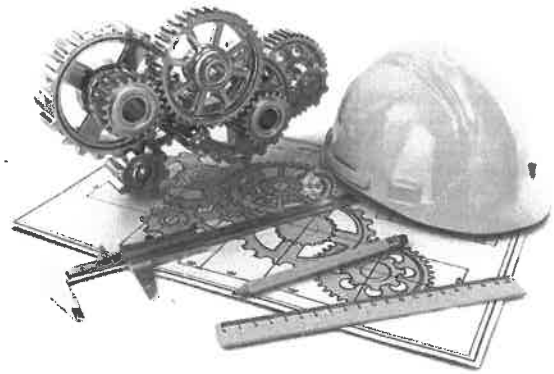
NATIONAL SENIOR CERTIFICATE EXAMINATION

2021

ENGINEERING GRAPHICS AND DESIGN
MARKING GUIDELINES
PAPER 2



MARKS:	200
TIME:	3 HOURS

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

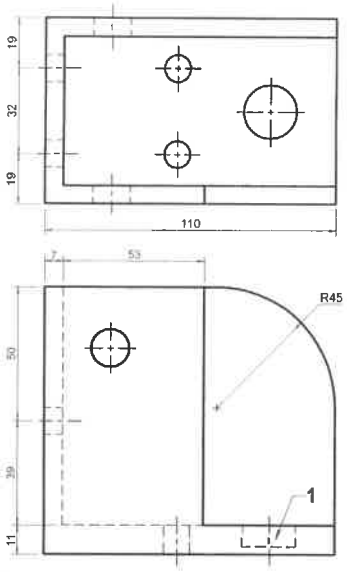
1. This question paper consists of **7 pages**, including the cover page and **5 questions**.
2. **All** questions must be answered.
3. Unless specified otherwise, all questions are in **third-angle orthographic projection.**
4. Unless specified otherwise, all questions are to be completed to **a scale of 1:1**.
5. **All** answer sheets must be re-stapled in numerical order and handed in, even 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**.
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**.

