



NATIONAL SENIOR CERTIFICATE EXAMINATION  
2016

ENGINEERING GRAPHICS AND DESIGN  
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 **4 questions**.
2. **All** the 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 **stapled** in **numerical** order and handed in, even unattempted/blank 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. Any dimensions or detail not given may 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	
2a	LOCUS CAM			20	
2b	LOCUS MECHANISM			20	
3	ISOMETRIC DRAWING			40	
4	MECHANICAL ASSEMBLY			100	
SYMBOL	TOTAL			200	
	TOTAL			100	

FINAL CONVERTED MARK	CHECKED BY
100	

EXAMINATION NUMBER

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QUESTION 1

MECHANICAL ANALYTICAL

Figure A

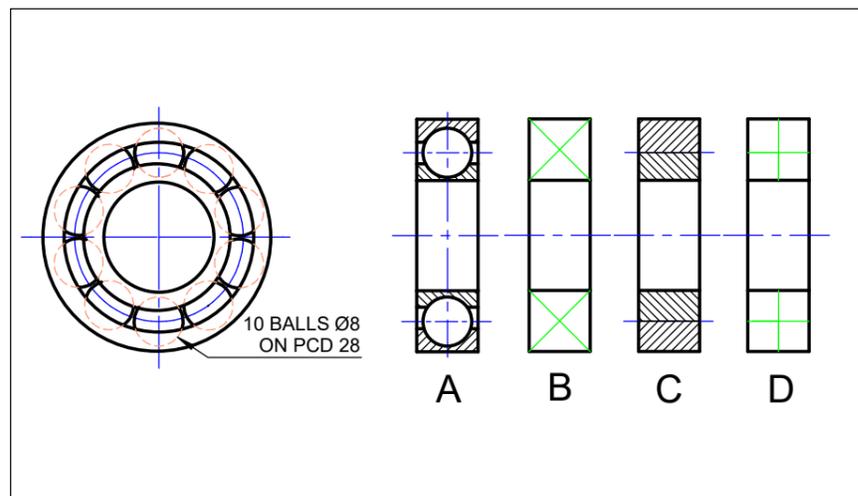


Figure B

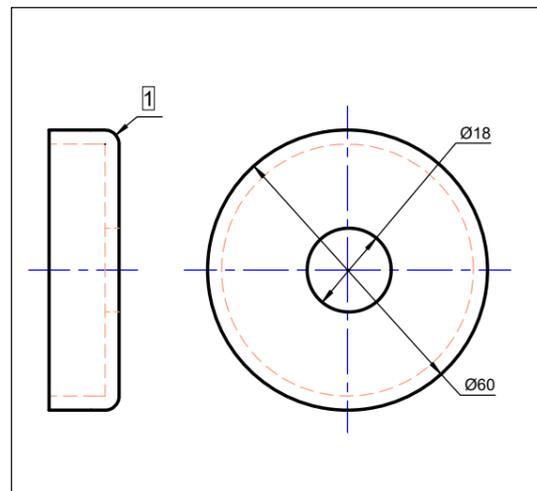


Figure C

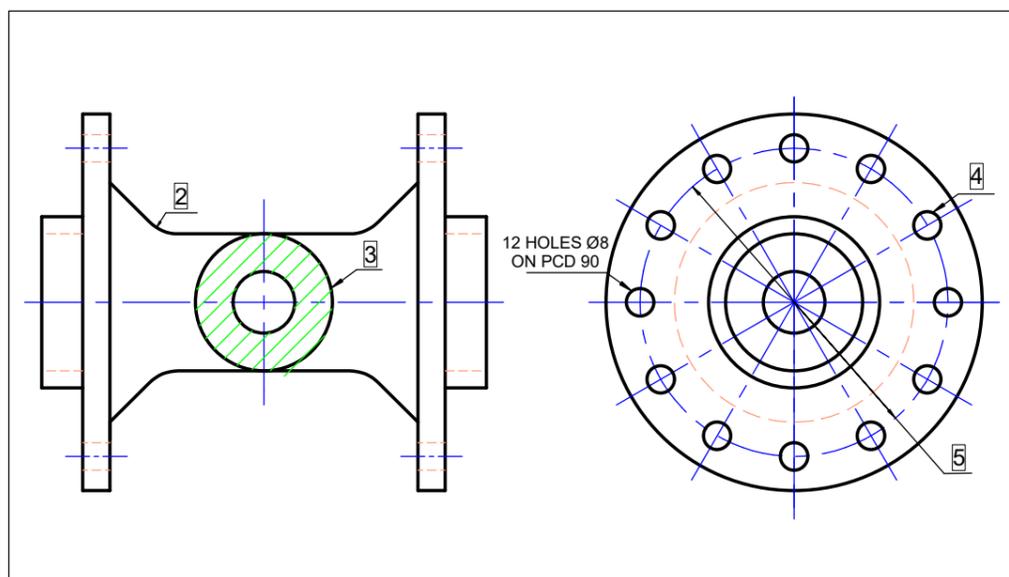


Figure D

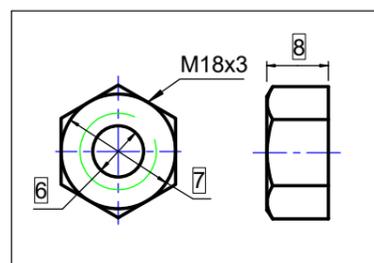


Figure F

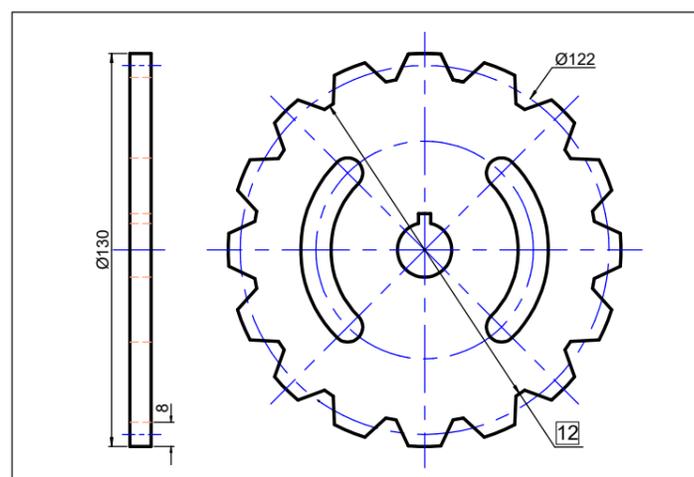
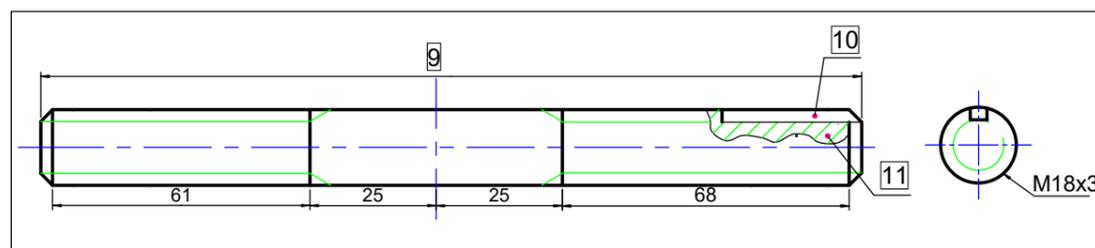


Figure E



