



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE

GRADE 12

ENGINEERING GRAPHICS AND DESIGN P2

NOVEMBER 2021

MARKS: 100

TIME: 3 hours

This question paper consists of 6 pages.

Barcode label



INSTRUCTIONS AND INFORMATION

1. This question paper consists of FOUR questions.
2. Answer ALL the questions.
3. ALL drawings are in third-angle orthographic projection, unless otherwise stated.
4. ALL drawings must be prepared using pencil and instruments, unless otherwise stated.
5. ALL answers must be drawn accurately and neatly.
6. ALL the questions must be answered on the QUESTION PAPER, as instructed.
7. ALL the pages, irrespective of whether the question was attempted or not, must be re-stapled in numerical sequence in the TOP LEFT-HAND CORNER ONLY.
8. Time management is essential in order to complete all the questions.
9. Print your examination number in the block provided on every page.
10. Any details or dimensions not given must be assumed in good proportion.

FOR OFFICIAL USE ONLY											
QUESTION	MARKS OBTAINED			$\frac{1}{2}$	SIGN	MODERATED			$\frac{1}{2}$	SIGN	RE-MARKING
1											
2											
3											
4											
TOTAL											
	2	0	0			2	0	0			2 0 0

FINAL CONVERTED MARK

100

CHECKED BY

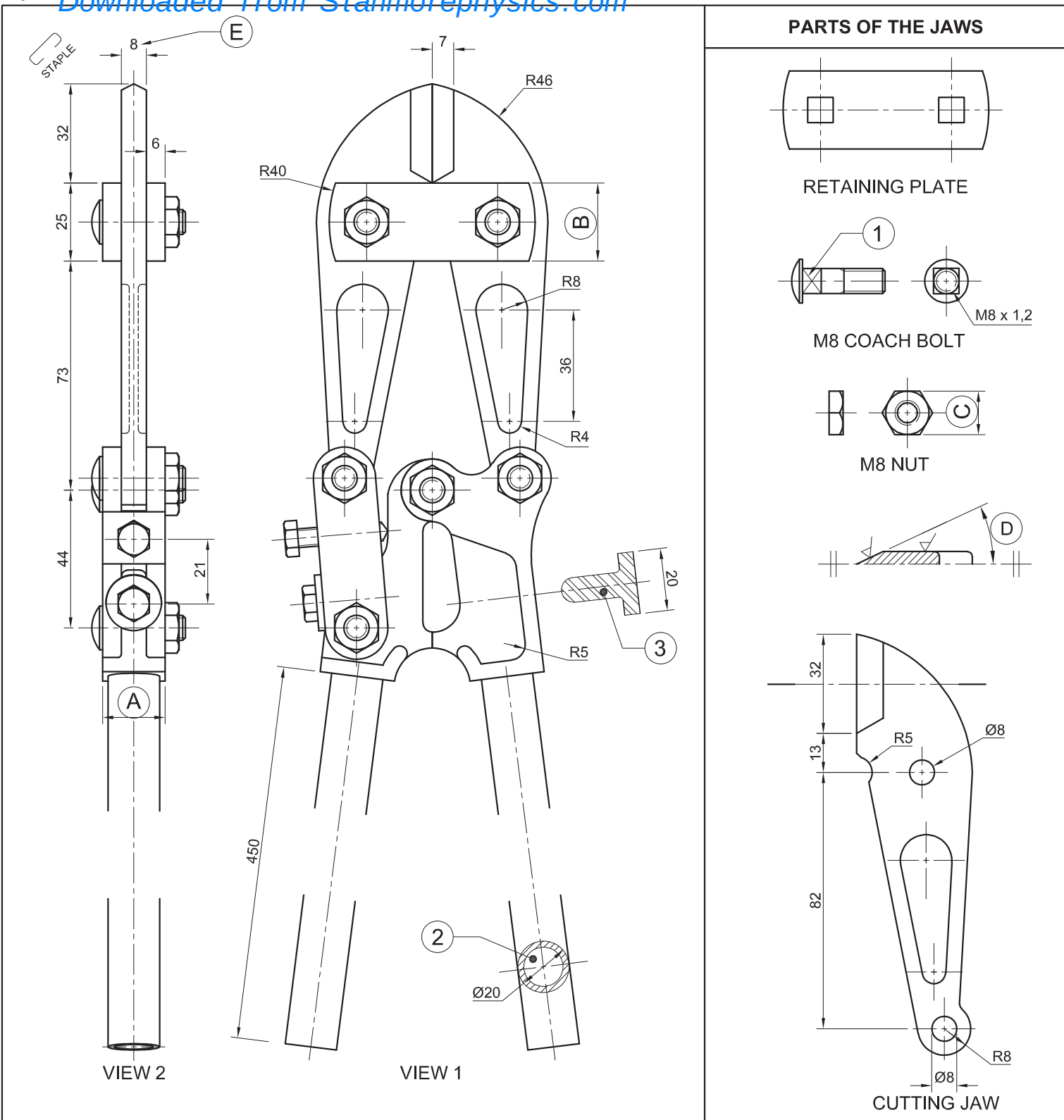
COMPLETE THE FOLLOWING:

CENTRE NUMBER

CENTRE NUMBER

EXAMINATION NUMBER

EXAMINATION NUMBER



FILE NAME: WVJ - 2021-091	MATERIAL: STEEL	ALL UNSPECIFIED RADII ARE 3 mm	TOLERANCE: +0,32 -0,21	
DRAWING No. 11	SCALE 1 : 4	ALL DIMENSIONS ARE IN MILLIMETRES	QUANTITY: 1 000 BOLT CUTTERS	
COMMISSIONED BY: CUT BOLT MANUFACTURERS, EDMOND ST, SPRINGS	DRAWING PROGRAMME: AUTOCAD 2021	DRAWN BY: RAY	DATE: 2021-01-08	
www.siedadraw.co.za 020 321 4567	CHECKED BY: ALDIN	DATE: 2021-02-01	APPROVED BY: WESLEY	
SIEDA DRAUGHTING CC 63 STANNARD CRESCENT HENNOPS PARK 9669		DATE: 2021-03-05		
TITLE BOLT CUTTER				

QUESTION 1: ANALYTICAL (MECHANICAL)

Given:
The incomplete front view and left view of a bolt cutter, views of the parts of the jaws, a title block and a table of questions. The drawings are not presented to the indicated scale.

Instructions:
Complete the table below by neatly answering the questions, which refer to the accompanying drawings, the title block and mechanical content.

