INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION

INSTRUMENT DRAWING

ENGINEERING GRAPHICS & TECHNOLOGY
PAPER 1
NOVEMBER 2022

MARKS: 200 TIME: 3 HOURS

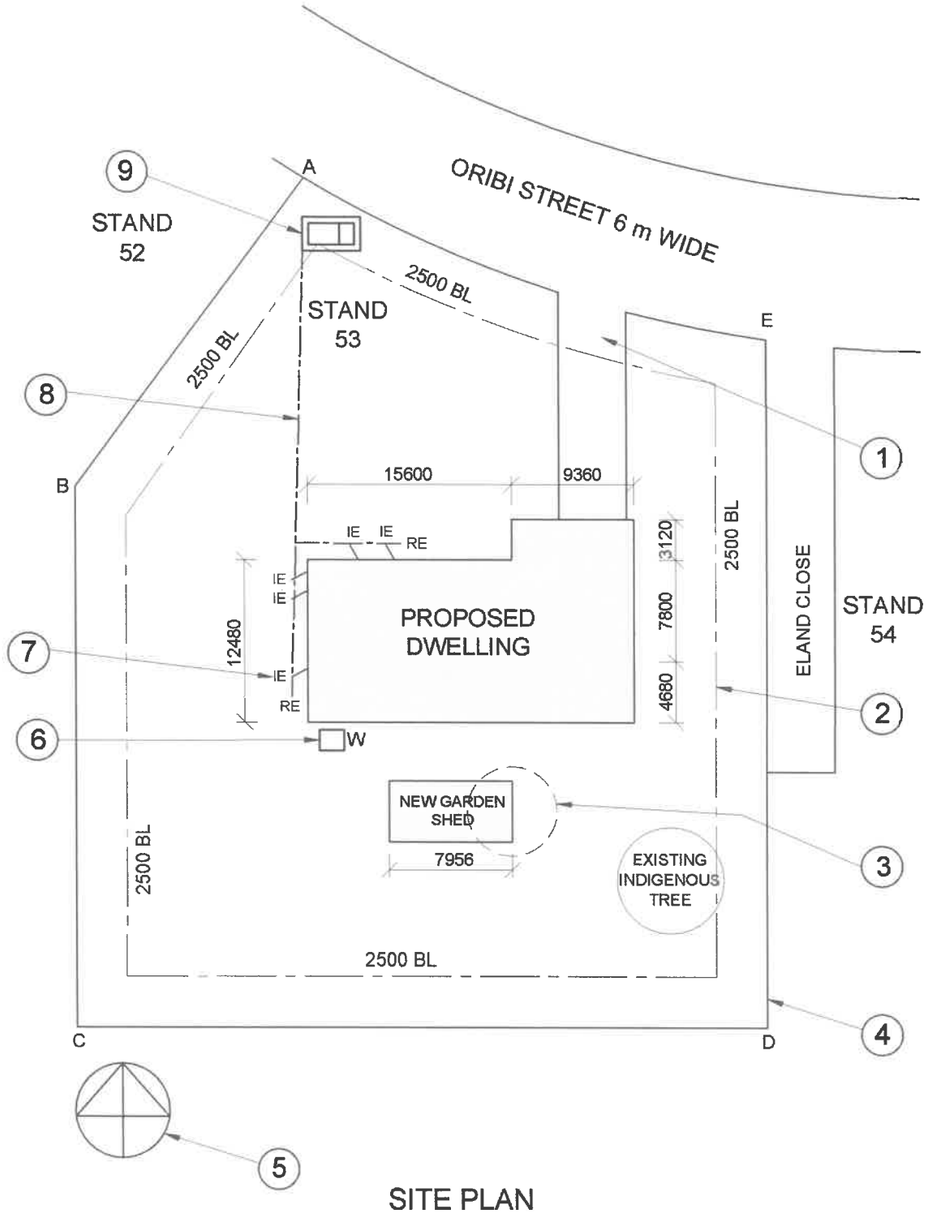
GENERAL INSTRUCTIONS

1. This examination must be answered using **drawing instruments.**
2. **Non-programmable calculators** may be used.
3. **Section A** (compulsory questions) has **2 questions** - **answer BOTH Questions 1 & 2.**
4. **Section B** (compulsory questions) has **2 questions** - **answer BOTH Questions 3 & 4.**
5. **Section C** (choice questions) has **3 questions** - **answer ONE question from either Question 5, Question 6 or Question 7.**
6. Answer **5 questions** in total.
7. Print your **examination number** neatly on each page.
8. Draw on the **answer sheets** provided.
9. All dimensions or detail not given may be **assumed** in **good proportion**.
10. 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**.

NOTE: This question paper consists of **8 pages** including the cover page and **7 questions**.

