



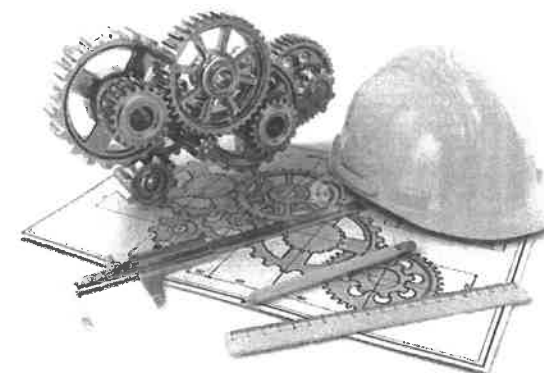
# NATIONAL SENIOR CERTIFICATE EXAMINATION

**MAY 2023**

## ENGINEERING GRAPHICS AND DESIGN

### PAPER 2

**MARKS: 200**  
**TIME: 3 HOURS**



#### FOR OFFICIAL USE ONLY

QUESTION	SECTION	MARK	MODERATED	MAXIMUM	CODE
1	MECHANICAL ANALYTICAL			20	
2.1	LOCI MECHANISM			15	
2.2	LOCI CAM			25	
3	ISOMETRIC DRAWING			40	
4	MECHANICAL ASSEMBLY			100	
	TOTAL			200	

#### PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of **7 pages**, including the cover page and **5 questions**.
2. **All** questions must be answered.
3. Unless specified otherwise, all questions are in **third-angle orthographic projection**.
4. Unless specified otherwise, all questions are to be completed to a **scale of 1:1**.
5. **All** answer sheets must be re-stapled in numerical order and handed in, including unanswered questions.
6. All **construction work** must be shown, even if a **stencil** was used.
7. Print your **examination number** neatly on each page.
8. Use only the **answer sheets** provided.
9. Your drawings should be **well presented** and reflect **neatness** and **accuracy**. Marks will be **deducted** for untidy and inaccurate work.
10. All dimensions or detail not given must be **assumed** in **good proportion** with the rest of the drawing.
11. **Stencils** and **calculators** may be used.
12. **All** drawings must adhere to the SANS 10111-1.
13. In order to save time, **detailed assembly parts** must be **drawn to convention**.

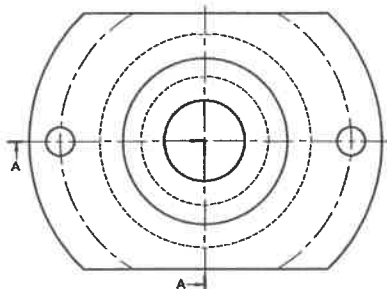
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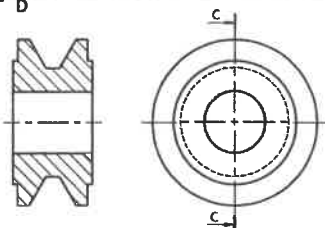
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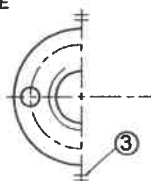
## PART A



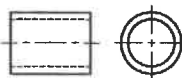
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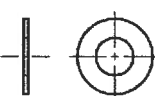
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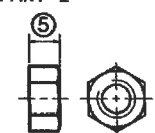
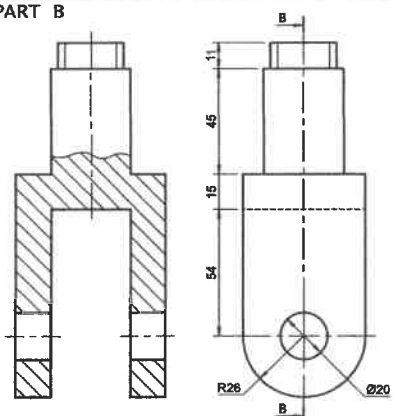
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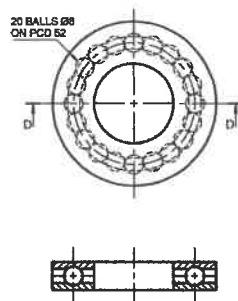
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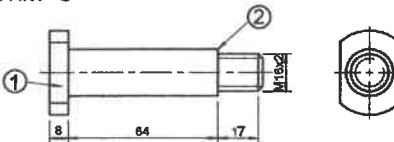
## PART I

