NATIONAL SENIOR CERTIFICATE EXAMINATION

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			

CHECKED BY

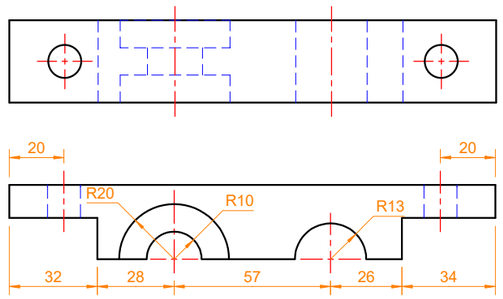
Please paste the barcoded lable here

EXAMINATION NUMBER

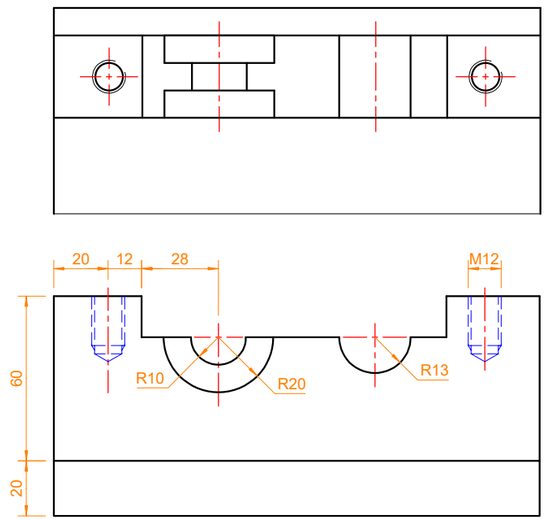
PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

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**.

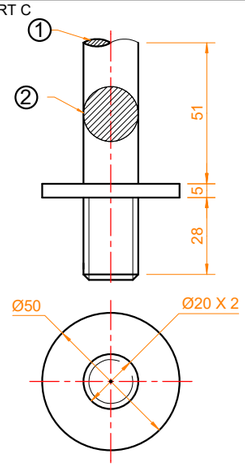
PART A



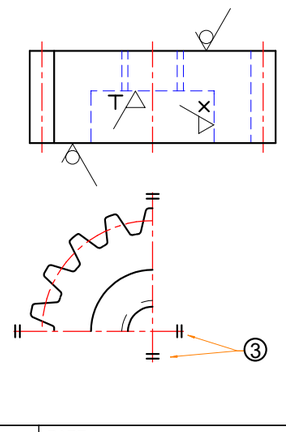
PART B



PART C



PART D



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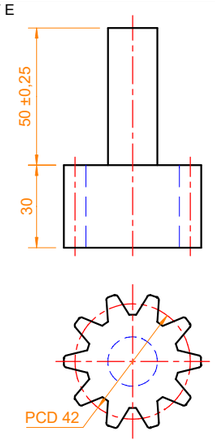
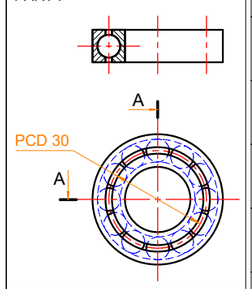
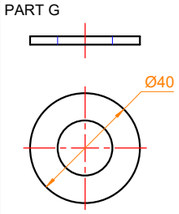