Answer the following questions and print the correct answer in the space provided.

- 1.1 Which sectioned side view in Figure A is correct to convention? \_\_\_\_\_ (1)
- 1.2 What is feature 1 in Figure B called? \_\_\_\_\_ (1)
- 1.3 What is feature 2 in Figure C called? \_\_\_\_\_ (1)
- 1.4 What type of sectioning is shown by 3 in Figure C? \_\_\_\_\_ (1)
- 1.5 Calculate the dimension 4 in Figure C. \_\_\_\_\_ (1)
- 1.6 Calculate the dimension 5 in Figure C. \_\_\_\_\_ (1)
- 1.7 Calculate the dimension 6 in Figure D. \_\_\_\_\_ (1)
- 1.8 Calculate the dimension 7 in Figure D. \_\_\_\_\_ (1)
- 1.9 Calculate the dimension 8 in Figure D. \_\_\_\_\_ (1)
- 1.10 Calculate the dimension 9 in Figure E. \_\_\_\_\_ (1)
- 1.11 What is feature 10 in Figure E called? \_\_\_\_\_ (1)
- 1.12 What type of sectioning is shown by 11 in Figure E? \_\_\_\_\_ (1)
- 1.13 Calculate the dimension 12 in Figure F. \_\_\_\_\_ (1)
- 1.14 Is the thread in Figure E internal or external? \_\_\_\_\_ (1)
- 1.15 Figure G shows a **machining symbol**. Complete the table below by printing the correct letter next to the corresponding phrase. (3)

