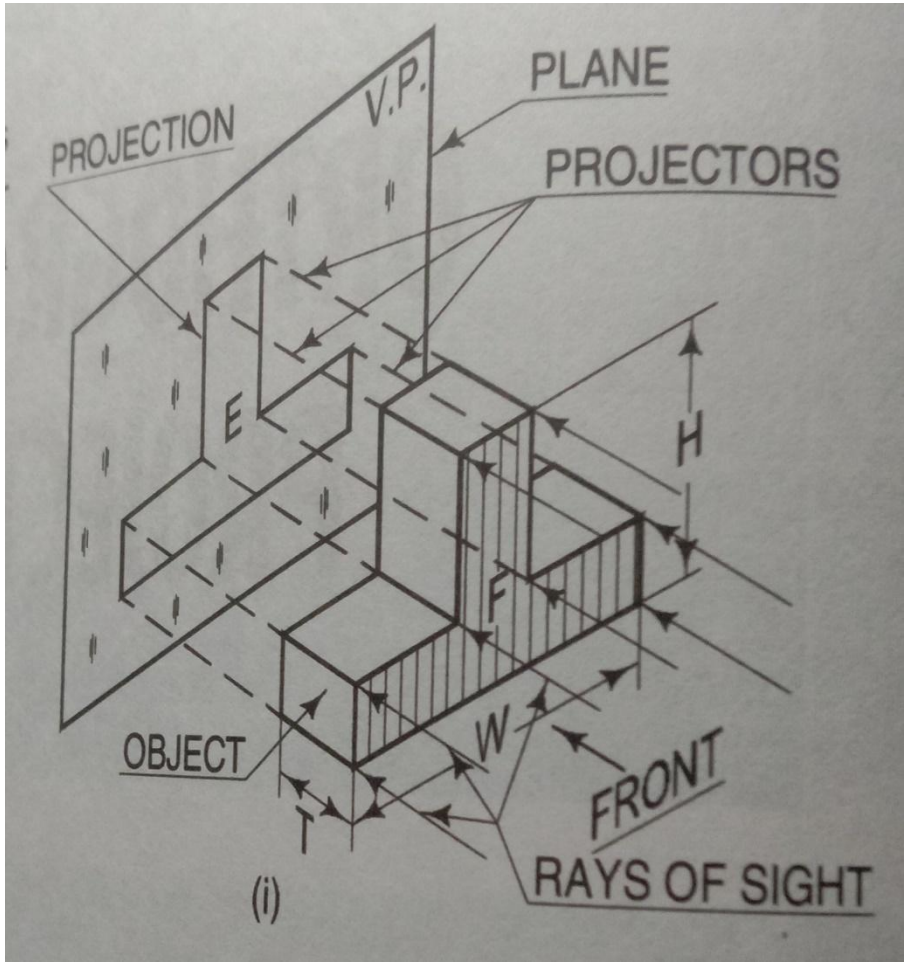
Projection of Points and Lines

Topics

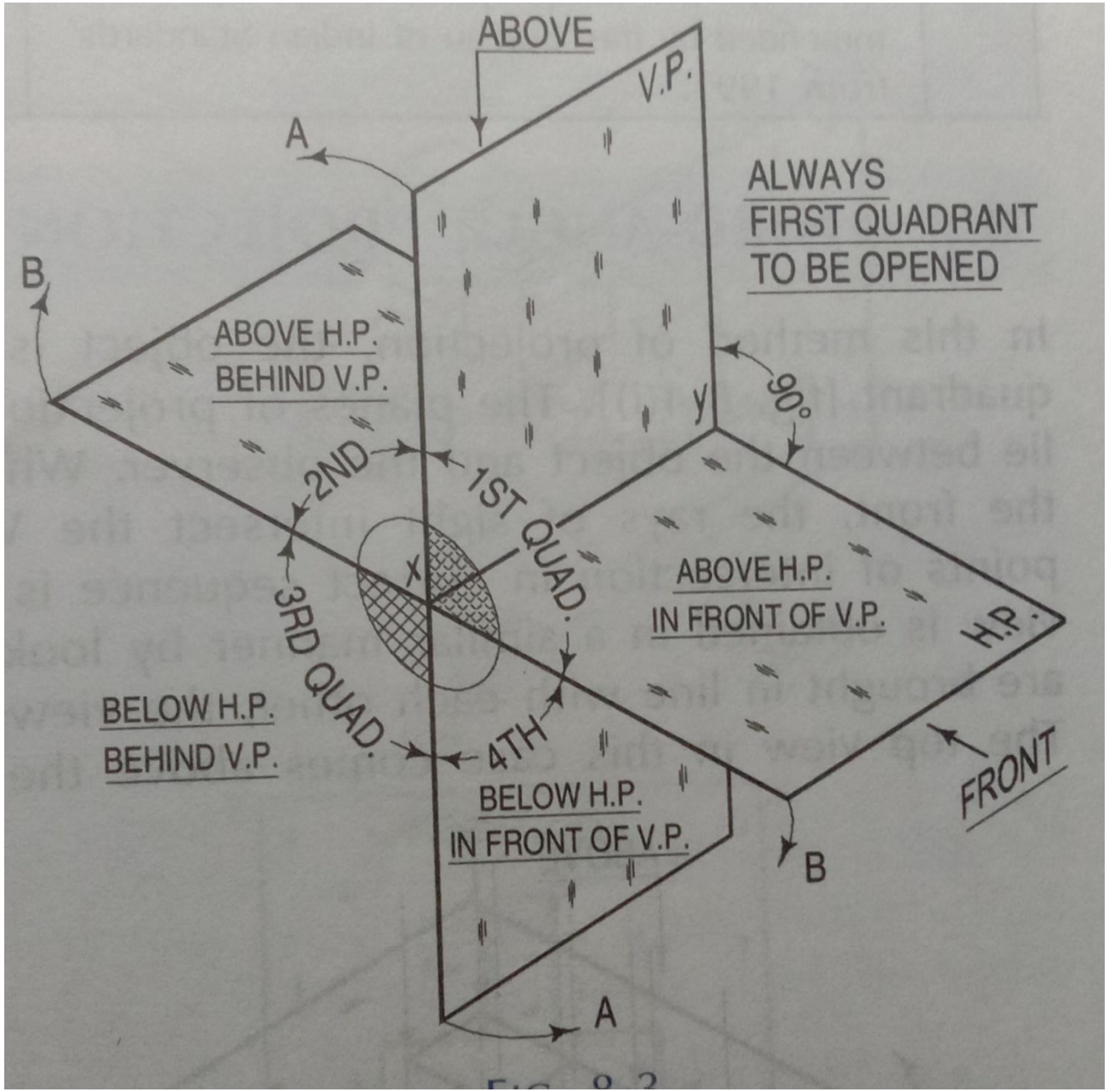
1. Orthographic projection terminology
2. Projection of point
3. Projection of line

Orthographic Projection

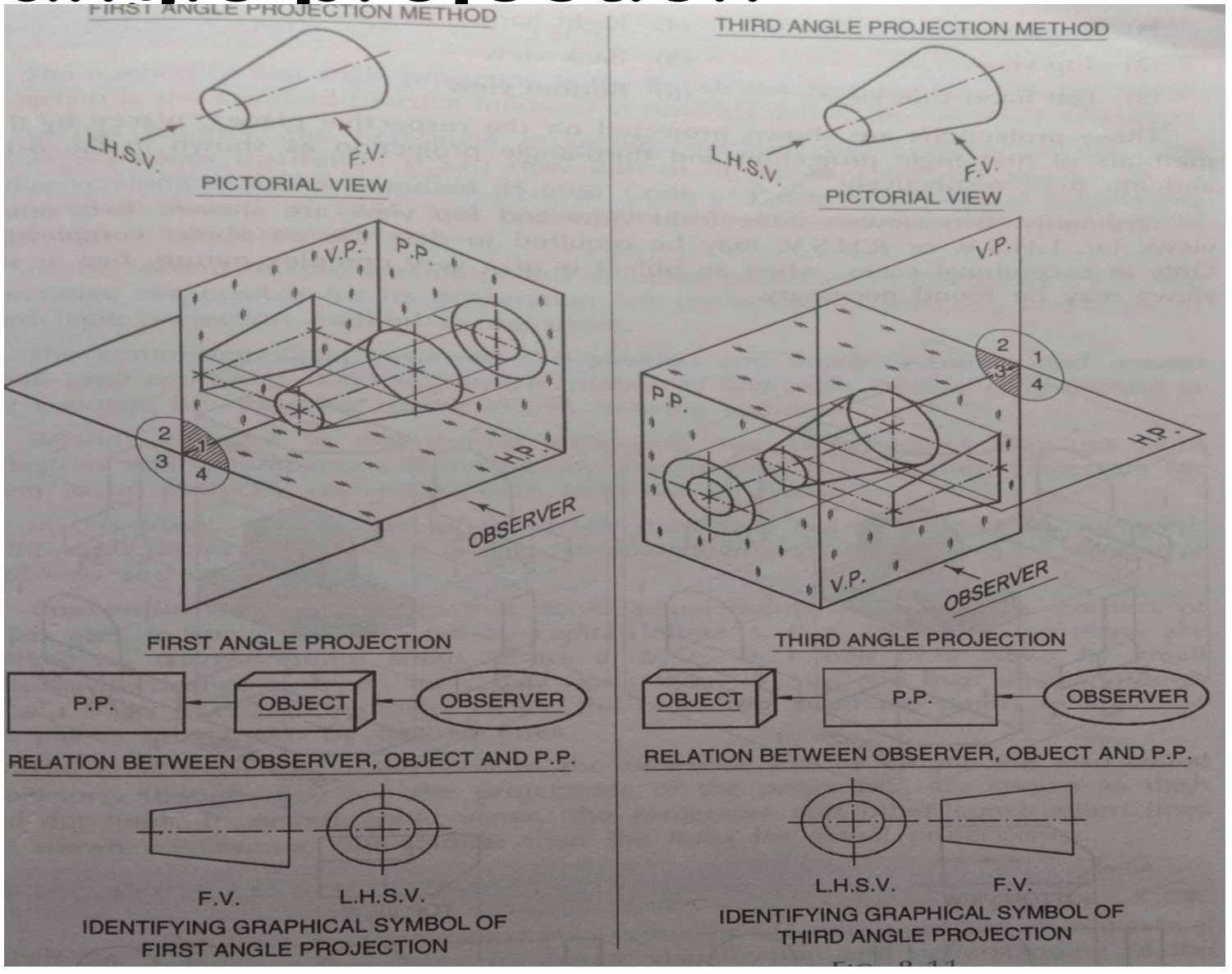
- When the projectors are parallel to each other and also perpendicular to the plane



Quadrant

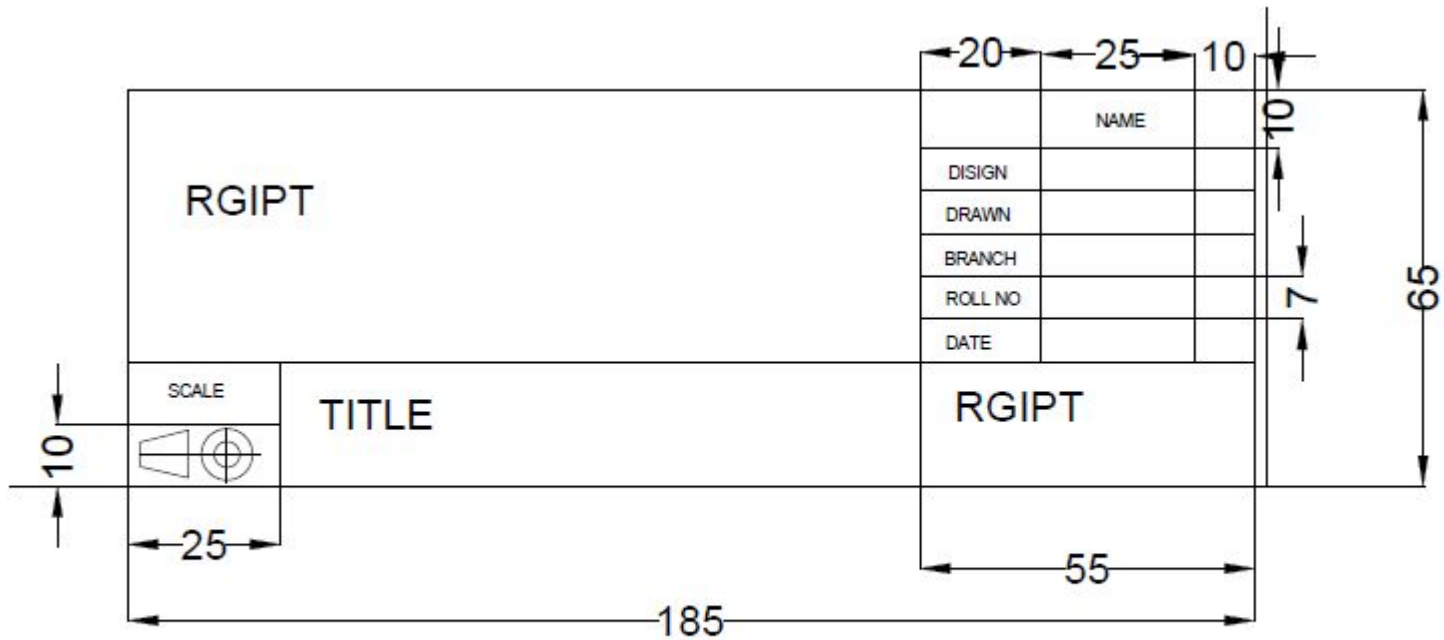

ABOVE
V.P.
A
ALWAYS
FIRST QUADRANT
TO BE OPENED
B
ABOVE H.P.
BEHIND V.P.
y
90°
2ND
1ST QUAD.
x
3RD QUAD.
ABOVE H.P.
IN FRONT OF V.P.
H.P.
BELOW H.P.
BEHIND V.P.
4TH
BELOW H.P.
IN FRONT OF V.P.
FRONT
B
A

1st and 3rd angle projection



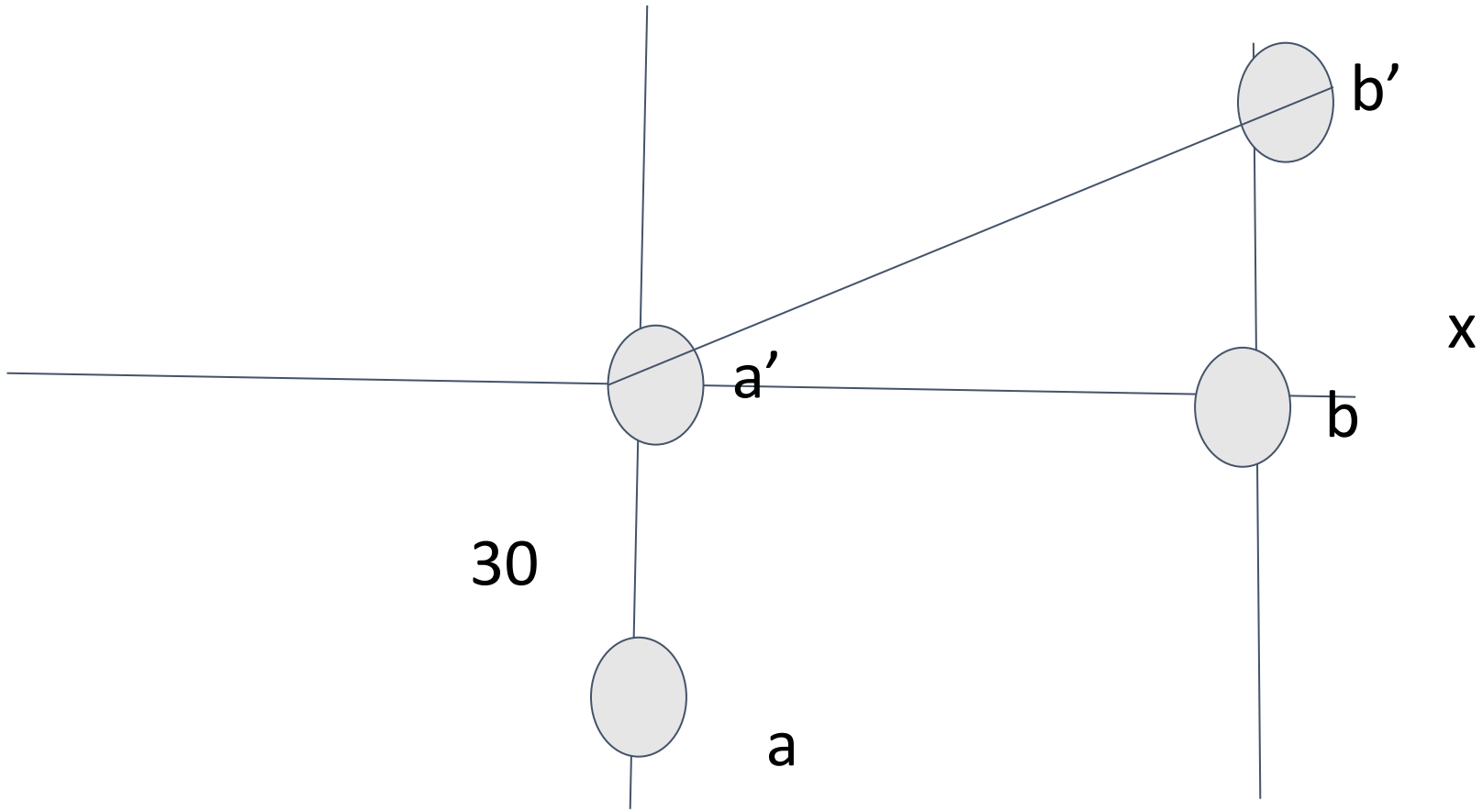
BIS Code of orthographic projection

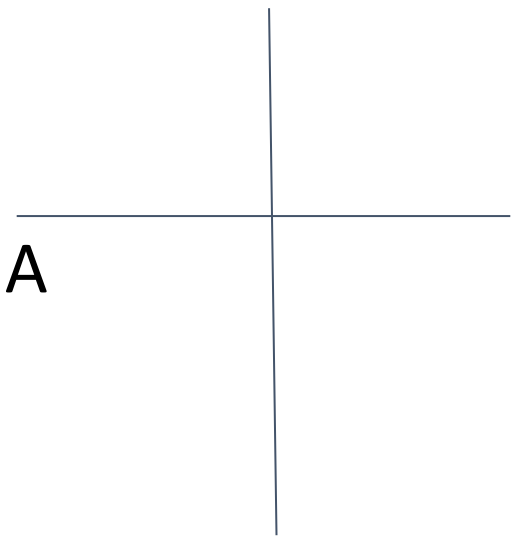
- In space points are represented as A,B,C,D, etc. and their **top view (TV)** marked by corresponding small letters a, b, c, d, etc. and their **front view (FV)** marked as a', b', c', d', etc.
- The side views by a_1', b_1', c_1', d_1', etc
- The projectors and other construction lines are shown continuous but thinner than actual projections