	FOR OFFICIAL USE ONLY					
	QUESTION	SECTION	MARK	MODERATED	MAXIMUM	CODE
SECTION A Compulsory Questions Answer **BOTH** Questions 1 and 2	1	CIVIL SITE PLAN			15	
	2	MECHANICAL ANALYTICAL			15	
SECTION B Compulsory Questions Answer **BOTH** Questions 3 and 4	3	CIVIL ASSEMBLY			80	
	4	CIVIL DRAWING			40	
SECTION C Choice Questions Answer **ONE** question from either Question 5, 6 or 7. **Do not answer all**	5	CAM PROFILE			50	
	6	HELICOID HELIX			50	
	7	CRANK MECHANISM			50	
	TOTAL				200	
	FINAL CONVERTED MARK				100	

EXAMINATION NUMBER



SITE PLAN
(The drawing is **NOT** to scale)

1.1. What is the space at 1 called? (1)	
1.2. What is the line at 2 called? (1)	
1.3. What is the feature at 3 called? (1)	
1.4. What is the line at 4 called? (1)	
1.5. What is the feature at 5 called? (1)	
1.6. What is the feature at 6 called? (1)	
1.7. What does the abbreviation at 7 stand for? (1)	
1.8. What is the line at 8 called? (1)	
1.9. What is the feature at 9 called? (1)	
1.10. When was the land surveyed? (1)	
1.11. What does the abbreviation 'WB' stand for? (1)	
1.12. What is the area of the proposed dwelling in square metres, to one decimal place? (1)	
1.13. What type of road is Eland Close? (1)	

1.14. Draw in first-angle orthographic projection and in neat **FREEHAND,** the correct plan and elevation symbol for a **WATER CLOSET**, in the space below. (2)
Penalty for **NOT** drawing **FREEHAND**: -1

MARKS	
15	

SECTION A	QUESTION 1 15 MARKS
Compulsory Question	CIVIL SITE PLAN

The adjacent details refer to the site plan of STAND 53 Oribi Street, Khomasdal:

SPECIFICATIONS:

As per given site plan.

REQUIREMENTS:

Refer to the site plan and given information and answer the questions in the table.

ASSESSMENT CRITERIA:

You will be assessed on your ability to do the following:
- recall, process, comprehend and calculate the given information and drawing.

NOTES:

STAND 53 BOUNDARY DIMENSIONS
- AB = 30885
- BC = 22452
- CD = 40729
- DE = 40695
- EA = 28825

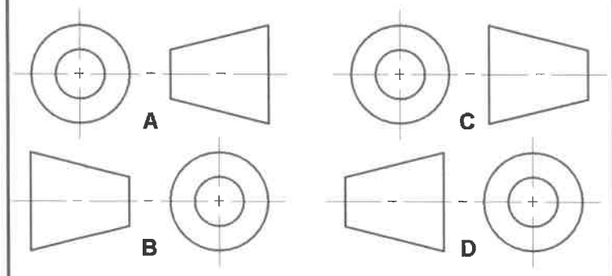
STAND 53 CORNER LEVELS
- A = 66,5
- B = 65,9
- C = 64,3
- D = 64,8
- E = 65,2

LAND SURVEYOR'S CERTIFICATE SIGNED ON 26-02-22

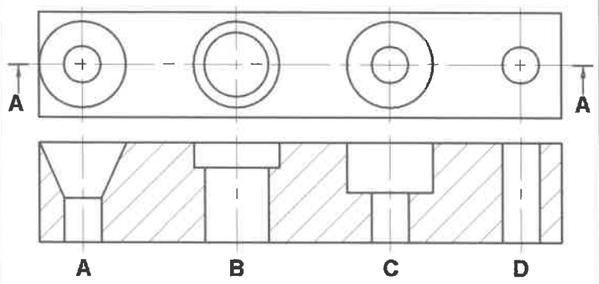
ANSWER SHEET 1

EXAMINATION NUMBER

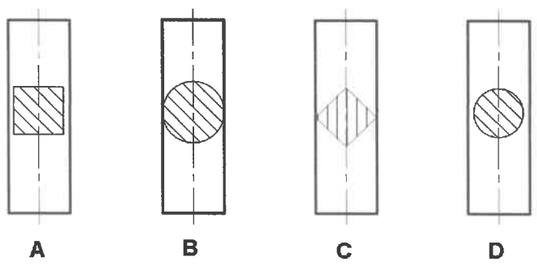
2.1 Which is the correct symbol for ***THIRD-ANGLE ORTHOGRAPHIC PROJECTION***?



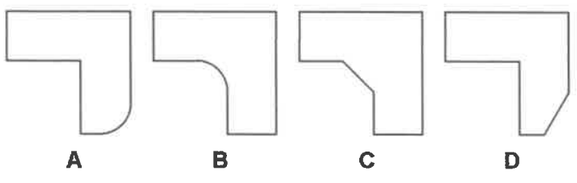
2.2 Which of the following shows a ***COUNTERBORE*** hole?



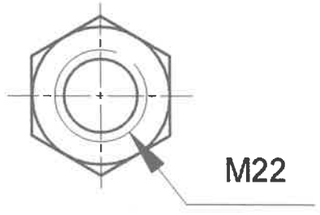
2.3 Which shaft shows a ***REVOLVED SECTION***?