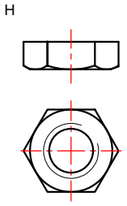
PART F



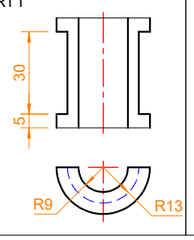
PART G



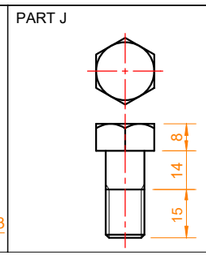
PART H



PART I

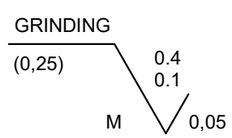


PART J

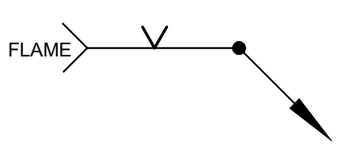


PARTS LIST			
NO	PART	QUANTITY	MATERIAL
A	BEARING CAP	1	MILD STEEL
B	BEARING BASE	1	MILD STEEL
C	GEAR SHAFT	1	HIGH TENSILE STEEL
D	INPUT GEAR	1	CARBON STEEL
E	OUTPUT GEAR	1	CARBON STEEL
F	BALL BEARING	2	CHROME STEEL
G	WASHER	1	MILD STEEL
H	M20 LOCK NUT	1	HIGH TENSILE STEEL
I	BUSH	2	BRASS
J	M12 BOLT	2	HIGH TENSILE STEEL

MACHINING SYMBOL



WELDING SYMBOL



QUESTION 1

MECHANICAL ANALYTICAL

The adjacent figures show the parts of a gear drive assembly. The questions below are based on these figures.
Choose the correct answer and write down its corresponding LETTER in the space provided.

	ANSWER	
1.1 How many parts are needed for the gear drive assembly? **A**. Ten **B**. Eleven **C**. Twelve **D**. Thirteen		1
1.2 From what material is the ball bearing (Part F) manufactured? **A**. Carbon steel **B**. Mild steel **C**. Chrome steel **D**. High-tensile steel		1
1.3 What is the total length of the bearing cap (Part A)? **A**. 175 **B**. 177 **C**. 179 **D**. 181		1
1.4 What is the dimension of the threaded holes on the bearing base (Part B)? **A**. R20 **B**. 10 **C**. M12 **D**. R13		1
1.5 What does Feature ***1*** on the gear shaft (Part C) represent? **A**. Symmetry **B**. Revolved section **C**. Part section **D**. Interrupted view		1
1.6 What does Feature ***2*** on the gear shaft (Part C) represent? **A**. Half-section **B**. Revolved section **C**. Part section **D**. Removed section		1
1.7 On how many surfaces is the removal of material not permitted on the input gear (Part D)? **A**. 0 **B**. 2 **C**. 3 **D**. 4		1
1.8 What is the indicated length of the gear shaft (Part C)? **A**. 51 **B**. 56 **C**. 84 **D**. 86		1
1.9 What does Feature ***3*** on the input gear (Part D) represent? **A**. Symmetry **B**. Parallel section **C**. Square section **D**. Quarter view		1
1.10 What is the minimum length of the output gear (Part E)? **A**. 49,75 **B**. 50,25 **C**. 79,75 **D**. 80,25		1
1.11 How many teeth are shown on the output gear (Part E)? **A**. 18 **B**. 14 **C**. 12 **D**. 10		1
1.12 What part would reduce the friction between the gearshaft (Part C) and the base (Part B)? **A**. Washer **B**. Ball bearing **C**. M20 Lock nut **D**. M12 Bolt		1
1.13 What is the length of the thread on the M12 bolt (Part J)? **A**. 15 **B**. 14 **C**. 8 **D**. 29		1
1.14 What is the maximum limit roughness value on the machining symbol? **A**. 0,1 **B**. 0,25 **C**. 0,4 **D**. 0,05		1
1.15 What is the machining allowance on the machining symbol? **A**. 0,1 **B**. 0,25 **C**. 0,4 **D**. 0,05		1
1.16 What is the direction of the lay on the machining symbol? **A**. Multi-directional **B**. Multi-crossed **C**. Multi-circular **D**. Multi-radial		1
1.17 What does the solid circle on the welding symbol indicate? **A**. Site weld **B**. Weld all around **C**. Flame weld **D**. Fillet weld		1
1.18 What type of welding is shown by the welding symbol? **A**. Single-U butt weld **B**. Single-V butt weld **C**. Bevel butt weld **D**. Square butt weld		1
1.19 What welding process is shown by the welding symbol? **A**. Arc welding **B**. TIG welding **C**. MIG welding **D**. Gas flame welding		1
1.20 What is the correct symbol for third-angle orthographic projection? **A.** **B.** **C.** **D.**		1