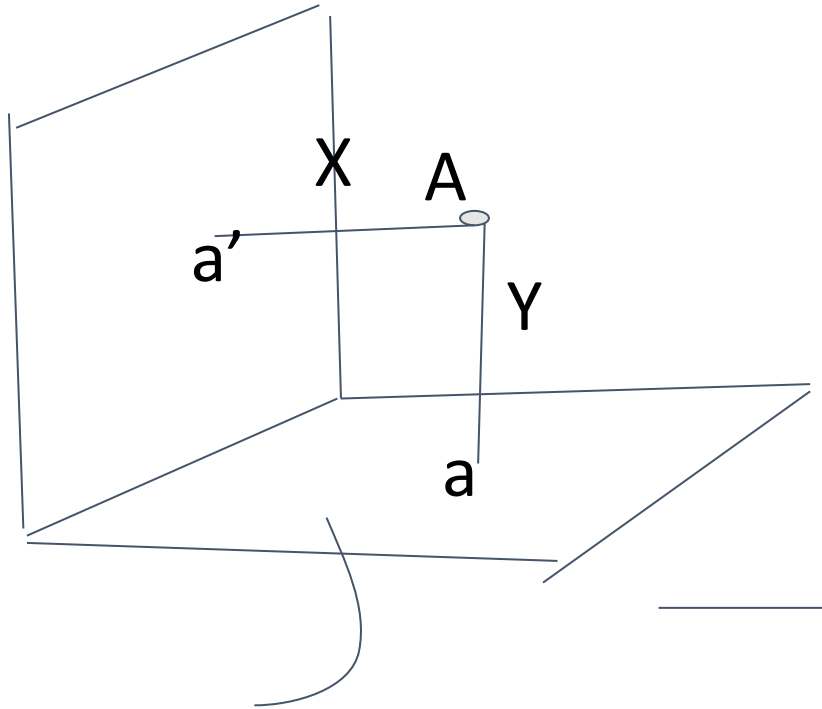

20
25
10
NAME
10
RGIPT
DISIGN
DRAWN
BRANCH
ROLL NO
DATE
7
65
SCALE
TITLE
RGIPT
10
25
55
185

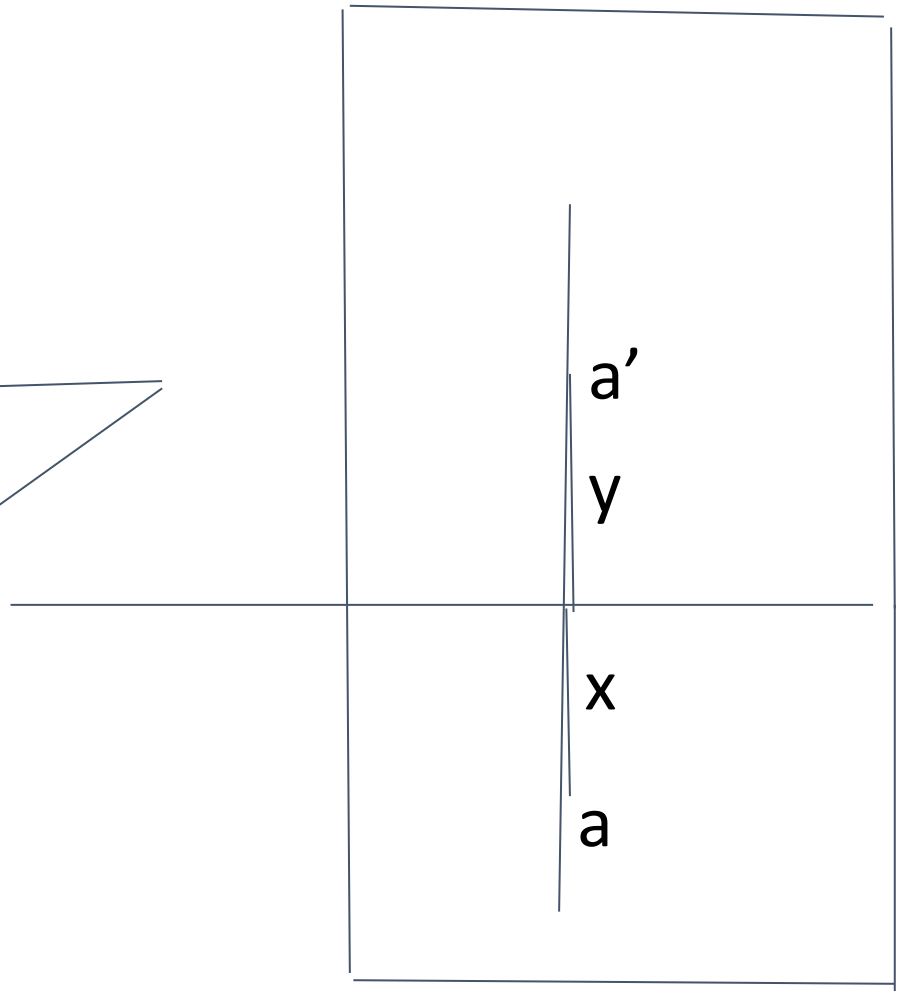
Point Projection Exercise

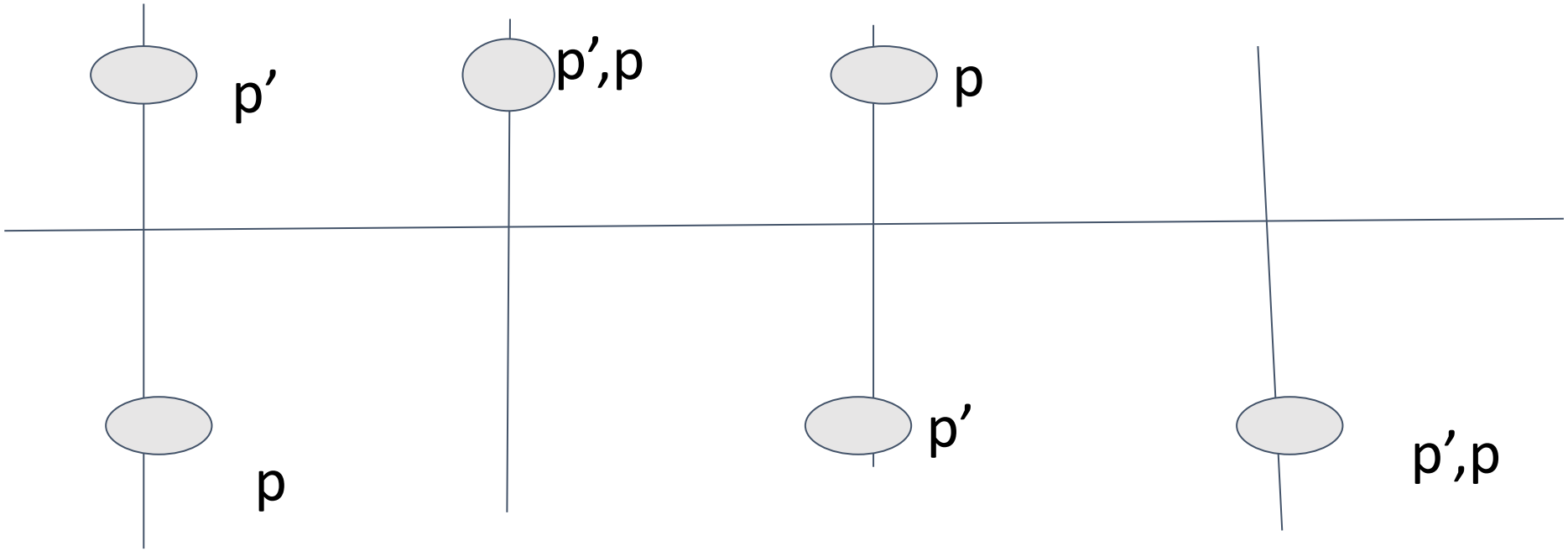
1. A point P is 50 mm from both the reference planes, draw its projections in all possible positions
2. Draw the projections of the point A in the HP and 20 mm behind VP
3. Draw the projections of the point B 40 mm above HP and 25 mm in front of the VP
4. Draw the projections of the point C in the VP and 40 mm above HP.
5. Draw the projections of the point D 25 mm below HP and 25 mm behind VP.
6. Two points A and B are in HP. The point A is 30 mm in front of the VP while B is behind VP. The distance between their projectors is 75 mm and the line joining their top views makes an angle of 45° with xy. Find the distance of the point B from VP.


b’
x
a’
b
30
a


A


X
A
a’
Y
a


a’
y
x
a


p’
p’,p
p
p
p’
p’,p

Projection of Line

- Line is parallel to one or both the planes
- Line is perpendicular to one of the plane
- Line is inclined to one plane and parallel to other
- Line is inclined to both the planes

Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi
An Institution of National Importance, Government of India

Engineering Graphics (ME121)

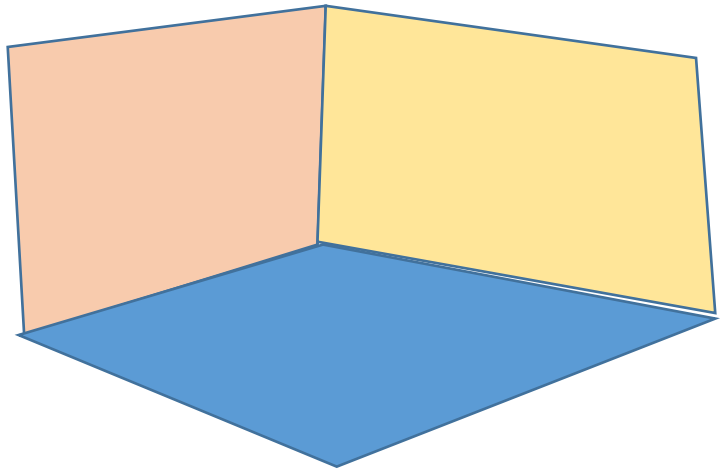
Projection of Lines

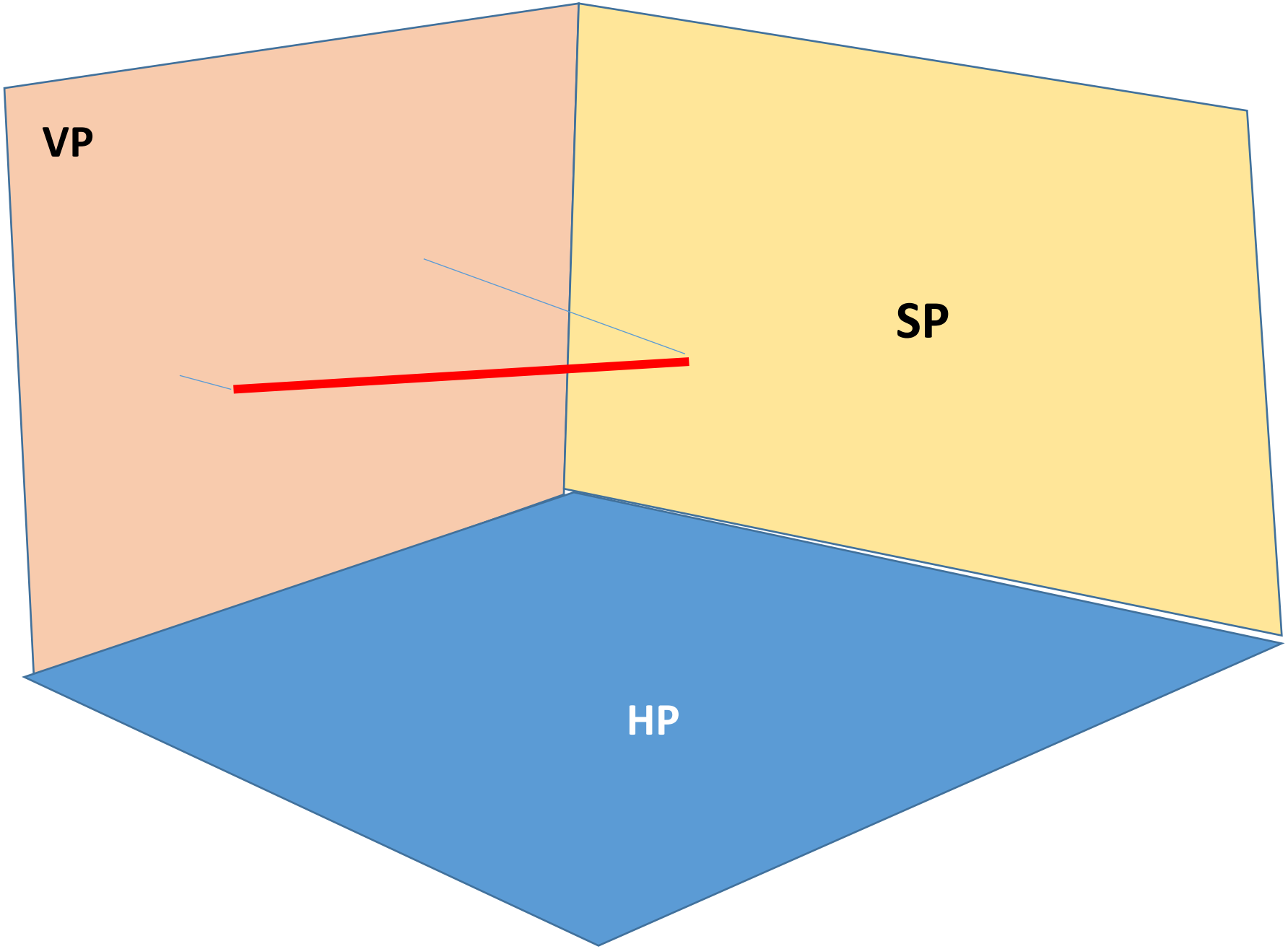
Topics

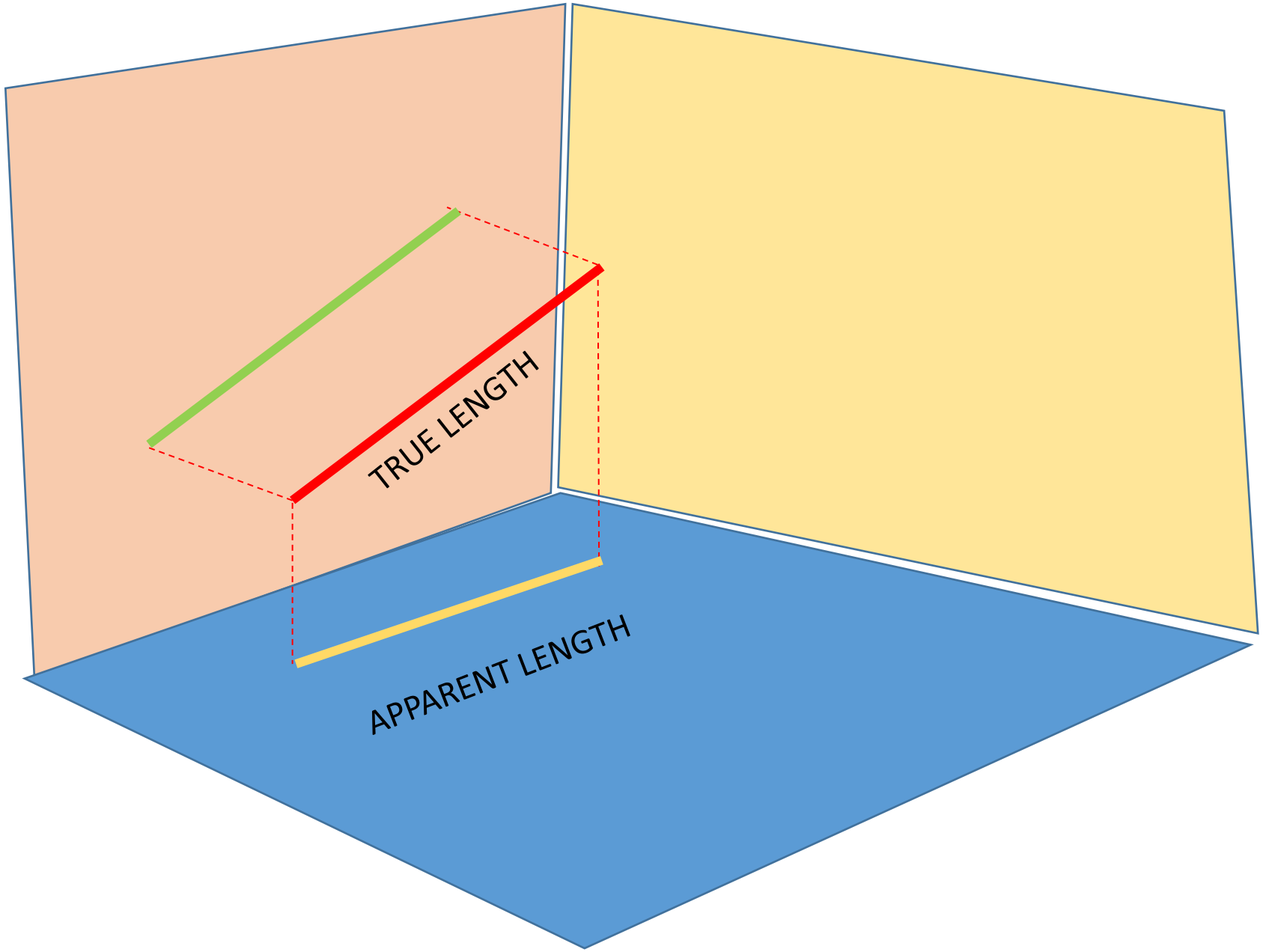
1. Introduction of line projection
2. Concept of true length and applications
3. Exercise