QUESTIONS		ANSWERS		
1	What was Aldin responsible for?	1		
2	What is indicated by the number WVJ-2021-091?	1		
3	Who is the client that commissioned the project?	1		
4	What is the radius of all unspecified curves?	1		
5	What is VIEW 2 called?	1		
6	How many cutting jaws will be required for the full order?	1		
7	How many M8 nuts are required for each bolt cutter?	1		
8	What is indicated by the cross at 1?	1		
9	What type of section is indicated at 2?	1		
10	Determine the complete dimension at: A: B: C:	3		
11	Measure the angle at D.	1		
12	Determine the total length of the cutting jaw.	1		
13	What is the specified depth of the thread on the M8 coach bolt?	1		
14	Complete the cutting plane on the cutting jaw by inserting the arrows. Label the cutting plane K-K.	3		
15	How many surfaces of the cutting jaw must be machined?	1		
16	Referring to the machining symbol in the title block, what is indicated by the symbol at 4?	1		
17	Describe the mistake at 3.	1		
18	With reference to the tolerance, determine the minimum dimension at E.	1		
19	With reference to the welding symbol below (QUESTION 19), match the letter on the symbol with the correct label in the column to the right of this question.	TAIL	1	
		CONTOUR	1	
		WELDING PROCESS	1	
		FINISH SYMBOL	1	
		WELDING PITCH/SPACING	1	
20	Complete, in neat freehand, the pipe below (ANSWER 20), by adding the SANS 10111 convention for an interrupted view, as required for the gaps in the handles of the bolt cutter.	3		
TOTAL		30		

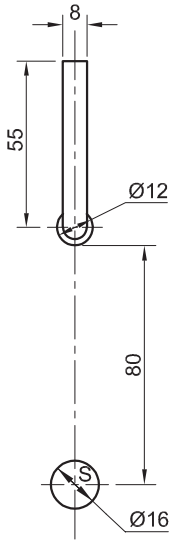
QUESTION 19

ANSWER 20

EXAMINATION NUMBER	
EXAMINATION NUMBER	2



S



ROLLER-FOLLOWER AND CAMSHAFT DETAIL

QUESTION 2: LOCI (CAM)

- Given:**
- The detail of a camshaft and a roller-follower at the maximum distance from the camshaft centre
 - The position of centre point S on the drawing sheet

- Specifications:**
- The roller-follower reciprocates along the vertical centre line that passes through the centre of the camshaft
 - The **minimum** distance from the **circumference** of the roller of the follower to the centre of the camshaft = 14 mm
 - Rotation = anti-clockwise

- Motion:**
- The cam imparts the following motion to the roller-follower:
- There is a dwell period for the first 45°
 - It then descends 22 mm with uniform motion over the next 45°
 - It descends to its minimum distance with simple harmonic motion over the next 90°
 - It returns to its original position with uniform acceleration and retardation over the remainder of the rotation

- Instructions:**
- Using centre point S on the drawing sheet, draw, to scale 1 : 1, the camshaft and roller-follower in the given position.
 - Draw to a rotational scale of 30° = 8 mm and a displacement scale of 1 : 1, the complete displacement graph for the required motion.
 - 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]

ASSESSMENT CRITERIA					
1	GIVEN + MINIMUM DISTANCE + CL	5			
2	GRAPH CONSTRUCTION	6			
3	PLOTTING GRAPH + GRAPH CURVES	8 1/2			
4	CAM CONSTRUCTION	5			
5	PLOTTING + CAM PROFILE	13 1/2			
PENALTIES (-)					
TOTAL		38			
EXAMINATION NUMBER					
EXAMINATION NUMBER					3

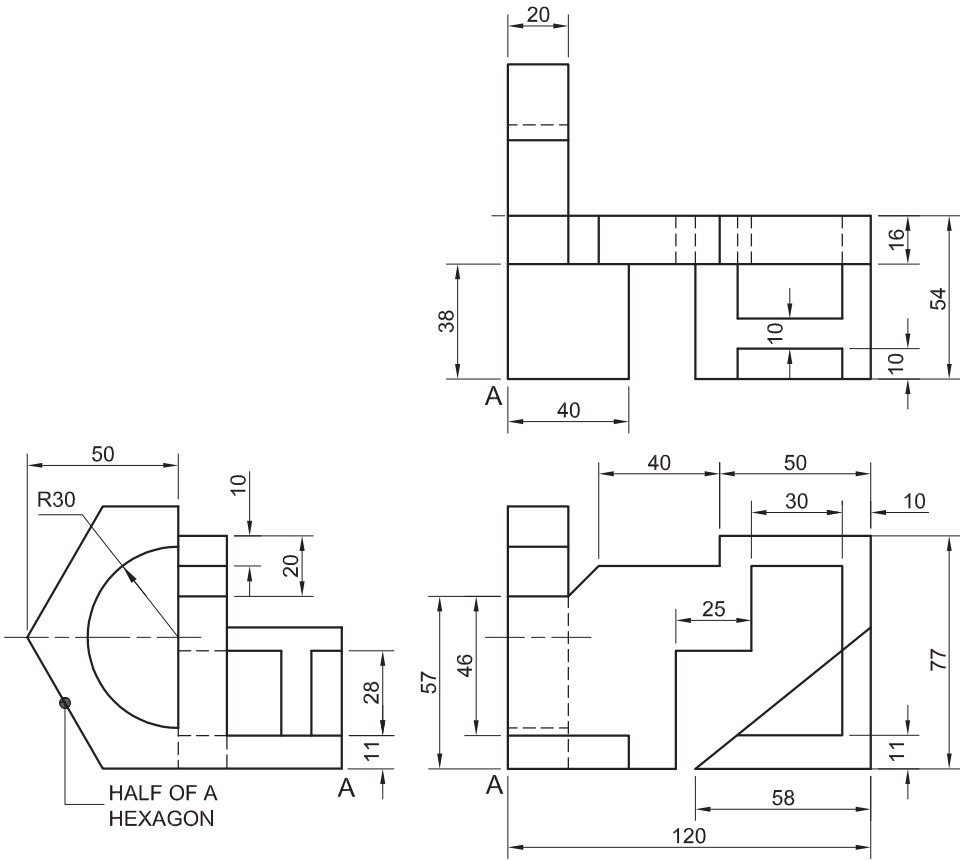


QUESTION 3: ISOMETRIC DRAWING

- Given:**
- The front view, top view and left view of a gauge
 - The position of point A on the drawing sheet

Instructions:
Using scale 1 : 1, convert the orthographic views of the gauge into an isometric drawing.

