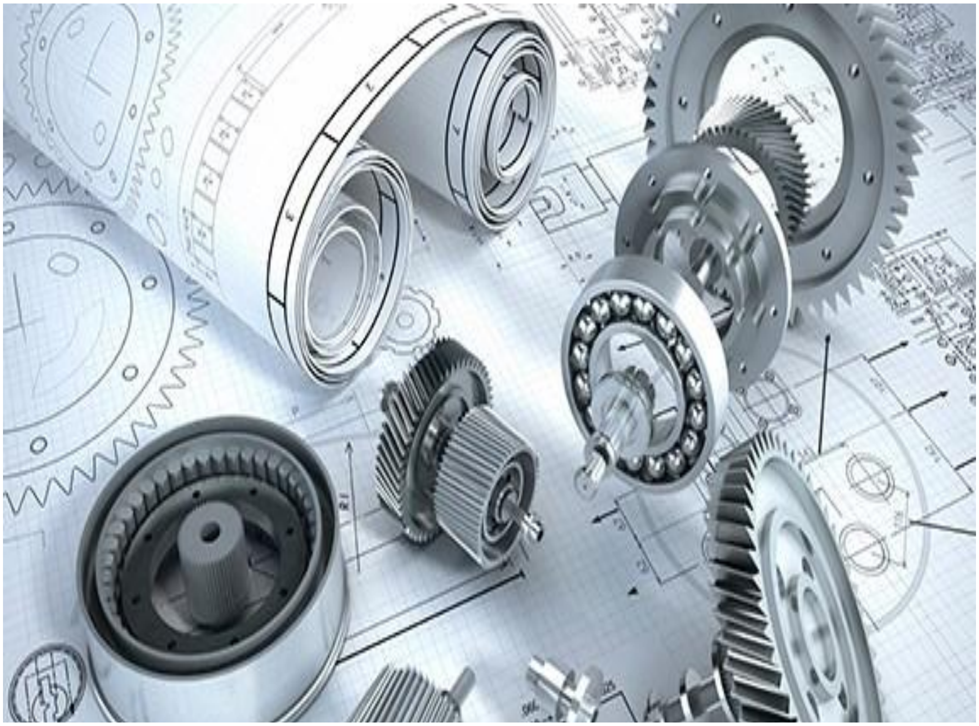
8208 – E.G.SPILLAY ENGINEERING COLLEGE,NAGAPATTINAM
DEPARTMENT OF MECHANICAL ENGINEERING

GE 6152-ENGINEERING GRAPHICS

FIRST SEMESTER



DRAWINGINSTRUMENTS ANDSHEET LAYOUT

Drawing Board

Compass

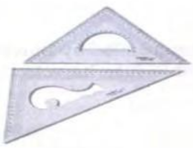
Protractor

T-Square

Eraser

Pencil Sharpener

French Curves



Set Squares

Drawing Pins

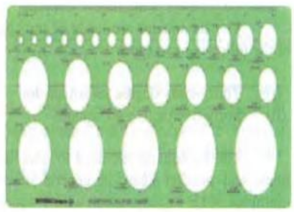
Instrument Box

Drawing Clips

Pencils

Cello Tapes

Drafting Machine

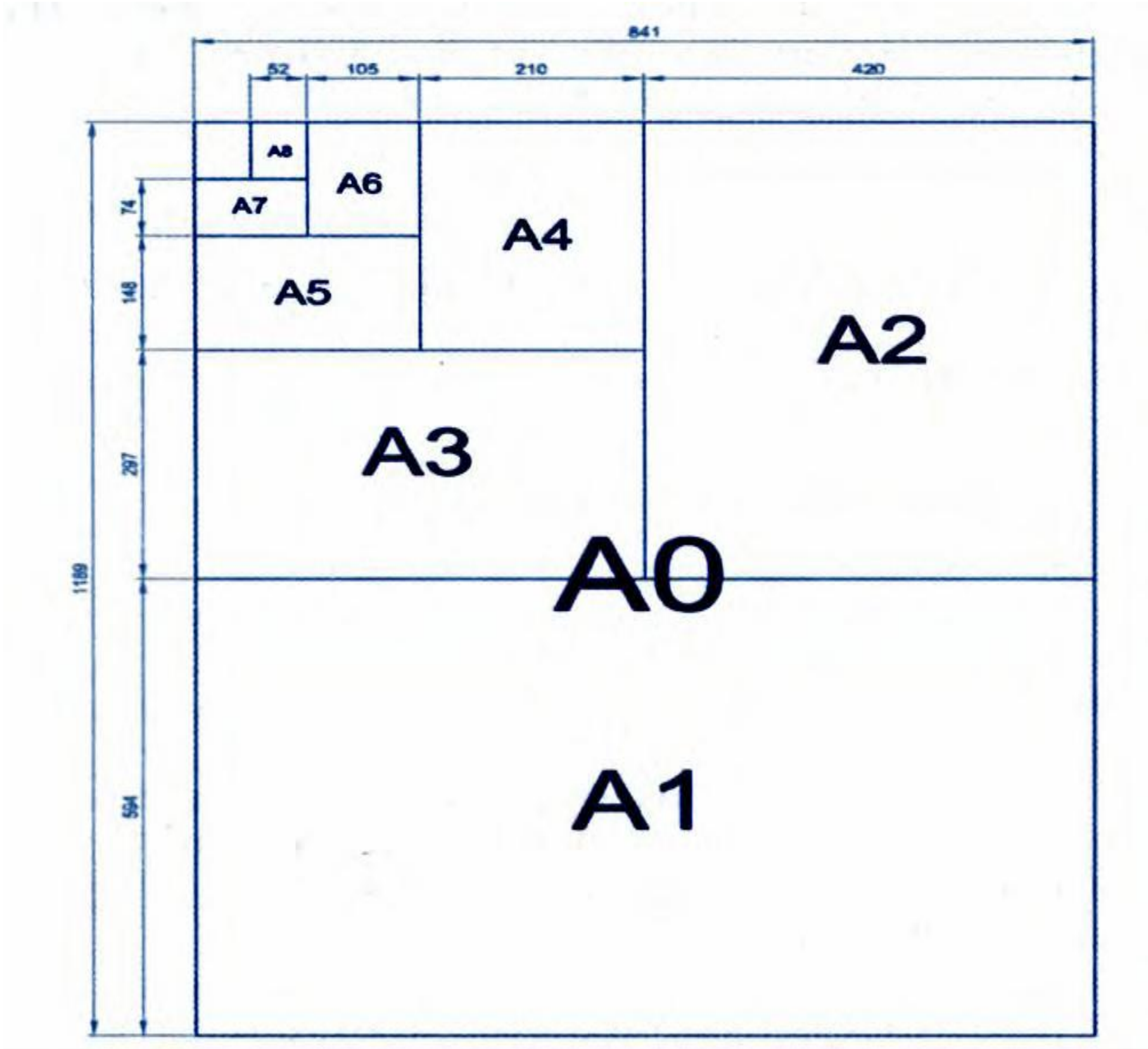


Template

DRAWINGBOARD SIZE

Sl. No.	Designation	Length x Width (in mm)	Thickness (in mm)	To be used with Sheet Sizes
1.	D00	1525 x 1220	22	-
1.	D0	1270 x 920	22	A0
3.	D1	920 x 650	22	A1
4.	D2	650 x 470	22	A2
5.	D3	500 x 350	22	A3

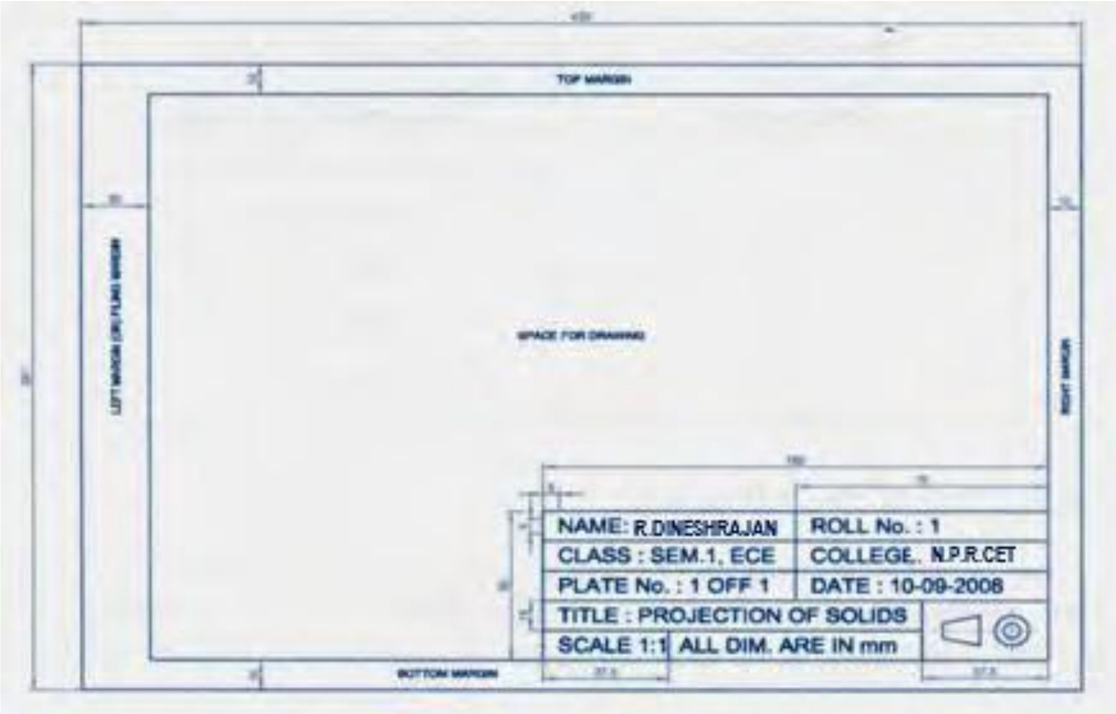
DRAWINGSHEET LAYOUT



DRAWINGSHEET SIZE

Designation	Trimmed size (mm)
A0	841 x 1189
A1	594 x 841
A2	420 x 594
A3	297 x 420
A4	210 x 297

TITLE BLOCK OF DRAWING SHEET



LINES,LETTERINGAND DIMENSIONING

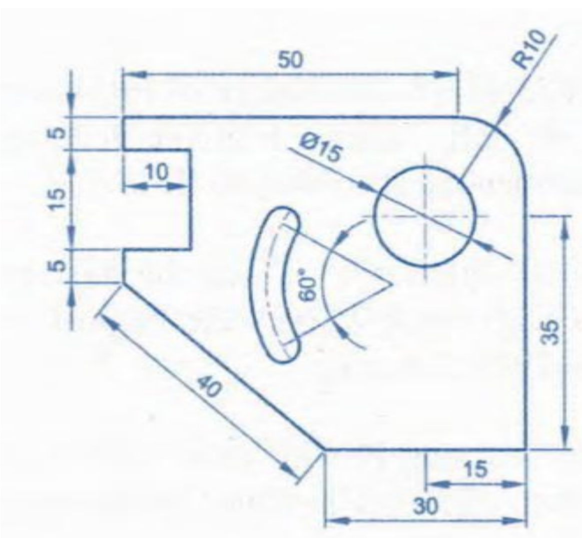
LINE TYPE	DESCRIPTION	APPLICATION
A	THICK CONTINUOUS	VISIBLE OUTLINES AND EDGES
B	THIN CONTINUOUS	DIMENSIONS AND LEADER LINES, PROJECTION LINES, HATCHING LINES, SHORT CENTRE LINE AND REVOLVED SECTIONS.
C_1	THIN CONTINUOUS IRREGULAR	LIMITS OF PARTIAL OR INTERRUPTED VIEWS OR SECTIONS WHEN THE LINE IS NOT AN AXIS.
C_2	STRAIGHT WITH ZIGZAG	
D	THIN OR THICK SHORT DASHES	HIDDEN OUTLINES AND EDGES
E	THIN CHAIN	CENTRE LINES, LINES OF SYMMETRY, PITCH CIRCLES AND LINES
F	CHAIN, THICK AT ENDS AND AT CHANGES OF DIRECTION, THIN ELSEWHERE	CUTTING PLANE
G	THIN CHAIN SHORT DOUBLE DASHES	OUTLINES AND EDGES OF ADJACENT PARTS AND EXTREME POSITIONS OF MOVABLE PARTS

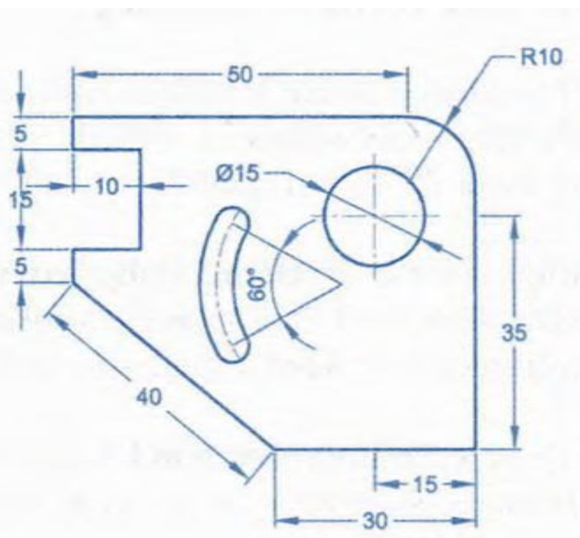
SPECIFICATION OF“A”TYPE LETTERING:

Specifications	Value	Size						
Capital Letter Height	h	2.5	3.5	5	7	10	14	20
Lowercase Letter Height	a = (5/7) h	-	2.5	3.5	5	7	10	14
Thickness of Lines	b = (1/14) h	0.18	0.25	0.35	0.5	0.7	1	1.4
Spacing between Characters	c = (1/7) h	0.35	0.5	0.7	1	1.4	2	2.8
Min.Spacing between words	d = (3/7) h	1.05	1.5	2.1	3	4.2	6	8.4
Min. Spacing between Base Lines	e = (10/7) h	3.5	5	7	10	14	20	28

SPECIFICATION OF“B”TYPELETTERING:

Specifications	Value	Size						
Capital Letter Height	h	2.5	3.5	5	7	10	14	20
Lowercase Letter Height	a = (7/10) h	-	2.5	3.5	5	7	10	14
Thickness of Lines	b = (1/10) h	0.25	0.35	0.5	0.7	1	1.4	2
Spacing between Characters	c = (1/5) h	0.5	0.7	1	1.4	2	2.8	4
Min.Spacing between words	d = (3/5) h	1.5	2.1	3	4.2	6	8.4	12
Min. Spacing between Base Lines	e = (7/5) h	3.5	5	7	10	14	20	28

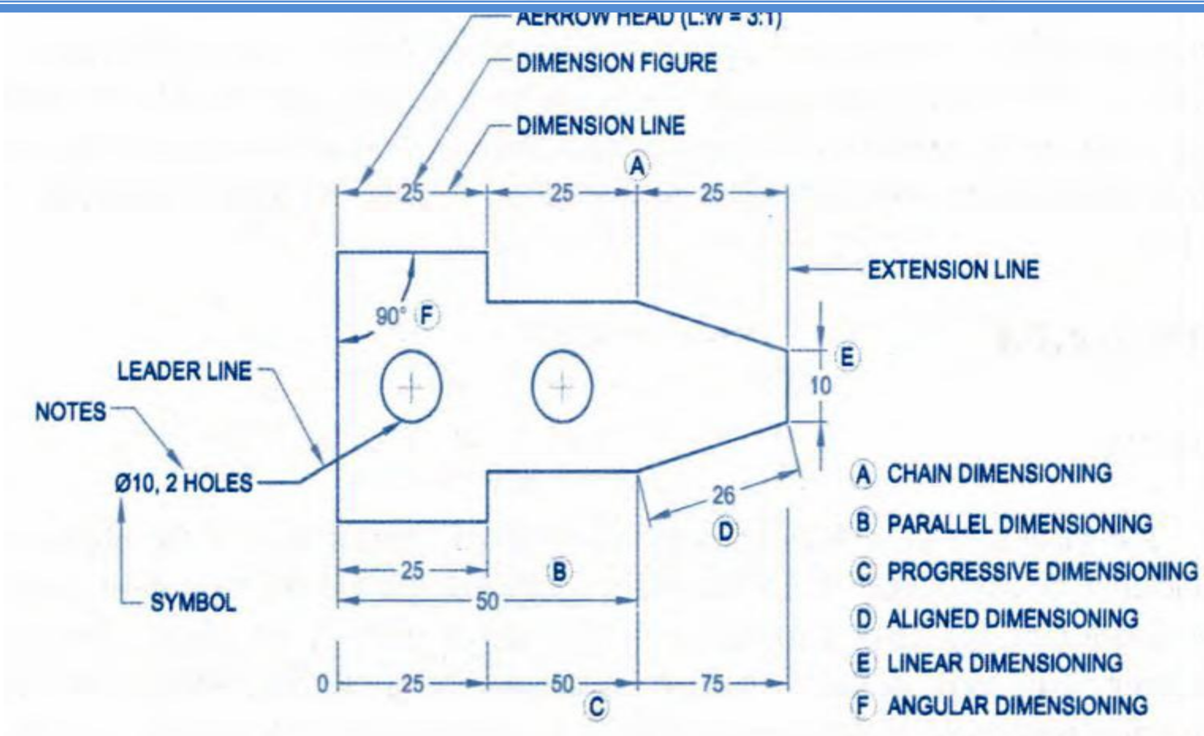




ALIGNEDDIMENSION

UNIDIRECTION

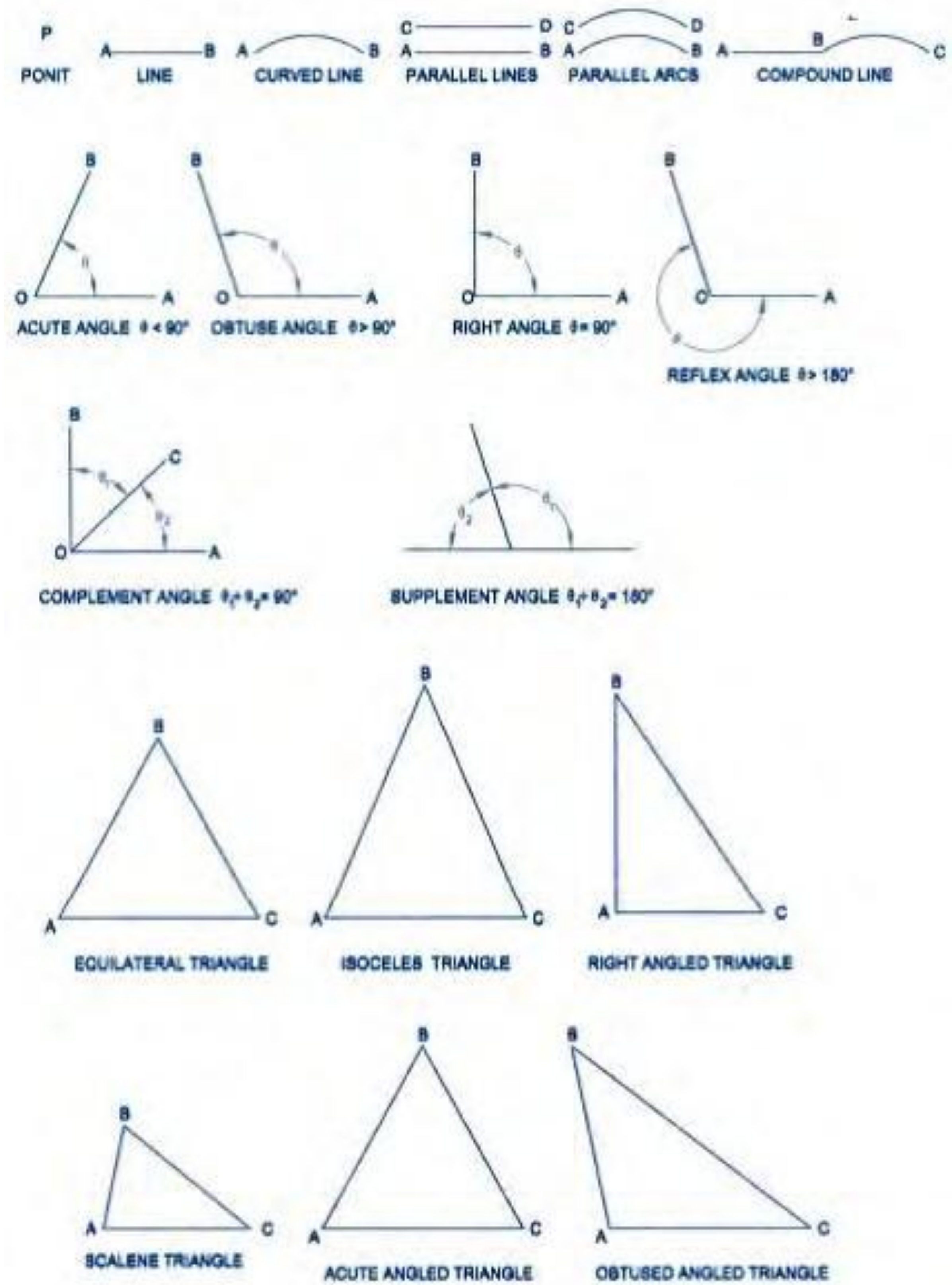
DIMENSION



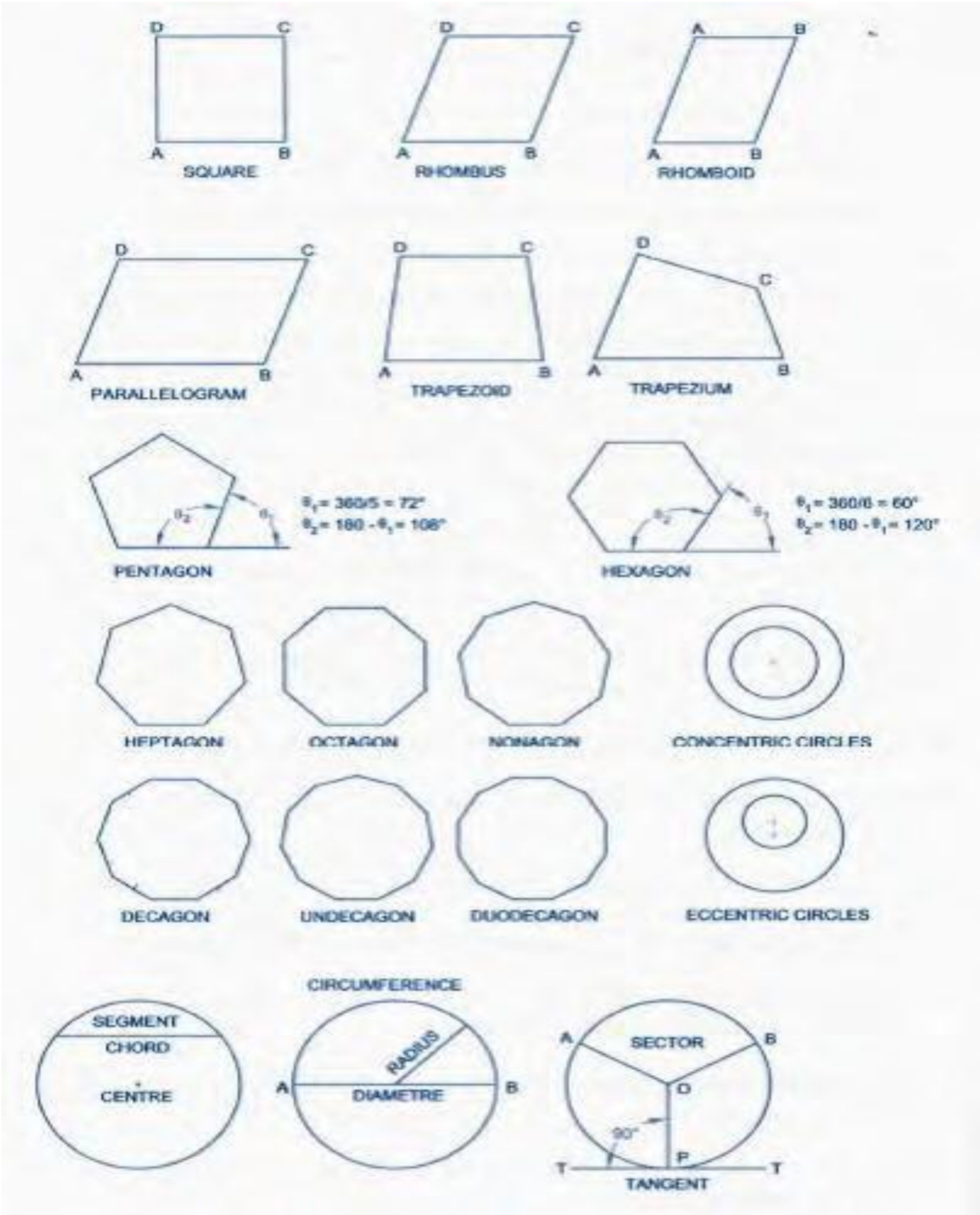
GENERALDIMENSION

GEOMETRICALCONSTRUCTIONS

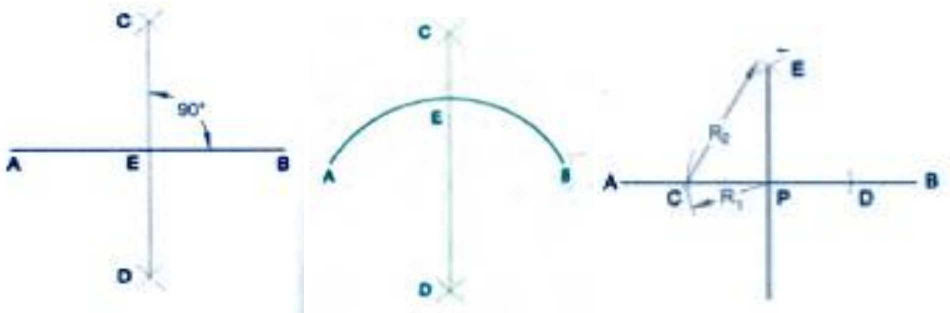
The constructionofplane figuressuchastriangle,circles,andpolygonsetc.,usedinplanegeometryis calledgeometricalconstructions.


P
PONIT
A B
LINE
A B
CURVED LINE
C D
A B
PARALLEL LINES
C D
A B
PARALLEL ARCS
A B C
COMPOUND LINE
ACUTE ANGLE θ < 90°
OBTUSE ANGLE θ > 90°
RIGHT ANGLE θ = 90°
REFLEX ANGLE θ > 180°
COMPLEMENT ANGLE θ1+ θ2= 90°
SUPPLEMENT ANGLE θ1+ θ2= 180°
EQUILATERAL TRIANGLE
ISOCELES TRIANGLE
RIGHT ANGLED TRIANGLE
SCALENE TRIANGLE
ACUTE ANGLED TRIANGLE
OBTUSED ANGLED TRIANGLE

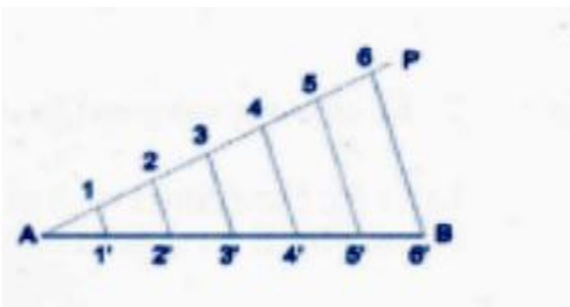
(i) APentagon is thatwhichhasfive equalsides.
(ii) A hexagon is thatwhichhassix equalsides.
(iii) A heptagon is thatwhichhassevenequalsides.
(iv) Anoctagon is thatwhichhaseight equalsides.
(v) A nonagon is thatwhichhasnine equalsides.
(vi) Adecagonis thatwhichhas tenequal sides.
(vii) An UN decagonis that whichhas elevenequalsides.
(viii) decagonisthatwhich hastwelveequalsides.
(ix) A diagonalofapolygonis the line joininganytwo ofitsangularpoints.

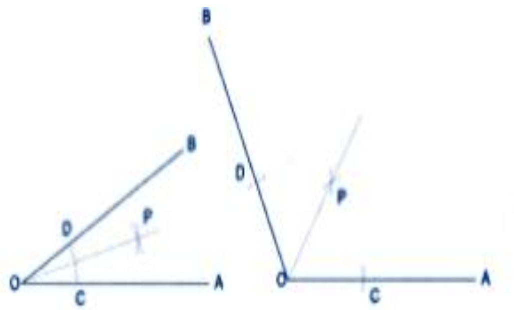

SQUARE
RHOMBUS
RHOMBOID
PARALLELOGRAM
TRAPEZOID
TRAPEZIUM
θ1 = 360/5 = 72°
θ2 = 180 - θ1 = 108°
PENTAGON
θ1 = 360/6 = 60°
θ2 = 180 - θ1 = 120°
HEXAGON
HEPTAGON
OCTAGON
NONAGON
CONCENTRIC CIRCLES
DECAGON
UNDECAGON
DUODECAGON
ECCENTRIC CIRCLES
SEGMENT
CHORD
CENTRE
CIRCUMFERENCE
RADIUS
DIAMETRE
SECTOR
90°
TANGENT

Bisecttheline, Bisectthe Arc, andDrawtheperpendicularline



To dividealineinto any numberofequal partandBisectanglebetween twolines





<u>SCALE</u>

Scale =Size of Drawing /ActualSize

Category	Scales		
Enlargement Scales	2 : 1	20 : 1	
	5 : 1	50 : 1	
	10 : 1		
Reduction Scales	1 : 2		1 : 200
	1 : 5		1 : 500
	1 : 10		1 : 1000
	1 : 20		1 : 2000
	1 : 50		1 : 5000
	1 : 100		1 : 1000
Full Scale	1 : 1		

UNITI

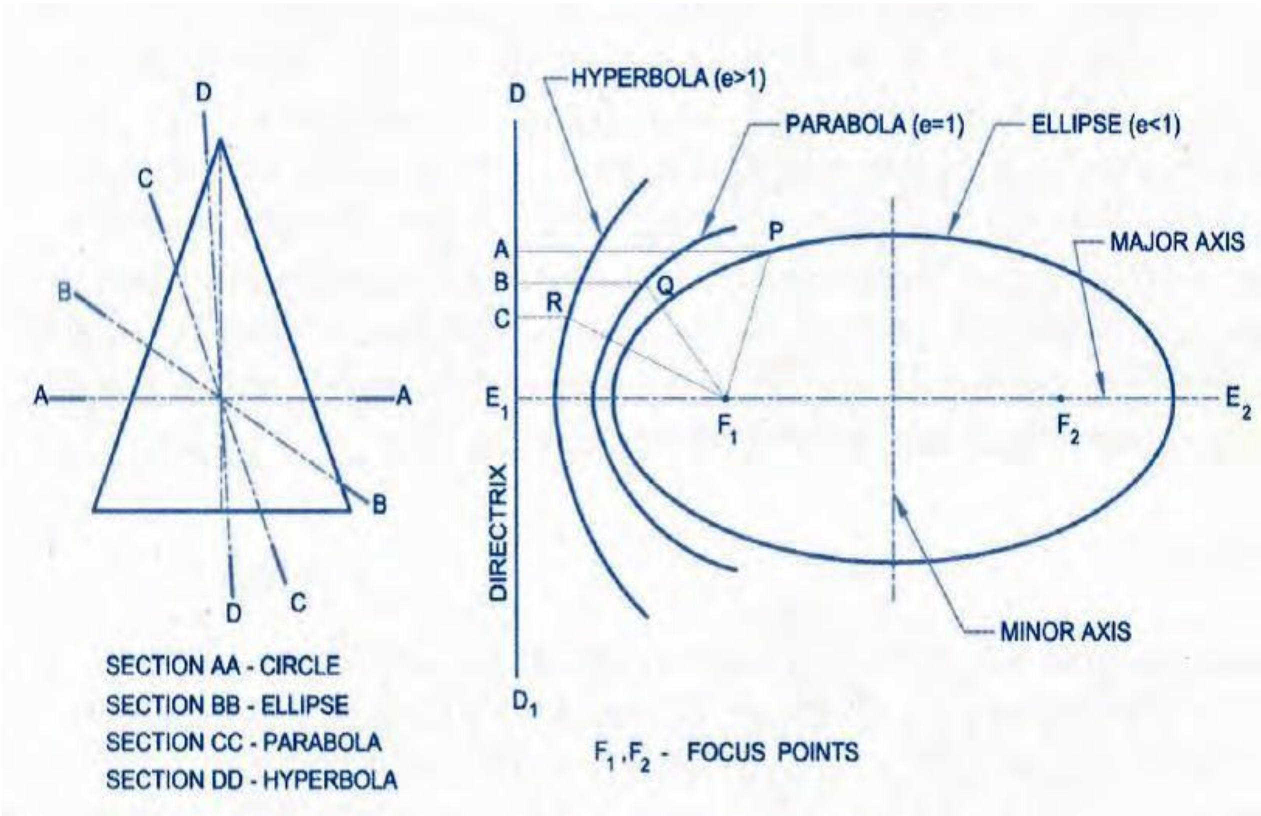
PLANECURVESANDINTRODUCTIONTOORTHOGRAPHIC PROJECTION(CurvesusedinEngineeringPractices)

ConstructionofEllipse,parabolaandhyperbolabyeccentricitymethodonly. ConstructionofCYCLOID,INVOLUTEOFSQUAREANDCIRCLE only.Drawingnormalandtangenttotheabovecurves.

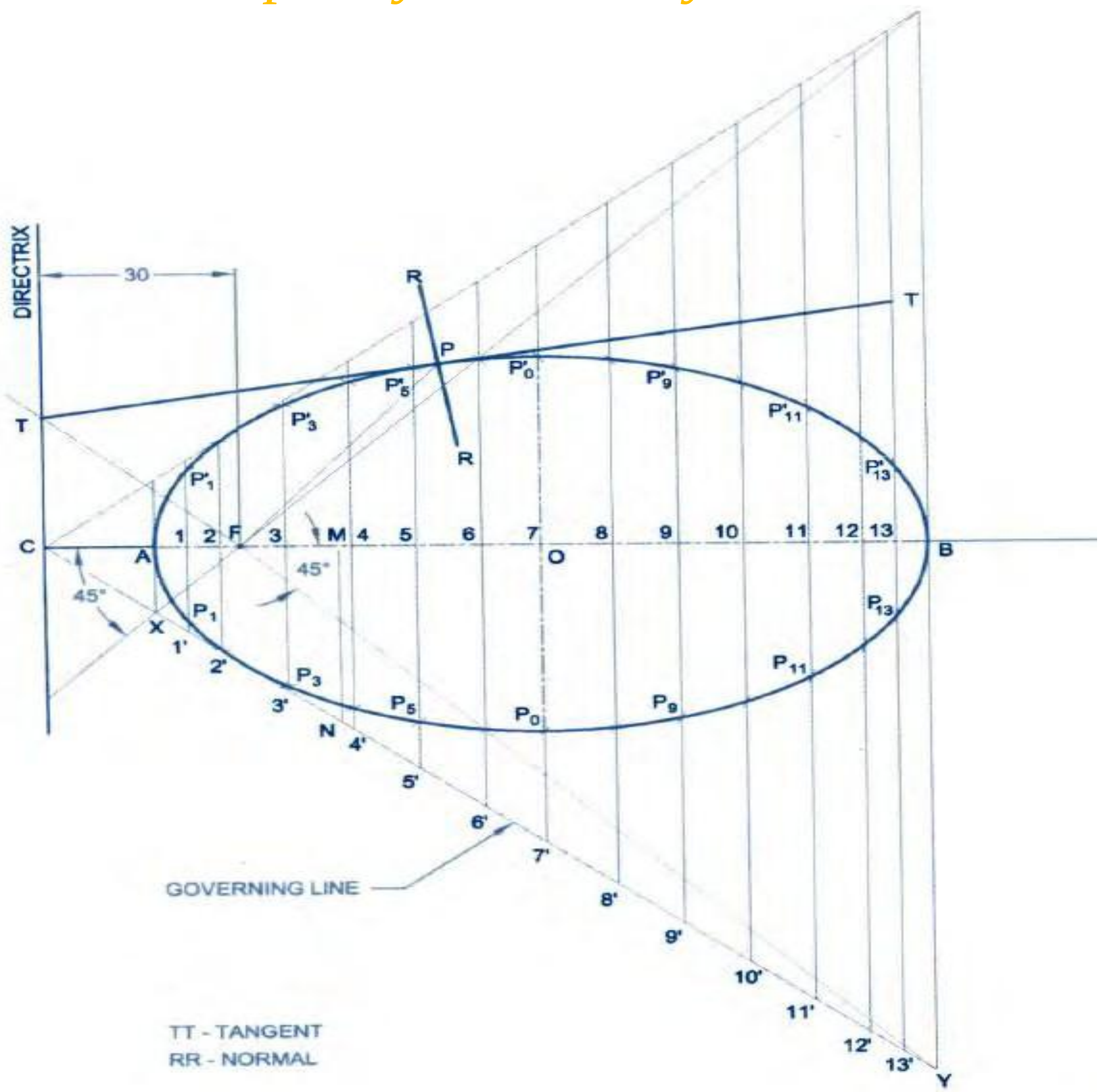
INTRODUCTION TOORTHOGRAPHIC PROJECTION

Principleof1stangleand3rdangleprojection.Projectionofpointssituatedinallthefourquadrants.Problemsinvolvingprojectionofpoints,projectionoftwopointssituatedindifferentquadrants.