Projection of Line

- Line is parallel to one or both the planes
- Line is perpendicular to one of the plane
- Line is inclined to one plane and parallel to other
- Line is inclined to both the planes




VP
SP
HP


TRUE LENGTH
APPARENT LENGTH

Exercise(1st angle)

1. A line PQ, 90 mm long, is in the H.P. and makes an angle of 30° with the V.P.. Its end P is 25 mm in front of the V.P. Draw its projections
2. The length of the TV of a line parallel to the VP and inclined at 45° to the HP is 50 mm. One end of the line is 12 mm above the HP and 25 mm in front of VP. Draw the projections of the line and determine its true length.
3. The FV of the line inclined at 30° to the VP is 65 mm long. Draw the projection of the line when it is parallel to and 40 mm above the HP, its one end being 30 mm in front of the VP.
4. The TV of a 75 mm long line measures 55 mm. The line is in the VP its one end being 25 mm above the HP. Draw its projections.
5. A 100 mm long line is parallel to and 40 mm above the HP. Its two ends are 25 mm and 50 mm in front of the VP respectively. Draw its projections and find its inclination with the VP.

Steps to draw inclined line projection

1. Assume line is parallel to both the planes.
2. Draw projection with first step condition and as per position of point.
3. Now rotate line as per given condition i.e. if line is inclined to HP rotate its FV and if inclined with VP rotate its TV (with pivot with one point)
4. Make an arc from pivot point with radius equal to true length of line and after getting new point on rotated view, project this point toward (TV if FV rotate or FV if TV rotate) view which we get on step 2.
5. The new position after intersection of projector line and TV/FV give you final TV/FV and now final views represents with thicker lines.

Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi
An Institution of National Importance, Government of India

Engineering Graphics (ME121)

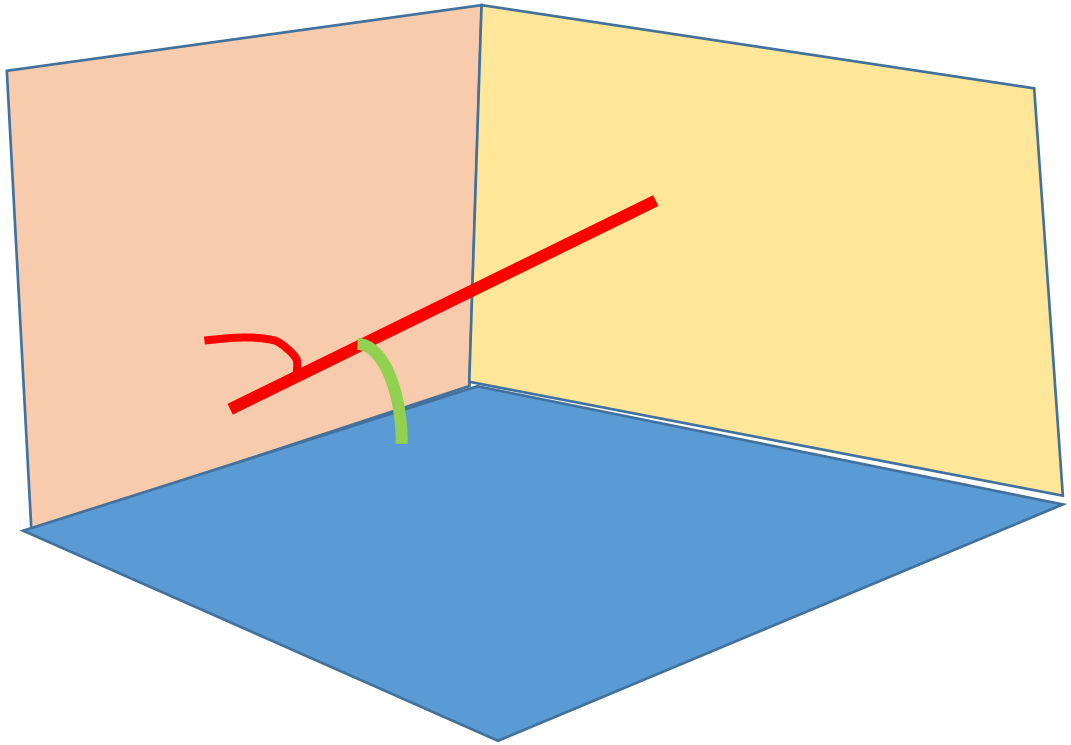
Projection of Lines and Planes

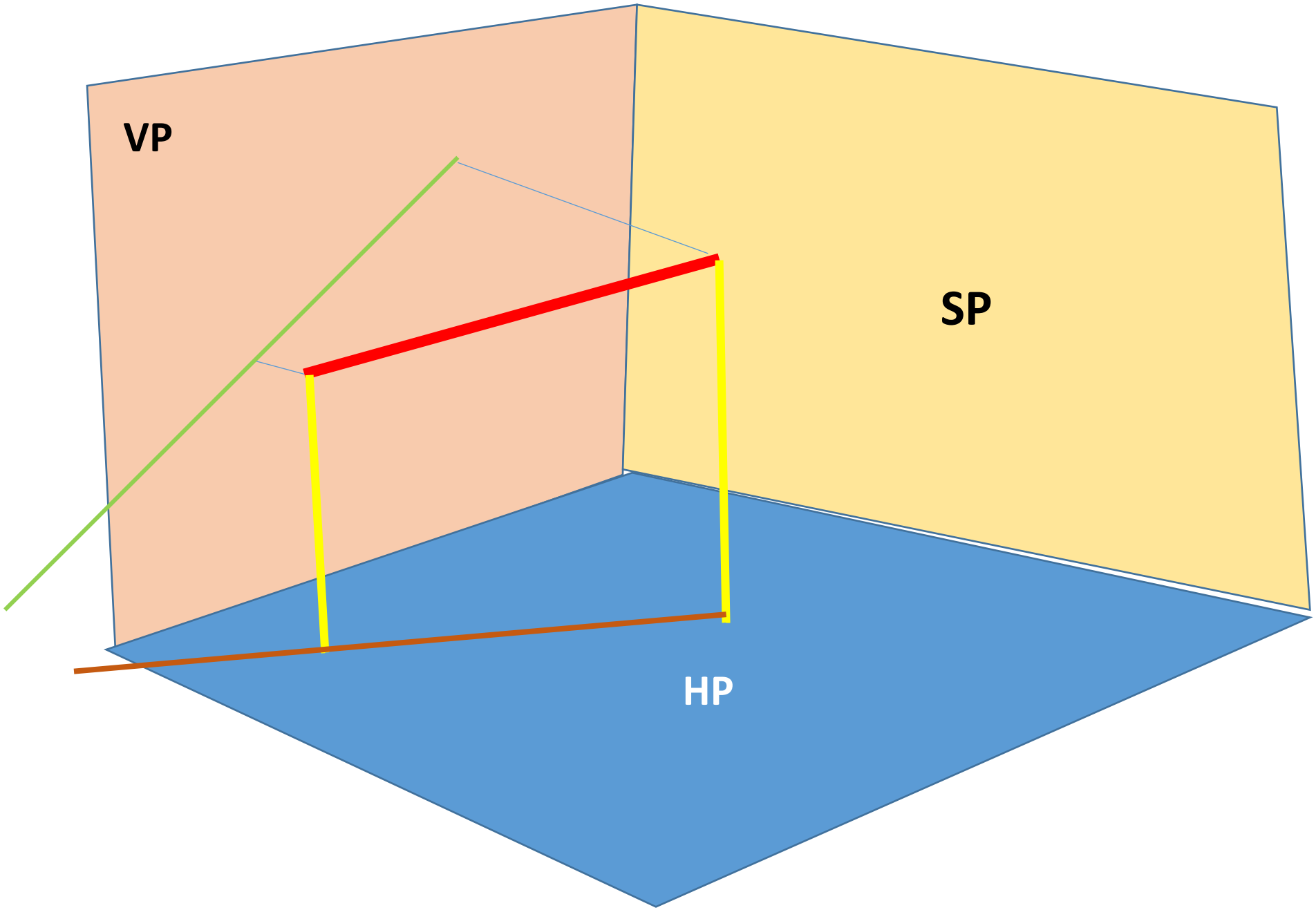
Topics

1. Projection of line
2. Projection of Plane
3. Introduction of Solid projection
4. Exercise

Projection of Line

- Line is inclined to both the planes




VP
SP
HP

Exercise(1st angle)

1. A line AB, 50 mm long, has its end A in both the HP and the VP. It is inclined at 30° to the HP and at 45° to the VP. Draw its projections
2. A line PQ 75 mm long, has its end P in the VP and the HP. The line is inclined at 30° to the HP and 60° to the VP. Draw its projections.
3. A line AB, 75mm long, is inclined at 45° to the HP and 30° to the VP. Its end B is in the HP and 40 mm in front of the VP. Draw its projections and determine its traces.
4. The TV of a 75 mm long line measures 65 mm, while the length of its front view is 50 mm. its one end A is in the HP and 12 mm in front of the VP. Draw the projections of AB and determine its inclinations with the HP and VP.
5. A line AB, 65 mm long, has its end A 20 mm above the HP and 25 mm in front of the VP. The end B is 40 mm above the HP and 65 mm in front of the VP. Draw the projections of AB and show its inclinations with HP and VP.

Steps to draw projection of line inclined with both plane

1. Assume line is parallel to both the planes.
2. Draw projection with first step condition and as per position of point.
3. Rotate its FV as per given condition and mark true length on rotated view (by making arc with radius to actual length and center as Piot point) and make a parallel line (Locus line) above xy at that point and draw a projector line which intersect the TV which we get in step 2 mark this point as 1 suffix.
4. Now rotate its TV as per given condition and mark true length on rotated view (by making arc with radius to actual length and center as Piot point) and make a parallel line (Locus line) above xy at that point and draw a projector line which intersect the FV which we get in step 2 mark this point as 1 suffix.
5. The new position point (with 1 suffix) in FV and TV is now move on locus line and it will archive by taking an arc of radius equal to Piot point to new point (with 1 suffix) and make an arc with center as piot point and arc intersect the locus line and mark as 2 suffix now join the piot point with this news position for respective views. These are the final FV and TV and angles are greater than actual inclinations these angles are known as apparent angles

Projection of Plane

1. Plane is area inscribed by lines
2. Plane are two types: (a) perpendicular plane (b) oblique plane
   a) Perpendicular planes
      I. Perpendicular to both planes
      II. Perpendicular to one plane and parallel to other
      III. Perpendicular to one plane and inclined to other
   b) Oblique plane: plane has its surface inclined to one plane and an edge or a diameter or a diagonal parallel to that plane and inclined to other plane.

Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi
An Institution of National Importance, Government of India

Engineering Graphics (ME121)

Projection of Planes and Solids

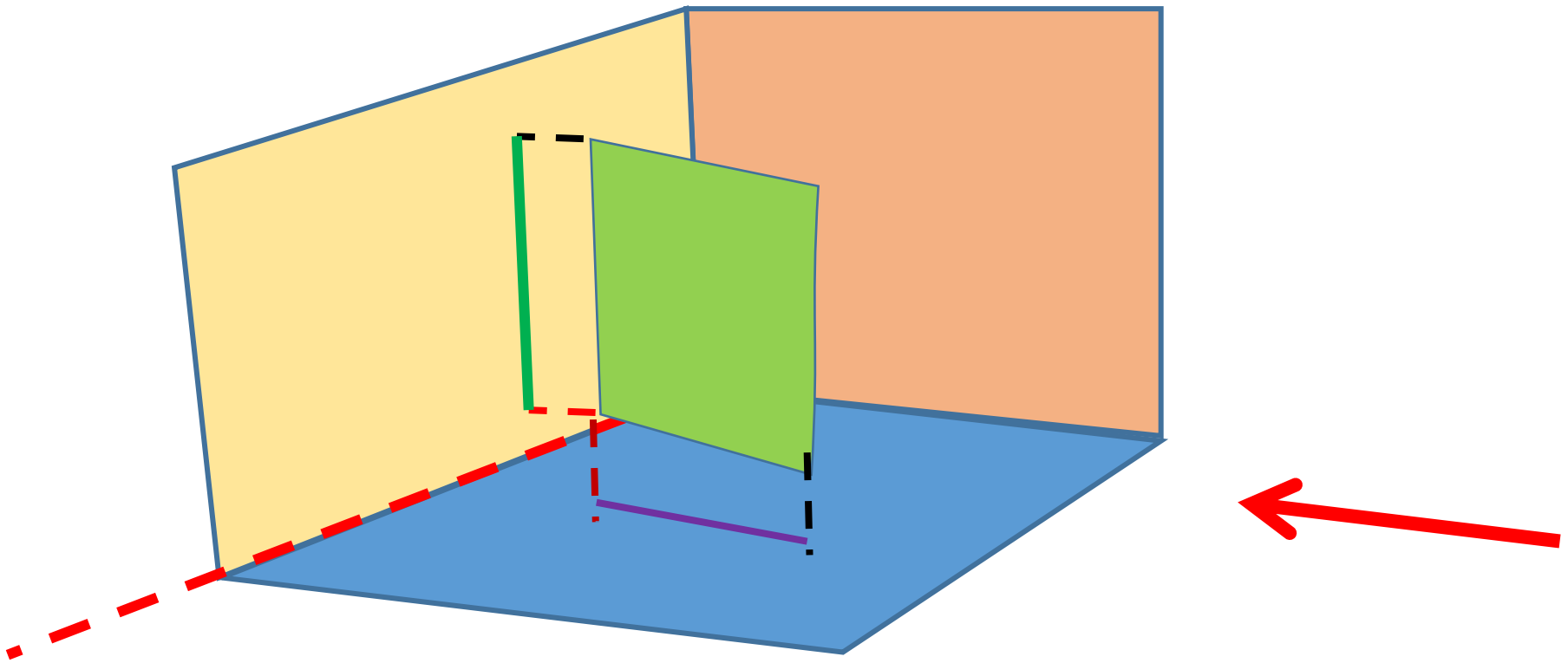
Topics

1. Projection of Plane
2. Projection of Solid
3. Exercise

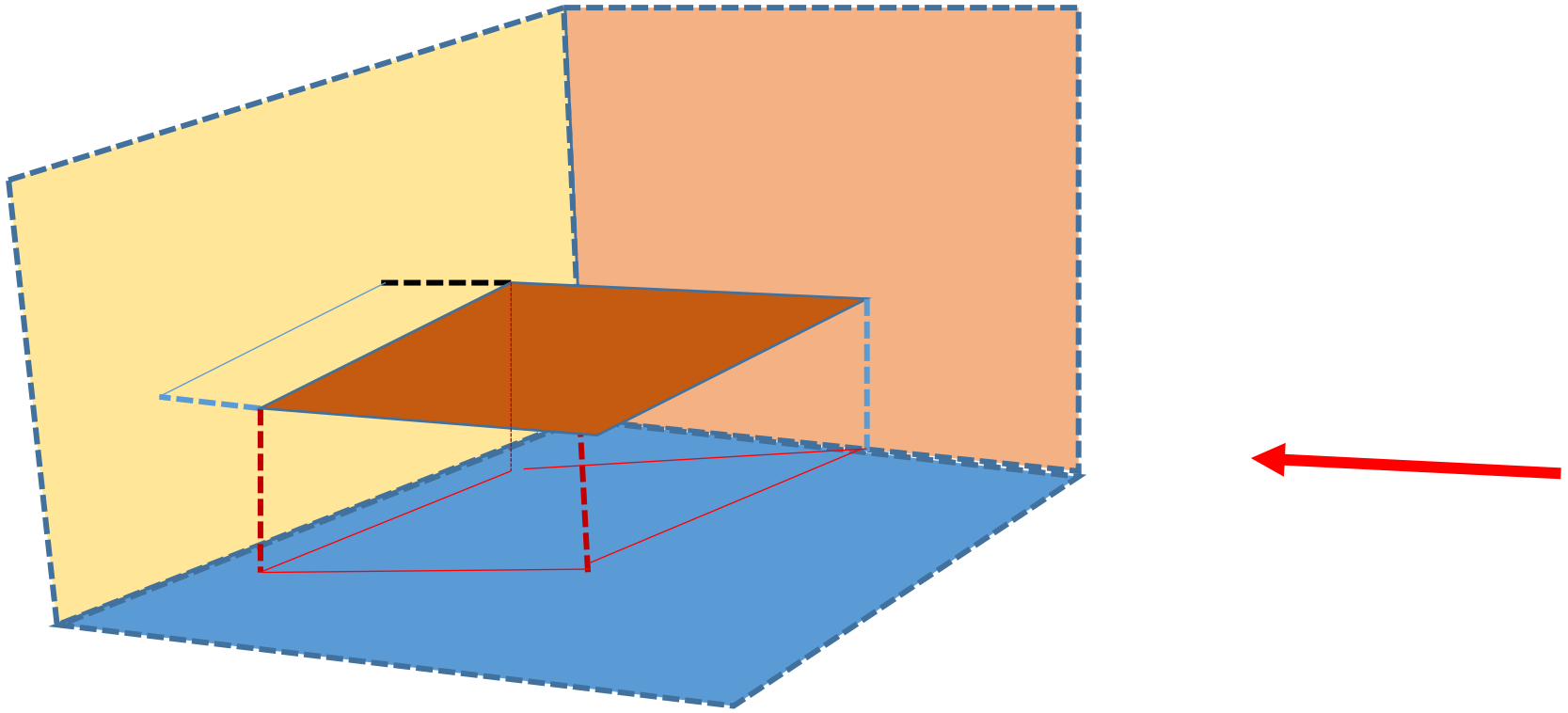
Projection of Plane

1. Plane is area inscribed by lines
2. Plane are two types: (a) perpendicular plane (b) oblique plane
   a) Perpendicular planes
      I. Perpendicular to both planes
      II. Perpendicular to one plane and parallel to other
      III. Perpendicular to one plane and inclined to other
   b) Oblique plane: plane has its surface inclined to one plane and an edge or a diameter or a diagonal parallel to that plane and inclined to other plane.