**PART B**

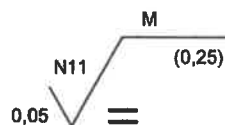
## PART F



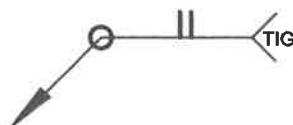
## PART C



### MACHINING SYMBOL



### WELDING SYMBOL






### QUESTION 1

MECHANICAL  
ANALYTICAL

## ANSWER

The adjacent figures show the parts of a swivel pulley. The questions below are based on these figures.

- |      |   |  |  |  |  |
|------|---|--|--|--|--|
| 1.1  | How many parts are manufactured with mild steel?                                  | A. One   | B. Two   | C. Three   | D. Four  |
| 1.2  | From what material is the ball bearing (Part F) manufactured?                     | A. Copper  | B. Mild steel  | C. Carbon steel  | D. High-tensile steel  |
| 1.3  | What is Feature 1 on the shaft (Part C)?  | A. Square on a shaft   | B. Flat face on a shaft  | C. Across flats  | D. Bearing   |
| 1.4  | What is Feature 2 on the shaft (Part C)?  | A. Round   | B. Shoulder on a shaft   | C. Sphere  | D. Chamfer   |
| 1.5  | What type of sectioning (A-A) is shown on the support (Part A)?                   | A. Half-section  | B. Full section  | C. Part section  | D. Top section   |
| 1.6  | What symbol does Feature 3 represent on the retaining collar (Part E)?            | A. Parallel  | B. Square  | C. Equal to  | D. Symmetrical   |
| 1.7  | What type of hole does Feature 4 represent on the retaining collar (Part E)?      | A. Threaded hole   | B. Blind hole  | C. Counterbore hole  | D. Countersunk hole  |
| 1.8  | How many balls are in the bearing (Part F)?                                       | A. 16  | B. 18  | C. 20  | D. 22  |
| 1.9  | What is the total length of the fork (Part B)?                                    | A. 80  | B. 95  | C. 140   | D. 151   |
| 1.10 | What is the total length of the shaft (Part C)?                                   | A. 81  | B. 89  | C. 91  | D. 93  |
| 1.11 | Calculate the exact thickness, Feature 5, of the nut (Part I).                    | A. 11,2  | B. 12  | C. 12,8  | D. 16  |
| 1.12 | Which part could decrease the friction between a shaft and a pulley?              | A. Nut   | B. Collar  | C. Washer  | D. Bush  |
| 1.13 | What does the circle on the welding symbol indicate?                              | A. Site weld   | B. Weld all around   | C. Gas weld  | D. Fillet weld   |
| 1.14 | What type of welding is shown by the welding symbol?                              | A. Single-U butt weld  | B. Single-V butt weld  | C. Single-J butt weld  | D. Square butt weld  |
| 1.15 | What welding process is shown by the welding symbol?                              | A. Arc welding   | B. TIG welding   | C. MIG welding   | D. Gas flame welding   |
| 1.16 | How many surfaces needs machining by removal of material on the support (Part A)? | A. 1   | B. 2   | C. 3   | D. 4   |
| 1.17 | What is the roughness value on the machining symbol?                              | A. 0,25  | B. 0,05  | C. N11   | D. M   |
| 1.18 | What is the machining allowance on the machining symbol?                          | A. 0,25  | B. 0,05  | C. N11   | D. M   |
| 1.19 | What is the direction of the lay on the machining symbol?                         | A. Equal   | B. Crossed   | C. Perpendicular   | D. Parallel to plane   |
| 1.20 | What is the correct symbol for third angle orthographic projection?               | A.  | B.  | C.  | D.  |

