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Basic Education  
**REPUBLIC OF SOUTH AFRICA**

## **NATIONAL SENIOR CERTIFICATE**

**GRADE 12**

**CIVIL TECHNOLOGY**

**FEBRUARY/MARCH 2013**

**MARKS: 200**

**TIME: 3 hours**

**This question paper consists of 16 pages, 5 answer sheets and 1 formula sheet.**

**REQUIREMENTS**

1. Drawing instruments
2. A non-programmable pocket calculator
3. ANSWER BOOK

**INSTRUCTIONS AND INFORMATION**

1. This question paper consists of SIX questions.
2. Answer ALL the questions.
3. Answer each question as a whole; do NOT separate subquestions.
4. Start the answer to EACH question on a NEW page.
5. Do NOT write in the margin of the ANSWER BOOK.
6. Sketches may be used to illustrate your answers.
7. ALL calculations and written answers must be done in the ANSWER BOOK or on the attached ANSWER SHEETS.
8. Use the mark allocation as a guide to the length of your answers.
9. Drawings and sketches must be done in pencil, fully dimensioned and neatly finished off with descriptive titles and notes to conform to the SANS/SABS Code of Practice for Building Drawing Practice.
10. For the purpose of this question paper, the size of a brick should be taken as 220 mm x 110 mm x 75 mm.
11. Use your discretion where dimensions and/or details have been omitted.
12. Answer QUESTIONS 1.2, 3.6, 4.5, 6.1 and 6.2 on the attached ANSWER SHEETS using drawing instruments where necessary.
13. Write your CENTRE NUMBER and EXAMINATION NUMBER on every ANSWER SHEET and hand them in with your ANSWER BOOK, whether you have used them or not.
14. Drawings in the question paper are NOT to scale due to electronic transfer.

**QUESTION 1: CONSTRUCTION PROCESSES**

- 1.1 Choose a description from COLUMN B that matches a term in COLUMN A. Write only the letter (A–G) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK, for example 1.1.7 H.

COLUMN A		COLUMN B	
1.1.1	Mass concrete	A	a common method used to prevent corrosion of steel and iron
1.1.2	Safety officer	B	Occupational Health and Safety Act
1.1.3	OHSA	C	ensures that the employer follows safety regulations
1.1.4	Strut	D	to accurately level the dumpy level horizontally
1.1.5	Skirting	E	casted without reinforcement
		F	a moulding that is found where the wall meets the floor
		G	used for roof construction to brace the trusses

(5)

- 1.2 FIGURE 1.2 on ANSWER SHEET 1.2 shows the construction lines of an incomplete gauged arch.

- 1.2.1 Complete the gauged arch by drawing the voussoirs (bricks). (3)
- 1.2.2 Label the key voussoir (brick). (1)
- 1.2.3 Indicate and label the rise on your drawing. (1)
- 1.2.4 Indicate and label the span on your drawing. (1)
- 1.2.5 Indicate the intrados on your drawing. (1)
- 1.2.6 Indicate the extrados on your drawing. (1)
- 1.2.7 Identify the bond used in the surrounding brickwork and label it on the drawing. (1)

- 1.3 FIGURE 1.3 below illustrates the top view of a roof layout showing the roof trusses and the external wall of a building. Analyse the illustration and answer the questions that follow.