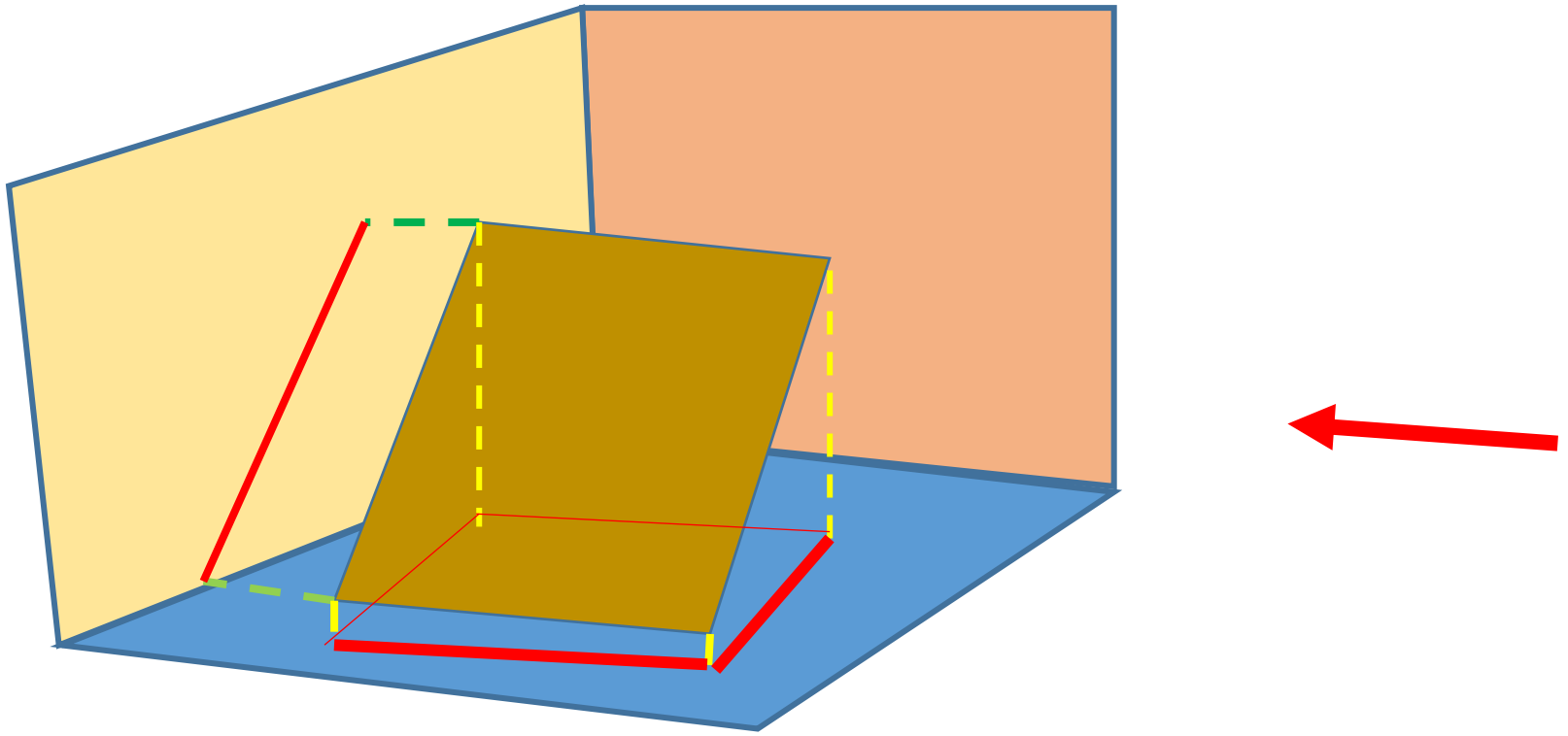
Plain perpendicular to HP and VP



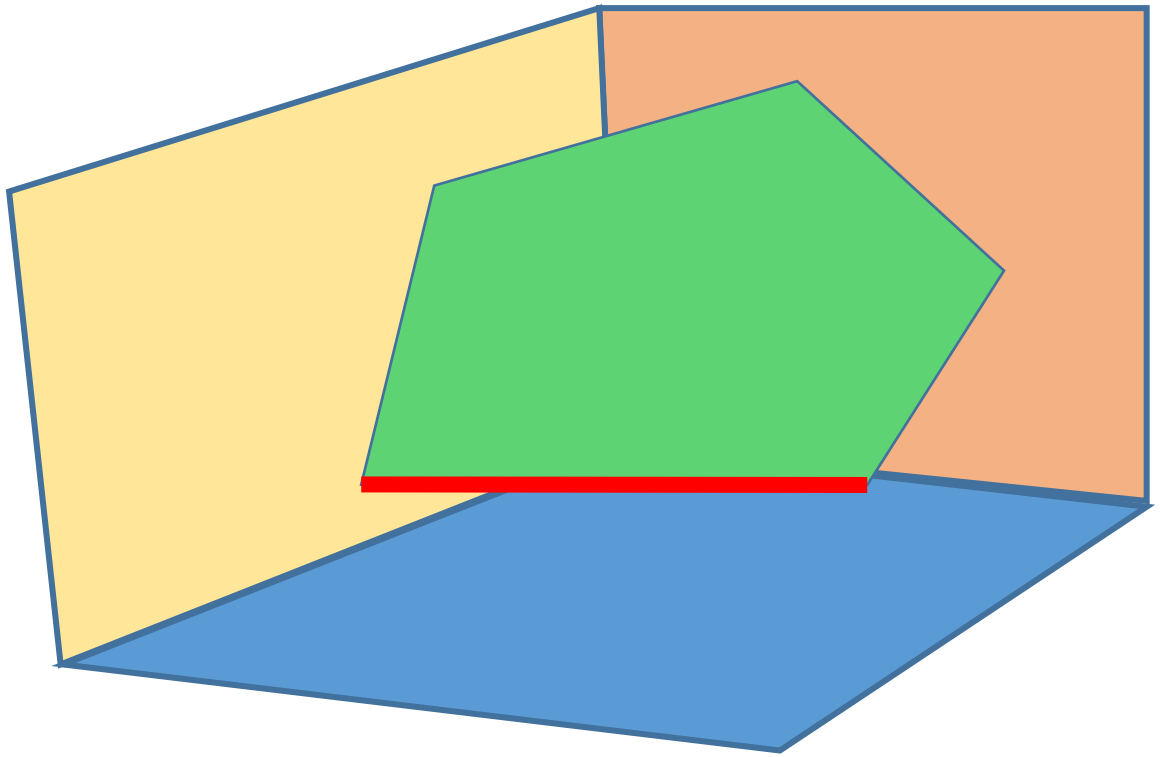
Plain Parallel to HP and perpendicular to VP



Plain inclined to HP and perpendicular to VP



Base line inclined to VP and plain inclined to HP



Exercise

1. An equilateral triangle of 50 mm side has its VT parallel to and 25 mm above xy. It has no HT. draw its projection when one of its sides is inclined at 45° to the VP.
2. A regular pentagon of 25 mm side has one end on the ground. Its plain is inclined at 45° to the HP and perpendicular to the VP draw its projections.
3. Draw the projections of a regular hexagon of 25 mm side having one of its sides in the HP and inclined at 60° to the VP and its surface making an angle of 45° with the HP.

Solid Projection

- Prism: having two equal and similar faces parallel to each other called its base and other faces are parallelogram.
- Pyramid: having one base and faces are triangular shapes
- Solid of revolution: Cylinder, cone sphere

- Positions of Solid in quadrants on the basis of their axis

a) Axis perpendicular to one of plain
b) Axis parallel to both plain
c) Axis incline to one plain and parallel to other
d) Axis inclined to both the plains

Exercise

1. A square pyramid base 40 mm side and 65 mm long has its base in the VP. One edge of base is inclined at 30° to the HP and a corner contained by that edge on the HP. Draw its projection

Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi
An Institution of National Importance, Government of India

Engineering Graphics (ME121)

Orthographic projections of solid

Topics

1. Projection of Solid
2. Exercise

Solid Projection

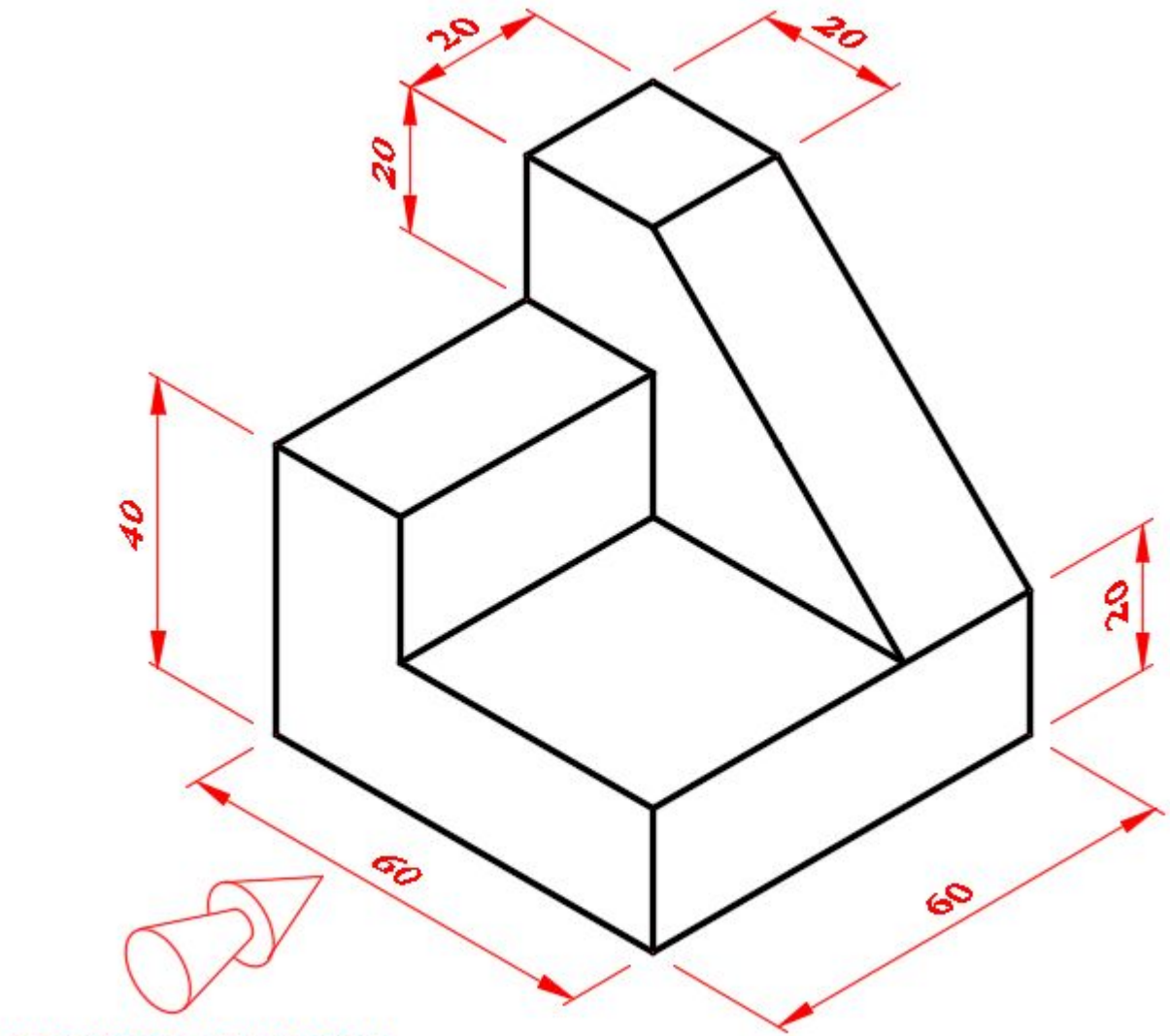
- **Prism**: having two equal and similar faces parallel to each other called its base and other faces are parallelogram.
- **Pyramid**: having one base and faces are triangular shapes
- **Solid of revolution**: Cylinder, cone sphere

- Positions of Solid in quadrants on the basis of their axis

a) Axis perpendicular to one of plain
b) Axis parallel to both plain
c) Axis incline to one plain and parallel to other
d) Axis inclined to both the plains

Exercise

1. A square pyramid base 40 mm side and 65 mm long has its base in the VP. One edge of base is inclined at 30° to the HP and a corner contained by that edge on the HP. Draw its projection.
2. A hexagonal prism has one of its rectangular face parallel to the HP. Its axis is perpendicular to the VP and 3.5 cm above the ground. Draw its projection when the nearer end is 2 cm in front of the VP. Side of base 2.5 cm long and axis 5 cm long.
3. A pentagonal prism has one of its rectangular face parallel to the VP Its axis is perpendicular to the HP Its Side of base 3.5 cm long and axis 7 cm long.



