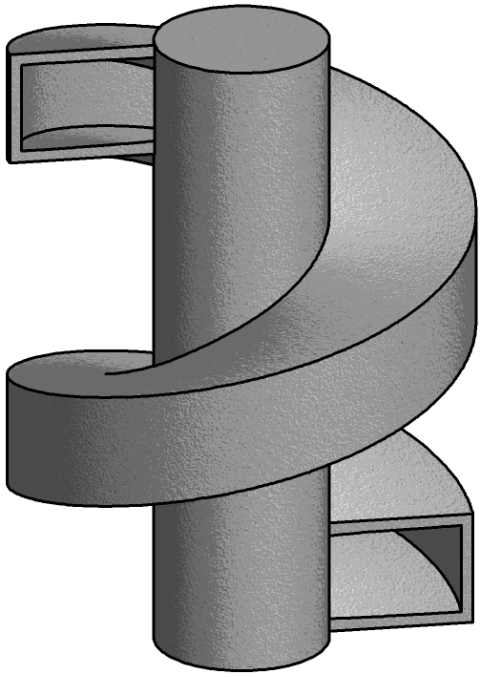
Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2006

Technical Drawing

Paper 2A - Higher Level

(Engineering Applications)



Marking Scheme and Sample Solutions

(Other valid solutions are acceptable and marked accordingly)

MARKING SCHEME: QUESTION 1

(a)	ASSEMBLY	7
(b)	SECTIONAL ELEVATION	23
(c)	ADDITIONAL REQUIREMENTS	15
(d)	OPERATION/MODIFICATION	5
	TOTAL	50 Marks

ASSEMBLY	**(7)**
Gasket in position	1
Cover in valve body	1
Spindle piston in cover	1
Valve seat in body	1
Valve on spindle	1
Nut and washer on spindle	1
Valve in closed position	1

SECTIONAL ELEVATION	**(23)**
BODY	**7**
Body outline	3
Internal features	3
Fillets	1
GASKET	**2**
Left area	1
Right area	1
COVER	**3**
M75 thread convention & chamfer	1
Ø100 mm x 10 mm flange	1
Nut portion of cover	1
VALVE SEAT	**2**
Outline	1
Ø 40mm hole & chamfer	1
VALVE	**2**
Chamfer & body	1
Boss & spindle hole	1
SPINDLE	**4**
Piston end areas	1
Ø 4 mm hole	1
Ø 20 mm x 45 mm shank	1
M12 thread end	1
WASHER	**1**
Washer outline	1
M12 NUT	**2**
Three faces on nut	1
Curves on faces	1

ADDITIONAL REQUIREMENTS	**(15)**
Centre lines	1
Hatching of components	3
Parts item referenced (Leaders; Terminations; Numbers)	3
Title supplied (G=1; Ex=2)	2
Overall presentation (F=4; G=5; Ex=6)	6

OPERATION /MODIFICATION	**(5)**
Flow direction	1
Purpose of 4 mm hole	1
Suitable modification suggested	1
Method shown in sketch	1
Sketch presentation	1

MARKING SCHEME: QUESTION 2

(a)	CAM & DISPLACEMENT DIAGRAM	30
(b)	MECHANISM	20
	TOTAL	50 Marks

CAM	**(30)**
DISPLACEMENT DIAGRAM	**14**
Twelve appropriate divisions	2
Correct heights	1
S.H.M construction	2
S.H.M curve drawn & correct	1
Dwell	1
U.A.R construction	2
U.A.R curve drawn & correct	1
Dwell	1
Instantaneous fall	1
Identification system	1
Presentation	1
CAM PROFILE	**16**
Rotation correct	2
Angular divisions 0^0 to 360^0	2
Nearest approach correct	1
Heights projected and swung	1
Roller followers drawn	1
S.H.M drawn/correct	1
Dwell arc drawn/correct	1
U.A.R drawn/correct	1
Dwell arc drawn/correct	1
Instantaneous fall/correct	1
Camshaft	1
Identification system	1
Presentation	2
(G=1; Ex=2)	

MECHANISM	**(20)**
LAYOUT	**4**
Centre lines	1
Crank OD	1
Link AB	1
Link BC	1
LOCUS	**16**
Circle OD divided into 12 parts	1
Rotation OD correct	1
Location of points B on arc AB	3
Location of points C	3
Location of points P	3
Locus drawn & correct	2
Indexing	1
Presentation	2
(G=1; Ex=2)	

MARKING SCHEME: QUESTION 3

(a)	GIVEN VIEWS		6
(b)	TRUE LENGTHS		12
(c)	DEVELOPMENT		22
(d)	SHEET SIZE		3
(e)	SHEET METAL JOINT		7
		TOTAL	50 Marks

GIVEN VIEWS	**(6)**
Elevation correct	2
Plan correct	2
End elevation correct	2

TRUE LENGTHS	**(12)**
Surface divided into triangles	2
True lengths obtained/identified	8
T/L layout	1
Identification system	1

DEVELOPMENT	**(22)**
Triangular area correct (17 triangles)	17
One piece development	1
Seam correct	1
Identification system	1
Presentation (G=1; Ex=2)	2

SIZE OF RECTANGULAR SHEET	**(3)**
Minimum sheet size shown/stated	3

SHEET METAL JOINT	**(7)**
Single grooved seam sketch	3
Suitable seam allowance shown	2
Allowance indicated both ends	1
Sketch presentation	1

MARKING SCHEME: QUESTION 4

(a)	ISOMETRIC DRAWING	30
(b)	PIPE BEND	20
	Total	50 Marks

ISOMETRIC DRAWING	**(30)**
Body	**10**
Front face outline	2
25 mm x 65 mm cut out	1
Left base area	1
Left slot	1
Right base area	1
Left side area	1
Top area	1
Ø 20 mm hole	1
Other profiles	1
Height Adjusting Nut	**5**
Isometric circles	2
Screw threads	1
Tangents	1
Knurling	1
Support	**6**
Support head Vee	1
Support head chamfers	1
Support head thickness	1
Support shank & threads	1
Isometric arcs	1
VIEW DETAILS	**9**
Isometric drawing provided	1
Correct viewpoint	1
Method of assembly shown	1
Construction for isometric circles	2
Construction of angles	1
Centre lines	1
Presentation	2
(G=1; Ex=2)	

PIPE BEND	**(20)**
ELEVATION	**5**
Top flange	1
Bottom flange	1
Ø50 mm pipe bend	1
Hidden detail bore	1
Hidden detail flanges	1
SIDE ELEVATION	**6**
Top flange OD	1
Four bolt holes	1
Bottom flange	1
Ø50 mm pipe	1
Hidden detail Ø40 bore	1
Hidden detail flanges	1
ADDITIONAL REQUIREMENTS	**9**
Drawing in $1^{st}/3^{rd}$ angle projection	1
Centre lines	1
Welding symbols	1
Dimensions	4
Overall presentation	2
(G=1; Ex=2)	