20 MARKS

ANSWER SHEET 1

EXAMINATION NUMBER

QUESTION 2.1

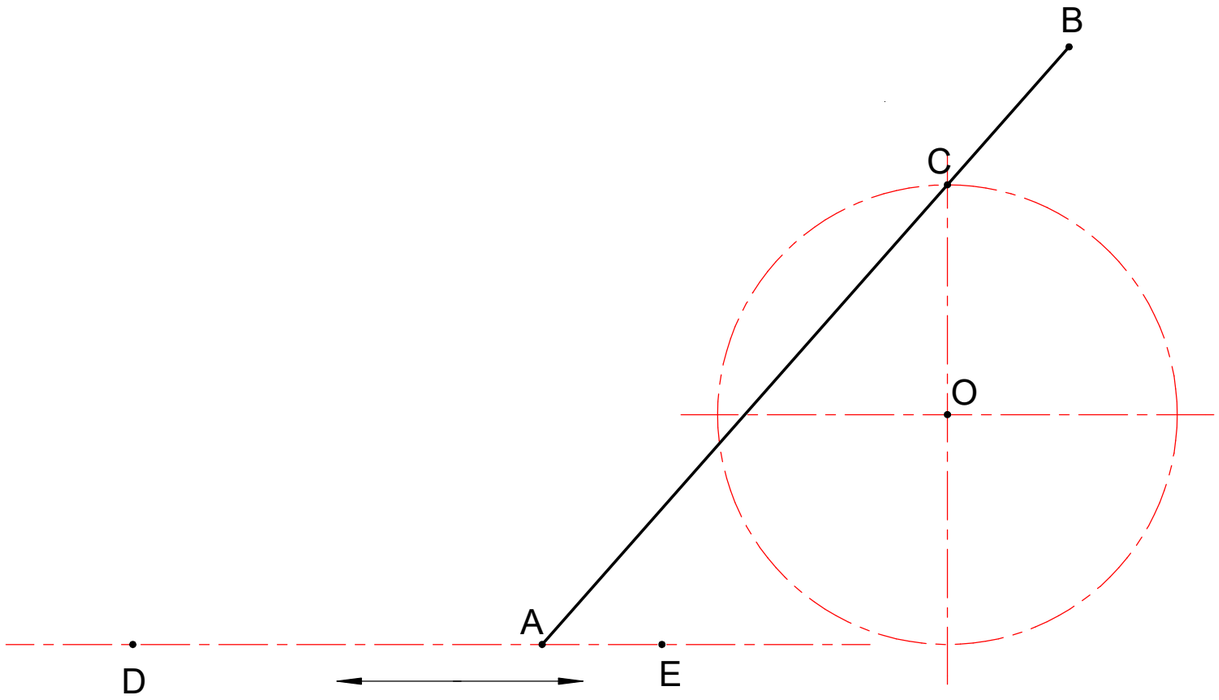
LOCI MECHANISM

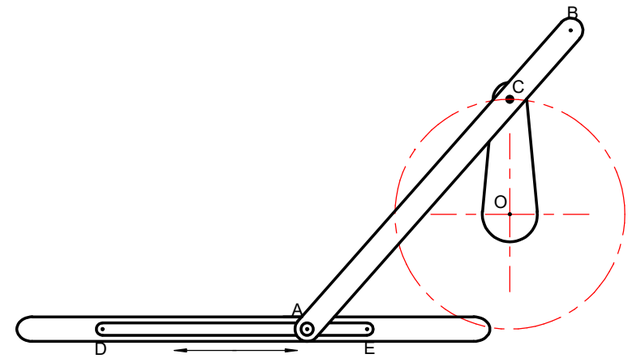
The figure below shows a mechanism consisting of a crank **OC**, with connecting rod **AB.**
Crank **OC** and rod **AB** are pin joined at point **C**.

The crank **OC** rotates **clockwise** around centre **O.**
Rod **AB** slides left and right in a groove at point **A** between points **D** and **E** during rotation.

