STAPLE

QUESTION 2: LOCI

NOTE: Answer QUESTIONS 2.1 and 2.2.

2.1 CAM

Motion:

A cam rotates at constant velocity imparting the following motion to a follower:
- It rises with uniform motion for 21 mm over the first 60°.
- There is a dwell period for the next 75°.
- It rises with uniform motion for a further 43 mm over the next 45°.
- It descends with simple harmonic motion back to the original position over the rest of the rotation.

Instructions:

- Draw, to a rotational (horizontal) scale of 360° = 114 mm and a displacement scale of 1 : 1, the complete displacement graph for the required motion.
- Label the displacement graph and include the scale.

Show ALL construction.   **[11]**

ASSESSMENT CRITERIA 2.1		
1	CONSTRUCTION	4		
2	POINTS + CURVE	6		
3	LABELS	1		
PENALTIES (-)				
SUBTOTAL	**11**		

2.2 MECHANISM

Given:

- A schematic drawing of a mechanism consisting of crank OA, sliding rod AB, rod CD, horizontal groove FG and swivel guide E
- The position of centre point O on the drawing sheet

Specifications:

- The positions of centre point O, swivel guide E and groove FG are fixed
- Sliding rod AB is pin-jointed to crank OA at A
- Rod CD is pin-jointed to sliding rod AB at C
- CD = 90 mm

Motion:

As crank OA rotates in a clockwise direction, point B, of sliding rod AB, reciprocates along groove FG, and rod CD slides through swivel guide E.

Instructions:

- Draw, to scale 1 : 1, the given schematic drawing of the mechanism.
- Trace the loci generated by point C and by point D for ONE complete rotation of crank OA.

Show ALL construction.   **[25]**

O

ASSESSMENT CRITERIA 2.2		
1	GIVEN	6		
2	CONSTRUCTION	5		
3	POINTS + CURVE	14		
PENALTIES (-)				
2.2 SUBTOTAL	**25**		
2.1 SUBTOTAL	**11**		
TOTAL	**36**		
EXAMINATION NUMBER				
EXAMINATION NUMBER			3

BASIC-EDUCATION

STAPLE

QUESTION 2: LOCI
NOTE: Answer QUESTIONS 2.1 and 2.2.

2.1 CAM
Given:
The position of the bottom left corner of the displacement graph on the drawing sheet

Motion:
The cam imparts the following motion to a follower:
- It descends 54 mm with simple harmonic motion over the first 90°.
- It descends a further 18 mm with uniform motion over the next 60°.
- There is a dwell period for the next 30°.
- It returns to its original position with uniform acceleration and retardation over the rest of the rotation.

Instructions:
- Draw, to a rotational (horizontal) scale of 360° = 126 mm and a displacement scale of 1 : 1, the complete displacement graph for the required motion.
- Label the graph and include the scale.
- Show ALL construction.   **[18]**

0°

ASSESSMENT CRITERIA					
1	CONSTRUCTION	$7\frac{1}{2}$			
2	POINTS + CURVE	$9\frac{1}{2}$			
3	LABELS	1			
	SUBTOTAL 2.1	**18**			

2.2 COIL SPRING (HELIX)
Given:
- The right view of a coil spring with DE indicating the starting position
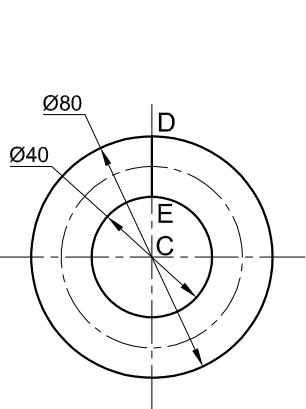- The position of centre point C on the drawing sheet

Specifications:
- Spring profile   : Ø20
- Pitch   : 108 mm
- Turn   : ONE
- Direction   : Right-handed

Instructions:
- Draw, to scale 1 : 1, the given right view and the complete front view of the coil spring.
- Show ALL construction.
- NO hidden detail is required.   **[21]**

C

Ø80
Ø40
D
E
C

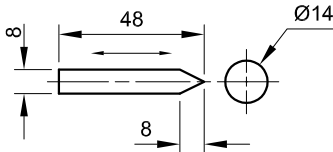| ASSESSMENT CRITERIA					
1	GIVEN + CENTRE LINES	3			
2	CONSTRUCTION	6			
3	FRONT VIEW	12			
	2.2 SUBTOTAL	**21**			
	2.1 SUBTOTAL	**18**			
PENALTIES (-)					
	TOTAL	**39**			
EXAMINATION NUMBER					
EXAMINATION NUMBER					3

QUESTION 2: LOCI (CAM)

Given:
The detail of a wedge-shaped follower and the camshaft

Specifications:
- The follower reciprocates on the horizontal centre line of the camshaft
- The minimum distance from the follower to the centre of the camshaft = 14 mm
- Rotation = clockwise

Motion:
The cam imparts the following motion to the follower:
- It moves left with uniform acceleration and retardation for 40 mm over the first 180°
- It moves further left with uniform motion for 15 mm over the next 90°
- It moves right with simple harmonic motion back to the original position for the rest of the rotation.

Instructions:
- Draw, to scale 1 : 1, the given camshaft and the wedge-shaped follower at the minimum distance.
- Draw, to a rotational scale of 30° = 8 mm and a displacement scale of 1 : 1, the complete displacement graph for the required motion.
- Label the displacement graph and include the scale.
- Project and draw the cam profile from the displacement graph.
- Show the direction of rotation on the cam profile.
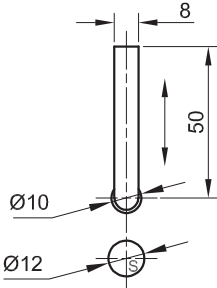- Show ALL construction. **[40]**

ASSESSMENT CRITERIA

1	GIVEN + MINIMUM DISTANCE + CL	5			
2	GRAPH CONSTRUCTION	7			
3	PLOTTING POINTS + GRAPH CURVES	11			
4	CAM CONSTRUCTION	6			
5	PLOTTING OF CAM	7			
6	CAM PROFILE	4			
PENALTIES (-)					
TOTAL		**40**			
EXAMINATION NUMBER					
EXAMINATION NUMBER					3

8

50

Ø10

Ø12   S

QUESTION 2: LOCI (CAM)

Given:
- The detail of a roller-ended follower and the cam shaft
- The position of centre point S on the drawing sheet

Specifications:
- The follower reciprocates on the vertical centre line of the cam shaft
- The minimum distance from the follower to the centre of the cam shaft = 15 mm
- Roller = Ø10 mm
- Rotation = anti-clockwise

Motion:
The cam imparts the following motion to the follower:
- It rises with uniform motion for 25 mm over the first 45°
- There is a dwell period for the next 30°
- It rises with uniform motion for 24 mm over the next 30°
- It rises with uniform motion a further 7 mm over the next 45°
- There is a dwell period for the next 30°
- It descends with simple harmonic motion to the original position over the rest of the rotation.

Instructions:
- Draw, to scale 1 : 1, the given camshaft and the roller-ended follower at the minimum distance.
- Draw, in the correct position and to a rotational (horizontal) scale of 30° = 8 mm and a displacement scale of 1 : 1, the complete displacement graph for the required motion.
- Label the displacement graph and include the scale.
- Project and draw the cam profile from the displacement graph.
- Show the direction of rotation on the cam profile.
- Show ALL construction and projection.   **[38]**

S

| ASSESSMENT CRITERIA					
1	GIVEN + MINIMUM DISTANCE + CL	5			
2	GRAPH CONSTRUCTION	7			
3	PLOTTING POINTS + CURVE	8			
4	CAM CONSTRUCTION	5			
5	PLOTTING	7			
6	CAM PROFILE	6			
	TOTAL	38			
EXAMINATION NUMBER					
EXAMINATION NUMBER					3

QUESTION 2: LOCI
NOTE: Answer QUESTIONS 2.1 and 2.2.