MARKING SCHEME: QUESTION 5

(a)	HELICAL CHUTE	38
(b)	BOARD GAME PIECE	12
	TOTAL	50 Marks

HELICAL CHUTE	**(38)**
LAYOUT	**10**
Centre line	1
Chute inlet	1
Chute outlet	1
Outside diameter	1
Root diameter	1
Division of circles	1
Divisions of pitches	1
Projection lines for crest	1
Projection lines for root	1
Indexing	1
CHUTE HELIX	**17**
Helix rotation correct	3
1st crest helix plotted	3
2nd crest helix plotted	3
1st root helix plotted	3
2nd root helix plotted	3
Crest flats drawn	1
Root flats drawn	1
FINISHED CHUTE	**11**
Drawing of finished visible profile	3
Drawing of hidden profile	2
Drawing of column	2
Finished plan	2
Presentation	2
(G=1; Ex=2)	

BOARD GAME PIECE	**(12)**
Equilateral triangle in plan	2
Find centre in plan	2
Establish apex and draw elevation	3
Find ‘X’ circumcentre in elevation	3
Determined angle $109^{o} \pm 2^{o}$	2

MARKING SCHEME: QUESTION 6A

(a)	GEAR AND RACK	28
(b)	CLUTCH	22
	TOTAL	50 Marks

GEAR AND RACK	**(28)**
SPUR GEAR TEETH	**13**
Centre lines	1
PCD	1
Addendum circle	1
Dedendum circle	1
Base circle	1
Tooth thickness	1
Construction of tooth profile (involute curve or any recognised approximate method acceptable)	2
Root radii drawn	1
Second tooth drawn	2
Presentation (G=1; Ex=2)	2

RACK	**9**
Pitch line on gear pcd	1
Addendum line	1
Dedendum line	1
Tooth thickness	1
Pressure angle	1
Three teeth correctly drawn	2
Teeth correctly meshing	1
Presentation	1

TABLE OF GEAR VALUES	**6**
Calculations and formulae shown	1
Gear Data (6 off x ½ mark each)	3
Table drawn	1
Presentation	1

CLUTCH	**(22)**
PARTS LIST	**13**
12 parts identified (1 mark each)	12
Presentation / lettering	1
CLUTCH OPERATION	**6**
Operation explained	3
Sketches of clutch	3
THRUST BEARING	**3**
Sectional sketch	3

MARKING SCHEME: QUESTION 6B

(a)	SHORT CAD QUESTIONS	12
(b)	3D MODEL	10
(c)	CAD COMMAND PAIRS	11
(d)	CAD PROFILE	17
	Total	50 Marks

SHORT CAD QUESTIONS (12)

(i)	Four advantages of CAD	2
(ii)	Parametric CAD system	2
(iii)	Line types	2
(iv)	Layers	2
(v)	Ordinate dimensioning	2
(vi)	Drawing template	2
(vii)	Oblique angle	2
(viii)	Hyperlink	2

Maximum 12 marks

3D MODEL (10)

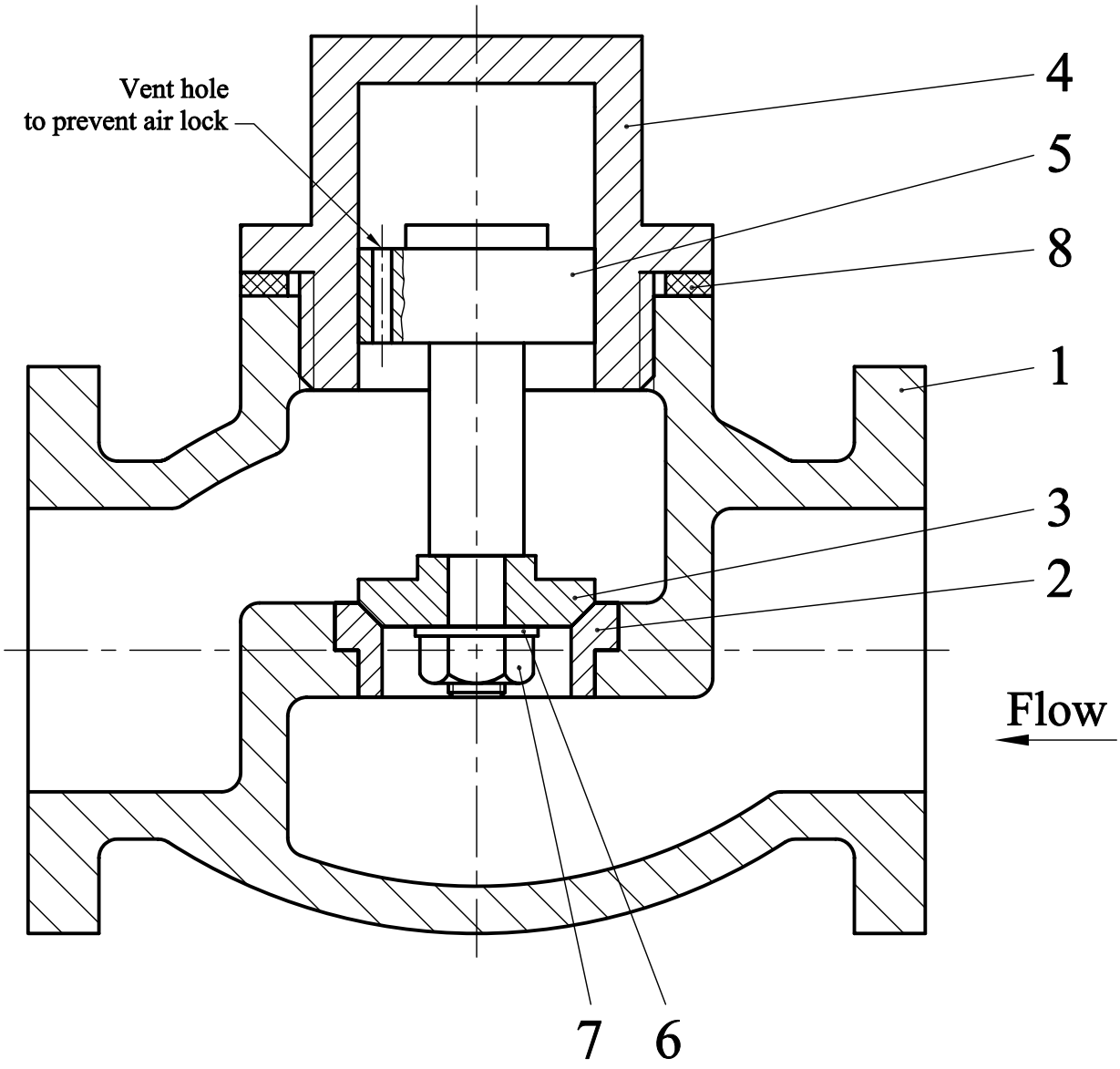
CAD package	1
Commands used to draw the model	9
(Explanation 5)	
(Sketches 4)	

CAD COMMAND PAIRS (11)