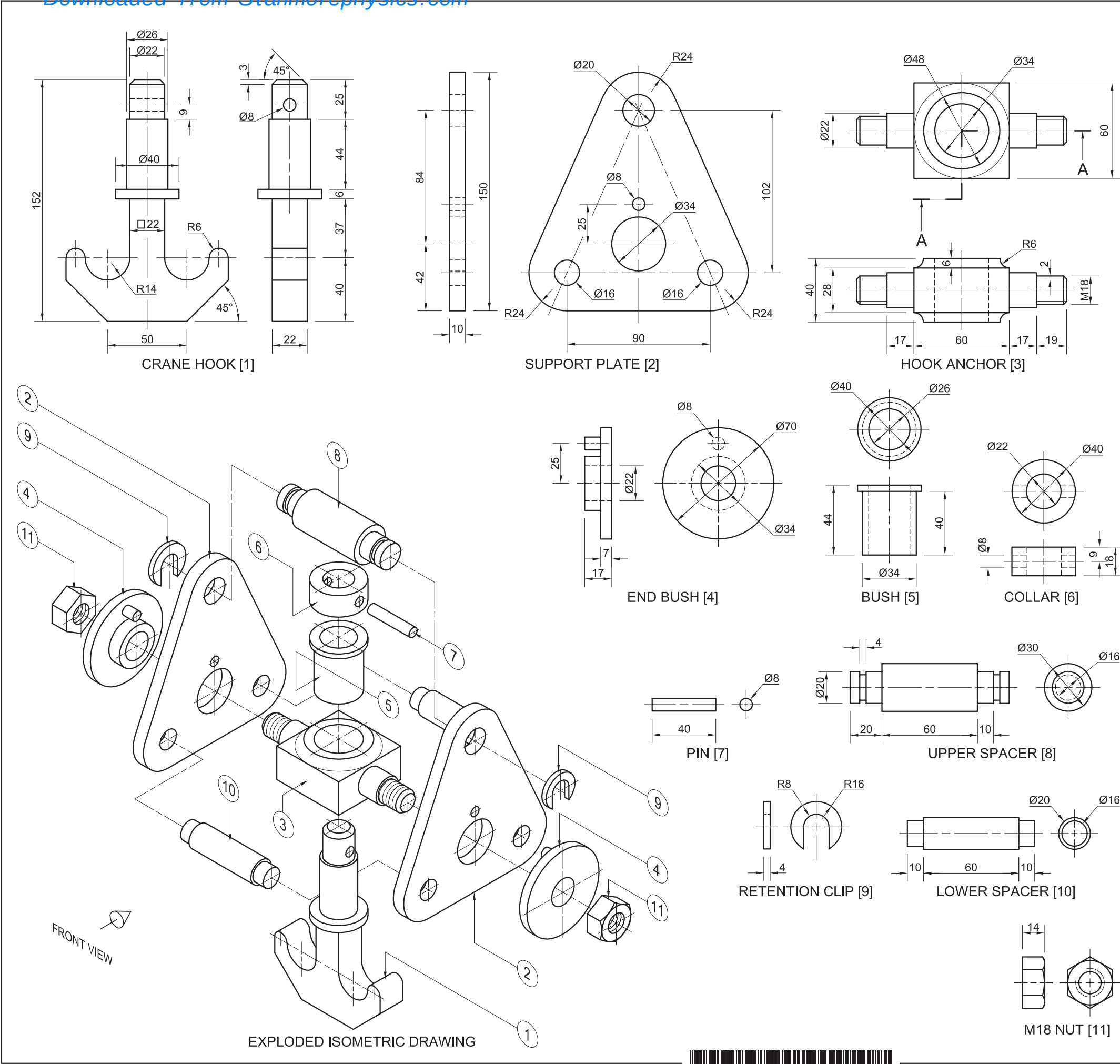
- Make A the lowest point of the drawing.
- Show ALL construction.
- NO hidden detail is required. **[40]**



↓
A

ASSESSMENT CRITERIA				
1	PLACING + AUX. VIEW	2		
2	FRONT + MIDDLE SURFACES	16 ¹ / ₂		
3	SLOPED SURFACE	11		
4	CIRCLE + HEXAGON	10 ¹ / ₂		
PENALTIES (-)				
TOTAL		40		
EXAMINATION NUMBER				
EXAMINATION NUMBER				4





QUESTION 4: MECHANICAL ASSEMBLY

Given:

- The exploded isometric drawing of the parts of a crane hook assembly, showing the position of each part relative to all the others
- Orthographic views of each of the parts of the crane hook assembly

Instructions:

- Answer this question on page 6.
- Draw, to scale 1 : 1 and in third-angle orthographic projection, the following views of the assembled parts of the crane hook assembly:

4.1 The right view.

4.2 A half sectional front view on cutting plane A-A.

Show the right half in section, as seen from the direction of the arrow as shown on the exploded isometric drawing. The cutting plane is shown on the top view of the hook anchor (part 3).

NOTE:

- Planning is essential.
- The drawing must comply with the SANS 10111 guidelines.
- The convention of symmetry may NOT be applied.
- Show THREE faces of the M18 nut (part 11) on the right side and TWO faces of the M18 nut (part 11) on the left side of the half sectional view.
- NO hidden detail is required.

[92]

PARTS LIST

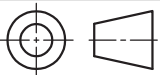
PARTS		QUANTITY	MATERIAL
1	CRANE HOOK	1	FORGED STEEL
2	SUPPORT PLATE	2	MILD STEEL
3	HOOK ANCHOR	1	MILD STEEL
4	END BUSH	2	MILD STEEL
5	BUSH	1	MILD STEEL
6	COLLAR	1	MILD STEEL
7	PIN	1	MILD STEEL
8	UPPER SPACER	1	MILD STEEL
9	RETENTION CLIP	2	MILD STEEL
10	LOWER SPACER	2	MILD STEEL
11	M18 NUT	2	MILD STEEL

LIFTWELL
ENGINEERING CC

7 MAC STREET
INDUSTRIA
www.liftwell.co.za
012 345 6789

CRANE HOOK ASSEMBLY

ALL DIMENSIONS ARE IN MILLIMETRES.