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	

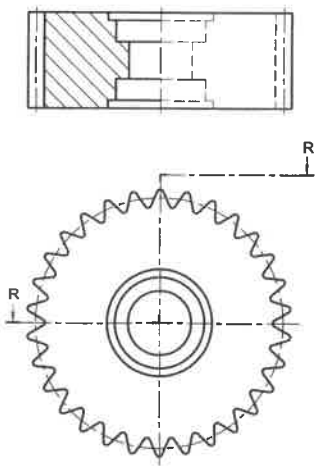
CHECKED BY

EXAMINATION NUMBER

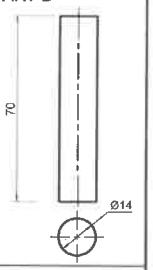
PART A



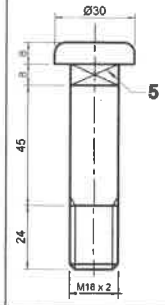
PART C



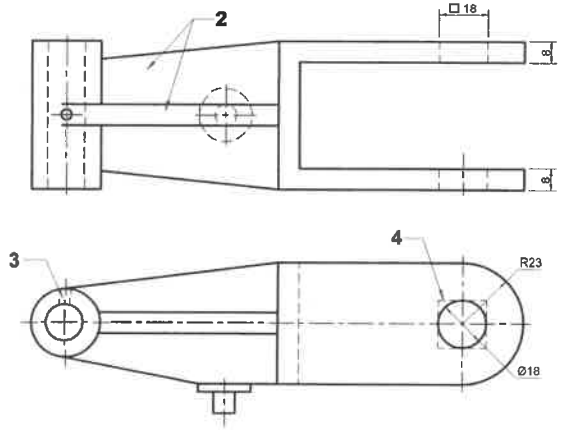
PART D



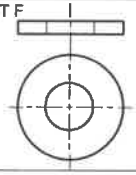
PART E



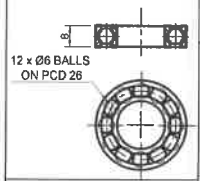
PART B



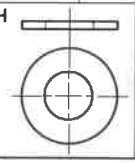
PART F



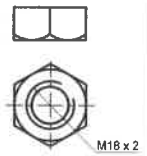
PART G



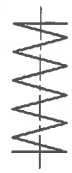
PART H



PART I

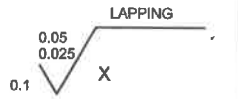


PART J

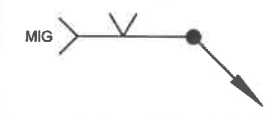


PARTS LIST			
NO	PART	QUANTITY	MATERIAL
A	HOUSING	1	MILD STEEL
B	FORK	1	MILD STEEL
C	GEAR	1	HIGH-TENSILE STEEL
D	PIN	1	MILD STEEL
E	M18 BOLT	1	HIGH-TENSILE STEEL
F	BEARING COVER	2	MILD STEEL
G	BEARING	2	STEEL
H	WASHER	1	MILD STEEL
I	M18 NUT	1	HIGH-TENSILE STEEL
J	SPRING	1	SPRING STEEL

MACHINING SYMBOL



WELDING SYMBOL



QUESTION 1

MECHANICAL ANALYTICAL

The adjacent figures show the parts of a belt tensioner. 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 make up this assembly? **A.** Ten **B.** Eleven **C.** Twelve **D.** Thirteen	C	1
1.2	From what material is the gear (Part C) manufactured? **A.** Steel **B.** Mild steel **C.** Spring steel **D.** High-tensile steel	D	1
1.3	What type of hole is represented by feature **1** on the housing (Part A)? **A.** Blind hole **B.** Spot face **C.** Threaded hole **D.** Counterbore	A	1
1.4	The total height of the housing (Part A) is: **A.** 70 **B.** 93 **C.** 100 **D.** 107	C	1
1.5	Feature **2** on the fork (Part B) is a/an: **A.** Reinforcement **B.** Rib **C.** Elbow **D.** Shackle	B	1
1.6	Feature **3** on the fork (Part B) is a/an: **A.** Ventilation hole **B.** Air hole **C.** Inspection eye **D.** Oil hole	D	1
1.7	The dimension for feature **4** on the fork (Part B) is: **A.** Ø18 **B.** 9 x 18 **C.** 18 x 18 square **D.** R18	C	1
1.8	What type of sectioning is shown on the gear (Part C)? **A.** Half-section **B.** Full section **C.** Part section **D.** Top section	A	1
1.9	The length of the shaft on the M18 bolt (Part E) is: **A.** 24 **B.** 77 **C.** 83 **D.** 85	B	1
1.10	Feature **5** on the M18 bolt (Part E) indicates: **A.** Rectangle on section **B.** Roller bearing **C.** Knurling **D.** Square on a shaft	D	1
1.11	How many balls are in the bearing (Part G)? **A.** 2 **B.** 6 **C.** 12 **D.** 26	C	1
1.12	Calculate the exact height of the M18 nut (Part I). **A.** 9 **B.** 12.6 **C.** 14 **D.** 14.4	D	1
1.13	The type of spring shown at Part J is a/an: **A.** Compression spring **B.** Extension spring **C.** Torsion spring **D.** Tension spring	A	1
1.14	The machining symbol has a maximum roughness value of: **A.** 0.1 **B.** 0.05 **C.** 0.025 **D.** N8	B	1
1.15	The machining symbol has an allowance of: **A.** 0.1 **B.** 0.05 **C.** 0.025 **D.** N8	A	1
1.16	The direction of the lay on the machining symbol is: **A.** Equal **B.** Crossed **C.** Perpendicular **D.** Parallel	B	1
1.17	What does the solid circle on the welding symbol indicate? **A.** Site weld **B.** Weld all around **C.** Gas weld **D.** Fillet weld	A	1
1.18	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.** Fillet butt weld	B	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	C	1
1.20	The correct symbol for third angle orthographic projection is: **A.**  **B.**  **C.**  **D.** 	C	1