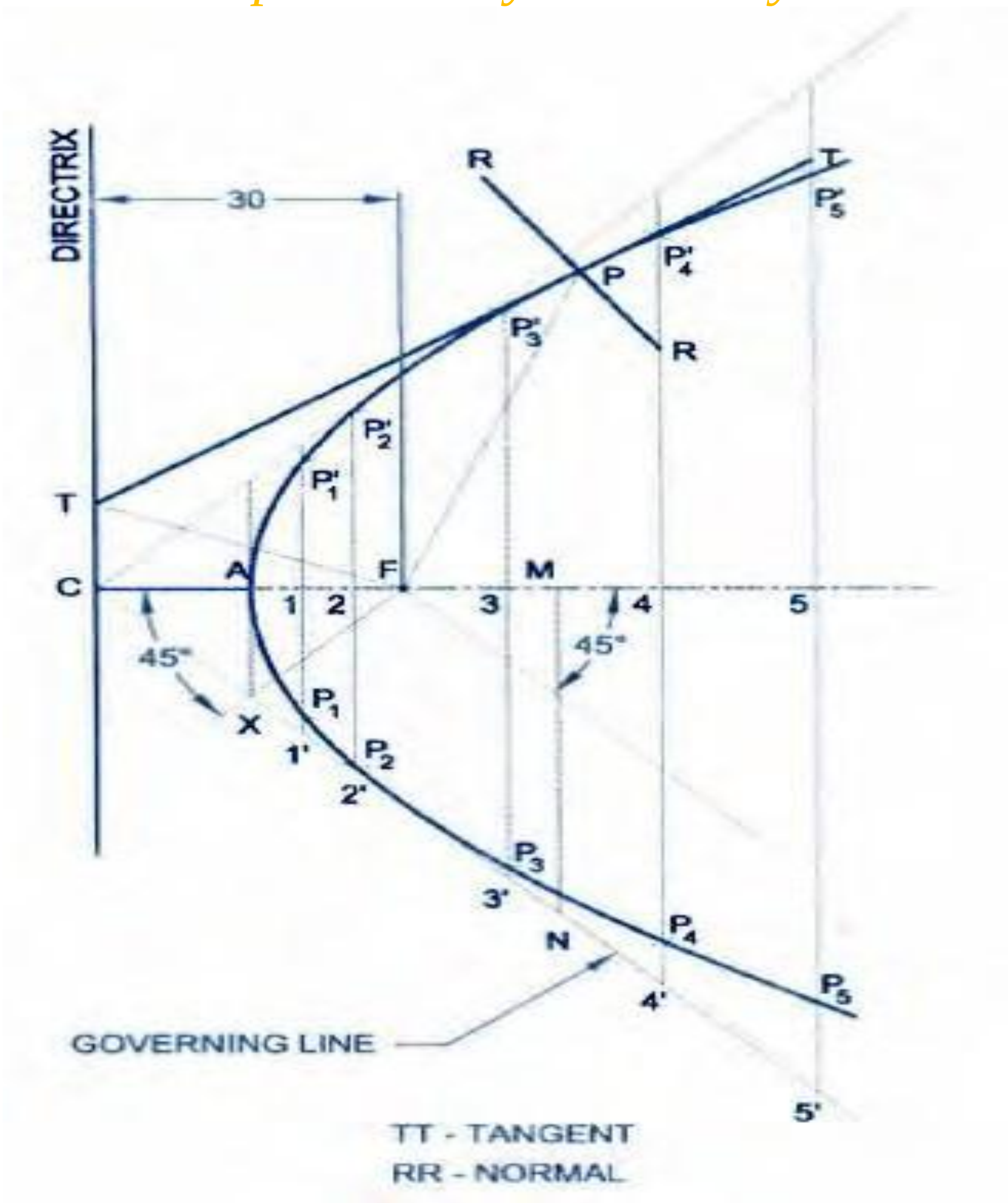
EngineeringCurves



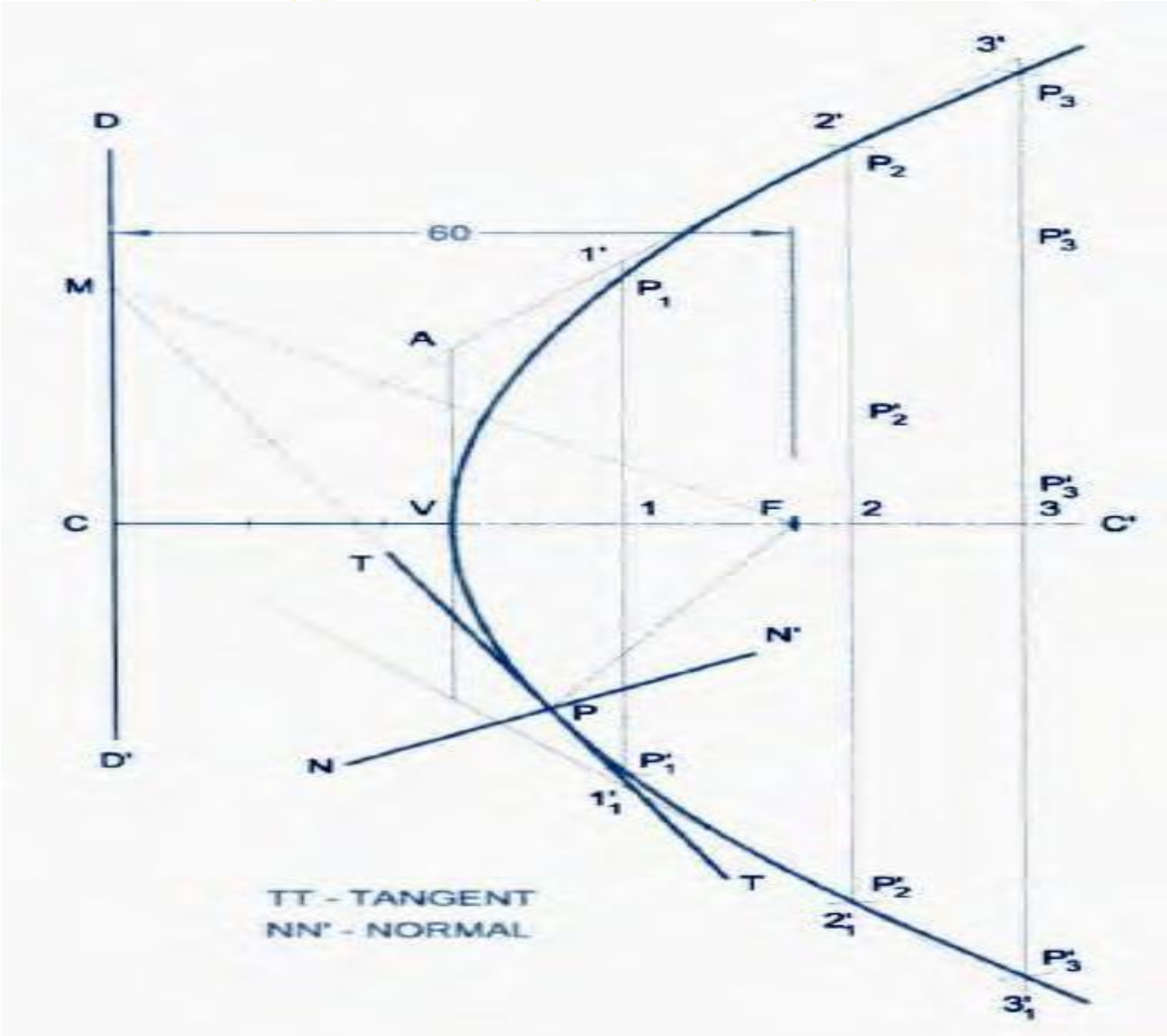
Constructanellipse byeccentricity



Constructaparabola byeccentricity



Constructahyperbolabyeccentricity

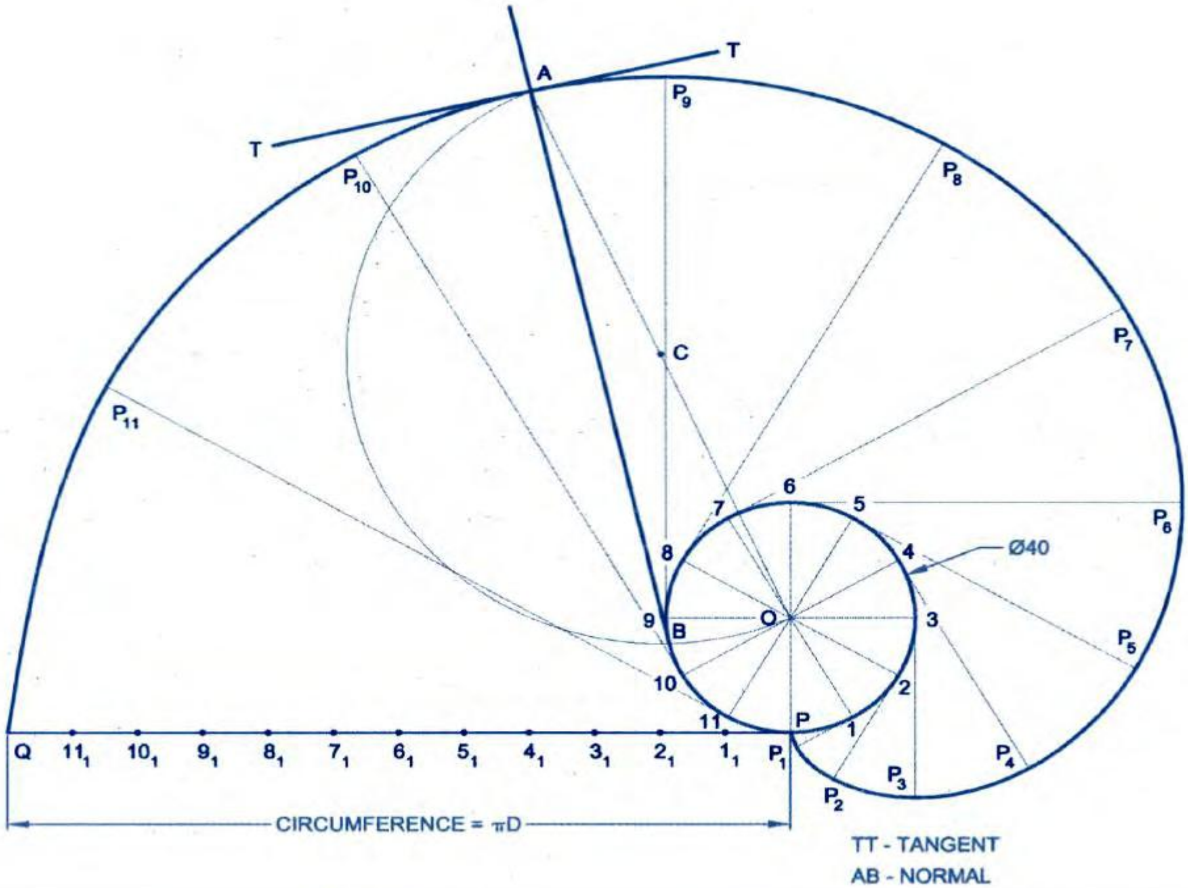


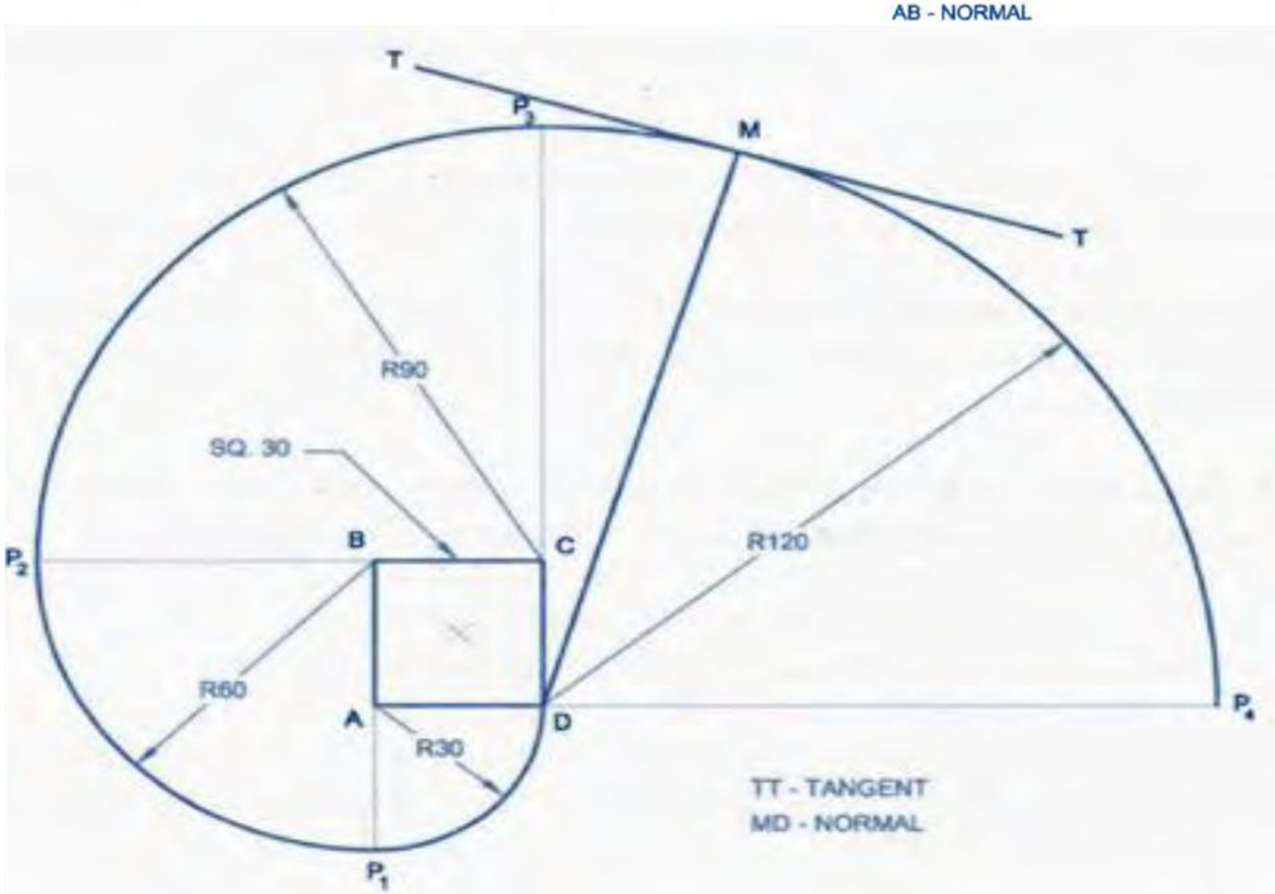
SPECIAL CURVES

INVOLUTE:

An involuteisthelocusofapointonastring, as thestringunwinds itselffromalineorpolygon,ora circle, keepingalwaysthestringtaut.

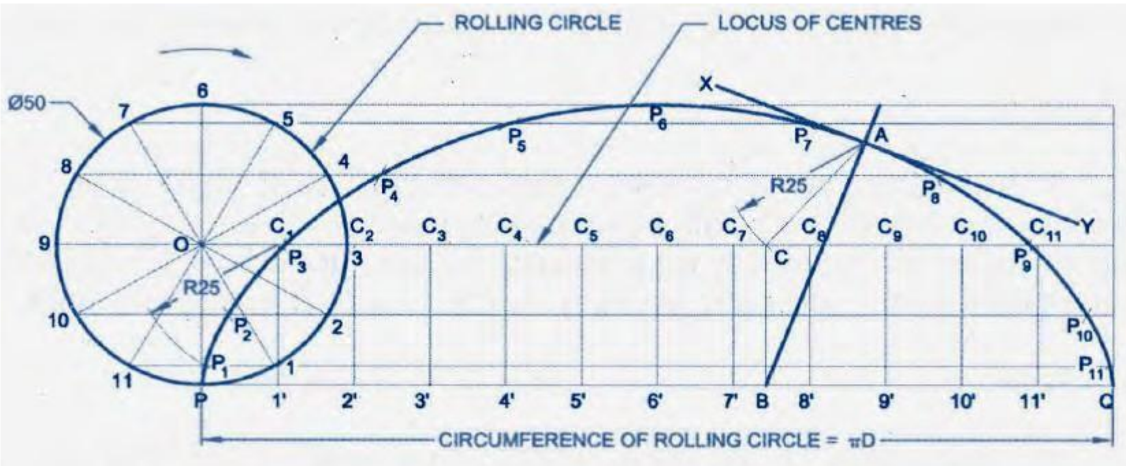
INVOLUTE OFA CIRCLE AND SQUARE





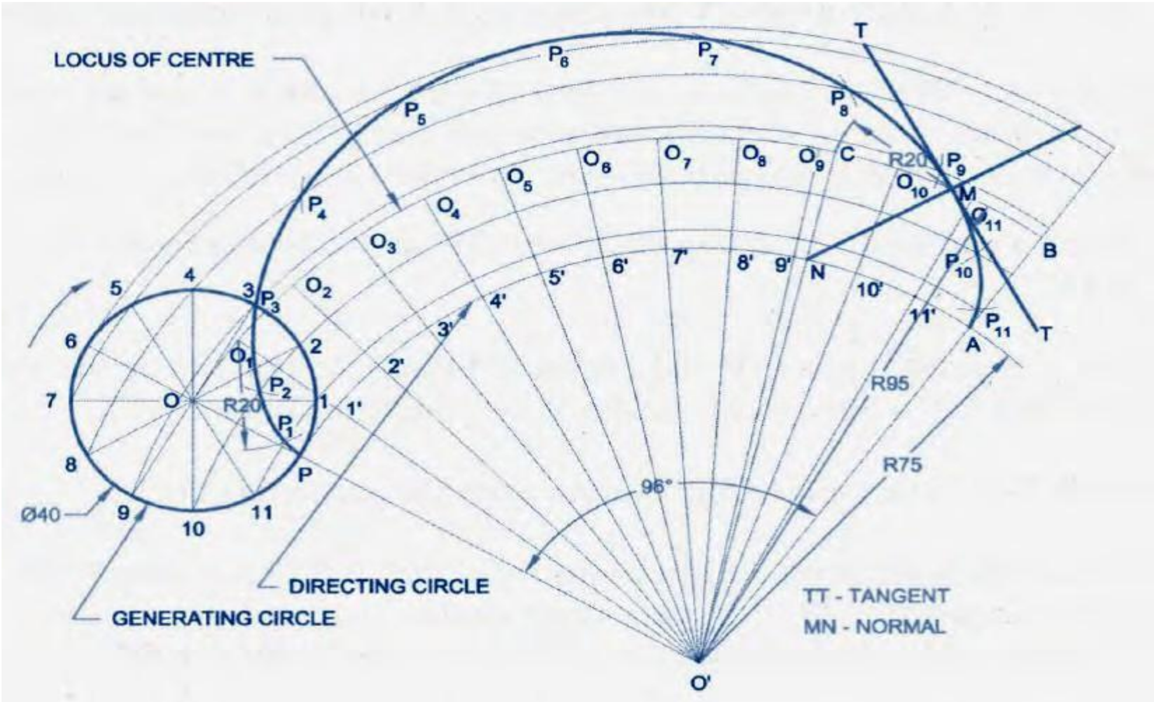
CYCLOIDAL:

Cycloid curvesareformedbyapointonthecircumstanceofacircle,rollinguponali neorananothercircle.Therollingcircleiscalled thegeneratingcircle.Thelineon whichthe generatingcirclerollsiscalledbaseline.Thecircleonwhichthegenerating circlerollsiscalleddirectingorbasecircle.Acycloidisacurvetracedbyap ointonthecircumferenceofacirclewhichrollswithoutslipping along a line



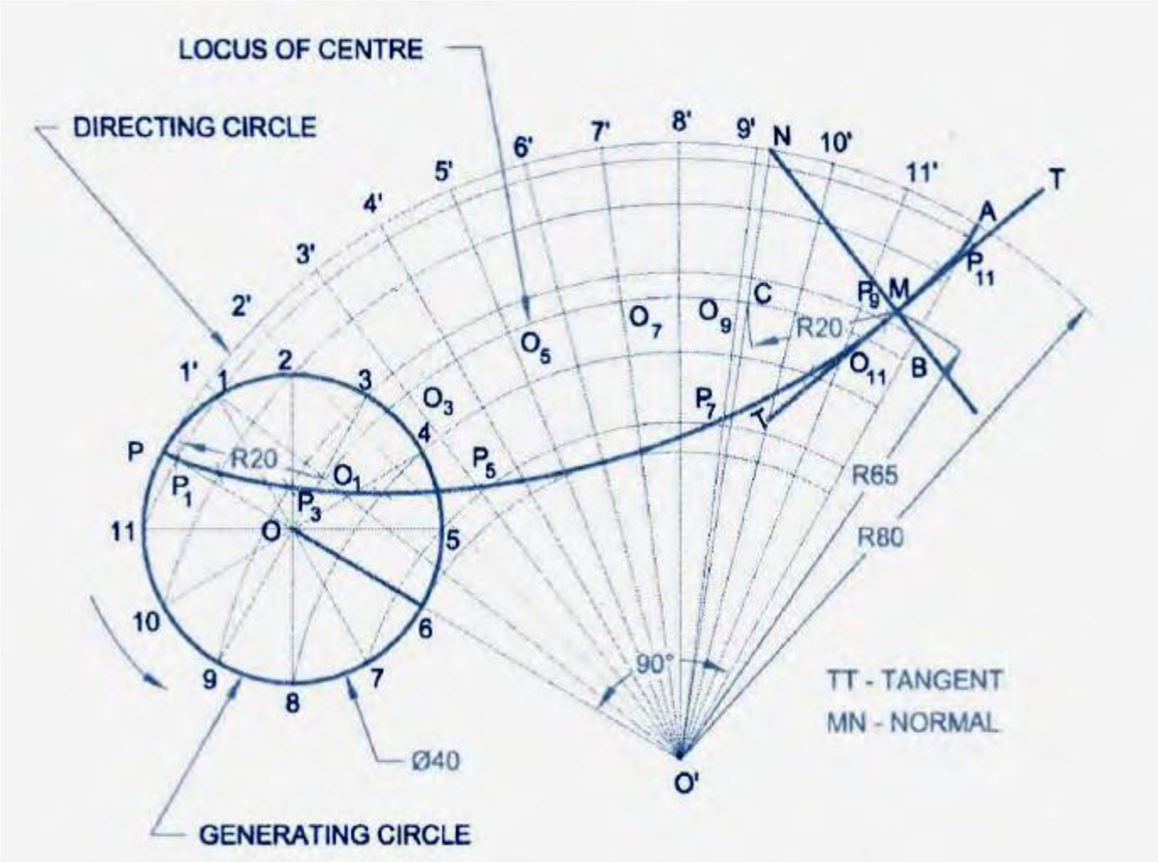
EPICYCLOID:

An epicycloidsis acurve tracedbyapoint onthecircumference ofacircle which Rolls withoutslippingonthe outsideofan another circle.


LOCUS OF CENTRE
DIRECTING CIRCLE
GENERATING CIRCLE
Ø40
R20
R95
R75
96°
TT - TANGENT
MN - NORMAL

HYPOCYCLOID:

A hypocycloidis acurve tracedbyapoint onthecircumference ofa circle when itrolls withoutslippingonthe insideofanother circle.

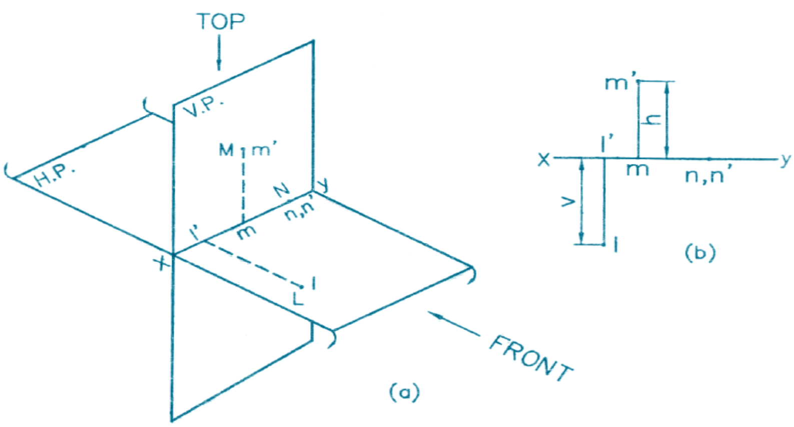


Projection ofPoints:

A point is simplyaspacelocation ofinfinitesimalsize. Itmayrepresent thecornerofanobject,the intersectionoftwo lines oradesignatedspotinspace. The projectionobtained on verticalplaneVPis calledtheelevationandonhorizontalplane**HP,**theplan.
The intersectionlineoftheverticalplane and thehorizontalplaneis known as groundlineorreferenceline.

Position ofpoints:

(i) Infrontofthe VPandabove the HP
(ii) Infrontofthe VPandintheHP
(iii) IntheVPand abovetheHP
(iv) Behindthe VPandabove theHP
(v) Behindthe VPandintheHP
(vi) Behindthe VPandbelowtheHP
(vii) IntheVPand belowtheHP
(viii) Infrontof the VPandbelow theHP
(ix) IntheVPandHP



GENERALPROCEDURETO DRAWPROJECTION OFPOINTS

1. Fromgiven data identifythequadrant
2. Draw theXY lineandprojection
3. Alongthisprojectormarkbydotsthedistancesofthegivenpointform theHPandVP,onthecorrespondingsideoftheXYline,dependingup onthequadrantinwhichthepointlies,tolocate thefrontviewandthe top view,respectively.
4. Makethefrontviewandthetopviewboldandrubofftheunwantedlen gth oftheprojector tocomplete thesolution.

Important Questions

1. Drawtheinvolutesof a circleof diameter 40mmanddrawthetangentandthenormal totheinvolutes atanypoints onthecurve.
2. Drawthefront, top,and sideviewsof theobject shown below.
3. Drawthecoincure,ifthedistanceoffocusfromthedirectoryis70mmandtheeccentricityis¾.Alsodrawatangentandanormalatanypointonthecurve.
4. Acircleof50mmdiameterrollsasahorizontallinefor¾ofarevolutionclockwise.Drawthepathtracedbypoint Ponthecircumferenceofthecircle.Alsodrawatangentand normal at anypointon thecure
5. Draw a hyperbola whenthe distance betweenitsfocusanddirectrixis50mmandeccentricityis3/2.Alsodrawthetangentandnormalatapoint23mmfromthedirectrix.
6. Thefocusofa conic is50mmfrontthedirectory.Draw the locus ofapointPmovinginsuchawaythatitsdistancefromthedirectrixisequaltoitsdistancefromthefocus.Namethecure.Drawatangenttothecurveatapoint60mmfromthedirectrix.
7. Drawtheinvolutesofacircleofdiameter40mmanddrawthetangentandthenormal totheinvolutesatanypointon thecure.

UNIT II

PROJECTION OFSTRAIGHTLINESAND PLANES[FIRSTANGLE]

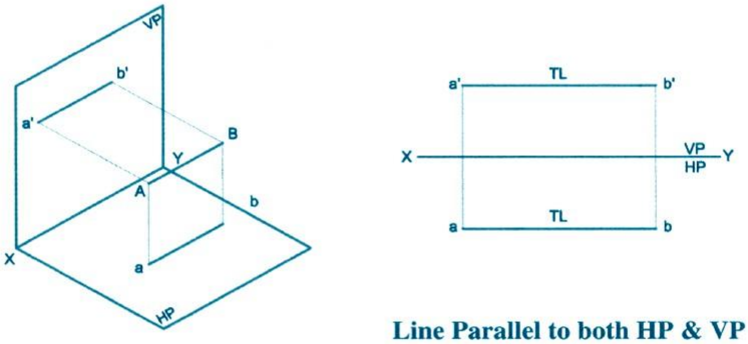
Projectionofstraightlines,situated infirstquadrantonly,inclined to bothhorizontaland vertical planes– LOCATION OF TRACESONLY.Determinationof truelengthand trueinclinationsof straightlines fromtheprojections (not involvingtraces)Projectionofplane surfaces likerectangle,square, pentagon,hexagon,circle- surfacesinclined to one referenceplane.

UNIT-II

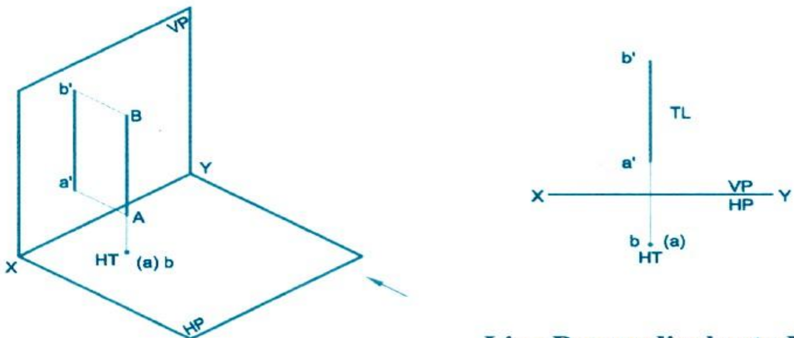
PROJECTION OF LINESANDPLANES

A*straight*lineistheshortestdistancebetweentwopoints.Projectionsoftheendsofanylinecanbedrawnusingtheprinciplesdeveloped forprojectionsof points.Topviewsofthetwoendpointsofaline,whenjoined,givethetopviewoftheline.Frontviewsofthetwoendpointsoftheline,whenjoined,give thefrontview oftheline.BoththeseProjectionsarestraightlines.

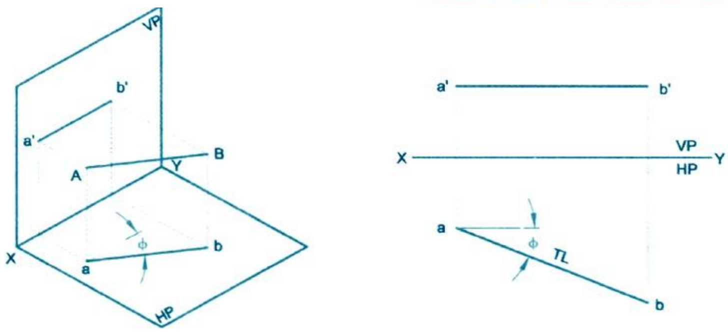
Projection of straight lines



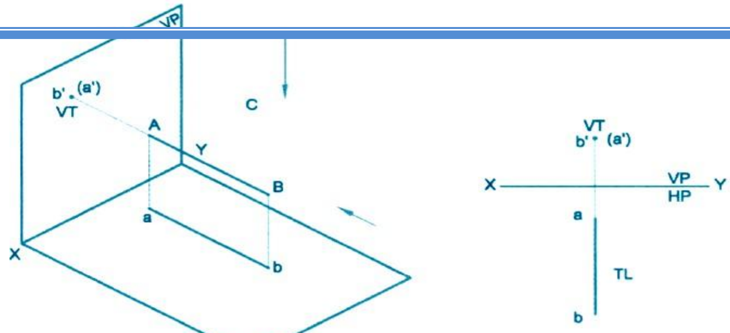
Line Parallel to both HP & VP



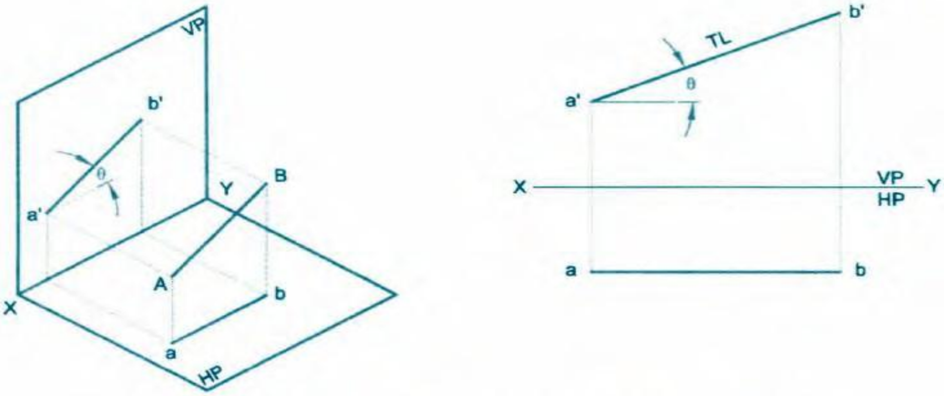
Line Perpendicular to HP



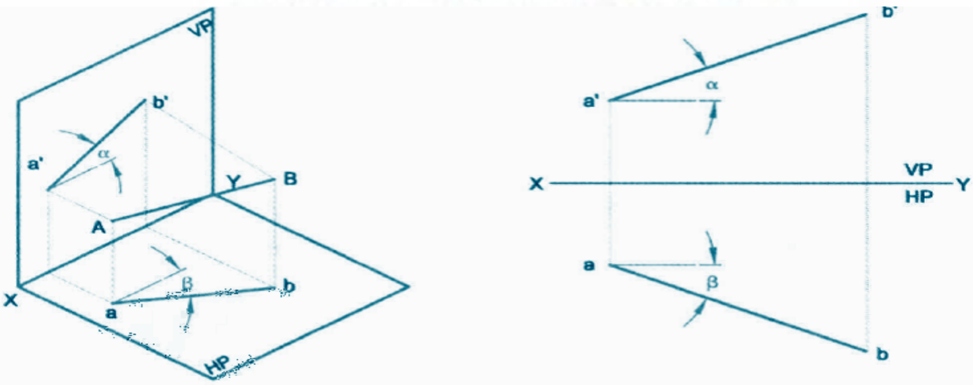
Line Inclined to VP & Parallel to HP



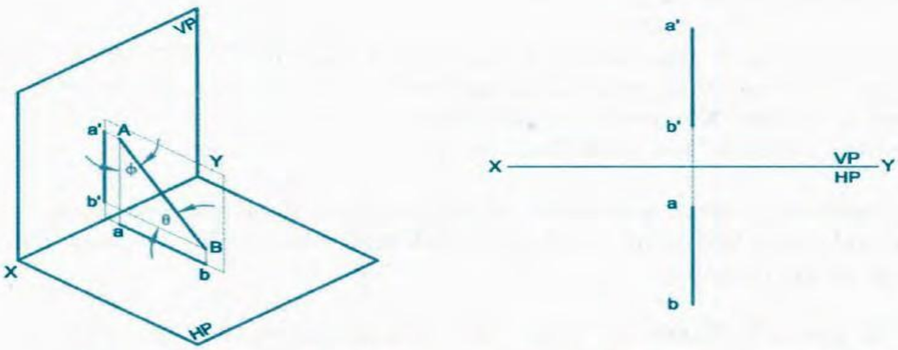
Line Perpendicular to VP



Line Inclined to HP & Parallel to VP



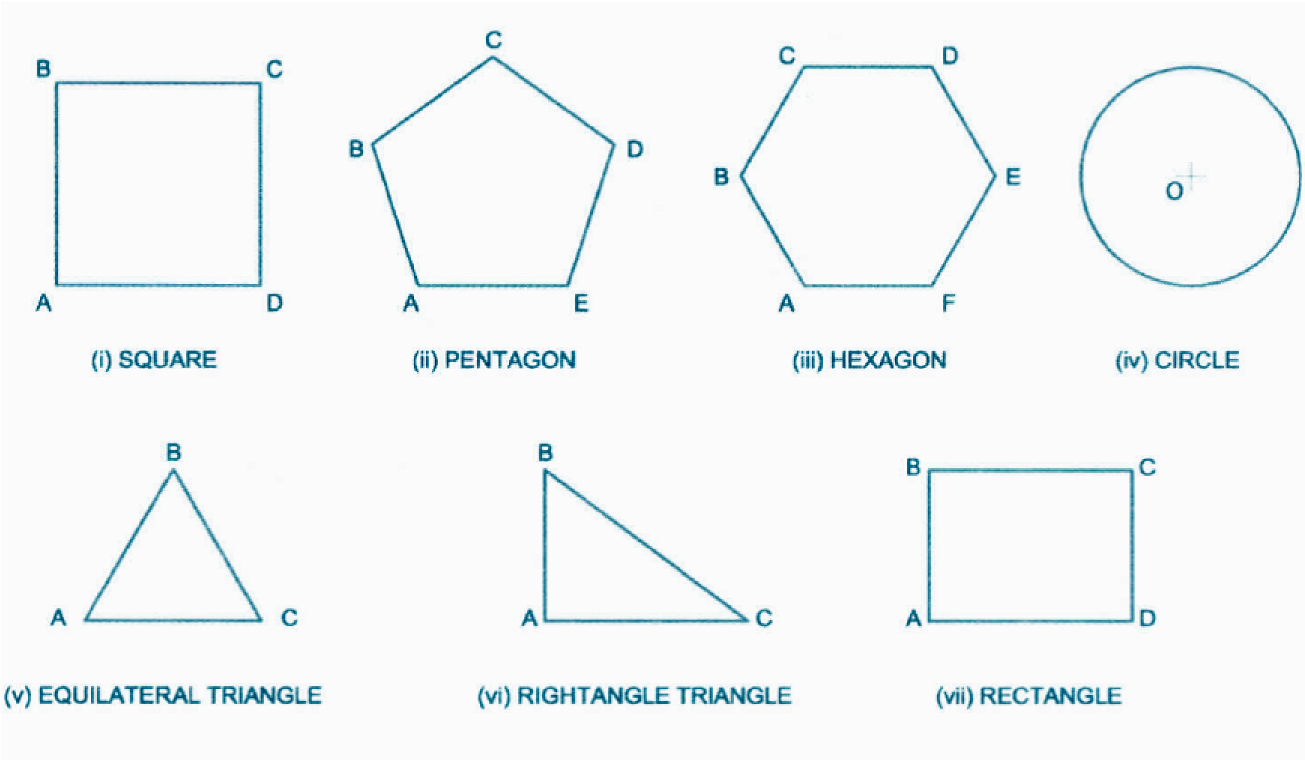
Line Inclined to both HP & VP



Line contained by a plane perpendicular to both HP & VP

ProjectionofPlaneSurfaces:

A plane isatwodimensionalobjecthavinglength and breadthonly.Itsthicknessis always neglected;variousshapes ofplanefigures areconsideredsuchassquare,rectangle,circle, pentagon,hexagon, etc.



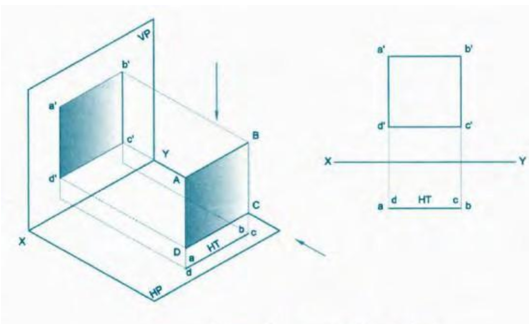
TYPESOF PLANES:

1. Perpendicularplaneswhichhavetheirsurfaceperpendicularto anyoneofthereferenceplanesandparallelorinclined to theotherreferenceplane.
2. Obliqueplaneswhichhavetheirsurfaceinclinedtoboththerefere nce planes.

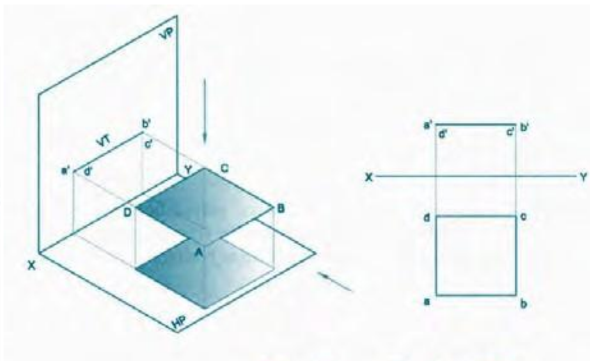
TRACE OFPLANE:

The traceofa plane is theline ofintersectionormeeting oftheplane surface withthe referenceplane; ifnecessarytheplanesurface is extendedtointersectthereferenceplane. Theintersectionline of the planesurface with**HP** iscalledthe**Horizontal Trace**(HT)and that of**VP**is calledthe**VerticalTrace** (VT).

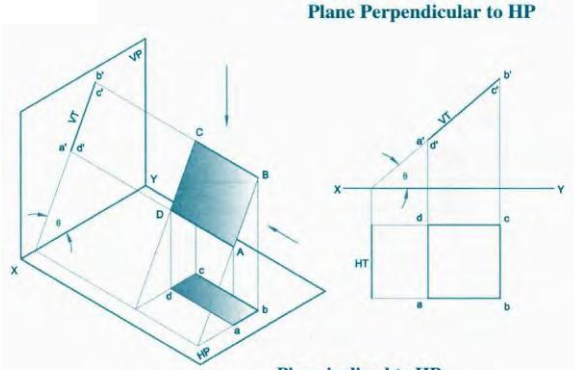
A plane figureispositionedwithreference tothereferenceplanesbyreferring its surface inthe followingpossiblepositions.



