



# basic education

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Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 12**

**CIVIL TECHNOLOGY**

**NOVEMBER 2015 (R)**

**MARKS: 200**

**TIME: 3 hours**

**This question paper consists of 19 pages, 8 answer sheets and a 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 subsections of questions.
4. Start the answer to EACH question on a NEW page.
5. Do NOT write in the margin of the ANSWER BOOK.
6. You may use sketches to illustrate your answers.
7. Write ALL calculations and answers 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. Make drawings and sketches in pencil, fully dimensioned and neatly finished off with descriptive titles and notes to conform to the *SANS/SABS Code of Practice for Building Drawings*.
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 own discretion where dimensions and/or details have been omitted.
12. Answer QUESTIONS 1.10.1, 1.11.4, 1.11.5, 2.10, 4.3, 5.2, 5.3, 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. Due to electronic transfer, drawings in the question paper are NOT to scale.

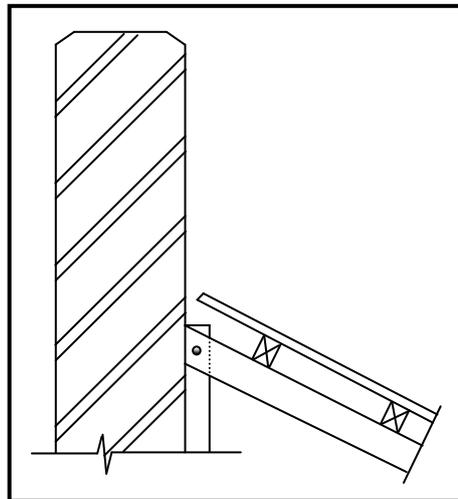
**QUESTION 1: CONSTRUCTION, SAFETY AND MATERIALS**

- 1.1 FIGURE 1.1 below shows a building site. Recommend TWO arrangements that a safety officer should make to prevent accidents such as those in the picture.

**FIGURE 1.1**

- (2)
- 1.2 Describe TWO safety measures that must be adhered to when using a crosscut saw. (2)
- 1.3 Explain ONE safety regulation to protect the public when excavations are done. (1)
- 1.4 If you want to preserve plastic objects you can either paint them with a brush or use spray paint. Recommend the best method to use. Motivate your answer. (2)
- 1.5 Differentiate between an *I-beam* and an *H-beam* by drawing a two-dimensional line diagram of each. (2)
- 1.6 Describe ONE function of admixtures in concrete. (1)
- 1.7 Name ONE admixture that can be used in concrete. (1)
- 1.8 Describe TWO disadvantages of a thatched roof. (2)
- 1.9 Name TWO types of roof covering that are commonly used, other than thatched roof covering. (2)

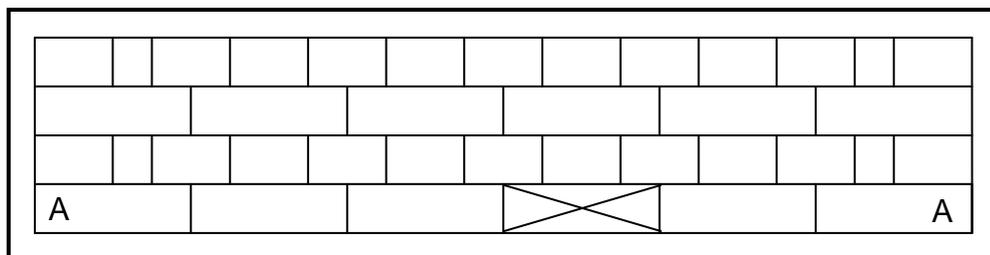
1.10 FIGURE 1.10 below shows a section through a brick parapet wall with a lean-to roof.



**FIGURE 1.10**

- 1.10.1 Draw, on ANSWER SHEET 1.10, the flashing where the roof is joined to the wall. (2)
- 1.10.2 Name ONE type of material that can be used as flashing. (1)
- 1.10.3 Explain the purpose of flashing if installed in FIGURE 1.10. (1)

1.11 FIGURE 1.11 below shows the front elevation of a one-brick wall. Study the drawing and answer the questions that follow.



**FIGURE 1.11**

- 1.11.1 Identify the bond used to build the wall. (1)
- 1.11.2 State TWO properties of the bond used to build the wall. (2)
- 1.11.3 Describe in your own words how a wall can be finished after being plastered. (1)
- 1.11.4 Draw the end view of this wall on ANSWER SHEET 1.11. (2)
- 1.11.5 Use ANSWER SHEET 1.11 and project and draw, from the given front elevation, the plan course of a T-junction of course AA. The T-junction is from the fourth brick from the left-hand side of the drawing, as indicated by the cross. (4)

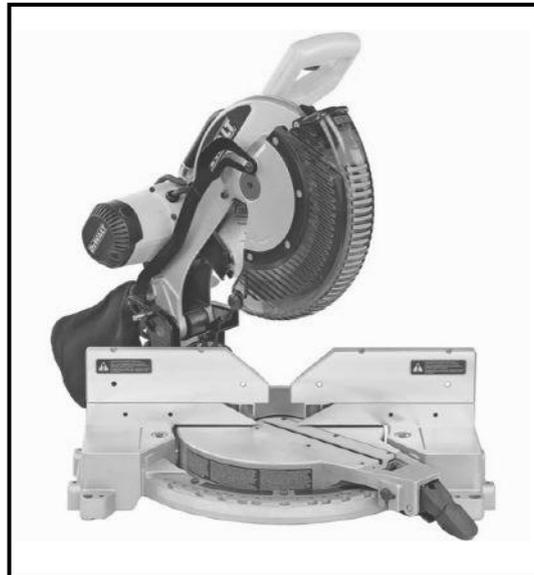
1.12 Name ONE material that can be used as ceiling boards. (1)

**[30]**

**QUESTION 2: ADVANCED CONSTRUCTION AND EQUIPMENT**

Start this question on a NEW page.

2.1 FIGURE 2.1 below shows a power tool used on a construction site.



**FIGURE 2.1**

2.1.1 Identify the power tool in FIGURE 2.1. (1)

2.1.2 Explain ONE use of this power tool. (1)

2.1.3 Justify the use of the equipment in FIGURE 2.1 instead of a hand saw. (2)

2.2 Explain how you will use a transparent pipe level to transfer levels from one point to another. (2)

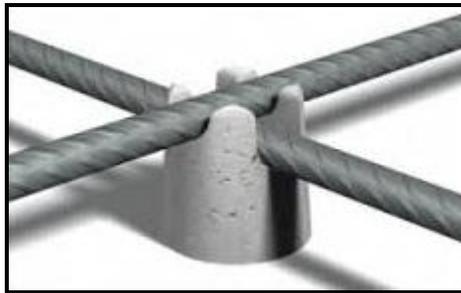
2.3 FIGURE 2.3 below shows a portable generator. Explain, in your own words, the purpose of a generator on a building site.