2.1 LOCI (HELIX)

Given:
- A front view and left view of the shaft of an auger with Q indicating the starting position
- The position of point P on the drawing sheet

108

Ø34

P Q   Q
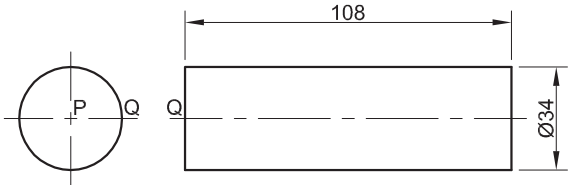
AUGER SHAFT DETAIL

Specifications:
- Nominal diameter : Ø74 mm
- Pitch : 72 mm
- Turns : ONE AND A HALF
- Direction : Left-handed

Instructions:
Draw, to scale 1 : 1, the complete front view and left view of the auger.

- Show ALL construction.
- NO hidden detail is required. **[23]**

ASSESSMENT CRITERIA 2.1					
1	GIVEN + CENTRE LINES	3			
2	CONSTRUCTION	8			
3	OUTER HELIX	$5\frac{1}{2}$			
4	INNER HELIX + SHAFT	$4\frac{1}{2}$			
5	CURVE QUALITY	2			
PENALTIES (-)					
SUBTOTAL		**23**			

2.2 CAM

Given:
The bottom left 0° starting position of the displacement graph on the answer sheet

Motion:
- The follower rises with uniform motion for 15 mm over the first 30° of rotation.
- There is a dwell period for the next 15°.
- The follower rises with simple harmonic motion for 65 mm over the next 135°, to the maximum displacement of 80 mm.
- There is a dwell period for the next 90°.
- The follower returns with uniform acceleration and retardation to the original position over the rest of the rotation.

Instructions:
Draw, to a displacement scale of 1 : 1 and a horizontal scale of 360° = 180 mm, the complete displacement graph for the required motion.

- Label the graph and indicate the horizontal scale.
- Show ALL construction. **[16]**

ASSESSMENT CRITERIA 2.2					
1	CONSTRUCTION	6			
2	POINTS + CURVES	9			
3	LABELS	1			
PENALTIES (-)					
2.2 SUBTOTAL		**16**			
2.1 SUBTOTAL		**23**			
TOTAL		**39**			
EXAMINATION NUMBER					
EXAMINATION NUMBER					3

P

0°

QUESTION 2: LOCI
**NOTE:** Answer QUESTIONS 2.1 and 2.2.

2.1 MECHANISM
Given:
- A schematic drawing of a mechanism consisting of crank OA, connecting rod AB, swivel guide C, sliding rod DE, pin F and horizontal groove GH
- The position of centre point O on the drawing sheet

Specifications:
- The positions of O, C and groove GH are fixed
- Connecting rod AB is pin joined to crank OA at A
- Sliding rod DE is pin-joined to connecting rod AB at D
- Pin F is fixed to sliding rod DE
- AB   = 120 mm
- DE   = 120 mm
- AD   = 40 mm
- DF   = 40 mm

Motion:
As crank OA rotates in a clockwise direction, connecting rod AB freely slides through swivel guide C.
Point E of sliding rod DE reciprocates along groove GH during the rotation.

Instructions:
- Draw, to scale 1:1, the given schematic drawing of the mechanism.
- Trace the locus generated by point F for ONE complete rotation of crank OA.

Show ALL necessary construction.   **[20]**
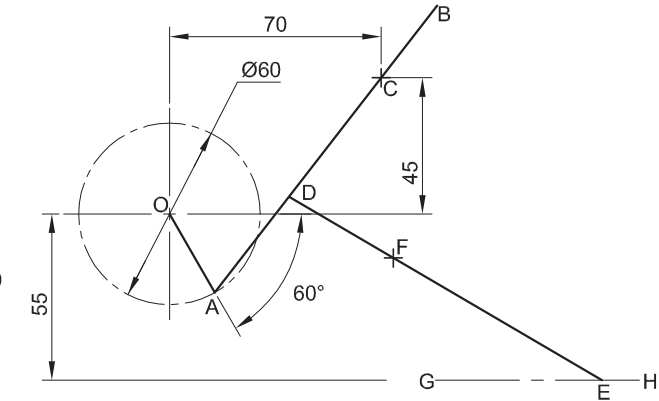
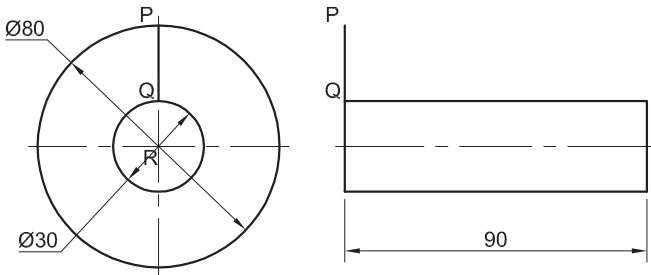| ASSESSMENT CRITERIA 2.1				
1	GIVEN	5		
2	CONSTRUCTION	7		
3	POINTS + CURVE	8		
	SUBTOTAL	**20**		

2.2 AUGER (HELIX)

Given:
- The incomplete front view and the left view of an auger with PQ indicating the starting position
- The position of centre point R on the drawing sheet

Specifications:
- Pitch   : 60 mm
- Turns   : ONE AND A HALF
- Direction   : Right-handed

Instructions:
Draw, to scale 1 : 1, the given left view and the complete front view of the auger.

- Show ALL necessary construction.
- No hidden detail is required.   **[22]**

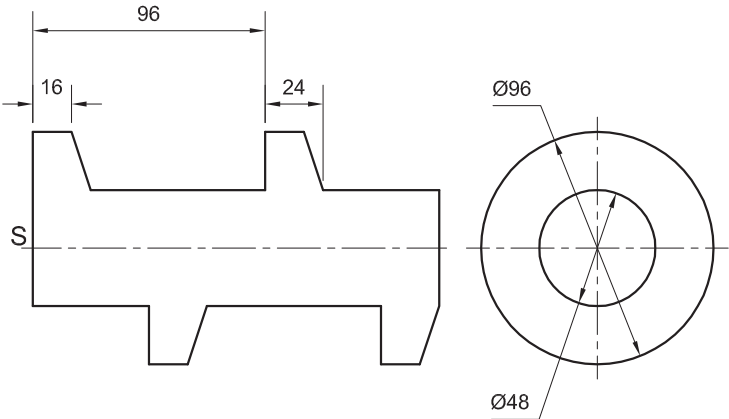| ASSESSMENT CRITERIA 2.2				
1	GIVEN + CENTRE LINES	4		
2	CONSTRUCTION	6		
3	OUTSIDE HELIX + CURVE QUALITY	8		
4	INSIDE HELIX + SHAFT	4		
	SUBTOTAL 2.2	**22**		
	SUBTOTAL 2.1	**20**		
	TOTAL	**42**		
EXAMINATION NUMBER				
EXAMINATION NUMBER				3

O

R

STAPLE

QUESTION 2: LOCI (HELIX)

Given:
- The core and the profile of the incomplete front view as well as the right view of a shaft with a unique single-start right-handed thread
- The position of S on the drawing sheet

Specifications:
- Pitch   = 96
- Turns   = ONE and a HALF
- Direction   = Right-handed

Instructions:
Draw, to scale 1 : 1, the following views of the shaft with a unique single-start right-handed thread:
2.1   The given right view
2.2   The complete front view

- Show ALL necessary construction.
- NO hidden detail is required.   [32]

S +

ASSESSMENT CRITERIA					
1	RIGHT VIEW + CENTRE LINES	5			
2	CONSTRUCTION	5			
3	OUTER CURVE POINTS	10			
4	INNER CURVE POINTS	5			
5	CURVE QUALITY	4			
6	STRAIGHT LINES	3			
	TOTAL	**32**			
EXAMINATION NUMBER					
EXAMINATION NUMBER					3

QUESTION 2: LOCI
**NOTE:** Answer QUESTIONS 2.1 and 2.2.

2.1 MECHANISM
Given:
- A schematic drawing of a mechanism consisting of gear A and gear B as well as a slotted bar CD, attached at C to gear A
- The position of pin E on gear B
- The position of centre point F

Motion:
As gear A rotates in an anti-clockwise direction, it drives gear B in a clockwise direction. The slotted bar CD slides over pin E during the rotation.