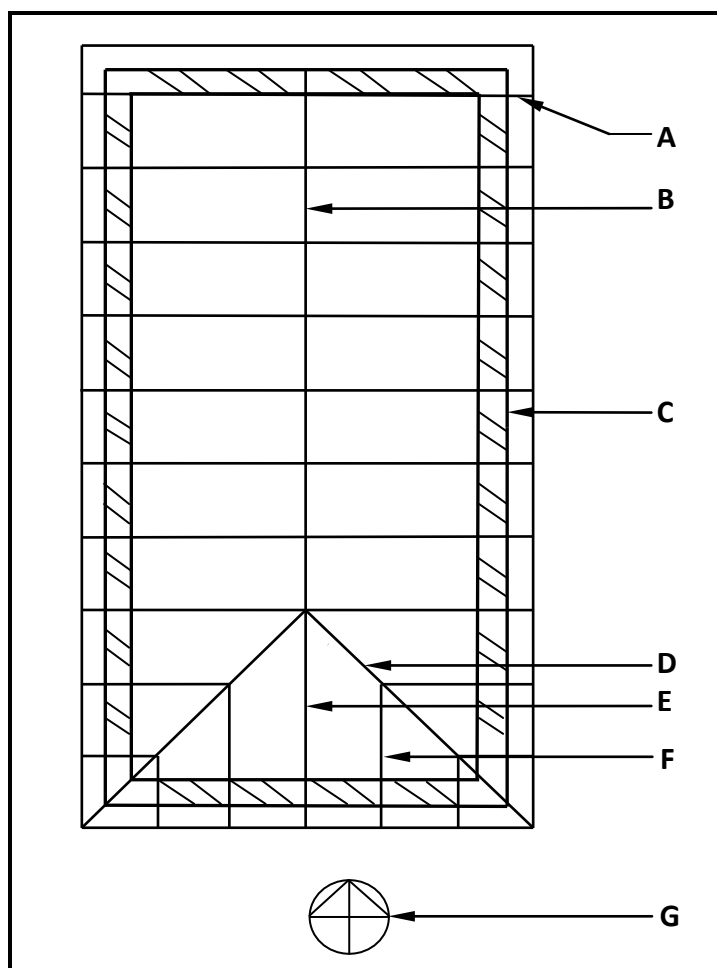


FIGURE 1.3

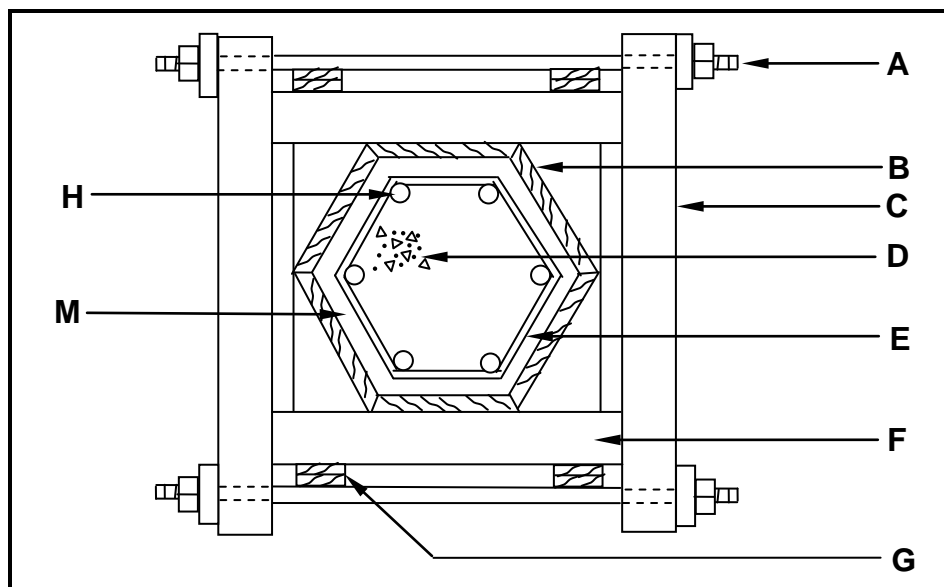
- |        |   |     |
|--------|---|-----|
| 1.3.1  | Identify component <b>A</b> .   | (1) |
| 1.3.2  | Name part <b>B</b> .  | (1) |
| 1.3.3  | Identify component <b>C</b> .   | (1) |
| 1.3.4  | Name rafter <b>D</b> .  | (1) |
| 1.3.5  | Name truss <b>E</b> .   | (1) |
| 1.3.6  | Name rafter <b>F</b> .  | (1) |
| 1.3.7  | Identify drawing symbol <b>G</b> .  | (1) |
| 1.3.8  | What is the maximum distance between roof trusses when concrete and clay tiles are used as roof covering? | (1) |
| 1.3.9  | Identify the type of roof end on the south elevation.   | (1) |
| 1.3.10 | Differentiate between the use of a <i>barge board</i> and a <i>fascia board</i> in a roof construction.   | (2) |

- 1.4 Explain the purpose of a wall plate in roof construction. (2)
- 1.5 Explain TWO effects of adding too much water to concrete while it is being mixed. (2)
- 1.6 Safety signs are presented in the shapes of circles, squares and triangles. Which shape is used to indicate danger warning signs? (1)
- [30]**

## QUESTION 2: ADVANCED CONSTRUCTION PROCESSES

Start the answer to this question on a **NEW** page.

- 2.1 FIGURE 2.1 below shows hexagonal formwork for a concrete column with concrete and reinforcement in place. Analyse the illustration and answer the questions that follow.



**FIGURE 2.1**

- 2.1.1 Give the correct names of the parts labelled **A** to **H**. (8)
- 2.1.2 Recommend **ONE** material that can be used for item **B**. (1)
- 2.1.3 What is indicated by **M**? (1)
- 2.1.4 What is the purpose of **E**? (1)

2.2 FIGURE 2.2 below illustrates two types of beams.

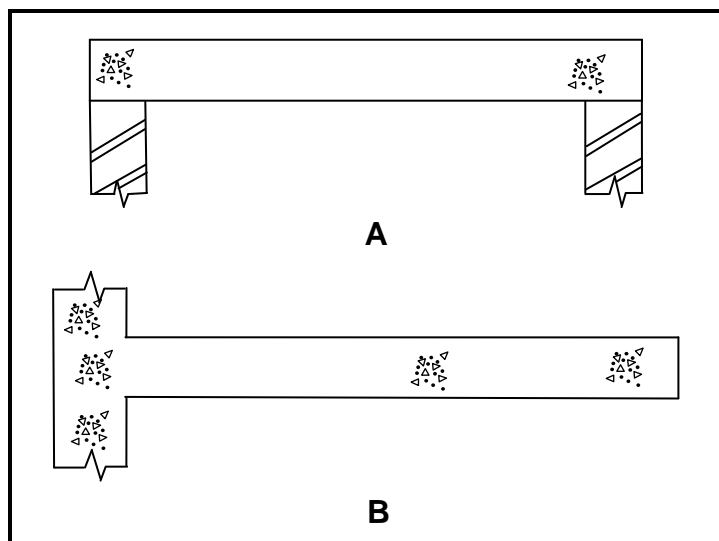


FIGURE 2.2

2.2.1 Name the type of beam in **A** and **B**. (2)

2.2.2 Explain where beams **A** and **B** will be used in construction. (2)

2.3 FIGURE 2.3 below shows different readings taken with a dumpy level. Study the given readings and answer the questions that follow.