20 MARKS

EXAMINATION NUMBER

ANSWER SHEET 1

QUESTION 2.1

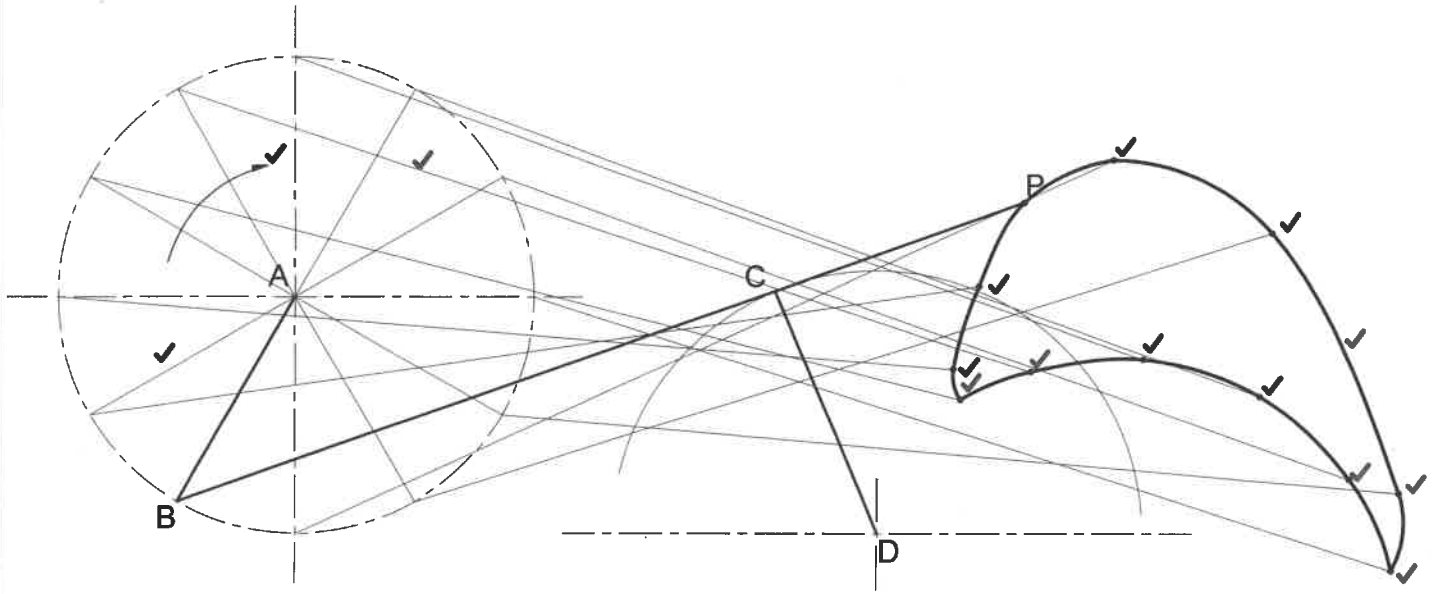
LOCI
MECHANISM

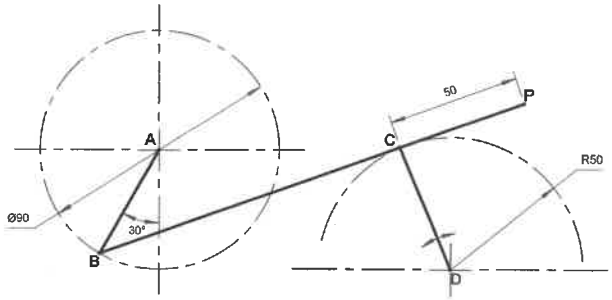
The given figure shows a mechanism consisting of a crank **AB**, with connecting rods **BC** and **CD** joined at point **C**.
P is a point extended on rod **BC**.

The crank **AB** rotates **clockwise** around centre **A** and rod **BC** pivots at **C** and **D** 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 **BC** is 120
- Draw the direction arrow
- Show all ***constructions***.





