NATIONAL SENIOR CERTIFICATE EXAMINATION

2022

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

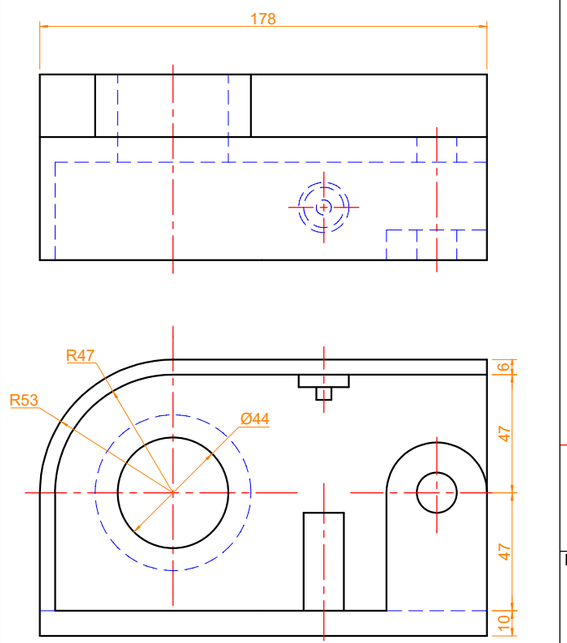
Please paste the barcoded lable here

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



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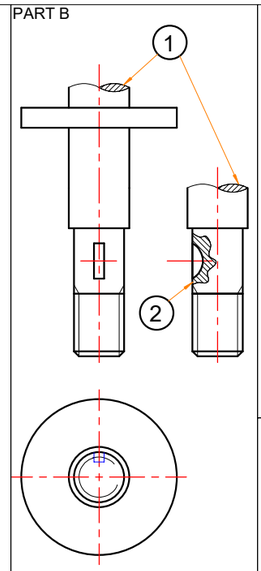
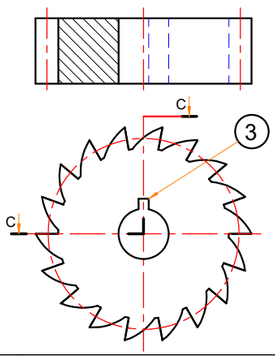
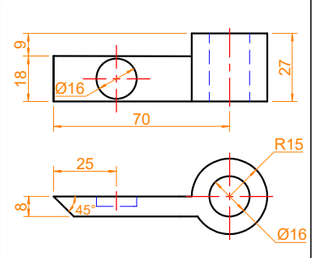


PART C



PART D



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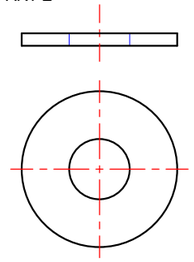
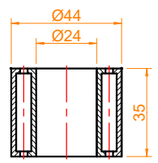


PART F



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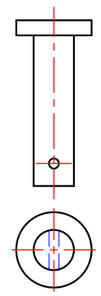
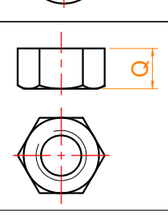
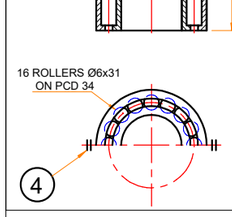


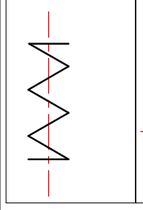
PART H



16 ROLLERS Ø6x31 ON PCD 34



PART I



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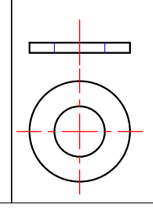

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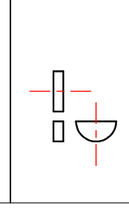

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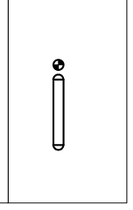
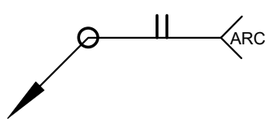
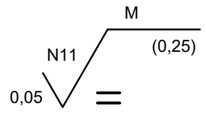