20 MARKS

## EXAMINATION NUMBER

ANSWER SHEET 1

QUESTION 2.1

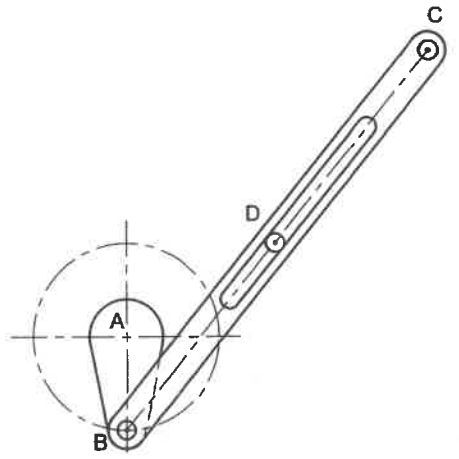
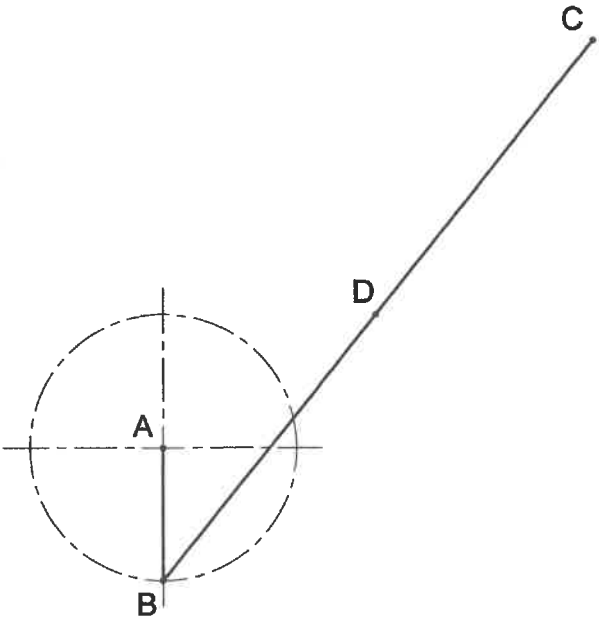
LOCI  
MECHANISM

The given figure below shows a mechanism consisting of a crank **AB** that is pin-jointed to a slotted link **BC**. The slotted link **BC** slides over a fixed pin **D**.

The crank **AB** rotates in an **anti-clockwise** direction. The slotted link **BC** slides over pin **D** during the rotation of crank **AB**.

Use the given centre lines to construct and draw the locus of point **C** for one full rotation of the mechanism.

- The length of rod **BC** is 130 mm.
- Draw the direction arrow.
- Show all **constructions**.



ASSESSMENT CRITERIA		
• Construction	2	
• Plot Points	11	
• Direction	1	
• Locus	1	