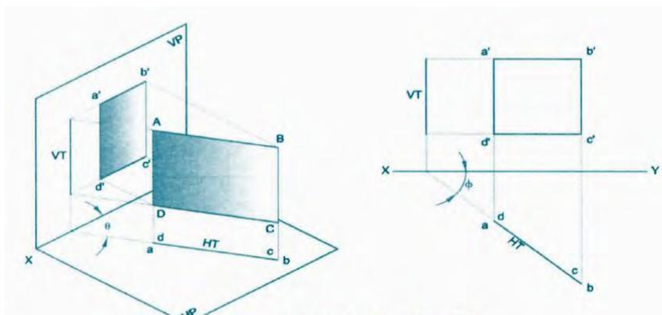
Plane Perpendicular to HP



Plane Perpendicular to VP

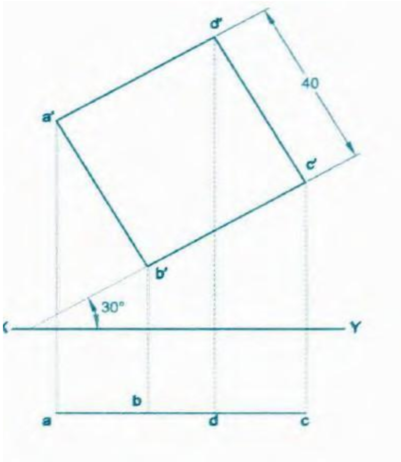


Plane inclined to HP

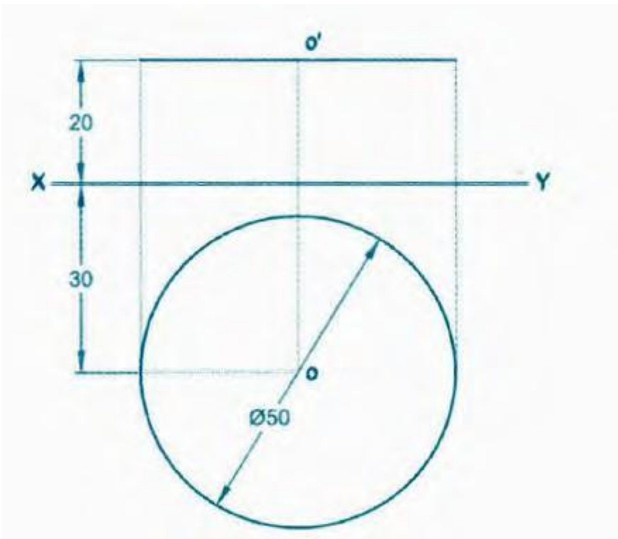


Plane inclined to VP

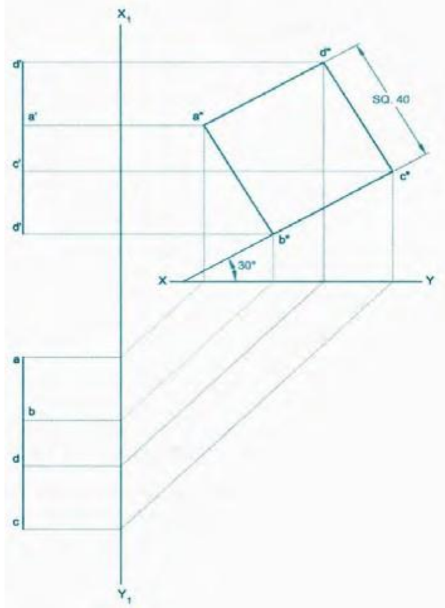
1. surfaceoftheplanekeptperpendicular to**HP**andparallel to **VP**



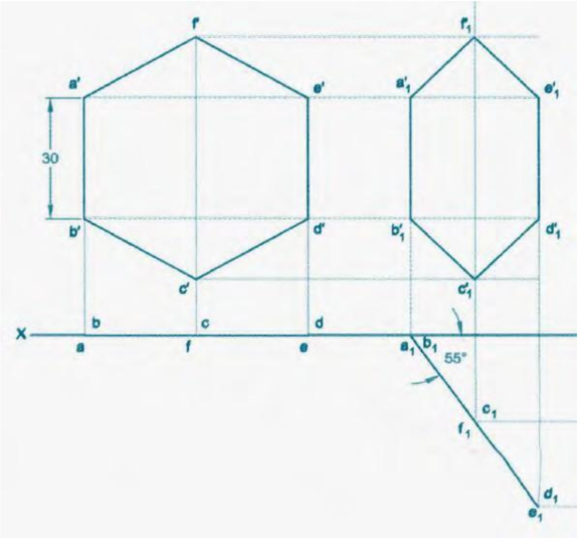
2. surfaceoftheplanekeptperpendicular to**VP** andparallel to **HP**



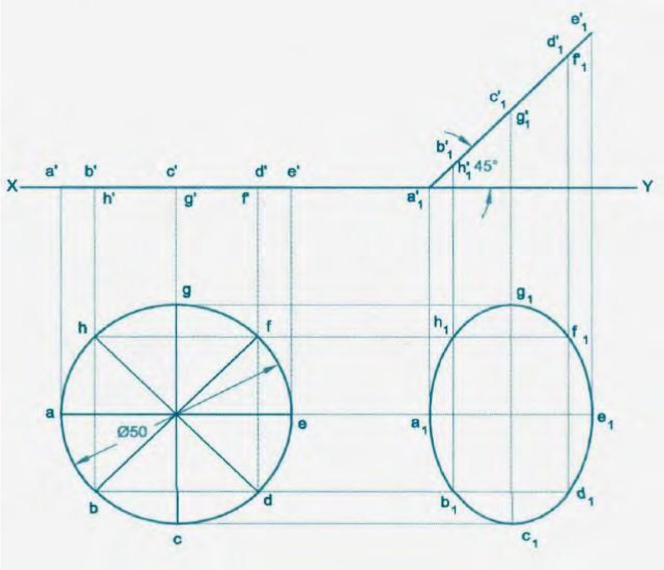
3. surfaceoftheplanekeptperpendicular toboth**HP**and**VP**


X1
d'
a'
c'
d'
a"
d"
SQ. 40
c"
b"
30°
X
Y
a
b
d
c
Y1

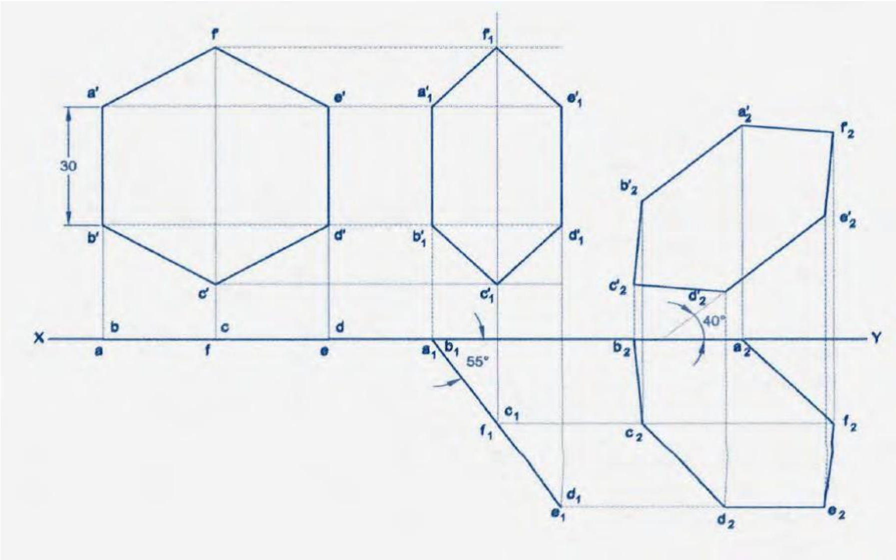
4. surfaceoftheplanekeptperpendicular to**HP**and inclinedto **VP**



5. surfaceoftheplanekeptperpendicular to**VP**and inclinedto **HP**



6. surfaceoftheplanekeptinclined to**HP**and**VP**



Important Questions

1. AlinePS65mmhasitsendp,15mmabovethehpand15mminfrontoftheVP.It is inclinedat 55^{o}tothehpand35® to theVP.Drawitsprojections.
2. Apentagonofsides30mmrestsonthegroundononeofitscornerswiththesidescontainingthecornersbeingequallyinclinedtotheground.Thesideoppositetothecorneronwhichitrestsisinclinedat30^{o}totheVPandisparalleltothehp.Thesurfaceofthepentagonmakes50^{o}withtheground.Drawthetop andfrontviews ofthepentagon.
3. AlineCD,inclinedat25®totheHP,measures80mm intopview.TheendCisinthefirstquadrantand25mmand15mmfromtheHPandtheVPrespectively.TheendDisatequaldistancefromthebooththereferenceplanes.Drawtheprojections,finetruelengthandtrueinclinationwiththeVP.
4. AstraightlineSThasitsendS,10mminfrontoftheVPandnearertoit.Themid-pointMlineis50mminfrontoftheVPand40mmaboveHP.Thefrontandtopviewmeasure90mmand120mmrespectively.Drawtheprojectionoftheline.Also findits truelengthandtrueinclinationswiththeHPandVP.
5. Aregularpentagonof30mmside,isrestingononeofitsedgesonHPwhichisinclinedat45®toVP.Itssurfaceisinclinedat30®toHP.Drawitsprojections.
6. AlinePQhasitsendP,10mmabovetheHPand20mminfrontoftheVP.TheendQis85mminfrontoftheVP.Thefrontviewofthelinemeasures75mm.thedistancebetweentheendprojectorsis50mm.drawtheprojectionsof thelineand find itstruelengthand itstrueinclinationswiththeVPandhp.

7. DrawtheprojectionsofacircleofΤ70mmdiameterrestingontheH.PonapointAofthe circumference.Theplaneisinclinedtothe HPsuchthatthetopviewofitisanellipseofminoraxis40mm.thetopviewofthediameter,throughthepointAismakinganangleof45®withtheV.P.determinetheinclinationof the plane with theHP
8. Theprojectionsofalinemeasure80mminthetopviewand70mminthefrontview.Themidpointofthelineis45mminfrontofVPand35mmaboveHP. oneend is 10mminfront of VP andnearer toit. Theotherend is nearertoHP.Drawtheprojections oftheline.Find thetruelengthand trueinclinations.
9. Drawtheprojectionofacircleof70mmdiameterrestingontheH.P.onapointAofthecircumference.Theplaneisinclinedtothe HPsuchthatthetopviewofitisanellipseofminoraxis40mm.thetopviewofthediameterthroughthepointAismakinganangleof45withtheV.P.determinetheinclination ofthe plane with theHP.
10. Apentagonofside30mmrestsonthegroundononeofitscornerswiththesidescontainingthecornerbeingequallyinclinedtotheground.Thesideoppositetothecorneronwhichitrestsisinclinedat30®totheVPandisparalleltotheHP.Thesurfaceofthepentagonmakes50®withtheground.Drawthetop andfrontviews ofthepentagon.
11. AlinePF,65mmhas itsend P, 15mmabovetheHPand15mminfront oftheVP.Itis inclinedat55®to theVP.Drawits projections.

UNITIII

PROJECTIONOFSOLIDSANDSECTIONOFSOLIDS

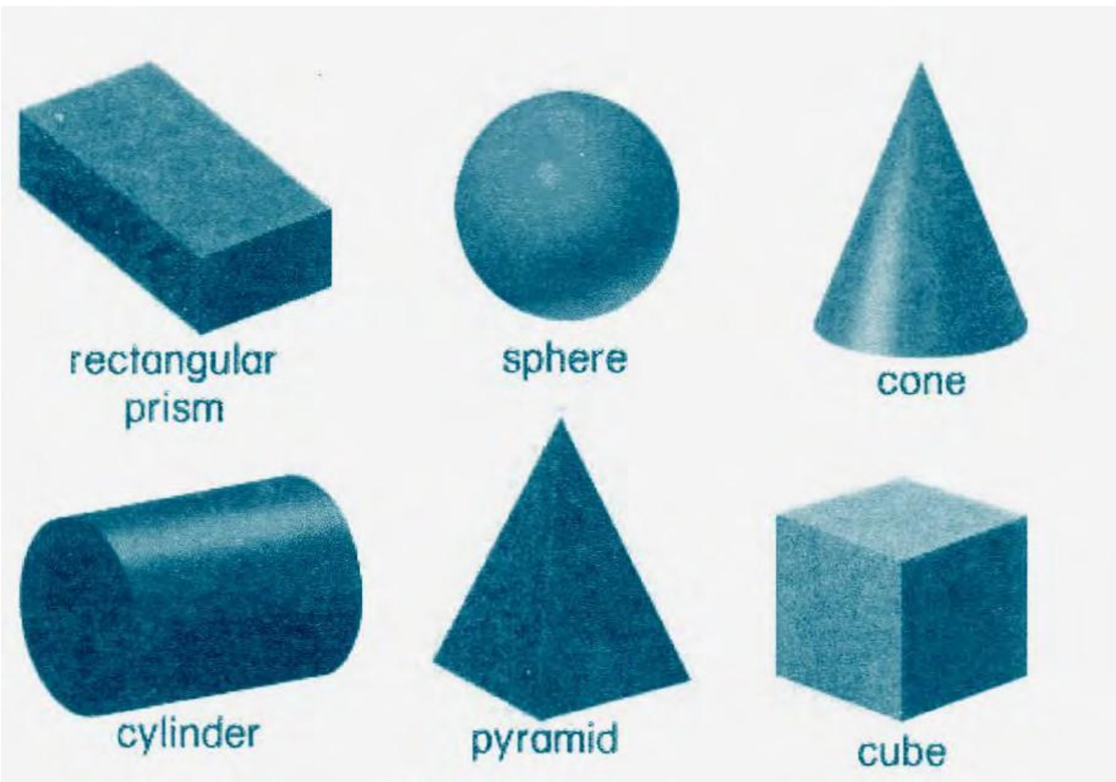
Projectionsofprism,pyramid,coneandcylinder,axisinclinedtooneplanebychang eofpositionmethod.Sectionofabovesolidsinsimpleverticalposition(axisperpen diculartoHPalone)byplaneseitherinclinedtoHPorVPalone-Trueshapeofsection.

UNIT-III

PROJECTIONOFSOLIDSANDSECTIONOFSOLIDS

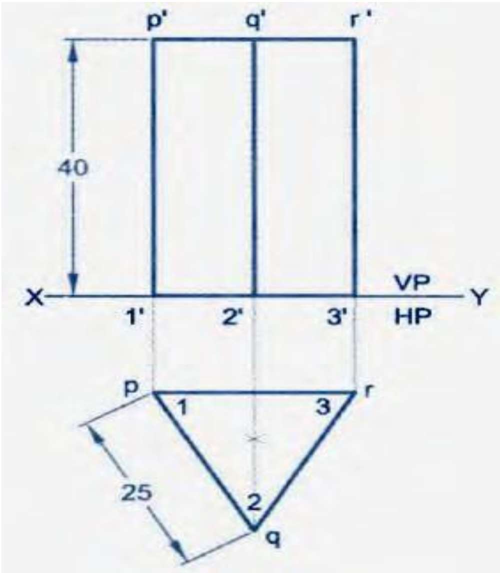
ProjectionofSolids:

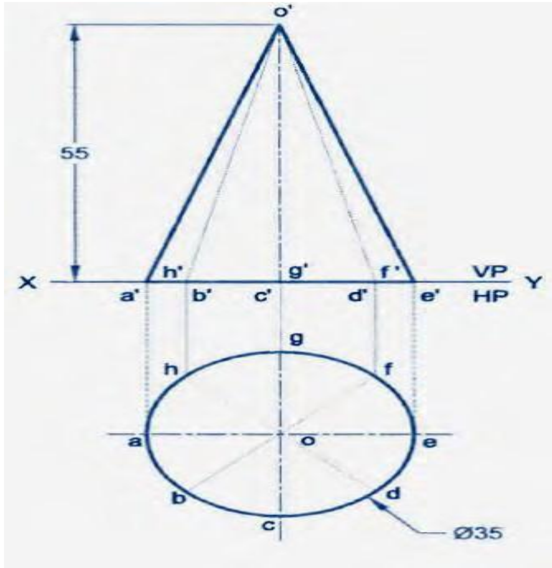
A solid isa threedimensional objecthavinglength,breadthandthickness.It is Completelyboundedbyasurfaceorsurfaces,whichmaybecurvedorplane. Theshapeofasolidisdescribedorthographicallybydrawingitstwoorthographic projections, usually, onthe twoprincipalplanesofprojection i.e.,**HP** andVP.

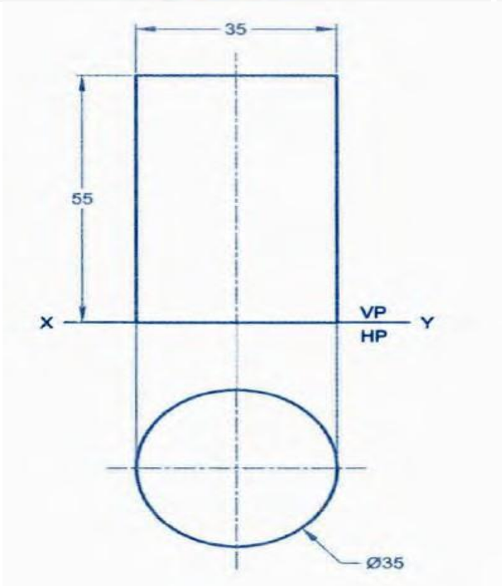


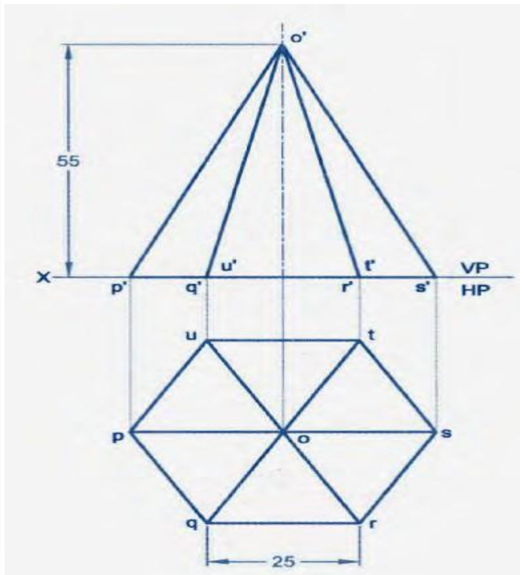
Thefollowingarethedifferentpositions whichtheaxis ofasolidcantakewithrespectto the referenceplanes:

1. Axis perpendicular to**HP**andparallel toVP.(CONEANDPYRAMID)

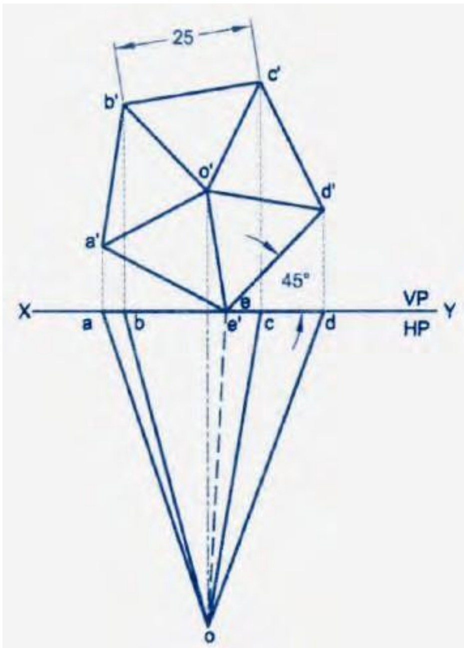


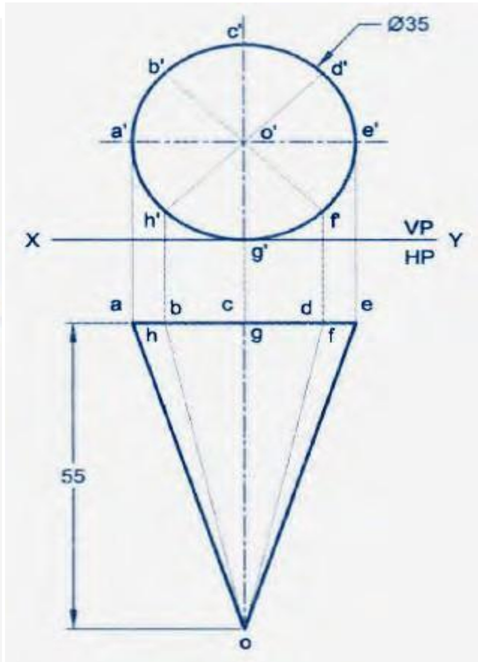


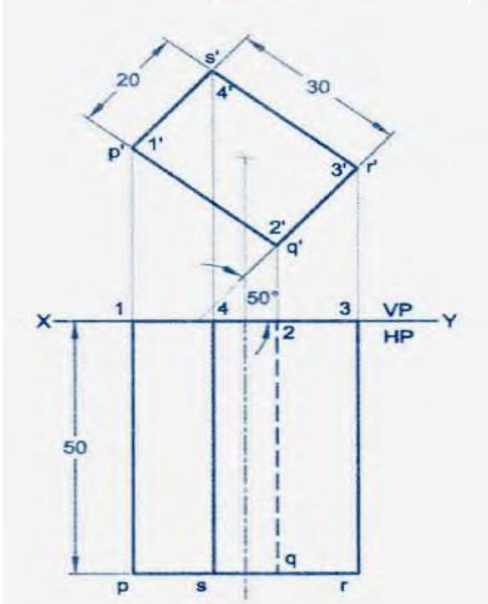




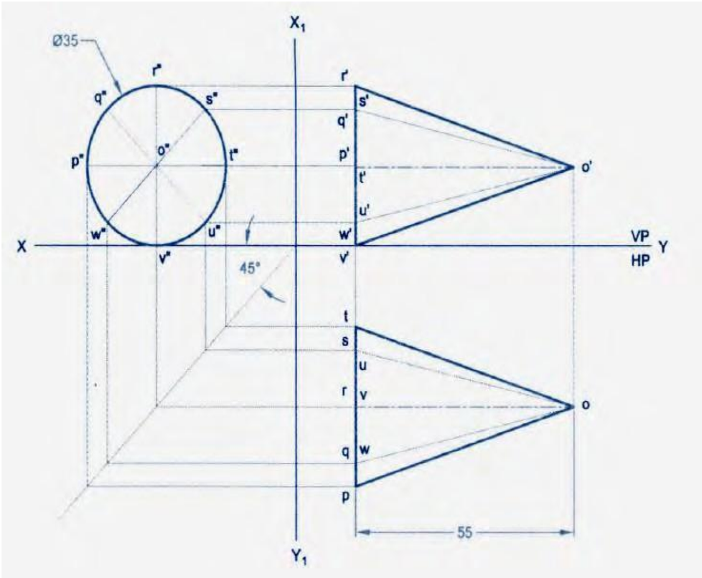
2. Axis perpendicular to VP andparallel toHP
(PYRAMID, CONE,PRISM)

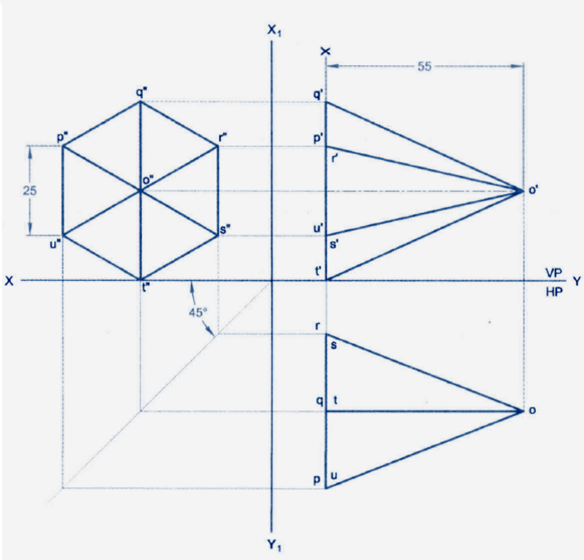




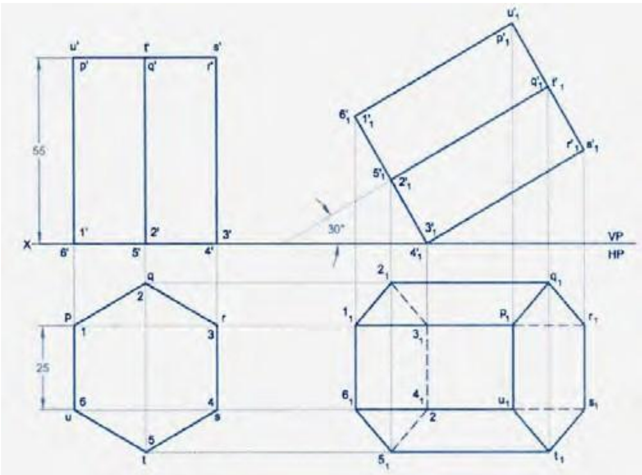


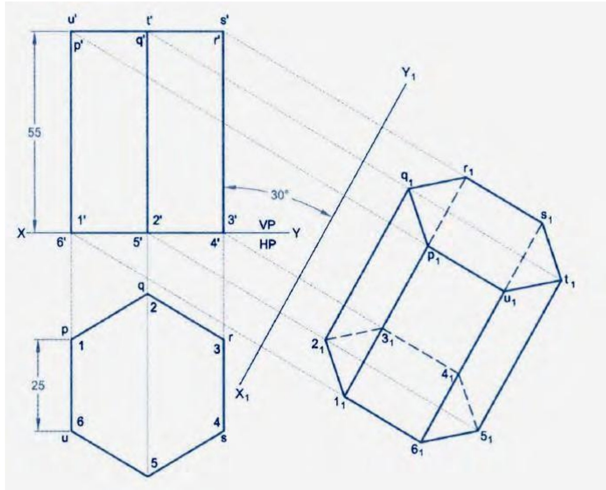
3. Axis paralleltobothHP andVP,i.e., axisperpendicular toaprofileplane.





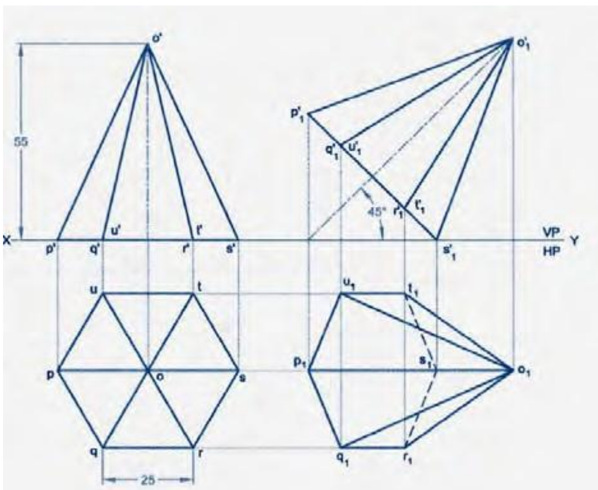
4. Axis inclined to **HP**andparallelto**VP.**

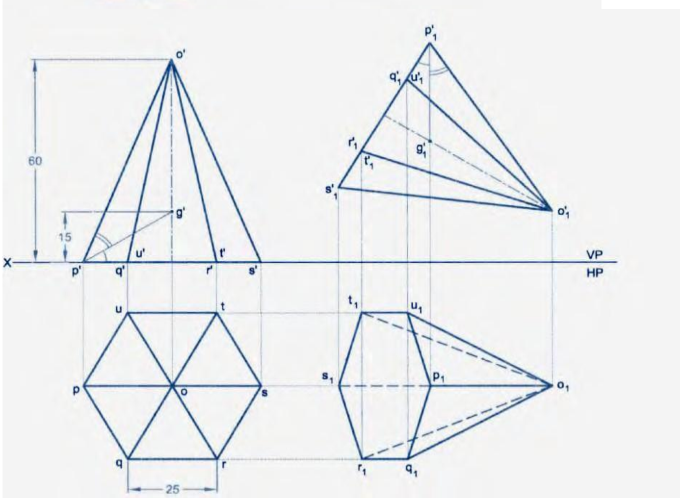




`

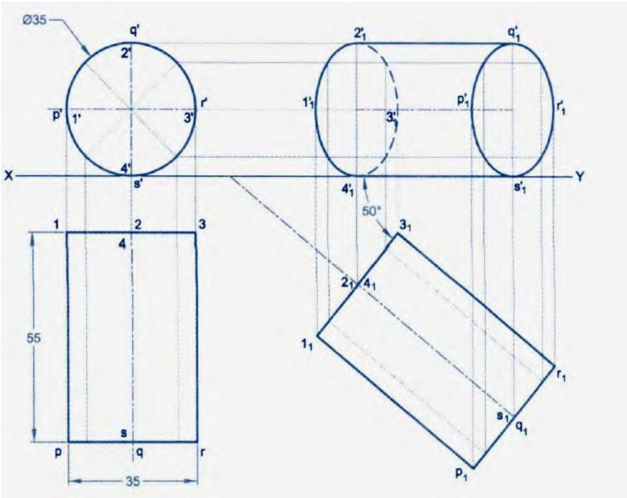
(Auxiliaryprojectionmethod)

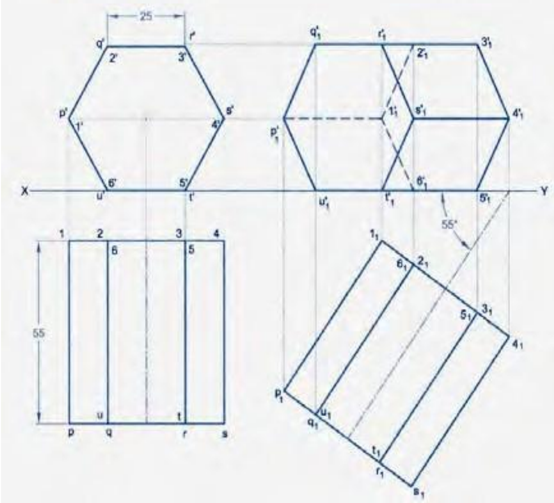


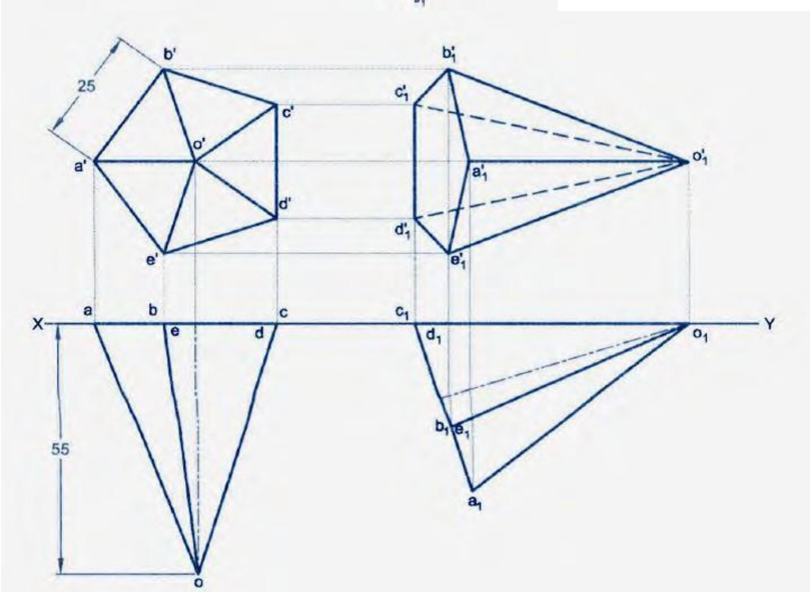


(freelysuspeded method)

5. Axis inclined to**VP** andparallel to**HP.**







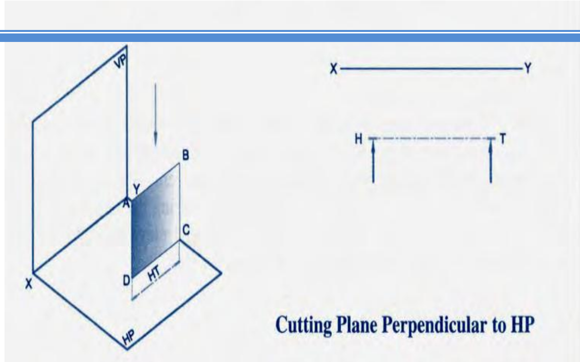
6. Axisinclined toboth**HP** and**VP.(NotFor UniversitySyllabus)**

SECTION OFSOLIDS:

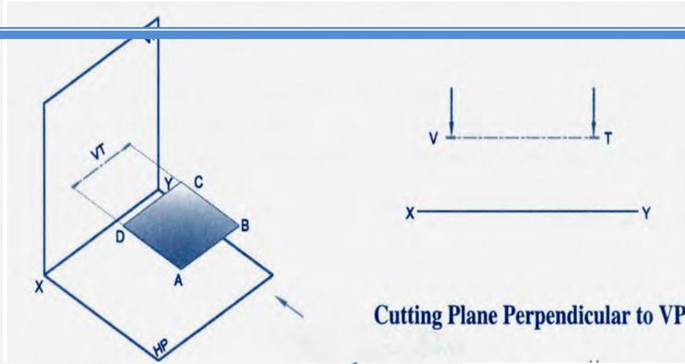
Thehiddenorinternalpartsofanobjectareshownbysectionalviewsintechnicaldrawings.Thesectionalviewofanobjectisobtainedbycuttingthroughtheobjectbya Suitableplaneknownasthesectionplaneorcuttingplaneandremovingtheportionlyingbetweentheplaneand theobserver. Thesurfaceproducedbycuttingtheobjectiscalledthesectionanditsprojectioniscalledasectionalplanorsectionalelevation.Thesectionisindicatedbythinsectionlinesuniformlyspacedandinclined at 45°.

Asectionalviewofanobjectisobtainedbyprojectingtheretainedportionofthe Jetwhichisleftbehindwhenobjectiscutbyanimaginarysectionplaneandtheportiontheobjectbetweenthesectionplaneandtheobserverisassumed asremoved.

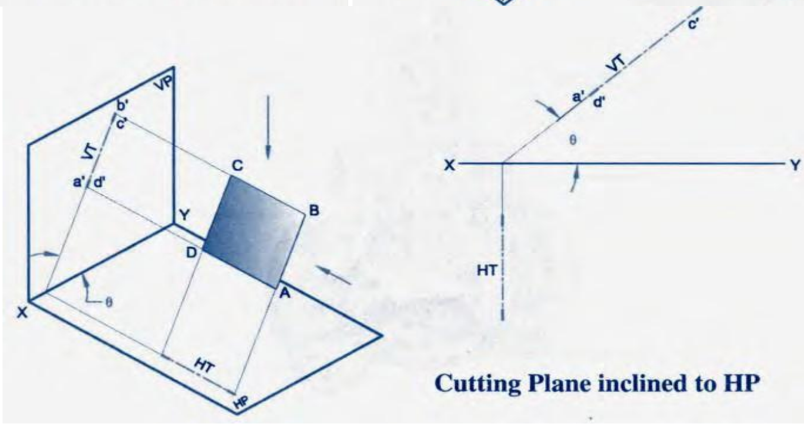
TheobjectiscutbyasectionplaneAA.Thefronthalfoftheobject between the Sectionplaneandtheobserverareremoved.Theviewoftheretainedportionoftheobjectisprojection VP.Thetopviewisprojected forthe wholeuncutobject.