PARTS LIST			
NO	PART	QUANTITY	MATERIAL
A	BASE	1	MILD STEEL
B	RATCHET GEAR SHAFT	1	CARBON STEEL
C	RATCHET GEAR	1	STAINLESS STEEL
D	PAWL	1	STAINLESS STEEL
E	SPACER	1	MILD STEEL
F	ROLLER BEARING	1	CHROME STEEL
G	PAWL SHAFT	1	MILD STEEL
H	M20 NUT	1	STEEL
I	SPRING	1	STAINLESS STEEL
J	WASHER	1	MILD STEEL
K	WOODRUFF KEY	1	ALLOY STEEL
L	PIN	1	MILD STEEL

WELDING SYMBOL



MACHINING SYMBOL



QUESTION 1

MECHANICAL ANALYTICAL

The adjacent figures show the parts of a ratchet gear and pawl. 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 manufactured from stainless steel? **A**. One **B**. Three **C**. Five **D**. Ten		1
1.2 From what material is the Woodruff key (Part K) manufactured? **A**. Carbon steel **B**. Mild steel **C**. Alloy steel **D**. High-tensile steel		1
1.3 What does Feature ***1*** on the ratchet gear shaft (Part B) represent? **A**. Symmetry **B**. Revolved section **C**. Part section **D**. Interrupted view		1
1.4 What does Feature ***2*** on the ratchet gear shaft (Part B) represent? **A**. Half-section **B**. Revolved section **C**. Part section **D**. Removed section		1
1.5 What type of sectioning (**C-C**) is shown on the ratchet gear (Part C)? **A**. Half-section **B**. Full section **C**. Part section **D**. Top section		1
1.6 What does Feature ***3*** on the ratchet gear (Part C) represent? **A**. Key **B**. Keybase **C**. Keylock **D**. Keyway		1
1.7 What is the total length of the pawl (Part D)? **A**. 47 **B**. 55 **C**. 70 **D**. 85		1
1.8 How many rollers are in the roller bearing (Part F)? **A**. 16 **B**. 17 **C**. 18 **D**. 20		1
1.9 What is the length of the rollers in the roller bearing (Part F)? **A**. 16 **B**. 24 **C**. 31 **D**. 34		1
1.10 What is the exact dimension of **Q** of the nut (Part H)? **A**. 14,8 **B**. 15 **C**. 16 **D**. 16,2		1
1.11 Which part would prevent the ratchet gear (Part C) from slipping on the ratchet gear shaft (Part B)? **A**. Nut **B**. Roller bearing **C**. Woodruff key **D**. Pin		1
1.12 How many teeth are shown on the ratchet gear (Part C)? **A**. 16 **B**. 18 **C**. 20 **D**. 22		1
1.13 What symbol does Feature ***4*** represent on the bearing (Part F)? **A**. Symmetrical **B**. Square **C**. Equal to **D**. Parallel		1
1.14 What does the circle on the welding symbol indicate? **A**. Site weld **B**. Weld all around **C**. Gas weld **D**. Fillet weld		1
1.15 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
1.16 What welding process is shown by the welding symbol? **A**. Arc welding **B**. TIG welding **C**. MIG welding **D**. Gas flame welding		1
1.17 What is the roughness value on the machining symbol? **A**. 0,25 **B**. 0,05 **C**. N11 **D**. N12		1
1.18 What is the machining allowance on the machining symbol? **A**. 0,25 **B**. 0,05 **C**. N11 **D**. N12		1
1.19 What is the direction of the lay on the machining symbol? **A**. Equal **B**. Crossed **C**. Perpendicular **D**. Parallel		1
1.20 What is the correct symbol for third-angle orthographic projection? **A.** **B.** **C.** **D.**		1