2.4 Which of the following shows a ***ROUND***?

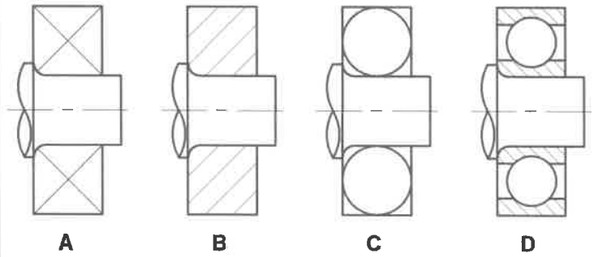


2.5. What is the exact working drawing ***THREAD THICKNESS*** shown below ?

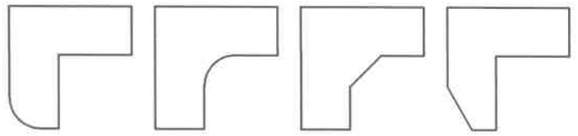


22 A | 2,22 B | 2,2 C | 2 D

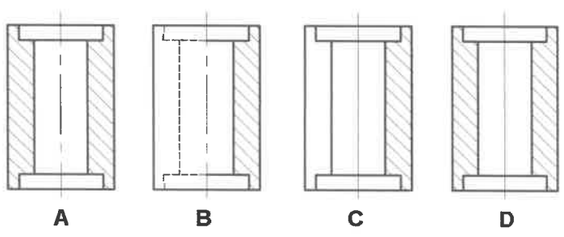
2.6 Which of the following represents the correct convention for a ***BEARING***?



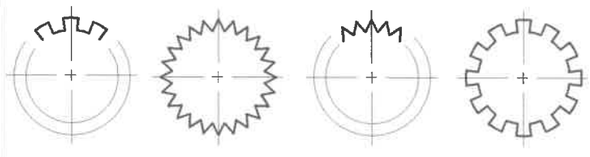
2.7 Which of the following shows a ***CHAMFER***?



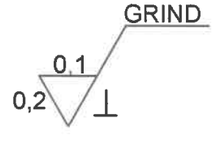
2.8 Which ***HALF-SECTIONED*** casting is correctly drawn?



2.9 Which of the following shows the convention for a ***SPLINED SHAFT***?

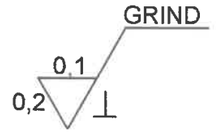


2.10 What does the number ***0,1*** represent on the symbol shown below?



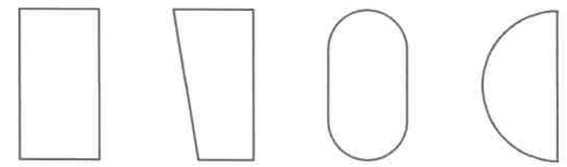
MACHINING ALLOWANCE A | ROUGHNESS VALUE B | MACHINE PROCESS C | SAMPLE LENGTH D

2.11 What ***MACHINING PROCESS*** is represented on the symbol shown below?

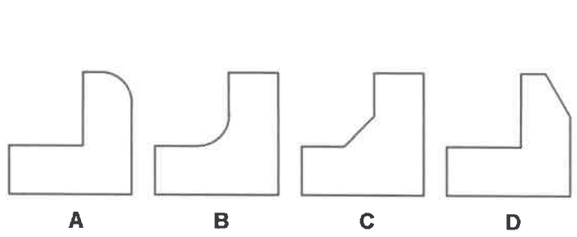


GRINDING A | PERPENDICULAR B | 0,2 C | 0,1 D

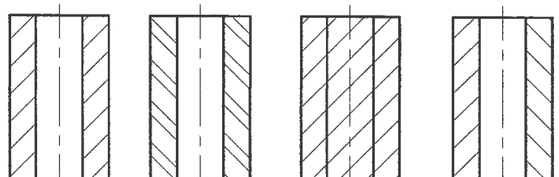
2.12 Which figure below shows a ***WOODRUFF KEY***?



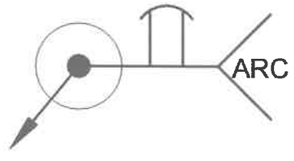
2.13 Which of the following shows a ***FILLET***?



2.14 Which sectioning for a ***NON-STEEL CASTING*** is correctly shown?



2.15 What type of ***WELD PROCESS*** is shown below?



CONCAVE A | ARC B | CONVEX C | ALL ROUND D

SECTION A	QUESTION 2 15 MARKS
Compulsory Question	MECHANICAL ANALYTICAL

The adjacent details refer to the analytical knowledge of mechanical technology.

REQUIREMENTS:

Answer the multiple choice questions and print the correct LETTER in the table below.

ASSESSMENT CRITERIA:

You will be assessed on your ability to do the following:

- recall, process, comprehend and calculate the given information and drawings.

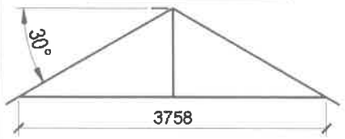
2.1.	2.2.	2.3.	2.4.	2.5.
2.6.	**2.7.**	**2.8.**	**2.9.**	**2.10.**
2.11.	**2.12.**	**2.13.**	**2.14.**	**2.15.**