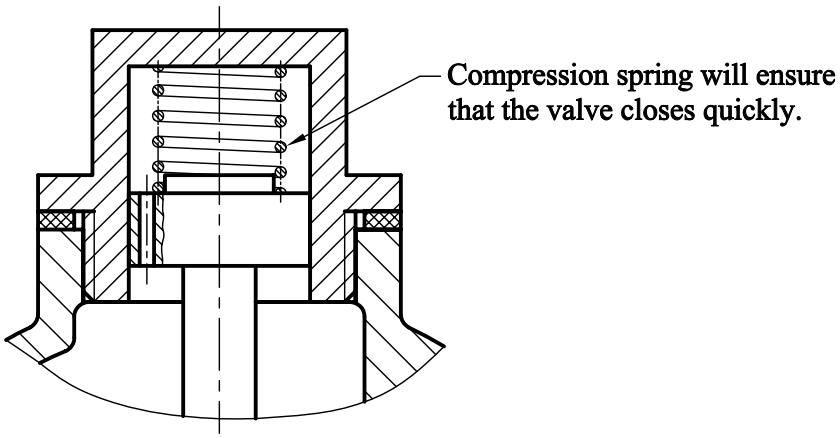
(i)	Scale/Zoom	2
(ii)	Text Align/Text Fit	2
(iii)	Associative/Non associative dimensions	2
(iv)	Wireframe/Solid models	2
(v)	Raster/Vector files	3

CAD PROFILE (17)

Sheet size	1
Circle	1
Ellipse	3
Lines	1
Extend	1
Trim	1
Arc	1
Polygon	2
Line	1
Offset	1
Fillets	1
Array	2
Presentation	1