20 MARKS

EXAMINATION NUMBER

ANSWER SHEET 1

QUESTION 2.1

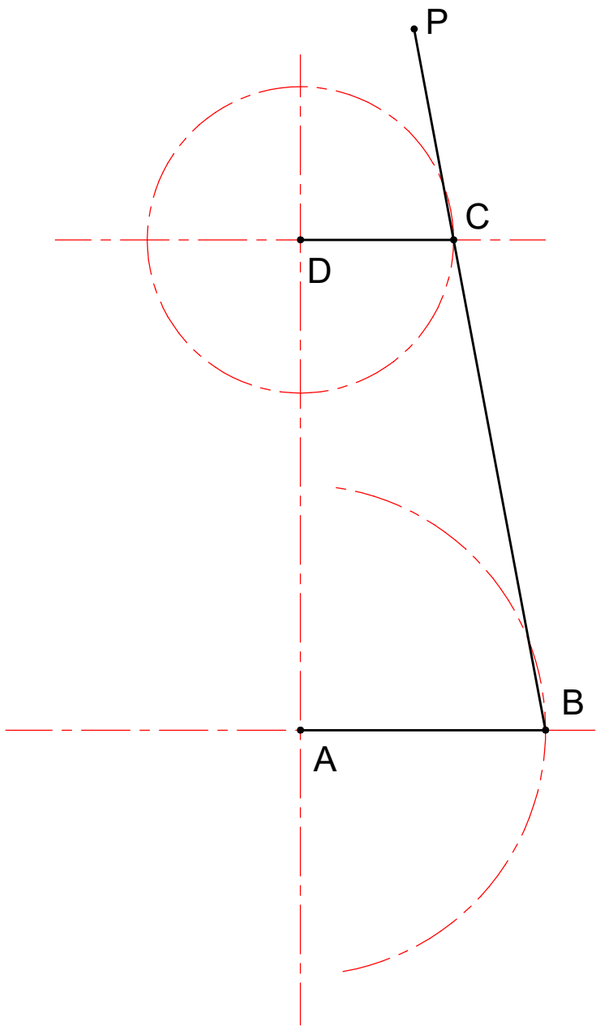
LOCI MECHANISM

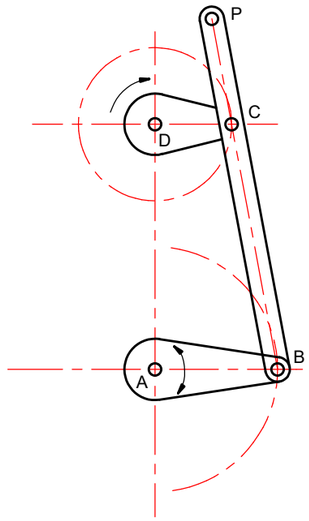
The figure below shows a mechanism consisting of a crank **CD**, with connecting rods **BC** and **AB.** Crank **CD** and rod **BC** are joined at point **C**. **P** is a point extended on rod **BC**.

The crank **CD** rotates **clockwise** around centre **D** and rod **AB** pivots at **A** and **B** during rotation.

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

- The length of rod **BP** is 116.
- Draw the direction arrow.
- Show all ***constructions***.





ASSESSMENT CRITERIA

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

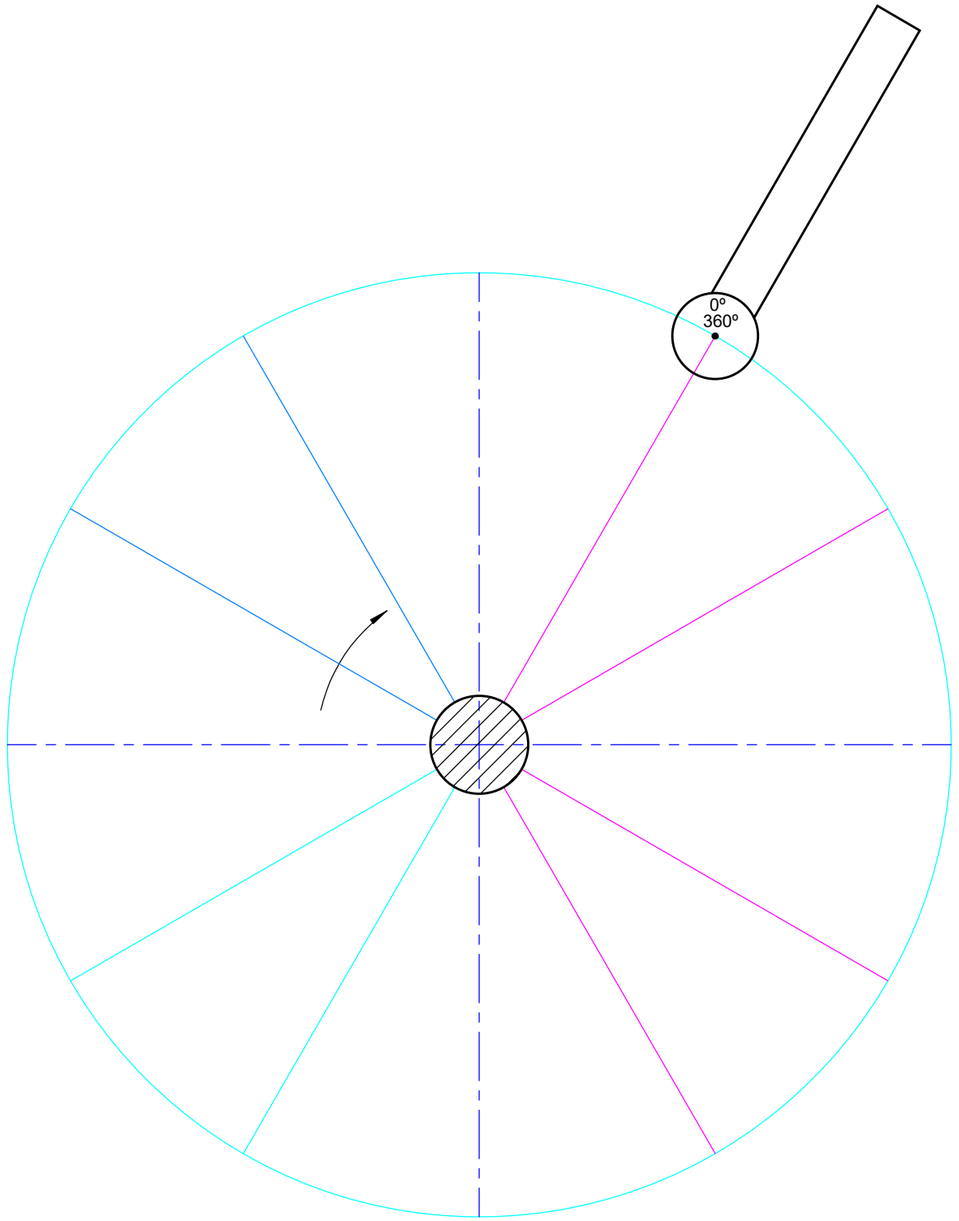
CON 2		
PTS 11		
DIR 1		
LOC 1		
15 MARKS		