5



FOR OFFICIAL USE ONLY	
INCORRECT ORTHOGRAPHIC PROJECTION	
INCORRECT OVERALL SCALE	
INCORRECT HATCHING	
PARTS NOT ASSEMBLED	
TOTAL PENALTIES (-)	

ASSESSMENT CRITERIA					
RIGHT VIEW					
		POSSIBLE	OBTAINED	SIGN	MODERATED
1	CRANE HOOK	2 ¹ / ₂			
2	SUPPORT PLATES + LOWER SPACERS	4			
3	HOOK ANCHOR + END BUSH	2			
4	RETENTION CLIP + UPPER SPACER	2			
5	M18 NUT	2 ¹ / ₂			
SUBTOTAL		13			
HALF SECTIONAL FRONT VIEW					
1	CRANE HOOK	13			
2	SUPPORT PLATES	7			
3	HOOK ANCHOR	11			
4	END BUSHES	7 ¹ / ₂			
5	UPPER + LOWER SPACERS	8			
6	BUSH	2			
7	COLLAR + PIN	4 ¹ / ₂			
8	RETENTION CLIPS	4			
9	M18 NUTS	7			
10	NO HATCHING LEFT HALF	1			
SUBTOTAL		65			
GENERAL					
1	CENTRE LINES	3			
2	ASSEMBLY	11			
SUBTOTAL		14			
TOTAL		92			
PENALTIES (-)					
GRAND TOTAL					
EXAMINATION NUMBER					
EXAMINATION NUMBER					6





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MARKING GUIDELINES

MARKS: 100

These marking guidelines consist of 6 pages.

ASSESSMENT CRITERIA		
1	GIVEN + MINIMUM DISTANCE + CL	5
2	GRAPH CONSTRUCTION	6
3	PLOTTING GRAPH + GRAPH CURVES	8 $\frac{1}{2}$
4	CAM CONSTRUCTION	5
5	CAM + CURVE QUALITY	13 $\frac{1}{2}$
TOTAL		38