MARKS	
15	

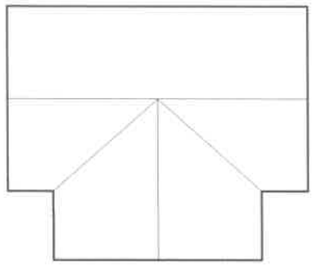
ANSWER SHEET 2

EXAMINATION NUMBER

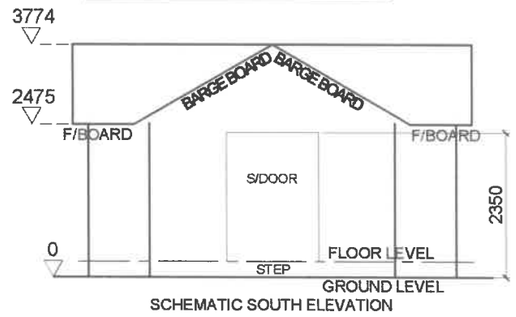
ROOF DETAIL



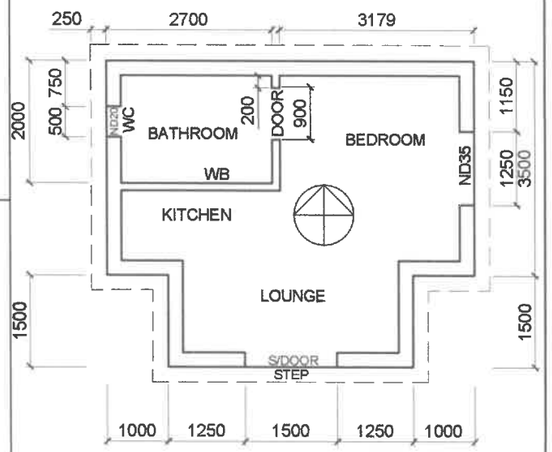
ROOF PROFILE



SCHEMATIC DIAGRAMS

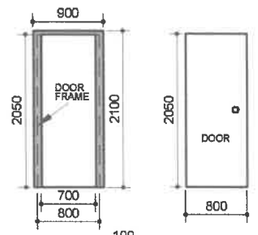


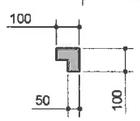
SCHEMATIC SOUTH ELEVATION



INCOMPLETE FLOOR PLAN

DOOR DETAIL

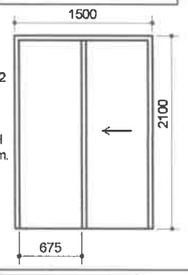




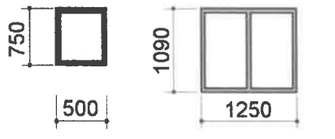
DOOR FRAME DETAIL

SLIDING DOOR DETAIL

SLIDING DOOR RUNS ON 2 RAILS EXTENDING 1500 mm AND CENTRALLY PLACED ON THE WALL. THE THICKNESS OF EACH DOOR AND RAIL IS 100 mm.



WINDOW DETAIL



ND 20 WOODEN WINDOW

ND 35 WOODEN WINDOW

ASSESSMENT CRITERIA

SOUTH ELEVATION

1	ROOF	9	
2	WALLS	5	
3	FASCIA & BARGE BOARD	7	
4	DOOR & STEP	8	
5	LABELS & FFL	4	
	SUBTOTAL	33	

FLOOR PLAN

6	WALLS	12	
7	DOOR & STEP	7	
8	WINDOWS	4	
9	ROOF PROFILE 12 * 2/3	8	
10	PLUMBING FIXTURES	4	
11	LABELS	2	
12	ELECTRICAL	6	
13	WALL HATCHING 8/2	4	
	SUBTOTAL	47	
	TOTAL	80	

SECTION B	QUESTION 3 80 MARKS
Compulsory Question	CIVIL ASSEMBLY

Details for a new ***BACHELOR FLAT*** are given as follows:

- An incomplete floor plan with walls, window, door, step and bathroom fixtures position.
- An incomplete south elevation with step and door position; ground level and floor level; roof heights.
- Door, window and roof detail; notes and north point.
- The bachelor flat is made up of a bathroom, lounge, kitchen and bedroom.

Draw the following:

3.1 the **complete floor plan**

3.2 the **south elevation**

- Answer this question on answer sheet 3.
- Use a scale of 1:50.
- All drawings and symbols must comply.

FLOOR PLAN INSTRUCTIONS

- Draw and hatch all external and internal walls.
- Draw the missing windows, doors and step.
- Label the floor plan and print the scale.
- Insert the following electrical detail:
  - ▶ 1 X TWO 40 watt fluorescent tube between the bedroom and the kitchen,
  - ▶ a light in the centre of the bathroom,
  - ▶ a switch for each light near the doors.
- Draw a water closet and wash basin in the bathroom.
- Draw the roof profile.

SOUTH ELEVATION INSTRUCTIONS

- Draw the south elevation.
- Draw all visible walls, sliding door and step.
- Draw detail for the 4 mm corrugated steel sheeting used for the roof.
- Label the south elevation, floor level and ground level.
- Draw the floor level throughout the view.
- Draw the fascia boards and barge boards.

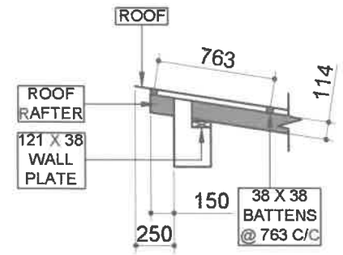
NOTES

- The bathroom door opens into the bathroom.
- The fascia board is 167 mm X 38 mm.
- Use 200 mm barge boards
- The step has a riser of 125 mm, a tread of 150 mm and a width of 1500 mm.
- The roof line is 250 mm from the outside walls.
- The windows do not have window sills.
- The external walls are 242 mm thick.
- The floor level is 250 mm above the ground level.