CON 2		
PTS 11		
DIR 1		
LOC 1		

15 MARKS

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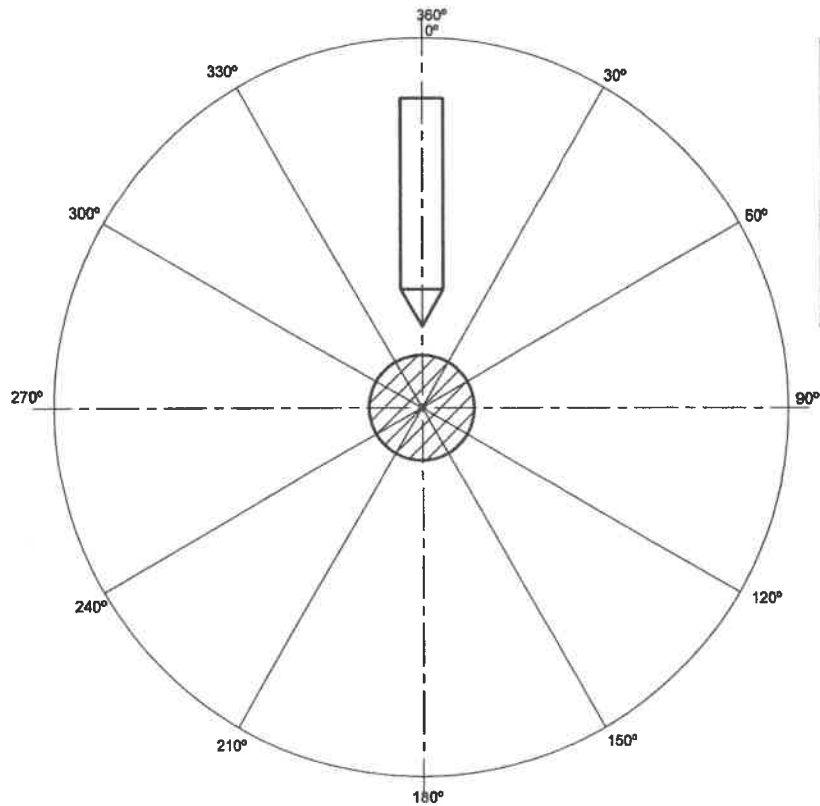
ANSWER SHEET 2.1

LOC  
CAM

- the incomplete **graph of displacement** in position for a **wedge-ended** follower.
- the vertical and horizontal centre lines of the camshaft.
- the camshaft and follower detail at the starting position.

- $0^\circ - 60^\circ$  the follower **ris**es 18 mm with **uniform motion**. (Given)
- $60^\circ - 120^\circ$  the follower is at **rest**. (Given)
- $120^\circ - 240^\circ$  the follower **ris**es 36 mm with **uniform acceleration and retardation**.
- $240^\circ - 360^\circ$  the follower returns to its original position with **simple harmonic motion**.

- 2.2.1 the complete graph of displacement for the required motion.
- 2.2.2 the cam profile from the displacement graph.
- 2.2.3 all constructions.
- 2.2.4 show the direction of rotation.



The graph shows a function on a coordinate plane with a grid. The x-axis ranges from 0 to 8, and the y-axis ranges from 0 to 2. The function is defined by the piecewise linear segments connecting the points (0, 0), (2, 2), and (8, 2). The function increases linearly from (0, 0) to (2, 2) and then remains constant at y = 2 for x from 2 to 8.

• Graph	10
• Plot Points	11
• Construction	2
• Direction	1
• Locus	1

GRPH 10		
PTS 11		
CON 2		
DIR 1		
LOC 1		

**25 MARKS**

EXAMINATION NUMBER

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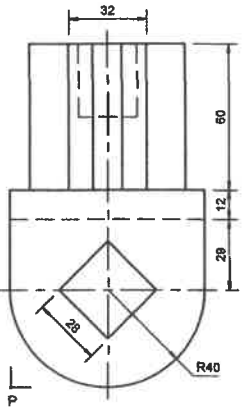
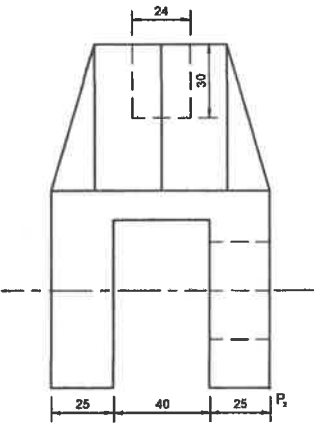
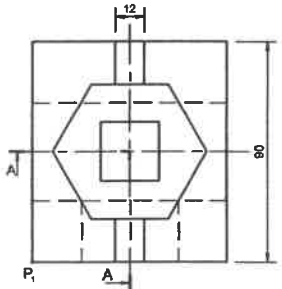
CONSTRUCTION AREA

QUESTION 3

ISOMETRIC  
DRAWING

The figures below show the front view, top view and left view of a heavy-duty **CASTING**. The **CASTING** is cut by **cutting-plane A-A**.