Phrase	Letter
1.15.1 Production method	
1.15.2 Direction of lay	
1.15.3 Machine allowance	

- 1.16 Figure H shows a **welding symbol**. Complete the table below by printing the correct letter next to the corresponding phrase. (3)

Phrase	Letter
1.16.1 Weld all around	
1.16.2 Welding process	
1.16.3 Welding symbol	

Figure G

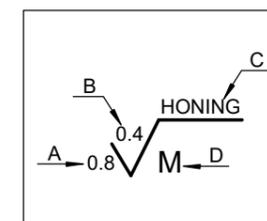
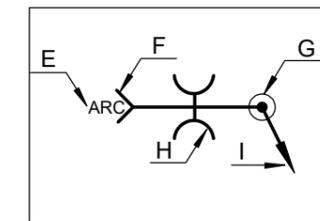


Figure H



20 MARKS

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ANSWER SHEET 1

QUESTION 2a

LOCUS  
CAM

Given is the incomplete **graph of displacement** of a **wedge-ended** follower as well as the centre of the cam shaft as shown by the given centrelines.

The graph of displacement has the following motion:

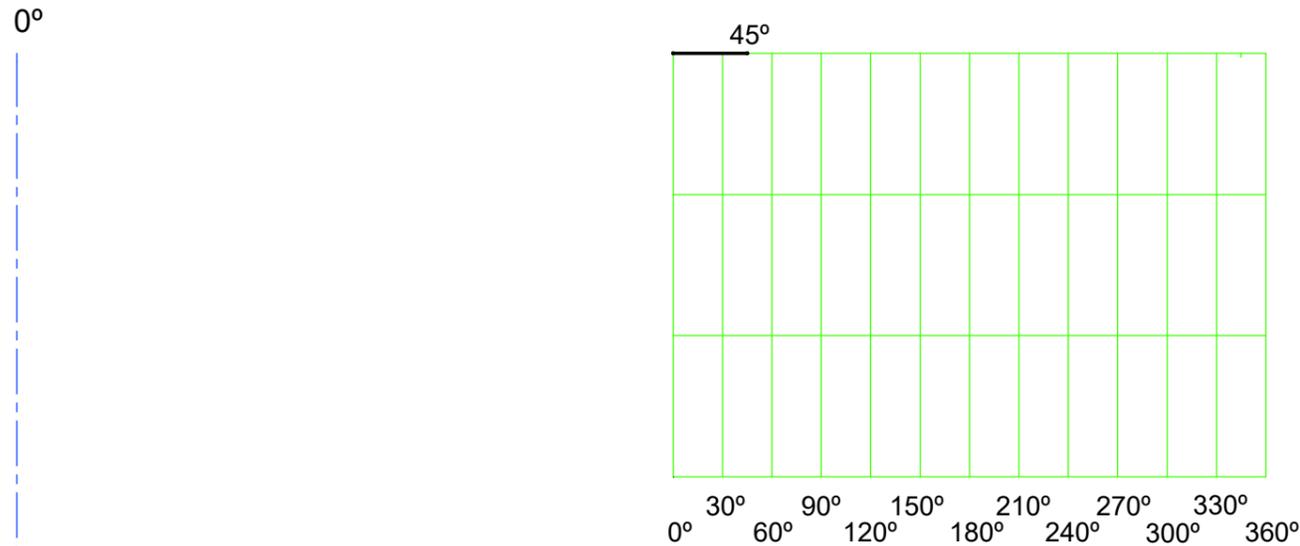
- ✓ 0° -45° the follower is at **rest**. (Given)  
**(Uniform motion)**
- ✓ 45° -60° the follower **falls 20 mm**.  
**(Uniform motion)**
- ✓ 60° -90° the follower is at **rest**.  
**(Uniform motion)**
- ✓ 90° -120° the follower **falls 20 mm**.  
**(Uniform motion)**
- ✓ 120° -150° the follower is at **rest**.  
**(Uniform motion)**
- ✓ 150° -180° the follower **falls 20 mm**.  
**(Uniform motion)**
- ✓ 180° -360° the follower **returns to its original position** with **simple harmonic motion**.