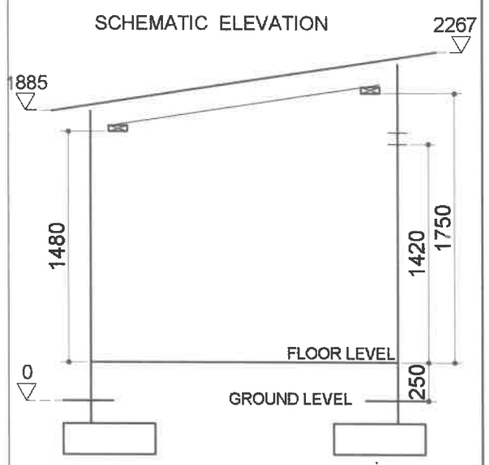
ANSWER SHEET 3

EXAMINATION NUMBER

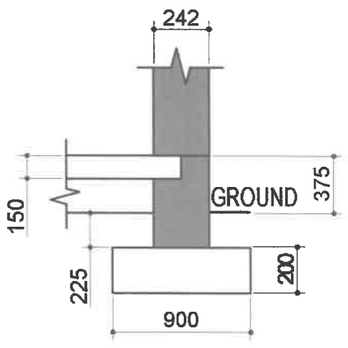
ROOF DETAIL

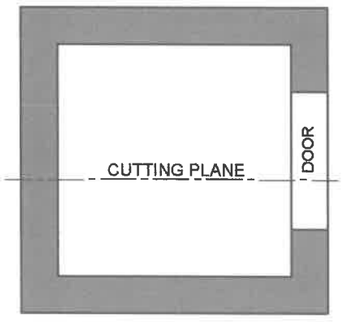


SCHEMATIC DIAGRAMS



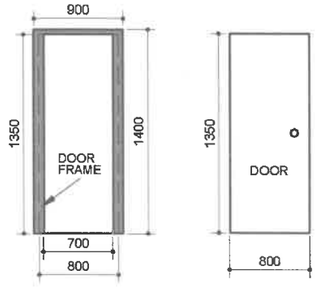
FOUNDATION & FLOOR DETAIL



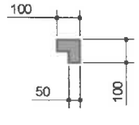


SCHEMATIC FLOOR PLAN

CUSTOM COOP DOOR



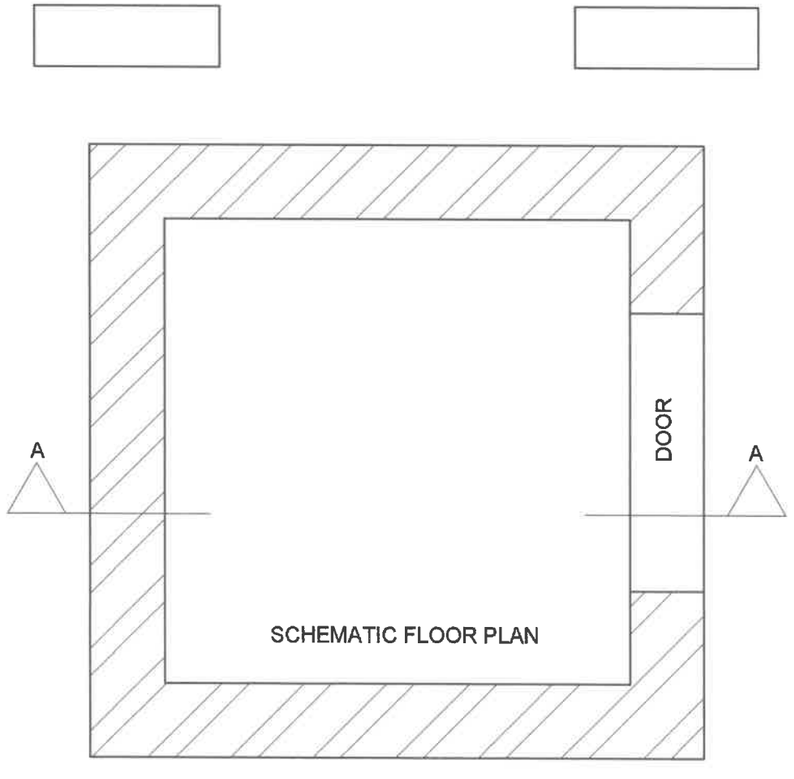
DOOR FRAME DETAIL



ASSESSMENT CRITERIA

SECTIONAL ELEVATION

1	FOUNDATION & FLOOR	5	
2	WALLS	4	
3	SECTIONED DOOR	6	
4	WALL PLATES	2	
5	ROOF RAFTER	2	
6	ROOF BATTENS	4	
7	ROOF	2	
8	HATCHING	12	
9	LABELS	3	
	TOTAL	40	



SCHEMATIC FLOOR PLAN

SECTION B | QUESTION 4 40 MARKS

Compulsory Question | CIVIL DRAWING

Details for a new ***PIGEON COOP*** are given as follows:

- A schematic floor plan with cutting plane A-A, walls and door position.
- An incomplete sectional elevation with ground, floor, door and roof position; ground level and floor level; roof heights.
- Notes, foundation, floor, door and roof detail.