Instructions:
- Draw, to scale 1 : 1, the given schematic drawing of the mechanism.
- Trace the locus generated by point D for ONE complete revolution of the mechanism.
- Show ALL necessary construction. **[19]**

GEAR B

Ø50

105

E

45°

C

F

Ø60

Ø50

Ø60

D

GEAR A

SCHEMATIC DRAWING
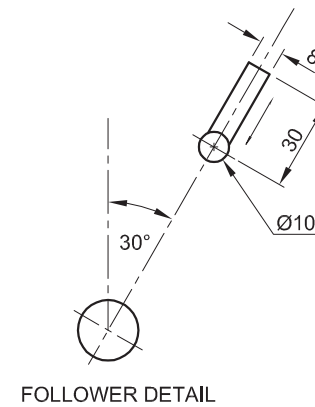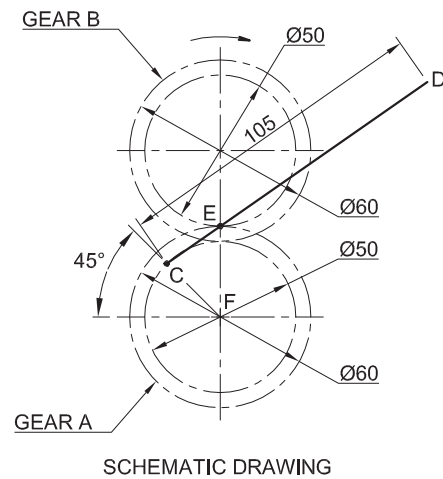
2.2 CAM
Given:
- The detail of a roller-ended follower, drawn to a reduced scale
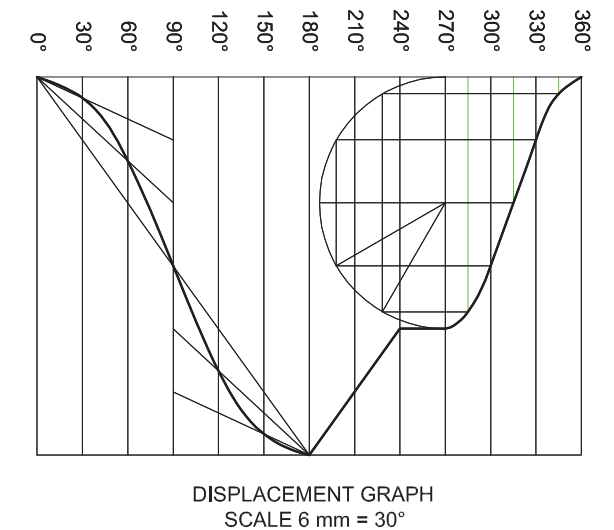- The displacement graph and the cam shaft, drawn to scale 1 : 1, in the correct position

Specifications:
- The follower reciprocates along the 30° centre line that runs through the centre of the cam shaft
- Rotation = clockwise

Instructions:
- Draw, to scale 1 : 1, the roller-ended follower in its correct position.
- Project and draw the cam profile from the given displacement graph.
- Show the direction of rotation on the cam profile.
- Show ALL necessary construction. **[21]**

8

30

Ø10

30°

FOLLOWER DETAIL

DISPLACEMENT GRAPH
SCALE 6 mm = 30°

0° 30° 60° 90° 120° 150° 180° 210° 240° 270° 300° 330° 360°

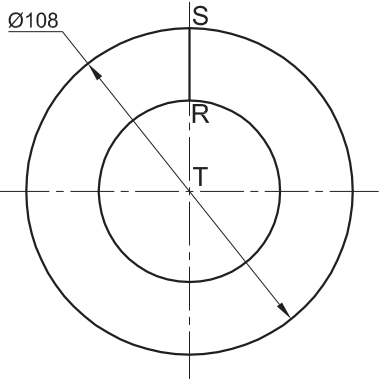| ASSESSMENT CRITERIA 2.1				
1	GIVEN + CENTRE LINES	5		
2	CONSTRUCTION	6		
3	POINTS + CURVE	8		
	SUBTOTAL 2.1	19		
ASSESSMENT CRITERIA 2.2				
1	CONSTRUCTION + FOLLOWER + DIRECTION	8		
2	PLOTTING	7		
3	CAM PROFILE	6		
	SUBTOTAL 2.2	21		
PENALTIES (-)				
	TOTAL	40		
EXAMINATION NUMBER				
EXAMINATION NUMBER				3

F

QUESTION 2: LOCI

HELIX

Given:
- The left view of a square spring with RS indicating starting position
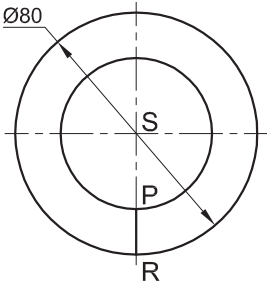- The position of centre point T on the drawing sheet

Specifications:
- Pitch   = 72
- Spring profile   = 24 x 24
- Direction   = Right-handed

Instructions:
Draw, to scale 1 : 1, the following:
2.1 The given left view with point T as reference
2.2 The front view for TWO turns of the square spring

- Show ALL necessary construction.
- No hidden detail is required.   [37]

ASSESSMENT CRITERIA				
1	GIVEN + CENTRE LINES + STARTING POINT	$4\frac{1}{2}$		
2	CONSTRUCTION	8		
3	OUTSIDE POINTS + CURVE + QUALITY	$14\frac{1}{2}$		
4	INSIDE POINTS + CURVE + QUALITY	10		
PENALTIES (-)				
TOTAL		37		
EXAMINATION NUMBER				
EXAMINATION NUMBER				3

STAPLE

Ø80

S

P

R

S

[21]

QUESTION 2: LOCI
NOTE: Answer QUESTIONS 2.1 and 2.2.

2.1 COIL SPRING (HELIX)
Given:
- The right view of a coil spring with PR indicating the starting position
- The position of centre point S on the drawing sheet

Specifications:
- Pitch　　　　　　　= 100
- Outer diameter　　= Ø80
- Inner diameter　　= Ø48
- Spring profile　　 = Ø16
- Direction　　　　 = Right-handed

Instructions:
- Draw, to scale 1 : 1, the given right view and the front view for ONE turn of the coil spring.
- Show ALL necessary construction.
- No hidden detail is required.　　　　　　　　　　　**[21]**

ASSESSMENT CRITERIA					
1	GIVEN + CENTRE LINES	3			
2	CONSTRUCTION	6			
3	POINTS + CURVES	12			
PENALTIES (-)					
SUBTOTAL 2.1		**21**			

2.2 CAM
Motion:
- The follower rises with uniform motion for 20 mm over the first 60° of the rotation.
- There is a dwell period for 30°.
- The follower rises with simple harmonic motion for 50 mm over the next 90° of the rotation, to the maximum displacement of 70 mm.
- The follower descends with uniform acceleration and retardation to the original position over the rest of the rotation.

Instructions:
- Draw, to a horizontal scale of 130 mm = 360° and a displacement scale of 1 : 1, the complete displacement graph for the required motions.
- Label the graph and indicate the scale.　　　　　**[17]**

ASSESSMENT CRITERIA					
1	CONSTRUCTION	$6\frac{1}{2}$			
2	POINTS + CURVES	$9\frac{1}{2}$			
3	LABELS	1			
PENALTIES (-)					
2.2 SUBTOTAL		**17**			
2.1 SUBTOTAL		**21**			
TOTAL		**38**			
EXAMINATION NUMBER					
EXAMINATION NUMBER					3

STAPLE

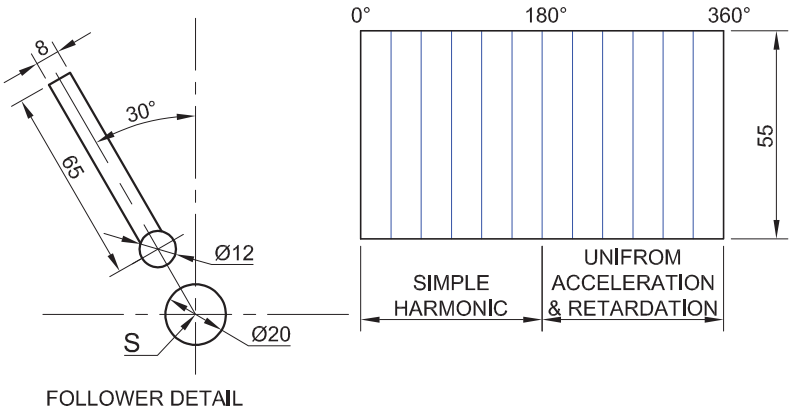## QUESTION 2: LOCI

CAM
Given:
- The detail of a roller-ended follower and the cam shaft
- The incomplete displacement graph
- The position of point S on the answer sheet