**FIGURE 2.3**

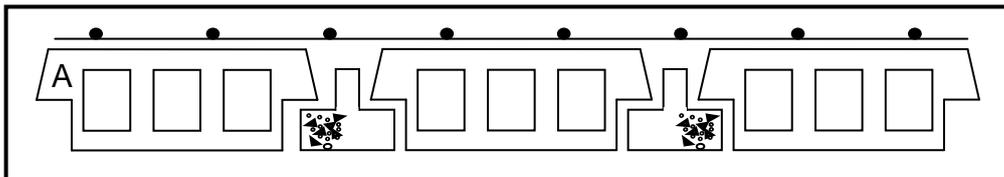
(1)

- 2.4 FIGURE 2.4 below shows a component used in reinforced concrete structures.



**FIGURE 2.4**

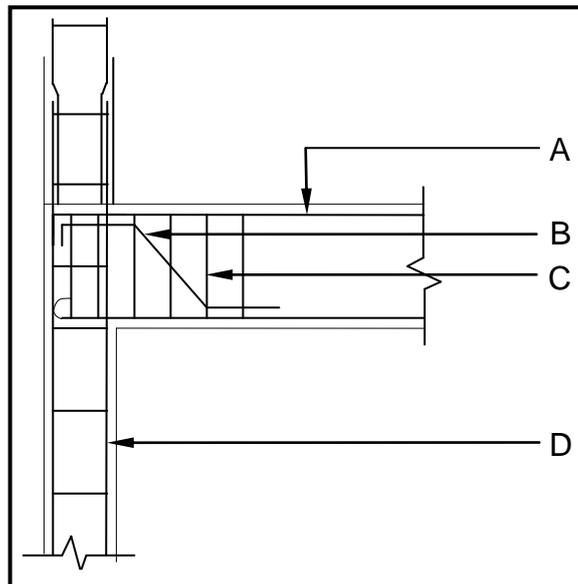
- 2.4.1 Identify the component in FIGURE 2.4 (NOT the steel bars). (1)
- 2.4.2 Describe the purpose of the component in FIGURE 2.4 (NOT the steel bars). (1)
- 2.5 FIGURE 2.5 below shows an incomplete elevation of a type of suspended floor construction.



**FIGURE 2.5**

- 2.5.1 Name the type of floor construction in FIGURE 2.5. (1)
- 2.5.2 Block **A** in this type of floor construction can be made of concrete or polystyrene. Describe TWO advantages of using polystyrene blocks instead of concrete blocks. (2)
- 2.5.3 Justify why you would rather use the type of floor construction in FIGURE 2.5 than an in situ cast suspended floor. (3)
- 2.6 Arches can be built in three basic shapes.
- 2.6.1 Name any TWO shapes in which arches can be built. (2)
- 2.6.2 Give the name of the last brick that is laid when building an arch. (1)
- 2.7 Differentiate between the purpose of a *slump test* and that of a *cube test*. (2)

2.8 FIGURE 2.8 below shows the front elevation of the reinforcement of a beam and column.

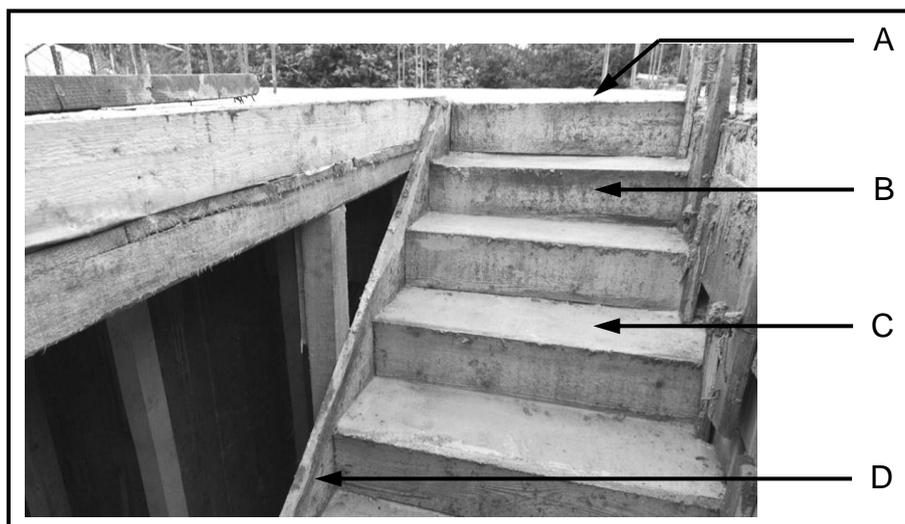


**FIGURE 2.8**

2.8.1 Name parts **A** to **D**. (4)

2.8.2 Justify why you would use ribbed bars rather than plain round bars as reinforcement. (1)

2.9 FIGURE 2.9 below shows the formwork for a concrete staircase. Study the picture and answer the questions that follow.



**FIGURE 2.9**

2.9.1 Identify part **A**. (1)

2.9.2 Recommend a suitable height for the rise at **B**. (1)

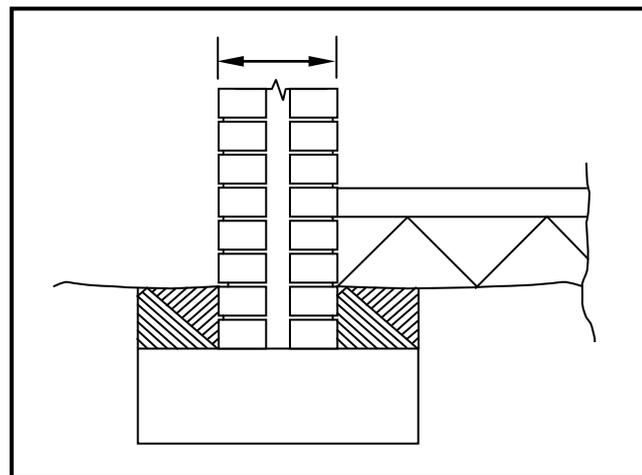
2.9.3 Identify part **C**. (1)

2.9.4 Identify part **D**. (1)

- 2.10 FIGURE 2.10 below shows an incomplete sectional view of a cavity wall with a cavity of 50 mm between the walls.