Draw the following:

- the complete **sectional elevation** on cutting plane A-A.
  - ▶ Answer this question on answer sheet 4.
  - ▶ Use a scale of 1:20.
  - ▶ All drawings and symbols must comply.

FLOOR PLAN INSTRUCTIONS

- The schematic floor plan is drawn for you.
- **Do not redraw the floor plan.**
- Work off the given floor plan.

SECTIONAL ELEVATION INSTRUCTIONS

- The foundation blocks are given. Use the foundation blocks as a starting point. **Do not redraw the foundation blocks.**
- The cutting plane A-A is given in the floor plan.
- Draw the floor slab details:
  - ▶ use 150 mm hardcore fill
  - ▶ use 20 mm screed
- Draw the sectional door including:
  - ▶ door frame detail
  - ▶ use TWO 121 x 75 concrete lintels above the door.
- Complete the roof details:
  - ▶ use 121 x 38 wall plates
  - ▶ use 114 x 38 roof rafters for the coop roof
  - ▶ use 38 x 38 roof battens @ 763 C/C
  - ▶ use 4mm corrugated steel sheeting for the roof
- Complete all hatch detail. All substructure hatching may be drawn in freehand.
- Label the sectional elevation, damp proof courses and ground level.

NOTES

- The roof line is 250 mm from the outside walls.
- The roof rafter protrudes 150 mm out from the outside walls.
- There are NO ceiling boards.
- There are NO truss plates.
- Wooden roof rafters are being used to hold up the roof.
- The finished floor level is at the top of the slab.
- The door opens into the pigeon coop.

ANSWER SHEET 4

EXAMINATION NUMBER

SECTION C	QUESTION 5 50 MARKS
Choice Question	CAM PROFILE

The following details refer to a cam profile:

GIVEN:

- Centre lines.

SPECIFICATIONS:

- Roller follower
- Anti-clockwise direction
- Line of stroke is on the vertical centre line.
- Cam shaft diameter = 18 mm
- Minimum distance from the centre of the cam shaft to the profile : 15 mm
- Follower roller diameter : 10 mm
- Horizontal scale: 8 mm = 30°
- Vertical scale: 1:1

GRAPH OF DISPLACEMENT MOTION:

0° - 90° : the follower falls 20 mm with ***uniform motion***,
90° - 150° : the follower is at ***rest***,
150° - 270° : the follower rises 70 mm with ***uniform acceleration and retardation***,
270° - 360° : the follower returns to its original position with ***simple harmonic motion***.

REQUIREMENTS:

5.1. Draw and label the graph of displacement.
5.2. Draw the cam profile.
5.3. Show all construction and the direction of rotation.
5.4. Answer the questions in the given answer block:
5.4.1. What is the travel of the follower at 210°?
5.4.2. What is the displacement of the follower at 210°?

ASSESSMENT CRITERIA:

You will be assessed on your ability to do the following:

• draw & label the graph of displacement	15
• accurately plot the minimum distance	4
• plot the points for the cam profile	15
• draw & hatch the cam shaft	2
• draw & label the divisions	2
• draw the follower	3
• draw the direction arrow	1
• draw a neat locus	3
• show all projection	3
• answer the questions correctly	2

5.4.1.	
5.4.2.	

ASSESSMENT CRITERIA			
1	DISPLACEMENT GRAPH	15	
2	MCP	4	
3	PROFILE POINTS	15	
4	CAM SHAFT	2	
5	PROFILE DIVISIONS	2	
6	FOLLOWER	3	
7	DIRECTION	1	
8	LOCUS	3	
9	PROJECTION	3	
10	ANSWERS	2	
	TOTAL	50	

ANSWER SHEET 5

EXAMINATION NUMBER

SECTION C	QUESTION 6 50 MARKS
Choice Question	HELIX

The diagram below shows the inner core of a **HELICOID/AUGER**, in first-angle orthographic projection and the following details have reference:

SPECIFICATIONS:

- Left-handed
- One and a half turns
- The helicoid is inclined at 30°
- Start from point P

GIVEN:

- Outer diameter
- Inner diameter
- Centre lines

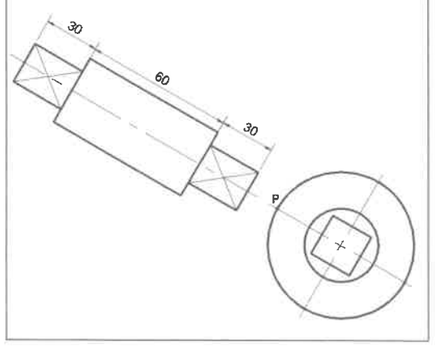
REQUIREMENTS:

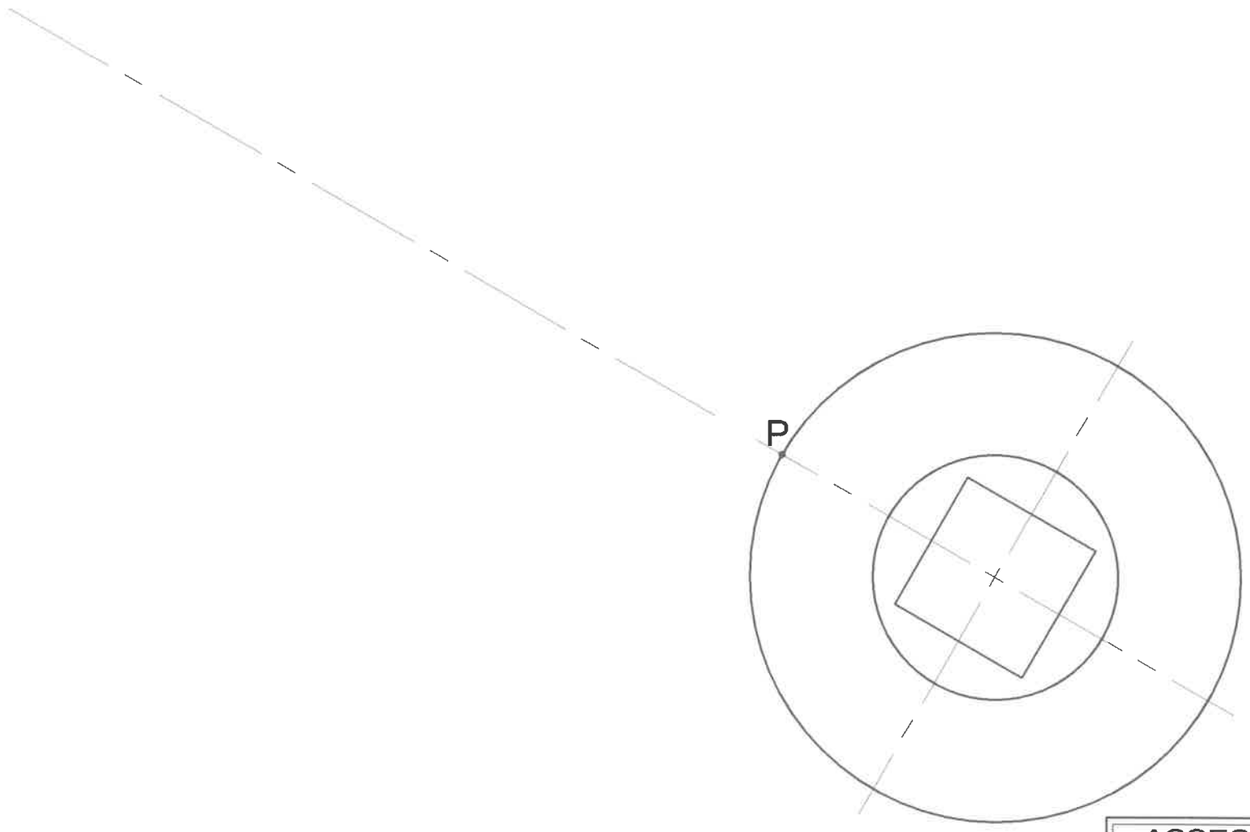
6.1. Draw the helicoid/auger according to the given specifications.
6.2. Calculate the pitch of the helicoid/auger. Write your answer in the given answer block.
6.3. Do not show any hidden detail.

ASSESSMENT CRITERIA

You will be assessed on your ability to do the following:

• plot the inner locus points	11
• plot the outer locus points	17
• draw the lines for the shaft	7
• draw the square on a shaft	6
• show all construction	6
• draw a neat locus	2
• calculate the pitch	1





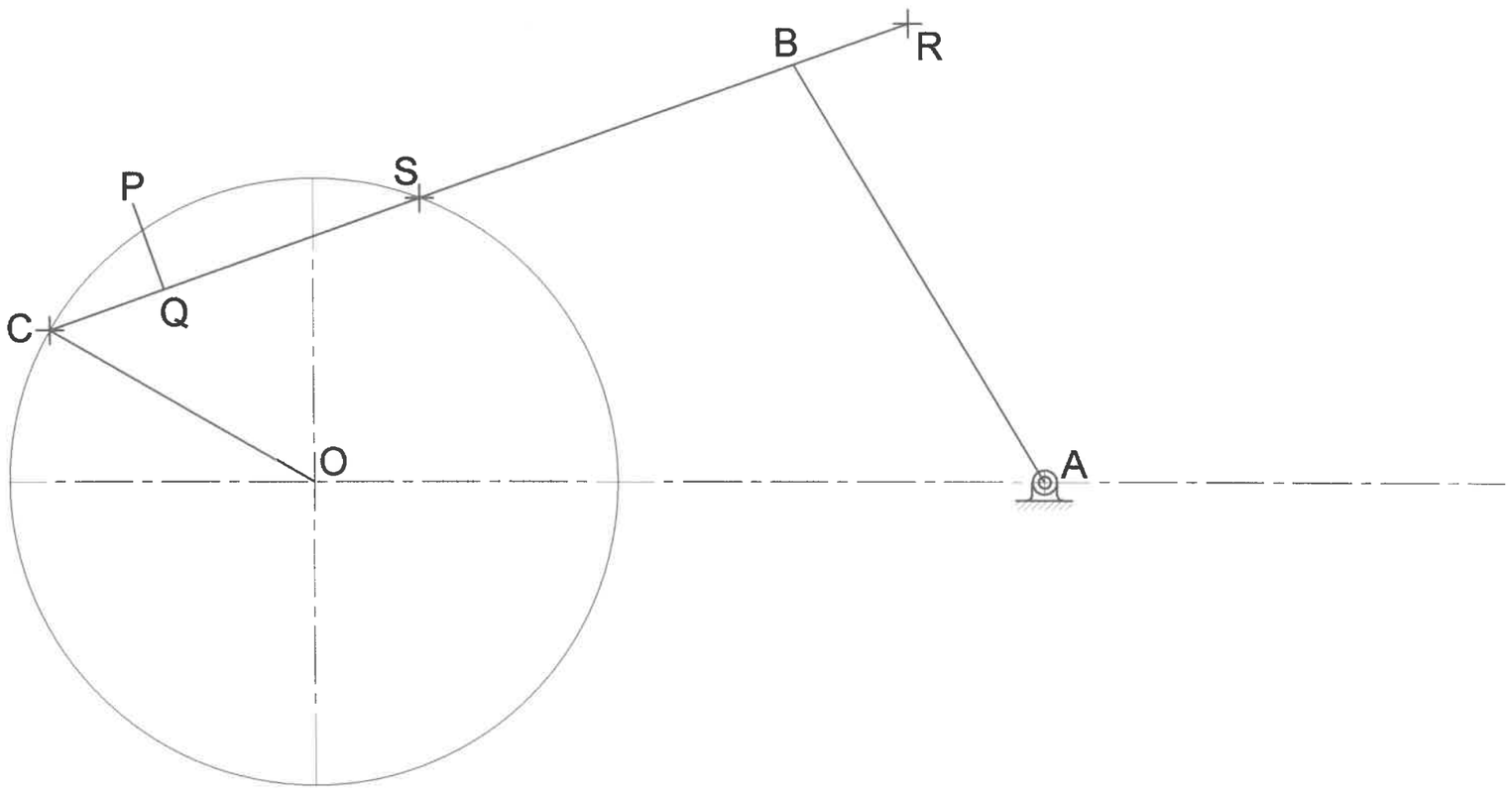
6.2.