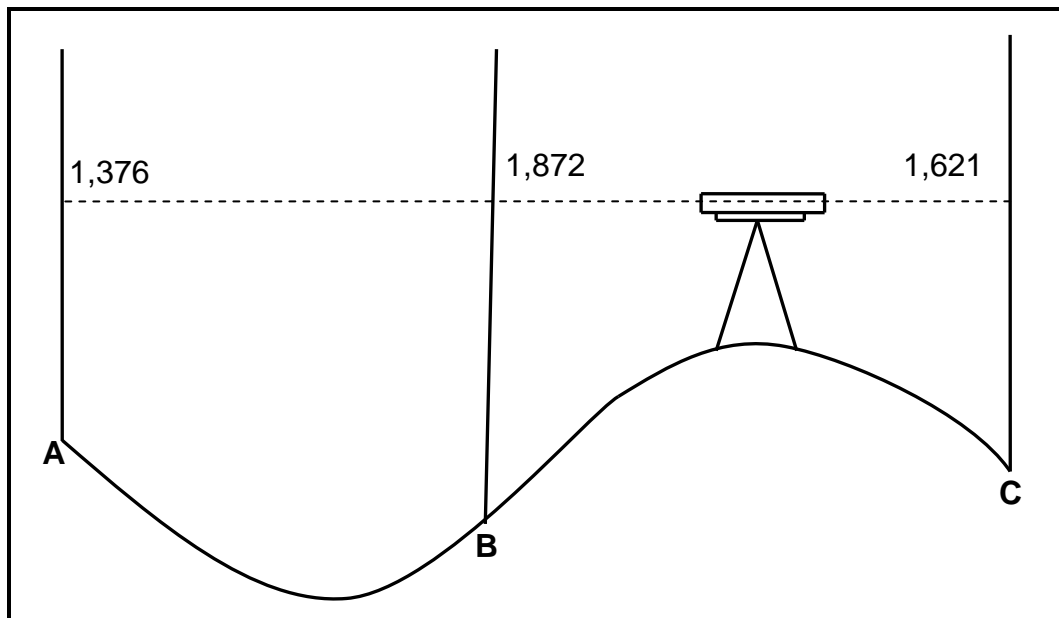


FIGURE 2.3

2.3.1 Calculate the difference in height between staff **A** and staff **B**. (2)

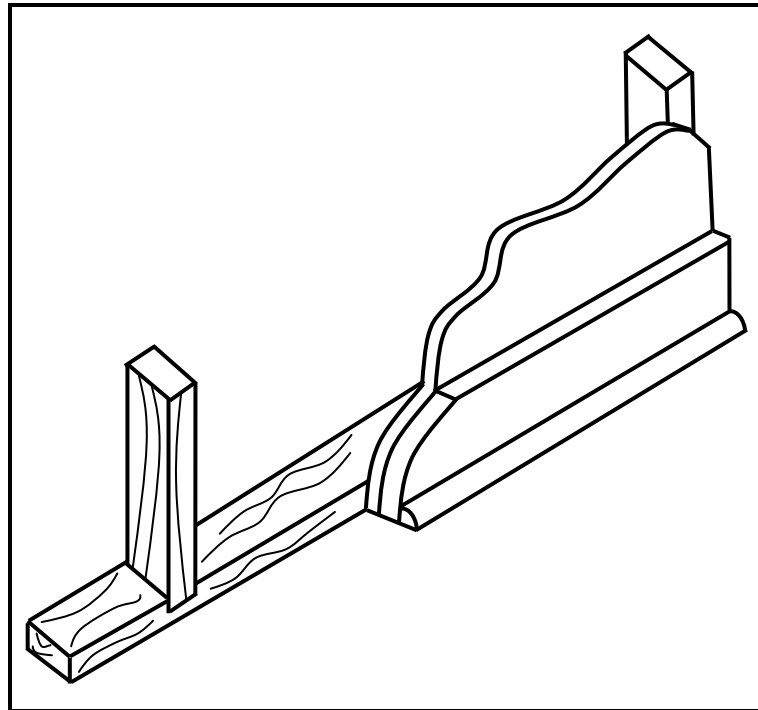
2.3.2 Calculate the difference in height between staff **B** and staff **C**. (2)

2.3.3 What is the reading at **B** called? (1)

2.3.4 Is there a rise or fall from **A** to **B**? (1)

2.4 Describe TWO uses of a dumpy level. (2)

2.5 FIGURE 2.5 shows an isometric view of a construction at the bottom of a dry wall construction. Do NOT redraw the sketch, but use it as a hint to answer QUESTION 2.5.1.



**FIGURE 2.5**

2.5.1 Using drawing instruments, draw a neat sketch of a vertical section through the bottom part of a dry wall construction showing how it is fixed to the concrete floor.

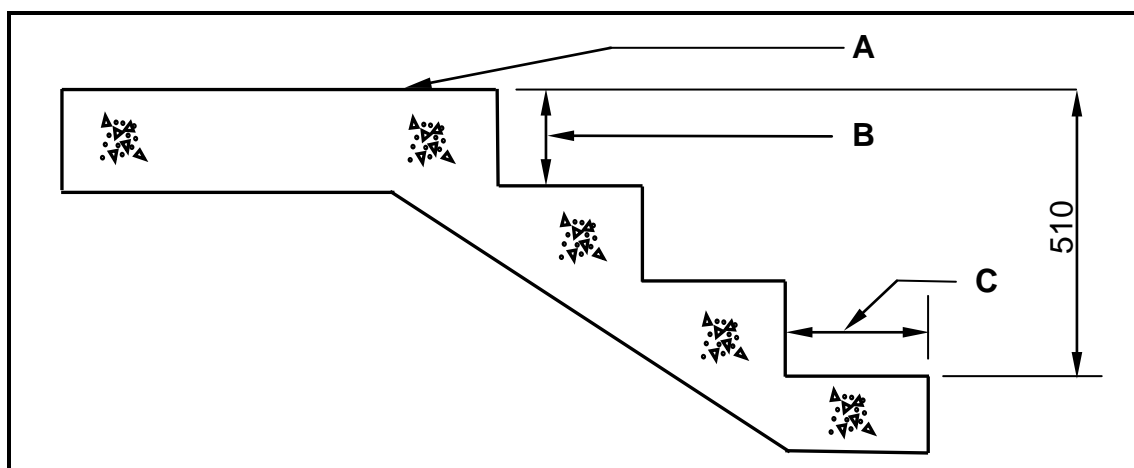
Show the following details:

- Concrete floor (1)
- Timber floor track (1)
- Screw or nail to fix timber track to floor (1)
- Timber strut (vertical) (1)
- Cladding (1)
- Skirting (1)
- Quadrant (1)

2.5.2 Show any TWO labels on your drawing. (2)

2.6 Explain how you will join rods in reinforced concrete structures before concrete is cast. (2)

2.7 FIGURE 2.7 below shows a drawing of a concrete staircase.



**FIGURE 2.7**

- 2.7.1 Name the parts labelled **A**, **B** and **C**. (3)
- 2.7.2 What is the height at **B**? (2)
- 2.7.3 What type of floor finishing would you recommend for this staircase? (1)
- [40]**

### QUESTION 3: CIVIL SERVICES

**Start the answer to this question on a NEW page.**

- 3.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.
- 3.1.1 A gulley is normally placed ... (1)
- A outside a building near a kitchen sink.
  - B in a toilet.
  - C near a storm water drain.
  - D at the overflow of a geyser.
- 3.1.2 The purpose of the pressure control valve of a geyser is to ... (1)
- A regulate water pressure in the geyser.
  - B regulate water entering the geyser.
  - C keep the water in the geyser warm.
  - D None of the above-mentioned
- 3.1.3 The diameter of the waste-water pipe of a sink should be ... (1)
- A 38 mm.
  - B 60 mm.
  - C 55 mm.
  - D 50 mm.

3.1.4 One method of making brackish borehole water fit for drinking is to ...

- A boil it.
- B add salt to it.
- C add sugar to it.
- D purify it with vinegar. (1)

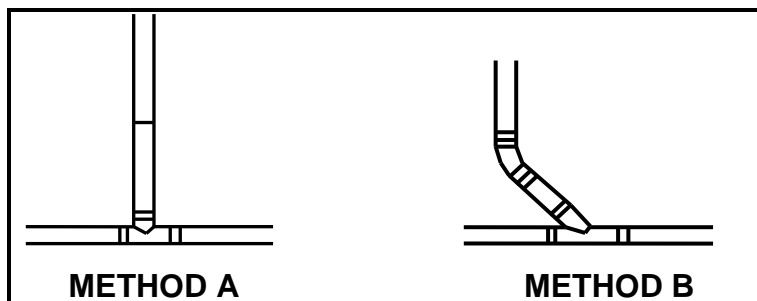
3.1.5 Copper pipes are joined by means of ...

- A welding.
- B soldering.
- C pop rivets.
- D PVC adhesives. (1)

3.2 Photovoltaic cells are an alternative means of generating electricity. Explain TWO advantages of using photovoltaic cells to generate electricity. (2)

3.3 Due to rising costs and constant electricity disruptions, more and more people are using gas appliances. Explain how gas appliances (such as gas water heaters) are maintained. (4)

3.4 FIGURE 3.4 below shows two methods used for the connection of sewerage pipes. Study the drawing and answer the questions that follow.