FRONT ELEVATION

Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi
An Institution of National Importance, Government of India

Engineering Graphics (ME121)

Isometric Projection

Anikesh Tripathi

Email:- anikeshmechanical@gmail.com

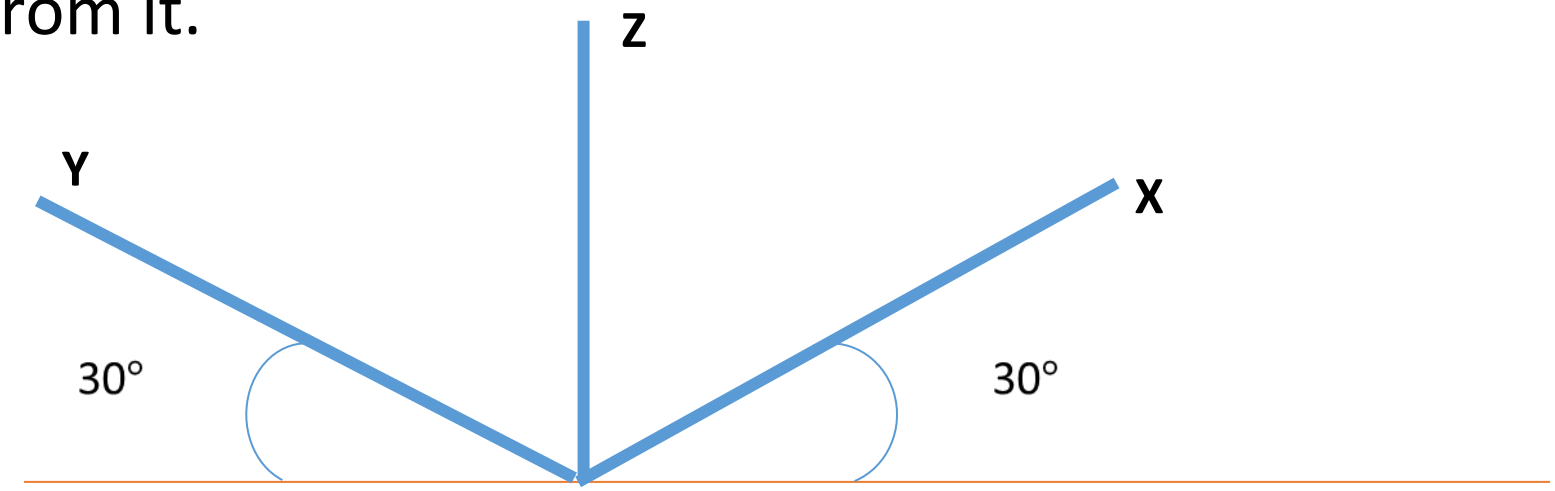
Contact no:- 9208465563/7897796938

Topics

1. Isometric projection principle and its method
2. Exercise

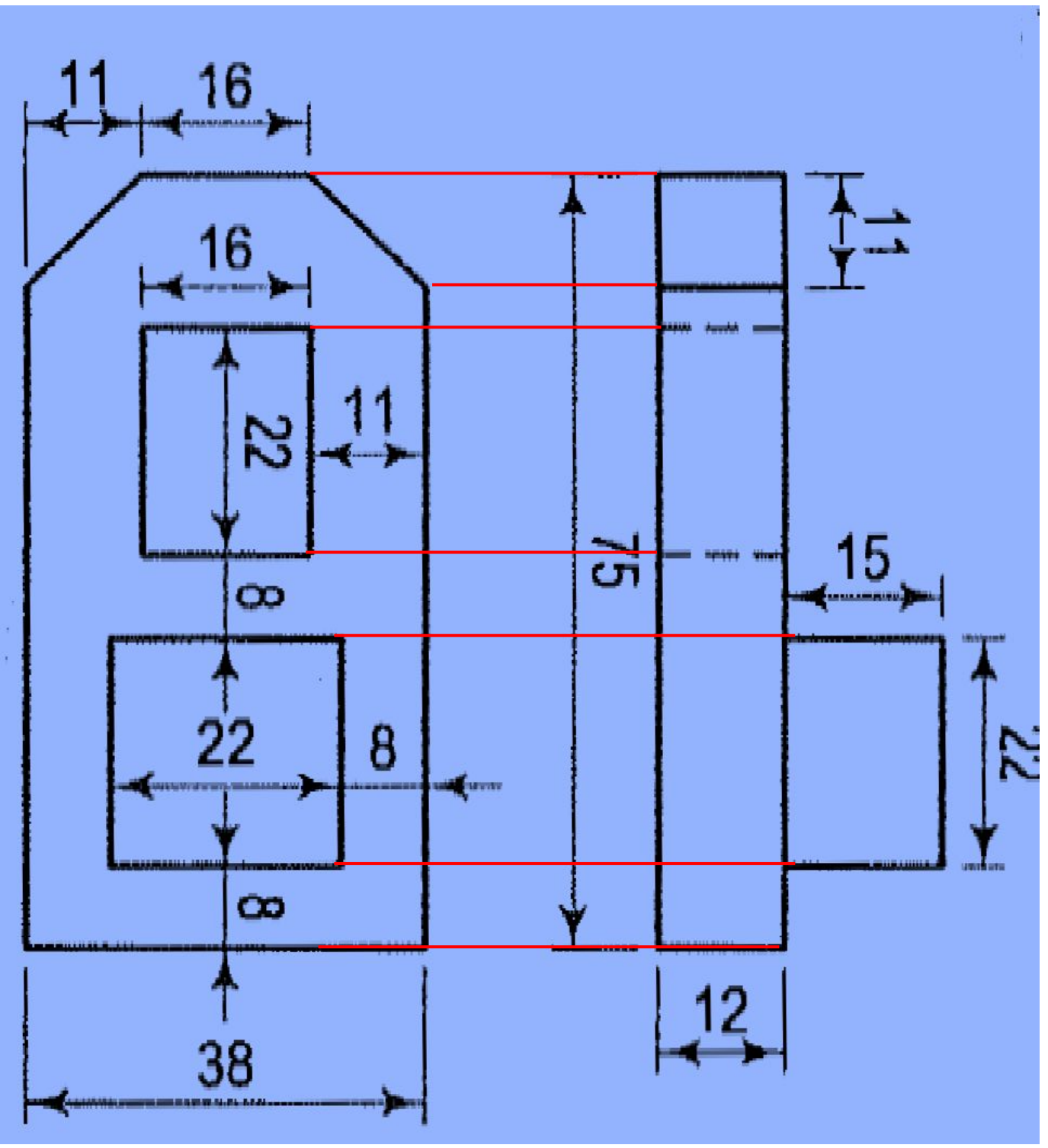
Isometric Projection

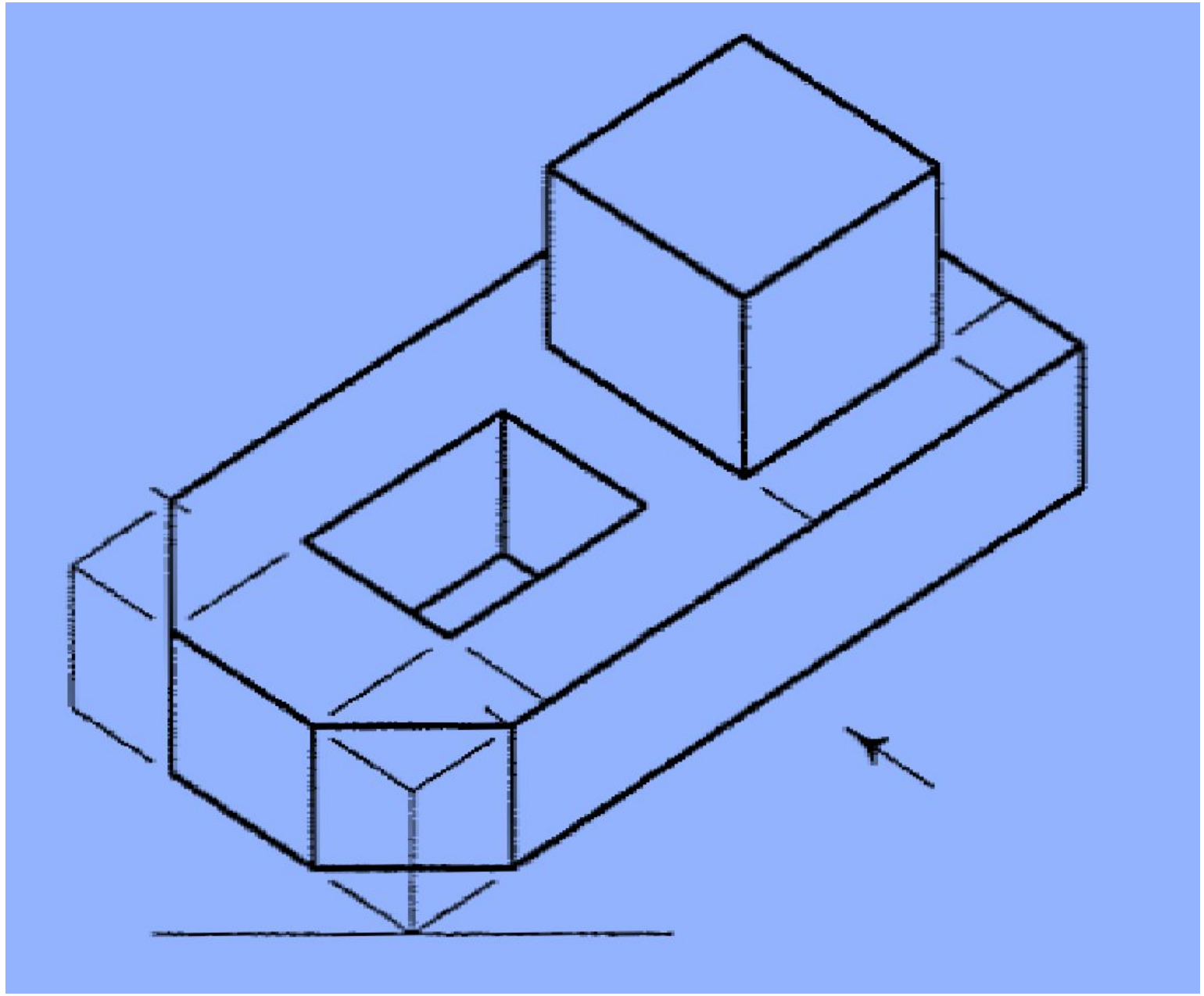
Isometric projection is a type of pictorial projection in which the 3D of solids are shown in one view and their actual sizes can be measured directly from it.