- 3.1 Draw a neat **half-sectioned isometric** drawing of the **CASTING** on **cutting-plane A-A**.
- 3.2 Draw the auxiliary view of the hexagon and the square in the construction area.
- 3.3 Draw the centre lines and show all the constructions for the circle.
- 3.4 Make point **P** the starting point of your drawing.



**ASSESSMENT CRITERIA**

- Construction 3
- Isometric Points 48/2 24
- Isometric Circles 6
- Hatching / Non-Hatching 5
- Centre lines 2

CON 3		
ISOM 24		
CIRC 6		
HAT 5		
CL 2		

40 MARKS

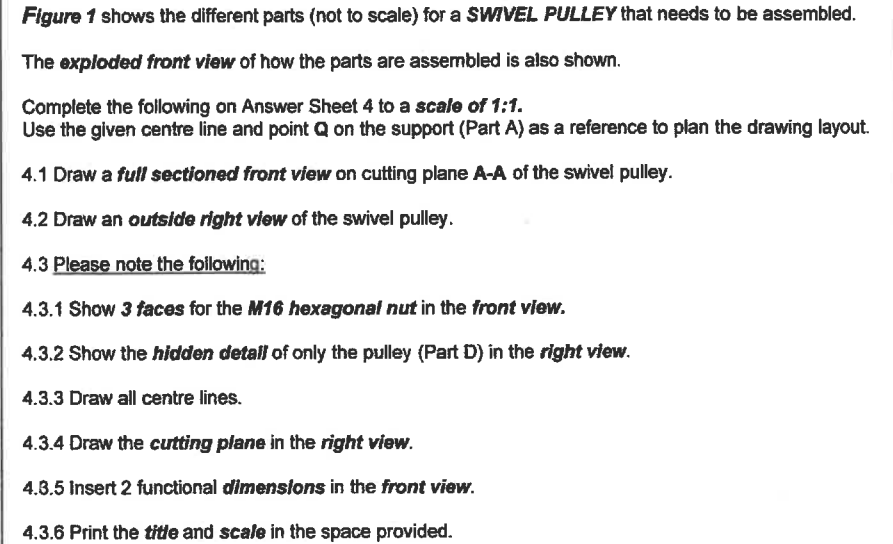
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ANSWER SHEET 3

**QUESTION 4**

**MECHANICAL ASSEMBLY**



VIEW

PART E

PART F

PART A

PART B

PART C

PART G

PART D

PART H

PART I

100 MARKS

EXAMINATION NUMBER

[illegible]

## QUESTION 4

MECHANICAL  
ASSEMBLY

Q

## ASSESSMENT CRITERIA

## SECTIONED FRONT VIEW

A SUPPORT	11		
B FORK	14		
C SHAFT	7		
D PULLEY	14		
E COLLAR	5		
F BEARING	2		
G BUSH	2		
H WASHER	2		
I M16 NUT	4		
TOTAL	61		

## OUTSIDE RIGHT VIEW

A SUPPORT 10/2	5		
B FORK 6/2	3		
C SHAFT	2		
D PULLEY	1		
H WASHER	1		
I M16 NUT	2		
HIDDEN DETAIL	4		
TOTAL	18		

## ADDITIONAL

CORRECT ASS.	3		
HATCHING 14/2	7		
NON-HATCHING	2		
CENTRE LINES 6/2	3		
DIMENSIONS	2		
CUTTING PLANE 4/2	2		
TITLE/SCALE	2		
TOTAL	21		

TOTAL 100

## EXAMINATION NUMBER

TITLE:

SCALE:

ANSWER SHEET 4