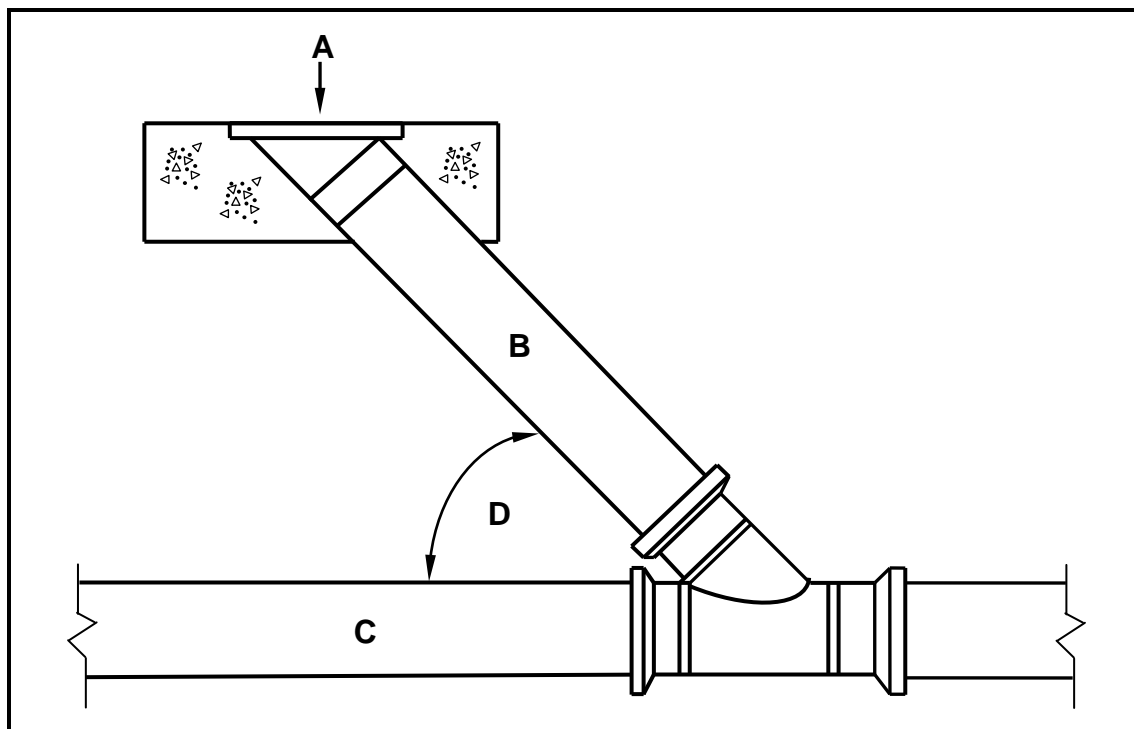


**FIGURE 3.4**

3.4.1 Identify the correct method (**A** or **B**) and explain why it is correct. (3)

3.4.2 Identify the incorrect method (**A** or **B**) and explain why it is incorrect. (3)

- 3.5 FIGURE 3.5 below shows part of a sewerage system. Analyse the illustration and answer the questions that follow.



**FIGURE 3.5**

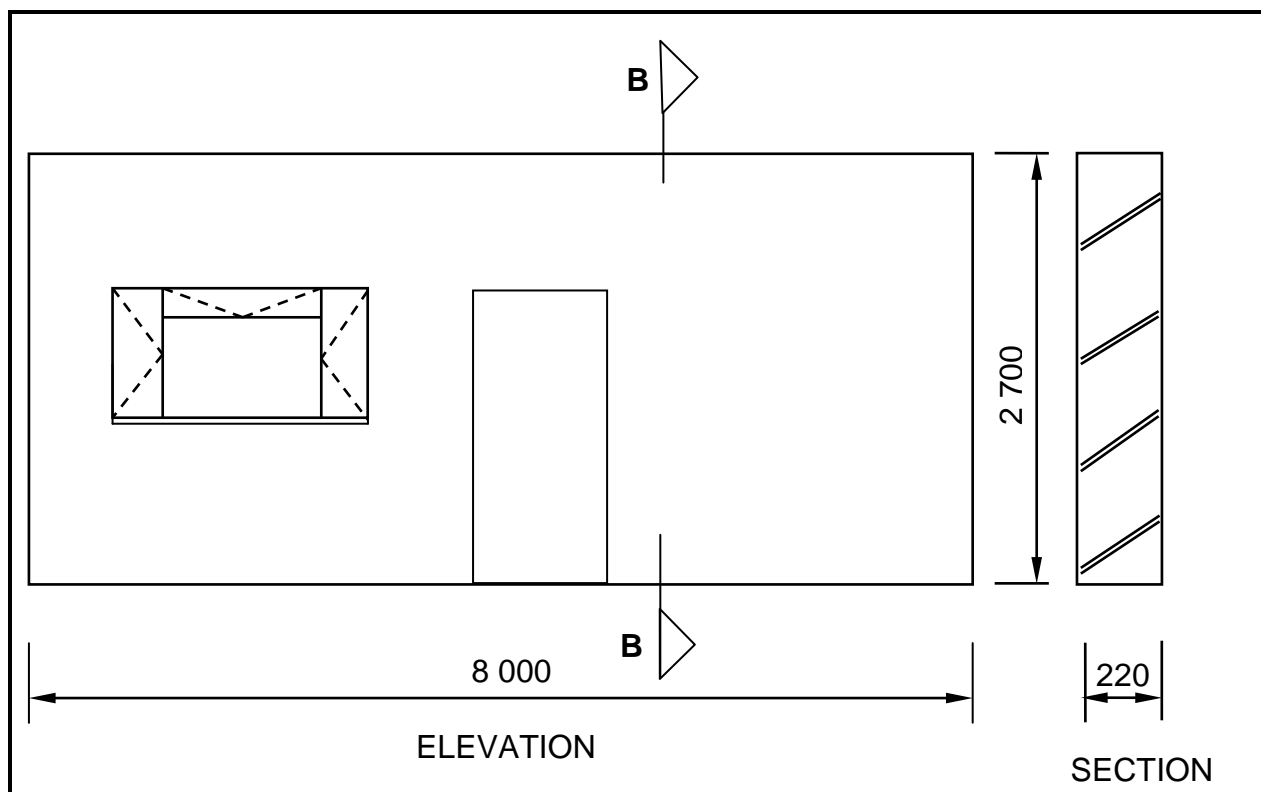
- 3.5.1 Explain why **A** is cast in concrete. (1)
- 3.5.2 What is the size of the angle between the two pipes indicated by **D**? (1)
- 3.5.3 Identify the letter indicating the branch pipe. (1)
- 3.5.4 Identify the letter indicating the main sewerage pipe. (1)
- 3.5.5 What material is used to manufacture the branch pipe? (1)
- 3.6 FIGURE 3.6 on ANSWER SHEET 3.6 shows a diagram of a plan view of a house. Draw the following electrical drawing symbols on ANSWER SHEET 3.6:
- 3.6.1 A one-way single-lever switch for bedrooms 1 and 2 (2)
- 3.6.2 A ceiling light for bedrooms 1 and 2 (2)
- 3.6.3 A single-tube fluorescent light for the kitchen (1)
- 3.6.4 A wall light against the outside of the outer wall of the lounge (1)
- 3.6.5 A socket outlet (power socket) in the TV room (1)
- 3.6.6 A meter box against the outside wall of the garage (1)
- [30]**