The cam profile has the following specifications:

- The direction of turn is **clockwise**.
- The **camshaft** has a radius of 11 mm.

Draw the following:

- 2a.1 the complete graph of displacement.
- 2a.2 the cam profile.
- 2a.3 the wedge-ended follower (to your own appropriate size and measurements).
- 2a.4 the camshaft.
- 2a.5 the direction of rotation.
- 2a.6 show all constructions.
- 2a.7 label the graph of displacement and the horizontal scale.



ASSESSMENT CRITERIA		
<input checked="" type="checkbox"/>	Graph 13/2	6½
<input checked="" type="checkbox"/>	Label/Scale	2
<input checked="" type="checkbox"/>	Setup/Plot Points 13/2	6½
<input checked="" type="checkbox"/>	Shaft and hatch	2
<input checked="" type="checkbox"/>	Direction	1
<input checked="" type="checkbox"/>	Locus	1
<input checked="" type="checkbox"/>	Follower	1

GRPH	6½	
LBL	2	
PLOT	6½	
SHFT	2	
DIR	1	
L/F	2	

20 MARKS

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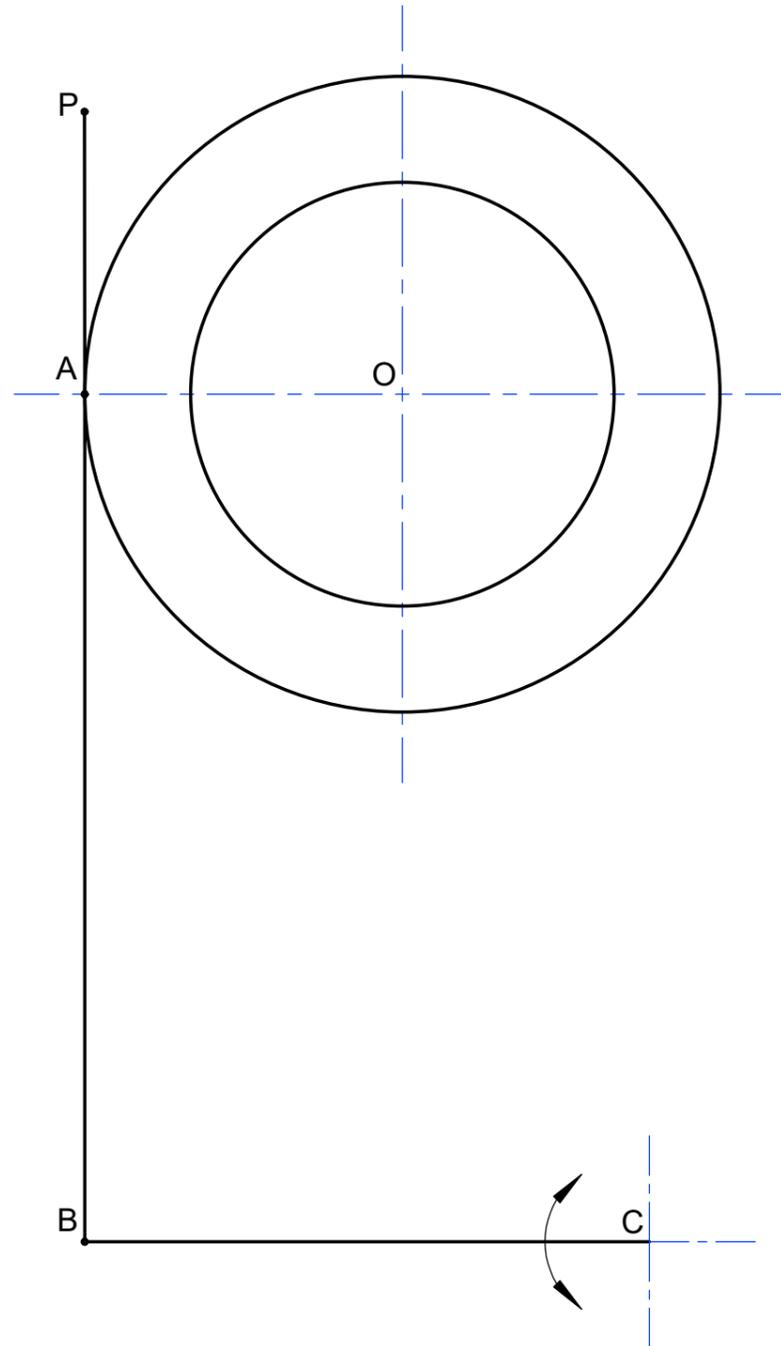
ANSWER SHEET 2a