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

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





ASSESSMENT CRITERIA

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

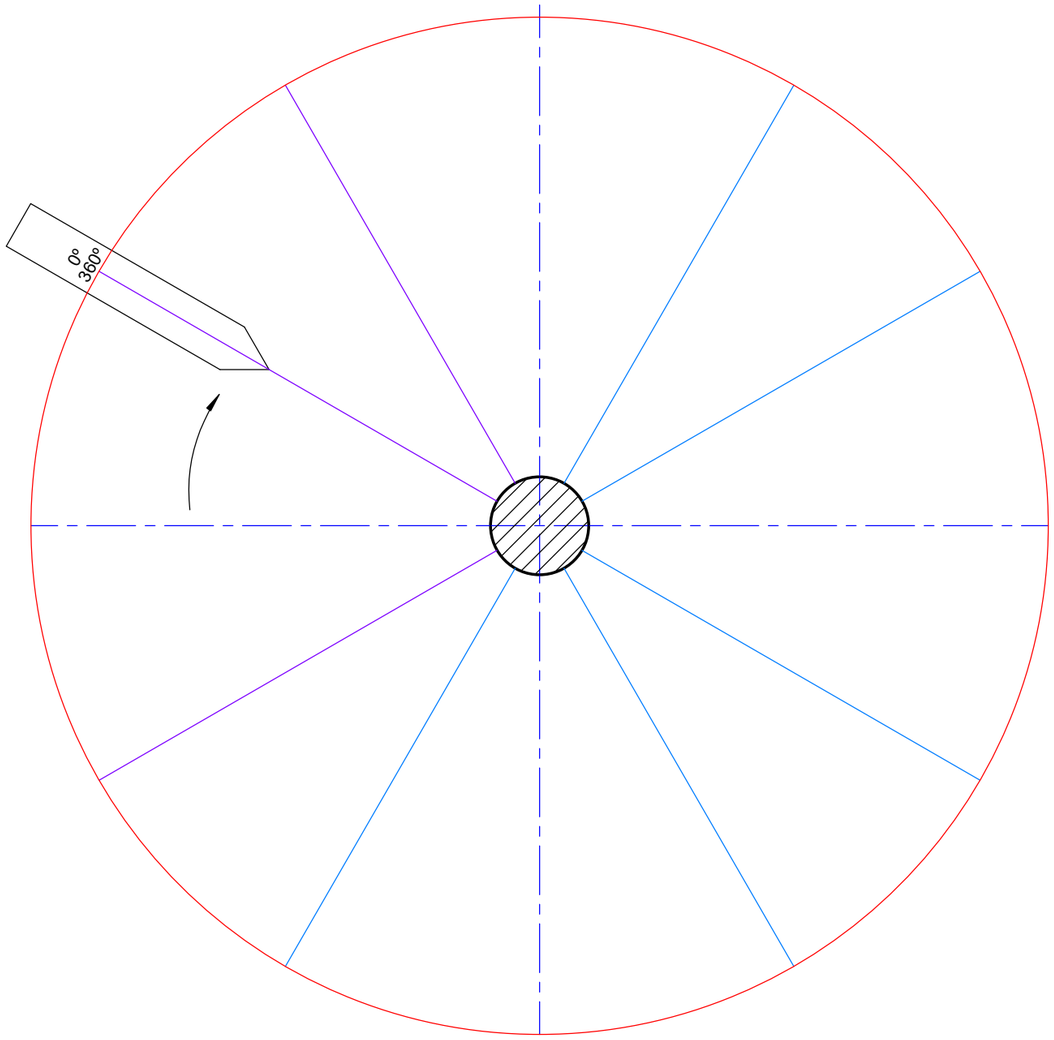
CON 2		
PTS 11		
DIR 1		
LOC 1		
15 MARKS		

EXAMINATION NUMBER

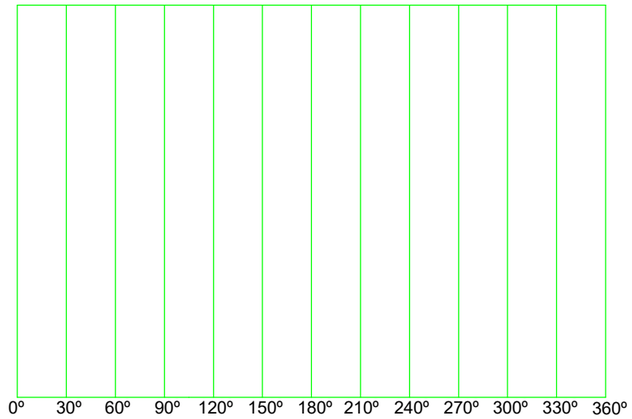
ANSWER SHEET 2.1

QUESTION 2.2

LOCI
CAM



DISPLACEMENT GRAPH



SCALE: 8 mm = 30°

The following are given in the adjacent drawing:

- the incomplete ***graph of displacement*** of a ***wedge-ended*** follower in position.
- the vertical and horizontal centre lines of the cam shaft.
- the shaft and follower detail at the starting position.
- the direction of the turn.

The cam imparts the following motion to the follower:

- 0° — 45° the follower ***falls*** 32 mm with ***uniform motion***.
- 45° — 60° the follower is at ***rest***.
- 60° — 300° the follower rises 64 mm with ***uniform acceleration and retardation***.
- 300° — 315° the follower is at ***rest***.
- 315° — 360° the follower returns to its original position with ***uniform motion***.

Do the following:

2.2.1 Draw the complete graph of displacement for the required motion.
2.2.2 Draw the cam profile from the displacement graph.
2.2.3 Label the divisions.
2.2.4 Show all constructions.

ASSESSMENT CRITERIA

• Graph	10
• Plot Points	13
• Locus	1
• Label Divisions	1

GRPH 10		
PTS 13		
LOC 1		
DIV 1		
25 MARKS		

EXAMINATION NUMBER

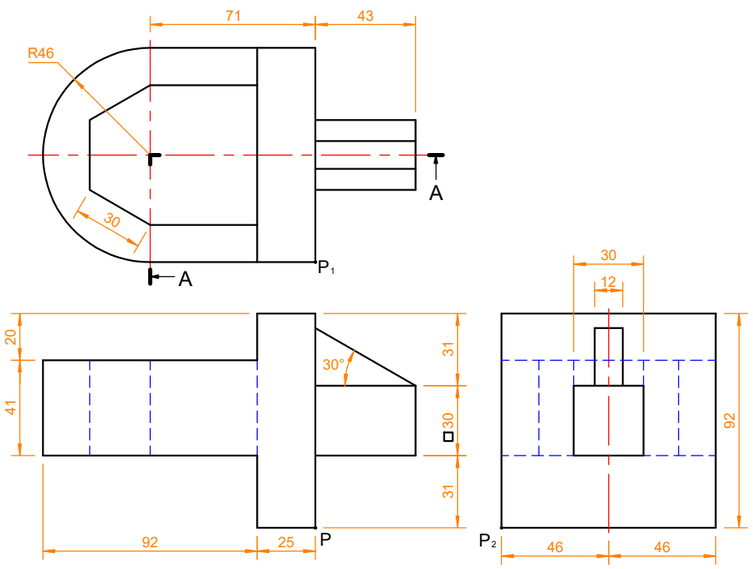
ANSWER SHEET 2.2

QUESTION 3

ISOMETRIC DRAWING

The figures below show the front view, top view and right view of a ***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 rib in the construction area.
3.3 Show all the constructions for the circle.
3.4 Make point **P** the starting point of the drawing.