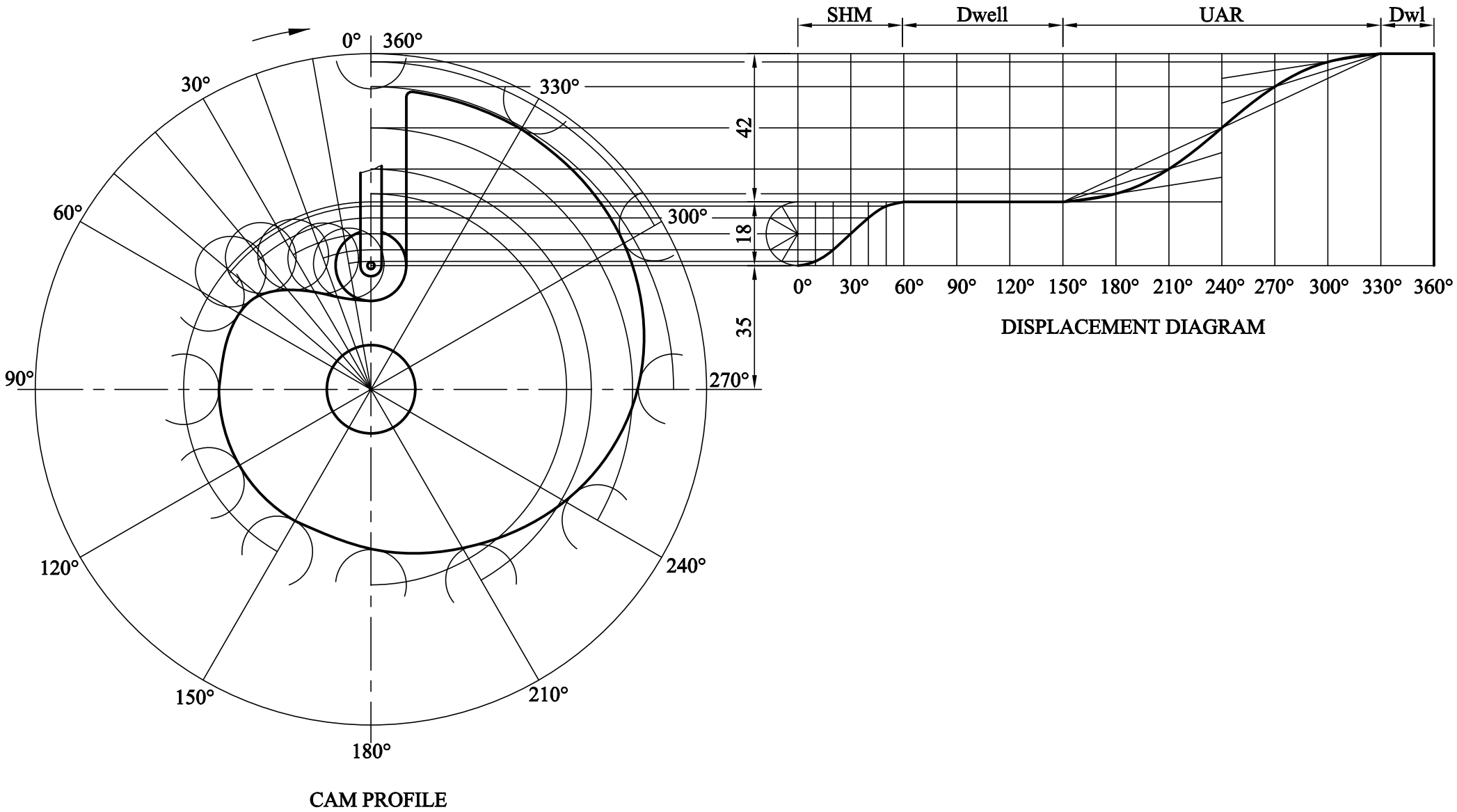


NON-RETURN VALVE

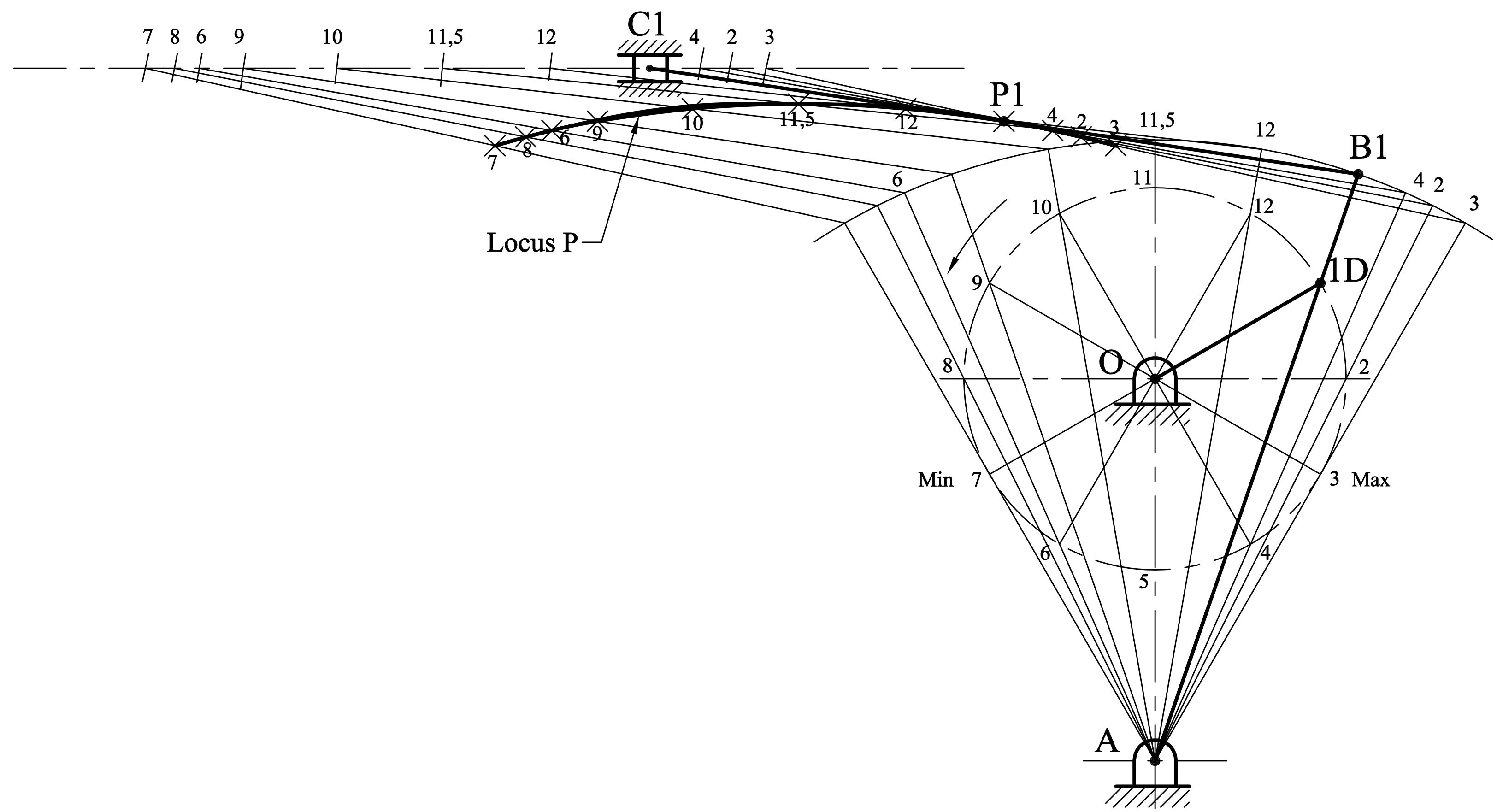


MODIFICATION

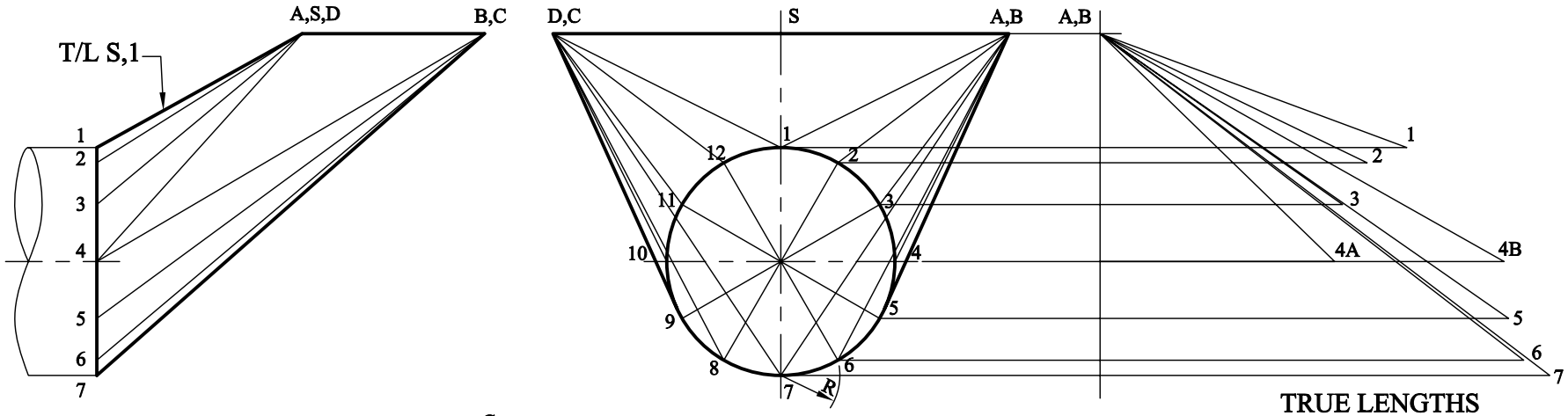
(a)

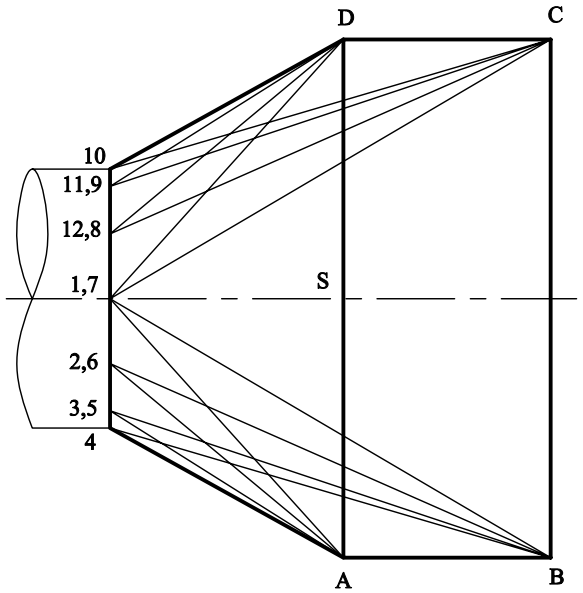

SHM
Dwell