QUESTION 2b

LOCUS MECHANISM

The given figure shows a wheel, rotating around the centre O, with a **rod AB** attached to it at point A. The end of the rod (B) is attached to a **second rod (BC)** that is free to move about its anchor point C. **Rod BC** rocks back and forth as the wheel rotates. Construct and draw the locus of **point P** if the direction of rotation is **clockwise**.

Show all **constructions** and indicate the **direction** correctly.



ASSESSMENT CRITERIA		
<input checked="" type="checkbox"/>	Setup	5
<input checked="" type="checkbox"/>	Plot Points	11
<input checked="" type="checkbox"/>	Direction	1
<input checked="" type="checkbox"/>	Locus	3

SET  
5

PTS  
11

DIR  
1

LOC  
3

20 MARKS

EXAMINATION NUMBER

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ANSWER SHEET 2b

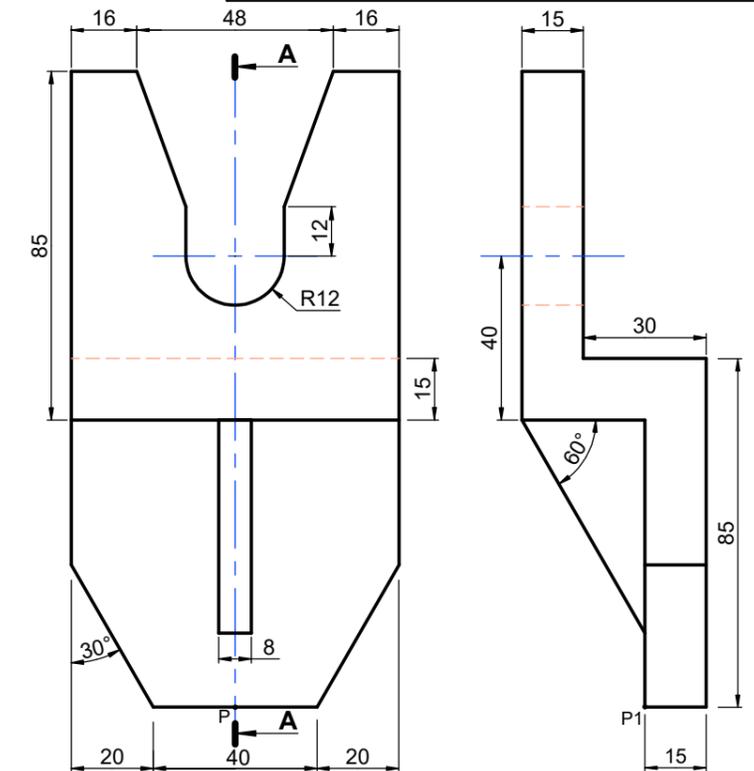
**QUESTION 3**

**ISOMETRIC  
DRAWING**

The figure below shows the front view and right view of a heavy duty **BRACKET**. The **BRACKET** has been cut by a **cutting plane A-A**.

Draw the following:

- 3.1 draw a neat **Sectioned Isometric** on the cutting plane A-A.
- 3.2 show the constructions for the hexagon and the angle in the given area.
- 3.3 draw all centrelines.
- 3.4 make point P the lowest part of your drawing.
- 3.5 start your drawing on the given crosshairs.