ASSESSMENT CRITERIA			
1	INNER LOCUS	11	
2	OUTER LOCUS	17	
2	SHAFT LINES	7	
4	SHAFT SQUARES	6	
5	CONSTRUCTION	6	
6	LOCUS	2	
7	ANSWER	1	
	INCORRECT PITCH	-4	
	NOT LEFT HAND	-2	
TOTAL		50	

ANSWER SHEET 6

EXAMINATION NUMBER

FIGURE A



SECTION C	QUESTION 7 50 MARKS
Choice Question	CRANK MECHANISM

Figure A shows the schematic of a Crank Mechanism. (Draw on Figure A)
Figure B shows the graphical representation of the Crank Mechanism. (Do not draw on Figure B)

SPECIFICATIONS:

- Rod AB is attached to rod RC at B.
- Rod RC is attached to the anchor wheel at C.
- The anchor wheel rotates in a clockwise direction about point O.
- Point A is a fixed point that does not move.
- Rod AB pivots about point A.
- Point B is a movable point that moves back and forth according to the mechanism movement.
- Rod PQ is attached to rod BC at Q and is perpendicular to rod BC.
- Point S lies between B and C on rod RC.
- AB = 80 mm
  BC = 130 mm
  OC = 50 mm
  BR = 20 mm
  CQ = 20 mm
  PQ = 15 mm

REQUIREMENTS:

7.1. Draw the locus of point P.

7.2. Draw the locus of point R.

7.3. Draw the locus of point S.

7.4. Show all construction.

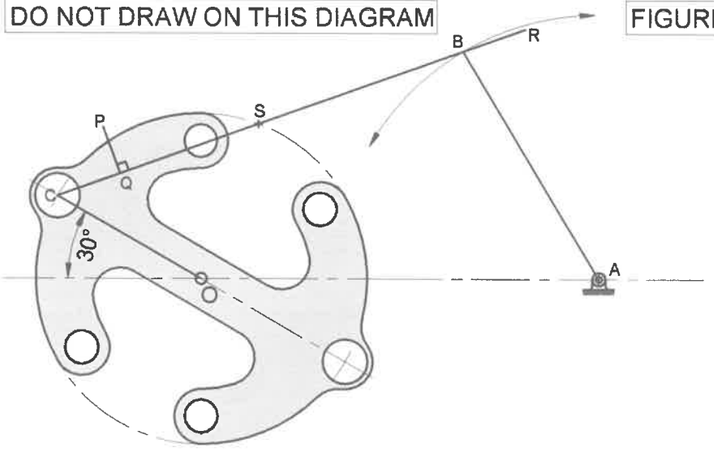
ASSESSMENT CRITERIA

You will be assessed on your ability to do the following:

• plot the points for the locus of P	11
• plot the points for the locus of R	11
• plot the points for the locus of S	11
• show all construction	11
• draw neat loci for P,R,S	6

DO NOT DRAW ON THIS DIAGRAM

FIGURE B



GRAPHICAL REPRESENTATION OF MECHANISM

ASSESSMENT CRITERIA			
1	LOCUS P	11	
2	LOCUS R	11	
3	LOCUS S	11	
4	CONSTRUCTION	11	
5	LOCUS QUALITY	6	
	TOTAL	50	

ANSWER SHEET 7

EXAMINATION NUMBER