**QUESTION 4: MATERIALS AND QUANTITIES**

**Start the answer to this question on a NEW page.**

- 4.1 Indicate whether the following statements are TRUE or FALSE. Write only 'true' or 'false' next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.
- 4.1.1 Aluminium is used to make window and door frames. (1)
  - 4.1.2 Sanding sealer is applied on metals to prevent them from rusting. (1)
  - 4.1.3 All sliding doors must be fitted with safety glass. (1)
  - 4.1.4 Ferrous metals are metals that will not rust. (1)
  - 4.1.5 An alloy is a combination of two or more metals. (1)
- 4.2 Creosote is used for the preservation of timber (to make timber more durable).
- 4.2.1 Describe TWO advantages of applying creosote to timber. (2)
  - 4.2.2 Describe TWO disadvantages of applying creosote to timber. (2)
- 4.3 The cube test and slump test are used to test concrete.
- 4.3.1 State the property of concrete that is tested in a cube test. (1)
  - 4.3.2 State the property of concrete that is tested in a slump test. (1)
- 4.4 Steel roof trusses are made of metal sections of various profiles.
- 4.4.1 Name TWO profiles that steel is available in. (2)
  - 4.4.2 Make simple sketches to illustrate the cross section of the TWO profiles that you named in QUESTION 4.4.1. (2)

- 4.5 FIGURE 4.5 below shows the front elevation and vertical cross section of a part of a wall (superstructure only).



**FIGURE 4.5**

Specifications:

- 110 bricks are used to build one square metre of a 220 mm thick wall.
- The window is 1 800 mm wide and 1 200 mm high.
- The door opening is 2 000 mm x 1 000 mm.

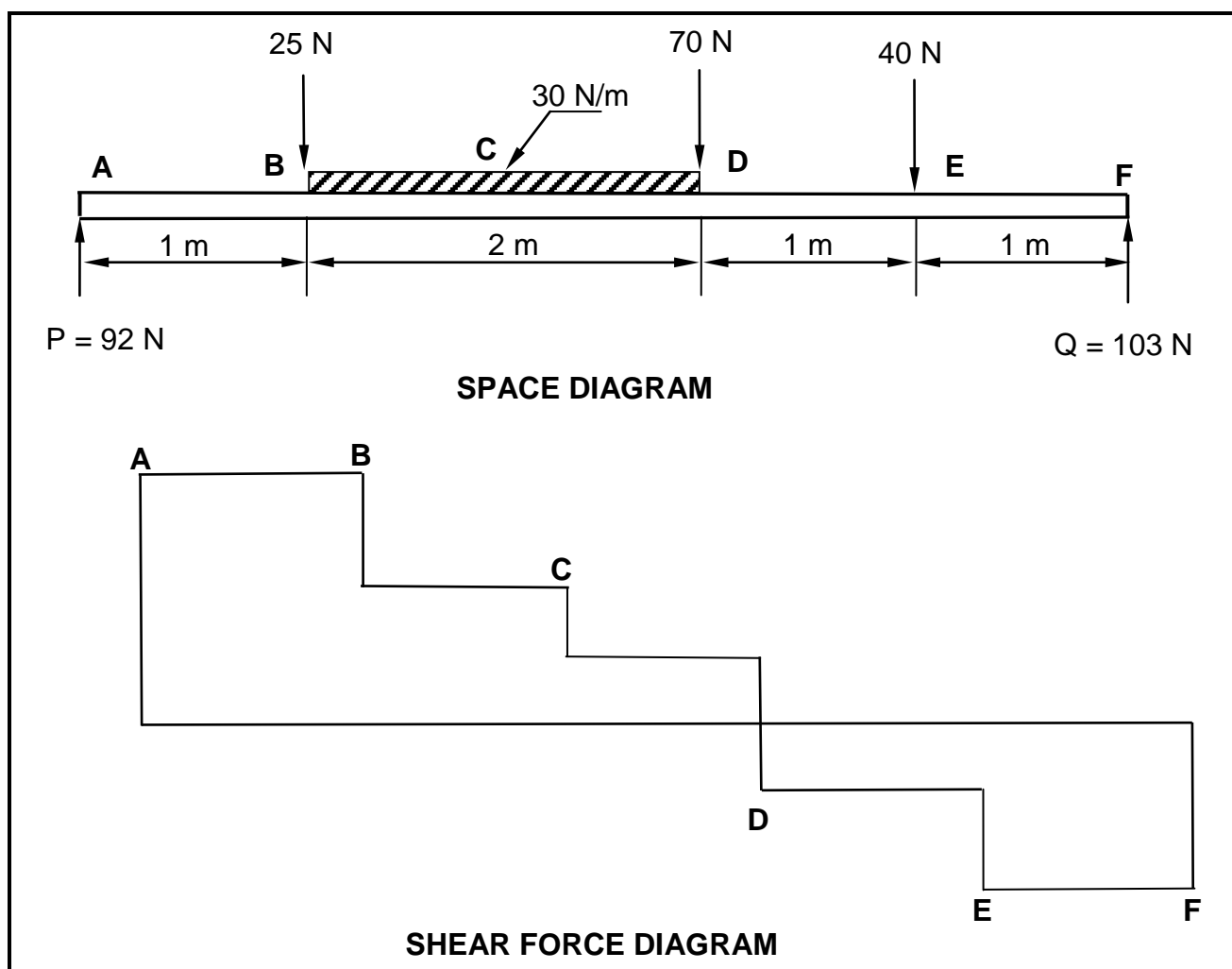
Use the specifications above and calculate the following on ANSWER SHEET 4.5:

- |       |  |             |
|-------|--|-------------|
| 4.5.1 | The total area of the wall, including the window (before deductions) | (4)         |
| 4.5.2 | The area of the window   | (3)         |
| 4.5.3 | The area of the door   | (3)         |
| 4.5.4 | The total wall area, excluding the window and door opening           | (1)         |
| 4.5.5 | The total number of bricks required to build the wall                | (4)         |
|       |  | <b>[30]</b> |

**QUESTION 5: APPLIED MECHANICS**

**Start the answer to this question on a new page.**

- 5.1 FIGURE 5.1 below shows the space and shear force diagrams of a beam with TWO point loads and ONE uniformly distributed load. Analyse the diagrams and answer the questions that follow.