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

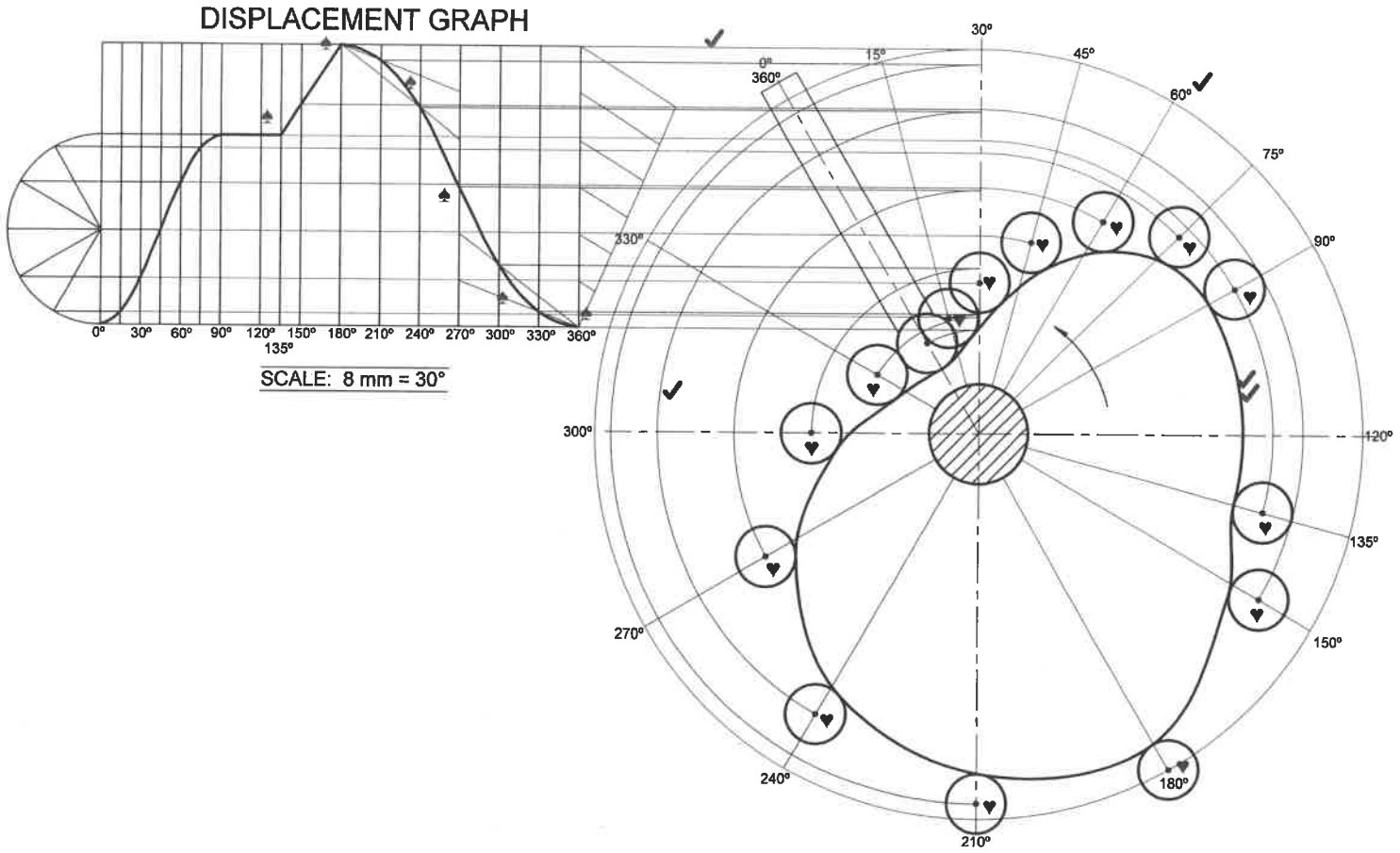
CON 2	✓	
PTS 11	✓	
DIR 1	✓	
LOC 1	✓	
15 MARKS		

EXAMINATION NUMBER

ANSWER SHEET 2.1

QUESTION 2.2

LOCI
CAM



The following are given in the adjacent drawing:

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

The cam imparts the following motion to the follower:

- 0° – 90° the follower ***rises*** 38 mm with ***simple harmonic motion.*** (Given)
- 90° – 135° the follower is at ***rest***.
- 135° – 180° the follower ***rises*** 18 mm with ***uniform motion***.
- 180° – 360° the follower returns to its original position with ***uniform acceleration and retardation***.

The roller diameter is 12 mm

Draw the following:

2.2.1 the complete graph of displacement for the required motion.
2.2.2 all missing divisions on the cam profile.
2.2.3 the cam profile from the displacement graph.
2.2.4 show all constructions.