CONSTRUCTION AREA

P

ANSWER SHEET 3

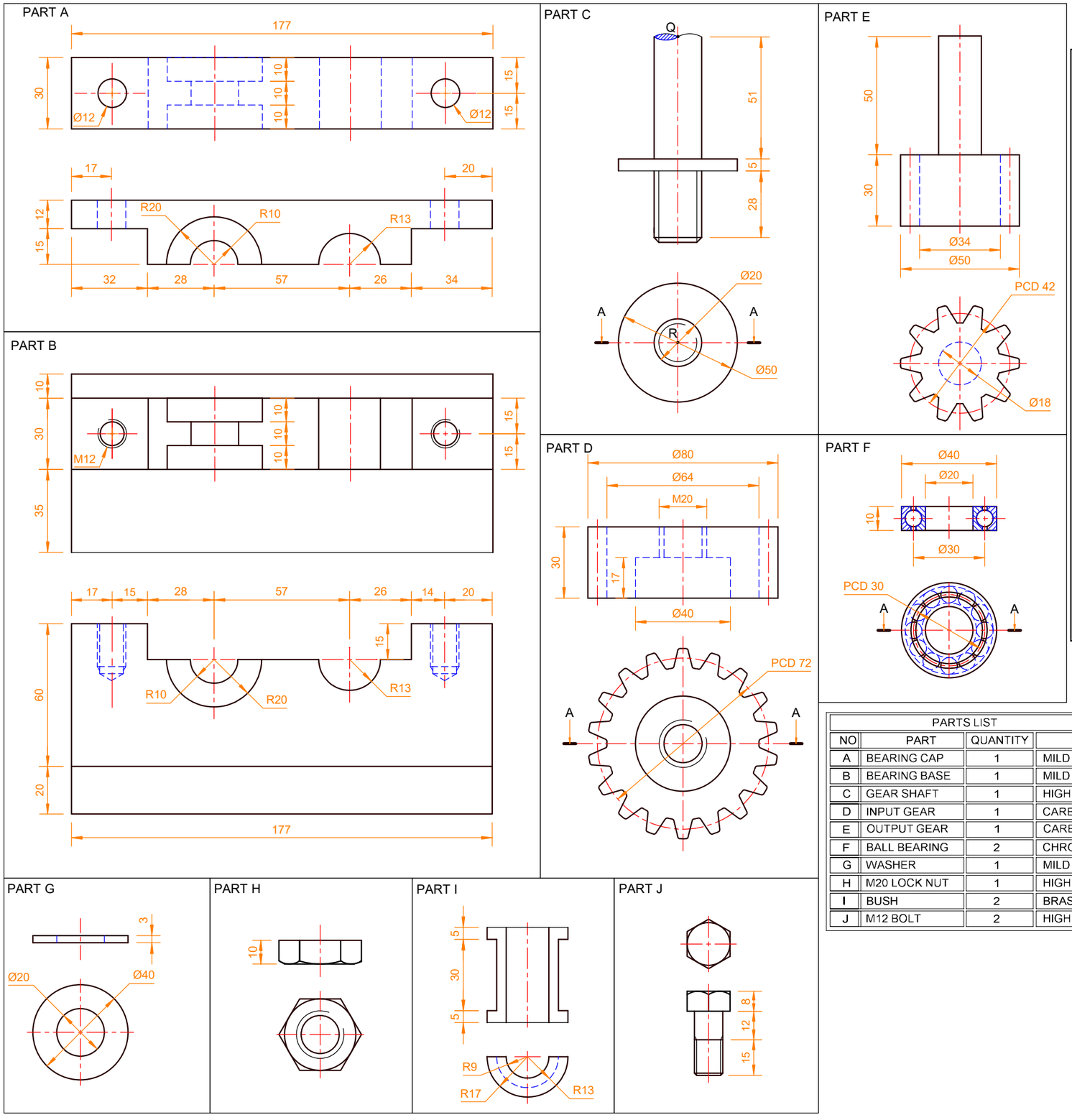
ASSESSMENT CRITERIA

• Construction	2
• Isometric Points	31
• Isometric Circles	4
• Hatching / Non-Hatching	3

CON 2		
ISOM 31		
CIRC 4		
HAT 3		
40 MARKS		

EXAMINATION NUMBER

FIGURE 1



QUESTION 4

MECHANICAL ASSEMBLY

Figure 1 shows the different parts (not to scale) for a ***GEAR DRIVE*** that needs to be assembled.

The ***exploded isometric view*** of how the parts are assembled is also shown.

Complete the following on Answer Sheet 4 to a ***scale of 1:1.***
Use the given centre lines and points **Q** and **R** on the gear shaft (Part C) as references to plan the drawing layout.

4.1 Draw an ***outside front view*** of the assembled parts on the given centre lines.

4.2 Draw a ***full sectional top view*** of the assembled parts on cutting plane **A-A** as shown on gear shaft (Part C) and the gear (Part D).