**FIGURE 5.1**

- 5.1.1 What will a suitable scale be for the space diagram to fit on a sheet of A4 paper? (2)
- 5.1.2 Convert the uniformly distributed load to a point load and write down the value of the converted point load. (1)
- 5.1.3 Deduce the value of the point load at **D** from the space diagram. (1)
- 5.1.4 Deduce the value of the uniformly distributed load at **D**. (1)
- 5.1.5 Determine the distance of the converted uniformly distributed load, that is now a point load (QUESTION 5.1.2), from **A**. (1)

- 5.1.6 Prove, by means of calculation, that the beam is in equilibrium (2)
- 5.1.7 Deduce the value of the shear force at **A** ( $SF_a$ ). (1)
- 5.1.8 Prove, by means of calculation, that the value of the shear force at **B** ( $SF_b$ ) is 67 N. (2)
- 5.1.9 Prove, by means of calculation, that the value of the shear force at **E** ( $SF_e$ ) is -103 N. (2)
- 5.1.10 Prove, by means of calculation, that the value of the shear force at **F** ( $SF_f$ ) is 0 N. (2)
- 5.1.11 Is there an error in the shape of the shear force diagram? Answer only YES or NO. (1)

5.2 FIGURE 5.2 below shows a figure of a shaped lamina.

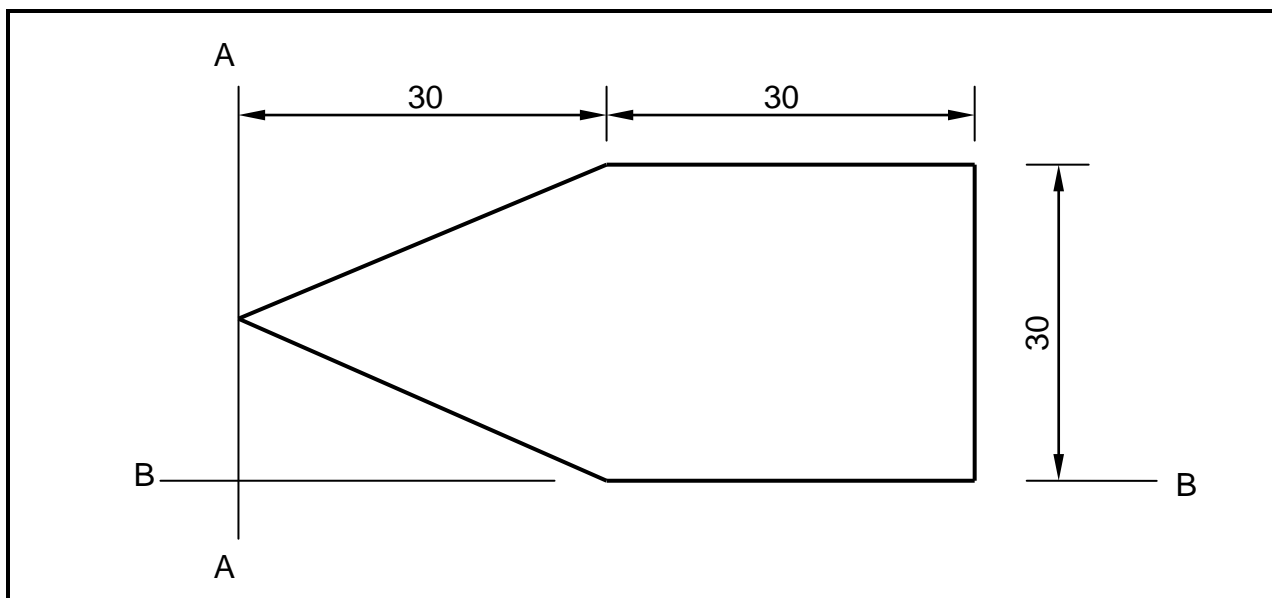


FIGURE 5.2

- 5.2.1 Calculate the position of the centroid of the lamina from **A–A**. (12)
- 5.2.2 Deduce the position of the centroid from **B–B** from FIGURE 5.2. Round off your answer to TWO decimal places. (2)

[30]

**QUESTION 6: GRAPHIC COMMUNICATION**

6.1 Use ANSWER SHEET 6.1 and draw, to scale 1 : 20, the front elevation of a king post roof truss of which all members are joined with gang nails.

6.1.1 Use the following specifications:

- Pitch of truss:  $30^\circ$
- Length of tie beam: 4 metres (4 000 mm)
- All timber for roof truss: 114 mm x 38 mm
- Eaves overhang: 300 mm

(10)