CONSTRUCTION AREA

P

**ASSESSMENT CRITERIA**

<input checked="" type="checkbox"/>	Constructions	4
<input checked="" type="checkbox"/>	Iso points	22
<input checked="" type="checkbox"/>	Iso circles	6
<input checked="" type="checkbox"/>	Centrelines	3
<input checked="" type="checkbox"/>	Hatching	3
<input checked="" type="checkbox"/>	Non-hatching	2
<input checked="" type="checkbox"/>	Positioning	-2

CON	4	
ISOM	22	
CIRC	6	
CLS	3	
HAT	3	
NO-H	2	
POS	-2	

**40 MARKS**

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ANSWER SHEET 3

QUESTION 4

MECHANICAL ASSEMBLY

FIGURE 1

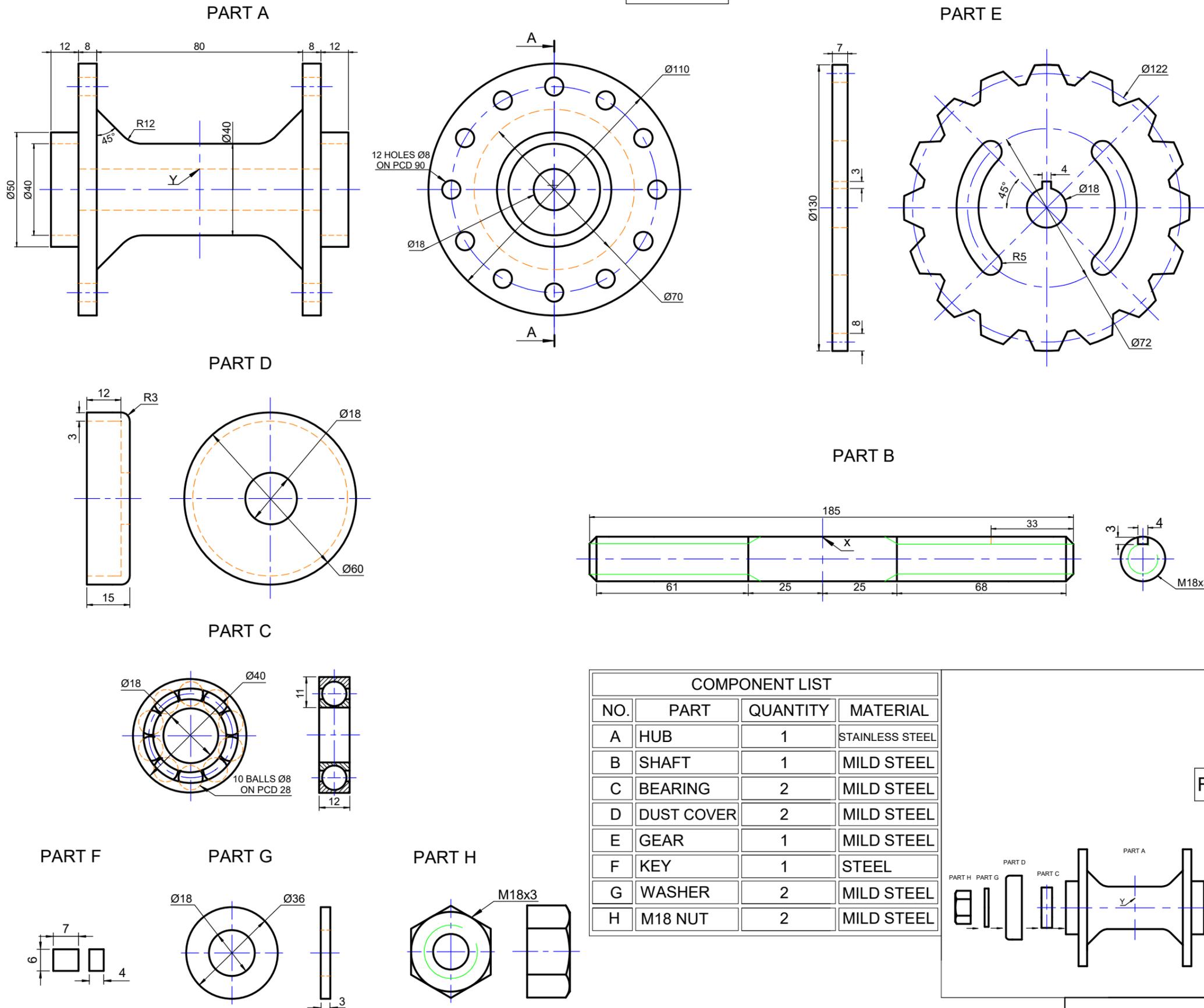


Figure 2 shows a series of pictures of a bicycle REAR HUB, as well as an exploded view of how the components of a similar, simplified system are assembled. A list of components is also shown.