UAR
Dwl
0°
360°
30°
330°
60°
300°
90°
270°
120°
240°
150°
210°
180°
42
18
35
0° 30° 60° 90° 120° 150° 180° 210° 240° 270° 300° 330° 360°
DISPLACEMENT DIAGRAM
CAM PROFILE

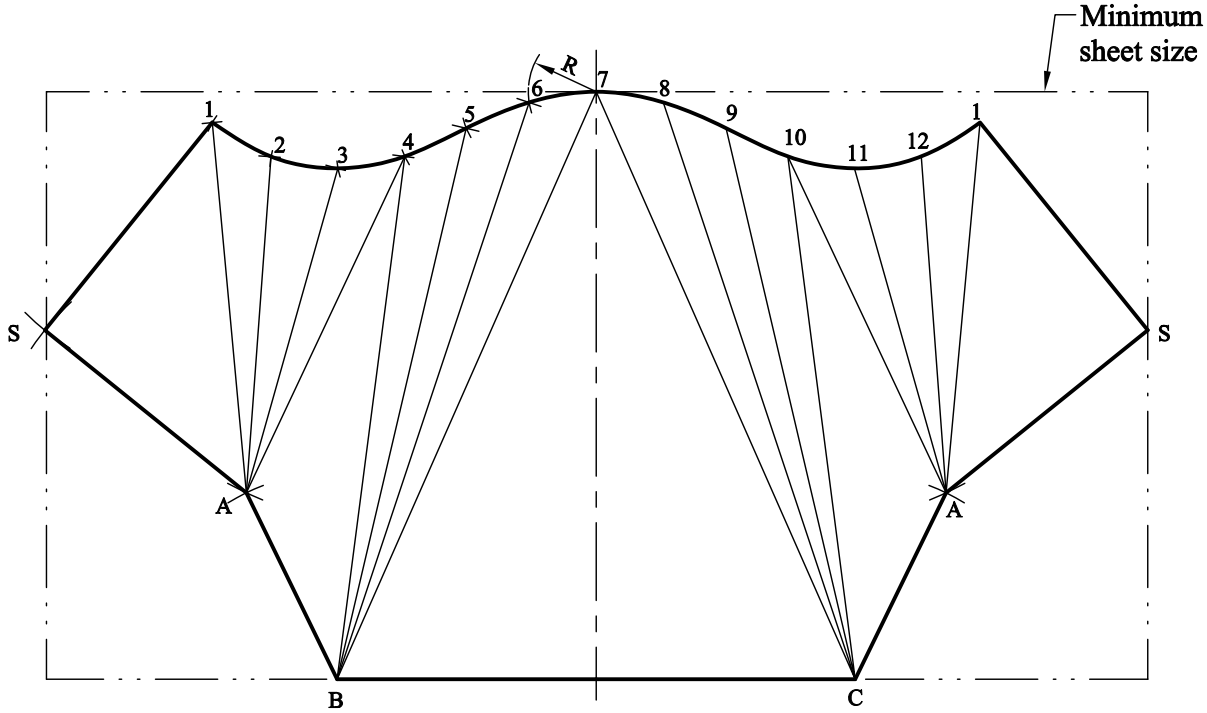
(b)