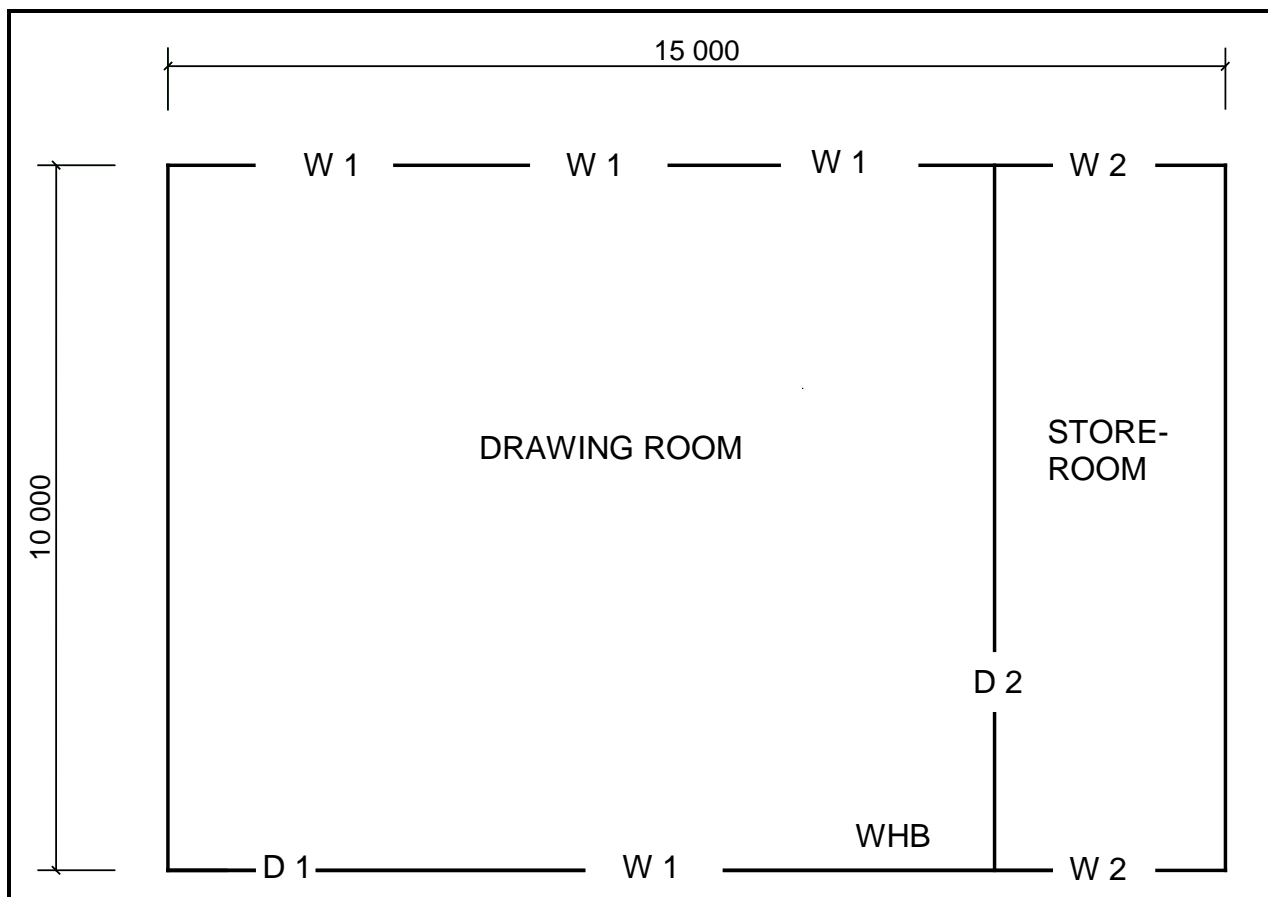
6.1.2 Show any THREE labels on the drawing.

(3)

6.1.3 Print the title and scale below the drawing.

(2)

6.2 A line diagram of the floor plan of a drawing room with a storeroom is shown in FIGURE 6.2 below. The overall length of the building is 15 m and the overall width is 10 m (external measurements).

**FIGURE 6.2**

6.2.1 Draw the floor plan of the drawing room to scale 1 : 100 on ANSWER SHEET 6.2.

- 6.2.2 Draw the windows and doors on the floor plan in the spaces as indicated on the line diagram.

Specifications/Measurements of the drawing room:

- Use measurements as shown on the line diagram.
- Inside measurements of the storeroom are 9 560 mm x 3 000 mm.
- External walls are 220 mm thick.
- Internal walls are 110 mm thick.

	WIDTH	HEIGHT
Window 1 (W1)	2 000 mm	1 200 mm
Window 2 (W2)	1 500 mm	600 mm
Door 1 (D1)	900 mm	2 000 mm

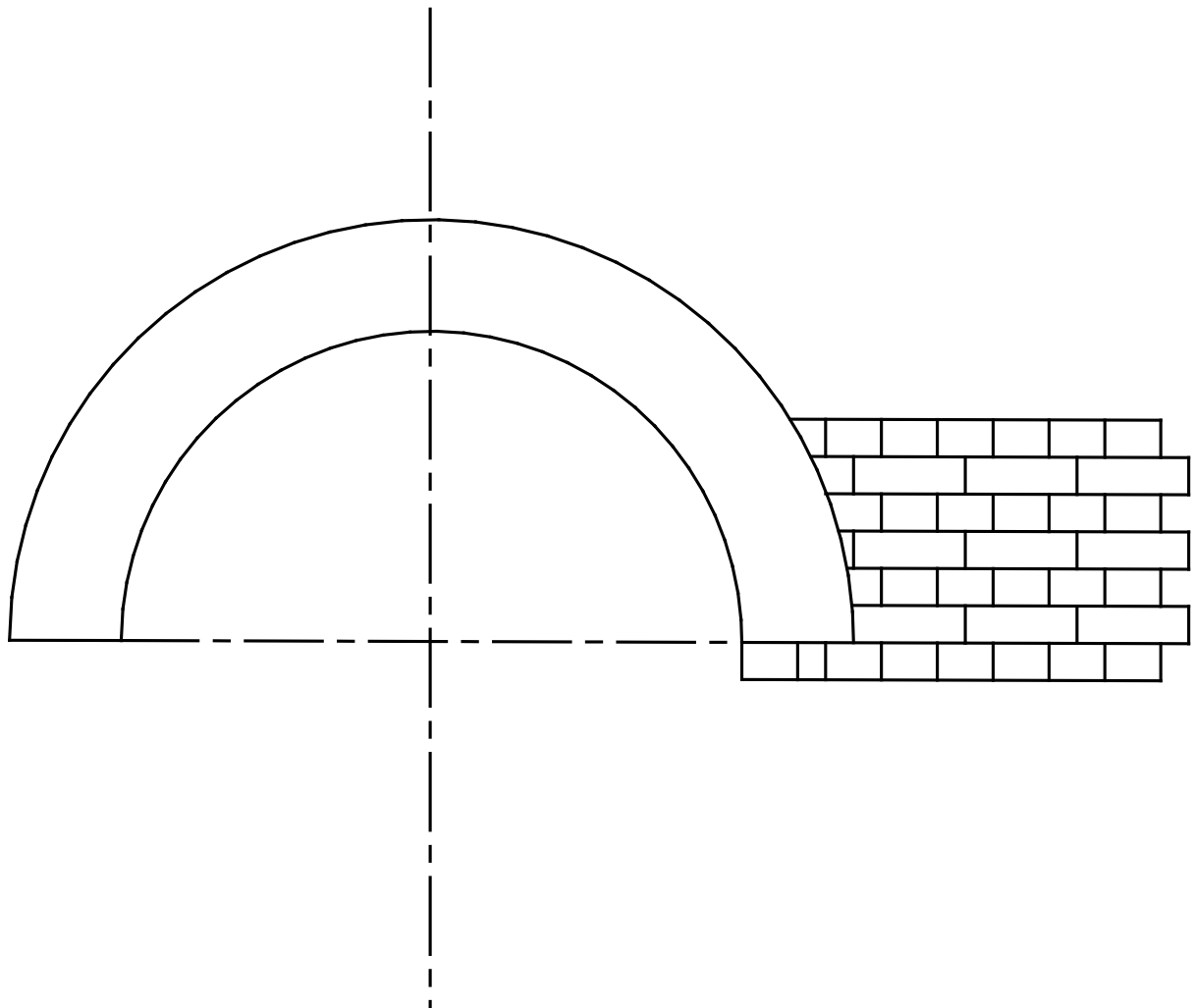
- 6.2.3 Draw the drawing symbol for a wash hand basin on your floor plan in the space as indicated on the line diagram.
- 6.2.4 Design and draw a gable roof in dashed lines on your floor plan on ANSWER SHEET 6.2.
- 6.2.5 Show TWO dimensions on the southern side of the drawing room.
- 6.2.6 Insert the title and scale. (25)