Use ANSWER SHEET 2.10 to draw the following:

- The symbol for a concrete foundation and concrete floor (1)
- The damp-proof course between the walls and the cavity (2)
- The damp-proof under the concrete floor (2)
- The weep hole (1)
- The concrete in the cavity wall (1)
- The wall tie (1)
- Show the dimension of the total width of the wall. (1)



**FIGURE 2.10**

- 2.11 Name the type of foundation that will be used when ground conditions are not suitable to use normal strip foundation. (1)
- 2.12 A large open space in a multi-storey building needs to be converted into offices. The floor cannot support the load of brick walls. Recommend a type of light-weight wall that can be used. (1)

**[40]**

**QUESTION 3: CIVIL SERVICES**

Start this question on a NEW page.

- 3.1 Choose a description from COLUMN B that matches an item in COLUMN A. Write only the letter (A–I) next to the question number (3.1.1–3.1.7) in the ANSWER BOOK, for example 3.1.8 J.

COLUMN A		COLUMN B	
3.1.1	Inspection eye	A	it is installed at a water closet at the highest point of a site sewerage system
3.1.2	Ventilation pipe		
3.1.3	Rodding eye	B	it is installed at points where drainpipes change direction and where several sewer pipes meet
3.1.4	Manhole		
3.1.5	French drain	C	a simple removable cover where a branch pipe and a main sewer pipe meet
3.1.6	Septic tank		
3.1.7	Conservancy tank	D	a trench filled with stones and covered with a layer of sand
		E	it is installed at least every 25 m along a site drainage system where no manhole is placed
		F	it stores sewage until it can be removed by the municipality
		G	the breakdown of solid human waste occurs by means of anaerobic bacterial action in this system
		H	it is placed every 50 m along a sewerage system
		I	it should be cleaned regularly with chemicals

(7 x 1) (7)

- 3.2 Predict the consequence of not installing the following in a sewerage system:

3.2.1 A gully (1)

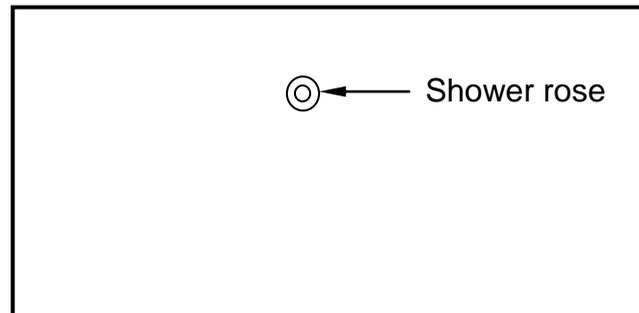
3.2.2 A rodding eye or manhole (1)

- 3.3 Name TWO methods that can be used to provide hot water to a household. (2)

- 3.4 Describe ONE method that is used in South Africa to extract water from a borehole. (1)
- 3.5 Name ONE other source that will supply water for human consumption. (1)
- 3.6 FIGURE 3.6 below shows the front elevation of a shower rose without the pipes and taps. (1)

Draw, in your ANSWER BOOK, a single-line diagram to show the basic cold and hot water pipe layout for a shower. Show the following in your drawing:

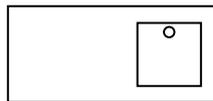
- Cold-water inlet pipe
- Hot-water inlet pipe
- Hot- and cold-water taps (no mixer tap)
- Supply pipe to the shower rose
- Water flow direction from the taps to the shower rose



**FIGURE 3.6**

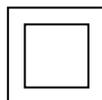
- 3.7 Identify the following drawing symbols: (5)

3.7.1



(1)

3.7.2



(1)

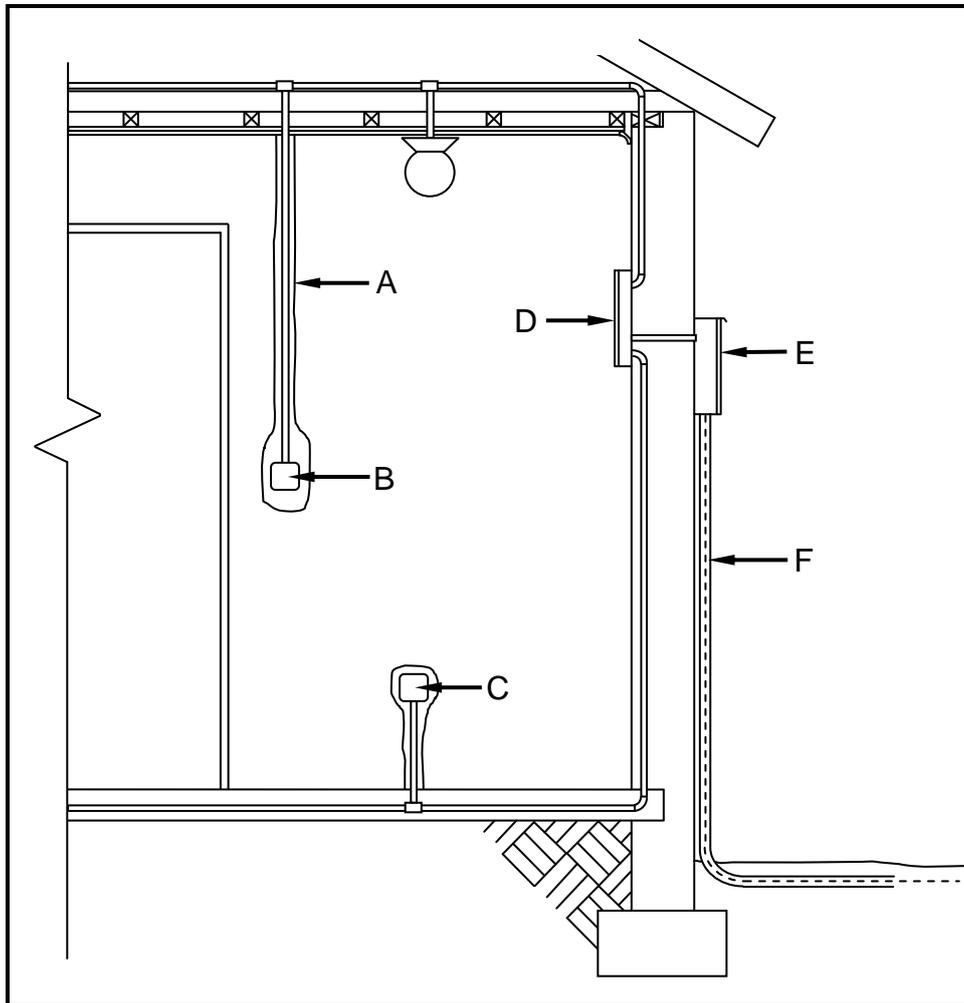
3.7.3



(1)

- 3.8 Explain how you, as a property owner, will ensure that large quantities of storm water are channelled to the municipal connection. (2)

3.9 FIGURE 3.9 below shows the electrical layout of a house. Study the illustration and answer the questions that follow.