EXAMINATION NUMBER

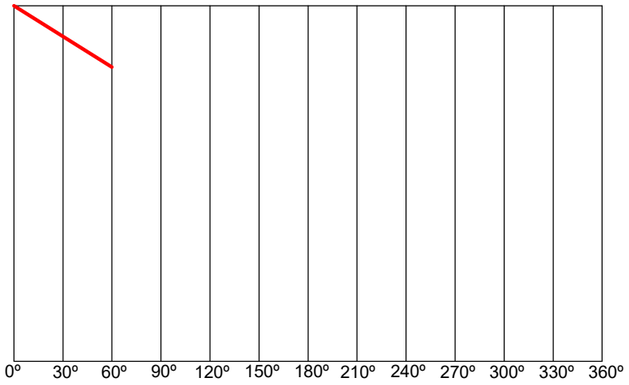
ANSWER SHEET 2.1

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 ***roller-ended*** follower in position.
- the vertical and horizontal centre lines of the camshaft.
- the shaft and follower detail at the starting position.
- direction of turn.

The cam imparts the following motion to the follower:

- 0° — 60° the follower ***falls*** 10 mm with ***uniform motion.*** (Given)
- 60° — 240° the follower ***falls*** a further 48 mm with ***uniform acceleration and retardation***.
- 240° — 360° the follower ***rises*** 58 mm with ***simple harmonic motion*** back to its original position.

The roller diameter is 14 mm.

<u>Do the following:</u>

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 Show all constructions.