Cutting Plane Perpendicular to HP



Cutting Plane Perpendicular to VP

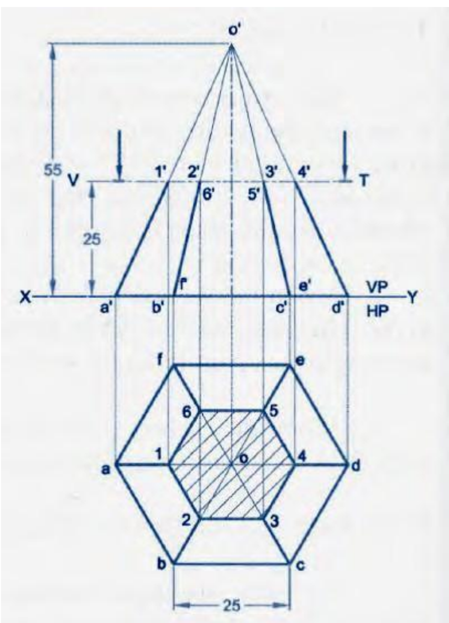


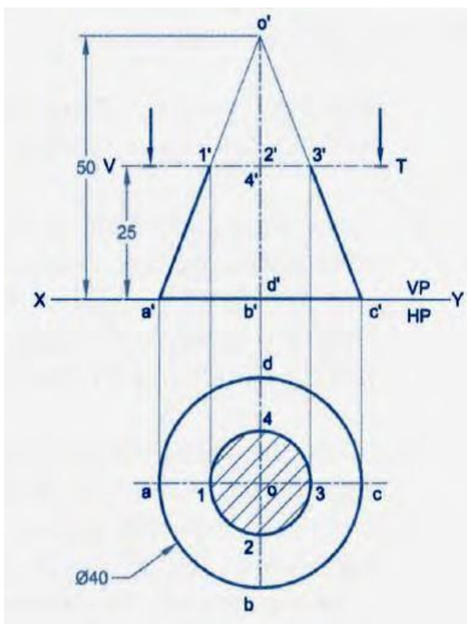
Cutting Plane inclined to HP

Types ofsectional viewsofsolids:

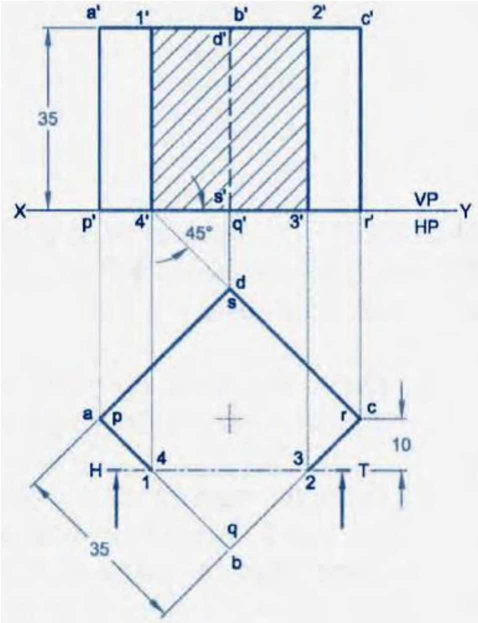
Byusingthefivedifferenttypesofperpendicular sectionplaneswe.obtainthe followingfivetypesofsectionalviews ofsolids:

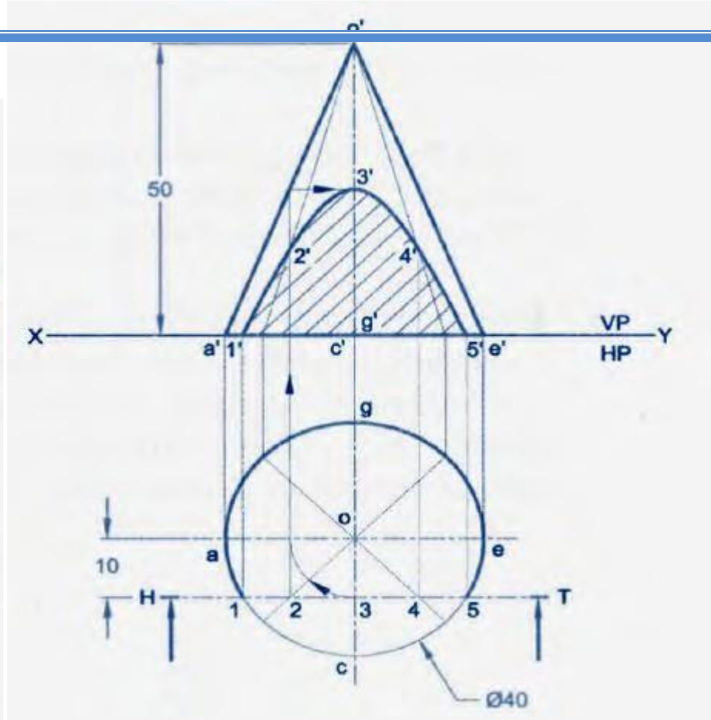
1. Sectionofsolidsobtainedby**horizontalplanes.**



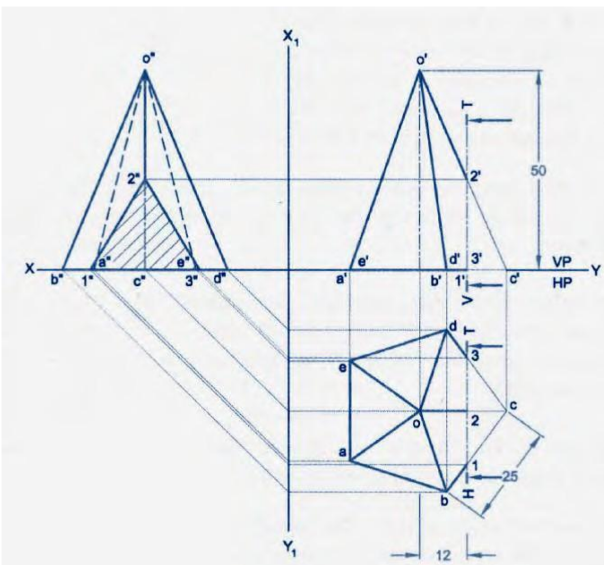


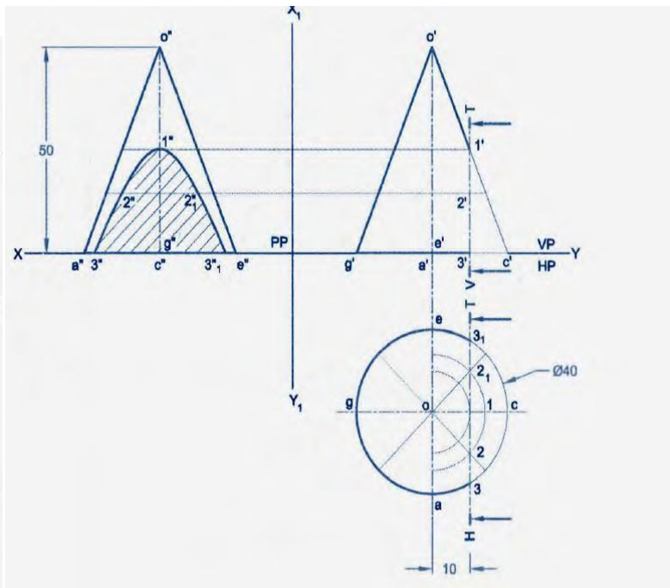
2. Sectionofsolidsobtainedby**verticalplanes.**

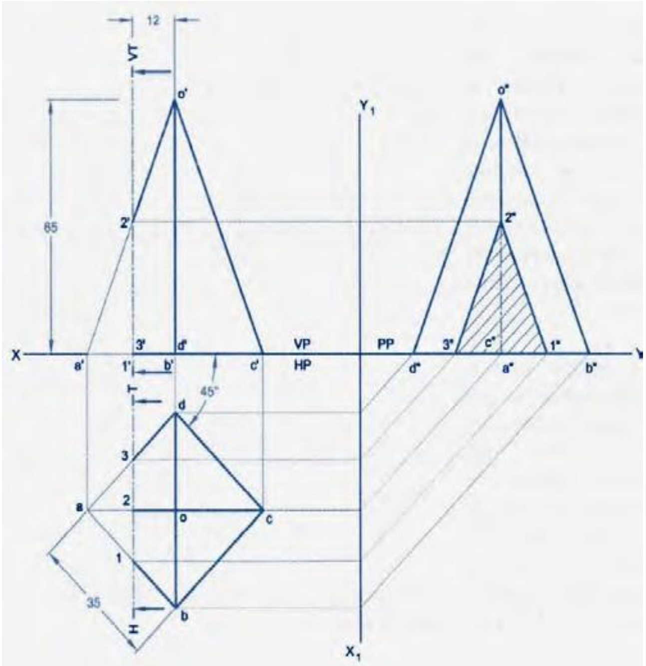


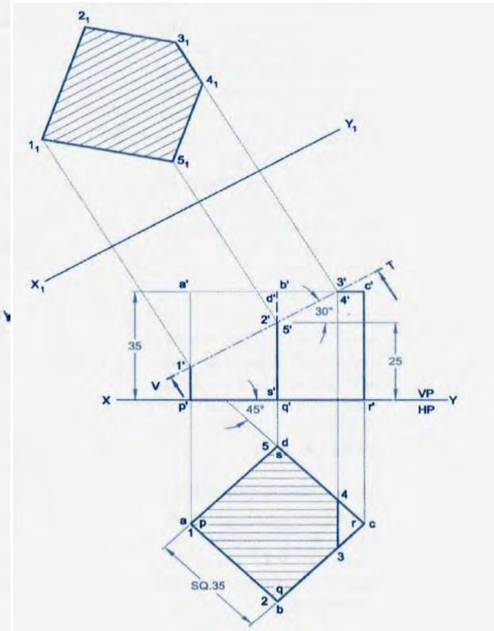


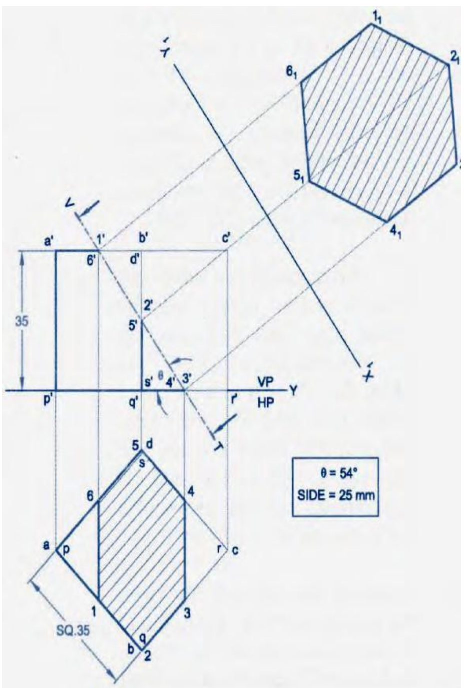
3. Sections ofsolidsobtainedby**auxiliaryinclinedplanes.**
4. Sectionofsolidsobtainedby**auxiliaryverticalplanes.**
5. Sectionofsolidsobtainedby**profileplanes.**

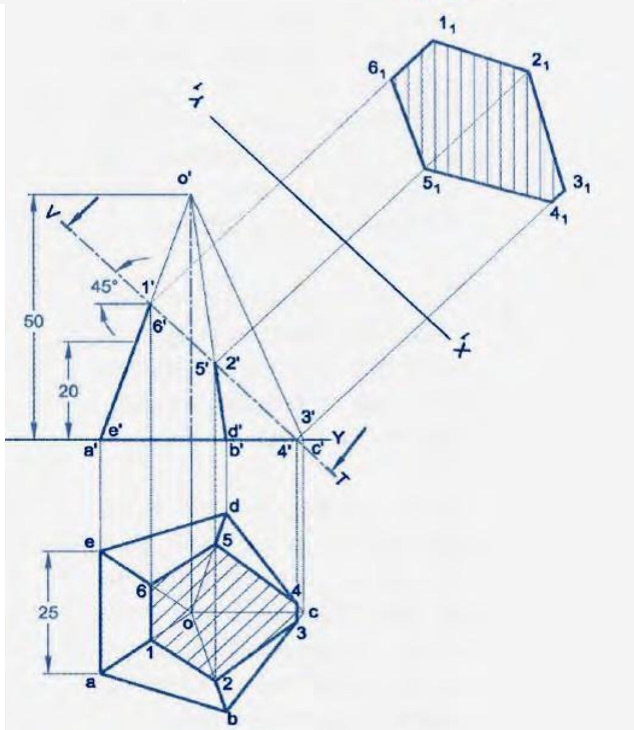


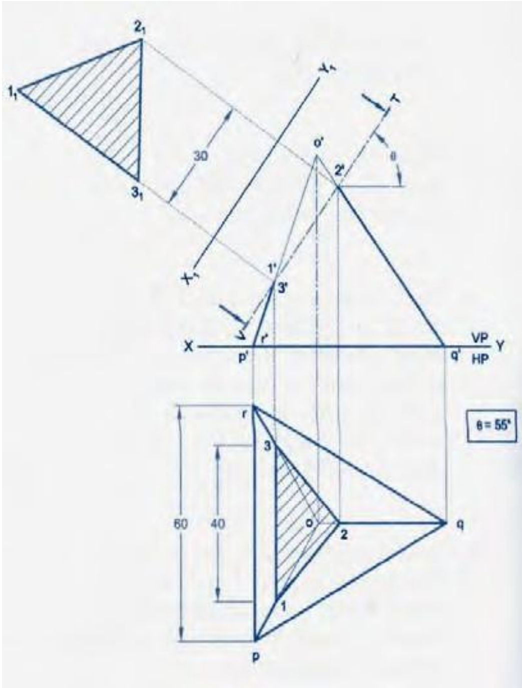



12
VT
65
45°
35
VP
HP
PP
H
T
X
Y

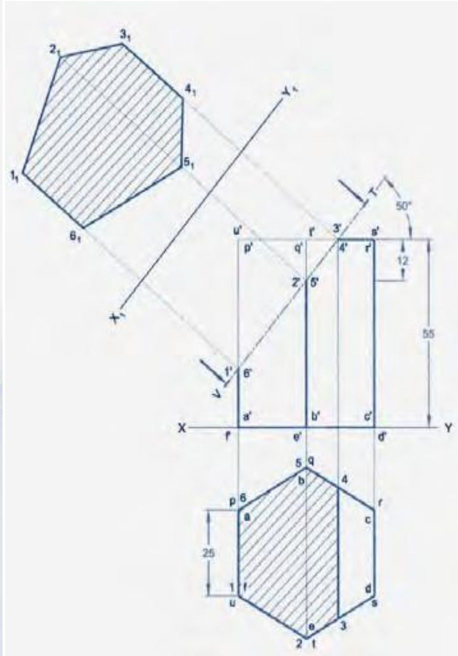

30°
35
25
45°
SQ.35
VP
HP
V
T
X
Y


35
VP
HP
θ = 54°
SIDE = 25 mm
SQ.35
V
T

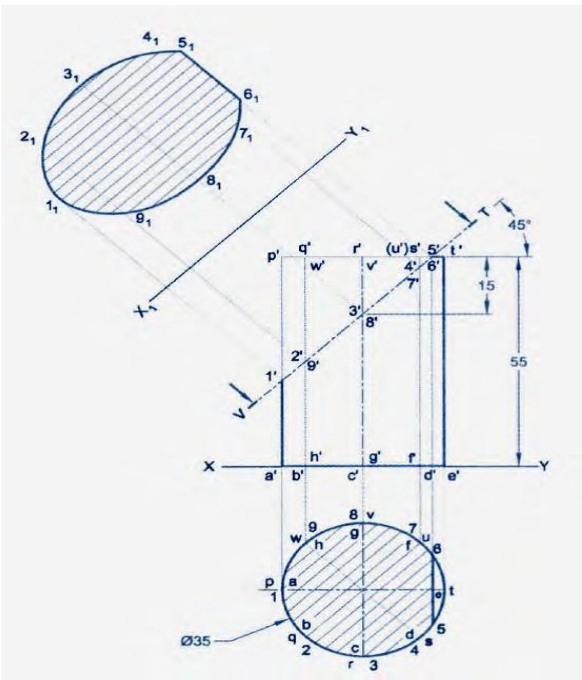

45°
50
20
25
V
T
Y



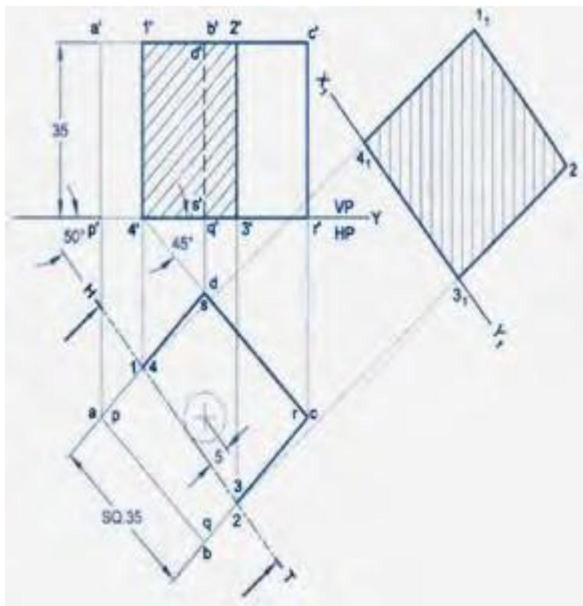
θ = 55°
30
60
40
X
Y
VP
HP
X1
Y1



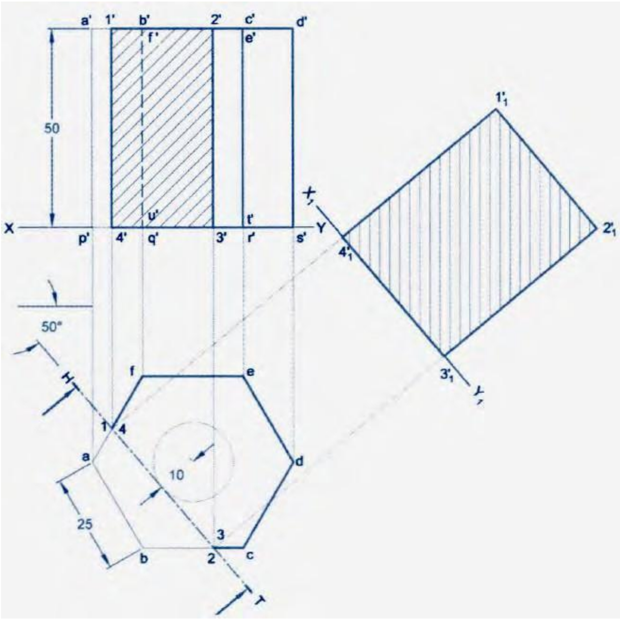
50°
12
55
25
X
Y
X1
Y1

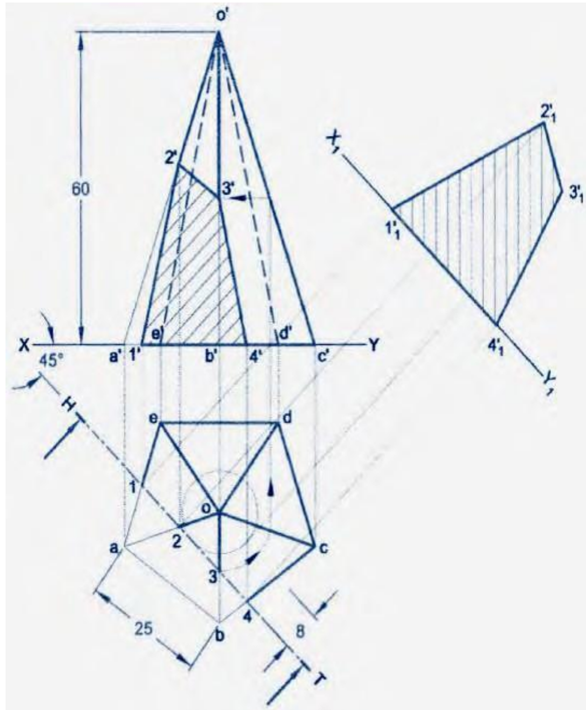


45°
15
55
Ø35
X
Y
X1
Y1



35
VP
HP
50°
45°
SQ.35
5
X
Y


a'
1'
b'
2'
c'
d'
f'
e'
50
X
p'
4'
q'
3'
r'
s'
Y
X1
1'1
2'1
4'1
3'1
Y1
50°
H
T
f
e
1
4
a
d
10
25
3
b
2
c


o'
60
2'
3'
X1
2'1
3'1
1'1
4'1
Y1
X
45°
a'
1'
e'
b'
4'
d'
c'
Y
H
e
d
1
o
a
2
c
3
4
25
b
8
T

Important Questions

1. Atetrahedronofedges30mmrests ononeofitsedgesontheVP.Thatedgesisnormaltothehp.oneofthefacescontainingthe restingedgeisinclinedat30^{o}to theVP.Draw theprojections ofthe tetrahedron.
2. Acubeof70mmlongedgeshasitsverticalfacesequalityinclinedtotheVP.Itiscutbyan auxiliaryinclinedplaneinsuchawaythatthetrueshapeofthecutpartisaregularhexago n.DeterminetheinclinationofthecuttingplanewiththeHP.Drawfrontview,sectional topviewand trueshapeofthesection.
3. AregularpentagonallaminaABCDFofside30mmhasoneofitsedgesparalleltotheV Pandinclinedat30®totheHP.Thepentagonisinclined45®to theVP.Drawprojections.
4. Apentagonalprismof30-mmsideofbaseand70mmheightisrestingononeof its edgesof thebasein such awaythat thebase makes anangelsof45®HP,and theaxisisparallel toVP.Drawthe projections oftheprism.
5. Drawthetopfrontviewsofarightcircularcylinderofbase45mmdiameterand60mmlo ngwhenitlineonHP,suchthatitsaxisisinclinedat30®toHPand theaxisappearstoparallel totheVP in thetopview.
6. Draw the projection ofa cylinder of diameter40mmandaxis70mmlongwhenitrestsontheVPononeofitsbasepoints.The axisifcylinderisparalleltoVP andinclinedat 30® to VP.
7. Ahexagonalpyramidofbasesside30mmandaxislength60mmisrestingonVP oneofitsbaseedgeswiththefacecontainingtherestingedgesperpendicular tobothHPandVP.Drawitsprojections.
8. Aconeofbasediameter60mmandaxis70mmisrestingonHPonitsbase.Itiscutbyapla neperpendiculartoVPandparalleltoacontourgeneratorandis10mmawayfromit.Dra

wthefrontview,sectionaltopviewandthetrueshapeofthesection.

9. Anequilateraltriangularprism20mmsideofbaseand50mmlongrestswithoneofitsshorteredgesonHPsuchthattherectangularfacecontainingtheedgeonwhichtheprismrestsisinclinedat30®toHP.Thisshorteredgeresting onHP is perpendicular toVP.
10. Asquarepyramidofbase40mmandaxis70mmlonehasoneofitstriangularfaces onVPand theedgeofbase contained bythatfaceis perpendiculartoVP. Draw itsprojections.
11. Ahexagonalprismofsideofbase35mmandaxislength55mmrestswithitsbaseonHP suchthattwooftheverticalsurfacesareperpendiculartoVP.Itiscutbyaplaneinclined at50®toHPandperpendiculartoVPandpassingthroughapointantheaxisatadistance15mmfromthetop.Drawitsfrontview,sectional topviewand trueshapeofsection.
12. Anequilateraltriangularprism20mmsideofbaseand50mmrestswithareofitsshorteredgesonH.P.suchthattherectangularfacecontainingtheedgeonwhichtheprismrestsisinclinedat30toH.P.theshorteredgerestingonHPisperpendicular toVP.
13. Drawtheprojectionsofahexagonalpyramidwithsideofthebase30mmandaxisonHP suchthatthetriangularfacecontainingthatsideisperpendiculartoHP andaxisis parallel to VP.
14. Averticalcylinder40mmdiameteriscutbyaverticalsectionplanemaking30toVPinsuchawaythatthetrueshapeofthesectionisarectangleof25mmand60mmside. Drawtheprojectionsand trueshapeof thesection.
15. Atetrahedronofedges30mmrestsononeofitsedgesontheVP.ThatedgeisnormaltotheHP.Oneofthefacescontainingtherestingedgeisinclinedat30® to theVP.Drawtheprojectionsof thetetrahedron.
16. A cone ofbasediameter60mmandaltitude 80mmrestson the HPwithitsaxisinclinedat30® tothe HPandparallel totheVP.Drawits front

andtopviews.

UNITIV

DEVELOPMENTOFSURFACESANDISOMETRICPROJECTION

Developmentof lateralsurfacesofvertical prism, cylinderpyramid,andconetruncatedbysurfacesof inclinedtoHPalone. Developmentofsurfacesof verticalcylinderand prismwithcylindricalcutouts perpendiculartotheaxis. Isometricprojectionofsolids likeprism, pyramid, cylinderandcone;combinationof anytwo;truncationwhensolid isinsimpleverticalposition, bya cuttingplaneinclinedtoHP.

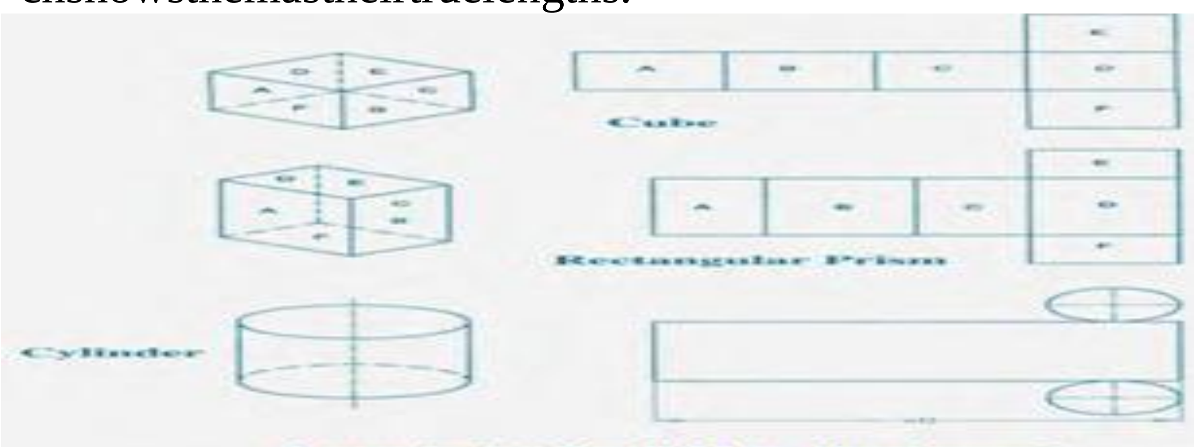
UNIT-IV

Development ofsurfaces:

A layoutofthecompletesurface of athreedimensionalobjectonaplanesurfaceiscalleditsdevelopmentorpattern.Developmentisatermfrequentlyusedinsheetmetalworkwhereitmeanstheunfoldingorunrollingofadetailintoaflatsheetcalledapattern Therearethreemethodsofpatterndevelopment;(i)Parallelline,
(ii) Radialline and (iii) Triangulation.

ParallelLineMethod:

Thismethodcanonlybeusedtodevelopobjects(orpartsthereof)havingaconstantcross-sectionfortheirfulllength,forexample,prismsandcylindersandrelatedforms.Parallellines,paralleltotheaxisofthedetail,areshownonaviewwhichshowsthemastheirtruelengths.



1. Afterdrawingthegivenviews,determinetheviewinwhichtherig htsectionofthesolidappearsasanedgeview.Hereitshould benoted that topviewsofrightprisms and cylindersare equivalenttotheirrightsections willhave to befound intheformofan auxiliaryview.

2. Layoutthestretch-outlineofthedevelopmentparalleltothe edge viewofthe rightsection.

3. Locatethedistancebetweenlateralcomeredgesbymeasuringfro mthetruesizeviewsintherightsectionandthentransferringthesemeasure mentstothestretch-outline.Nametheirpoints.

4. Drawthelateralfoldlinesperpendiculartothestretch-outlinethrough thepoints alreadyplotted.

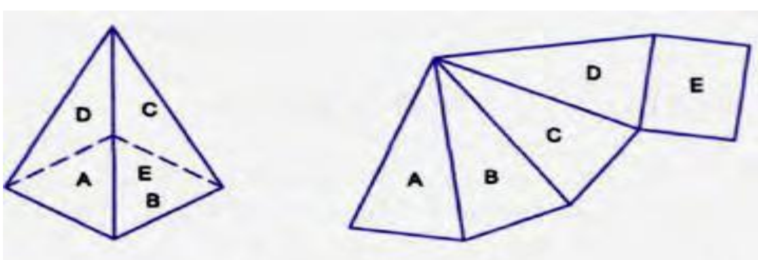
5. Thedevelopmentshould becommencedatthe shortestline,sothattheleastamountofweldingorotherjoiningeffortisreq uired.

6. Joinallendpointsformingtheboundaryofthepatterninproperord er.Onlytheboundaryofthepatternshouldbemadebold, leaving allother linesasthinlines.

7. Checkupthatthepointwherethedevelopmentendsisthesamepoi nt asthebeginningpointonthe rightsection.

RadialLine Method:

Thismethodofdevelopmentisusedforrightandobliquepyramidsan dcones.Itemploysradiallineswhichareslantedgesfromvertextobaseco merpointsforpyramids,andradialsurfacelinesonthe cone surfacefrom the vertex tothebase.



Square Pyramid

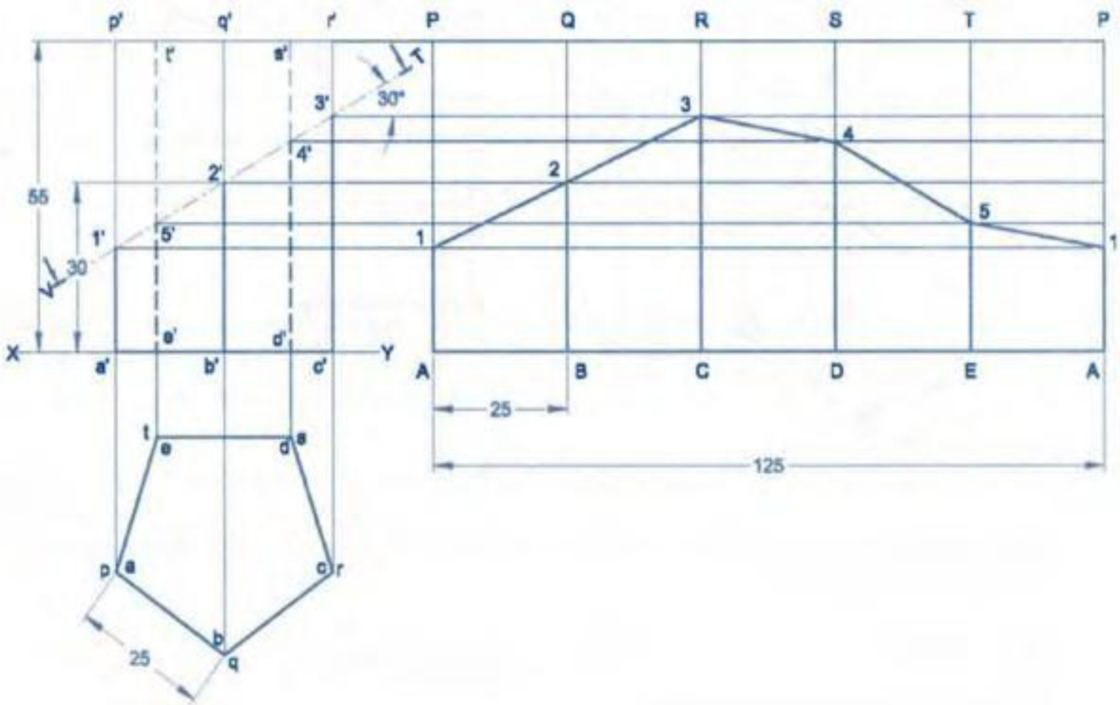
Development ofRight Cones

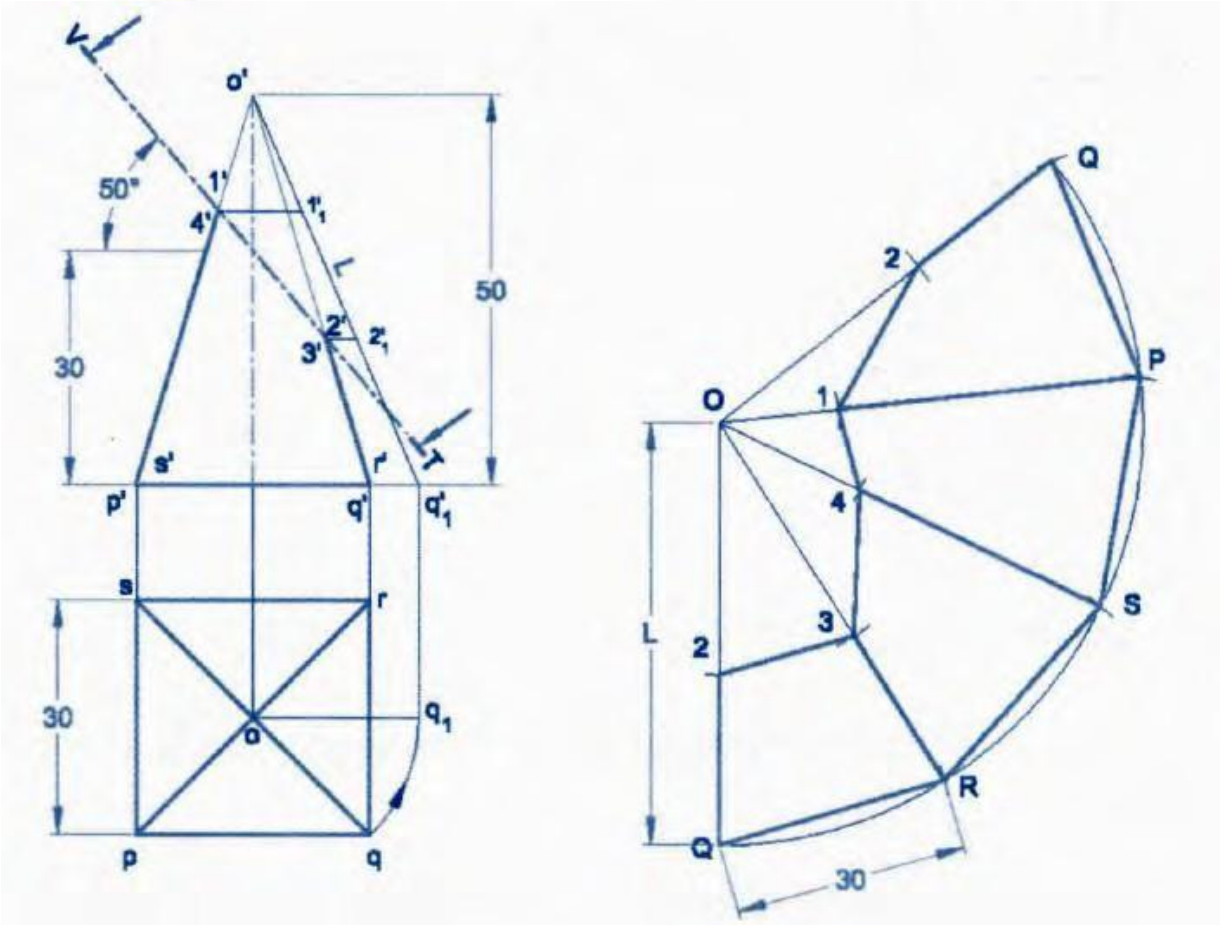
Thedevelopmentofanyrightconeisasectorofacirclesincetheradial surfaceLinesare allofthesametruelength.Theangle atcentreofthesectordependsonthebaseradiusandtheslantheightofthecone.Lettheradiusofthebaseoftheconebe**R,**theslantheightoftheconebe**L,** andtheangleatthecentreofthedevelopmentbeθ.

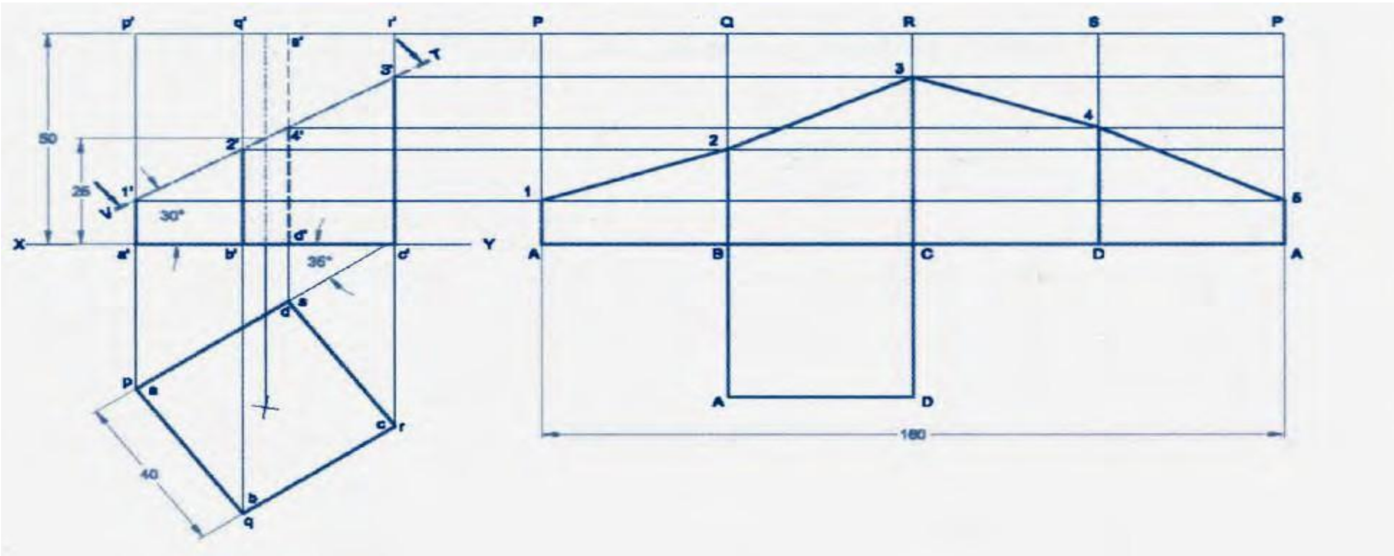
θ=(Radiusofthebasecircle/Trueslantlength)X360=(R/L)X360

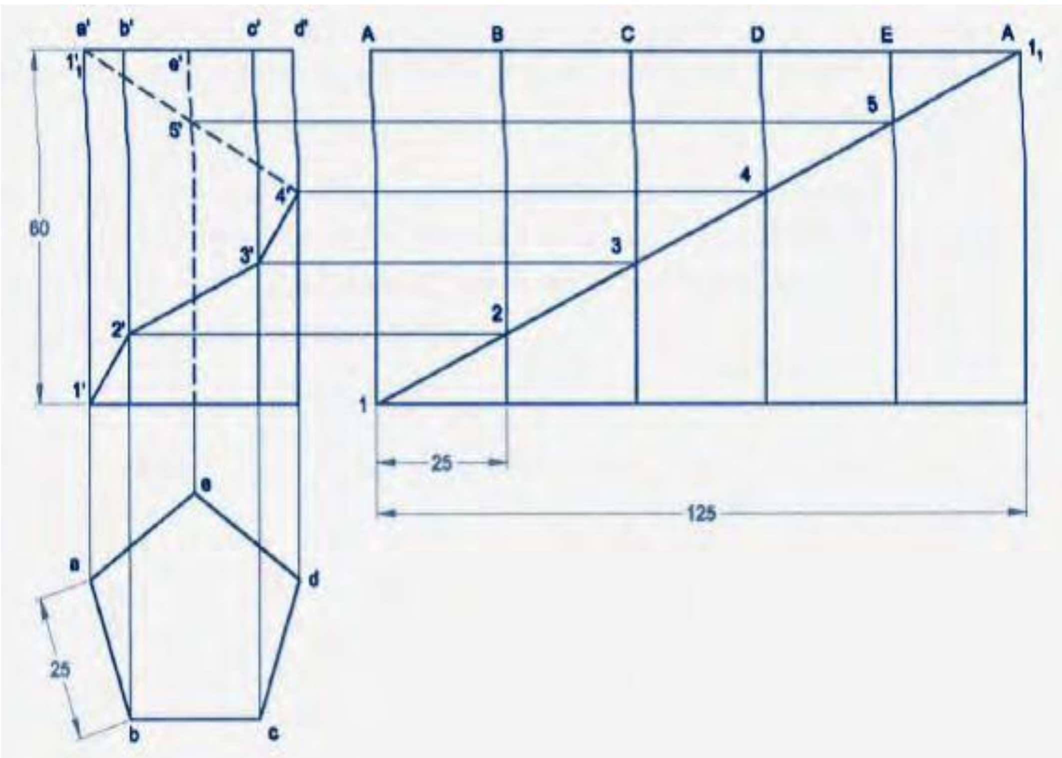
Inthismethodofdevelopmentthesurfaceoftheobjectisdividedinto anumberoftriangles.Thetruesizesofthetrianglesarefoundandthenthese trianglesaredrawninorder,sidebyside,toproducethepattern.**It**issimpletorealizethattofindthetruesizesofthetriangles,itisfirstnecessarytofindthetruelengthoftheirsides.

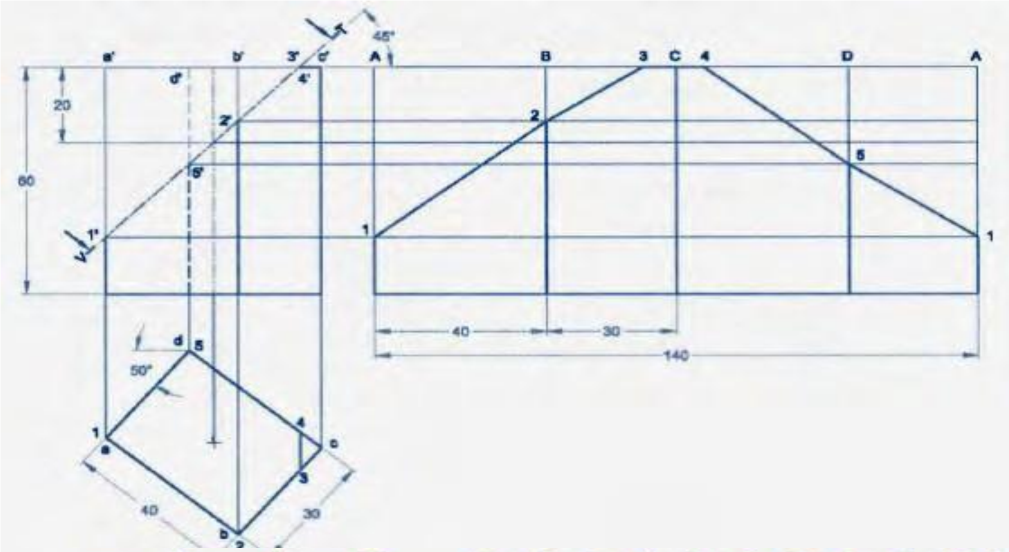
1. Whenthetopandbottomedgesofasheetmetaldetailareparalleltothe**HP**thetruelengthsoftheseedgesmaybetakendirectlyfromthe top view.
2. Incaseofcircularedges,chordaldistancemaybetakenandtransferredtothedevelopment.Thoughsuchlengthsarenottheoreticallyaccurate they aresatisfactoryfordevelopmentwork.
3. Foralltransitionpieceshavinginclinedtopandbottomedges,**TL** constructionmustbecarriedoutif theseedgesarecurved.
4. Awelldefinedlabelingsystemshouldbeusedinorderthattheconstructiontechniquemaybeprogressiveandeasytounderstand.