**[40]**

**TOTAL: 200**

**ANSWER SHEET 1.2****CENTRE NUMBER:****EXAMINATION NUMBER:****QUESTION 1.2**

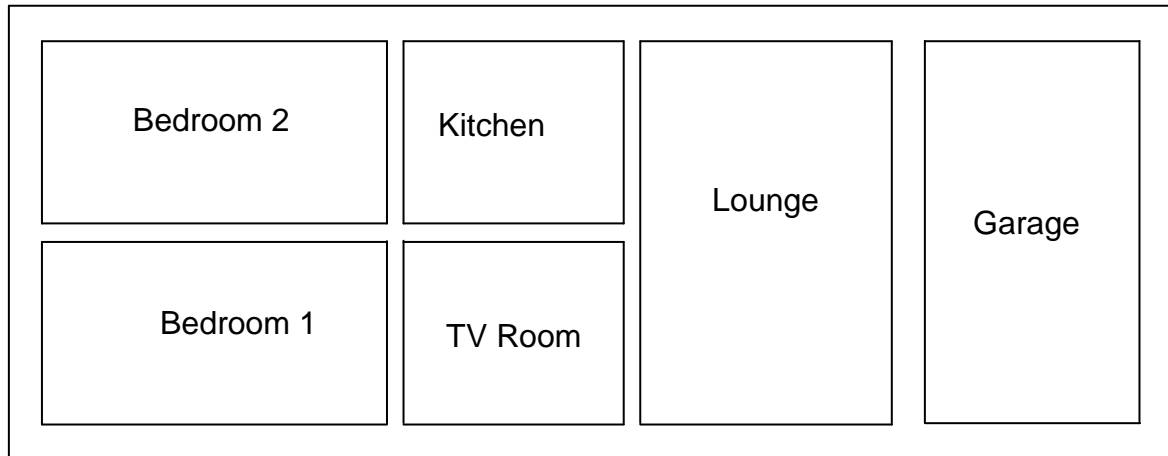
ASSESSMENT CRITERIA	MARK	MARK
Voussoirs	3	
Key voussoir (brick)	1	
Rise	1	
Span	1	
Intrados	1	
Extrados	1	
English bond	1	
<b>TOTAL</b>	<b>9</b>	

**FIGURE 1.2**

**ANSWER SHEET 3.6**

<b>CENTRE NUMBER:</b>								
-----------------------	--	--	--	--	--	--	--	--

<b>EXAMINATION NUMBER:</b>													
----------------------------	--	--	--	--	--	--	--	--	--	--	--	--	--

**QUESTION 3.6****FIGURE 3.6**

**ANSWER SHEET 4.5**

<b>CENTRE NUMBER:</b>									
-----------------------	--	--	--	--	--	--	--	--	--

<b>EXAMINATION NUMBER:</b>													
----------------------------	--	--	--	--	--	--	--	--	--	--	--	--	--

**QUESTION 4.5**

A	B	C	D
			Area of wall
			Area of window
			Area of door
			Total area of wall excluding window and door opening
			Number of bricks required (use 110 bricks for 1 m <sup>2</sup> of 220 mm thick wall)

**(15)**

**ANSWER SHEET 6.1**

<b>CENTRE NUMBER:</b>								
-----------------------	--	--	--	--	--	--	--	--

<b>EXAMINATION NUMBER:</b>													
----------------------------	--	--	--	--	--	--	--	--	--	--	--	--	--

**QUESTION 6.1**

ASSESSMENT CRITERIA	MARK	MARK
Rafter	2	
King post	1	
Tie beam	1	
Title	1	
Scale in print	1	
Neatness	2	
Application of scale	4	
Labels	3	
<b>TOTAL</b>	<b>15</b>	

ANSWER SHEET 6.2

CENTRE NUMBER:									
----------------	--	--	--	--	--	--	--	--	--

EXAMINATION NUMBER:														
---------------------	--	--	--	--	--	--	--	--	--	--	--	--	--	--

QUESTION 6.2

ASSESSMENT CRITERIA	MARKS	MARK
External walls	4	
Internal walls	1	
Windows	6	
Doors	2	
Roof line	5	
WHB	1	
Print title and scale	2	
Dimensions	2	
Application of scale	1	
Neatness	1	
TOTAL	25	



**FORMULA SHEET****IMPORTANT ABBREVIATIONS**

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
g	Centre of gravity	h	Height	d	Diameter
c	Centroid	b	Breadth/Width	r	Radius
ℓ	Length	s	Side	A	Area
π	Pi = $\frac{22}{7}$ = 3,142	Ø	Diameter	V	Volume

**FORMULAE**

AREA OF	FORMULA (in words)	FORMULA (in symbols)	FORMULA FOR THE POSITION OF CENTROID	
			X-axis	Y-axis
Square	Side x Side	s x s	$\frac{s}{2}$	$\frac{s}{2}$
Rectangle	Length x Breadth	ℓ x b	$\frac{\ell}{2}$	$\frac{b}{2}$
Right-angled triangle	$\frac{1}{2}$ x base x height	$\frac{1}{2}b \times h$	$\frac{b}{3}$	$\frac{h}{3}$
Equilateral triangle/ Pyramid	$\frac{1}{2}$ x base x height	$\frac{1}{2}b \times h$	$\frac{b}{2}$	$\frac{h}{3}$
Circle	π x radius x radius	$\pi r^2$	Centroid is in the centre	
Circle	π x diameter x diameter divided by 4	$\frac{\pi d^2}{4}$		
Semi-circle	π x radius x radius divided by 2	$\frac{\pi r^2}{2}$	Centroid is 0,424r on the centre line	

$$\text{Position of centroid} = \frac{(A_1 \times d) \pm (A_2 \times d)}{\text{Total area}}$$

**OR**

$$X = \frac{\sum Ax}{\sum A}$$