4.3 Please note the following:

4.3.1 Draw only one ***M12 hexagonal bolt head*** on the right side of the assembly showing ***2 faces*** in the ***front view***.

4.3.2 Show ***3 faces*** for the ***M20 hexagonal nut*** in the ***top view.***

4.3.3 Show the ***hidden detail*** of ***only*** the Ø12 holes of the bearing cap (Part A) in the ***front view***.

4.3.4 Draw all the centre lines.

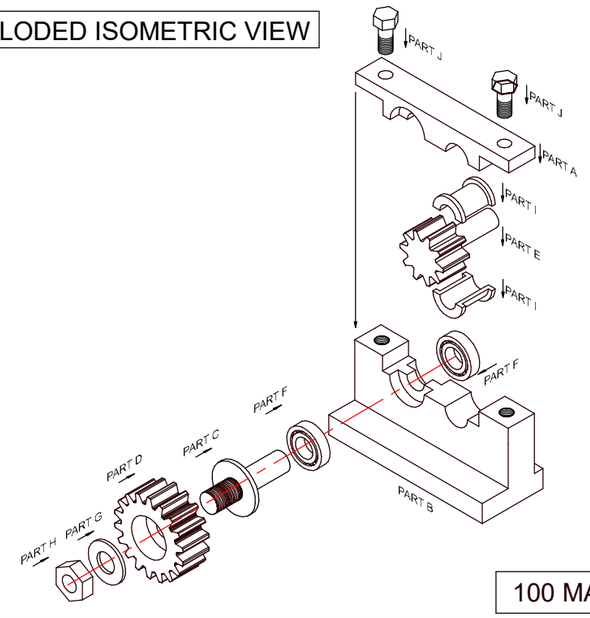
4.3.5 Draw the ***cutting plane*** in the ***front view***.

4.3.6 Insert 2 functional ***dimensions*** in the ***front view***.

4.3.7 Print the ***title*** and ***scale*** in the space provided.

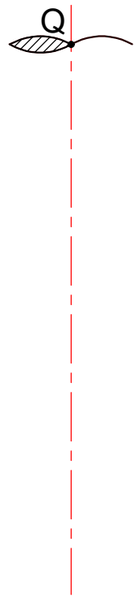
PARTS LIST			
NO	PART	QUANTITY	MATERIAL
A	BEARING CAP	1	MILD STEEL
B	BEARING BASE	1	MILD STEEL
C	GEAR SHAFT	1	HIGH TENSILE STEEL
D	INPUT GEAR	1	CARBON STEEL
E	OUTPUT GEAR	1	CARBON STEEL
F	BALL BEARING	2	CHROME STEEL
G	WASHER	1	MILD STEEL
H	M20 LOCK NUT	1	HIGH TENSILE STEEL
I	BUSH	2	BRASS
J	M12 BOLT	2	HIGH TENSILE STEEL

EXPLODED ISOMETRIC VIEW



100 MARKS

EXAMINATION NUMBER



QUESTION 4

MECHANICAL ASSEMBLY

ASSESSMENT CRITERIA			
SECTIONED TOP VIEW			
B BEARING BASE	12		
C GEAR SHAFT	8		
D INPUT GEAR	8		
E OUTPUT GEAR	5		
F BALL BEARING	4		
G WASHER	1		
H M20 LOCK NUT	5		
I BUSH	6		
TOTAL	49		

OUTSIDE FRONT VIEW			
A BEARING CAP	4		
B BEARING BASE	4		
C GEAR SHAFT	2		
D INPUT GEAR	2		
E OUTPUT GEAR	2		
G WASHER	1		
H M20 LOCK NUT	2		
J M12 BOLT	4		
HIDDEN DETAIL	4		
TOTAL	25		

ADDITIONAL				
CORRECT ASS.		3		
HATCHING		5		
NON-HATCHING	10/2	5		
CENTRE LINES	12/2	6		
DIMENSIONS		2		
CUTTING PLANE		3		
TITLE & SCALE		2		
TOTAL		26		
TOTAL		**100**		

TITLE:

SCALE:

ANSWER SHEET 4

EXAMINATION NUMBER