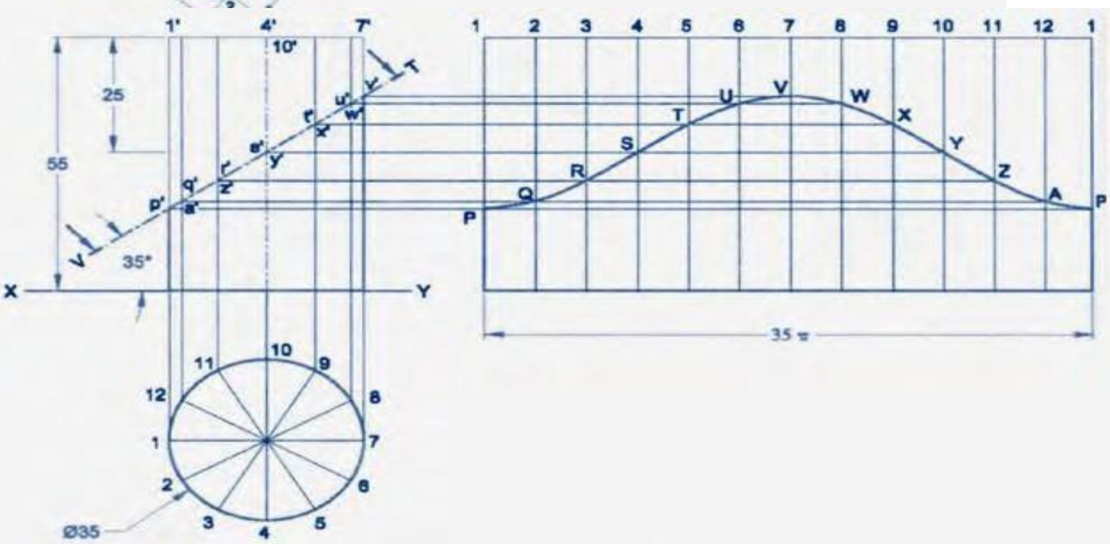

p' q' r' P Q R S T P
t' s'
3' 30° T
4'
2'
55
1' 5'
V 30
1 2 3 4 5 1
X e' d' Y
a' b' c' A B C D E A
25
125
t e d s
p a c r
b q
25

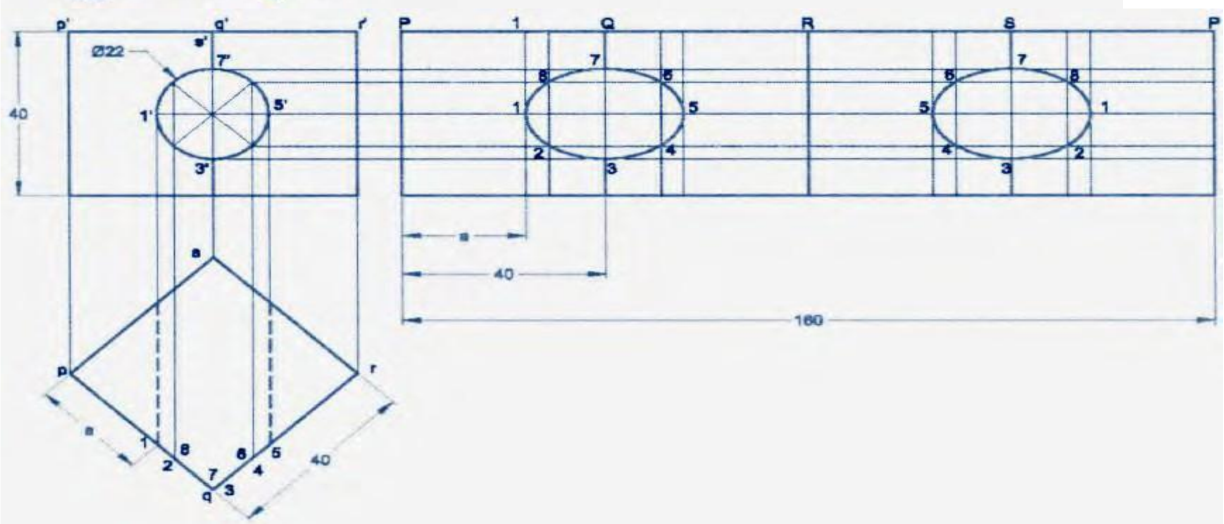

V
o'
50°
1'
4'
$1'_1$
L
50
2'
3'
$2'_1$
30
T
s' r'
p' q' q'_1
s r
30
o q_1
p q
Q
2
P
O 1
4
L
S
3
2
R
Q
30

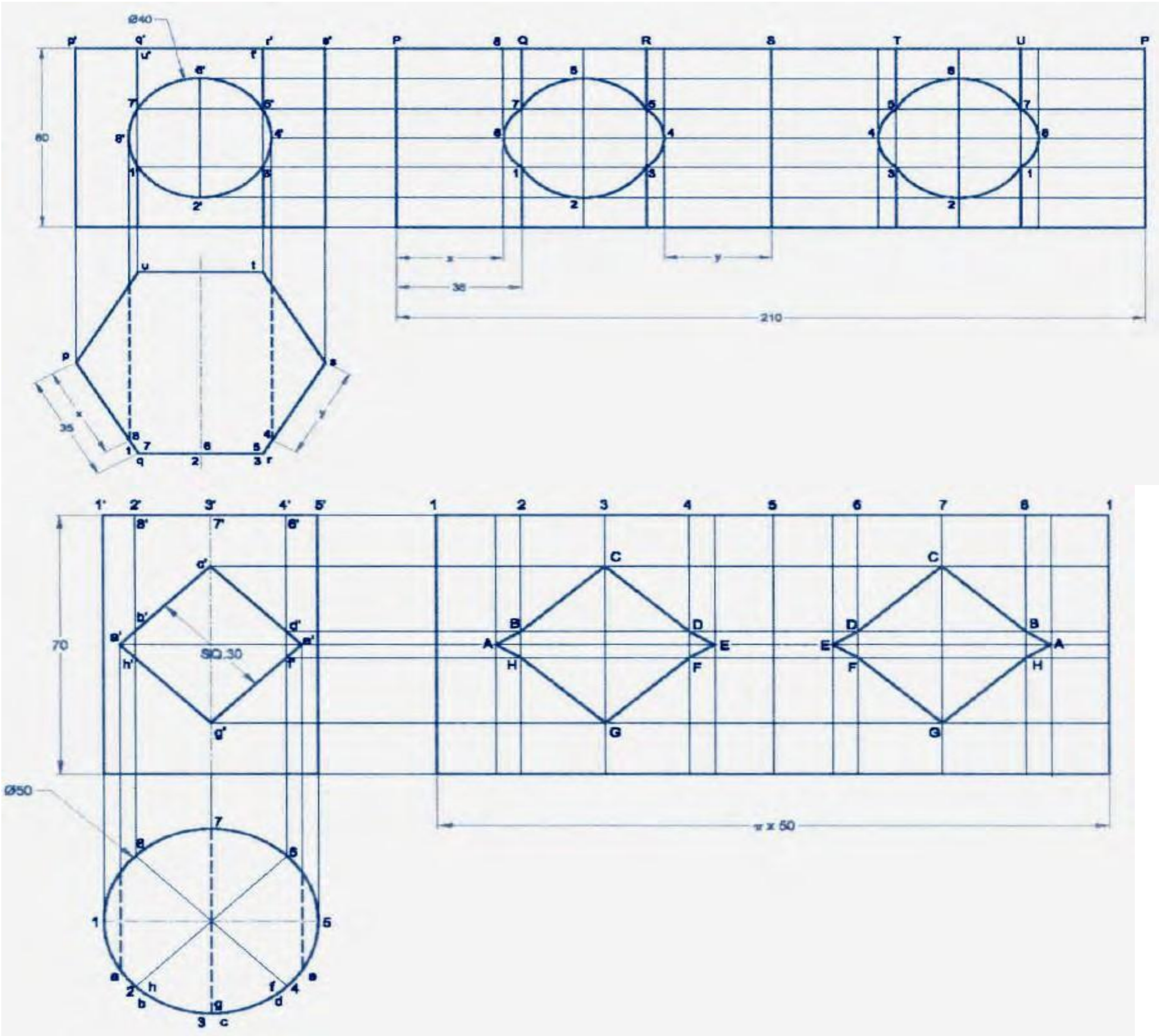

p'
q'
r'
s'
P
Q
R
S
P
T
3'
3
4'
4
2'
2
1'
1
5
V
50
25
30°
X
a'
b'
d'
c'
Y
36°
A
B
C
D
A
d
s
p
a
c
r
b
q
40
A
D
160


a'
b'
c'
d'
e'
A
B
C
D
E
A
1_1
$1'_1$
5'
5
4'
4
3'
3
2'
2
1'
1
60
25
125
e
a
d
b
c
25

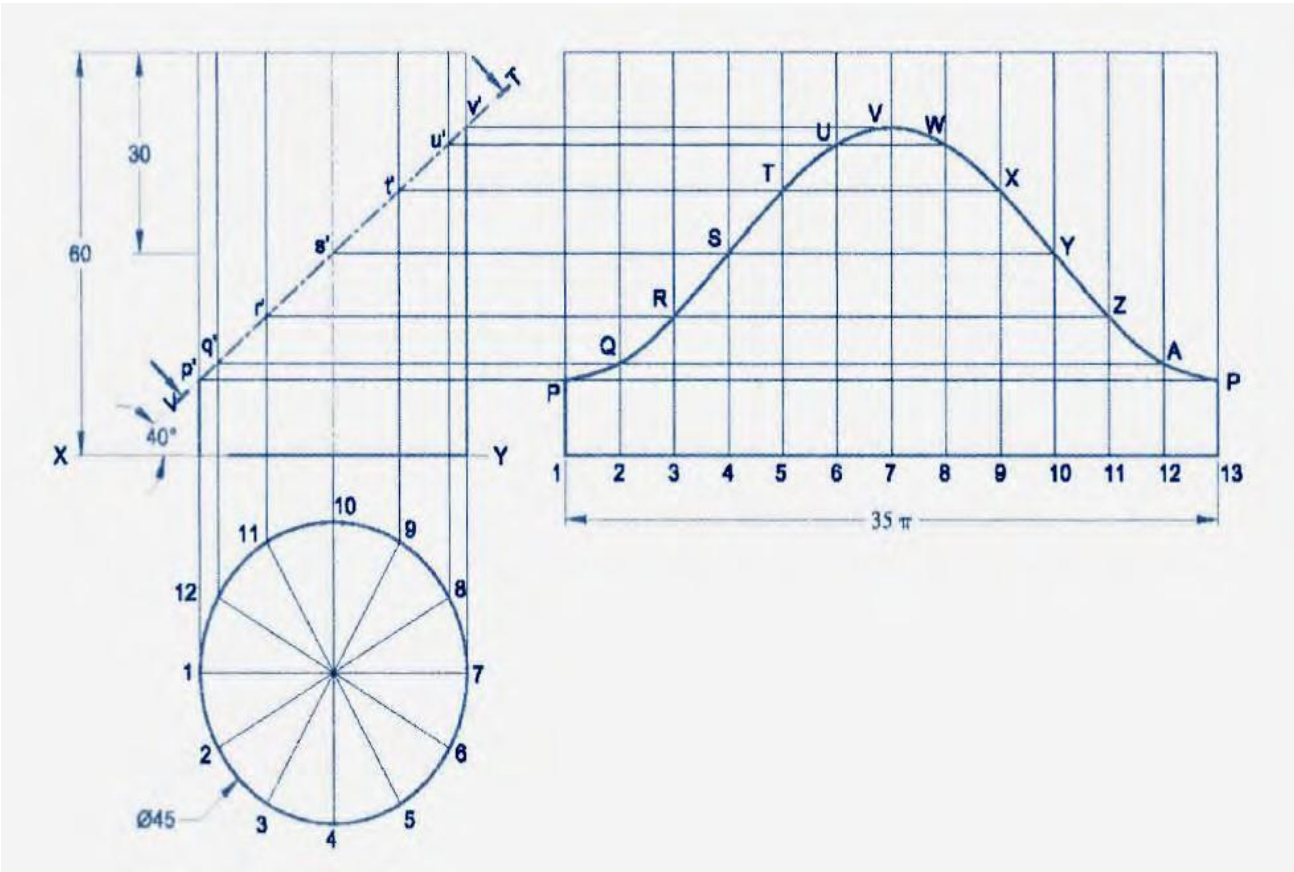

a' b' 3' c'
d' 4'
2'
5'
1'
A B 3 C 4 D A
2
5
1 1
20
60
45°
T
V
40 30
140
d 5
50°
1 a
4 c
3
b 2
40
30


1' 4' 7'
10'
1 2 3 4 5 6 7 8 9 10 11 12 1
25
55
T
V
35°
P Q R S T U V W X Y Z A P
X Y
35 π
11 10 9
12 8
1 7
2 6
3 4 5
Ø35

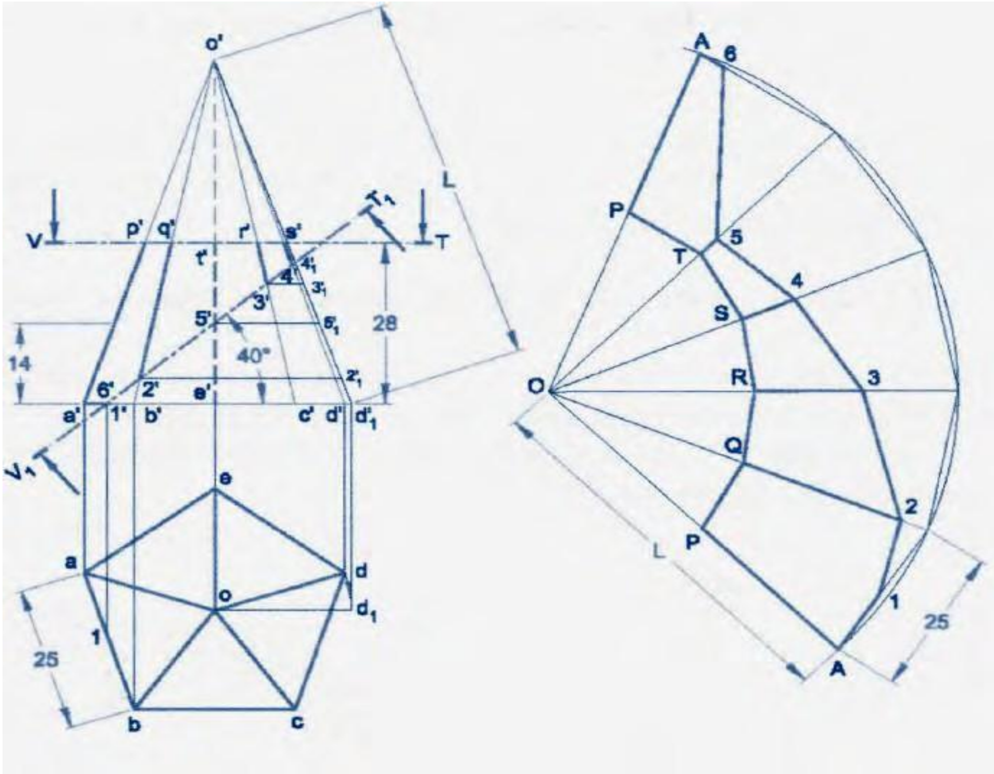

p' q' r'
Ø22
8' 7'
1' 5'
3'
40
P 1 Q R S P
8 7 6
1 5
2 3 4
6 7 8
5 1
4 3 2
a
40
160
s
p r
1 8 2 7 3 6 4 5
q
40



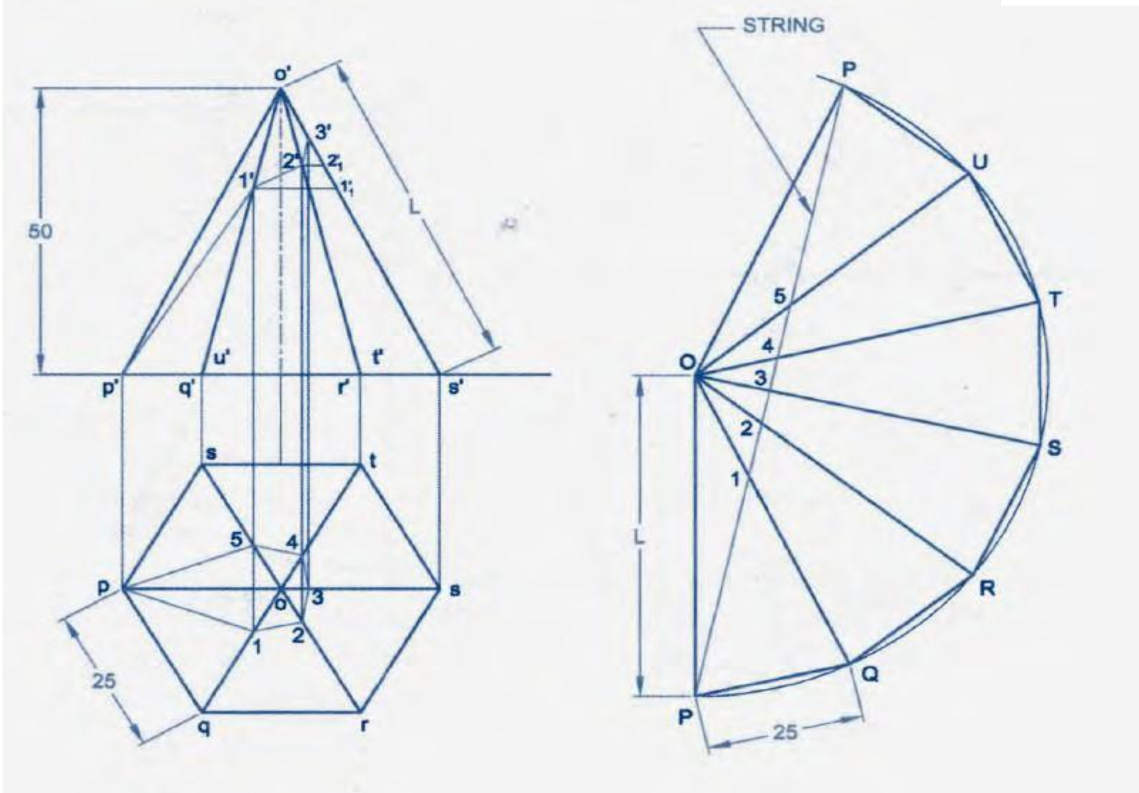
Ø40
60
35
x
y
210
70
SQ.30
Ø50
π x 50



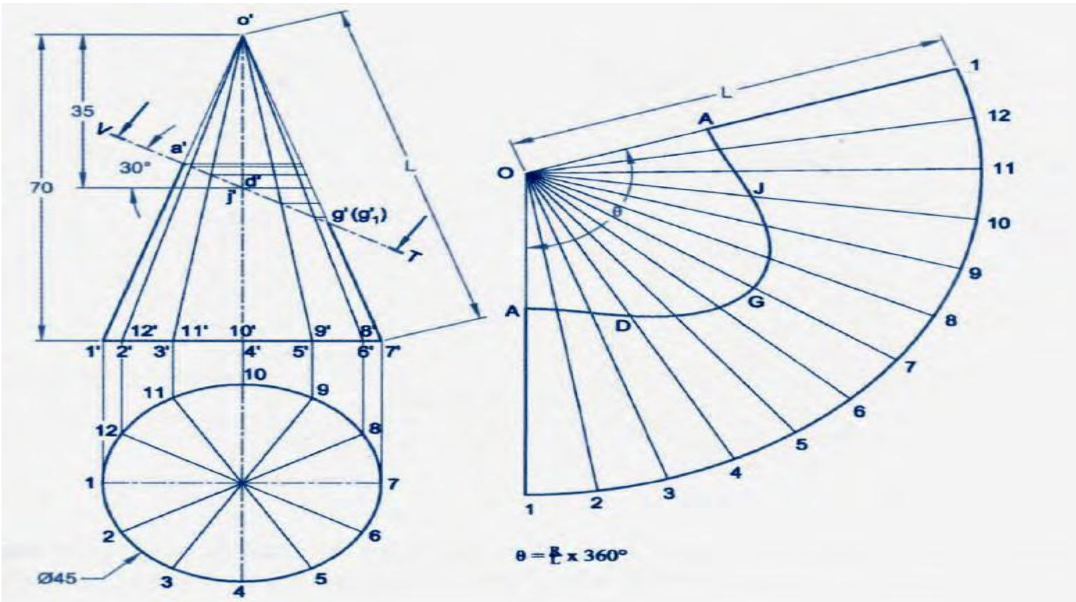
30
60
40°
X
Y
p'
q'
r'
s'
t'
u'
v'
T
P
Q
R
S
T
U
V
W
X
Y
Z
A
P
1
2
3
4
5
6
7
8
9
10
11
12
13
35 π
Ø45

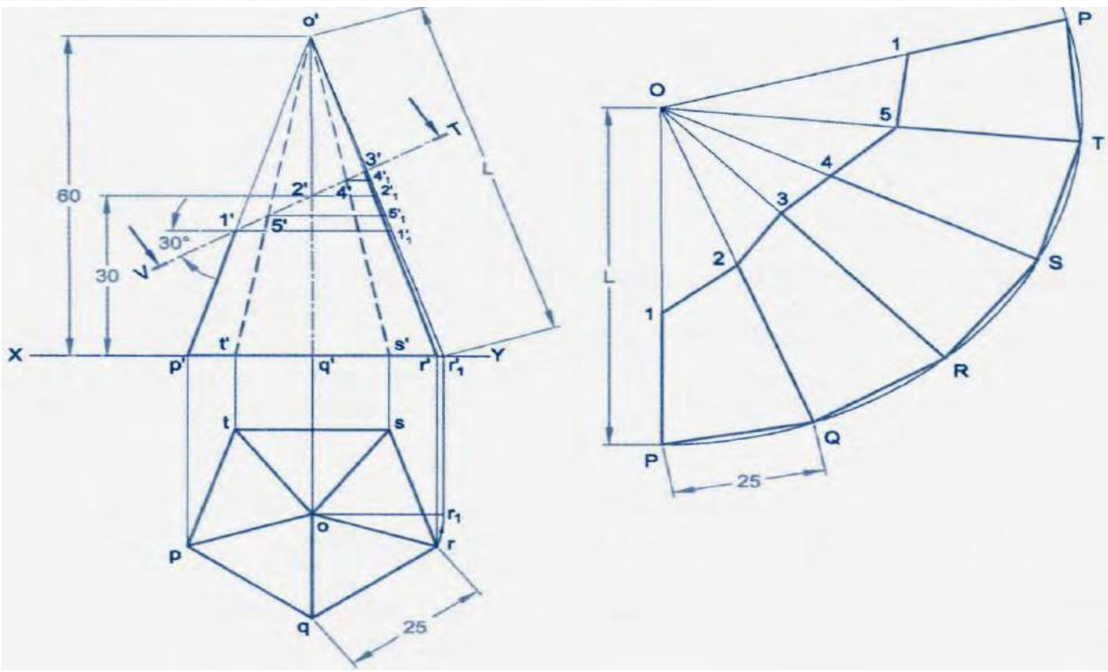


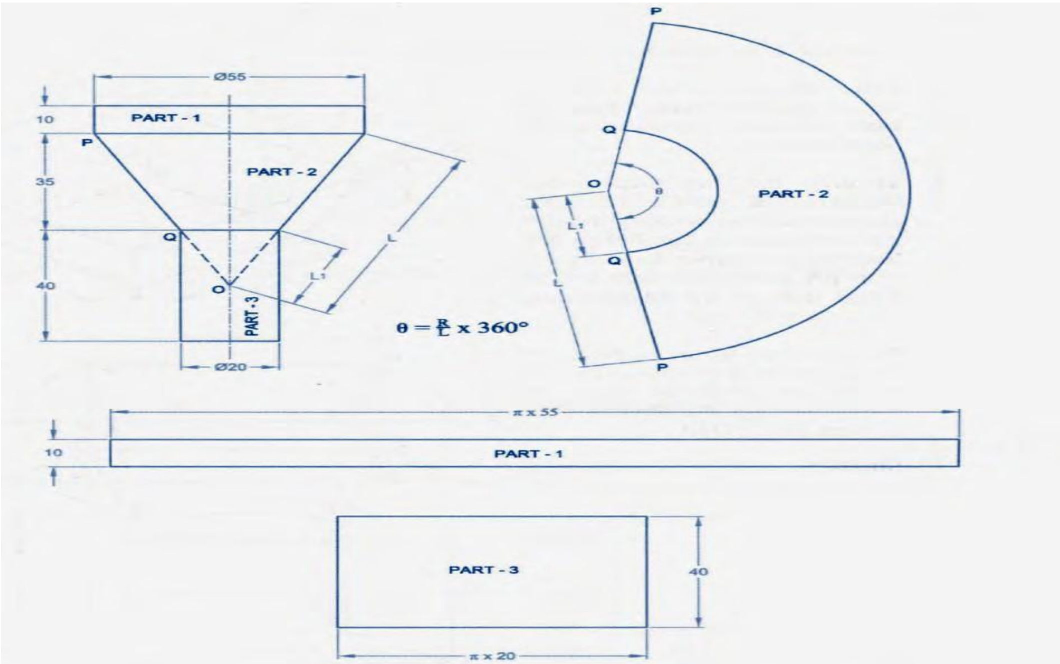
L
28
14
40°
25

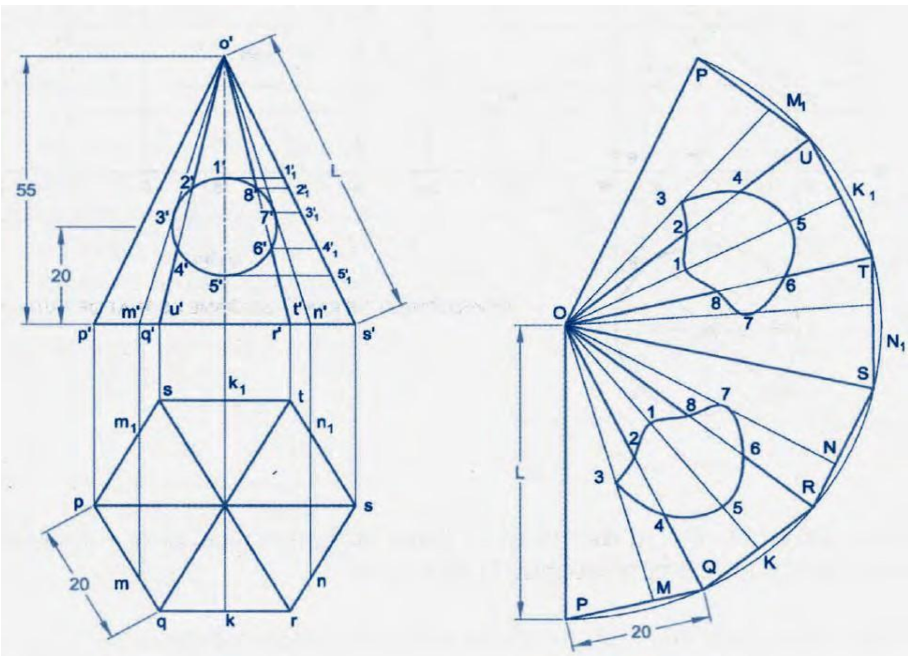


STRING
50
L
25


o'
35
70
30°
a'
d'
j'
g' (g'1)
T
V
L
12' 11' 10' 9' 8'
1' 2' 3' 4' 5' 6' 7'
Ø45
O
A
J
G
D
θ
θ = R/L x 360°


o'
60
30
30°
V
T
L
X
Y
p' t' q' s' r' r'1
t s o p q r r1
25
O
P
T
S
R
Q
1 2 3 4 5





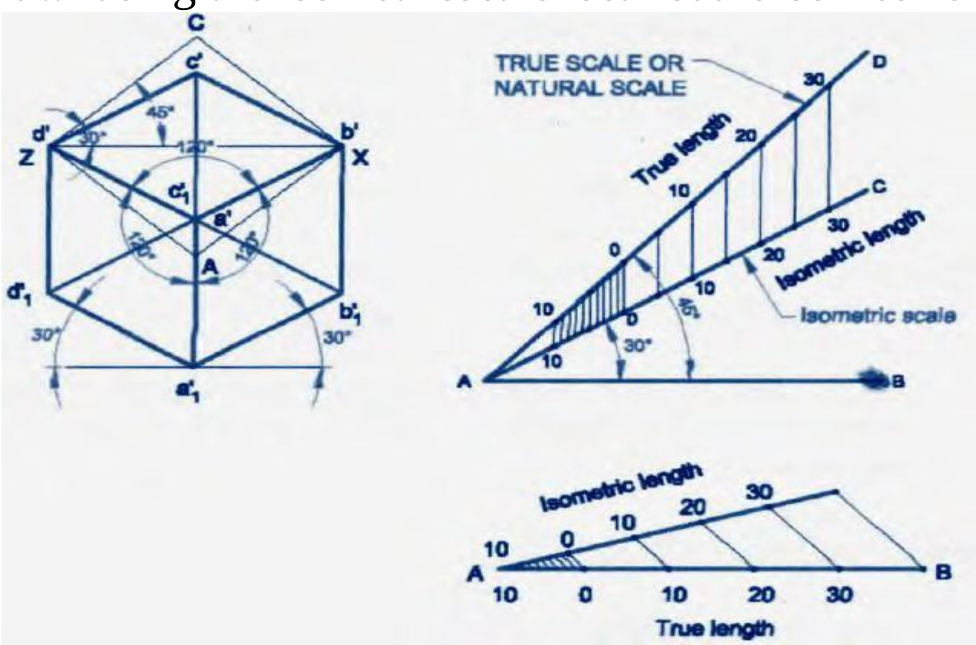
IsometricProjection:

Theisomericprojectionofanobjectisobtainedonaverticalplaneofpr ojectionbyplacingtheobjectinsuchawaythatitsthreemutuallyperpendic ularedgesmakeequalinclinationswiththeplaneofprojection.Sincethethr eemutuallyperpendicularedgesofanobjectareprojectedintheisometricp rojectionatequal axonometricangles,theanglesbetweenthoseedgesintheisometricprojectionwillbeat12°.Thelengthsofthethreemutuallyperpendicularedgesoftheobjectintheisometricprojectionare foreshortenedinthesameproportion.

IsometricScale:

Inthe isometric projection,alltheedgesofanobjectalongthedirection ofthethreeisometric axes are foreshortenedto**0.816**timestheiractuallengths. To facilitate an easyand quickmethod ofmeasurement ofthe lengths of thedifferentedgesin theirreducedsizeswhile drawingtheisometricprojectionofthe object,aspecialscale called**isometricscale**isconstructed.

Theviewdrawn to theactualscaleiscalledthe**isometricview**orIsometricDrawingwhile thatdrawnusing the isometricscale iscalledthe**Isometric Projection**.

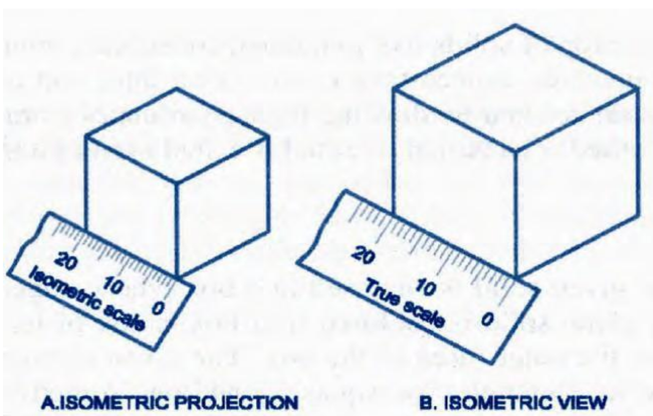


ImportancePointsin Isometric:

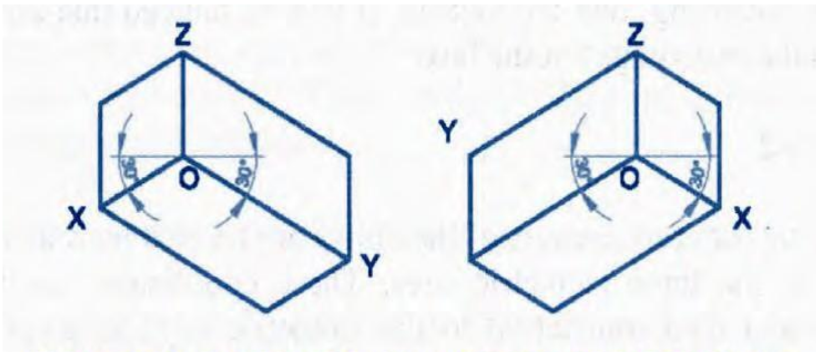
1. For drawing the isometric,theobjectmust beviewedsuchthateitherthefront-rightorthe left edges becomes

nearest.
2. Allvertical edgesofthe objectremainverticalinisometric
3. Thehorizontaledgesofthe object whichareparallel totheisometric axesaredrawnat**30°**to the horizontal.

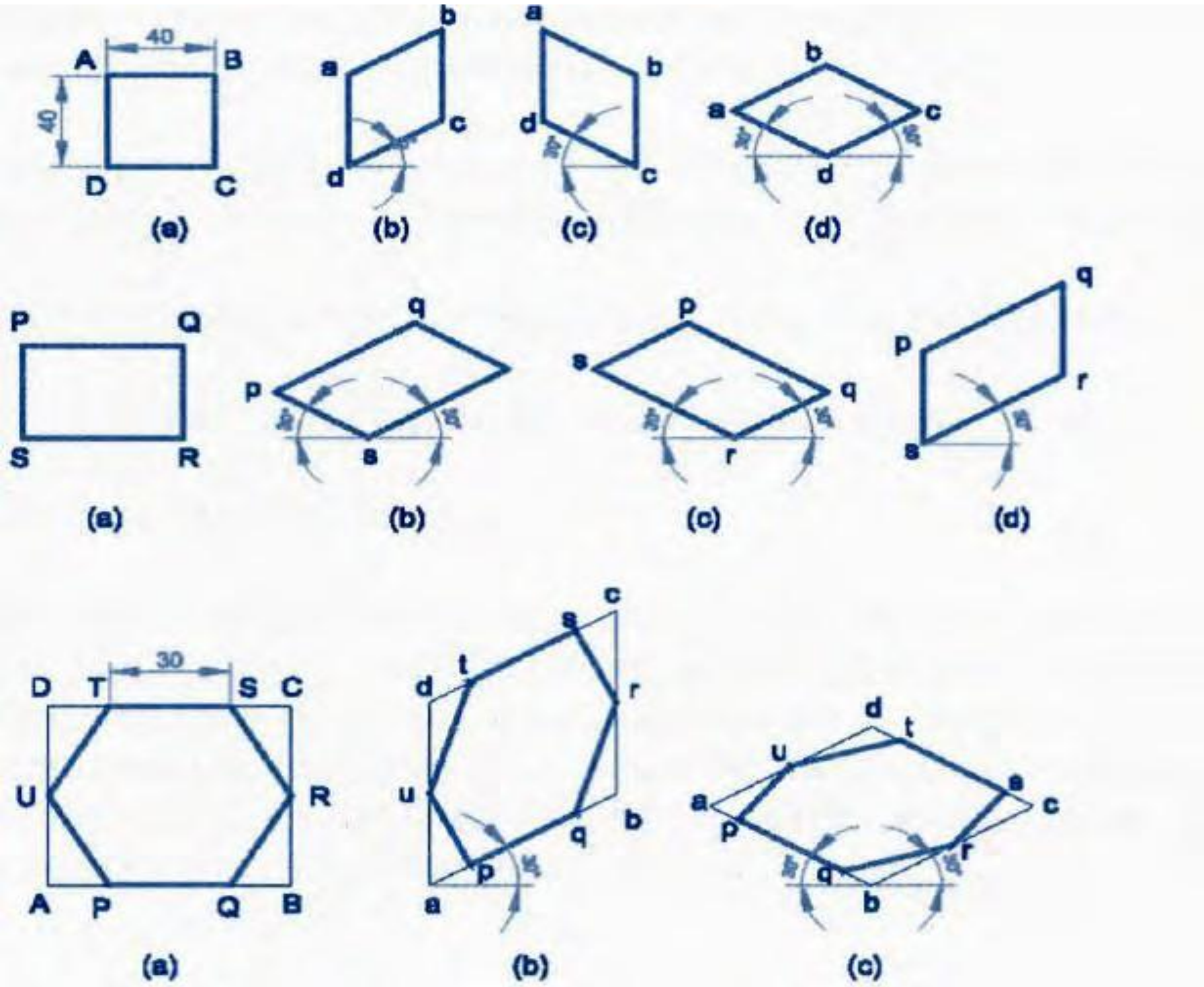
4. The inclinededgeswhich are notparallel totheisometric axesshould notbedrawnat thegiven inclination in isometric. Theseinclined edgesaredrawnbyfirstlocatingthe endpoints inisometric andthenjoined.
5. All circlesare representedasellipses in isometric.
6. Allconstructionlineshave toberetained as thinlinesandthevisible edgesare to beshown asthicklines.
7. Generallythe hiddenedges neednotbe shown inisometricunlessotherwiserequiredeitherforlocatinga comer,oran edge,orface, ormentioned.
8. Unless otherwisespecificallymentionedtodraw the isometricview or isometricdrawingalldimensionlinesparallel totheisometricunlessotherwise if mentioned.
9. No dimensions areindicated inisometric unlessotherwisementioned.
10. Thegivenorthographicviews neednotbedrawn unlessrequiredfor consideration



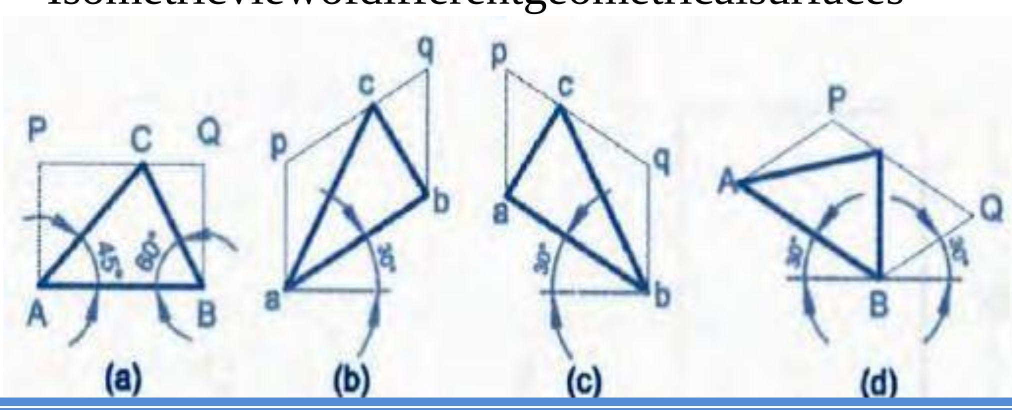
.