Figure 1 shows the different components (not drawn to scale) that need to be assembled.

Complete the following to a SCALE of 1:1:

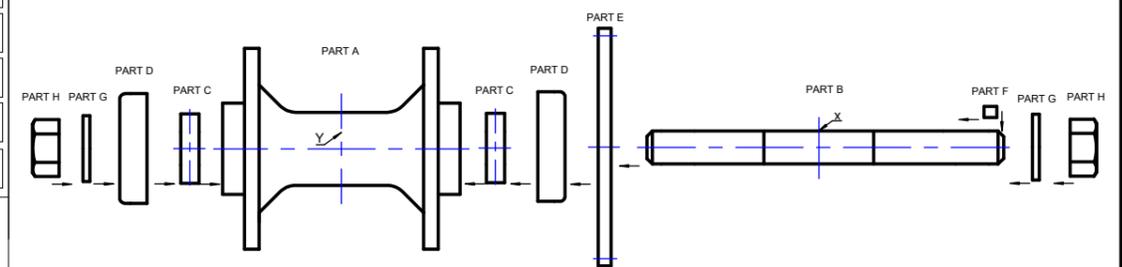
- 4.1 A sectioned **Front View** of the assembled components on the cutting plane **A-A**.
- 4.2 A **Right View** of the assembled components.
- 4.3 Please note the following:
  - 4.3.1 **Point Y** on the hub (Part A) must be assembled on **Point X** of the shaft (Part B).
  - 4.3.2 **Point Y** indicates the midpoint.
  - 4.3.3 Show **3 faces** for the hexagonal **nuts** on the front view.
- 4.4 Show **hidden detail** on the **right view** of only the **Dust Cover** (Part D) and **Key** (Part F).
- 4.5 Draw the **cutting plane** and the **centrelines**.
- 4.6 Draw 3 functional **dimensions**.
- 4.7 Draw the projection **symbol** in the space provided.
- 4.8 Print the **title** and **scale** in the space provided.
- 4.9 Label the **sectioned view**.

FIGURE 2



COMPONENT LIST			
NO.	PART	QUANTITY	MATERIAL
A	HUB	1	STAINLESS STEEL
B	SHAFT	1	MILD STEEL
C	BEARING	2	MILD STEEL
D	DUST COVER	2	MILD STEEL
E	GEAR	1	MILD STEEL
F	KEY	1	STEEL
G	WASHER	2	MILD STEEL
H	M18 NUT	2	MILD STEEL

FRONT VIEW



100 MARKS

EXAMINATION NUMBER

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**QUESTION 4**

**MECHANICAL ASSEMBLY**

**ASSESSMENT CRITERIA**

FRONT VIEW		
A	HUB	20
B	SHAFT	5
C	BEARINGS	6
D	DUST COVERS	6
E	GEAR	4
F	KEY	1
G	WASHERS	4
H	M18 NUTS	6
<b>TOTAL</b>	<b>52</b>	

RIGHT VIEW		
E	GEAR	9
F	KEY	1
G	WASHER	1
H	M18 NUT	2
B	SHAFT	2
	HIDDEN DETAIL	3
<b>TOTAL</b>	<b>18</b>	

ADDITIONAL		
	CORRECT ASS.	3
	HATCHING	9
	NON-HATCHING	4
	CENTRELINES <sup>8/2</sup>	4
	DIMENSIONS	3
	CUTTING PLANE	2
	SYMBOL	2
	TITLE/SCALE	2
	LABEL	1
<b>TOTAL</b>	<b>30</b>	
<b>TOTAL</b>	<b>100</b>	



TITLE	
SCALE	

SYMBOL	
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ANSWER SHEET 4

100 MARKS

EXAMINATION NUMBER											