ASSESSMENT CRITERIA

• Graph	12
• Plot Points	11
• Locus	1
• Label Divisions	1

GRPH 12		
PTS 11		
LOC 1		
DIV 1		
25 MARKS		

EXAMINATION NUMBER

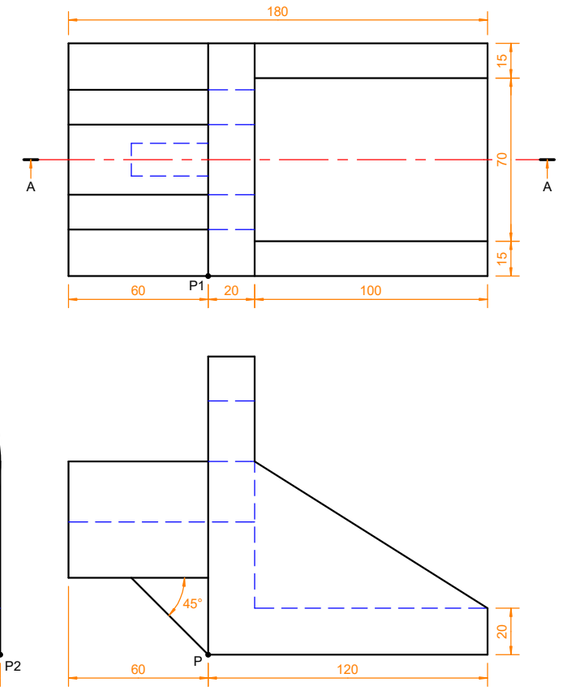
ANSWER SHEET 2.2

QUESTION 3

ISOMETRIC DRAWING

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

3.1 Draw a neat ***full-sectioned isometric*** drawing of the ***CASTING*** on ***cutting-plane* A-A.**
3.2 Draw the auxiliary view of the hexagon and the triangle 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.



P

CONSTRUCTION AREA

ANSWER SHEET 3

ASSESSMENT CRITERIA

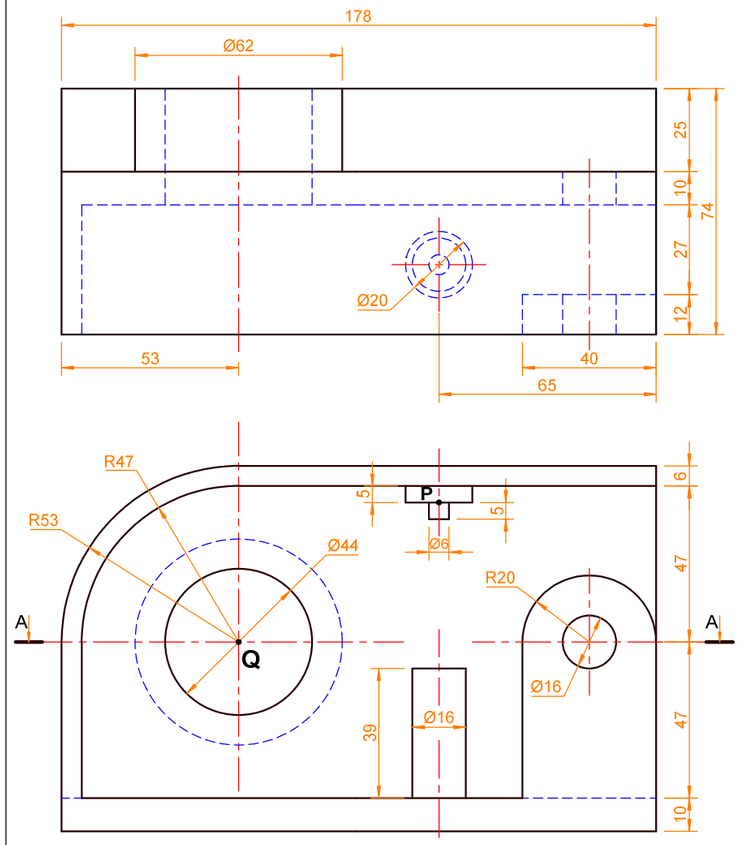
• Construction	2
• Isometric Points	28
• Isometric Circles	5
• Hatching / Non-Hatching	4
• Centre lines	1