Specifications:
- The minimum distance from the cam profile to the centre of the camshaft = 19 mm
- The follower reciprocates along the 30° centre line which passes through the centre of the camshaft
- Rotation = clockwise

Instructions:
- Draw, to scale 1 : 1, the given follower and camshaft.
- Draw, to a horizontal scale of 8 mm equal to 30° and a displacement scale of 1 : 1, the complete displacement graph for the required motions. Label the graph.
- Project and draw the cam profile from the displacement graph.
- Show the direction of rotation on the cam profile.
- Show ALL necessary construction and projection. **[40]**

S

FOLLOWER DETAIL

8

30°

65

Ø12

S

Ø20

0°   180°   360°

55

SIMPLE HARMONIC | UNIFROM ACCELERATION & RETARDATION

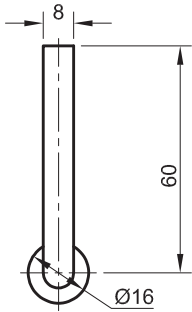|	ASSESSMENT CRITERIA				
1	PLACEMENT, GRAPH DIVISIONS + CONSTRUCTION FOR MOVEMENT + LABEL	$7\frac{1}{2}$			
2	PLOTTING POINTS & CURVE	$10\frac{1}{2}$			
3	FOLLOWER + MIN. DIST' C'LINES+ CAMSHAFT+ DIRECTION	9			
4	CONSTRUCTION	3			
5	PLOTTING	6			
6	PROFIEL	4			
	TOTAL	**40**			
	EXAMINATION NUMBER				
	EXAMINATION NUMBER				3

QUESTION 2: LOCI

Given:
The detail of the roller-ended follower for a disc cam.

Specifications:
- The minimum distance from the centre of the cam shaft to the cam profile = 20 mm
- Camshaft = Ø 20 mm
- Rotation = clockwise

Motion:
The disc cam rotates at constant velocity imparting the following uniform motion to the roller-ended follower:
- Over the first 60° the follower is at rest.
- Over the next 60° the follower rises to a height of 57 mm.
- There is a dwell period for the next 45°.
- Over the next 45° the follower falls 20 mm.
- There is a dwell period for the next 60°.
- Over the final 90° the follower returns to its original position.

Instructions:
- Using a horizontal scale of 30° equal to 8 mm and a displacement scale of 1 : 1, draw the displacement graph for the given motion.
- Label the displacement graph and include the scale.
- Draw, to scale 1 : 1, the given roller-ended follower in the correct position.
- Project and draw the cam profile from the displacement graph.
- Show the direction of rotation on the cam profile.
- Show ALL necessary construction. **[36]**

ASSESSMENT CRITERIA				
1	DISPLACEMENT GRAPH	10		
2	FOLLOWER, ARROW, SHAFT + CENTRE LINES + MIN DIST. + ROTATION	9		
3	CONSTRUCTION	4		
4	ROLLER + PROFILE	13		
	TOTAL	**36**		
EXAMINATION NUMBER				
EXAMINATION NUMBER				3

STAPLE

C

P

B

A

D
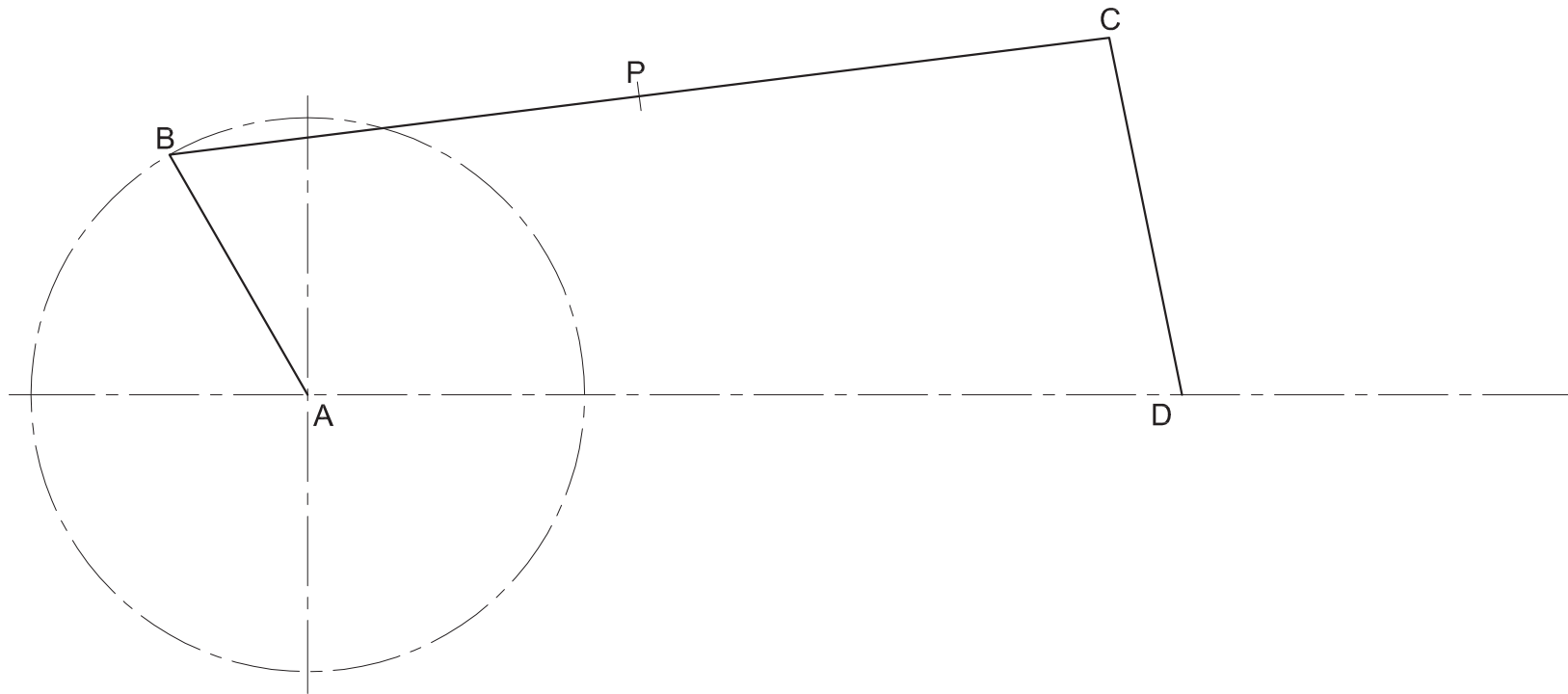
QUESTION 2: LOCI
NOTE: Answer QUESTIONS 2.1 and 2.2.

2.1 MECHANISM
Given:
A schematic diagram of crank AB, connecting rod BC and rocker CD.
A and D are fixed points.

Motion:
As crank AB rotates in an anticlockwise direction, rocker CD oscillates back and forth.

Instructions:
Using the given diagram, trace the locus generated by point P for ONE revolution.

Show ALL necessary construction.   [14]

	ASSESSMENT CRITERIA			
1	CONSTRUCTION	6		
2	LOCUS OF P	8		
	SUBTOTAL	**14**		

2.2 CHUTE
Given:
The front view of the shaft of a chute with the profile of the chute in the start and end positions.
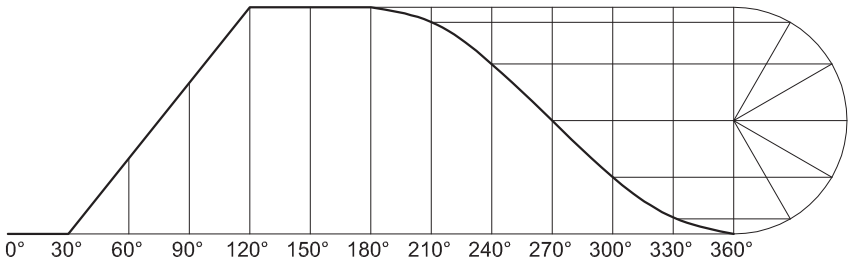
Specification:
• Direction: left-hand
• Turns: ONE AND A HALF

Instructions:
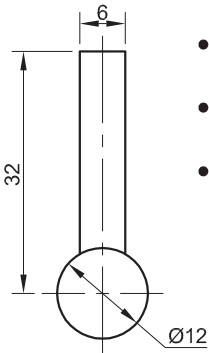Draw, to scale 1 : 1, the chute around the shaft.