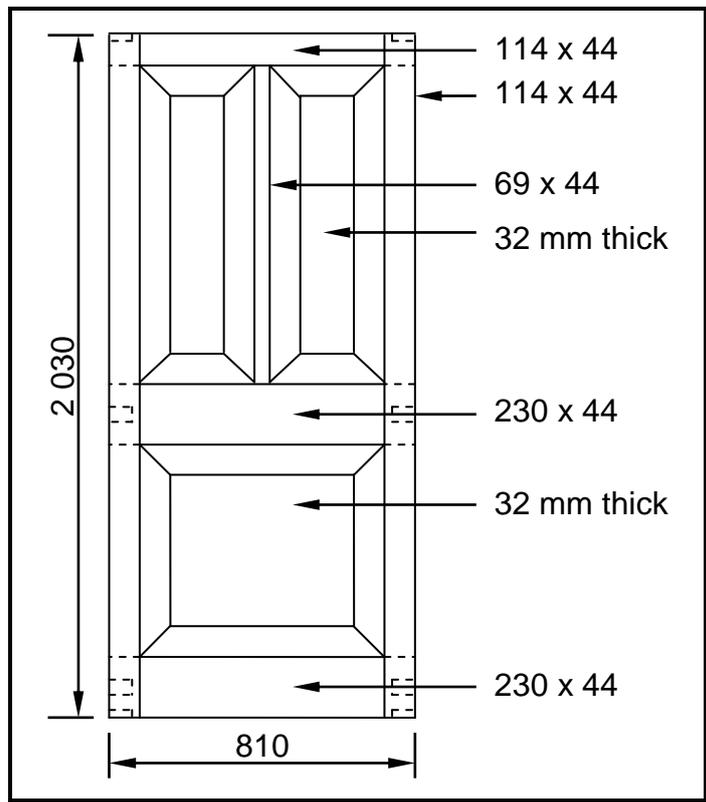
**FIGURE 3.9**

- 3.9.1 Name the method that is used to install the conduit indicated at **A**. (1)
- 3.9.2 Name the electrical fitting that can be installed at **B**. (1)
- 3.9.3 Identify parts **C**, **D** and **E**. (3)
- 3.9.4 Explain what the purpose of **F** is. (1)
- 3.9.5 Draw the drawing symbol for **E**. (1)
- [30]**

**QUESTION 4: QUANTITIES, MATERIALS AND JOINING**

Start this question on a NEW page.

4.1 FIGURE 4.1 below shows the front view of a three-panel door. Study the drawing and complete the incomplete cutting list below. Write only the answer next to the question number (4.1.1–4.1.7) in the ANSWER BOOK.



**FIGURE 4.1**

MEMBER	QUANTITY	UNIT	LENGTH	WIDTH	THICKNESS	MATERIAL
Stile	4.1.1	mm	2 032	114	44	Meranti
Top rail	1	mm	810	4.1.2	4.1.3	Meranti
4.1.4	1	mm	1 050	69	44	Meranti
Lock rail	1	mm	4.1.5	230	44	Meranti
Raised and fielded panel	1	mm	540	630	4.1.6	Meranti
Bottom rail	1	mm	810	4.1.7	44	Meranti

(7)

4.2 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 (4.2.1–4.2.8) in the ANSWER BOOK, for example 4.2.9 C.

- 4.2.1 The area of a gable wall with a height of 2 000 mm and a width of 7 000 mm is ...
- A 28 m<sup>2</sup>
  - B 18 m<sup>2</sup>
  - C 7 m<sup>2</sup>
  - D 21 m<sup>2</sup>
- (1)
- 4.2.2 If the length of a foundation is 6 m, the width 0,6 m and the depth 0,3 m, then the volume of concrete needed will be ...
- A 2,1 m<sup>3</sup>
  - B 1,08 m<sup>3</sup>
  - C 1,8 m<sup>3</sup>
  - D 1,5 m<sup>3</sup>
- (1)
- 4.2.3 ... is/are used to join wall plates to walls.
- A Rawl bolts
  - B Countersunk screws
  - C Steel nails
  - D Hoop iron
- (1)
- 4.2.4 ... is a type of nail used to attach ceiling boards to the brandering.
- A Clout nails
  - B Cut nails
  - C Wire nails
  - D Oval wire nails
- (1)
- 4.2.5 ... is a material used to join copper pipes.
- A Brazing rod
  - B Welding rod
  - C Grease
  - D Solder
- (1)
- 4.2.6 ... is/are used to join the members of a timber roof truss.
- A Screws
  - B Clout nails
  - C Rawl bolts
  - D Gang nails/A connector plate
- (1)

4.2.7 ... are used to attach knotty pine planks to the ceiling battens.

- A Panel pins
- B Clout nails
- C Wire nails
- D Cut nails

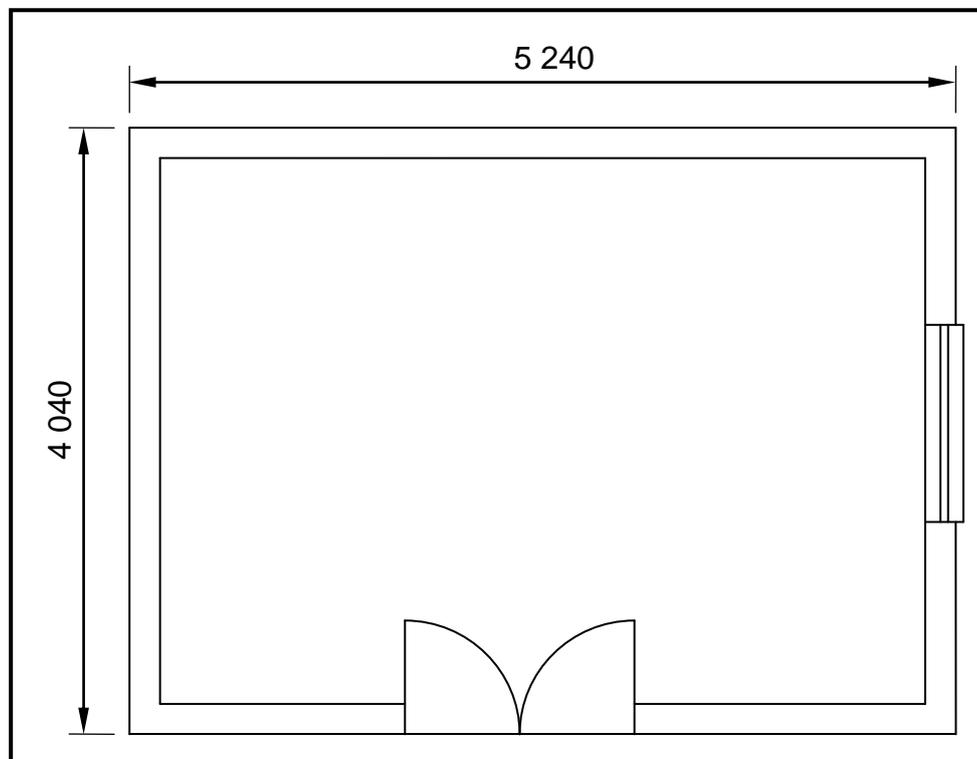
(1)

4.2.8 ... can be used to join sewer pipes.