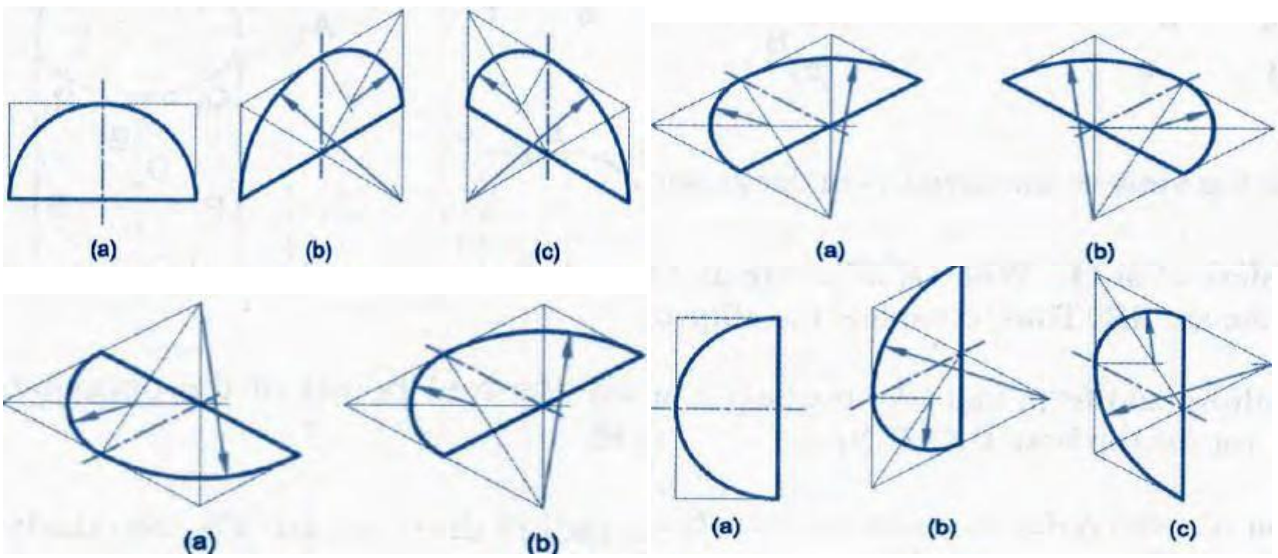
ISOMETRIC PROJECTIOS WITH DIFFERENT FACES VISIBLE



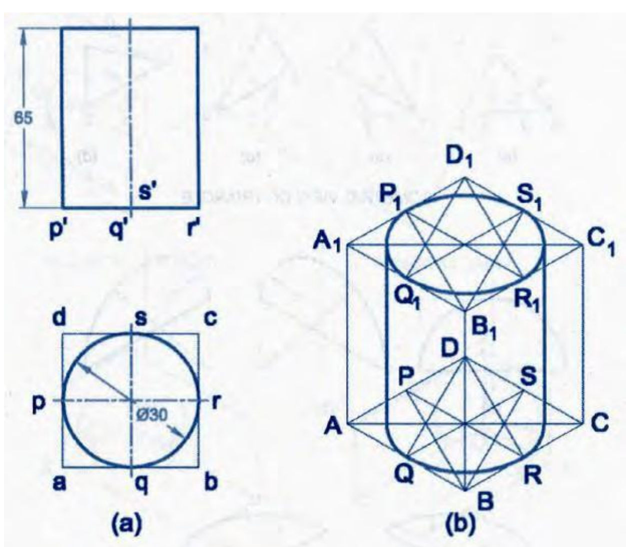
Isometricviewofdifferentgeometricalsurfaces

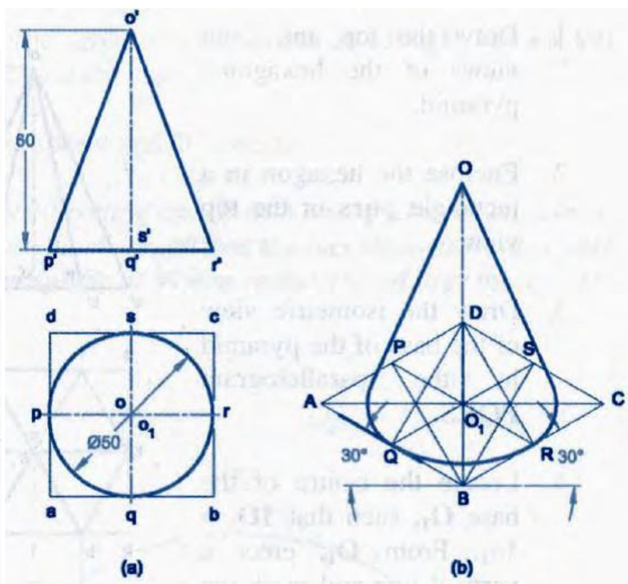


Isometricviewoftriangle



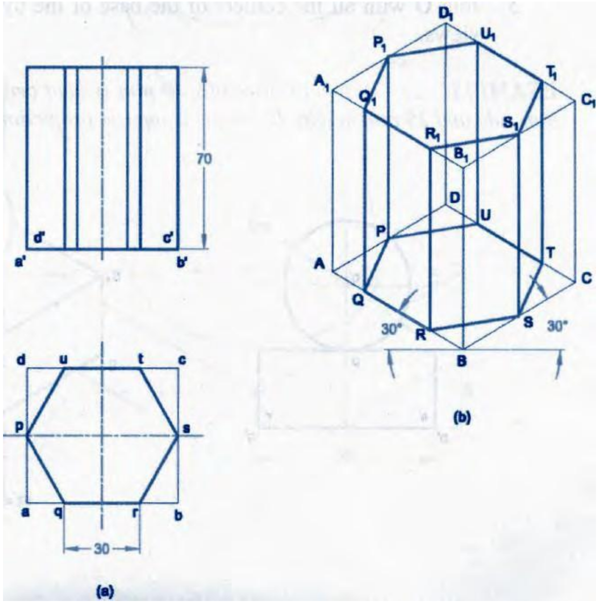
Isometricviewofsemicircle

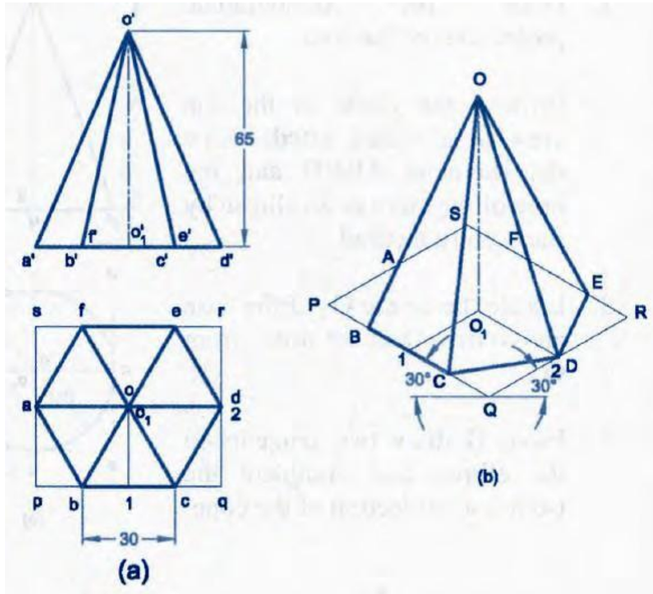




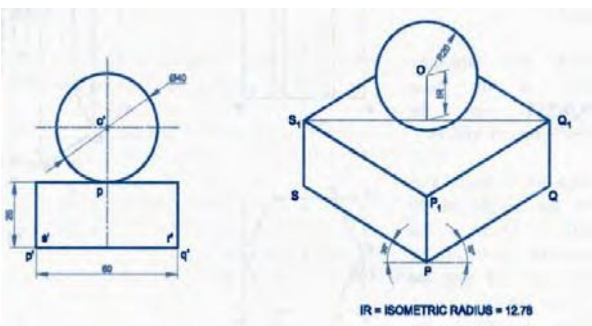
Isometricforcylinder

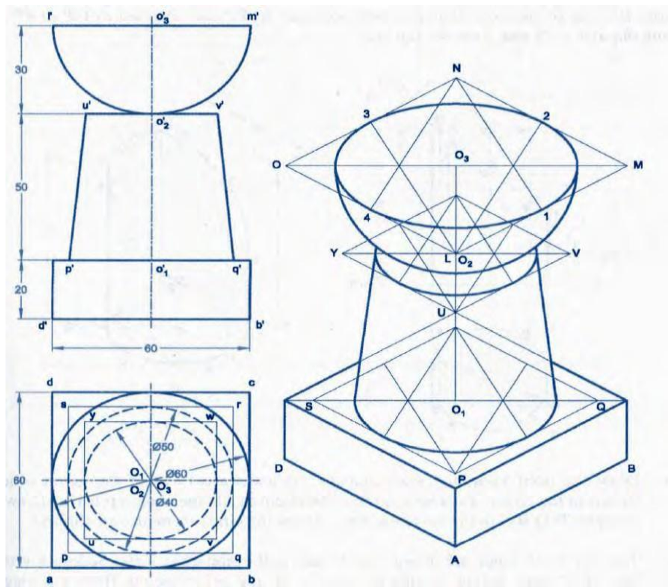
Isometricforcone



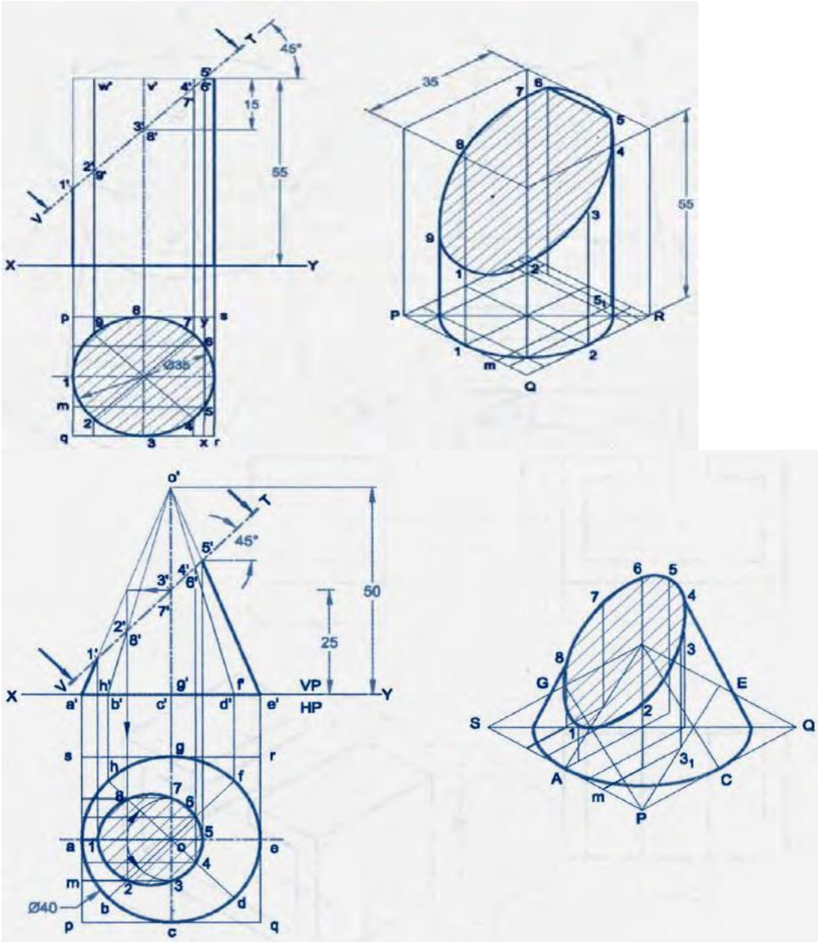


IsometricforprismIsometricforpyramid

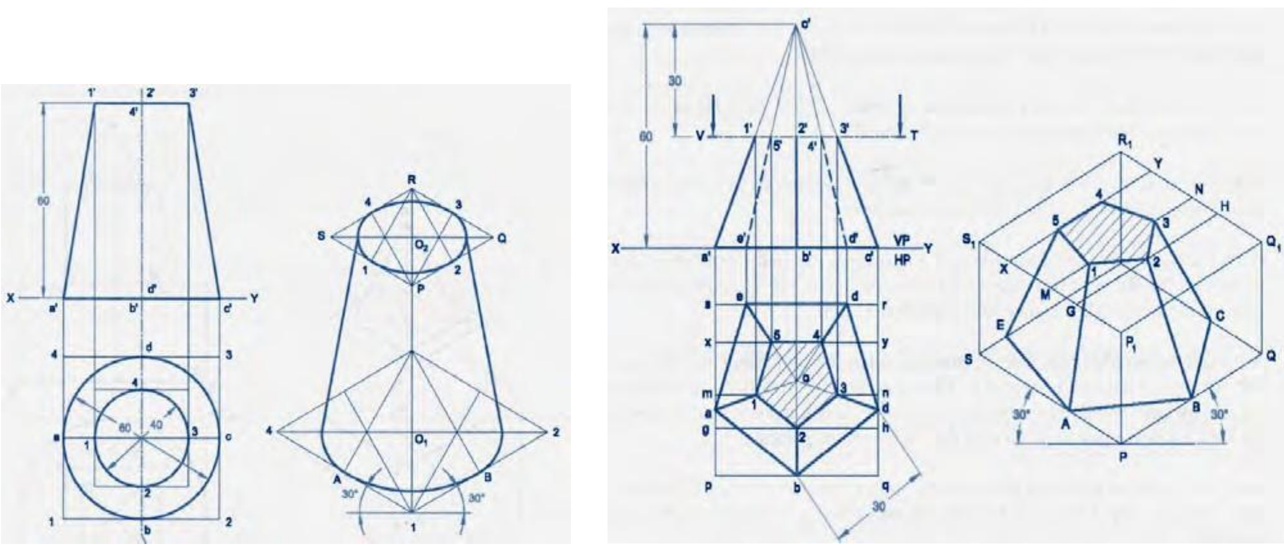




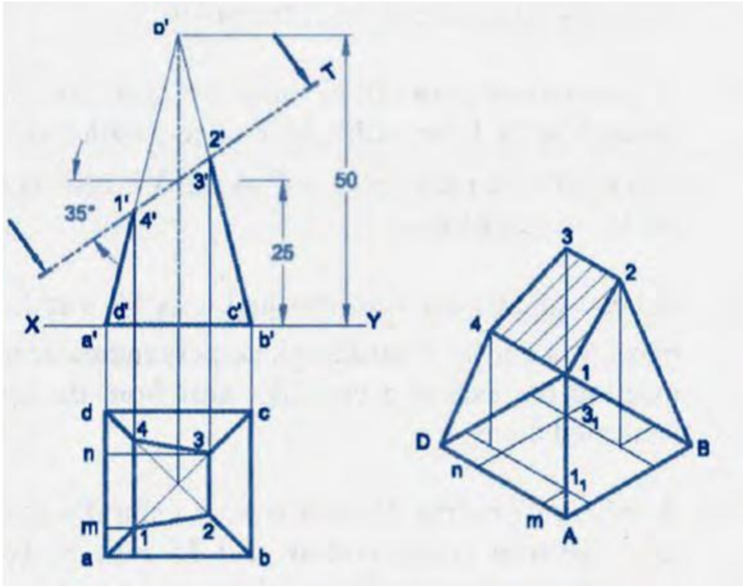
Isometricforcombination solid



Isometricforcuttingmodel incylinder andcone



Isometricforcuttingmodel inconeand pyramid



Isometricforcuttingmodelsquarepyramid

Important Questions

1. Acylinderofdiameter40mmandheight50mmisrestingverticallyononeofitsendonthehp. Itiscutbyaplaneperpendiculartothevpandinclinedat30®tothehp.Theplanemeetstheaxis atapoint30mmfromthebase.Drawthedevelopmentofthelateralsurfaceofthelowerportio nsofthetruncatedcylinder.
2. Ahexagonalprismofbaseside20mmandheight40mmhasasquareholeofside16mmatthe centre.Theaxesofthesquareandhexagoncoincide.Oneofthefacesofthesquare isparallelto thefaceofthehexagon.Draw theisometricprojectionoftheprismwith holetofull scale.
3. Aright circularcone,40mmbaseand50mmheight,restsonitsbaseonHP.Asectionplaneperpendi culartoVPandinclinedtoHPAT45®cutstheconebisectingaxis.Drawprojectionsofthetru ncatedconeanddevelopitslateralsurface.
4. Apentagonalpyramidof40mmedgeofbaseandheight70mmrestswithitsbaseonHP.Oneo fthebasesedgesisperpendiculartoVPandlineontheleftofaxisofthepyramid.Asectionpla neperpendiculartoVPandinclinedat30®toVPcuttheaxisofthepyramidatapoint30mmab ovethebaseofthepyramid.Drawtheisometricprojectionof thetruncatedpyramid.
5. Apentagonalpyramidofbaseedge25mmandheight60mmrestsverticallyonitsbaseonthe HPsuchthatoneofitsbaseedgeparalleltoVP.Itiscutbyaplane,inclinedat60toHPandpasse sthroughapoint35mmfromtheapex.Drawthedevelopment of thelateralsurfaceofthepyramid.
6. Anobjectconsistsofahemisphericalvesselof80mmdiameterwhichisplacedcentrallyove racylinderof50mmdiameterandheightof60mm.thecylinderinturnisplacedcentrallyove rasquareprism of60mmbasesideand20mmhheight.Draw theisometricprojection oftheobject.
7. Drawthedevelopmentofthelateralsurfaceofthelowerportionofacylinderofdiameter50

mmandaxis70mm.

thesolidiscutbyasectionalplaneinclinedat40®toHPandperpendicularto VPandpassingthroughthemidpoint oftheaxis.

8. Drawtheisometricprojectionof the object fromtheviewshown infigure.
9. Aregularhexagonalpyramidsideofbase20mmandheight60mmisrestingverticallyonits baseonHP,suchthattwoofthesidesofthebaseareperpendiculartheVP.Itiscutbyaplanein clinedat40®toHPandperpendiculartoVP.Thecuttingplanebisectstheaxisofthepyramid .Obtainthedevelopment ofthelateralsurfaceofthetruncatedpyramid.
10. Acylinderof50mmdiameterand75mmheightstandswithitsbaseonHP.Itiscutbyasection planeinclinedat45®toHPandperpendiculartoVPpassingthroughapointontheaxis20m mbelowthetopend.Drawtheisometricprojectionat thetruncatedcylinder.
11. Acylinderofdiameter40mmandheight50mmisrestingverticallyononeofitsendsontheH P.ItiscutbyaplaneperpendiculartotheVPandinclinedat30®tothe HP.Theplane meetsthe axisatapoint 30mm fromthe base.Drawthedevelopmentofthelateralsurfaceofthelowerportionofthetruncatedcylind er.
12. Ahexagonalprismofbaseside20mmandheight40mmhasasquareholeofside16mmatcen ter.Theaxisofthesquareandhexagoncoincide.Oneofthefacesofthesquareholeisparallelt othefaceofthehexagon.Drawtheisometricprojectionoftheprismwith holeof fullscale.

UNIT V

FREEHAND SKETCHINGAND PERSPECTIVEPROJECTION

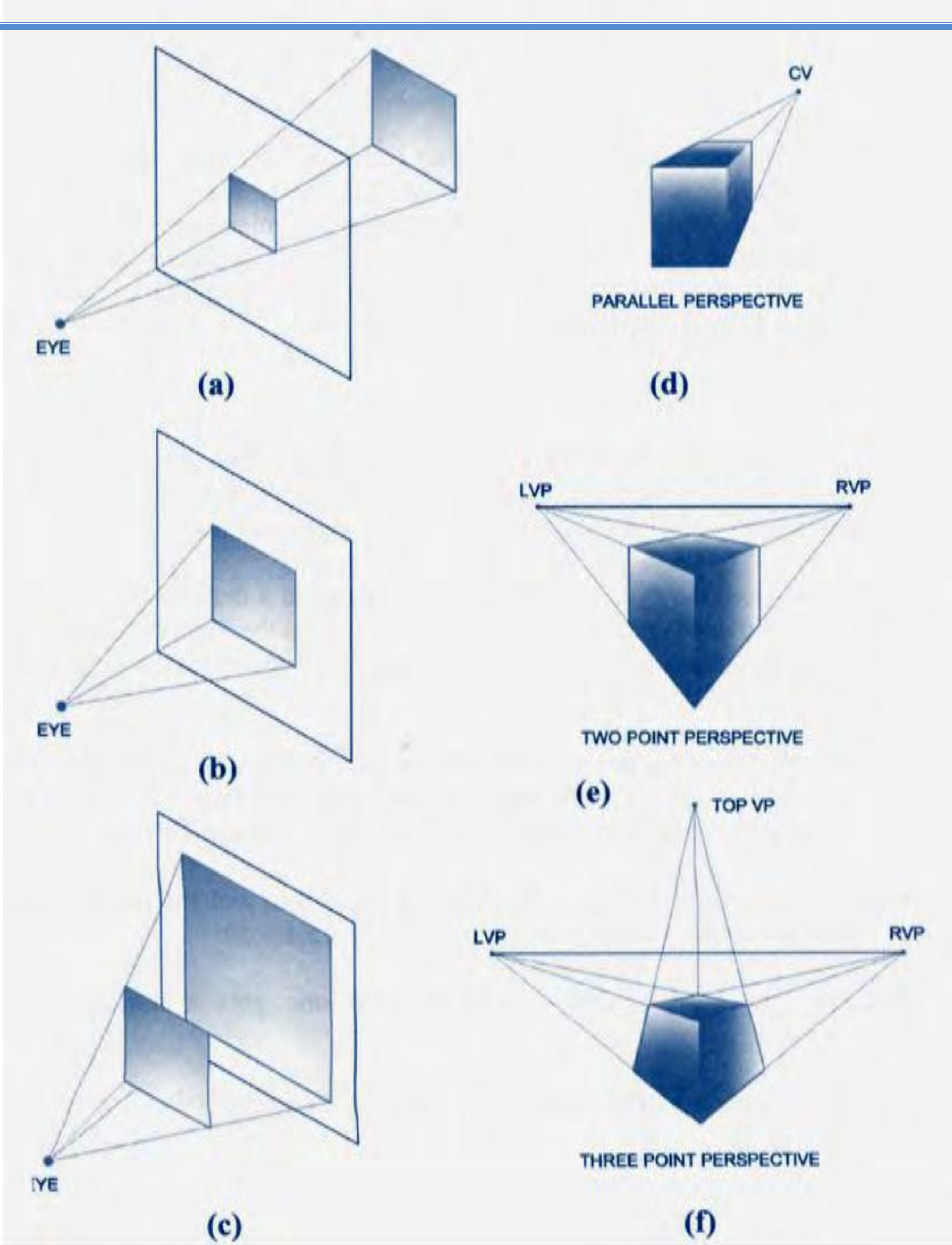
FreeHandsketchingoffrontview,topviewand asuitable sideview ofsimplecomponents fromtheirisometricviews.Normalperspectiveofprism,pyramid, cylinder&cone in verticalpositionbyvisual raymethodonly.

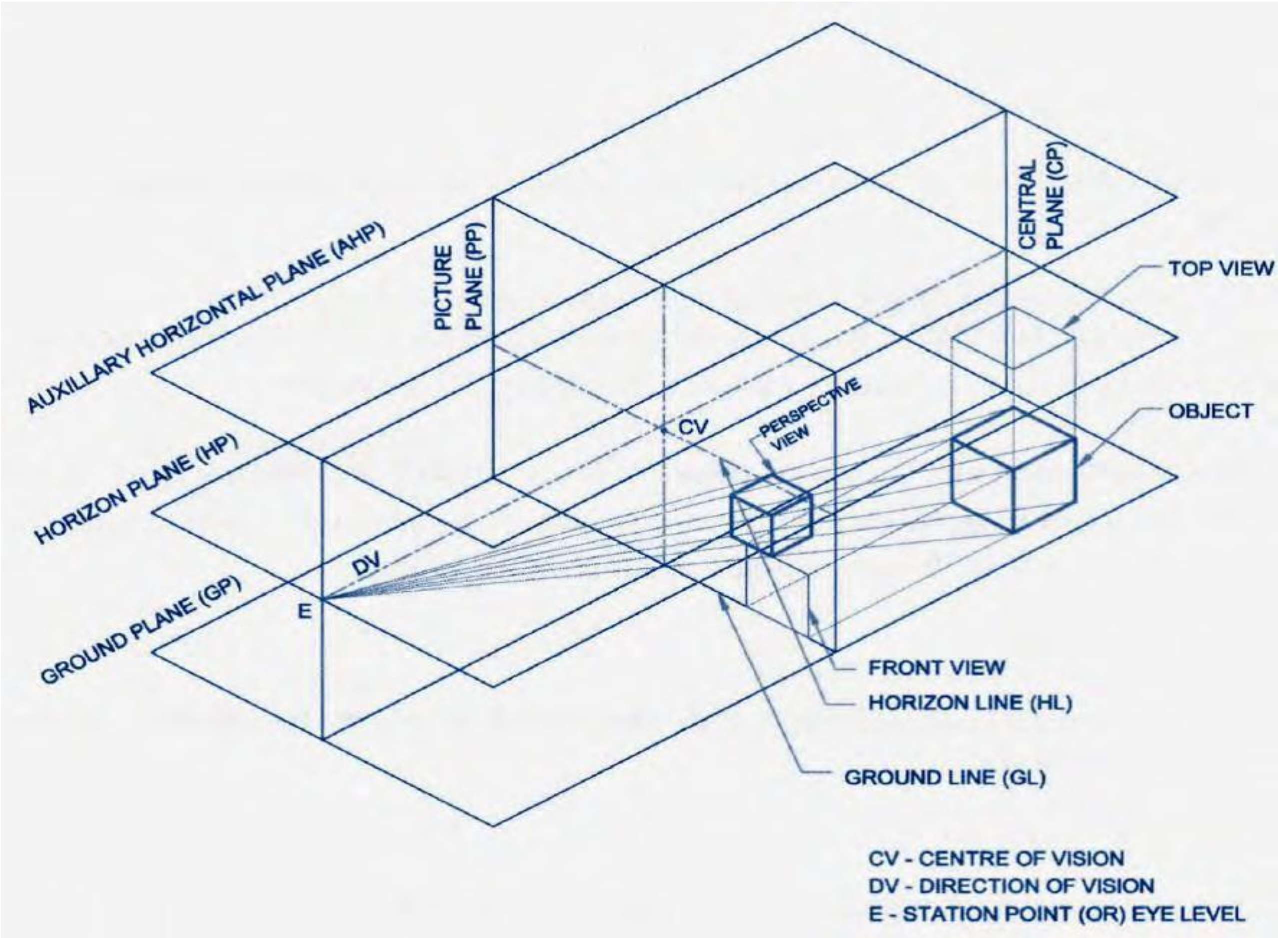
UNIT-V

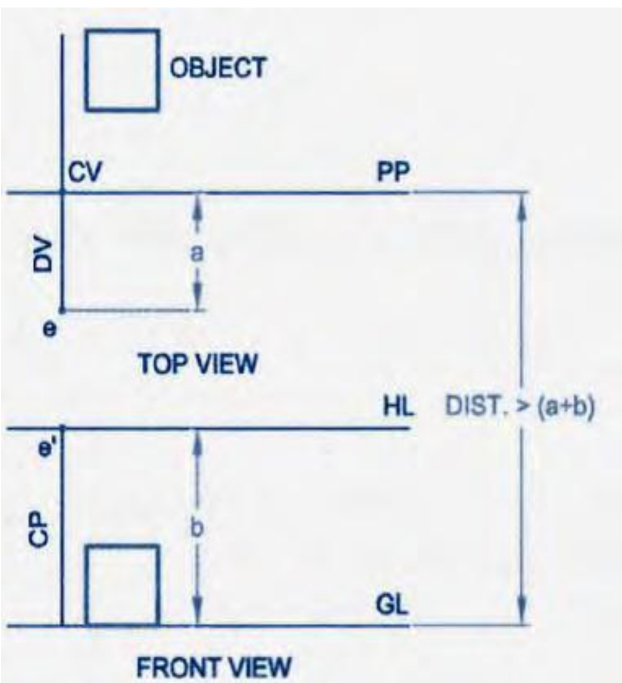
PerspectiveProjection:

The perspective projection, alsosometimescalledscenographicprojection orcentralprojection, is the form ofpictorialdrawingwhichmostnearlyapproachesthepicturesasseenb ythe eyes.

Perspectiveprojectionis sometimescalled**scenographicprojection orcentralprojection,**since the linesofsight convergetoasingle point or centre.Perspectiveobtained willdependontherelative positionofthe object,pictureplane and pointofsight. Inthis projection, the eyeis assumedtobesituatedata definiteposition relativetotheobject.Thepicture plane(verticalplane) isplacedbetweentheobjectand the eye.Visualraysfromthe eyetotheobjectpierce the pictureplaneandforman imageon it. Thisimageis knownas**perspective**ofthe object.


EYE
(a)
EYE
(b)
YE
(c)
CV
PARALLEL PERSPECTIVE
(d)
LVP
RVP
TWO POINT PERSPECTIVE
(e)
TOP VP
LVP
RVP
THREE POINT PERSPECTIVE
(f)


AUXILLARY HORIZONTAL PLANE (AHP)
PICTURE PLANE (PP)
CENTRAL PLANE (CP)
TOP VIEW
OBJECT
PERSPECTIVE VIEW
CV
HORIZON PLANE (HP)
DV
E
GROUND PLANE (GP)
FRONT VIEW
HORIZON LINE (HL)
GROUND LINE (GL)
CV - CENTRE OF VISION
DV - DIRECTION OF VISION
E - STATION POINT (OR) EYE LEVEL


OBJECT
CV
PP
DV
a
e
TOP VIEW
HL
DIST. > (a+b)
e'
CP
b
GL
FRONT VIEW

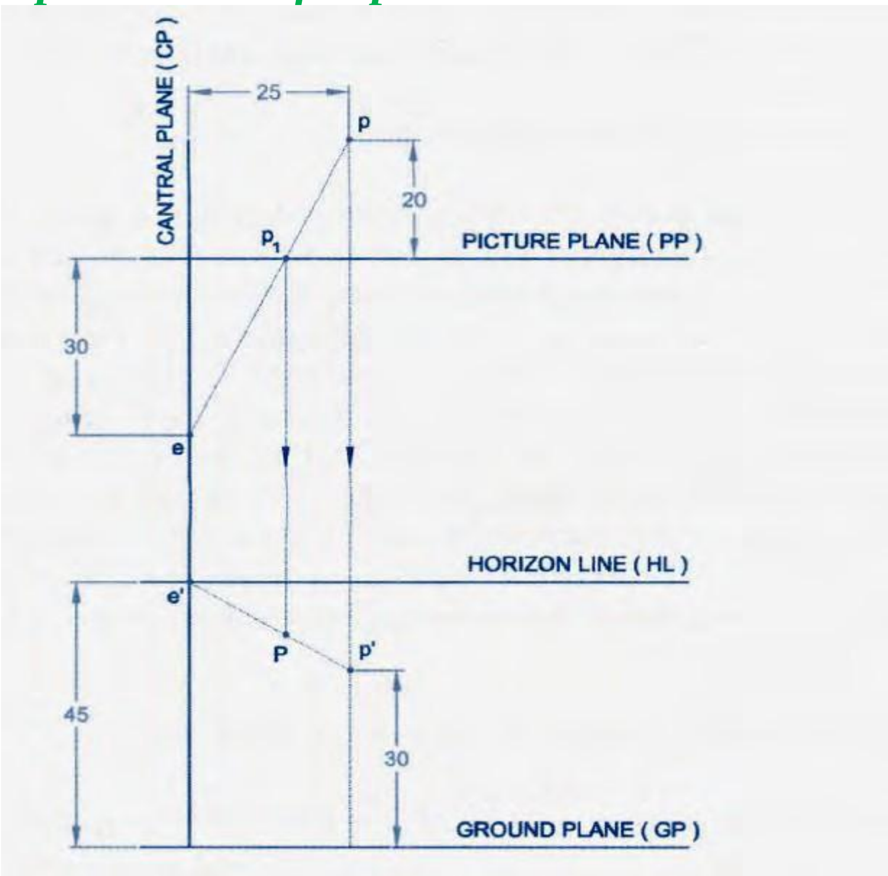
VisualRayMethod:

Thepoints at whichthevisual rays joiningthe stationpoint andtheobject piercesthepicture plane in both the top and profileviews,areprojectedtointersecteachothertogivepointsintheperspective. Since the perspectiveviewis obtained bytheintersectionofthevisualray, thismethod is called VisualRayMethod.

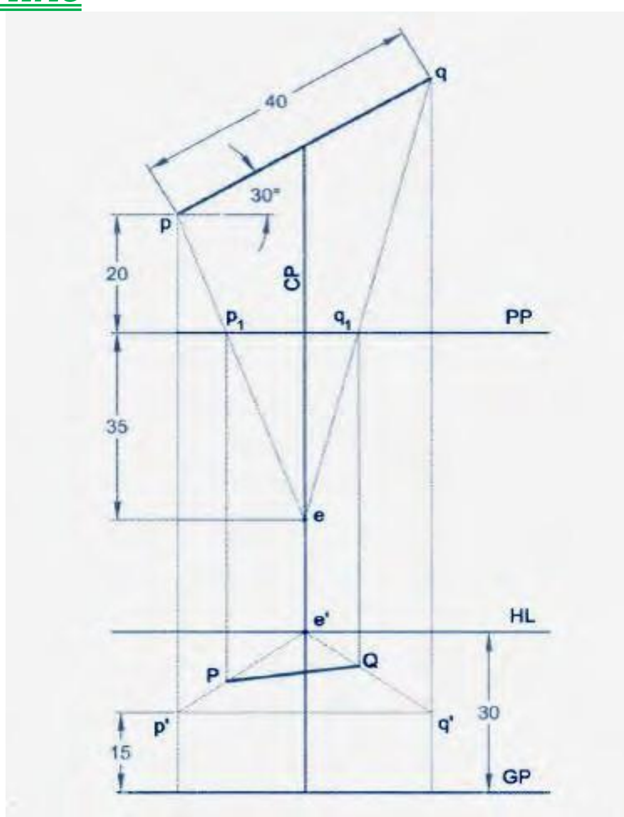
IMPORTANCEPOINTIN VISUALRAY METHOD:

1. Draw the PP linetorepresentthepictureplane inthetopview
2. DrawtheplanoftheobjectbasedonitspositionwithrespecttothePP
3. DrawtheGroundPlane,theGPatanyconvenientdistancefromPPandprojectthefrontviewbasedonthepositionofobject withrespecttoGP.
4. Locatethepositionofthecentralplanewithrespecttotheobjectandrepresentitasalineinbothþví views.Onitmarkthetopview(s)andfront view(s')ofthestationpointbasedon this positionwithrespect toPP andGP.
5. JoinallplanpointswithsandnotetheinterceptsofeachlinewithPP line
6. Fromeachintercept,withPP,drawprojectorverticallytillitmeetsthe linejoiningtheelevationofthecorrespondingpointands' togetthe perspective.
7. Followtheabovesteptogettheperspectiveofotherpointsoftheobject
8. Joinallthesepointsinpropersequencetogettheperspectiveofthe objective

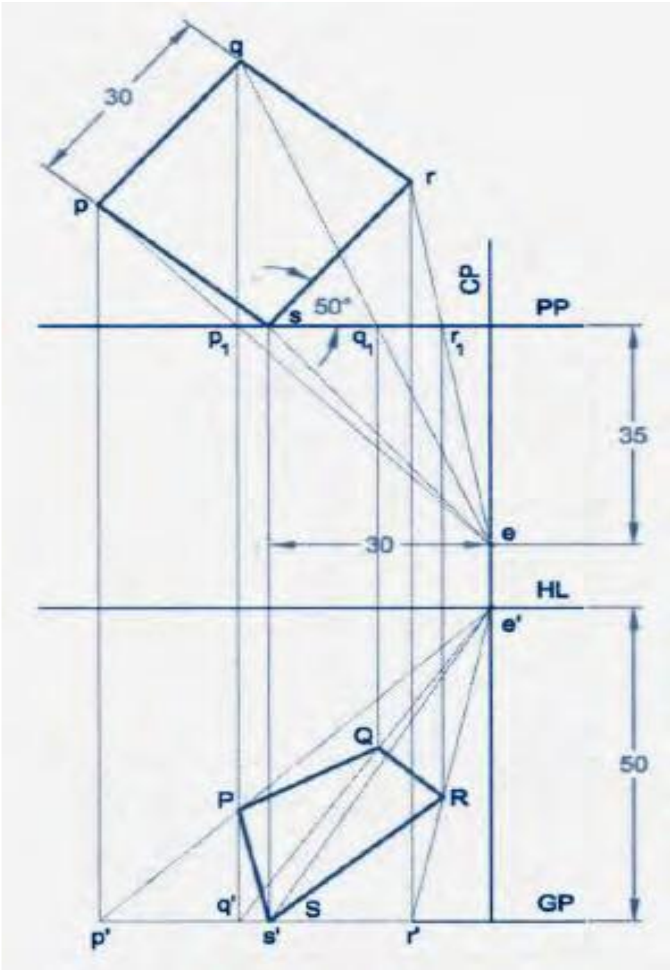
Perspective viewofthepointP.