(a)



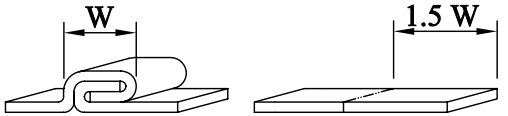




(b)

Minimum sheet size: 2130 mm x 1130 mm

(c)

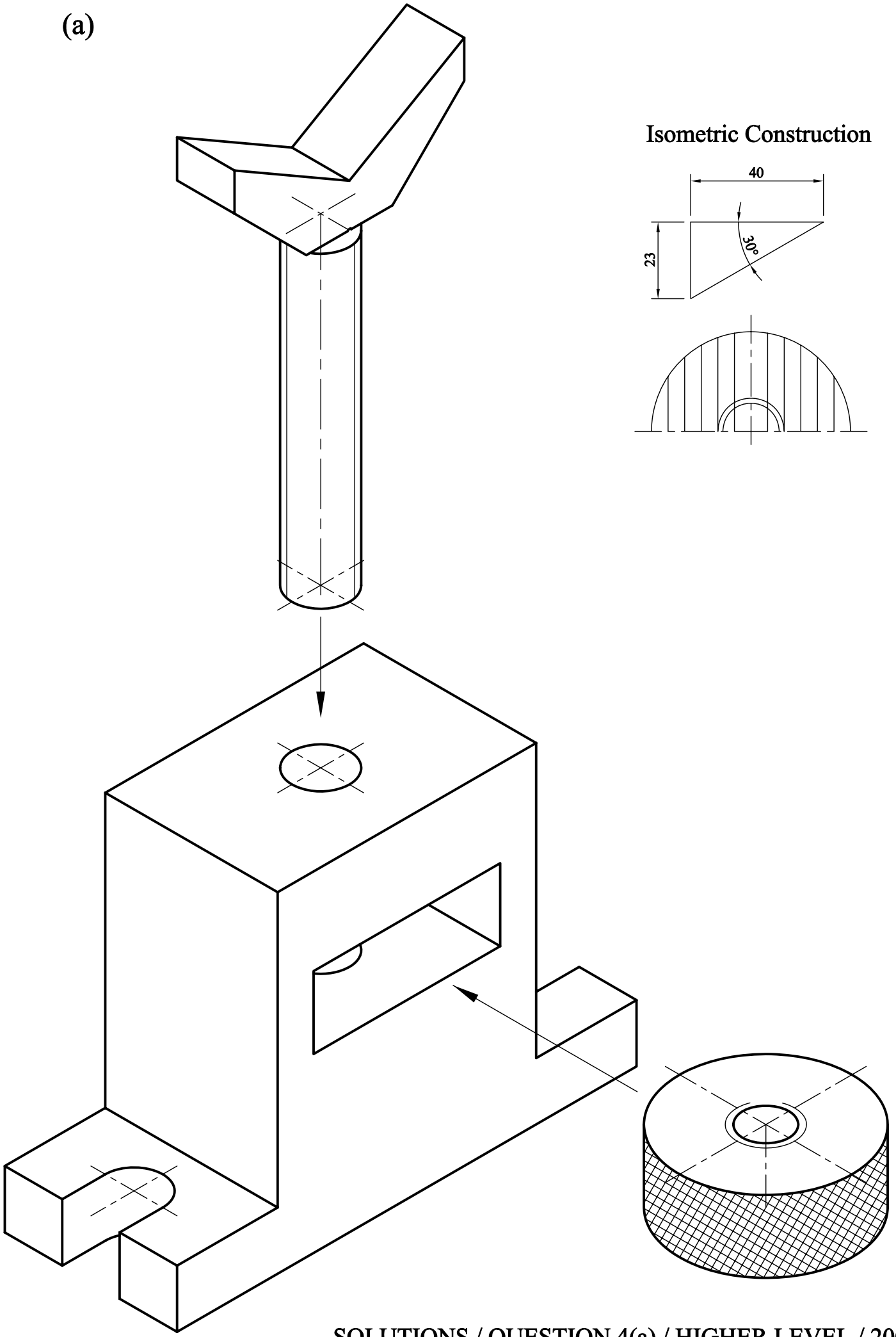


(i) Grooved Seam (ii) Seam Allowance

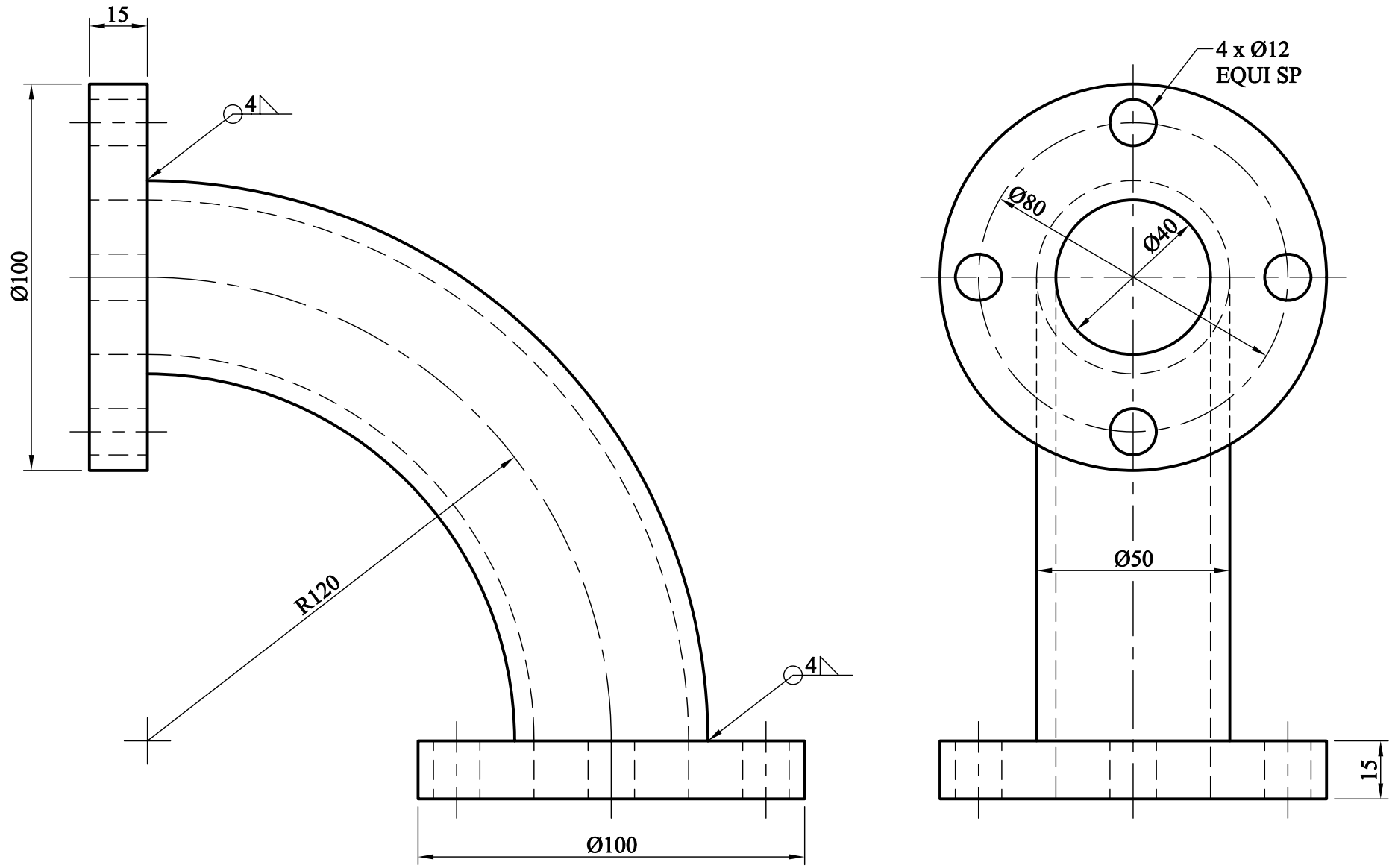
N.B. Same both ends

SOLUTIONS / QUESTION 3 / HIGHER LEVEL / 2006

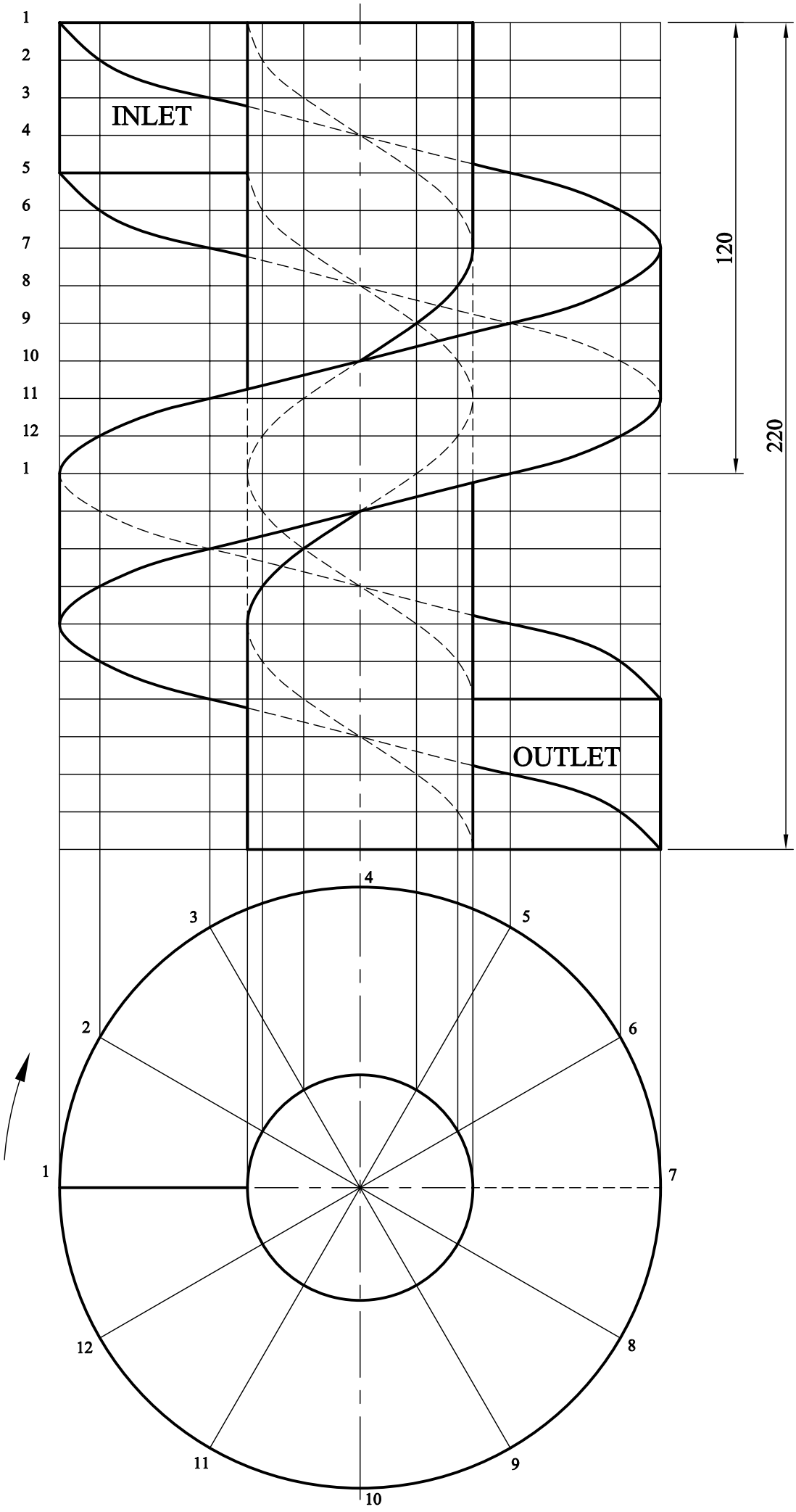
(a)