- A PVC glue
- B PVA glue
- C A compression joint
- D All the above-mentioned

(1)

4.3 FIGURE 4.3 below shows the floor plan of a store room.



**FIGURE 4.3**

**SPECIFICATIONS:**

- Outside measurements of the store room: 5 240 mm x 4 040 mm
- Width of the walls: 220 mm
- Dimensions of a ceiling board: 2 400 mm x 900 mm

Use ANSWER SHEET 4.3 and calculate the following:

4.3.1 The internal measurements of the store room

(6)

4.3.2 The internal area of the store room

(3)

4.3.3 The number of ceiling boards needed for the store room

(6)

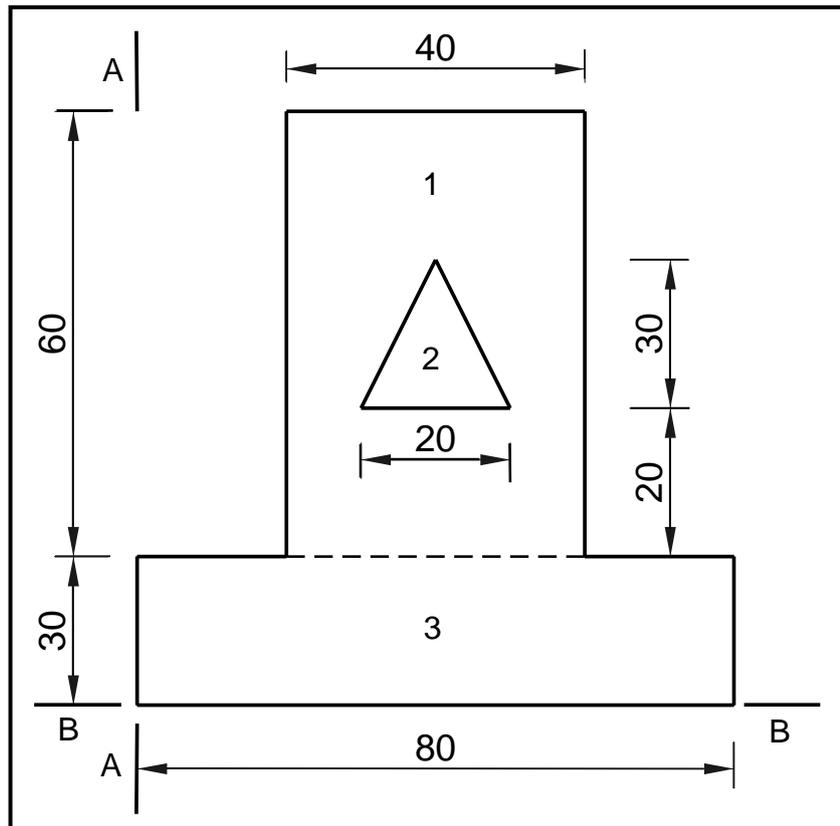
**[30]**

**QUESTION 5: APPLIED MECHANICS**

Start this question on a NEW page.

- 5.1 FIGURE 5.1 below shows a shaped lamina with an isosceles triangular hole. All dimensions are in millimetres. Study the lamina and answer the questions that follow.

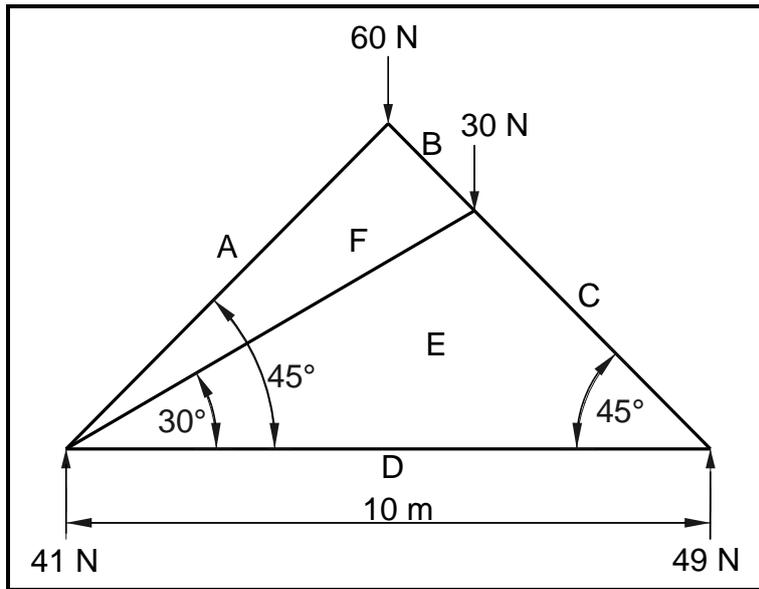
**HINT:** Use the formulae on the FORMULA SHEET.



**FIGURE 5.1**

- 5.1.1 Calculate the area of part 1. (1)
- 5.1.2 Calculate the area of part 2. (1)
- 5.1.3 Calculate the area of part 3. (1)
- 5.1.4 Calculate the total area of the lamina. (1)
- 5.1.5 Calculate the position of the centroid of part 2 from A–A. (1)
- 5.1.6 Calculate the position of the centroid of part 1 from B–B. (1)
- 5.1.7 Calculate the position of the centroid of part 2 from B–B. (1)
- 5.1.8 Deduce, from FIGURE 5.1, the position of the centroid of the whole lamina from A–A. (1)