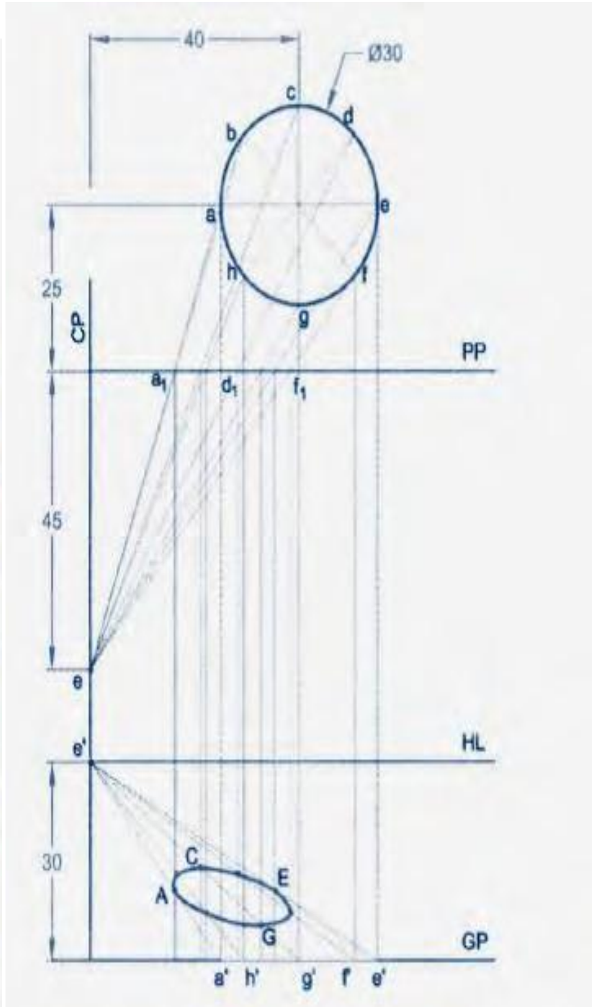


Perspective viewofline



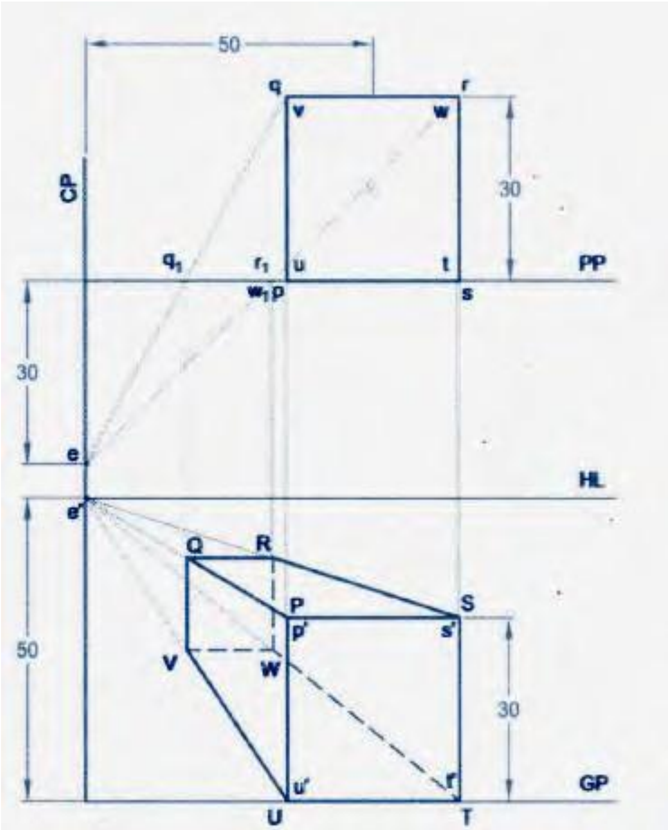
Perspective viewofplane

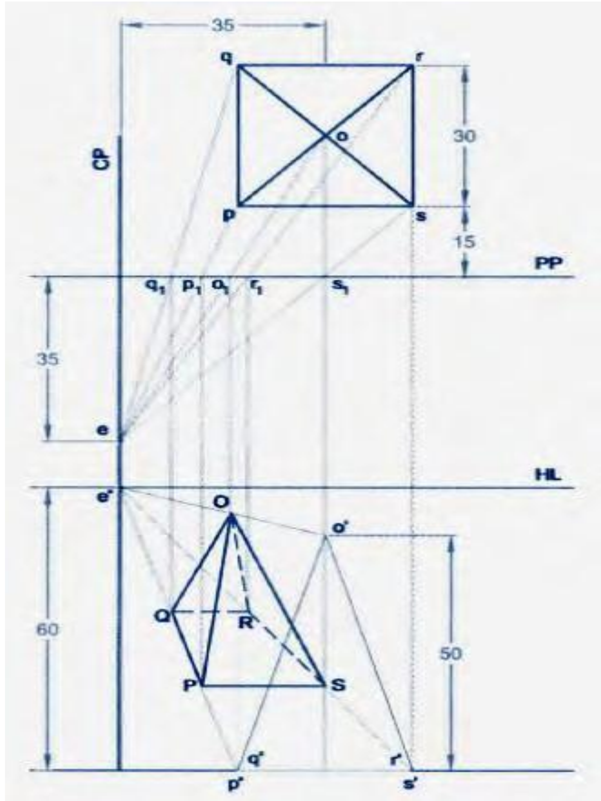




Perspective viewofsquareprism&pyramid

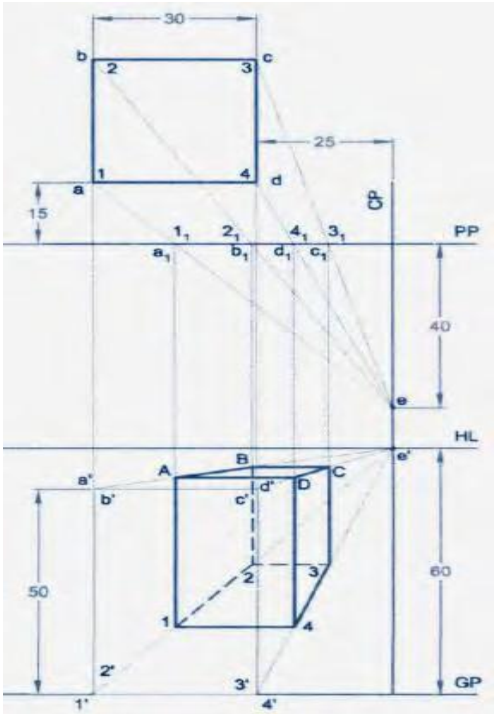
(Restingon theground ononeof itsfaces /onthegroundverticallywith anedge ofbaseparallel)

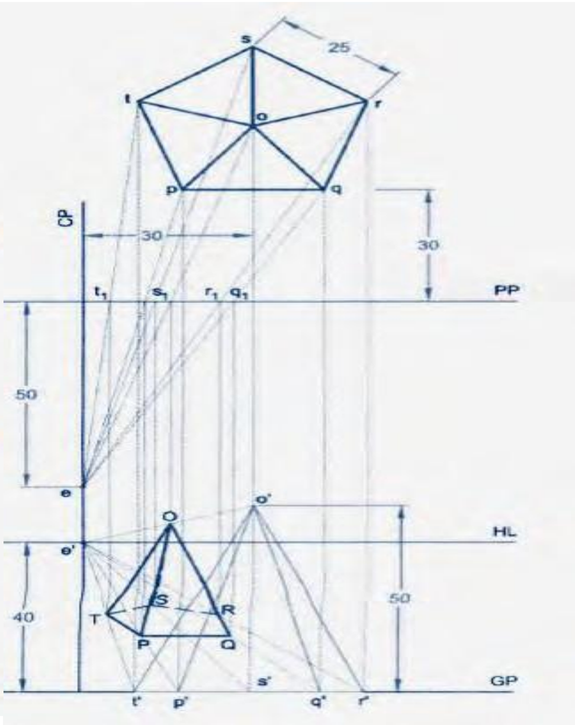


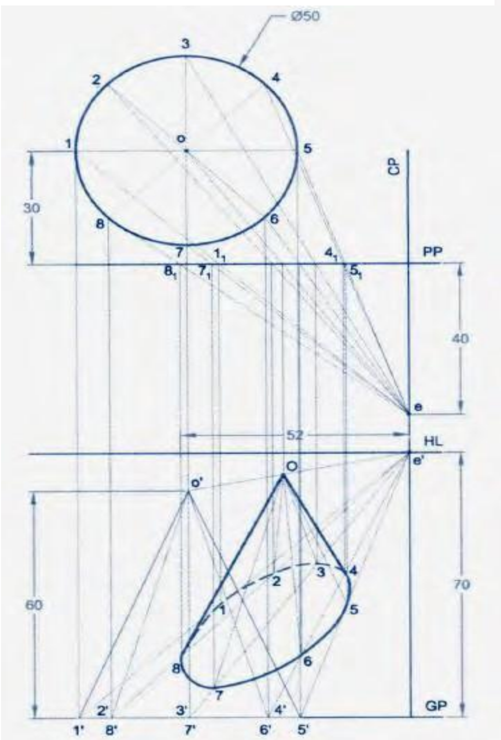


On theground on its basewithafaceparallel

Perspective view ofCONE

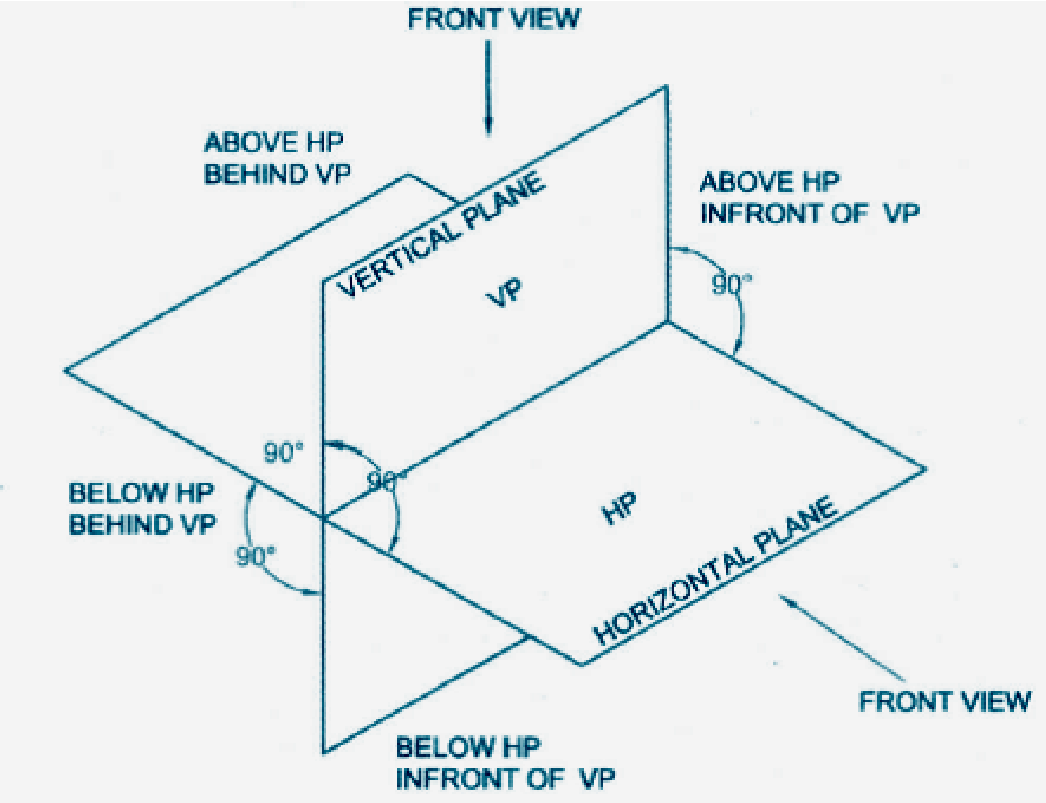




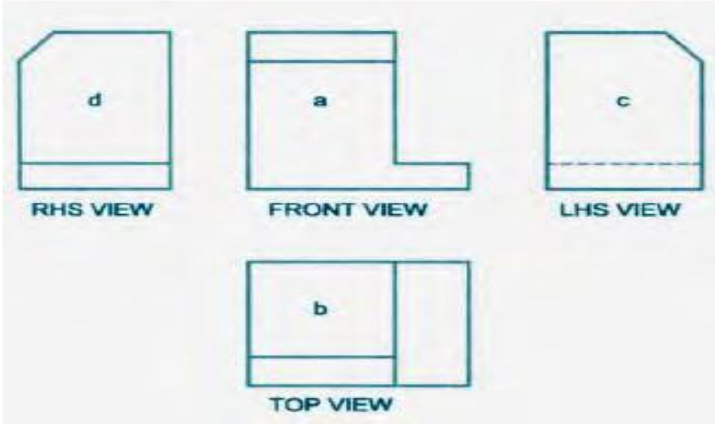


FreeHand Sketching:

Inorderto achievea complete shapedescription,itisnecessarytogetmorethan oneprojection, andtherefore,additionalplanesofprojectionareusedtoprojectmoreviews onthem,forthe object.Assuch, the orthographicsystem ofprojectionis also calledmulti-viewprojectionmethod.

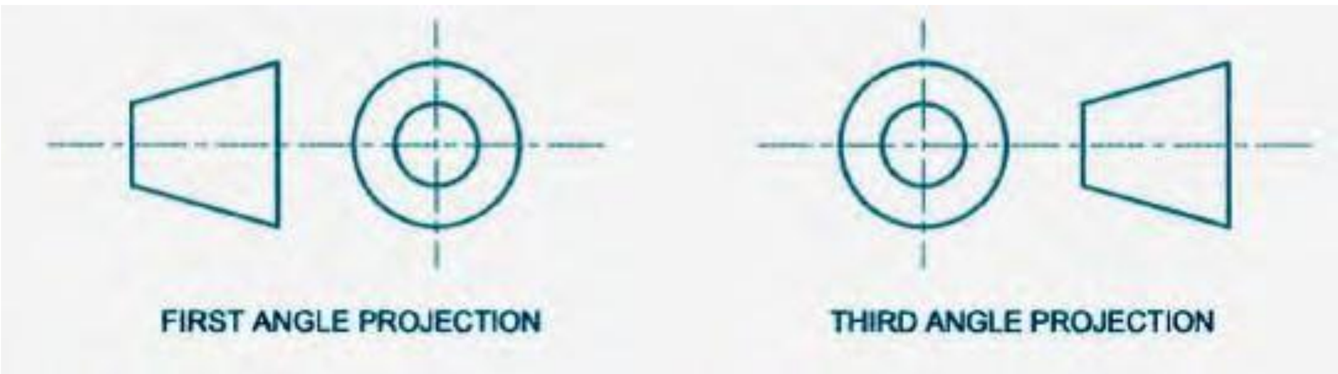


Intheorthographicprojectiondrawing,forgettingthedifferentviewsofanobject,threemainplanesareusuallyused.Oneofthesesetupinverticalpositioniscalledtheverticalplaneofprojection(VP)orFrontalPlane(FP).Thesecond,setupinhorizontalposition,i.e.,perpendiculartotheVP,iscalledHorizontalPlane(HP).Thethird,planesetupperpendiculartothevertical andhorizontalplanesiscalled Profile Plane(PP).

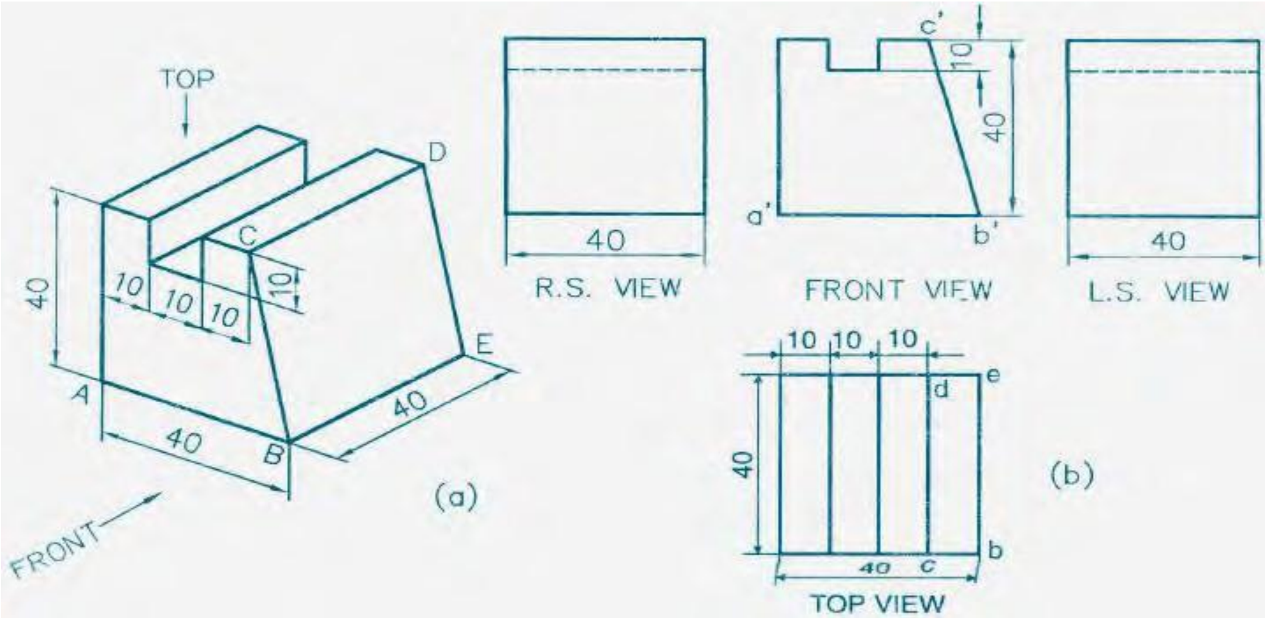


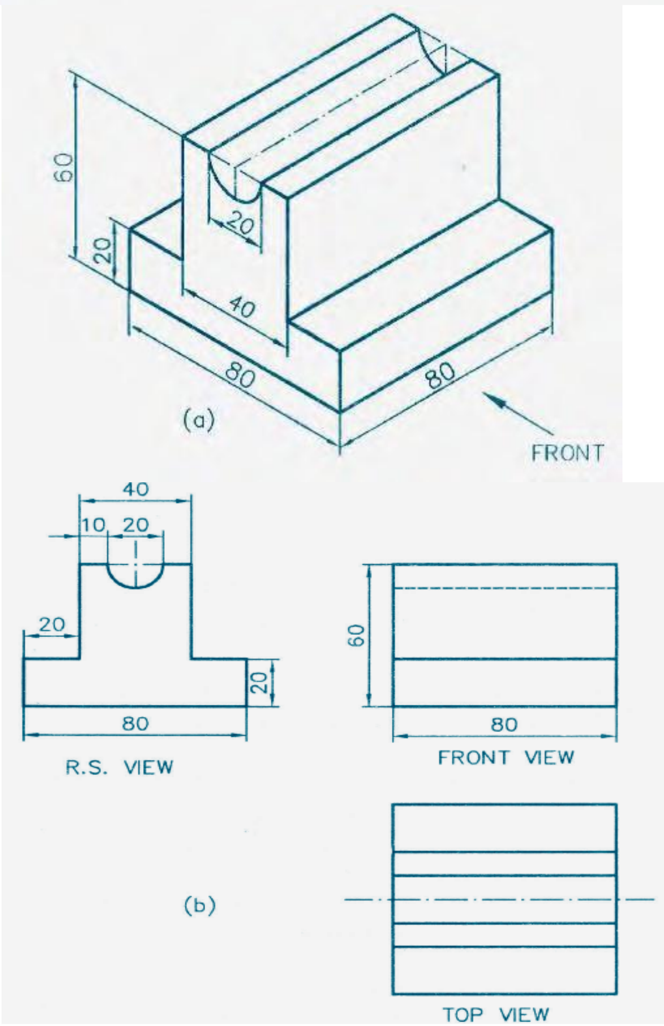
FIRSTANGLEPROJECTION

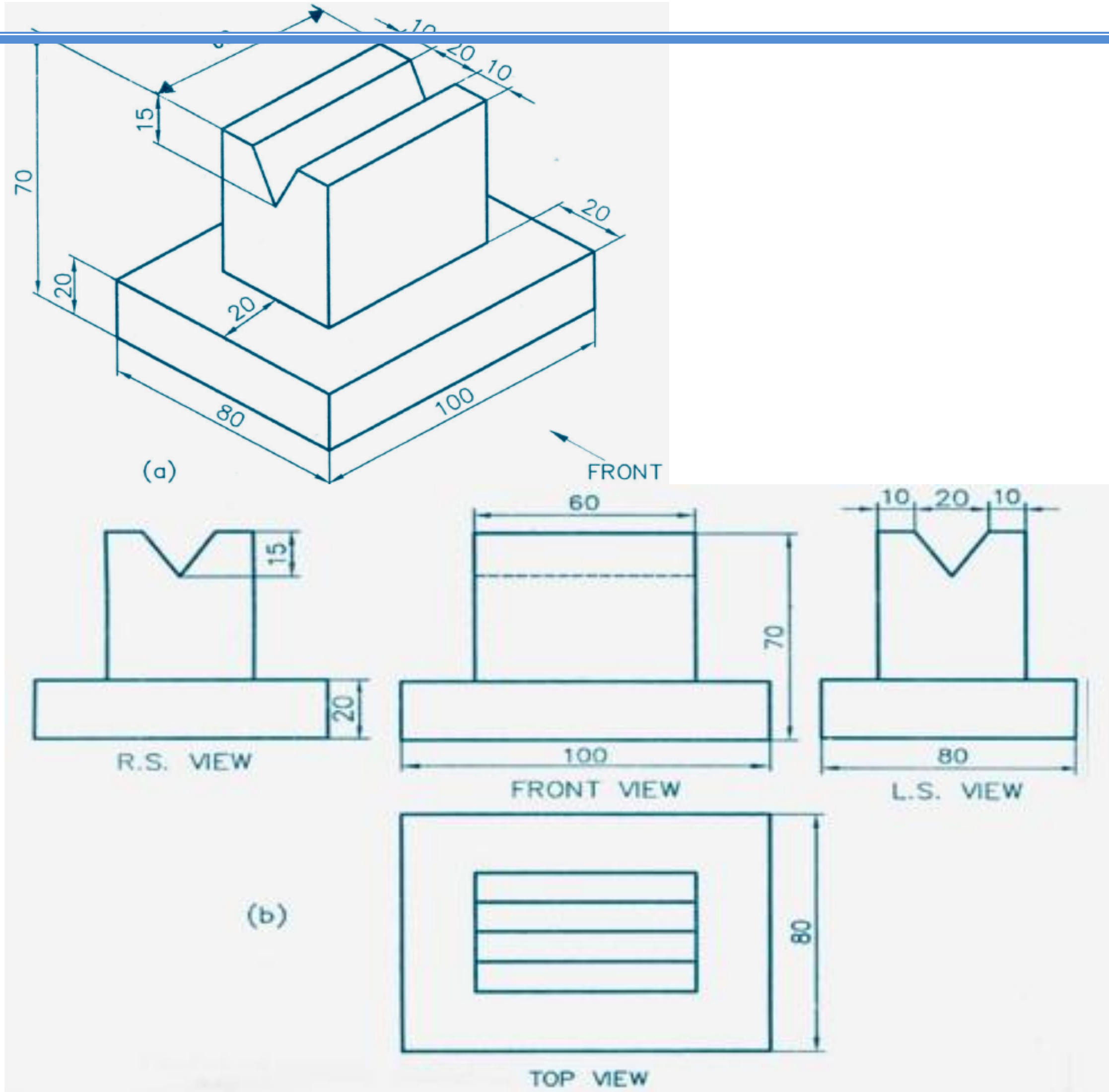
Symbolofprojection

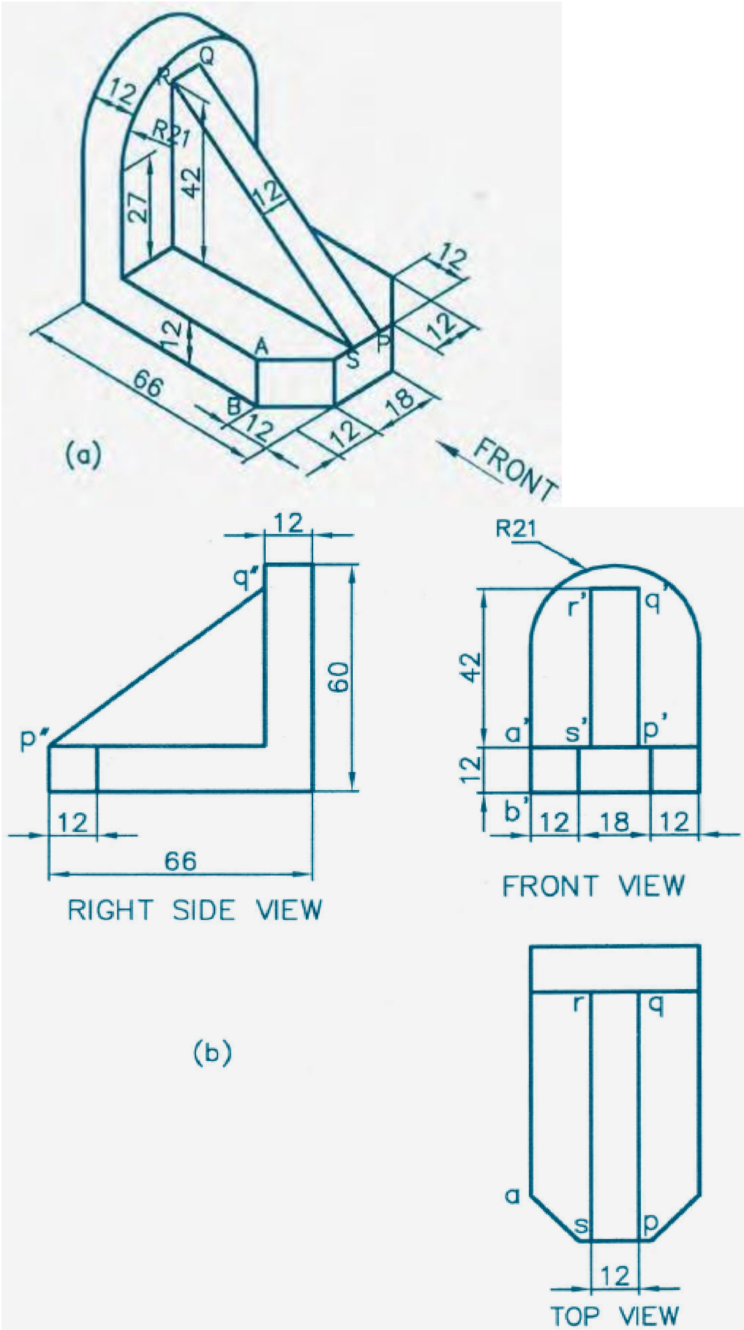


Inthefirstangleprojection,theprofileviewisprojectedontheoppositeside,i.e.,Leftviewisprojectedontherightplaneandviceversa,whereasinthethirdangleprojection,itisprojectedonthesame sideplane i.e.,leftview is projectedon the leftplane.

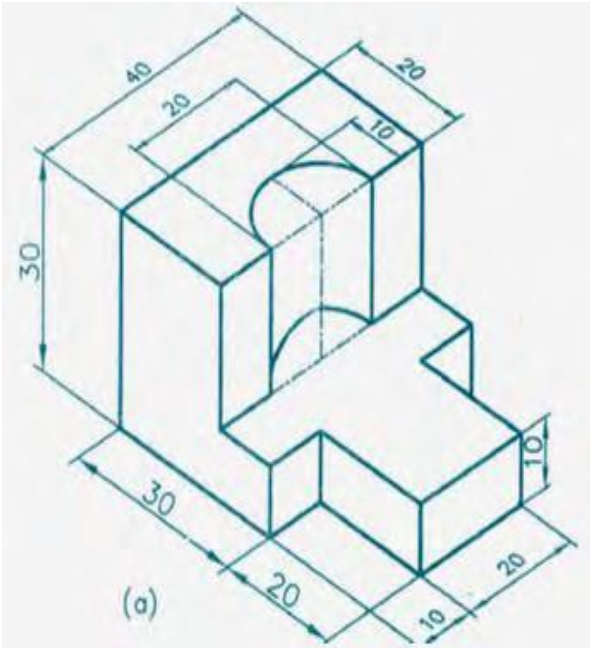

TOP
FRONT
A
B
C
D
E
40
10
10
10
10
40
40
(a)
R.S. VIEW
FRONT VIEW
L.S. VIEW
c'
a'
b'
10
40
40
40
TOP VIEW
10
10
10
d
e
b
c
40
40
(b)

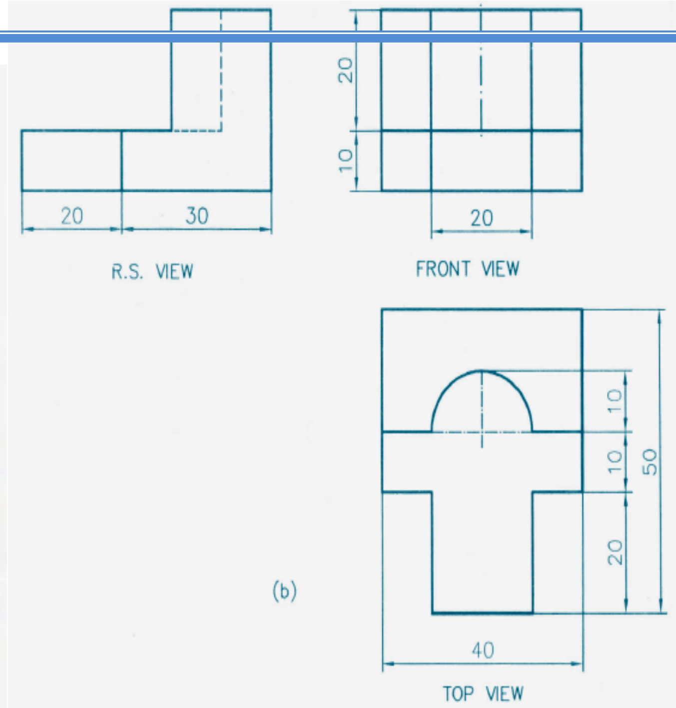

60
20
20
40
80
80
(a)
FRONT
40
10
20
20
20
80
R.S. VIEW
60
80
FRONT VIEW
TOP VIEW
(b)

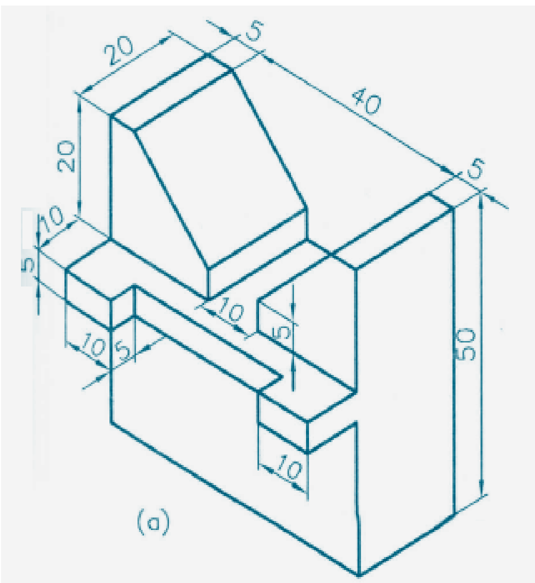

70
15
10
20
10
20
20
20
80
100
(a)
FRONT
60
10
20
10
15
70
20
R.S. VIEW
100
FRONT VIEW
80
L.S. VIEW
(b)
80
TOP VIEW

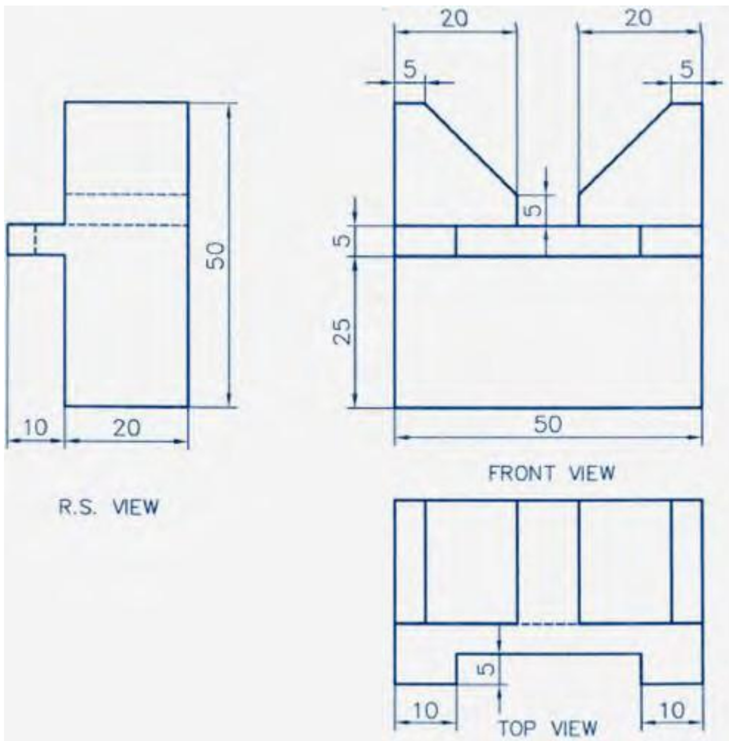


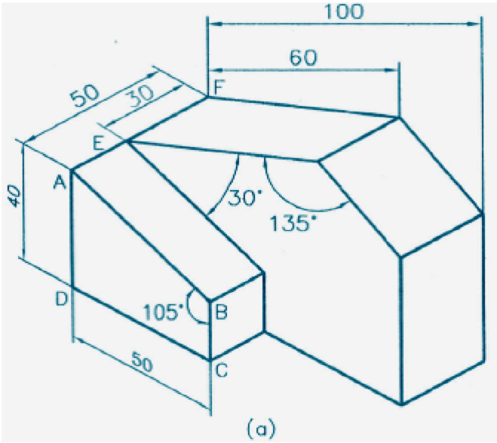
R
Q
12
R21
27
42
12
12
12
12
A
S
P
66
B
12
12
18
(a)
FRONT
12
q″
60
p″
12
66
RIGHT SIDE VIEW
R21
r'
q'
42
a'
s'
p'
12
b'
12
18
12
FRONT VIEW
r
q
(b)
a
s
p
12
TOP VIEW

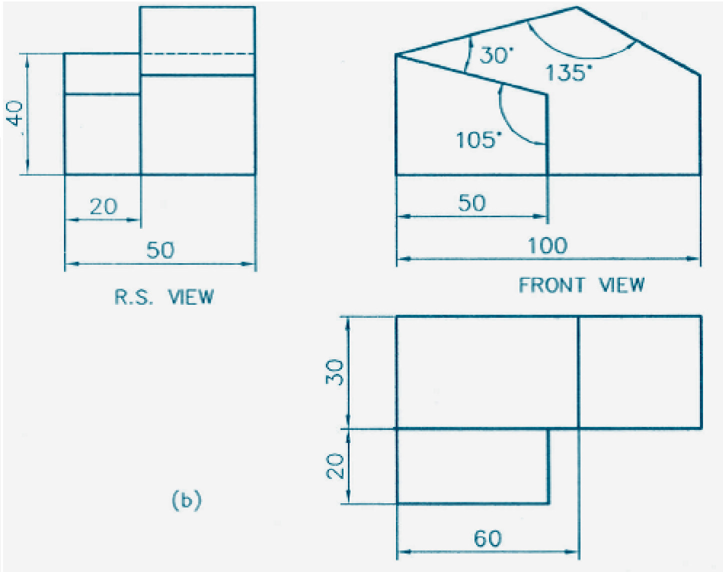

40
20
20
10
30
10
30
20
20
10
(a)

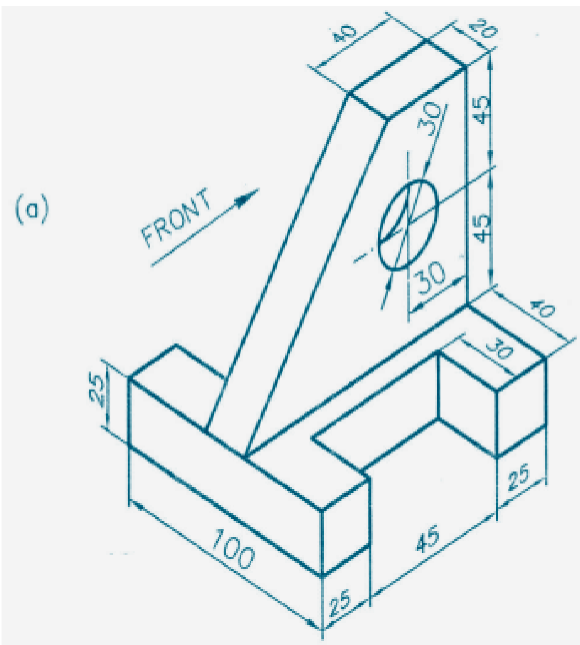

20
30
R.S. VIEW
20
10
20
FRONT VIEW
(b)
10
10
20
50
40
TOP VIEW

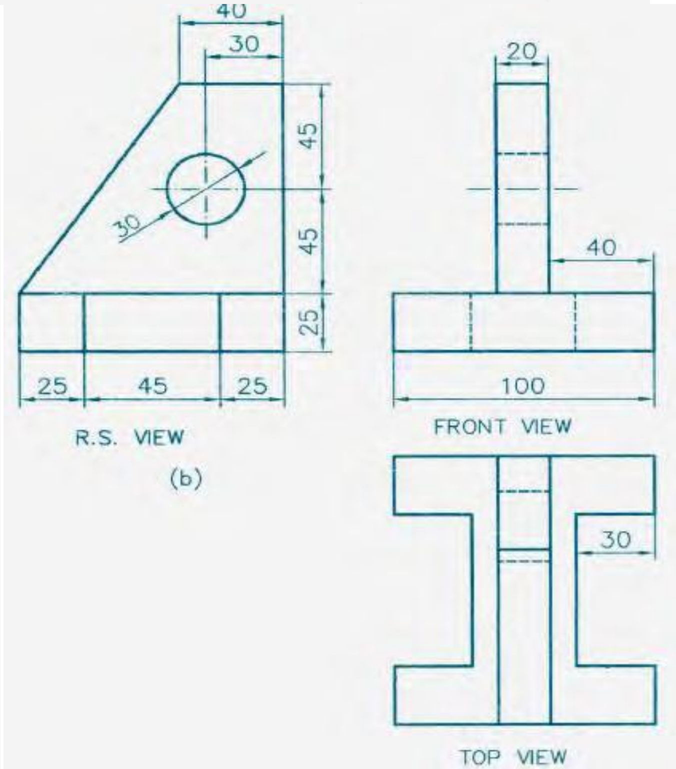

20
5
40
20
5
10
5
10
5
10
5
50
10
(a)