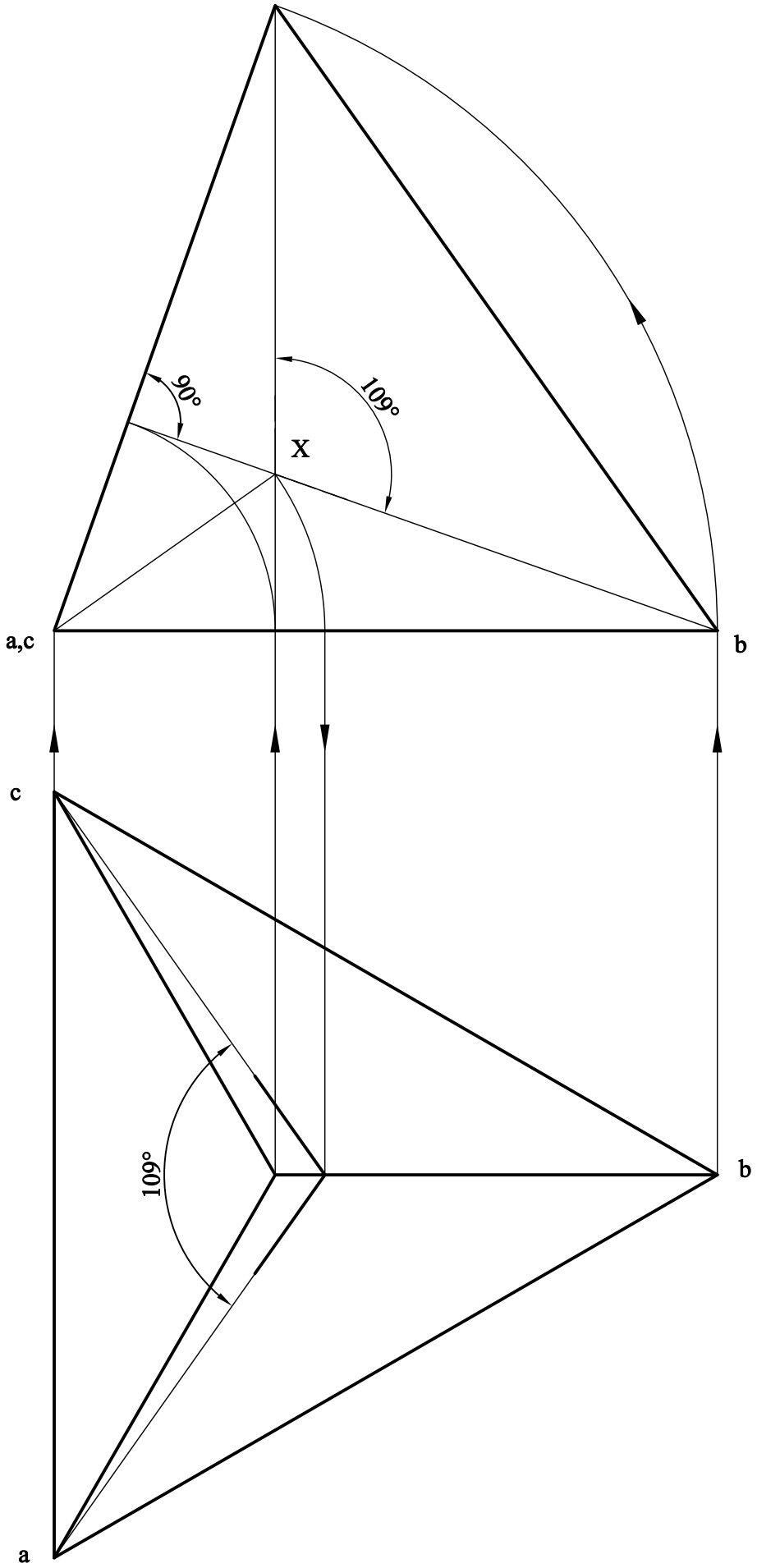
(b)



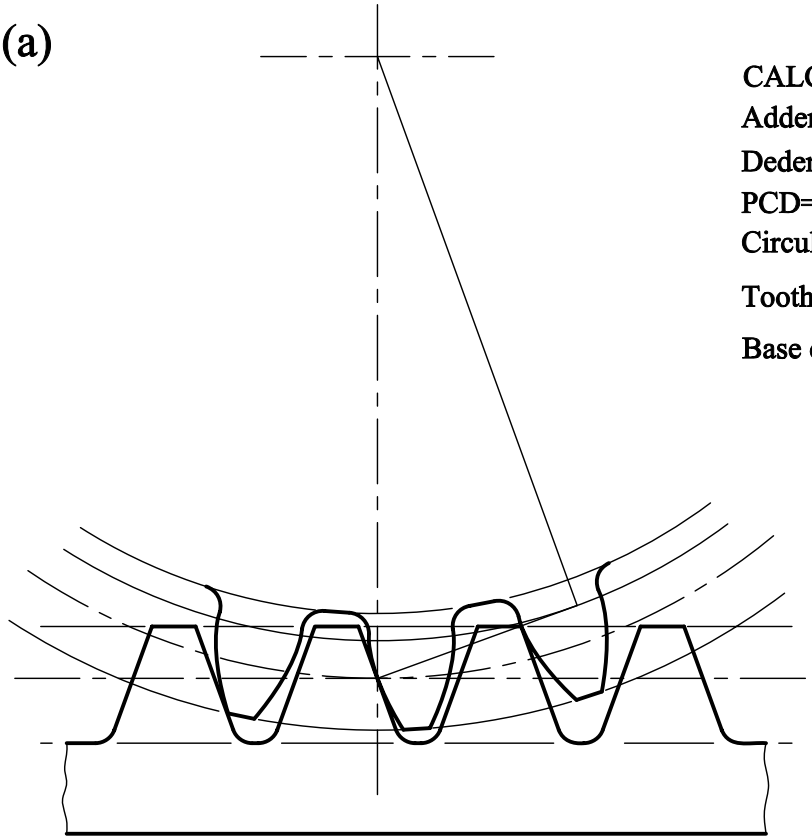
(a)



(b)



(a)



CALCULATIONS

Addendum = module = 10mm

Dedendum = 1.25 x module 1.25 x 10= 12.25mm

PCD= m x T 10 x 24 = 240mm

Circular pitch p = pi x m 3.142 x 10 = 31.42mm

Tooth thickness = $\frac{p}{2}$ $\frac{31.42}{2}$ = 15.71mm

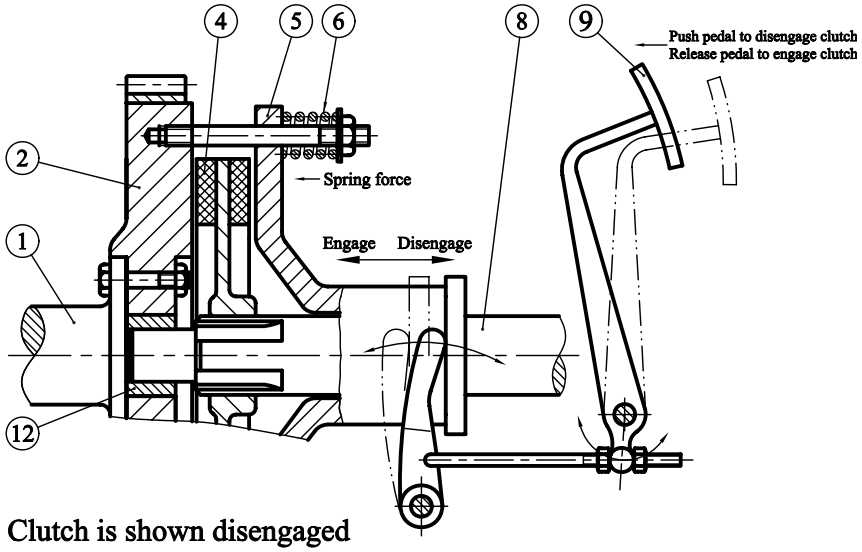
Base circle = Cos 20°x PCD 0.939 x 240 = 225.5 mm