5.2 FIGURE 5.2 below shows the space diagram of a roof frame.

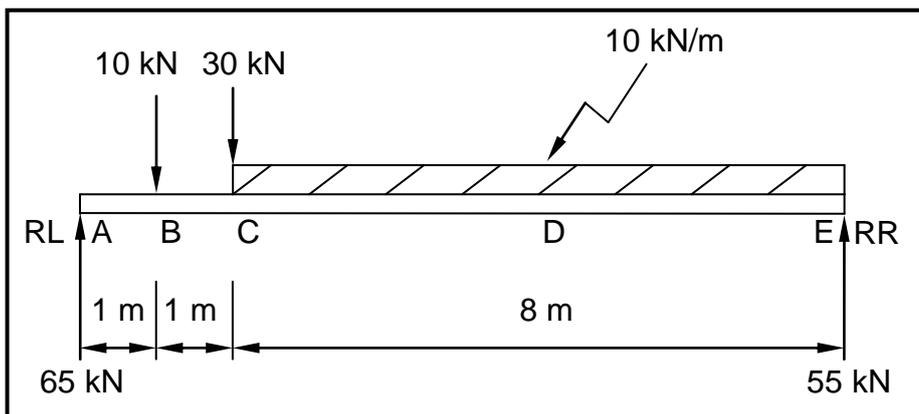


**FIGURE 5.2**

5.2.1 On ANSWER SHEET 5.2, develop and draw a vector diagram to graphically determine the magnitude and nature of the forces in each member (part) of the frame. Use scale 1 mm = 1 N. (8)

5.2.2 Deduce, from the space and vector diagrams, the nature and magnitude of the members indicated in the table on ANSWER SHEET 5.2. (4)

5.3 FIGURE 5.3 below shows the space diagram of a beam with a span of 10 metres with two point loads and a uniformly distributed load. Study the diagram and answer the questions that follow.



**FIGURE 5.3**

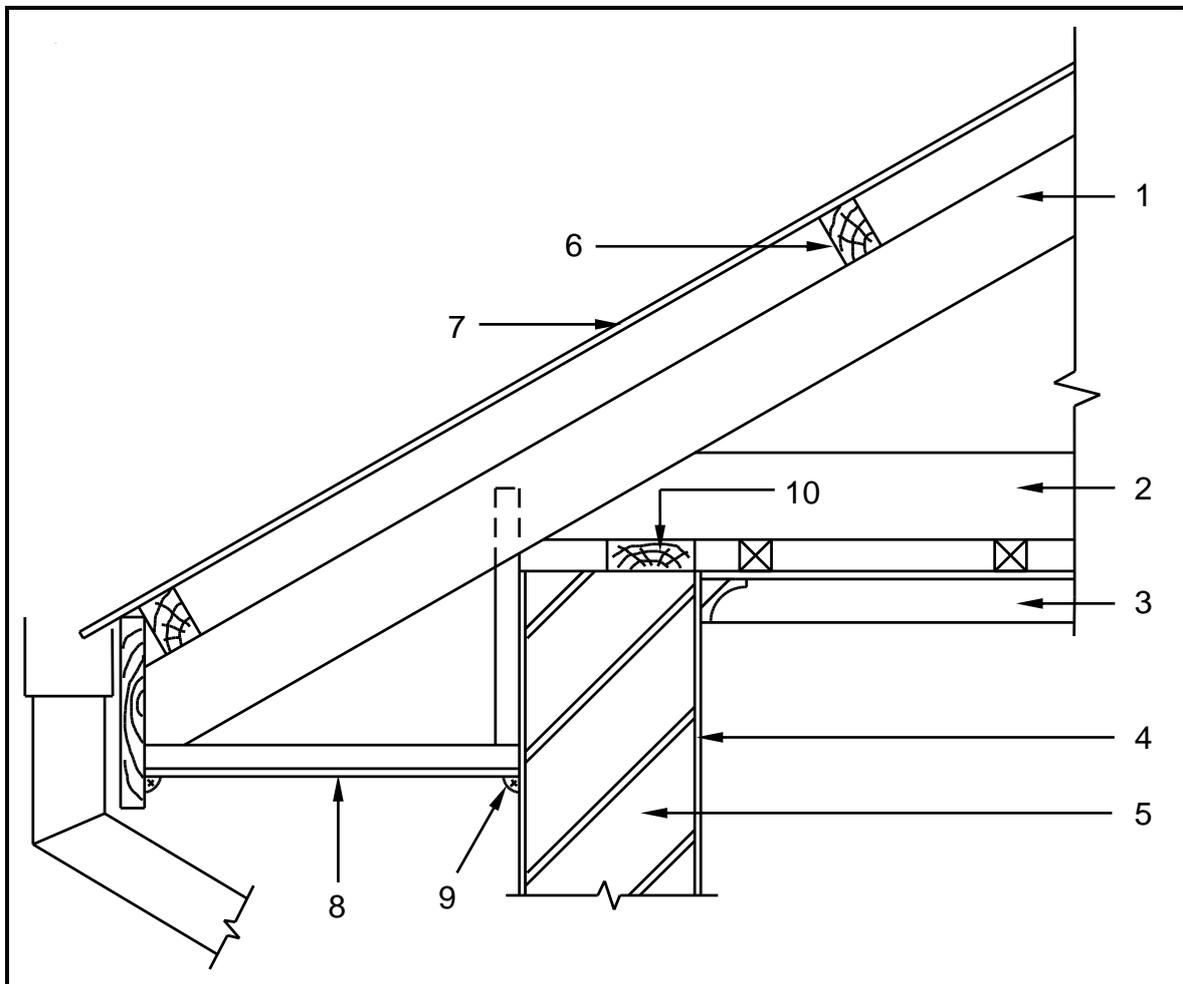
5.3.1 Deduce, from FIGURE 5.3, the value of the shear forces and draw the shear force diagram on ANSWER SHEET 5.3. Use scale 1 mm = 2 kN. (5)

5.3.2 The value of the bending moments at A = 0 kN/m, B = 65 kN/m, C = 120 kN/m, D = 140 kN/m and E = 0 kN/m. Use the given information and draw the bending moment diagram on ANSWER SHEET 5.3. Use scale 1 mm = 2 kN/m. (5)