Show ALL necessary construction.   [20]

Ø40
16
20
88
16
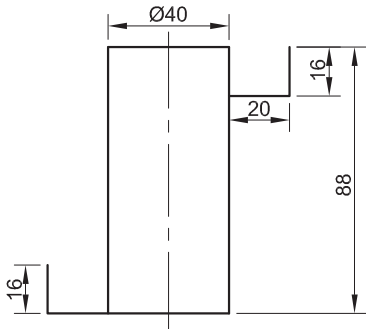
	ASSESSMENT CRITERIA			
1	CL + CONSTRUCTION	8		
2	CHUTE	12		
	SUBTOTAL	**20**		
	TOTAL	**34**		
	EXAMINATION NUMBER			
	EXAMINATION NUMBER			3

DISPLACEMENT GRAPH
SCALE 8 mm = 30°

6

32

Ø12

FOLLOWER DETAIL

QUESTION 2: LOCI
NOTE: Answer QUESTIONS 2.1 AND 2.2.

2.1 CAM
Given:
- The displacement graph showing uniform motion and simple harmonic motion
- The detail of a roller-ended follower

Specifications:
- The minimum distance from the cam profile to the centre of the camshaft = 19 mm
- Camshaft = Ø16 mm
- Rotation = clockwise

Instructions:
- Draw, to scale 1 : 1 and in the correct position, the given follower so that it will reciprocate along the vertical centre line of the camshaft.
- Project and draw the cam profile from the given displacement graph.
- Show the centre lines and the direction of rotation on the cam profile.
- Show ALL necessary construction.   **[19]**

ASSESSMENT CRITERIA

1	FOLLOWER + MIN. DIST' C'LINES + CAMSHAFT	5		
2	CONSTRUCTION	3		
3	PLOTTING + DIRECTION	7		
4	CURVE	4		
	SUBTOTAL	**19**		

2.2 HELICAL SQUARE SPRING
Given:
- The right view of a left-hand square spring, showing the starting position
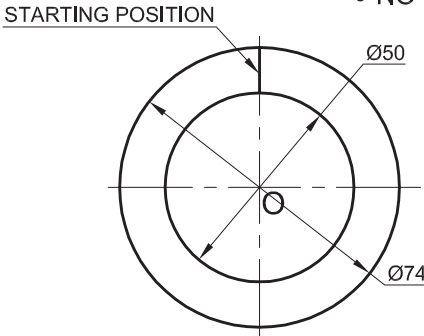- The position of centre point O on the answer sheet

Specifications:
- Pitch = 48 mm
- Spring profile = 12 x 12 mm

Instructions:
- Draw, to scale 1 : 1, the front view and right view of the left-hand square spring.
- Show ONE AND A HALF turns ONLY.
- Show ALL necessary construction.
- NO hidden detail is required.   **[21]**

+O

STARTING POSITION

Ø50

O

Ø74

ASSESSMENT CRITERIA

1	CONSTRUCTION	5		
2	POINTS + CURVE	16		
	SUBTOTAL	**21**		
	TOTAL	**40**		
	EXAMINATION NUMBER			
	EXAMINATION NUMBER			3

Ø42

24

24

S
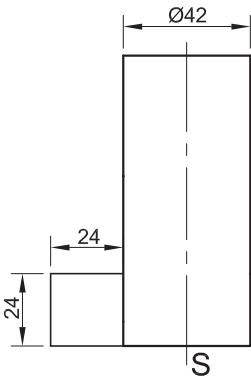
QUESTION 2: LOCI
NOTE: Answer QUESTIONS 2.1 AND 2.2.
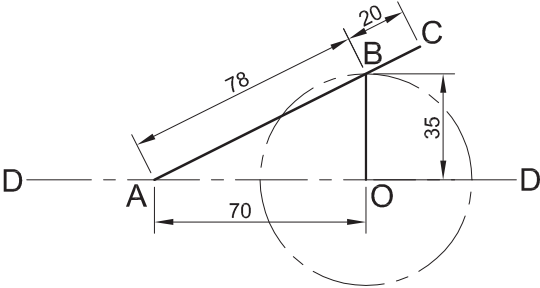
2.1 Thread
Given:
- The profile of a single-start right-hand square thread in the starting position
- The complete core
- The position of S on the drawing sheet

Instructions:
- Draw, to scale 1 : 1, ONE AND A HALF turns of the single-start right-hand square thread.
- Show ALL necessary construction.
- NO hidden detail is required.   **[24]**

2.2 Mechanism
Given:
- A schematic diagram of a mechanism consisting of a crank OB, which is attached to a connecting rod AC at point B
- The position of centre point O on the drawing sheet

Motion:
As crank OB rotates in a clockwise direction, point A moves to and fro along axis D-D.
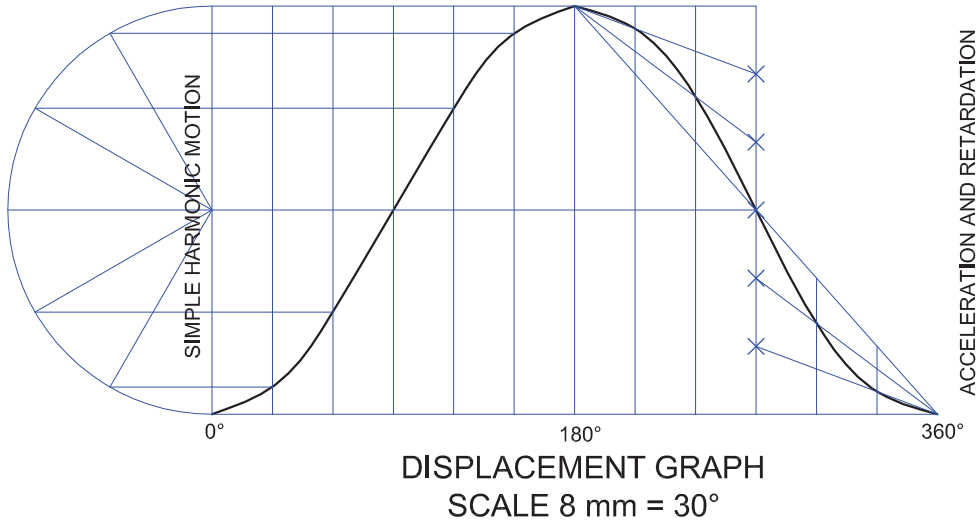
Instructions:
- Draw, to scale 1 : 1, the given schematic drawing of the mechanism.
- Trace the locus generated by point C for ONE complete revolution of the mechanism.
- Show ALL necessary construction.   **[18]**

20
C
B
78
35
D
A
70
O
D

+ S

+ O

ASSESSMENT CRITERIA				
1	CENTRE LINES + CONSTR'	6		
2	HELICES + SHAFT + DIRECTION	18		
	SUBTOTAL	**24**		

ASSESSMENT CRITERIA				
1	GIVEN	4		
2	CONSTRUCTION	6		
3	LOCUS + CURVE	8		
	SUBTOTAL	**18**		
	TOTAL	**42**		
EXAMINATION NUMBER				
EXAMINATION NUMBER				3

SIMPLE HARMONIC MOTION

ACCELERATION AND RETARDATION

0°   180°   360°

DISPLACEMENT GRAPH
SCALE 8 mm = 30°

8

56

Ø12

FOLLOWER DETAIL

QUESTION 2: LOCI
**NOTE:** Answer QUESTIONS 2.1 AND 2.2.