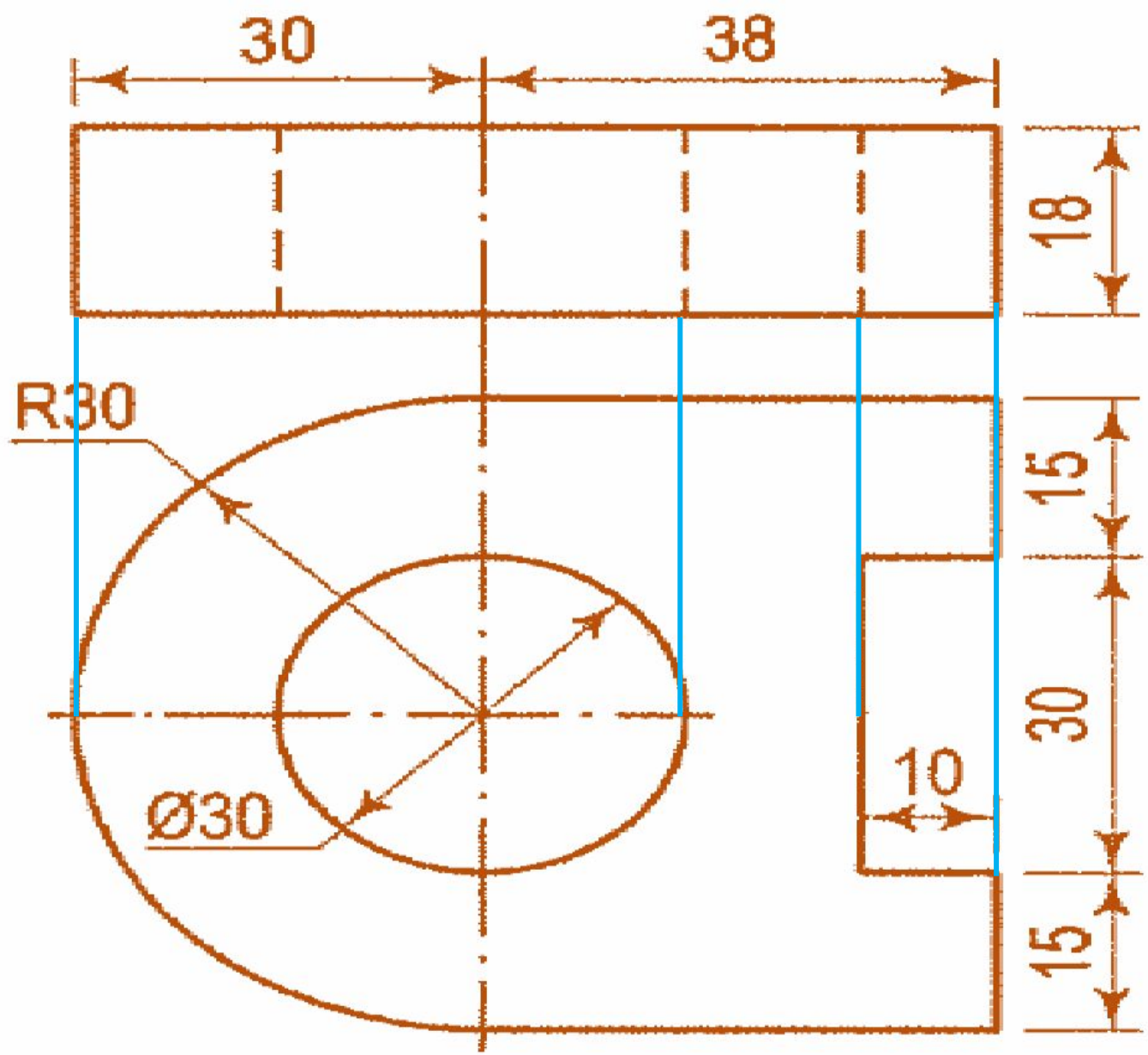


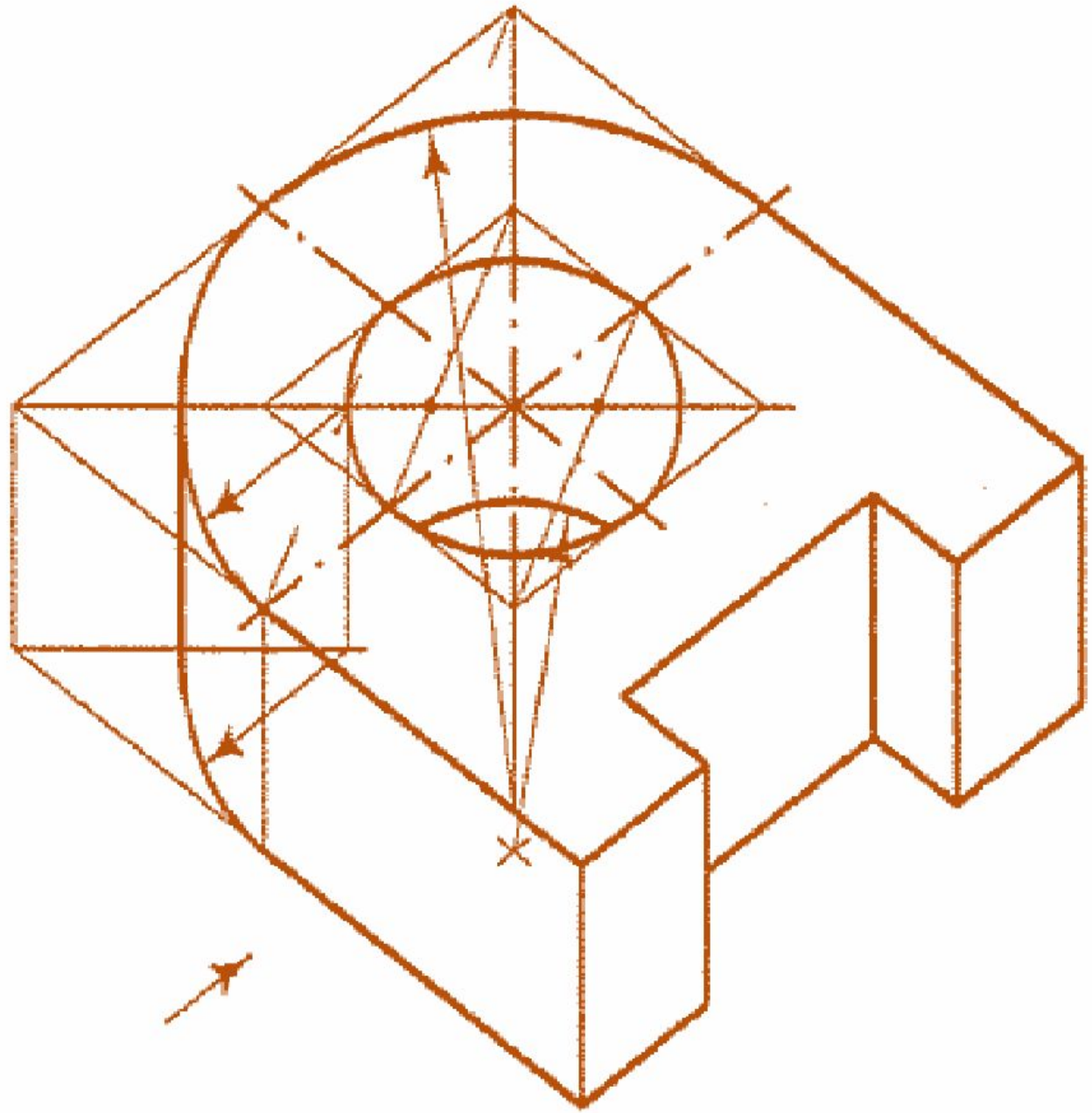
Exercise

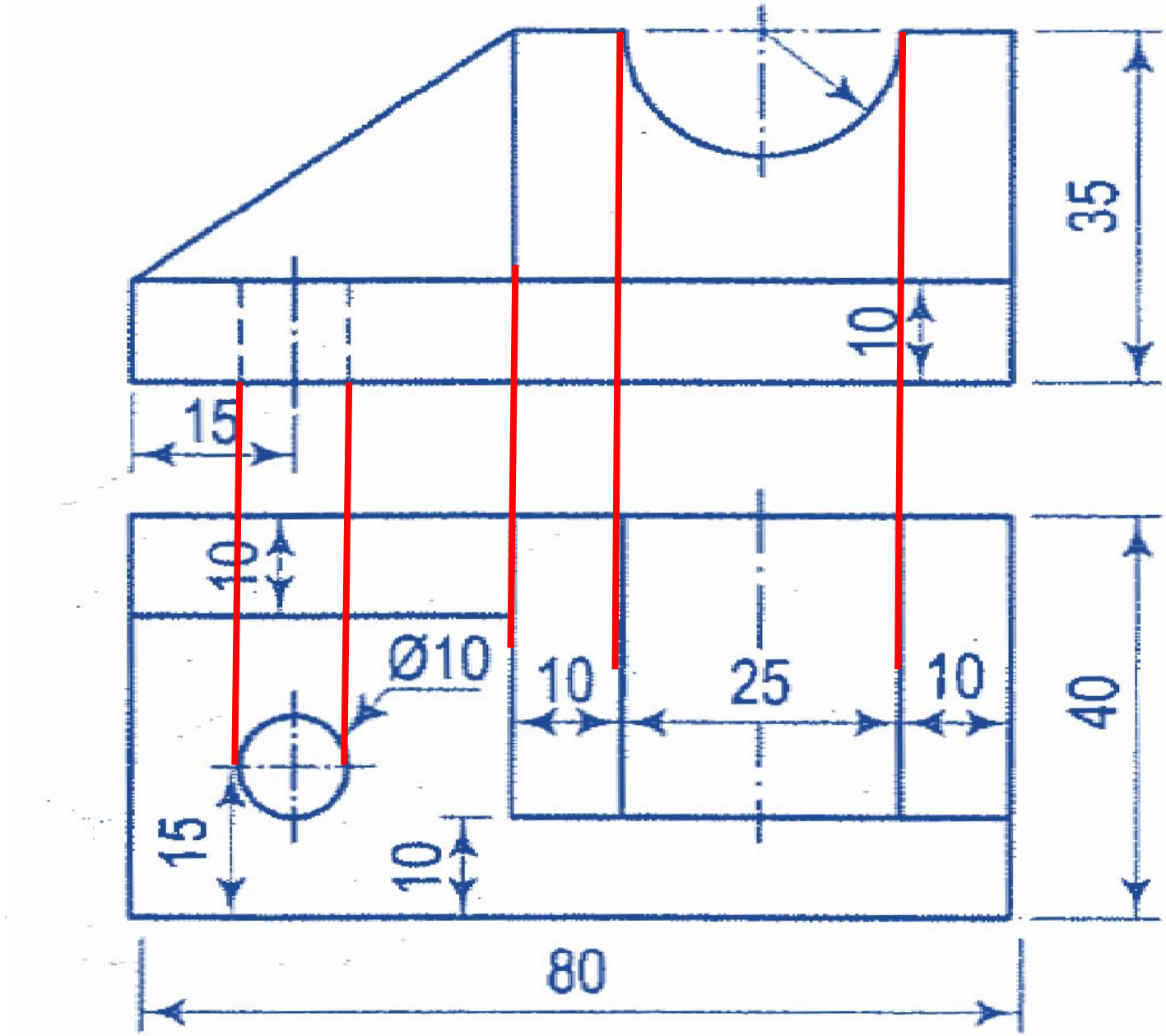
1. Draw a pentagon plain of 40 mm side in isometric projection
2. Draw a circle plain of 30 mm radius in isometric view
3. Draw the Isometric projections of orthographic projections

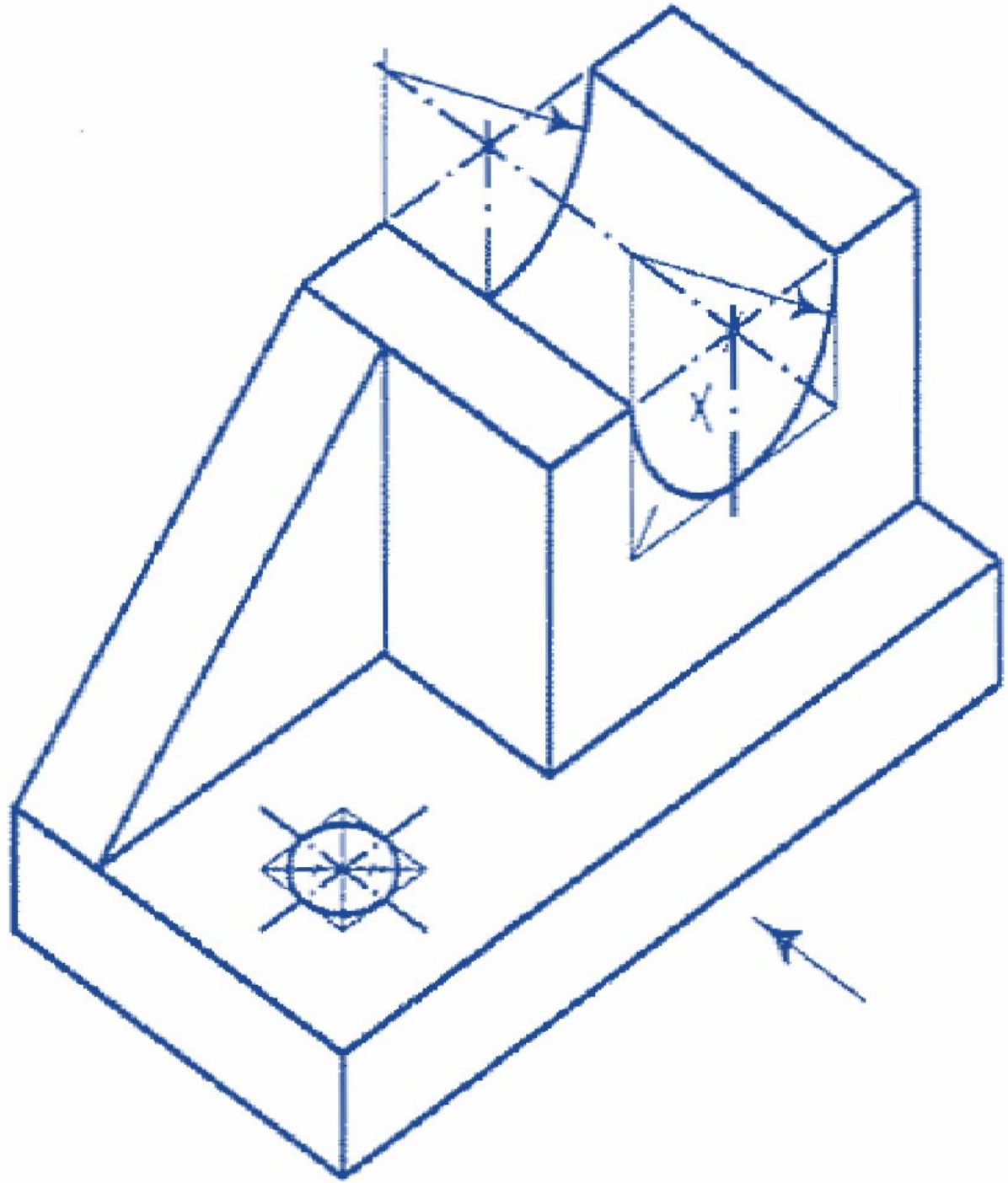

11
16
16
11
22
11
75
15
8
22
8
22
8
12
38

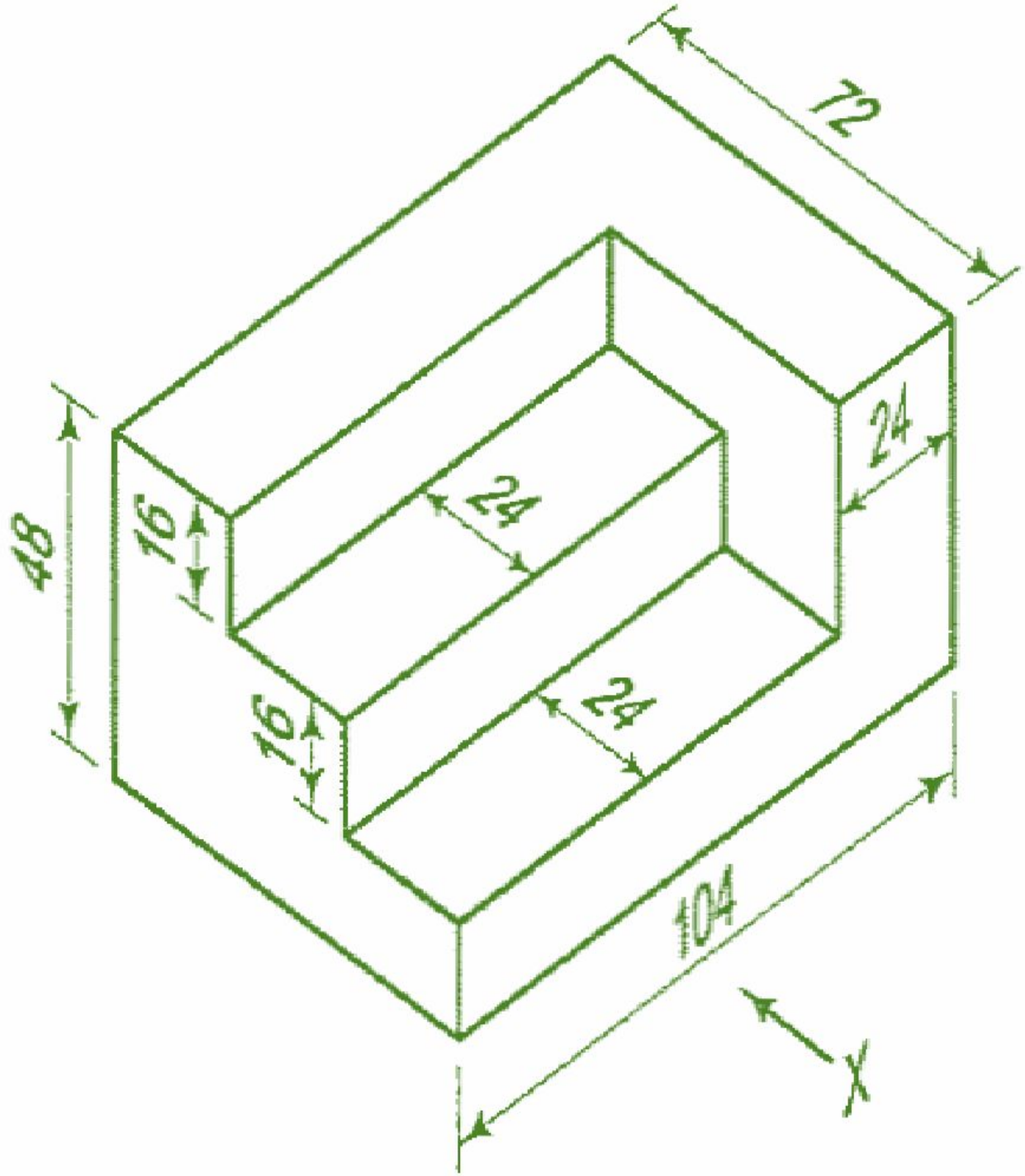


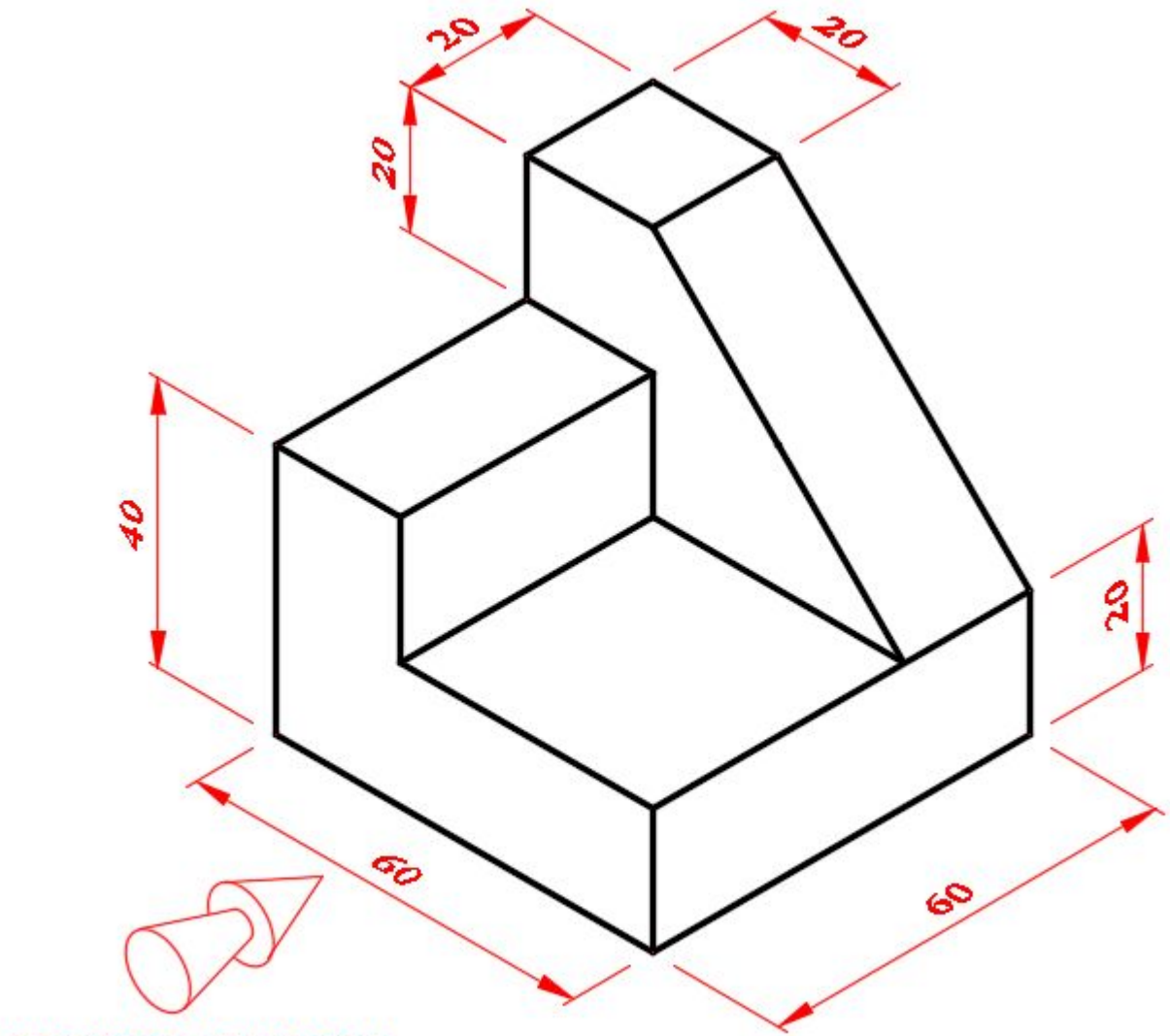

30
38
18
R30
15
30
10
Ø30
15




35
10
15
10
Ø10
10
25
10
40
15
10
80




72
48
16
24
24
16
24
104
X



FRONT ELEVATION

Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi
An Institution of National Importance, Government of India

Engineering Graphics (ME121)