**[30]**

**QUESTION 6: GRAPHICS AND COMMUNICATION**

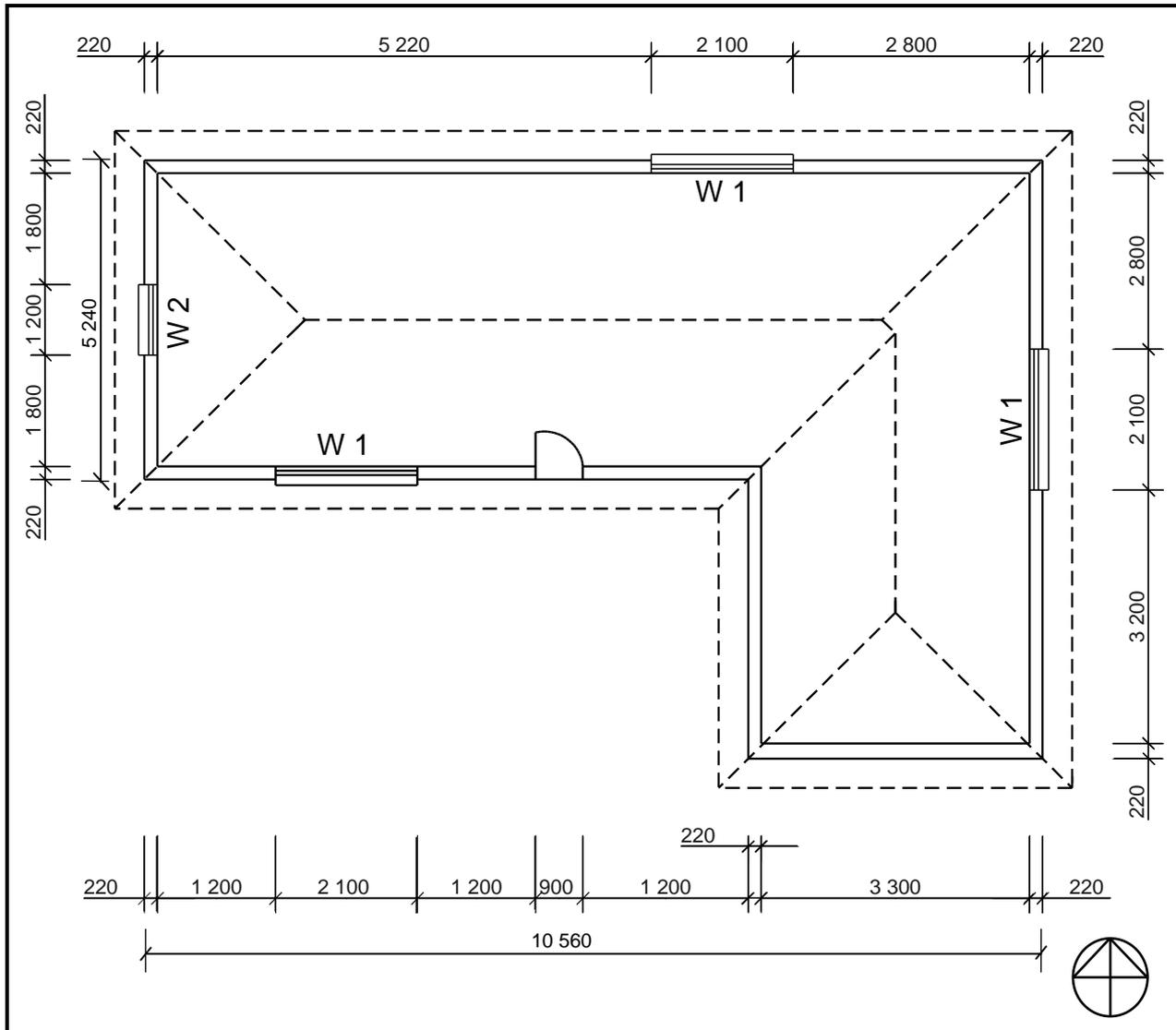
6.1 FIGURE 6.1 below illustrates a detailed sectional view of the foot of a king post roof truss. Study the drawing and complete the table on ANSWER SHEET 6.1.



**FIGURE 6.1**

(15)

6.2 FIGURE 6.2 below shows an incomplete floor plan with the roof layout of a proposed dwelling.



**FIGURE 6.2**

Study FIGURE 6.2 and develop and draw, on ANSWER SHEET 6.2, to scale 1 : 50, the SOUTH ELEVATION of the building. Use the specifications below and on the next page. (Use the assessment criteria on ANSWER SHEET 6.2 as a guideline for your drawing.)

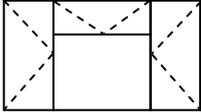
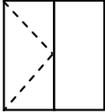
**SPECIFICATIONS:**

- The height between the natural ground level and the top level of the floor slab is 300 mm.
- The height between the floor slab and the underside of the wall plate is 2 600 mm.
- The roof is covered with tiles and is finished with 220 mm wide fascia board.
- Ridge capping is 100 mm high.

- Rain-water down pipes are 75 mm in diameter and 100 mm square gutters are used.
- Rain-water down pipes should be placed on every corner of the building.
- The eaves overhang is 500 mm.
- The door opening is 2 100 mm high and 900 mm wide.
- The door step is 150 mm high.
- The building has a hipped roof with a pitch of 30°.

The following must also be shown on the drawing:

- The method used to determine the roof height
- Window sills
- THREE rain-water down pipes

WINDOW SCHEDULE			
Window 1 (W1)		Window 2 (W2)	
			
Width	Height	Width	Height
2 100	1 500	1 200	1 500

THREE marks will be allocated for the application of the scale.

Start your drawing from corner A as indicated on the bottom left of ANSWER SHEET 6.2.

(25)  
[40]