- ## 2 GRAPH CONSTRUCTION

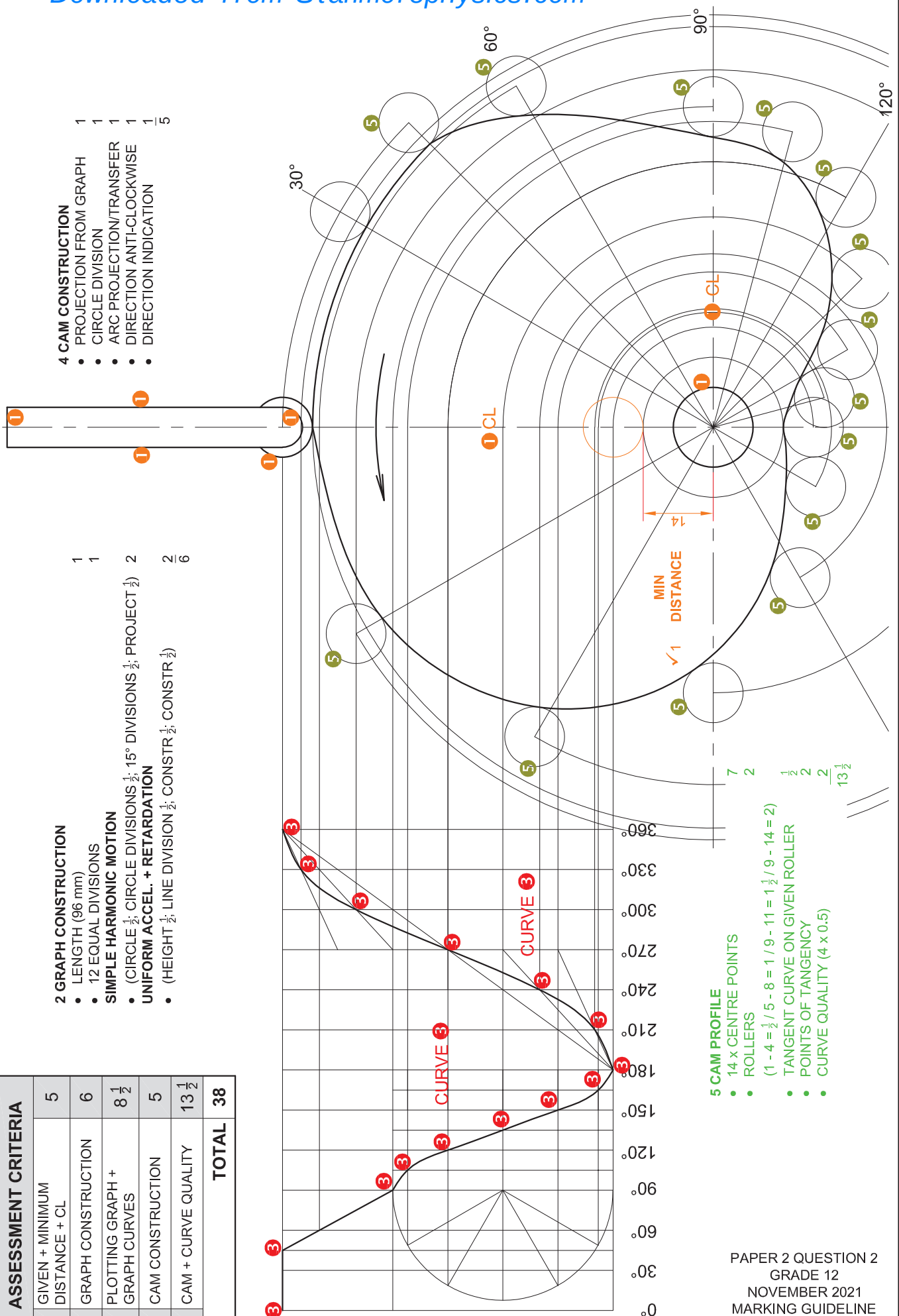
- LENGTH (96 mm)
- 12 EQUAL DIVISIONS

SIMPLE HARMONIC MOTION

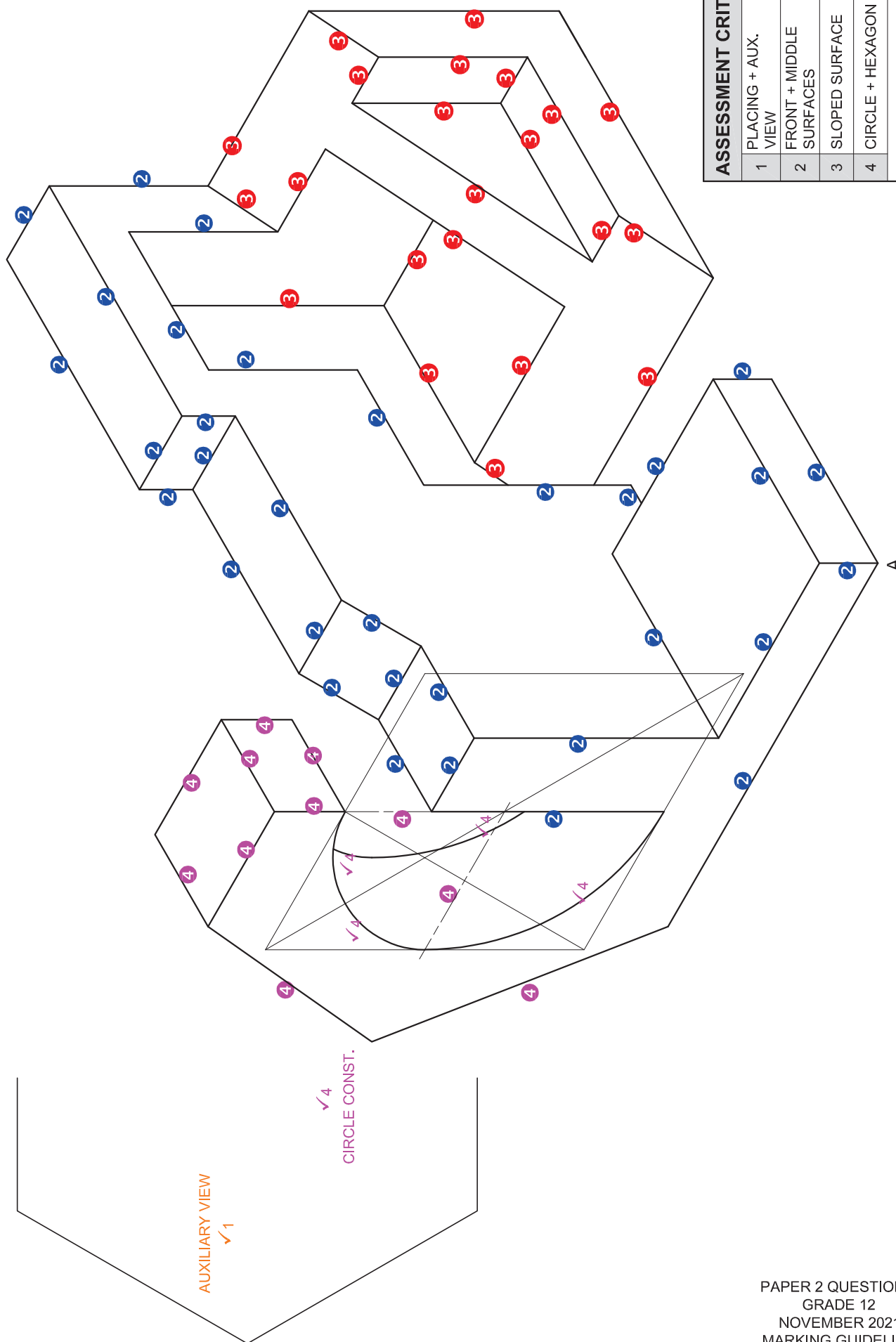
- (CIRCLE $\frac{1}{2}$: CIRCLE DIVISIONS $\frac{1}{2}$: 15° DIVISIONS $\frac{1}{2}$: PROJECT $\frac{1}{2}$) 2
- (HEIGHT $\frac{1}{2}$: LINE DIVISION $\frac{1}{2}$: CONSTR $\frac{1}{2}$: CONSTR $\frac{1}{2}$) 2

- ## 4 CAM CONSTRUCTION

- PROJECTION FROM GRAPH 1
- CIRCLE DIVISION 1
- ARC PROJECTION/TRANSFER 1
- DIRECTION ANTI-CLOCKWISE 1
- DIRECTION INDICATION 1



PAPER 2 QUESTION 2
GRADE 12
NOVEMBER 2021
MARKING GUIDELINE



ASSESSMENT CRITERIA			
1	PLACING + AUX. VIEW	2	
2	FRONT + MIDDLE SURFACES	16 $\frac{1}{2}$	
3	SLOPED SURFACE	11	
4	CIRCLE + HEXAGON	10 $\frac{1}{2}$	
TOTAL		40	