CON 2		
ISOM 28		
CIRC 5		
HAT 4		
CL 1		
40 MARKS		

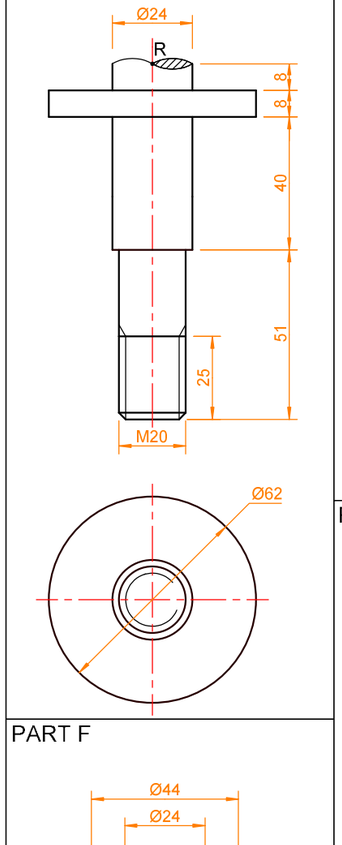
EXAMINATION NUMBER

FIGURE 1

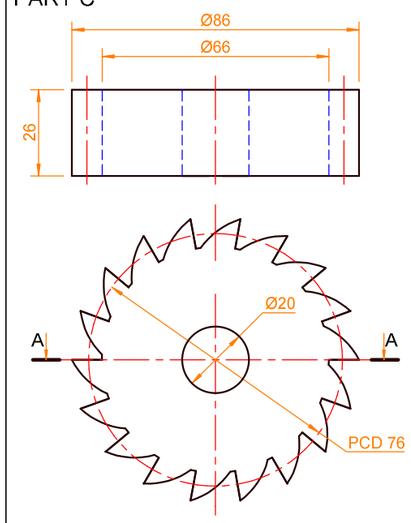
PART A



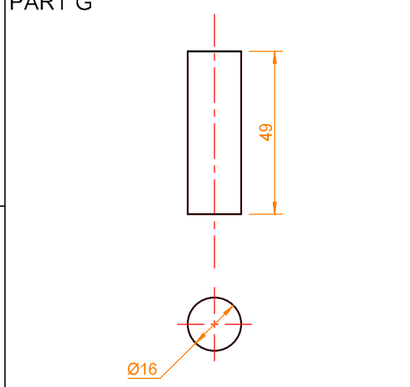
PART B



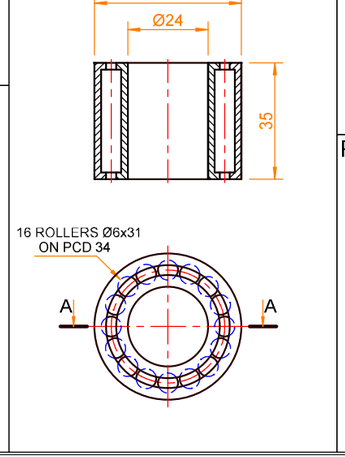
PART C



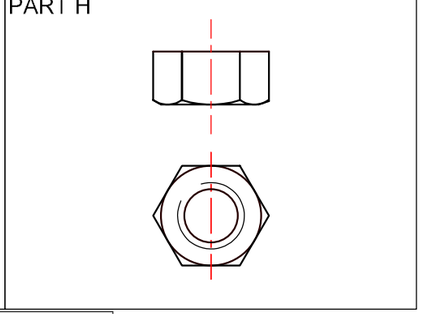
PART G



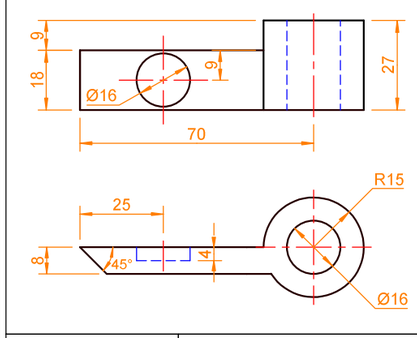
PART F



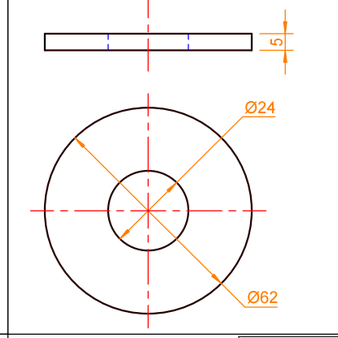
PART H



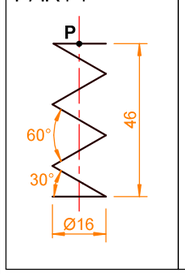
PART D



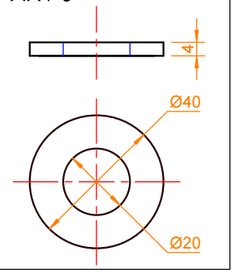
PART E



PART I



PART J



PARTS LIST			
NO	PART	QUANTITY	MATERIAL
A	BASE	1	MILD STEEL
B	RATCHET GEAR SHAFT	1	CARBON STEEL
C	RATCHET GEAR	1	STAINLESS STEEL
D	PAWL	1	STAINLESS STEEL
E	SPACER	1	MILD STEEL
F	ROLLER BEARING	1	CHROME STEEL
G	PAWL SHAFT	1	MILD STEEL
H	M20 NUT	1	STEEL
I	SPRING	1	STAINLESS STEEL
J	WASHER	1	MILD STEEL

QUESTION 4

MECHANICAL ASSEMBLY

Figure 1 shows the different parts (not to scale) for a ***RATCHET AND PAWL*** that need to be assembled.