SPUR GEAR TABLE	
Addendum	10
Dedendum	12.25
Pitch circle diameter	240
Circular pitch	31.42
Tooth thickness	15.71
Base circle diameter	225.5

(b) (i)

ITEM	NAME
12	Spigot bush
11	Operating fork
10	Adjustable link
9	Pedal
8	Drive shaft to gearbox
7	Driving stud
6	Pressure spring
5	Pressure plate
4	Clutch lining
3	Ring gear
2	Flywheel
1	Drive shaft from engine

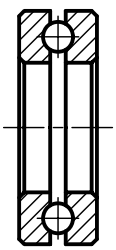
(ii)



Clutch is shown disengaged

This type of clutch consists of a double faced steel spinner plate with high friction lining rings (part 4) compressed between the fly wheel surface (part 2) and the driven pressure plate (part 5), the pressure is applied by the springs (part 6). This transmits power from from the engine drive shaft (part 1) to the drive shaft to the gearbox (part 8).
On depressing the pedal (part 9) the spinner plate is freed and the drive is lost, being automatically re-engaged as the foot pedal is released.

(iii)



Thrust Bearing

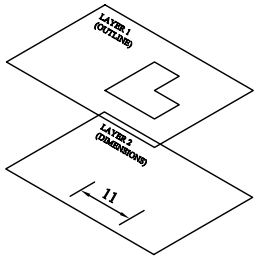
A ball thrust bearing is normally used instead of part 12 to take the axial forces.

(a) (i) Advantages of CAD: Higher productivity, faster and easier creation of drawings which can be easily retrieved and modified. Outstanding presentation possible, rendering allows photo realistic images with full animation.
Ability to store frequently used parts in libraries.
Automatic creation of elevations,cross sections and bill of materials.
Testing of the design using finite element analysis and so on.

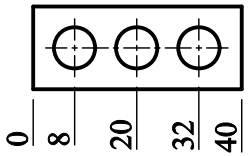
(ii) Parametric CAD system refers to the use of numeric parameters of an object to define the object. The user enters the relevant sizes and the cad system automatically generates a drawing of the object. For example in a parametric system a 3D box might be defined by length, width, and height. Since the system stores the box as a standard process with a set of defining parameters, it is simple to change any parameter at any time to obtain a new version of the box, changing a parameter changes the box.

(iii) Linetypes: Dashed Zigzag

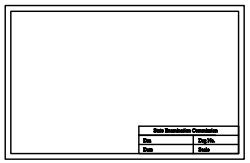
(iv) Layers are imaginary transparent surfaces that can be created within CAD. You can draw on these imaginary surfaces and group drawing objects on different layers. This helps to organize CAD drawings and makes editing much easier as layers can be turned On or Off to view or edit specific objects.



(v) Ordinate dimensioning



(vi) A drawing template file contains saved standard settings and conventions, such as title blocks, borders, logos, units, precision, layer names,snap, linetypes, text styles etc.

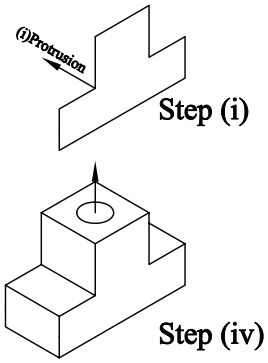


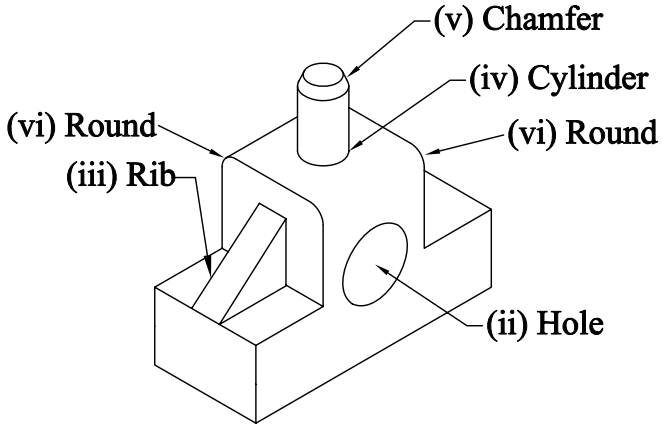
(vii) No oblique angle 24

Oblique angle set to 30° 24

(viii) Hyperlink: is a piece of text or an object defined in a web drawing and clicking it performs an action such as moving to a different part of the same drawing or displaying a new page/web site etc.

(b) Package:Solid Edge V17.
(i) Select reference plane and sketch profile/ outline of object to size and protrude.
(ii) Select front face, draw hole circle, set hole parameters and define extent/depth.
(iii) Define profile plane, sketch rib profile and define thickness.
(iv) Select plane- top surface draw circle and protrude upwards.
(v) Chamfer top edge of cylinder to size.
(vi) Insert the two rounds/fillets.
(vi) Save and print.





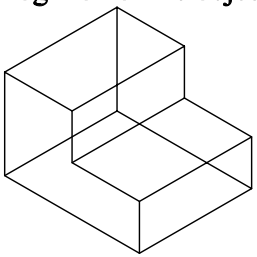
(c) (i) Scale increases/decreases the absolute size of the object. Whereas Zoom only changes the magnification of the view.

(ii) Fit: Specifies that text fits within two points and a defined text height.

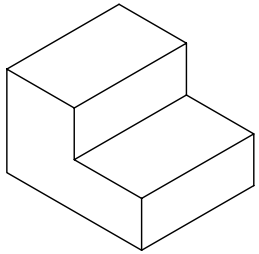
Align:Specifies both text height and text orientation by designating the endpoints of the baseline. The size of the characters adjusts in proportion to their height. The longer the text string, the shorter the characters.

(iii) Associative dimensions automatically adjust their locations, orientations, and measurement values when the geometric objects associated with them are modified. Nonassociative dimensions do not change when the geometric objects they measure are modified.

(iv) A wireframe model is an edge or skeletal representation of a real-world 3D object using lines and curves. The model does not contain any information about the surface, volume or mass of the object.
A solid model represents the entire volume of an object. It is a complete model of the object allowing analysis and interrogation of the object.



Wireframe model



Solid model

(v) A *raster* is a grid of x and y coordinates on a display space. A raster file identifies which of these coordinates to illuminate. The raster file is sometimes referred to as a bitmap because it contains information that is directly mapped to the display grid. Examples of raster file types are: BMP, GIF and JPEG files. A raster file is usually larger than a vector file.
Vector files are made up of many individual, scalable objects that are defined by mathematical equations rather than pixels. Vector-based files are resolution independent which means that you can increase and decrease the size of vector images to any degree and your lines will remain crisp and sharp. Examples of vector files are DXF, CDR, and WMF files.

(d)