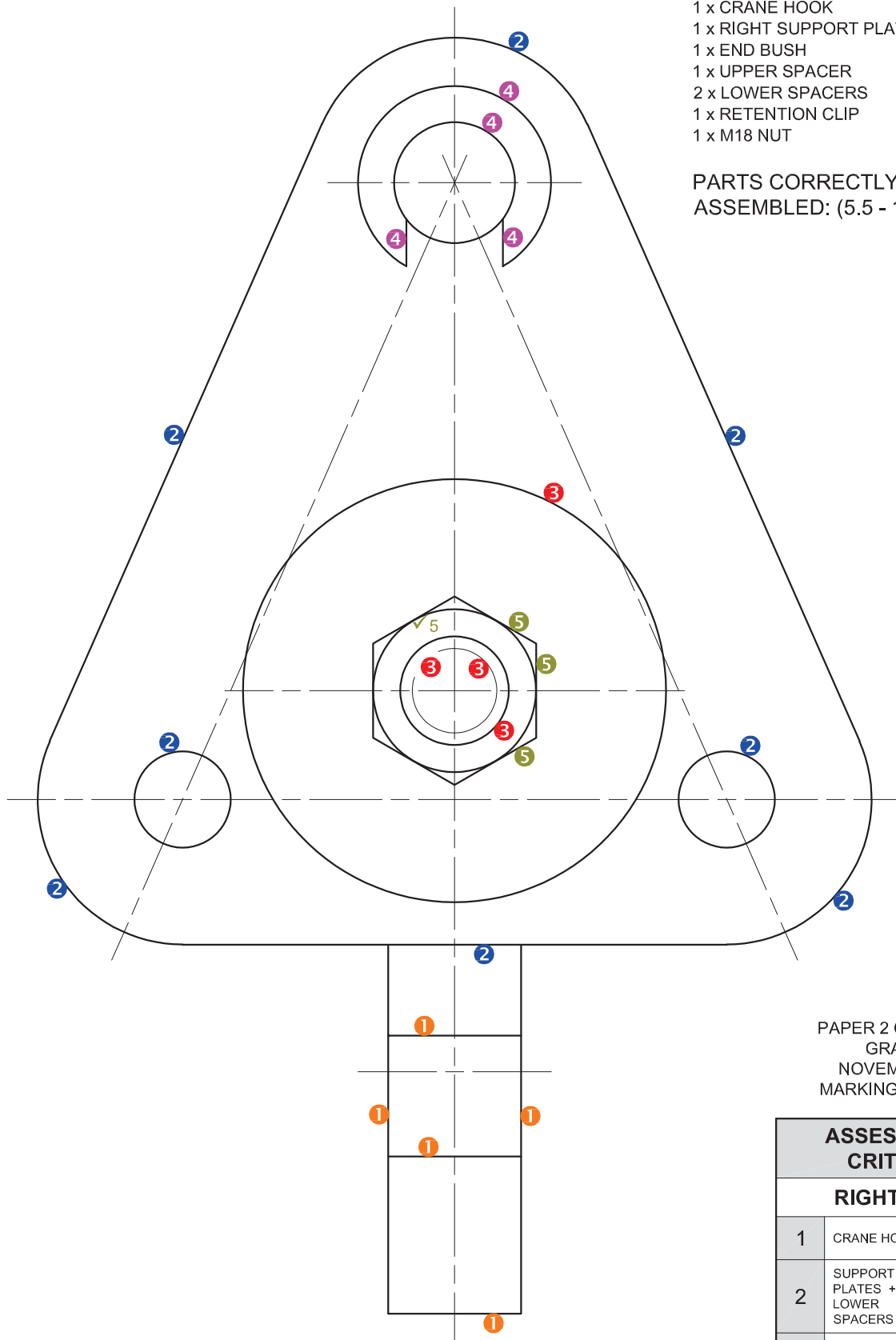
✓1 CORRECT PLACEMENT / ORIENTATION

PAPER 2 QUESTION 3
GRADE 12
NOVEMBER 2021
MARKING GUIDELINE

**2. ASSEMBLY if ONLY
RIGHT VIEW DRAWN**

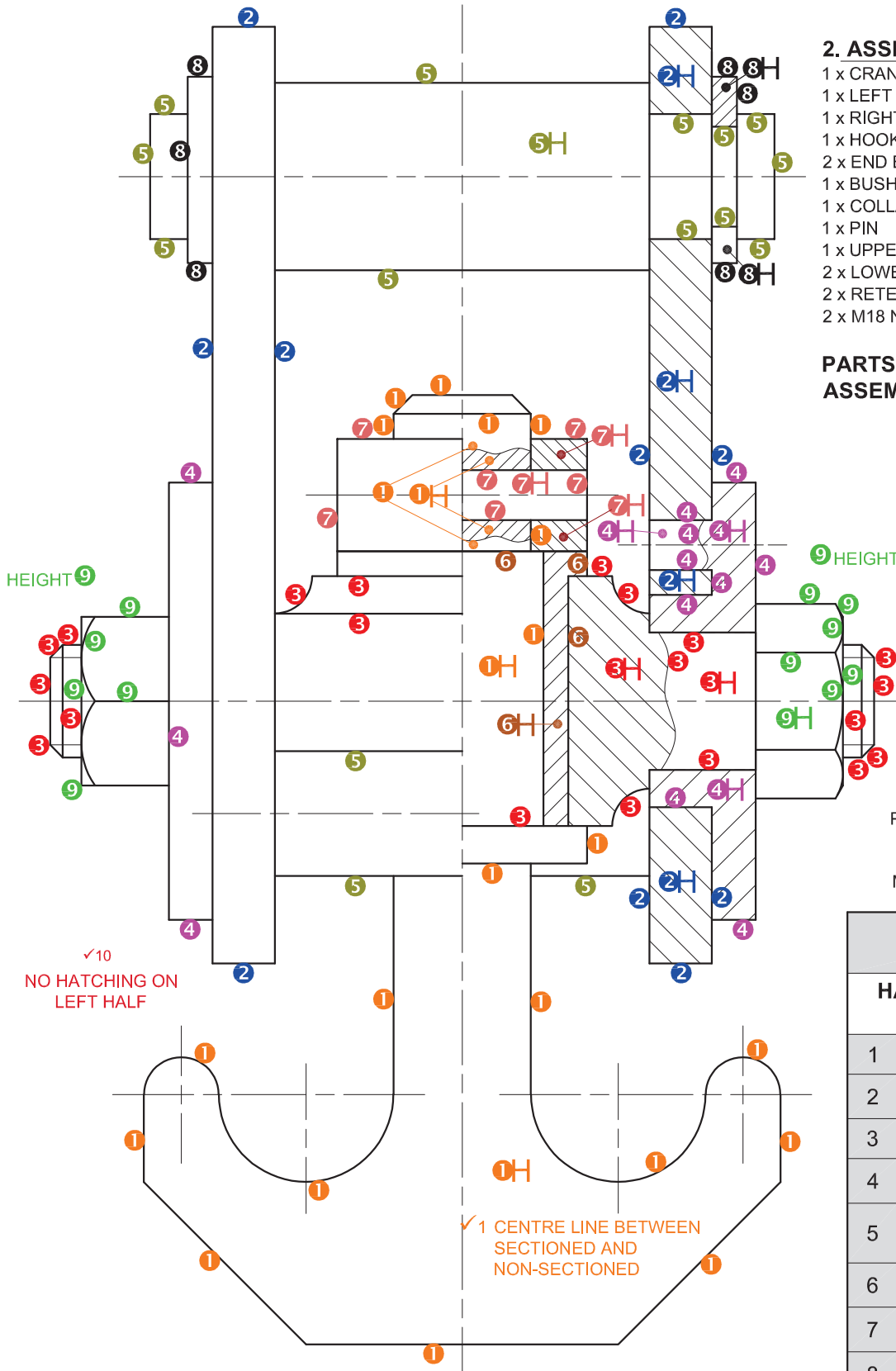
1 x CRANE HOOK	1
1 x RIGHT SUPPORT PLATE	1
1 x END BUSH	0.5
1 x UPPER SPACER	1
2 x LOWER SPACERS	1
1 x RETENTION CLIP	0.5
1 x M18 NUT	0.5
	<u>5.5</u>

**PARTS CORRECTLY
ASSEMBLED: (5.5 - 1 = 4.5)**



PAPER 2 QUESTION 4
GRADE 12
NOVEMBER 2021
MARKING GUIDELINE

ASSESSMENT CRITERIA		
RIGHT VIEW		
1	CRANE HOOK	2 $\frac{1}{2}$
2	SUPPORT PLATES + LOWER SPACERS	4
3	HOOK ANCHOR + END BUSH	2
4	RETENTION CLIP + UPPER SPACER	2
5	M18 NUT	2 $\frac{1}{2}$
SUBTOTAL		13