2.1 CAM
Given:
- The detail of a roller-ended follower and a displacement graph showing simple harmonic motion and uniform acceleration and retardation
- The vertical centre line of the cam profile

Specifications:
- Camshaft = Ø14 mm
- Minimum distance from the cam profile to the centre of the camshaft = 10 mm
- Rotation = clockwise

Instructions:
- Draw, to scale 1 : 1, the given follower detail so that it will reciprocate along the given centre line.
- From the given displacement graph, project and draw the cam profile.
- Show the centre line and the direction of rotation on the cam profile.
- Show ALL necessary construction.   **[19]**
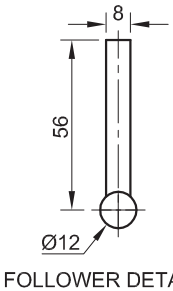
ASSESSMENT CRITERIA				
1. FOLLOWER + MIN. DIST' + CENTRE LINE + CAMSHAFT	6			
2. CONSTRUCTION	3			
3. PLOTTING + DIRECTION	6			
4. CURVE	4			
SUBTOTAL	**19**			

P

B

A

C

D
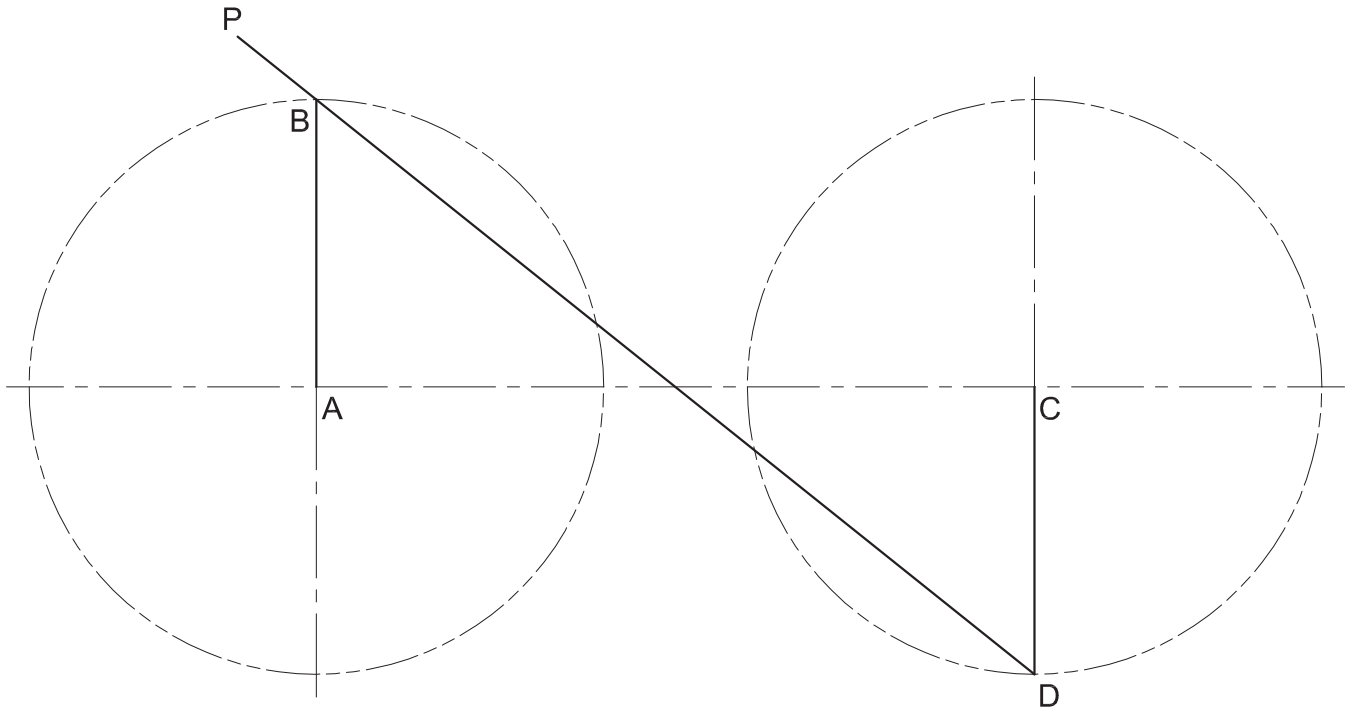
2.2 MECHANISM
Given:
A schematic diagram of a linked crank mechanism consisting of two cranks, AB and CD, joined by a rod, DP, which is fixed at D and slides through B.

Motion:
As crank AB rotates in an anticlockwise direction, crank CD rotates in a clockwise direction at the same velocity.

Instructions:
- Using the given diagram, trace the locus generated by point P for ONE complete revolution of the mechanism.
- Show ALL necessary construction.   **[19]**

ASSESSMENT CRITERIA				
1. CONSTRUCTION	5			
2. LOCUS OF P	14			
SUBTOTAL	**19**			
TOTAL	**38**			
EXAMINATION NUMBER				
EXAMINATION NUMBER				3

STAPLE

+O

QUESTION 2: LOCI
NOTE: Answer QUESTIONS 2.1 AND 2.2.

2.1 AUGER
Given:
- The front view and left view of the shaft of an auger
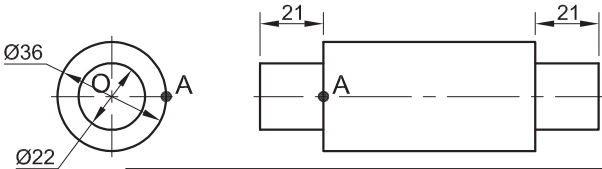- A reference point, labelled O, to help with the placement of the answer

Specifications:
- The pitch (ONE full turn) is 35 mm.
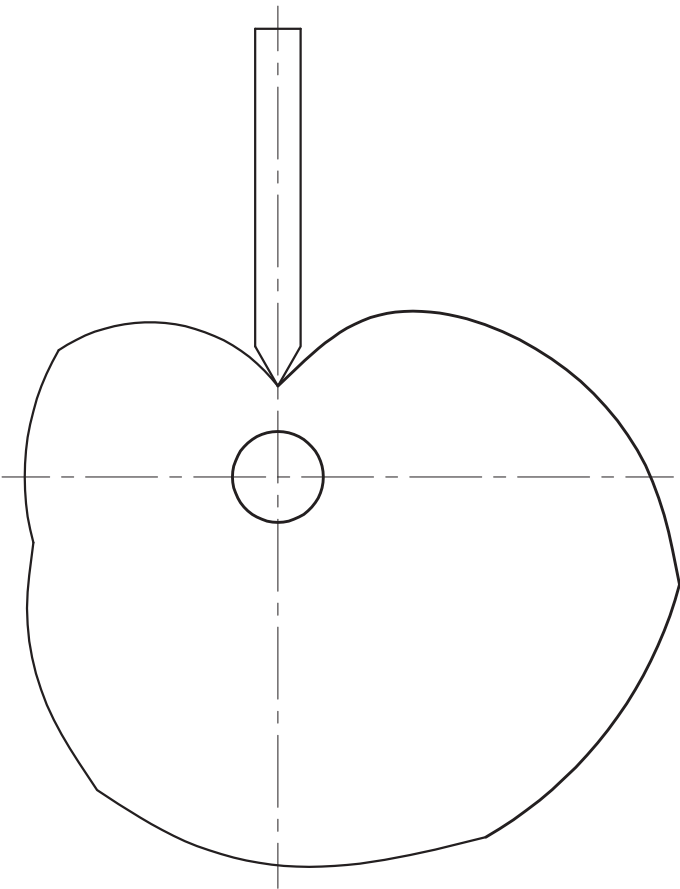- The outer diameter of the auger is Ø80.

Instructions:
- Starting at point A, draw, to scale 1 : 1, TWO turns of a right-hand auger on the given views of the shaft.
- Show ALL necessary construction.
- NO hidden detail is required.   **[27]**

Ø36
Ø22
O
A

21   21
A

ASSESSMENT CRITERIA			
GIVEN	5		
CENTRE LINES + CONSTR'	5		
HELIX/AUGER	17		
SUBTOTAL	**27**		

2.2 CAM
Given:
A cam profile with a wedge-ended follower

Specifications:
The cam rotates with constant velocity in a clockwise direction, imparting uniform motion to the follower.

Instructions:
- Draw the displacement graph for the cam, using a horizontal scale of 8 mm equal to 30°.
- Indicate the direction of rotation on the cam profile.
- Label the displacement graph and indicate the scale used.
- Show ALL necessary construction.   **[12]**

ASSESSMENT CRITERIA			
DISPLACEMENT GRAPH	7		
CONSTRUCTION	3		
LABELS + ARROW	2		
SUBTOTAL	**12**		
TOTAL	**39**		
EXAMINATION NUMBER			
EXAMINATION NUMBER			3

BASIC-EDUCATION

QUESTION 2: LOCI (HELIX)

A manufacturing company designed a single-start square threaded worm gear with the following specifications:
- Right handed
- One and a half revolutions
- Outside diameter = 120 mm
- Core diameter   = 80 mm
- Pitch   = 60 mm

Given:
- The incomplete front view of the worm gear showing the profile of the thread and the starting position AB, at the centre front of the shaft
- The centre line and starting position AB as a reference on the drawing sheet

Instructions:
Draw, to scale 1 : 1, the complete front view of the worm gear using the given centre line and starting position AB.