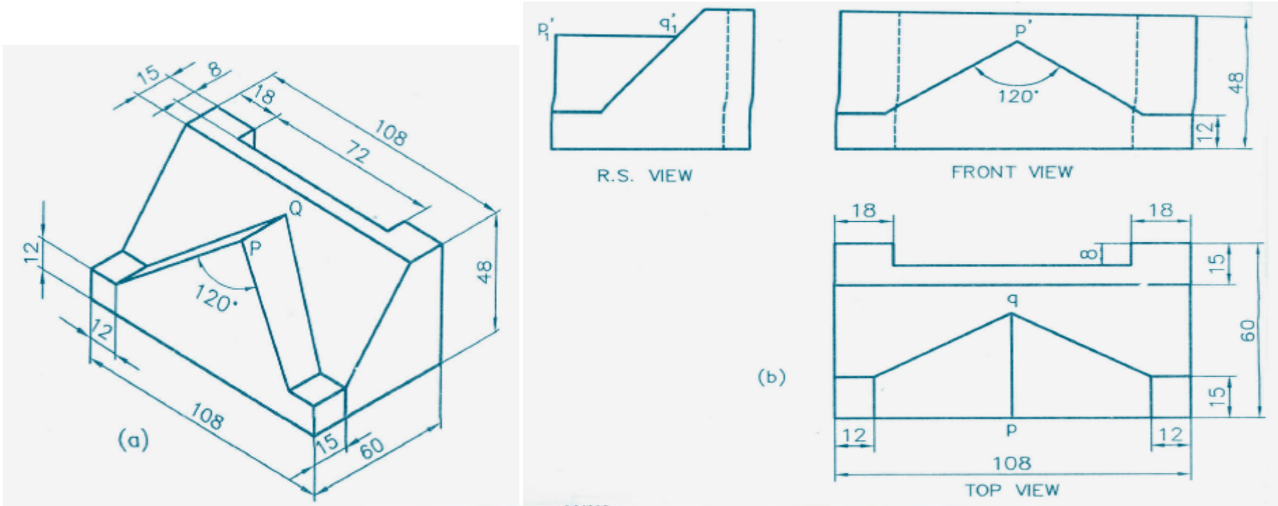

50
10
20
R.S. VIEW
20
20
5
5
5
5
25
50
FRONT VIEW
5
10
10
TOP VIEW

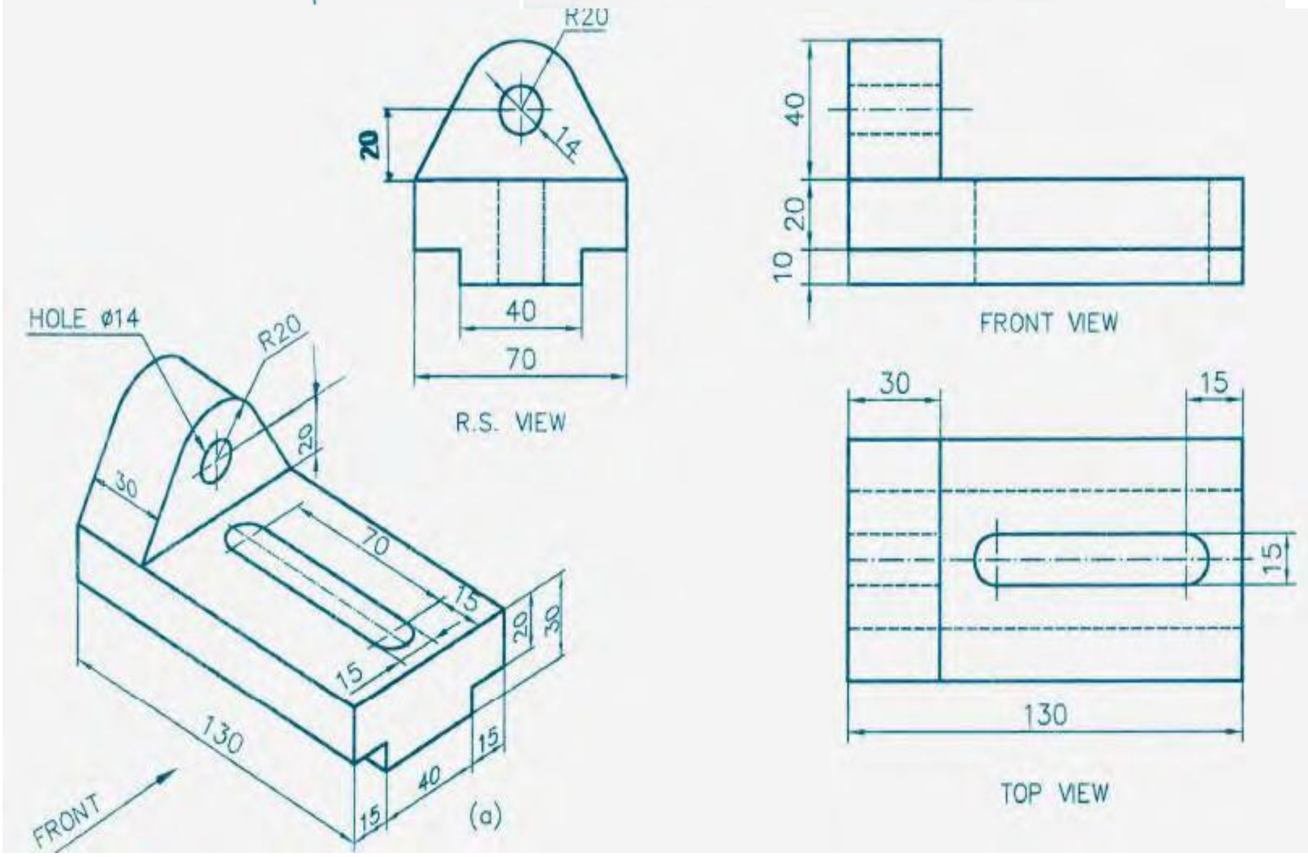

100
60
50
30
F
E
A
40
30°
135°
D
105°
B
C
50
(a)

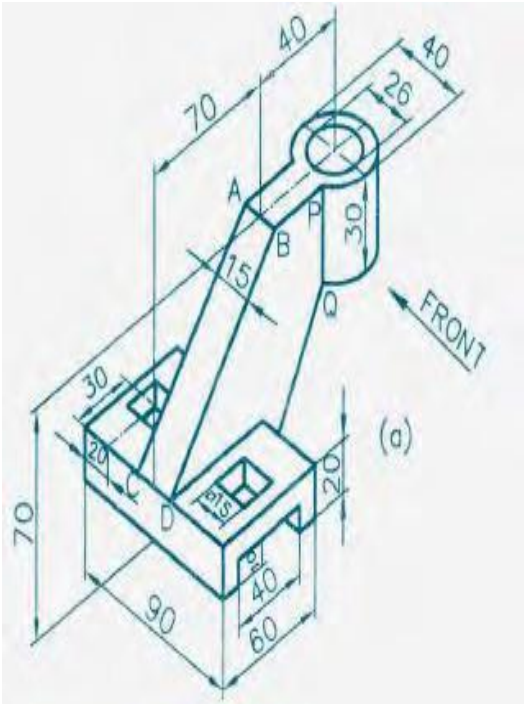

40
20
50
R.S. VIEW
30°
135°
105°
50
100
FRONT VIEW
30
20
60
(b)


(a)
FRONT
40
20
45
30
45
30
40
30
25
100
25
45
25

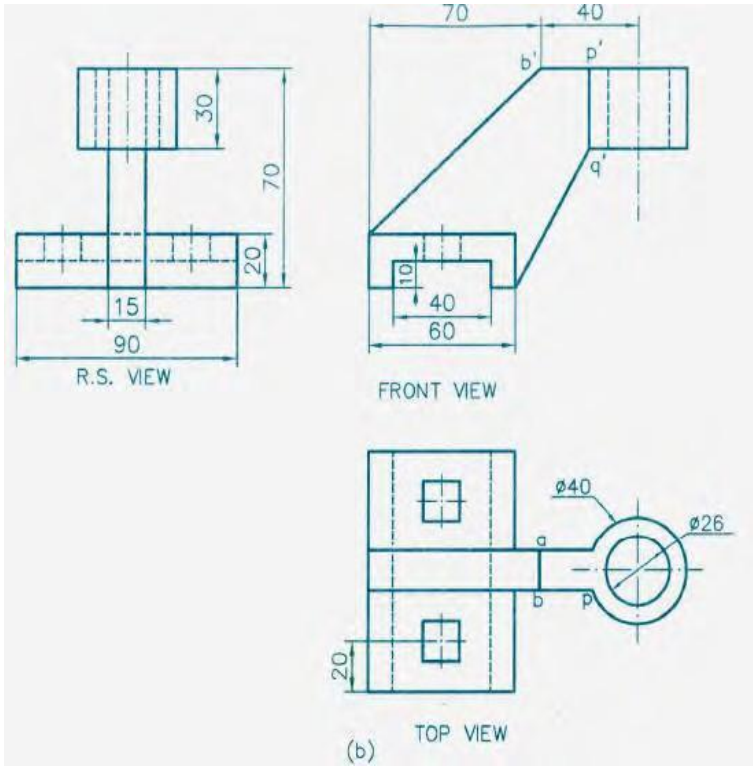

40
30
45
30
45
25
25
45
25
R.S. VIEW
(b)
20
40
100
FRONT VIEW
30
TOP VIEW


(a)
(b)
R.S. VIEW
FRONT VIEW
TOP VIEW
120°
108
72
60
48
18
15
12
8
P
Q


HOLE ø14
R20
FRONT
(a)
R.S. VIEW
FRONT VIEW
TOP VIEW
130
70
40
30
20
15
14
10



40
70
40
26
A
B
P
30
15
Q
FRONT
30
20
C
D
15
15
20
70
40
90
60
(a)



30
70
20
15
90
R.S. VIEW
70
40
b'
p'
q'
10
40
60
FRONT VIEW
Ø40
Ø26
a
b
p
20
TOP VIEW
(b)

Important Questions

1. Aregularhexagonalpyramidofbaseedge20mmandheight35mmrestsonitsbaseonthegroundplanewithoneofitsbaseedgestouchingthepictureplane.Thestationpointis30mmabovethegroundplaneand40mminfrontofthepp.thecenterplaneis30mmtotherightoftheaxis.Drawtheperspectiveprojectionof thepyramid.
2. Drawbyfreehand,frontview(fromX),topviewandasuitablesideviewoftheobjectshown infigure1.Addnecessarydimensions ofthepart.
3. Asquareprismof25mmsideofbaseandheight40mmrestswithitsbaseongroundsuchthatoneoftherectangularfacesisinclinedat30®tothepictureplane.Thenearestverticaledgetouchesthepictureplane.Thestationpointis50mminfrontofthepictureplane,60mmabovethegroundandliesoppositetothe nearestverticaledge the touchesthe pictureplane. Draw the perspectiveview.
4. Drawthefront,topandsideviewsoftheisometricviewoftheobjectshowninfigure 1.
5. Draw the perspective view ofa squareprismofedgeofbase 40mmandlength60mmlyingonarectangularfaceontheground,withacorneronPPandthebasesequallyinclinedtoPP.thestationpointis60mminfrontofPPand80mmaboveGLandliesinacentralplane,whichispassingthroughthecentreoftheprism. Makefreehandsketches offront,topand rightsideviews ofthe3D objectshownblow
6. Drawtheperspectiveprojectionofacubeof25mmedge,lyingonafaceonthegroundplane,withanedgetouchingthepicture planeandall vertical facesequallyinclinedtothepictureplane.Thestationpointis50mminfrontofthe

pictureplane,35mmabovethegroundplaneandliesinacenterplanwhichis10mmtot heleftofthecube.

7. Makefreehandstretchesofthefront,topandrightsideviewoftheobjectshown below.
8. Drawtheperspectiveprojectionofacubof25mmedge,lyinginafaceonthegroundpl ane,withanedgetouchingthepictureplaneandallverticalfacesequallyinclinedtoth epictureplane.Thestationpointis50mminfrontofthepictureplane,35mmabovethe groundplaneandplaneandliesinacentralplanewhich is 10mmto theleftofthecentreof thecube.
9. Drawthefront, top,and rightsideviewof theobjectshown below.
10. Aregularhexagonalpyramidofbaseedge20mmandheight35mmrestsonitsbaseont hegroundplanewithoneofitsbaseedgestouchingthepictureplane.Thestationpoint is30mmabovethegroundplaneand40mminfront ofthePP.thecenterplaneis30mmtotherightoftheaxis.Drawtheperspectiveprojecti onof thepyramid.

KEYPOINTS&NOTATIONS

IMPORTANT NOTATIONINENGINEERINGGRAPHICS

HP meanstheHorizontalPlaneVP

meanstheVertical PlaneFV

meanstheFrontView

TV means theTop

ViewSV

meanstheSideView

STV means theSectional

TopViewGR means theGround

TL means theTrueLengthCP

meanstheCutting Plane

PPP means thePicture Planefor PerspectiveProjection.

KEYPOINTSABOUTTHEPROJECTIONSOFPOINTS:

1. *Thefrontviewandthetopviewofapointarealwaysonthesameverticalline.*

2. *ThedistanceofthefrontviewofapointfromtheXYlineisalwaysequaltothedistanceof thegivenpointfromtheHP.*

3. *Ifagivenpointisabovethe*Hp*,itsfrontviewisabovetheXYline.Ifthegivenpoint isbelow the*Hp*,its frontview is belowtheXYline.*

4. *ThedistanceofthetopviewofapointfromtheXYlineisalwaysequaltothedistanceof thegiven point fromtheVP.*

5. *Ifagivenpointis infrontoftheVP,itstopview isbelowtheXYline. Ifthegivenpoint isbehind theVP,its topviewis abovetheXYline.]*

KEYPOINTSABOUTTHEPOSITIONSOF A POINTANDITSPROJECTIONS:

DihedralAngleor Quadrant	*PositionoftheGivenPoint*	*PositionintheFrontView*	*PositionintheTop View*
FIRST	*AbovetheHP,in frontof theVP*	*Above XY*	*Below XY*
SECOND	*AbovetheHP,behind theVP*	*Above XY*	*Above XY*
THIRD	*Below theHP,behindtheVP*	*Below XY*	*Above XY*
FOURTH	*Below theHP,infrontof theVP*	*Below XY*	*Below XY*

PROJECTIONS OFALINEINCLINED TOBOTH THE REFERENCEPLANES:

CaseI:

Ifastraightlineisprojectedwhenitisinclinedat*e*totheHPandeitherparallel totheVP or inclinedto theVP,then:

(i)) Thelengthinthetop or plan viewremains thesameand

(ii) IfoneendpointintheFVremainsatconstantdistancefrom*XY*,theotherendpointwillalsoremainatthesamedistancefromXY*,providedtheanglewiththe*HP*doesnotchange*.Inotherwords,ifpoint*A*ofastraightline*AB*isfixed,point*B*will haveits frontviewb' onapath parallel totheXYline.CaseII:

Ifastraightlineisprojectedwhenitisinclinedat*q;*totheVPandeitherparallel totheHP or inclinedto theHP,then:

(i)) Thelengthinthefront viewremains thesame and

(ii) IfoneendpointintheTVremainsataconstantdistanceandiftheanglefrom*XY* withtheVPdoesnotchange,theotherendpointwillalsoremainatthesamedistancefrom *XY*.Inotherwords,ifpoint*A*ofastraightline*AB*isfixed,point*B*will haveitstop view*b*on apath parallel tothe*XY*line.

KEYPOINTSTOREMEMBERABOUTPROJECTIONSOFPLANES:

1.Planeperpendicularto onereference planeandparallel to theother(onestep)

Ifit isparalleltotheVPand perpendicular totheHP,its front viewisdrawnwith thetrueshapeand sizeandthetop viewis a horizontalline.

*Ifit isparalleltothe*HP *and perpendicular totheVP,its top viewisdrawnwith thetrueshapeand sizeandthefrontviewis a horizontalline.*

II.*When a planeisperpendicular tooneand inclined to theother,two stepsarerequiredtodraw theprojections(two steps)*

Step I:

*Ifthegivenplaneisperpendicular to theVP and inclinedtotheHP,assumeit tobeparallel tothe*HP *inStep I. If it isperpendicular to the*HP *and inclinedto theVP,assumeit tobeparallel totheVP in Step I.Step* II: *Rotatetheplanetomakeit inclined to onereferenceplane, as required,keepingit perpendiculartotheother.*

III.*When a planeisinclinedtobothreferenceplanes,threestepsarerequiredtodrawtheprojections*

Step I:

Theplateisassumed to beparallel totheVP,perpendicular to theHP,andhaveoneof itsedges,say,A_lB_l*,perpendicular to theHP.*

Step II:

*Theplateisassumed to beinclined to theVP at anangle*Φ*,whileremaining perpendicularto the*HP.*Theotheredge,say,*A_2B_2*alsoremainsperpendicular to the*HP.*Asrelationswith the*HP *donot change,projection on* *theHP,that is,thetopview,remains asa straightlineand frontviews areat thesamedistancefromXYas thecorrespondingpointsarefromXYinStep 1.*

Step III:

*Theplateisassumed to berotatedsothatA_2B_2becomesAB,inclinedat etothe*HP.*However,noneof thelinesorpointschangestheirrelationswiththeVP.Hence,inthefront viewtheshapedoes not changeandthedistances ofvariouspointsfromtheXYlinein thetop viewremain thesamein StepIIandStep III.*

THEPOSITIONOF THE PLANETWO STEPPROBLEM:

Hint Number	Position of Plane Surface	Position of the Plane and Other Conditions in	
		Step I will be	Step II will be
1	⊥ the VP, ∠ the HP, + any line at an angle with the VP or any distance of any point from the HP and/or the VP.	⊥ the VP and || the HP + Relations with the VP	⊥ the VP, ∠ the HP + Relations with the HP
2	⊥ the HP, ∠ the VP, + any line at an angle with the HP or distance of any point from the HP and/or the VP.	⊥ the HP and || the VP + Relations with the HP	⊥ the HP, ∠ the VP + Relations with the VP
3	⊥ the VP, ∠ the HP, + *AB* || the HP or on the HP, or on ground (GR), where *AB* is one edge of the plane surface	⊥ the VP, || the HP + *AB* ⊥ the VP	⊥ the VP, ∠ the HP + *AB* || the HP or on the HP or on GR
4	⊥ the HP, ∠ the VP, + *AB* || the HP or on the VP where *AB* is one edge of the plane surface	⊥ the HP, || to the VP + *AB* ⊥ the HP	⊥ the HP, ∠ the VP + *AB* || the VP or on the VP
5	⊥ the VP, ∠ the HP + A on the GR or on the HP and two edges containing *A* are equally inclined to the HP.	⊥ the VP, || the HP + *A* at extreme left or right and edges containing *A* equally inclined to VP	⊥ the VP, ∠ the VP+ *A* on GR or the HP
6	⊥ the HP, ∠ to VP + *A* on the VP and two edges containing *A* are equally inclined to the VP.	⊥ the HP, || the VP + *A* at the extreme left or right and two edges containing *A* equally inclined to the HP	⊥ the HP, ∠ the VP + *A* on the VP

THEPOSITION OFTHE PLANE FOR THREE-STEP PROBLEMS:

Hint Number	Position of Plane Surface	Position of the Plane Surface and Other Conditions in		
		Step I	Step II	Step III
1	Plane $\angle\theta$ to the HP, AB on the GR or on the HP or || to the HP and AB at $\angle\varphi$ to the VP + any distance from the HP and/or the VP.	Plane || to the HP $AB \perp$ the VP	Plane at $\angle\theta$ to the HP, AB on the GR or on the HP or || to the HP distance from the HP	φ_{AB} Distance from the VP
2	Plane at $\angle\varphi$ to the VP, AB on the VP or || to the VP and AB at $\angle\theta$ to HP + any distance from the HP and/or VP.	Plane || to the VP $AB \perp$ the HP	Plane at $\angle\varphi$ to the VP, AB || the VP or on the VP + distance from the VP	θ_{AB} Distance from the HP
3	Plane at $\angle\theta$ to the HP, A on the GR or on the HP and edges containing A equally inclined to the HP or not + one edge at $\angle\beta$ to XY or $\angle\theta$ to the VP	Plane || to the HP. A at extreme left or right + edges containing A equally inclined to the VP, if they are to be equally inclined to the HP	Plane at $\angle\theta$ to HP, A on the GR or on the HP	Edge at $\angle\varphi$ to VP Or at $\angle\beta$ to XY
4	Plane at $\angle\theta$ to the VP, A on the VP and edges containing A equally inclined to the VP or not + one edge $\angle\alpha$ to XY or $\angle\theta$ to the HP	Plane || to the VP. A at extreme left or right + edges containing A equally inclined to the HP if they are to be equally inclined to the VP	Plane at $\angle\varphi$ to the VP, A on the VP	Edge at $\angle\theta$ to the HP or $\angle\alpha$ to XY
5	AB at $\angle\theta$ to the HP, PQ at $\angle\varphi$ to the VP, or TV of PQ at $\angle\beta$ to XY, A on GR or on HP and where AB and PQ are lines on the plane surface with AB $\perp$ PQ	Plane || the HP AB || the VP PQ $\perp$ the VP	AB at $\angle\theta$ to the HP A on GR on the HP	PQ at $\angle\varphi$ to VP or TV of PQ at $\angle\beta$ to XY

Projections of Solids:

Fordrawingprojectionsofsolids,onehastofrequentlydrawprojectionsoflineseitherparalleltotheHPortheVPandinclinedtotheotherwithananglethatisbetween0to90°.Similarly,sometimes,theprojectionsofplanesurfacesPerpendiculartooneandinclinedtotheotherarerequiredtobedrawn.

IMPORTANCE POINTSOF PROJECTIONOF LINES

Position of line	Front view (FV)	Top view (TV)	Side view (SV)
i) ⊥ the HP, || the VP, || the PP	Vertical line	Point	Vertical line
ii) ⊥ the VP, || the HP, || the PP	Point	Vertical line	Horizontal line
iii) ⊥ the PP, || the HP, || the VP	Horizontal line	Horizontal line	Point
iv) || the HP, $\angle\varphi$ the VP, ∠ the PP	Horizontal line	Line of TL and $\angle\beta$ toXY, where $\beta = \varphi$	Horizontal line
v) || the VP, $\angle\theta$ the HP, ∠ to the PP	Line of TL and $\angle\alpha$ to XY, where $\alpha = \theta$	Horizontal line	Vertical line
vi) || the PP, $\angle\theta$ to HP, $\angle\varphi$ the VP	Vertical line	Vertical line	Line of TL and $\angle\alpha$ to XY, where $\alpha = \theta$ and $\angle\beta$ to X_1Y_1, where $\beta = \varphi$

Further,it mayberecollected that therelationsof theoriginalpoint,line,or planewiththe HParetherelationsof its FV orSV withtheXYline. Similarly,thosewith theVP aretherelationsof its TV withtheXY lineorit'sSVwith the X_1Y_1 line.

IMPORTANCEPOINTSOFPROJECTION OF PLANES:

Position of Plane	Front View (FV)	Top View (TV)	Side View (SV)
i) ∥ the HP, ⊥ the VP, ⊥ the PP	Horizontal line	True shape	Horizontal line
ii) ∥ the VP, ⊥ the HP, ⊥ the PP	True shape	Horizontal line	Vertical line
iii) ∥ the PP, ⊥ the HP, ⊥ the VP	Vertical line	Vertical line	True shape
iv) ⊥ the VP, $\angle\theta$ the HP $\angle$ $(90-\theta)$ the PP	Line $\angle\alpha$ to XY, where $\alpha = \theta$	Apparent shape	Apparent shape
v) ⊥ the HP, $\angle\varphi$ the VP, $\angle(90-\varphi)$ the PP	Apparent shape	Line $\angle\beta$ to XY, where $\beta = \varphi$	Apparent shape
vi) ⊥ the PP, $\angle\theta$ the HP, $\angle\varphi$ the VP where, $\varphi = (90-\theta)$	Apparent shape	Apparent shape	Line $\angle\theta$ to XY and $\angle\varphi$ to X_1Y_1

PROJECTIONS OF SOLIDS WITH THEAXISPARALLELTOONE ANDINCLINEDTO THE OTHERREFERENCEPLANE:

Theprojectionsof a solidwithitsaxisparallel totheVPandinclined totheHP orparallel tothe HP andinclinedto theVPcannot bedrawndirectlyasthebaseofsuch asolidwillnot beparallel toanyoneofthereferenceplanes andtwo stepsare required to drawtheprojections.Suchproblemsare solved in twostepsandthepossiblecasesare listed in atable.

HINTSFORCONDITIONSTOBE SATISFIEDINTWO-STEPPROBLEMS:

S. No.	Position of Solid	Step I	Step II
1	Axis || the VP, ⊥ the HP, *AB* on *GR* or || the HP	Axis ⊥ the HP, *AB* ⊥ the VP	Axis ∠ the HP, *AB* on GR
2	Axis || the HP, ∠ the VP, *AB* || the VP or on VP	Axis ⊥ the VP, *AB* ⊥ the HP	Axis ∠ the VP, *AB* on the VP
3	Axis || the VP, ∠ the HP, *A* on GR or on the HP + Base edges containing *A* are equally ∠ the HP	Axis ⊥ the HP *A* at extreme left or right + Base edges containing *A* equally the ∠ VP	Axis ∠ the HP *A* on the GR or on the HP
4	Axis || the HP, ∠ the VP, *A* on VP + Base edges containing *A* are equally ∠ the VP	Axis ⊥ the VP *A* at extreme left or right + Base edges containing *A* equally ∠ to the HP	Axis ∠ the VP *A* on the VP
5	Axis || the VP, ∠ the HP φ_{AB} or $\varphi_{AA_1B_1B}$ + any point or line distance from the VP and/or from the HP	Axis ⊥ the HP φ_{AB} or $\varphi_{AA_1B_1B}$ + distance from the HP	Axis ∠ to VP + distance from the VP
6	Axis || the HP, ∠ the VP θ_{AB} or $\theta_{AA_1B_1B}$ + any point or line distance from the HP and/or from the VP	Axis ⊥ VP θ_{AB} or $\theta_{AA_1B_1B}$ + distance from the HP	Axis ∠ the VP + distance from the VP
7	Axis || the VP $\theta_{AA_1B_1B}$ or θ_{OAB} *AB* on GR or on the HP or || the HP	Axis ⊥ the HP *AB* ⊥ the VP	$\theta_{AA_1B_1B}$ or θ_{OAB} *AB* on the GR or on the HP or || the HP
8	Axis || the HP, $\varphi_{AA_1B_1B}$ or φ_{OAB} *AB* on the VP or || the VP	Axis ⊥ the VP *AB* ⊥ the HP	$\varphi_{AA_1B_1B}$ or φ_{OAB} *AB* on the VP or || the VP
9	Axis || the VP θ_{OA} or *OA* on the HP or on GR or *OA* || the HP	Axis ⊥ the HP *OA* || the VP	θ_{OA} or *OA* on the HP or on the GR or *OA* || the HP
10	Axis || the HP φ_{OA} or *OA* on VP or *OA* || the VP	Axis ⊥ the VP *OA* || the HP	φ_{OA} or *OA* on the VP or *OA* || the VP
11	Axis || the VP *OAB* on GR or on the HP or || the HP	Axis ⊥ the HP *AB* ⊥ the VP	*OAB* on GR or on the HP, or *OAB* || the HP

HINTFOR POSITIONOFTHE AXIS:

Given Line/ Surface Position	Position of Axis	Nomenclature
1. θ_{AA_1}	$\theta_{Axis} = \theta_{AA_1}$	θ = Angle with the HP φ = Angle with the VP AA_1 = Side edge of a prism or generator of a cylinder AA_1B_1B = Side surface of a prism OAB = Side surface of a pyramid OA = Side edge of a pyramid or generator of a cone AB = Edge of base
2. φ_{AA_1}	$\varphi_{Axis} = \varphi_{AA_1}$	
3. $\theta_{AA_1B_1B}$ and $AB \| \|$HP	$\theta_{Axis} = \theta_{AA_1B_1B}$	
4. $\varphi_{AA_1B_1B}$ and $AB \| \|$ VP	$\varphi_{Axis} = \varphi_{OAB} \pm$	
5. θ_{OAB} and $AB \| \|$HP	$\theta_{Axis} = \theta_{OA} \pm \angle$ between axis and OAB	
6. φ_{OAB} and AB $\| \|$VP	$\varphi_{Axis} = \varphi_{AA_1B_1B} \angle$ between axis and OAB	
7. (θ_{OA} and $OA \| \|$VP) or (OA on HP)	$\theta_{Axis} = \theta_{AA_1B_1B}$ θ between axis and OA	
8. (φ_{OA} and $OA \| \|$HP) or (OA on VP)	$\varphi_{Axis} = \theta_{AA_1B_1B} \angle$ between axis and OA	
9. θ_{Base}	$\theta_{Axis} = 90^\circ - \theta_{Base}$	
10. φ_{Base}	$\varphi_{Axis} = 90^\circ - \varphi_{Base}$	
11. θ_{AB} and $AB \| \|$VP + Axis $\angle$ to VP	Axis $\angle$ to HP	
12. φ_{AB} and $AB \| \|$HP + Axis $\angle$ to HP	Axis $\angle$ to VP	

PROJECTIONS OF SOLIDSWITHTHEAXISINCLINEDTOBOTHTHEHPAND THE VP(HINTSFORCONDITIONSTOBE SATISFIEDINTHETHREE-STEP PROBLEMS):

S.No.	Position of the Solid	Step I	Step II	Step III
1.	θ_{Axis} or θ_{AA_1} or $\theta_{OA}+\beta_{\text{Axis}}$ or β_{AA_1} or β_{OA} or β_{AB} + relations with the HP and/or the VP	Axis ⊥ the HP	θ+ relations with the HP	β+ relations with the VP
2.	φ_{Axis} or φ_{AA_1} or $\varphi_{OA}+\alpha_{\text{Axis}}$ or α_{AA_1} or α_{OA} or α_{AB} + relations with the HP and/or the VP	Axis ⊥ the VP	φ + relations with the VP	α+ relations with the HP
3.	$\theta_{\text{line}}+\varphi_{\text{line}}+A$ or AB on GR or on the HP or AB || HP	Axis ⊥ the HP + AB ⊥ the VP or A at extreme left or right	θ_{line} + relations with the HP	φ_{line} + relations with the VP
4.	$\theta_{\text{line}}+\varphi$ line + AB or A on VP or AB || the VP	Axis ⊥ the VP + AB ⊥ the HP or A at extreme left or right	φ_{line} + relations with the VP	θ_{line} + relations with the HP
5.	$\theta_{\text{side surface}}+\varphi$ or β of any line	Axis ⊥ the HP AB ⊥ the VP	$\theta_{\text{side surface}}$ + relations with the HP	φ or β of the line + relations with the VP
6.	$\varphi_{\text{sidesurface}}+\theta$ or α of any line	Axis ⊥ the VP AB ⊥ the HP	$\varphi_{\text{sidesurface}}$ + relations with the VP	θ or α of the line + relations with the HP
7.	$\theta_{OAB}=90^\circ$ + φ_{OAB} = any value	Axis ⊥ the HP AB ⊥ the VP	$\theta_{OAB}=90^\circ$ + relations with the HP	φ_{OAB} + relations with the VP
8.	$\varphi_{OAB}=90^\circ$ + θ_{OAB} = any value	Axis ⊥ the VP AB ⊥ the HP	$\varphi_{OAB}=90^\circ$ + relations with the VP	θ_{OAB} + relations with the HP

SECTIONOFSOLIDS:

Thefollowingsteps can beused to drawsectionalviews:

Step I: _

Drawtheprojectionsofthegivensolidinanuncutconditioninboththeviews (theFV andtheSTY) bythinconstructionlines.

Step II:

Draw the cuttingplane (orthesectionplane)asa straightlineinclinedat*B*tothe XY line in thefront view if itis givento be perpendicularto the VP.Drawitinclinedat*B*totheHPorasastraightlineinclinedatrptoXYinthetopview,ifit isgivento beperpendicularto theHPandinclinedatrp to theVP.**Step III:**

Ifthesolidisacylinderoracone,drawanumberofgeneratorsintersectingthecuttin gplaneline.Obtaintheirprojectionsintheotherview.Generatorsarelinesdrawnthrought hepointsonthebasecircleandareparalleltotheaxisfor a cylinder orjoiningtheapex for a cone.

Step IV:

Locatethepoint'scommonbetweenthecuttingplanelineandthesurfacelinesofthe solid.Thesesurfacelinesincludethebaseandsideedgesofprismsandpyramidsorthegen eratorsandcircularedgesofcylindersandcones.Numberthesepoints asfollows:

(i) Start fromone endofthecuttingplane,andmovetowardstheotherendnaming thepointsonvisiblesurfacelinessequentially.

(ii) Afterreachingtheotherend,returnalongthecuttingplanelineandcontinueton umberthosepointsthatareonhiddensurfacelinessequentially.In caseofahollowsolid,imaginetheholeasaseparatesolidandnumberthepointsin theusualmanner.

Step V:

Projectthepointsintheotherviewsby drawinginterconnectingprojectorsandintersectingtheconcernedsurfacelines.

Step VI:

JointhepointsobtainedinStepVbycontinuouscurvedlinesifthepointsareonacon icaloracylindricalsurface.Otherwise,jointhembystraightlines.Theapparentsectionis completedbydrawingcross-hatchingsectionlineswithin thenewlycutsurface.

Step VII:

Completetheprojectionsbydrawingtheproperconventionallinesforalltheexisti ngedgesandsurfaceboundaries.

HINTTOLOCATE THE CUTTINGPLANE:

Therequiredcuttingplanecanbequicklylocatedifthefollowinghintsarekeptinmind:

1. Thenumberofcomersinthetrueshapeofasectionisalwaysequaltothenumber of edgesofthesolidthat iscut bythecuttingplane.
2. Thetrueshapeofasectionhasaconfigurationsimilartothatofitsapparentsectio n.Thismeans:

(i)) Thenumber of edgesandcornersare equal.

(ii) Anypair oflines,ifparallel inone,will remainparallel intheother.

(iii) Arectangleinoneneednotbearectangleintheother.Instead,itwillbeafour-sidedfigurewiththeoppositesidesparallel.Thatis,itmaybearectangle,aSquareor a parallelogram.

(iv) Acurvedboundaryinonewillremainacurvedboundaryintheotherbut a Circleneed not beacircle.Itmayalso beanellipse.

3. Asectionascurvecanbeobtainedonlywhenthegeneratorsofacylinder or of aconearecut.

4. When a cuttingplanecutsall thegenerators ofa cylinder ora cone,thenthetrueshapeofthesection is anellipse.

5. Whenthecuttingplaneisinclinedtothebaseofaconeatananglethatisequalto,greaterthanorlessthanthatmadebyitsgeneratorwiththebase,thenthetrueshapeofthesectionisaparabolaahyperbola oranellipse,respectively.

6. Whenacuttingplanecutsalongthegeneratorsofacone,thenthetrueshapeofthesection is anisosceles triangle.

7. Whenacuttingplanecutsalongthegeneratorsofacylinder,thenthetrueshapeofthesection is arectangle.

Theactualprocedureto locatethecuttingplaneinvolves thefollowing steps:

Step I:

Drawtheprojectionsofthegivenuncutsolidintheproperpositionwithrespect totheHPand theVP bythenlines.

Step II:

IfthecuttingplaneistobeperpendiculartotheVPortheHP,drawanumberoftrialcuttingplanesinthefrontvieworinthetopview,respectively.Selectthosecuttingplanesthat intersectthenumberofedgesofthesolidequaltothenumber of cornersofthetrueshapeoftherequiredsection.Ifthesolid is aconeoracylinder,select the cuttingplanebased onHints(4) to(7).

StepIII:

Sketchtheshapeofthesectionbyprojectingpointsononeoftheselectedcuttingplanes.IfthecuttingplanelineisinclinedtotheXYline,theshapeofthesectionthatwillbeobtainedwillnotbethetrueshapeanditiscalledan*apparentsection.*

Step IV:

Fromasketchofthetrueshape,findoutthedependenceofitsdimensionsonthevariouslinesinprojections,andfindoutwhetherbyshiftingthecuttingplanethesameedgesandsurfacescanbecutandwhethertherequiredlengthscanbeobtainedforthetrueshapeofthesection.Accordingly,adjustthepositionofthecuttingplane.Ifadjustmentofdimensionsisnotpossible,tryanothercuttingplaneand rework stepsIIIand IV.

DEVELOPMENTOF SURFACES;

Step I:

Drawtheprojectionsofthegivensolidintheuncutconditionusingthin lines.

Step II:

DrawthecuttingplaneasalineinthefrontortopviewdependinguponwhetheritisperpendiculartotheVPortheHP.Ifthecutisacylindricalorprismatichole,itwillbedrawnasacircleorapolygonintheFVortheTVdependinguponwhether its axisisperpendicular totheVP ortheHP.

Step III:

DrawanumberofsurfacelinesparticularlytheonesthatareintersectingtheCuttingplanelineandpassingthroughthecriticalpointsasinthecaseof

intersectionsofsurfacesproblems.Foracurvedsolidoracurvedcut,drawatleast onemore surfacelinebetween two adjacentcritical points.

Step IV:

Locatethepoint'scommonbetweenthecuttingplanelinesandsurfacelines,andn umbertheminthesamemannerasinChapter10.Theedgesofthebaseorsidesurfacesare alsosurfacelines.

Step V:

Drawthedevelopmentoftheuncutsolidandlocatethepositionsofthesurface Lines bythinlinesdrawn in Step III.

Step VI:

Thepoint'scommonbetweenthecuttingplaneandthesurfacelinesnamed in StepIVcanbelocatedontherespectivesurfacelinesofthedevelopmentattruedistancesfr omtheknownendpointsofthosesurfacelines.Iftheconcernedsurfacelinedoesnotrepres entthetruelengtheitherintheFVortheTV,finditstruelengthbymakingoneviewparallelt oXYandtransferthecuttingplanepointonit.Finditstruedistancefromoneoftheendpoint s.Andusethisdistanceto plotthepointin thedevelopment.

Step VII:

Jointhecuttingplanepointsinserialcyclicorderinthedevelopment.Ifthesolidisacurve doneorthecuttingplaneiscurved,jointhepointsbycurvedlines,otherwise,bystraightl ines.Thenumberoflinesinthedevelopmentwillbeequaltothenumberofformedcorner s,andacornermayformwheretheedgeofthesolidiscutbythecuttingplaneorwherether eisacornerinthecut.Ifthetwopointstobejoinedinsequencearelocatedonedgesofthesa mebase,

theyshouldbejoinedbymovingalongexistingbase/vedgesifthedevelopmento f thelateralsurfaceis drawn.

Step VIII:

Completethedevelopmentbydrawingboundarylinesbythicklines.Completetheprojectionsbydrawingproperconventionallinesforallexistingedgesandsurfaceboundaries.

Isometric Projections:

Isometricand OrthographicProjectionsof PrincipalLines

Principlepositionoftheline	OrthographicProjection				IsometricProjection	
	Positionofline in FV	Positionofline in TV	Positionofline in SV	Length	Positionof line	Length
PerpendicularThe HP	Vertical	Point	Vertical	Truelengthifprojectionof lines	Vertical	Reduced ToIsometricScale
PerpendicularThe VP	Point	Vertical	Horizontal		inclinedat30^0 tothehorizontal	
PerpendicularThe PP	Horizontal	Horizontal	Point		Inclinedat30^0 tothehorizontalinotherdirection	

Thestepsfordrawing isometricprojections ofanobjectareasfollows:

Step I:

Draworthographicprojectionsofthegivenobjectandencloseeachviewinthesmallestrectangle.Thesidesoftherectanglesshouldbeverticalandhorizontallinesonlybecausetheyaresupposedtobetheprincipallinesoftheenclosingboxof theObject.

Step II:

Selectthefacesthataretobevisiblesothatthemaximumnumberofvisiblelines/surfac esareobtainedintheisometricprojection.Generally,thefrontface,thetopface,andone sidefacearemadevisible.Iftheleft-sideviewgivesthemaximumnumberofvisiblelines,theleftfaceismadevisible.Iftheright-sideviewgives themaximumnumber of visiblelines,therightface ismade visible.

Step III:

CorrelatetheprojectionsofthevarioussurfacesinalltheviewsbyusingthePropertiesofprojectionsofplanesurfaces.Havingco-relatedtheprojectionsintwoviewsormore,pointsshouldbemeasuredinprincipaldirectionsinanytwoviewsandshouldbeplottedinisometricprojections.*Coordinatedistancesshould bereducedtoisometricscalebeforeplotting.*

Step IV:

Drawalltheboundariesofsurfacesbyproperconventionallinesdependingupontheir visibility.

Importantpoints inperspectiveprojection:

AsurfacetouchingthePPP has itstrueshapeand sizein theperspectivev i e w

- PerspectiveviewsoflinestouchingthePPP are of theirtruelengthsandtrueinclinations.
- Perspectiveviewsofverticallinesare verticallines.
- Perspectiveviewsofhorizontallines,parallel toeachotherandinclinedtothePPP; convergeintoasinglepoint,which isthefrontviewofthevanishingpoint.

- Perspectiveviewsoflinesparallel tothePPP are parallel totheoriginallines.
- Iftheobject isbehindthePPP,thesizeofitsperspectiveviewwill bereduced in sizecompared to theobject.Also,thegreater thedistancefromthePPP,thesmallertheperspective.