ASSESSMENT CRITERIA

• Graph	6
• Plot Points	14
• Locus & Construction	4
• Direction & Divisions	1

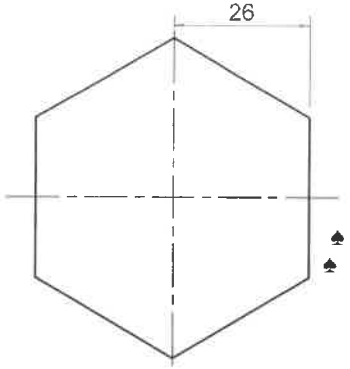
GRPH 6	♠	
PTS 14	♥	
LOC 4	✔	
DIR 1	✔	

25 MARKS

EXAMINATION NUMBER

ANSWER SHEET 2.2

CONSTRUCTION AREA

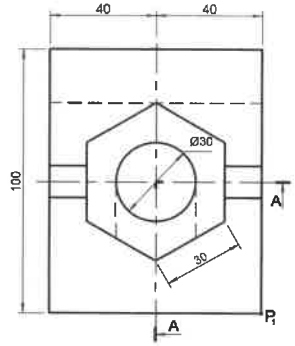


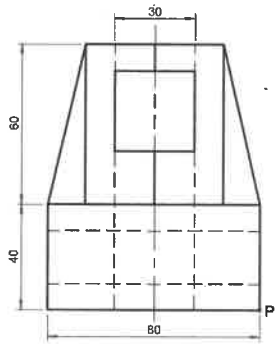
QUESTION 3

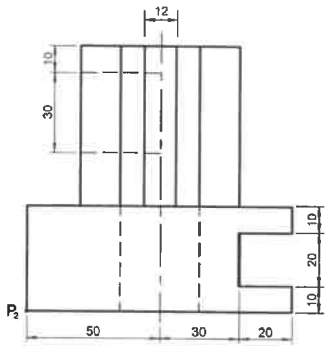
ISOMETRIC DRAWING

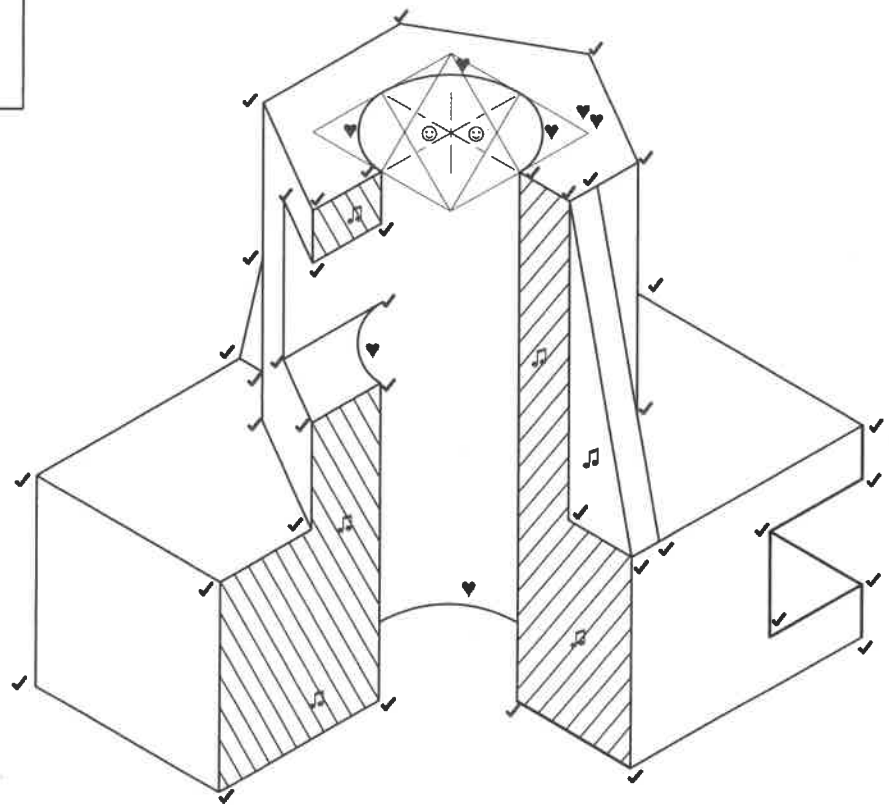
The figures below show the front view, top view and right view of a heavy-duty ***CASTING***. The ***CASTING*** is cut by ***cutting-plane*** **A-A.**

3.1 Draw a neat ***half-sectioned isometric*** drawing of the ***CASTING*** on ***cutting-plane*** **A-A.**
3.2 Draw the auxilary view of the hexagon 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	2
• Isometric Points 32/2	16
• Square Hole	7
• Isometric Circles	7
• Hatching / Non-Hatching	6
• Centre lines	2