- Show ALL necessary construction.
- NO hidden detail is required.   **[39]**

A

B

60

20

A

B

Ø80   20
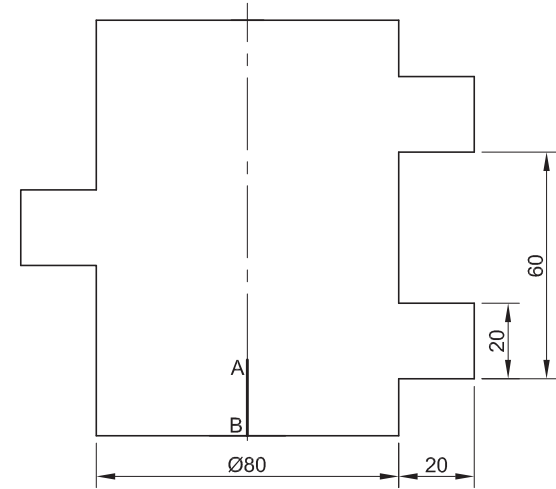
ASSESSMENT CRITERIA				
1. CONSTRUCTION	$8\frac{1}{2}$			
2. OUTSIDE CURVES + LINES	$15\frac{1}{2}$			
3. INSIDE CURVES	6			
4. QUALITY OF CURVES	4			
5. SHAFT	5			
TOTAL	39			
EXAMINATION NUMBER				
EXAMINATION NUMBER				3

GAUTENG

QUESTION 2: LOCI (CAM)

Given:
- The shaft and follower detail of an industrial cam with the follower shown at its furthest position to the left
- The vertical centre line of the camshaft as a reference on the drawing sheet

The specifications for the movement are as follows:
- The cam rotates clockwise at constant velocity and imparts uniform motion to the follower.
- Over the first 60° the follower moves 20 mm to the right.
- There is a dwell period for the next 30°.
- Over the next 30° the follower moves a further 20 mm to the right.
- Over the next 60° the follower moves a further 20 mm to the right.
- There is a dwell period for the next 45°.
- Over the next 45° the follower moves 50% of the displacement to the left.
- There is a dwell period for the next 30°.
- Over the final 60° the follower returns to its original position.

Instructions:
2.1 Draw, to scale 1 : 1, the given view of the camshaft and the follower using the given vertical centre line as reference. The arrow indicating the direction of rotation must be shown.
2.2 Draw the displacement graph with a rotational scale of 30° equal to 8 mm and a displacement scale of 1 : 1 for the given motion. Label the graph.
2.3 Project and draw the cam profile that would generate the given motion.

- Show ALL necessary construction.   **[33]**

Ø12
8 | 10 | 50
6
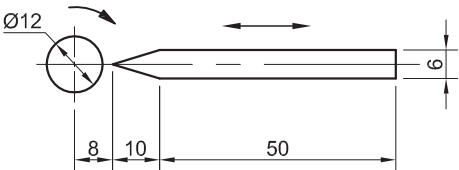
CAMSHAFT AND FOLLOWER DETAIL

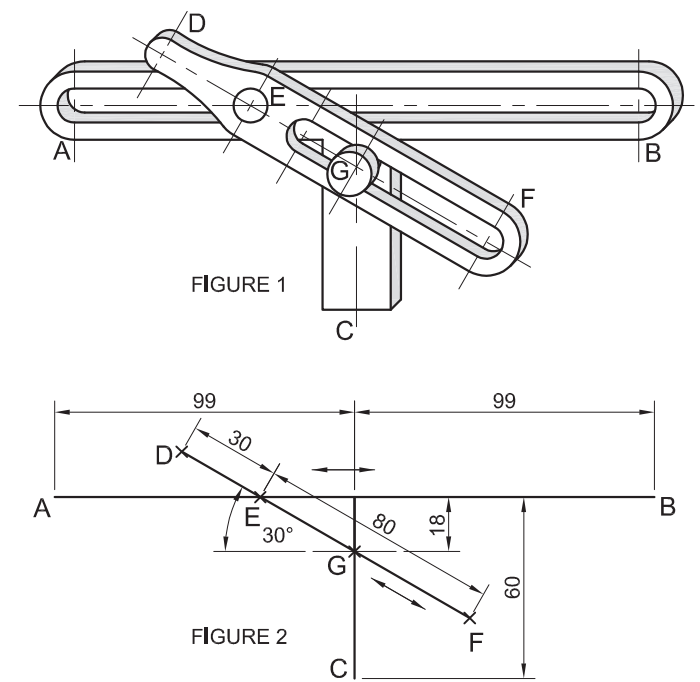| ASSESSMENT CRITERIA				
1. GRAPH	11			
2. FOLLOWER + SHAFT + ARROW	5			
3. CONSTRUCTION	4			
4. CAM POINTS	7			
5. CURVE + QUALITY	6			
TOTAL	33			
EXAMINATION NUMBER				
EXAMINATION NUMBER				3

QUESTION 2: LOCI (MECHANISMS)

Given:
- A mechanism consisting of a movable slider DF and a T-piece ABC
  FIGURE 1: An oblique drawing of the mechanism
  FIGURE 2: A schematic drawing of the mechanism
- Point G as the reference point on the drawing sheet

Motion:
Pin E, located on slider DF, slides freely in groove AB to its furthest position on the left, then to its furthest position on the right. Slider DF moves freely around a fixed pin G located on the T-piece ABC.

Instructions:
2.1 Draw, to scale 1:1, the given schematic drawing using point G as the reference point. Include ALL labels.
2.2 Trace the locus of point D for the complete movement of the slider.
2.3 Trace the locus of point F for the complete movement of the slider.

- Show ALL necessary construction.   [33]

G

FIGURE 1

FIGURE 2

ASSESSMENT CRITERIA				
GIVEN + LABELS	6			
CONSTRUCTION	6			
LOCUS D + CURVE	11			
LOCUS F + CURVE	10			
TOTAL	**33**			
EXAMINATION NUMBER				
EXAMINATION NUMBER				3

QUESTION 2: LOCI (MECHANISMS)

Given:
A mechanism consisting of a crank OP that is pin-joined to a slotted link AB. The slotted link AB slides over a fixed pin R that is located on the circumference of a wheel, centre Q.
FIGURE 1: A detailed drawing of the mechanism
FIGURE 2: A schematic drawing of the mechanism

Motion:
Crank OP rotates in an anti-clockwise direction while the wheel, centre Q, rotates at the same speed in a clockwise direction. The slotted link AB slides over pin R during the rotation.

Instructions:
2.1 Draw, to scale 1:1, the given schematic drawing using point O as a reference point. Include ALL the labels.
2.2 Trace the locus generated by point A of the slotted link for one revolution.
2.3 Trace the locus generated by point B of the slotted link for one revolution.

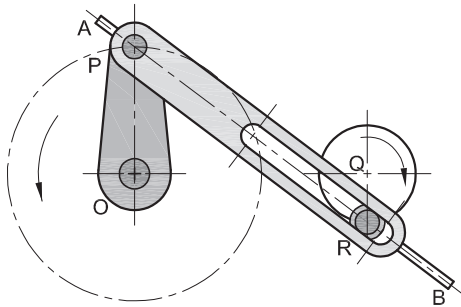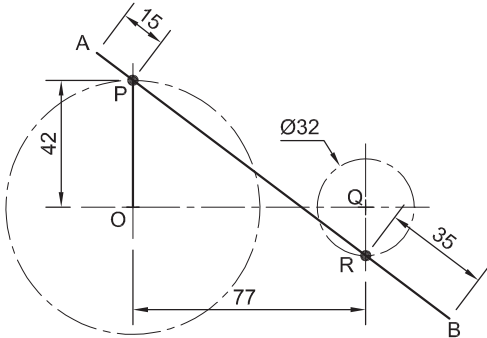• Show ALL necessary construction.   **[33]**

O+

FIGURE 1

FIGURE 2

ASSESSMENT CRITERIA				
GIVEN + LABELS	5			
CONSTRUCTION	8			
LOCUS A + CURVE	10			
LOCUS B + CURVE	10			
TOTAL	**33**			
EXAMINATION NUMBER				
EXAMINATION NUMBER				3

STAPLE

O

QUESTION 2: LOCI (MECHANISMS)

A manufacturing company designed a mechanism to open and close a mechanical gate on an assembly line in a bottling plant.