**2. ASSEMBLY**

1 x CRANE HOOK	1
1 x LEFT SUPPORT PLATE	1
1 x RIGHT SUPPORT PLATE	1
1 x HOOK ANCHOR	1
2 x END BUSH	1
1 x BUSH	1
1 x COLLAR	1
1 x PIN	1
1 x UPPER SPACER	1
2 x LOWER SPACERS	1
2 x RETENTION CLIPS	1
2 x M18 NUTS	1
	12

**PARTS CORRECTLY
ASSEMBLED: (12 - 1 = 11)**

PAPER 1 QUESTION 4
GRADE 12
NOVEMBER 2021
MARKING GUIDELINE

**ASSESSMENT
CRITERIA****HALF SECTIONAL
FRONT VIEW**

1	CRANE HOOK	13
2	SUPPORT PLATES	7
3	HOOK ANCHOR	11
4	END BUSHES	7 $\frac{1}{2}$
5	UPPER + LOWER SPACERS	8
6	BUSH	2
7	COLLAR + PIN	4 $\frac{1}{2}$
8	RETENTION CLIPS	4
9	M18 NUTS	7
10	NO HATCHING LEFT HALF	1

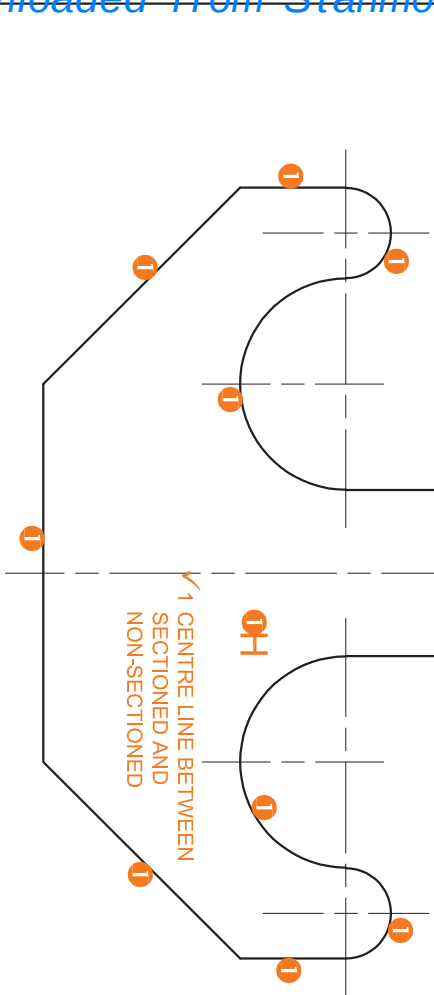
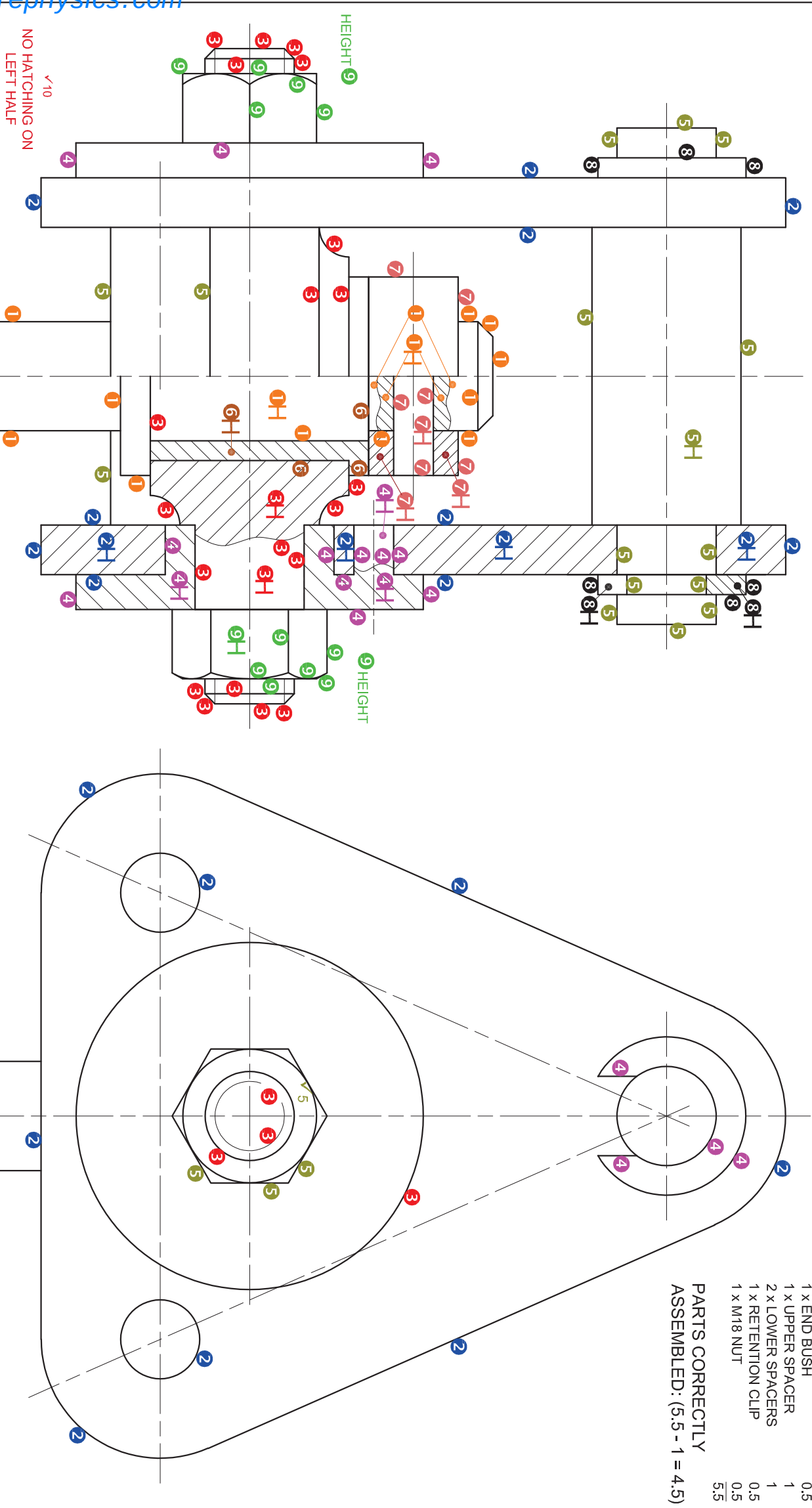
SUBTOTAL 65