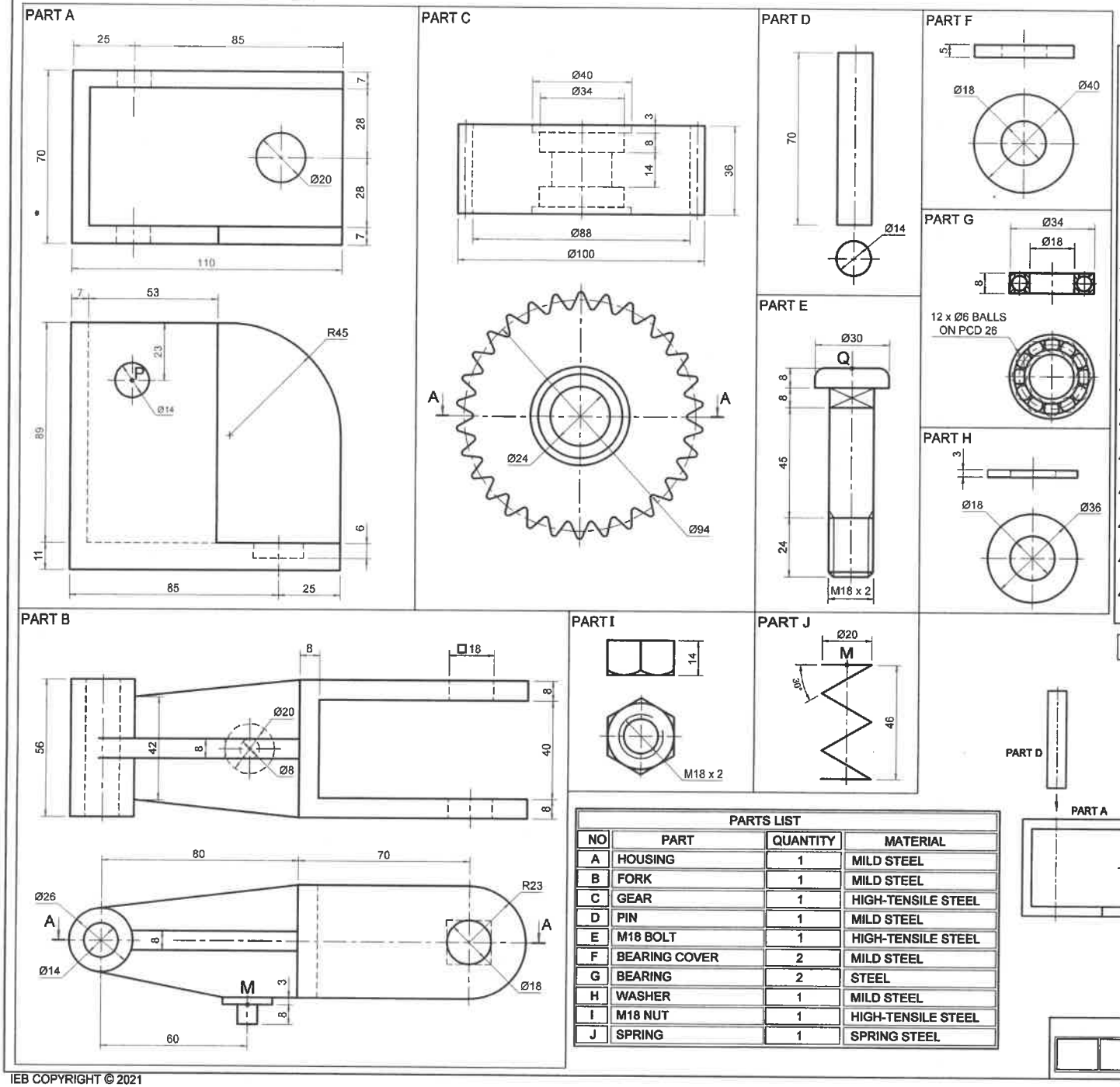
CON 2	♠	
ISOM 32/2	✓	
SQU 7	✓	
CIRC 7	♥	
HAT 6	♫	
CL 2	☺	
40 MARKS		

Incorrect hatch angle -1
Incorrect position of drawing -1

ANSWER SHEET 3

EXAMINATION NUMBER

FIGURE 1



QUESTION 4

MECHANICAL ASSEMBLY

Figure 1 shows the different parts (not to scale) for a ***BELT TENSIONER*** that needs 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 **P** on the housing (Part A) and point **Q** on the M18 bolt (Part E) as a reference 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 Show ***2 faces*** for the ***M18 hexagonal nut*** in the ***top view.***