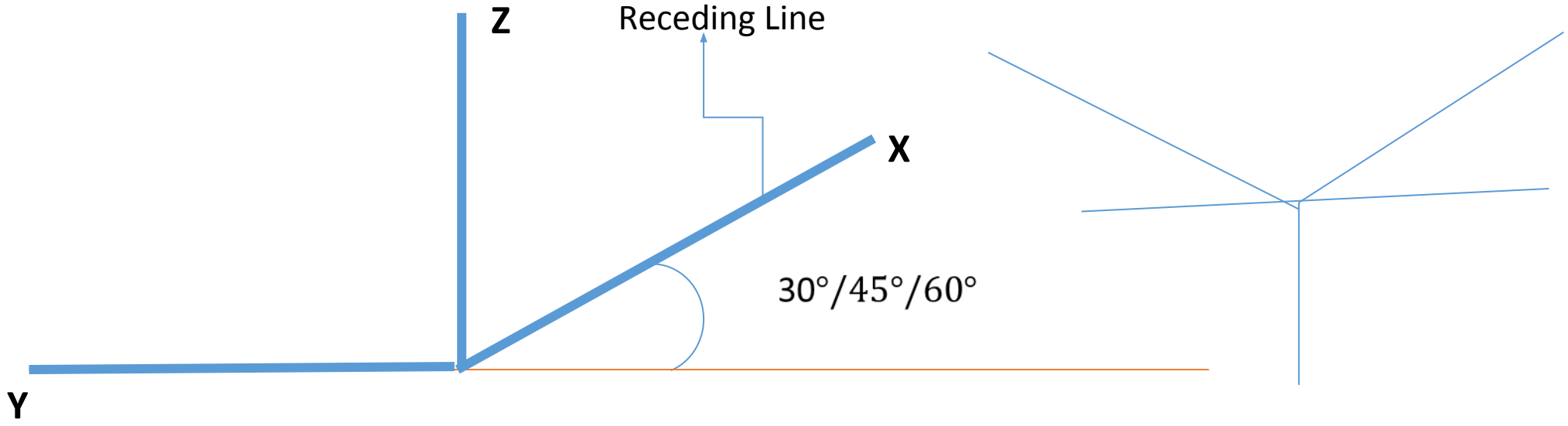
Oblique and Perspective Projections

Topics

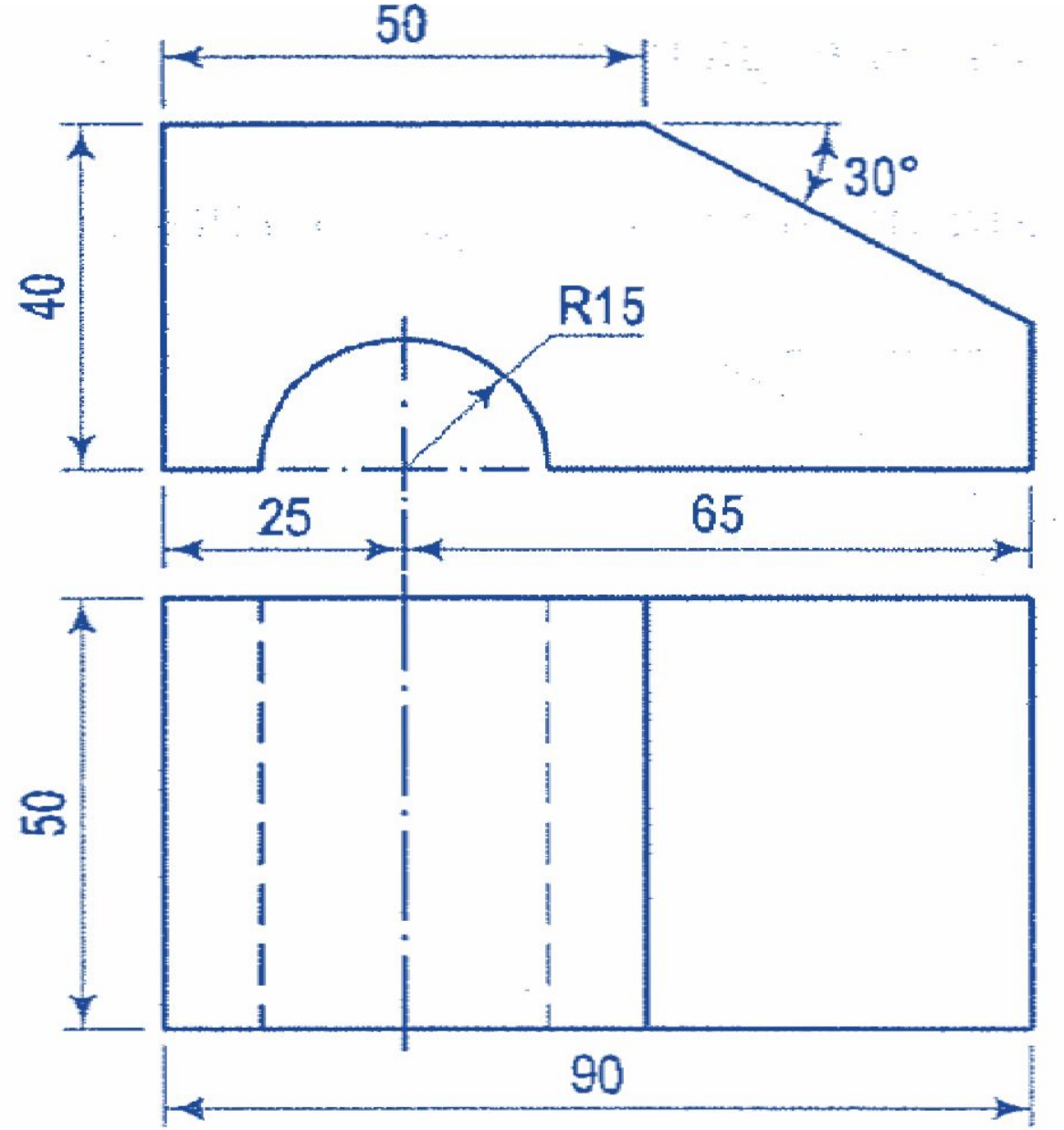
1. Oblique projection principle and its method
2. Exercise
3. Perspective Projection Principle and its method
4. Exercise

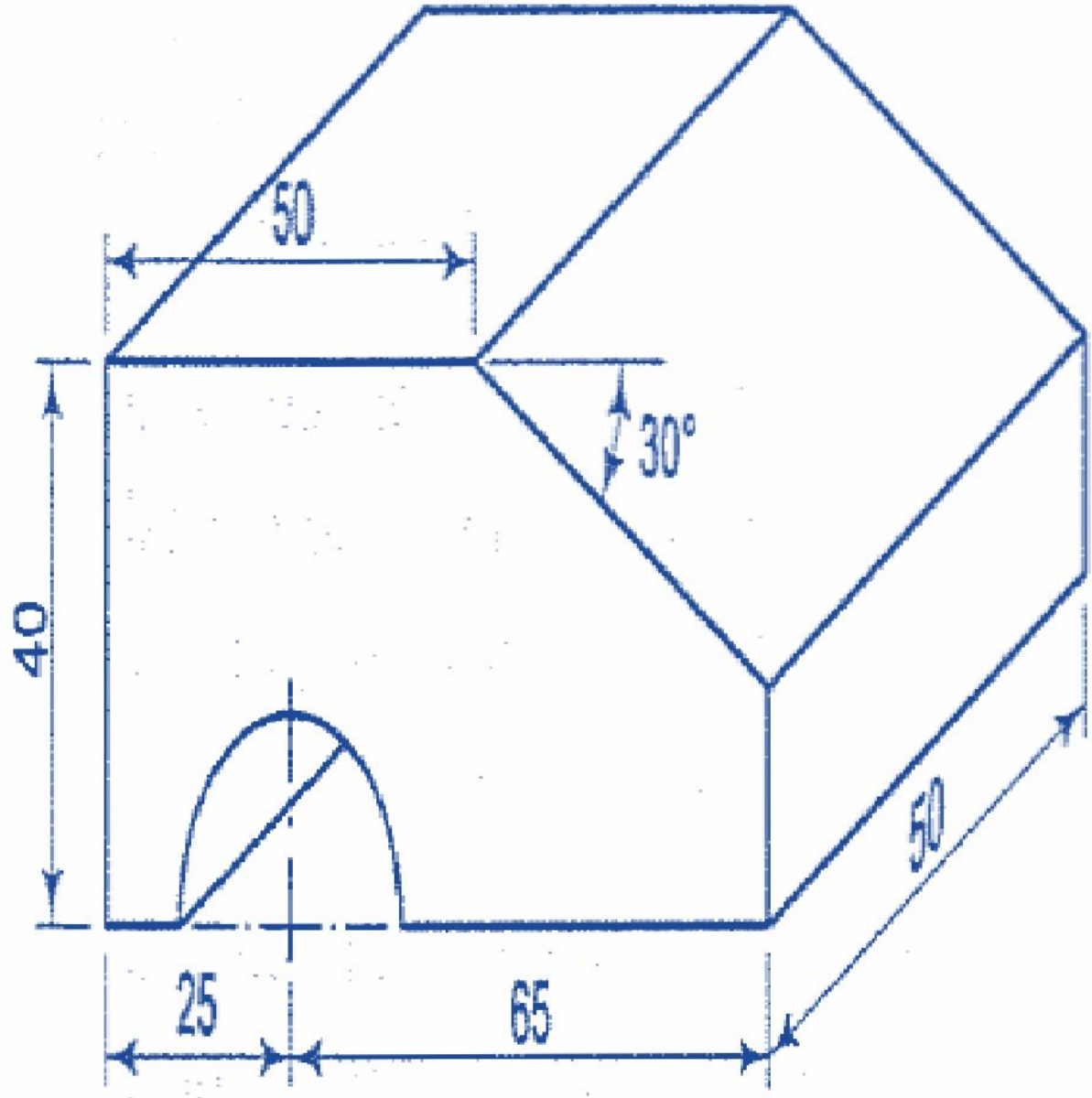
Oblique Projection

Oblique Projection is also pictorial projection and this type of projection is used for assembly of an object



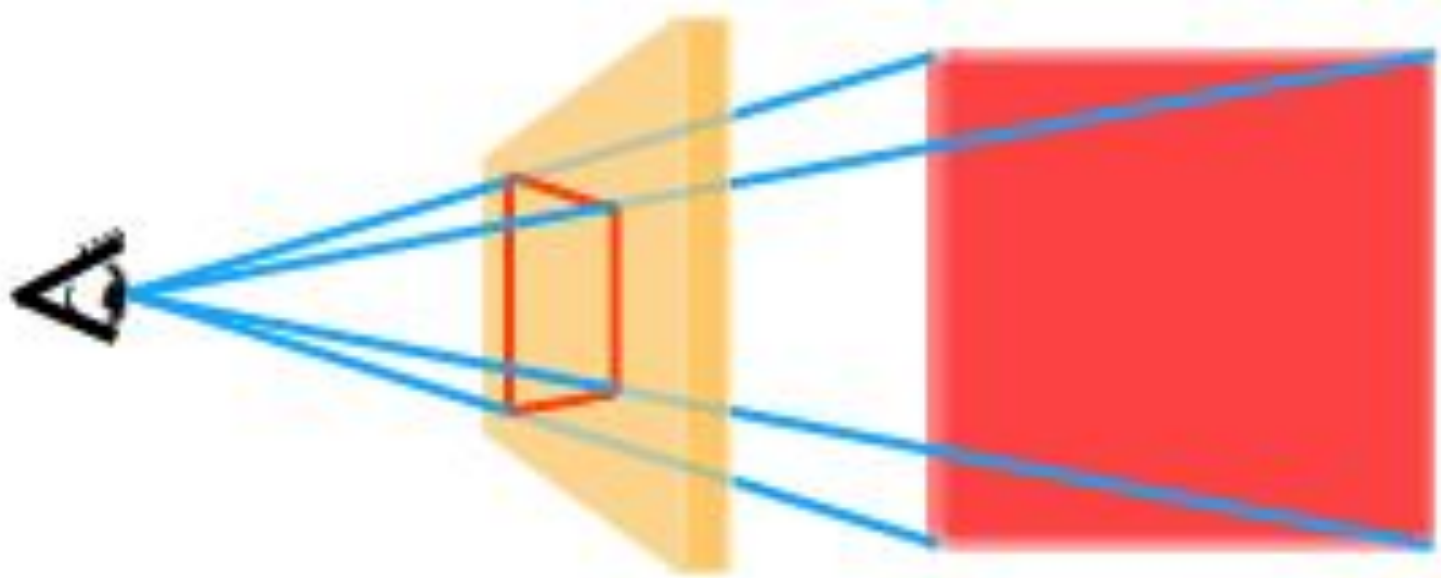
The principle difference between Oblique and Isometric projection is that in case of isometric projection all three axis are equally inclined at 120° whereas in oblique projection third axis is inclined at an angle of 30°/45°/60° wrt two perpendicular axis


50
30°
40
R15
25
65
50
90


50
30°
40
50
25
65

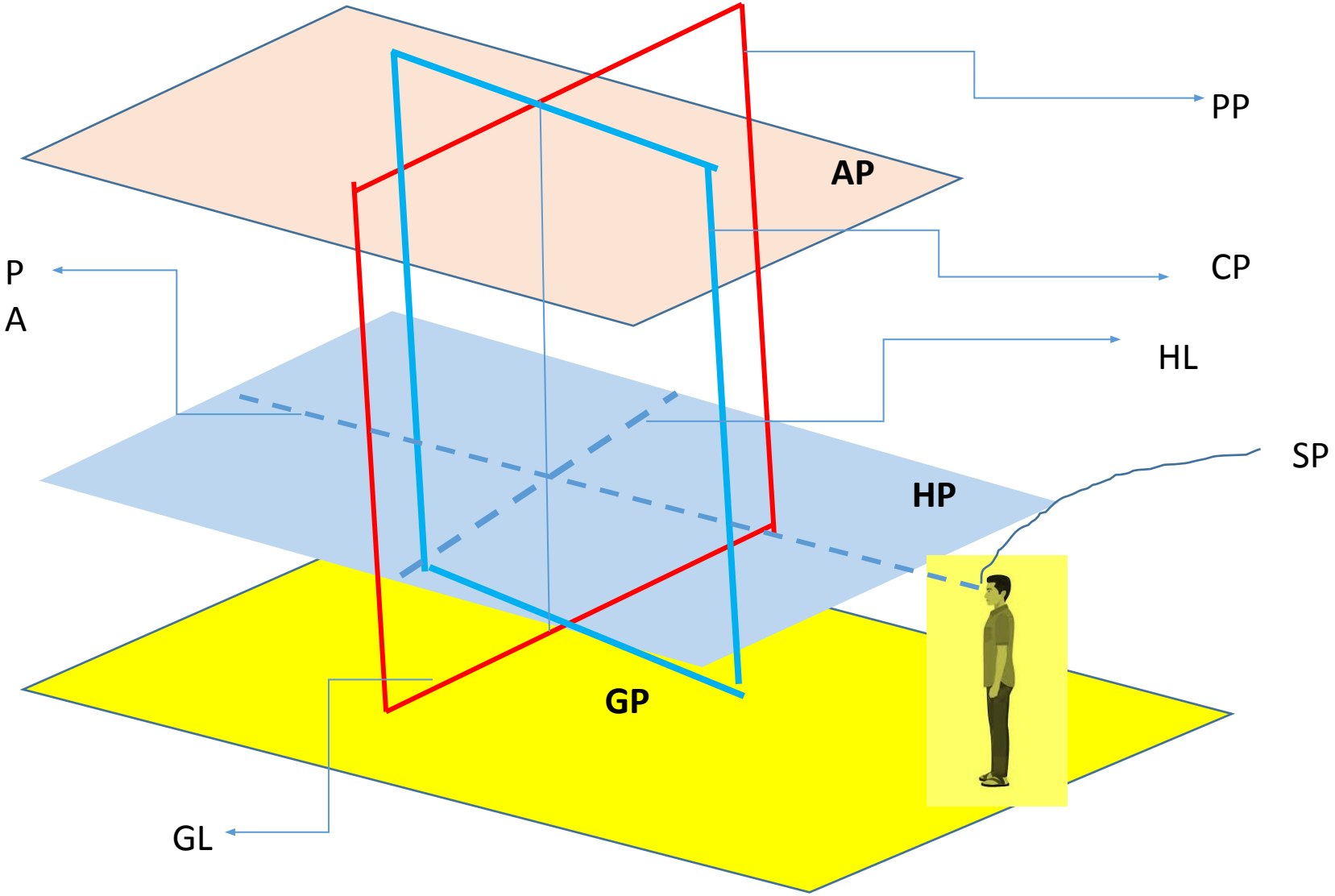
Perspective Projection

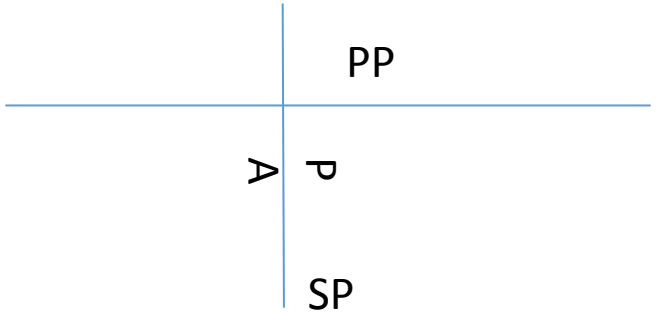
- In perspective projection, the eye is assumed to be situated at a definite position relative to the object. Here the vertical plain is called as picture plain and is placed between object and eye. The projector lines are not parallel to each other and these projectors are coincide at observer eye i.e. station point(SP)
- The perspective projection is third angle projection and it is used in architecture drawing and it is most realistic projection.