The mechanism consists of a crank, OA, attached to a shaft which rotates clockwise at a constant speed about a centre point O. Rod AB, attached to the crank at A, slides freely through a fixed point at C. AB rotates freely about point A.

During the design process the loci generated by points B and E on the moving parts of the mechanism had to be established.

Given:
FIGURE 1: A drawing showing the assembled parts of the mechanism.
FIGURE 2: A schematic drawing of the moving parts of the mechanism.

Instructions:
2.1 With point O as a reference, draw FIGURE 2 full size.
2.2 Trace the locus generated by point B located on the rod AB.
2.3 Trace the locus generated by point E located on the rod AB.

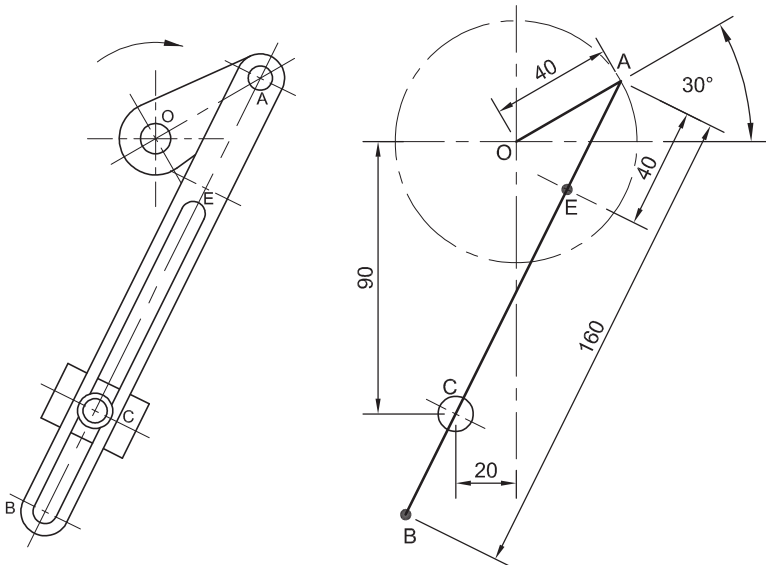• Show ALL necessary construction.   **[33]**

FIGURE 1

FIGURE 2

ASSESSMENT CRITERIA

GIVEN FIGURE	4
CONSTRUCTION	3
LOCUS B	13
LOCUS E	13
TOTAL	**33**

EXAMINATION NUMBER

EXAMINATION NUMBER	3

QUESTION 2: LOCI (CAM)

A toy manufacturing company wishes to design a toy car that when it is pushed along the ground, the body of the car rises and falls. This can be achieved by attaching a cam to the inside of the wheel with a roller-follower attached to the body of the car.

The specifications for the movement are as follows:
- The car rises with uniform motion to a height of 23mm over the first 90°
- There is a dwell period for the next 60°
- It then rises a further 37mm over the next 75°
- There is another dwell period for the next 60°
- The car returns to its original position over the final 75°

Given:
The cam shaft and the follower detail in its lowest position. The cam rotates in an anti-clockwise direction as shown by the arrow.

Instruction:
- Copy the camshaft and follower detail. Show the arrow indicating the direction of rotation.
- Draw a displacement graph with a horizontal scale of 30° equal to 8mm and a vertical scale of 1:1 for the given motion. Label the graph and include a scale.
- Project and draw the cam profile that would generate the given motion.

[36]

8
60
Ø12 ROLLER
21
Ø20 SHAFT
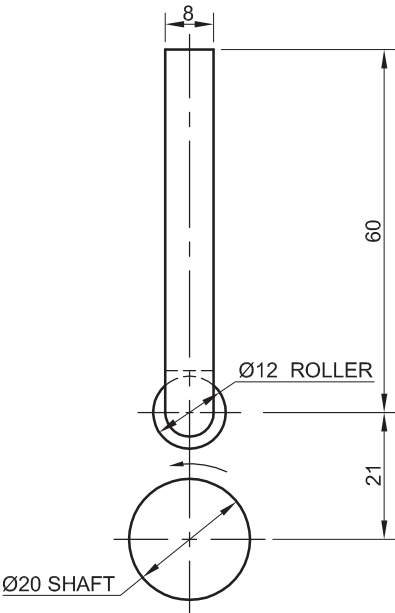
CAMSHAFT AND FOLLOWER DETAIL

ASSESSMENT CRITERIA

GRAPH	9
GIVEN INFO: FOLLOWER, MIN HEIGHT	
DIRECTION ARROW	
SHAFT and CL,s	11
CONSTRUCTION	4
ROLLER POSITIONS + CURVE QUALITY	12
TOTAL	**36**

EXAMINATION NUMBER

EXAMINATION NUMBER   3

STAPLE

QUESTION 2: LOCI (HELIX)

A manufacturing company has its packaging division located on the first floor of its factory. An open chute was installed to move the packed boxes from the first floor to the ground floor.

Given:
- The incomplete front view of the chute showing the start and the end points
- The top view of the chute
- The profile of the chute

Instructions:
Draw, to scale 1:10, the complete front view and the top view of the chute according to the following specifications:
- Right-hand helical chute
- The chute floor drops 900 mm over 1½ turns
- The sides of the chute are 150 mm high
- The chute floor is 300 mm wide

Note:
NO hidden detail is required.
Study the given diagrams carefully before you start drawing.

[45]

Ø300   Ø900

CHUTE START

300

900

CHUTE END

CHUTE FLOOR

CHUTE SIDE

150

300

THE CHUTE PROFILE
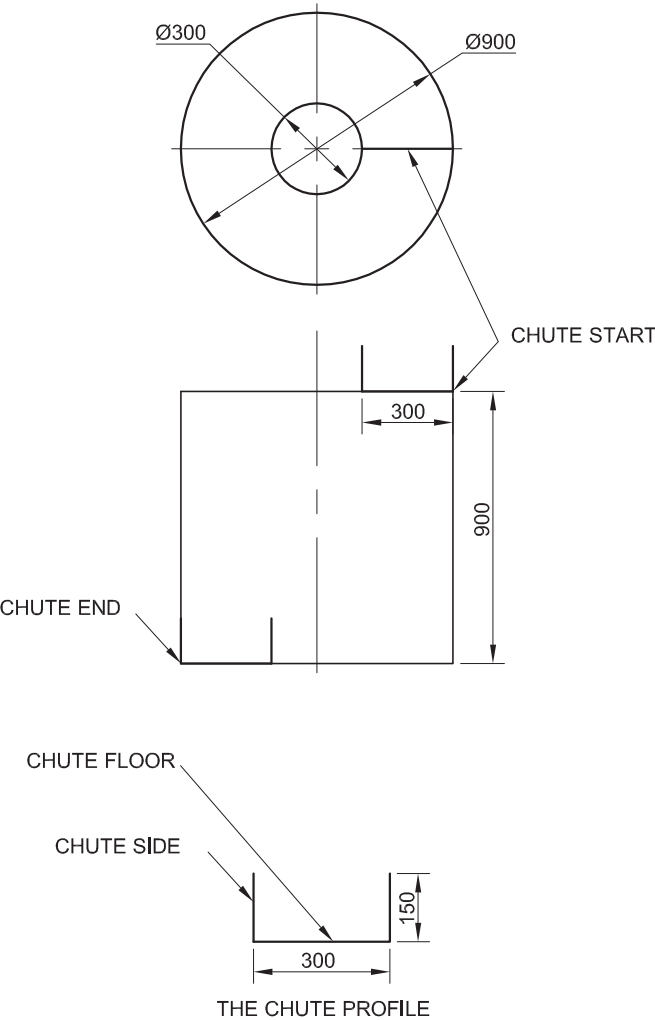
ASSESSMENT CRITERIA

CONSTRUCTION	=	6
TOP VIEW	=	2
DIRECTION	=	4
CENTRE LINES	=	2
HELIX	=	31
TOTAL	**=**	**45**

EXAMINATION NUMBER

EXAMINATION NUMBER   3