4.3.2 Show the ***hidden detail*** of only the housing (Part A) in the ***front view.***

4.3.3 Draw all the centre lines.

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

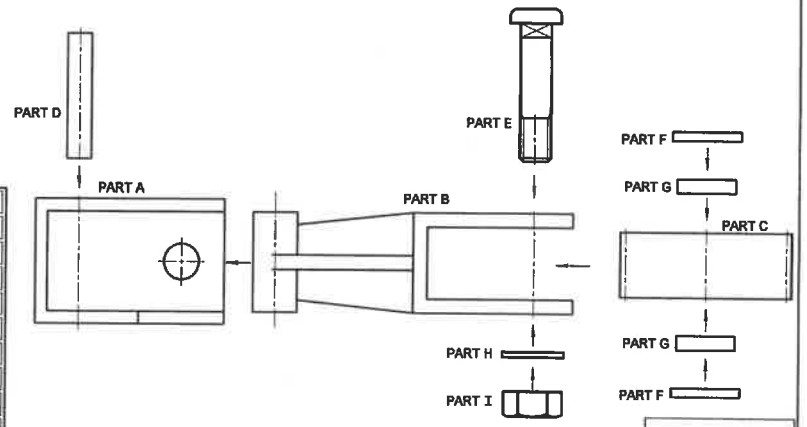
4.3.5 Insert 3 functional ***dimensions*** in the ***front view.***

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

4.3.7 Correctly label the completed ***top view.***

4.3.8 Point **M** on the spring (Part J) fits on point **M** on the fork (Part B) and is only seen in the outside front view.

EXPLODED TOP VIEW



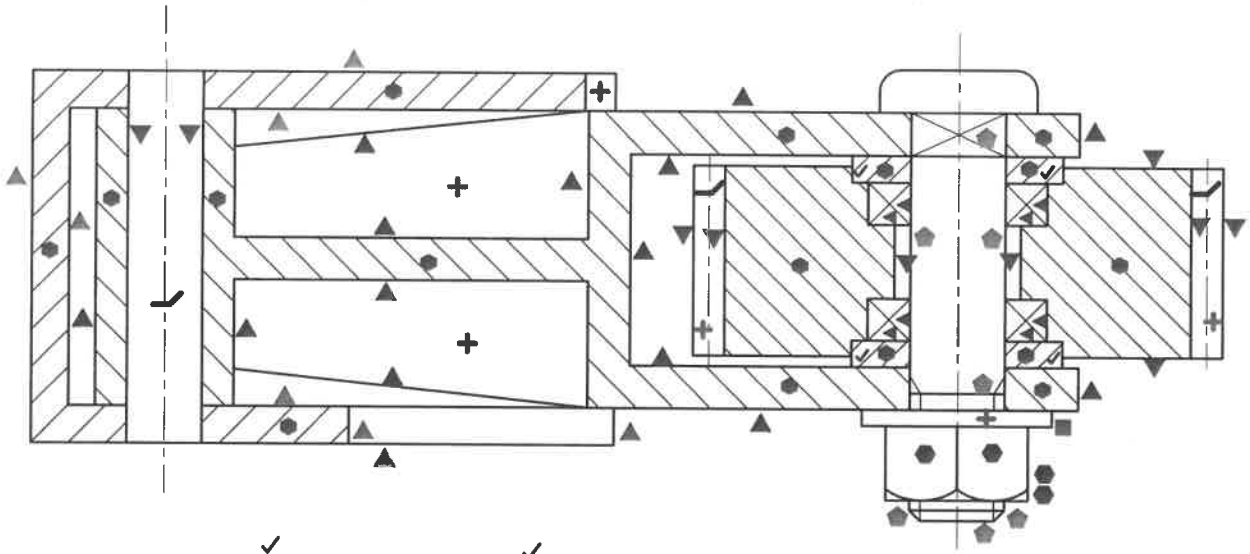
PARTS LIST			
NO	PART	QUANTITY	MATERIAL
A	HOUSING	1	MILD STEEL
B	FORK	1	MILD STEEL
C	GEAR	1	HIGH-TENSILE STEEL
D	PIN	1	MILD STEEL
E	M18 BOLT	1	HIGH-TENSILE STEEL
F	BEARING COVER	2	MILD STEEL
G	BEARING	2	STEEL
H	WASHER	1	MILD STEEL
I	M18 NUT	1	HIGH-TENSILE STEEL
J	SPRING	1	SPRING STEEL