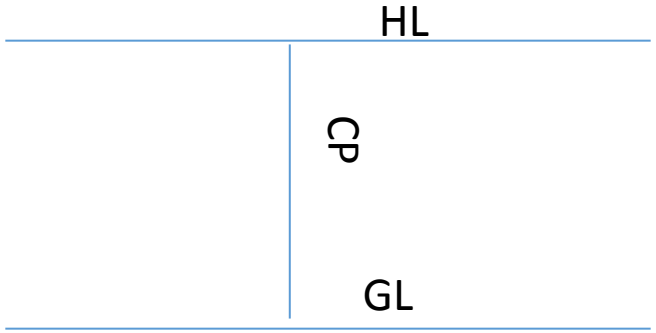


Types of plains

- Ground Plain(GP): It is horizontal plain where object placed.
- Station Point(SP): It is point where observer eye located
- Picture Plain (PP): it is VP located b/w SP and object
- Horizontal Plain (HP): It is imaginary plain is at level of eye
- Auxiliary Plain(AP): it is horizontal plain above HP where top view form







PA=Perpendicular axis

Type of perspective projection

- One point PP
- Two point PP
- Three point PP

exercise

1. Draw the one point perspective projection for a box of dimensions $(40\times 50 \times 70)$ mm the station point 70 mm away from PP and 90 mm above ground if SP is 100 mm to the left of axis
2. If SP is 100 mm to the right of axis

Rajiv Gandhi Institute of Petroleum Technology
Jais, Amethi

An Institution of National Importance, Government of India

Engineering Graphics (ME121)

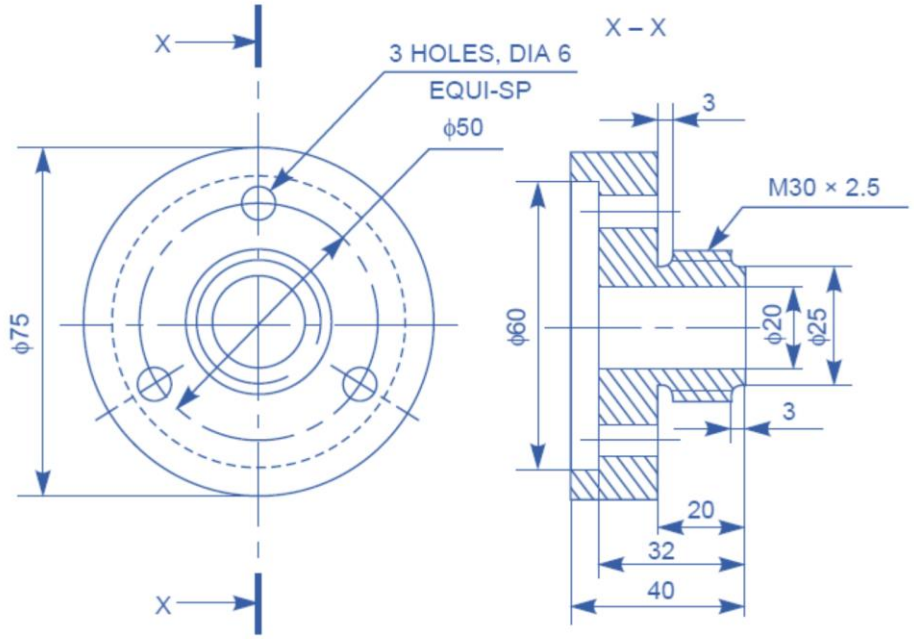
Machine Drawing and CAD Modeling

Topics

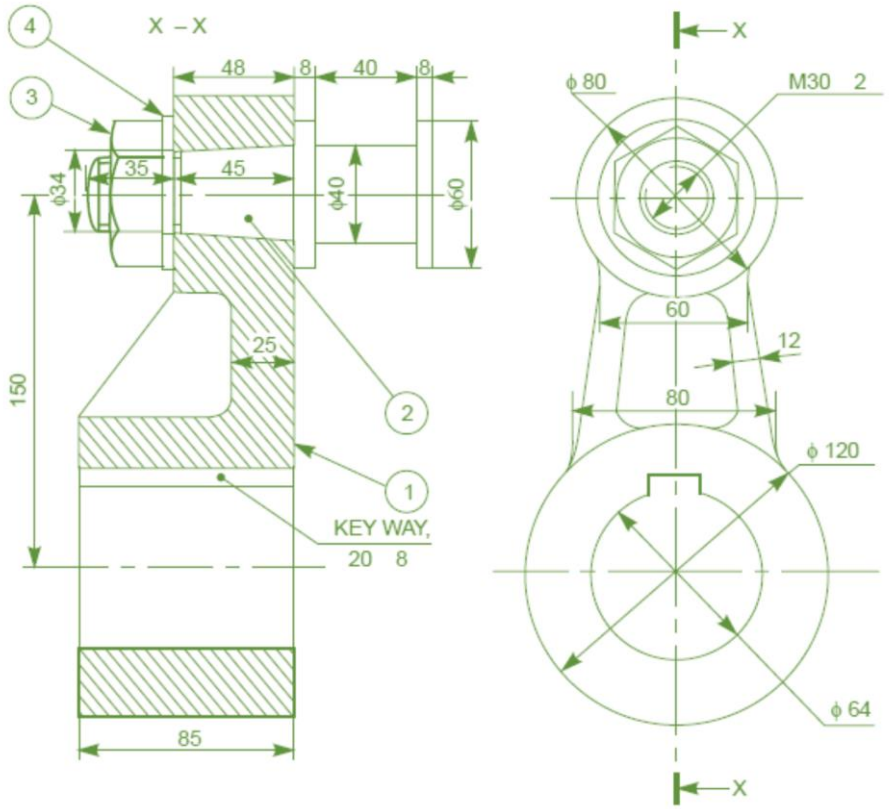
1. Introduction of Machine drawing
2. CAD modelling 2D to 3D
3. Exercise

Machine Drawing

- It is pertaining to machine parts or components. It is presented through a number of orthographic views, so that the size and shape of the component is fully understood. Part drawings and assembly drawings belong to this classification.

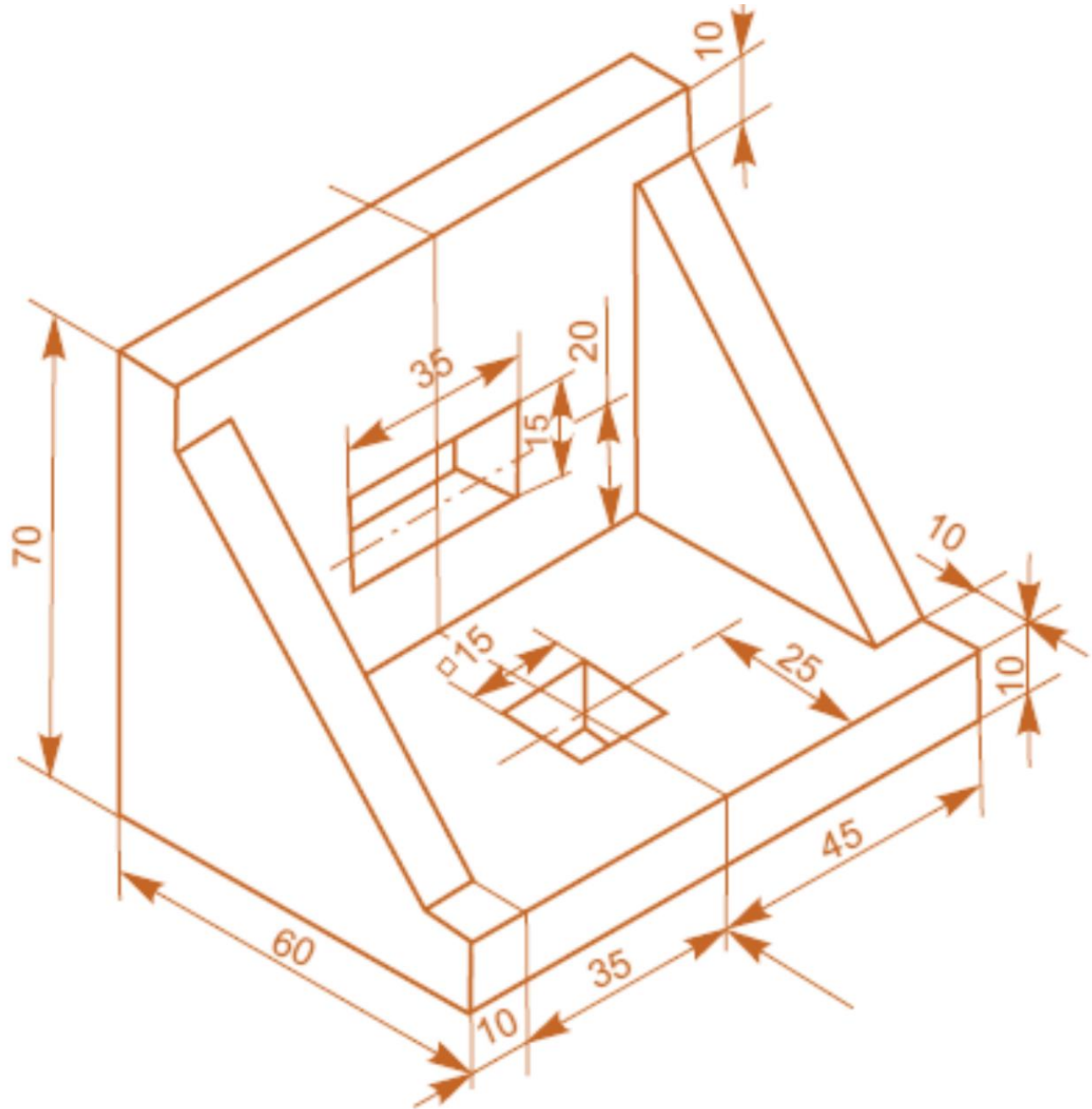


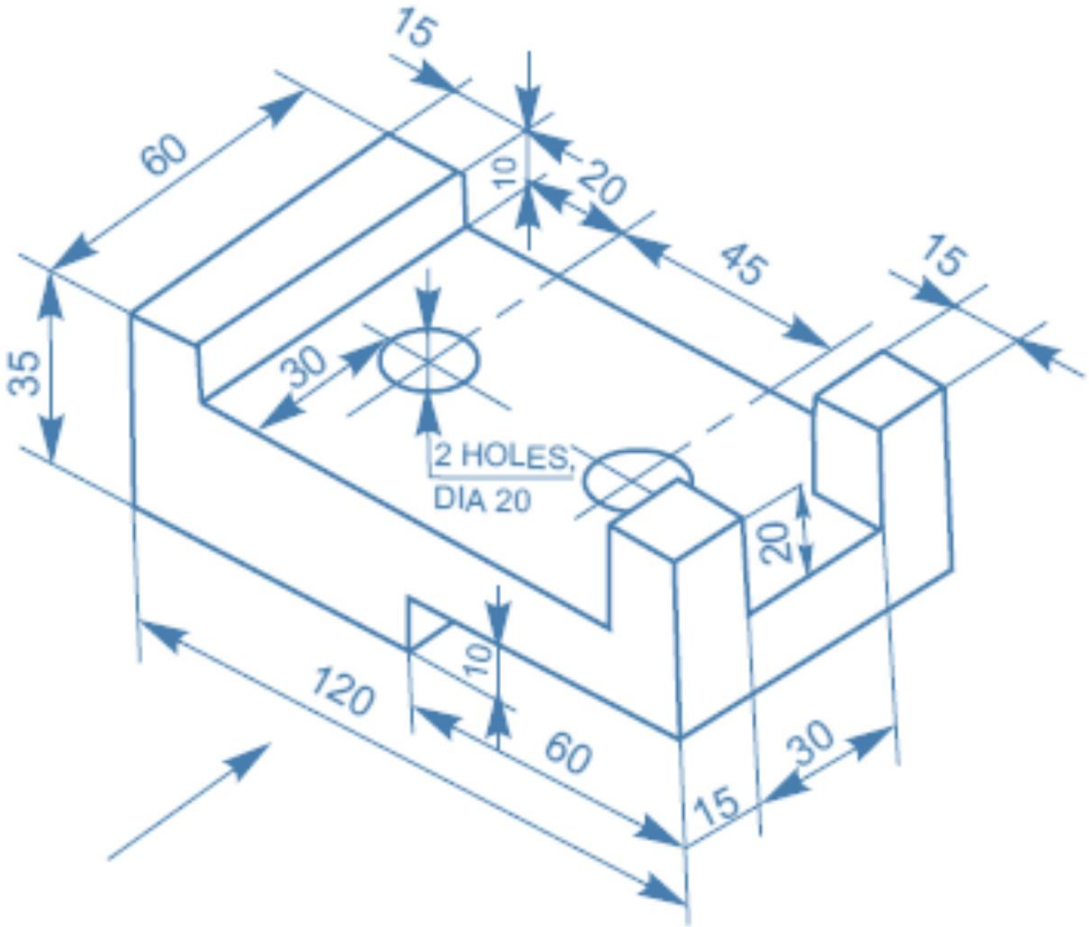
Assembly drawing

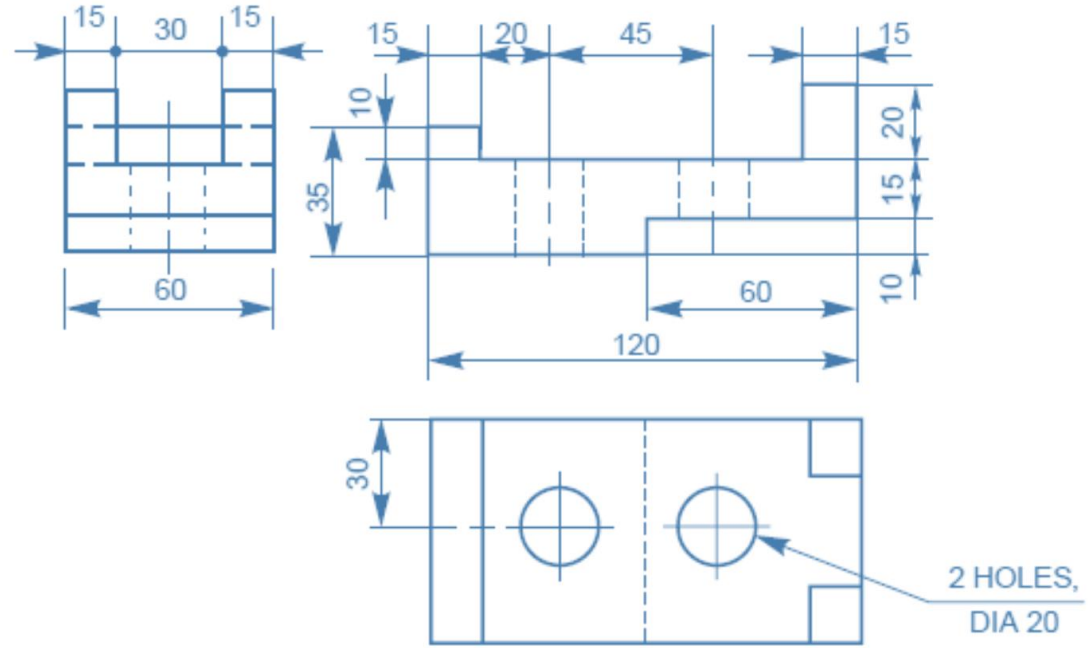


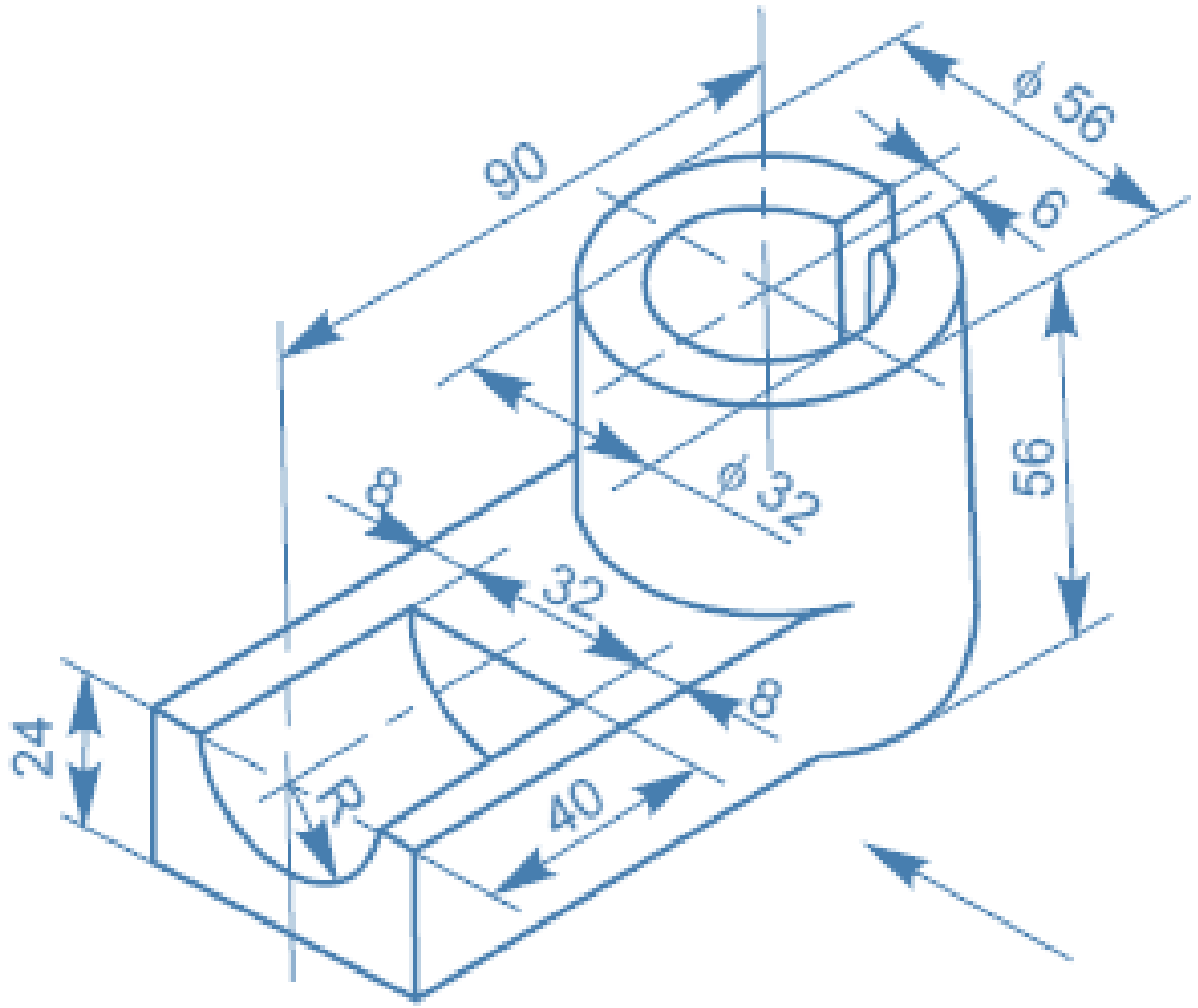
Parts List

Part No.	Name	Material	Qty
1	Crank	Forged Steel	1
2	Crank Pin	45C	1
3	Nut	MS	1
4	Washer	MS	1


10
35
20
15
70
10
□15
25
10
45
60
10
35


15
60
10
20
45
15
35
30
2 HOLES,
DIA 20
20
120
10
60
15
30


15
30
15
60
15
20
45
15
10
35
20
15
10
60
120
30
2 HOLES,
DIA 20


90
ø 56
6
ø 32
56
8
32
8
24
R
40