The ***exploded top 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 point **Q** on the base (Part A) and **R** on the ratchet gear shaft (Part B) 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**.

4.3 Please note the following:

4.3.1 Point **P** on the spring (Part I) fits on point **P** on the base (Part A) and is only seen in the outside 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 pawl (Part D) in the ***front view***.

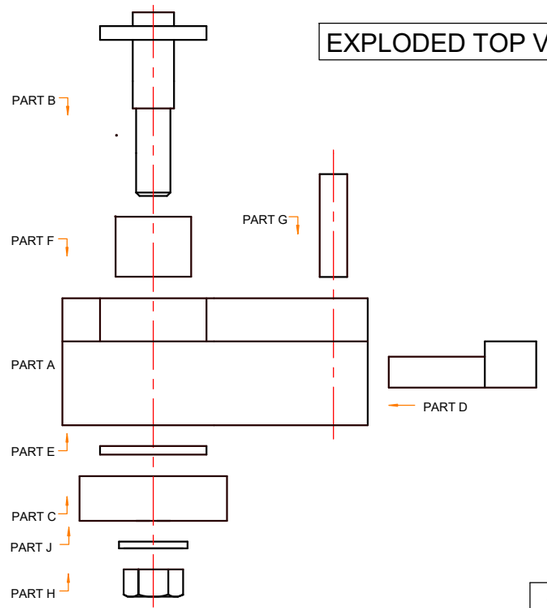
4.3.4 Draw all the centre lines.

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.

EXPLODED TOP VIEW

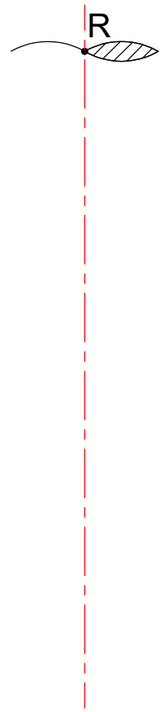


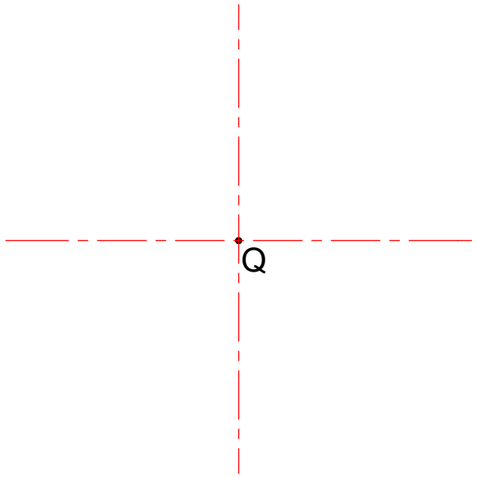
100 MARKS

EXAMINATION NUMBER

QUESTION 4

MECHANICAL ASSEMBLY





ASSESSMENT CRITERIA			
SECTIONED TOP VIEW			
A BASE	14		
B RATCHET GEAR SHAFT 12/2	6		
C RATCHET GEAR	6		
D PAWL	5		
E SPACER	2		
F ROLLER BEARING	2		
G PAWL SHAFT	2		
H M20 NUT	5		
J WASHER	2		
TOTAL	44		

OUTSIDE FRONT VIEW			
A BASE	16		
B RATCHET GEAR SHAFT	2		
C RATCHET GEAR	2		
D PAWL	2		
H M20 NUT	2		
I SPRING	3		
J WASHER	1		
HIDDEN DETAIL	7		
TOTAL	35		

ADDITIONAL			
CORRECT ASS.	3		
HATCHING 12/2	6		
NON-HATCHING 2/2	1		
CENTRE LINES 8/2	4		
DIMENSIONS	2		
CUTTING PLANE 6/2	3		
TITLE & SCALE	2		
TOTAL	21		
TOTAL	**100**		

TITLE:		SCALE:	

ANSWER SHEET 4

EXAMINATION NUMBER