100 MARKS

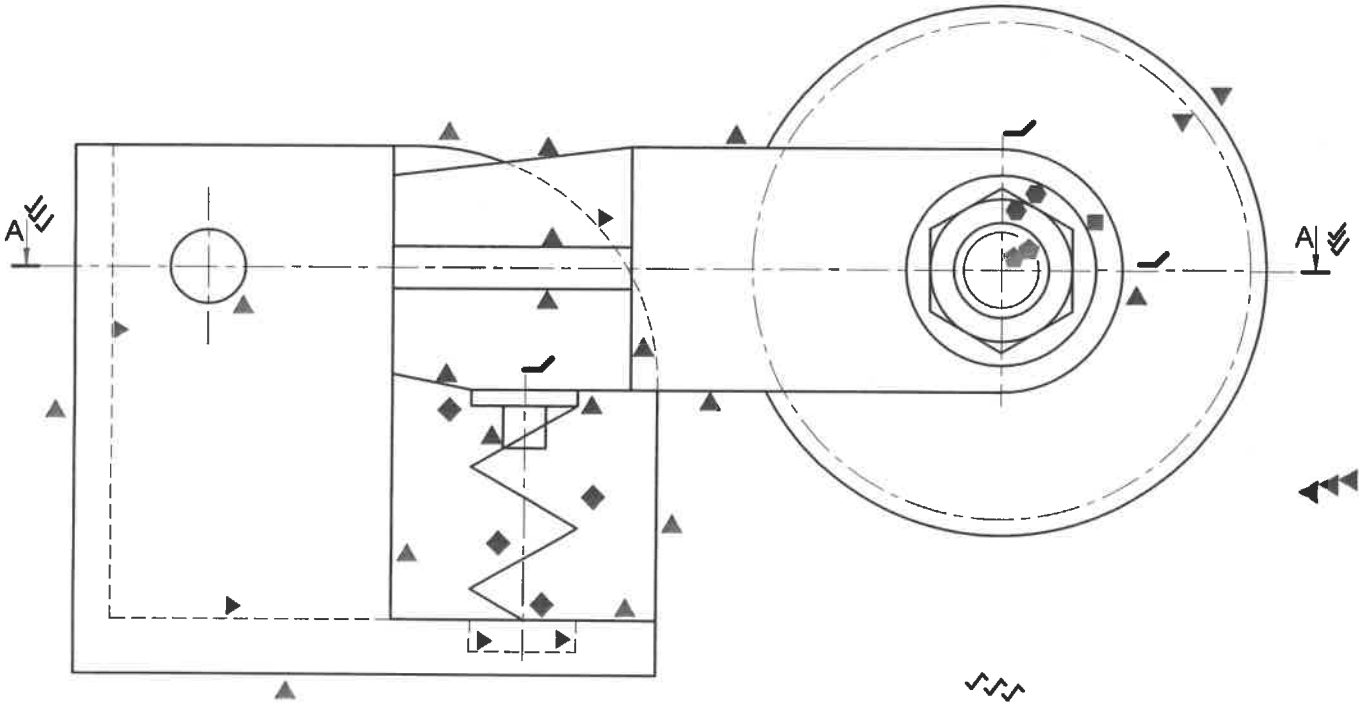
EXAMINATION NUMBER

QUESTION 4

MECHANICAL ASSEMBLY



SECTIONAL TOP VIEW ON AA



ASSESSMENT CRITERIA			
SECTIONED TOP VIEW			
A HOUSING	8	▲	
B FORK 14/2	7	▲	
C GEAR 8/2	4	▼	
D PIN	2	▼	
E M18 BOLT	7	⬟	
F BEARING COVER	4	✓	
G BEARING	8	◀	
H WASHER	1	■	
I M18 NUT	4	⬣	
TOTAL	45		

OUTSIDE FRONT VIEW			
A HOUSING	7	▲	
B FORK 10/2	5	▲	
C GEAR	2	▼	
E M18 BOLT	2	⬟	
H WASHER	1	■	
I M18 NUT	2	⬣	
J SPRING	4	◆	
HIDDEN DETAIL	5	▶	
TOTAL	28		

ADDITIONAL			
CORRECT ASS.	3	✓	
HATCHING 16/2	8	⬢	
NON-HATCHING 6/2	3	✚	
CENTRE LINES 6/2	3	▬	
DIMENSIONS	3	◀	
CUTTING PLANE 6/2	3	✓	
TITLE/SCALE/LABEL	4	✓	
TOTAL	27		
TOTAL	**100**		

TITLE:	BELT TENSIONER ✓	SCALE:	SCALE 1:1✓

ANSWER SHEET 4

EXAMINATION NUMBER