GENERAL

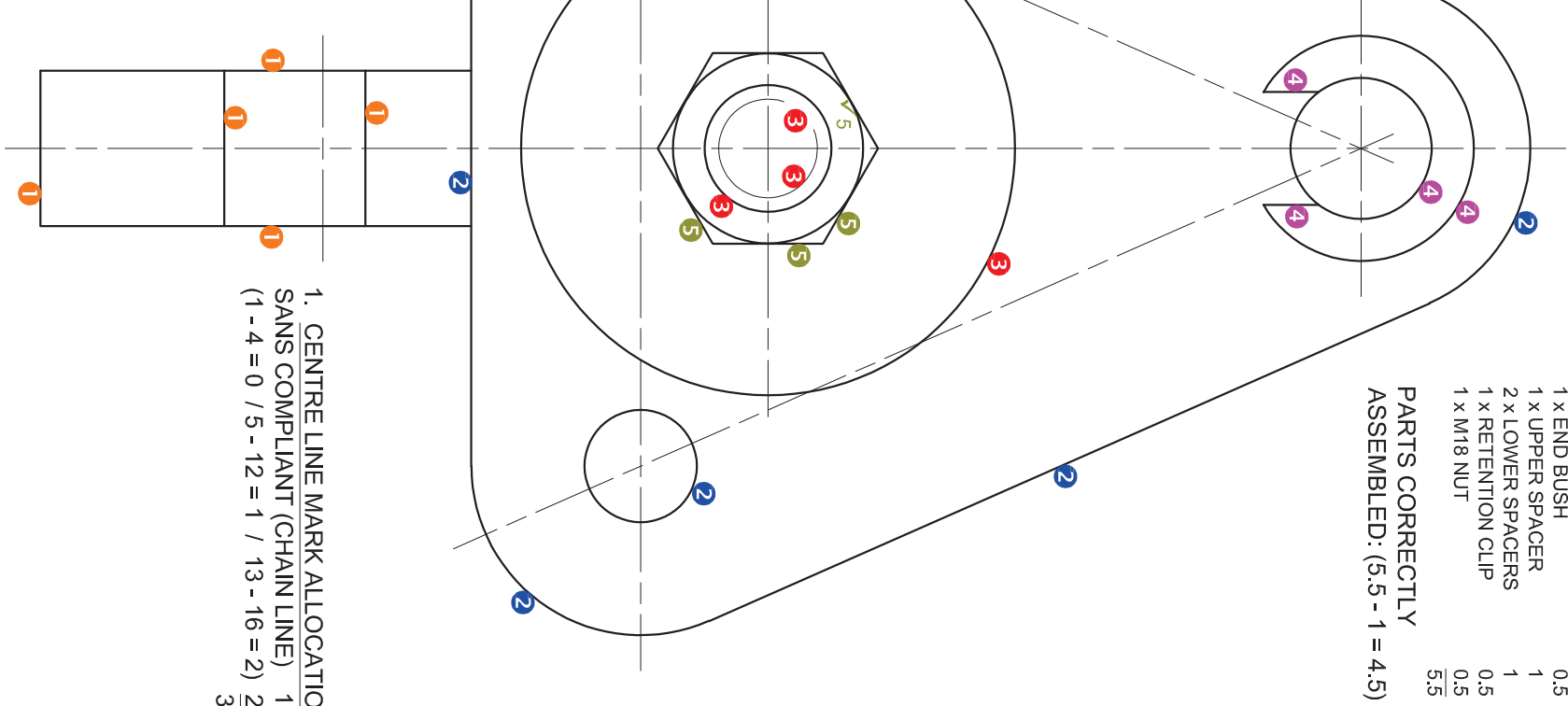
1	CENTRE LINES	3
2	ASSEMBLY	11

1. CENTRE LINE MARK ALLOCATION

SANS COMPLIANT (CHAIN LINE) 1
(1 - 4 = 0 / 5 - 12 = 1 / 13 - 16 = 2) $\frac{2}{3}$



- 2. ASSEMBLY**
- 1 x CRANE HOOK
 - 1 x LEFT SUPPORT PLATE
 - 1 x RIGHT SUPPORT PLATE
 - 1 x HOOK ANCHOR
 - 2 x END BUSH
 - 1 x BUSH
 - 1 x COLLAR
 - 1 x PIN
 - 1 x UPPER SPACER
 - 2 x LOWER SPACERS
 - 2 x RETENTION CLIPS
 - 2 x M18 NUTS
- PARTS CORRECTLY ASSEMBLED: (12 - 1 = 11)**



- 2. ASSEMBLY if ONLY RIGHT VIEW DRAWN**
- 1 x CRANE HOOK
 - 1 x RIGHT SUPPORT PLATE
 - 1 x END BUSH
 - 1 x UPPER SPACER
 - 2 x LOWER SPACERS
 - 1 x RETENTION CLIP
 - 1 x M18 NUT
- PARTS CORRECTLY ASSEMBLED: (5.5 - 1 = 4.5)**

FOR OFFICIAL USE ONLY			
INCORRECT ORTHOGRAPHIC PROJECTION			
INCORRECT OVERALL SCALE			
INCORRECT HATCHING			
PARTS NOT ASSEMBLED			
TOTAL PENALTIES (-)			
5.5			
ASSESSMENT CRITERIA			
RIGHT VIEW			
	POSSIBLE	OBTAINED	SIGN MODERATED
1	CRANE HOOK	2 1/2	
2	SUPPORT PLATES + LOWER SPACERS	4	
3	HOOK ANCHOR + END BUSH	2	
4	RETENTION CLIP + UPPER SPACER	2	
5	M18 NUT	2 1/2	
SUBTOTAL		13	
HALF SECTIONAL FRONT VIEW			
1	CRANE HOOK	13	
2	SUPPORT PLATES	7	
3	HOOK ANCHOR	11	
4	END BUSHES	7 1/2	
5	UPPER + LOWER SPACERS	8	
6	BUSH	2	
7	COLLAR + PIN	4 1/2	
8	RETENTION CLIPS	4	
9	M18 NUTS	7	
10	NO HATCHING LEFT HALF	1	
SUBTOTAL		65	
GENERAL			
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SUBTOTAL		14	
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PENALTIES (-)			
GRAND TOTAL			
EXAMINATION NUMBER			
EXAMINATION NUMBER			
6			