**TOTAL: 200**

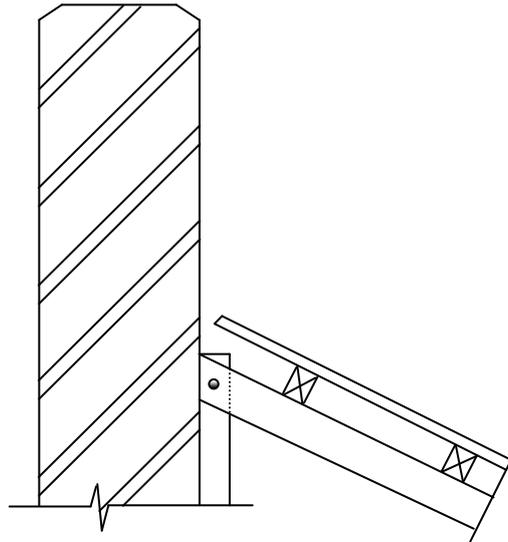
**CENTRE NUMBER:**

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**EXAMINATION NUMBER:**

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**ANSWER SHEET 1.10**



**FIGURE 1.10**

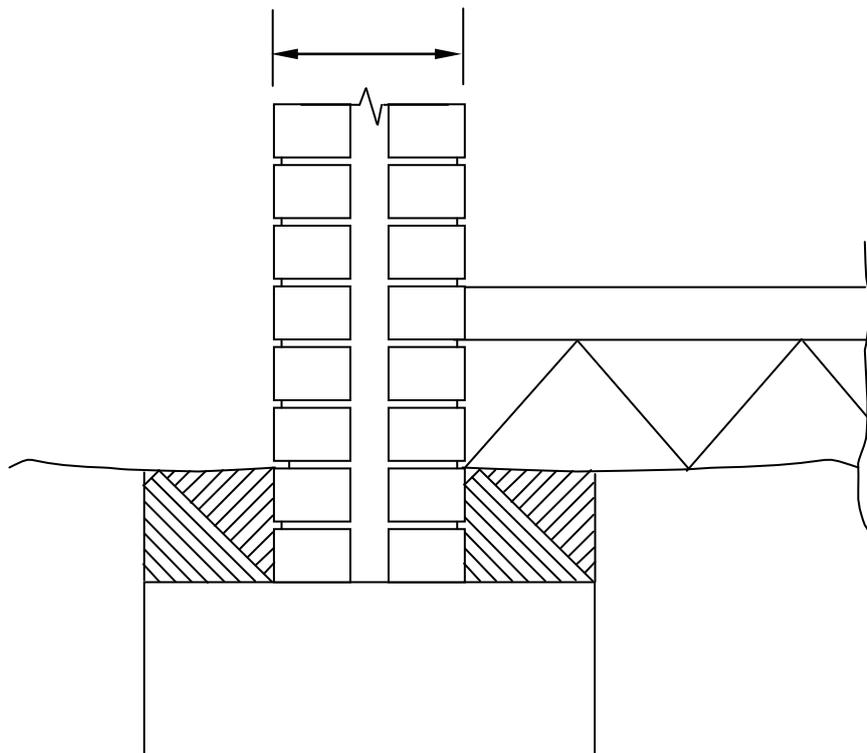
ASSESSMENT CRITERIA	MARK	CANDIDATE'S MARK
Flashing correctly drawn	2	



**CENTRE NUMBER:**

**EXAMINATION NUMBER:**

**ANSWER SHEET 2.10**



ASSESSMENT CRITERIA	MARK	CANDIDATE'S MARK
Symbol for concrete foundation and concrete floor	1	
Damp-proof course between walls and cavity	2	
Damp-proofing under concrete floor	2	
Weep hole	1	
Concrete in cavity wall	1	
Wall tie	1	
Dimension of total width of wall	1	
<b>TOTAL:</b>	<b>9</b>	

**CENTRE NUMBER:**

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**EXAMINATION NUMBER:**

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**ANSWER SHEET 4.3**

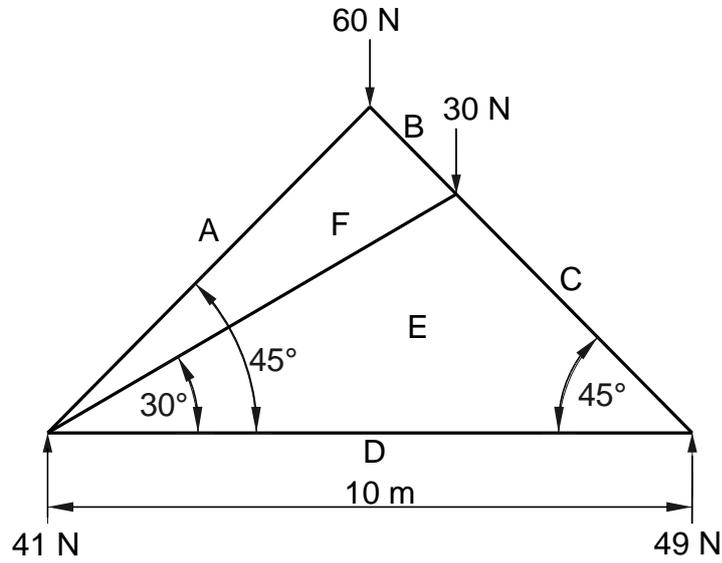
Complete your answers in the spaces indicated with \_\_\_\_\_ .

	A	B	C	D	
4.3.1				Internal measurements of:	
				Long walls = _____ - _____	
				= _____	
				Short walls = _____ - _____	
				= _____	(6)
4.3.2	1/	_____		Internal area of the store room	
		_____	_____ m <sup>2</sup>		(3)
4.3.3				Number of ceiling boards	
	1/	_____		Area of one ceiling board (CB):	
		_____	_____		
				Ceilingboardsneeded = $\frac{\text{Area of room}}{\text{Area of CB}}$	
				= _____	
				= _____	(6)

**CENTRE NUMBER:**

**EXAMINATION NUMBER:**

**ANSWER SHEET 5.2**



a

MEMBER	NATURE	FORCE
AF		
CE		

Tolerance of 1 N to either side

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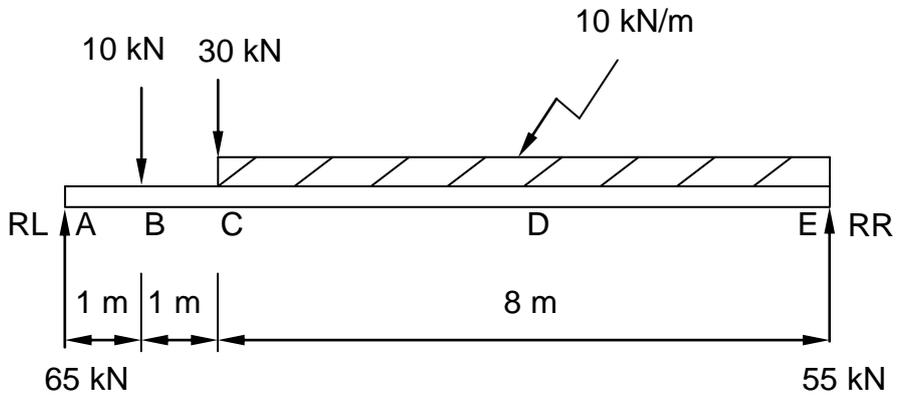
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EXAMINATION NUMBER: 

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**ANSWER SHEET 5.3**



5.3.1

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(5)

5.3.2

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(5)

<b>CENTRE NUMBER:</b>										
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<b>EXAMINATION NUMBER:</b>															
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**ANSWER SHEET 6.1**

<b>NO.</b>	<b>QUESTIONS</b>	<b>ANSWERS</b>	<b>MARKS</b>
1	Identify the type of eave construction used in the drawing.		1
2	State the minimum pitch (slope) of number 1.		1
3	State the standard dimension of number 2.		1
4	State the centre-to-centre spacing between the brading of the ceiling construction.		1
5	State the purpose of number 3.		1
6	Draw the drawing symbol for number 4.		1
7	State the width of the external wall indicated by number 5, excluding plaster.		1
8	Name the colour coding that should be used for number 6.		1
9	As a draughtsperson, recommend a type of roof sheeting for number 7.		1
10	Name ONE material that can be used for number 8.		1
11	Identify number 9.		1
12	What is the standard dimension of number 10?		1
13	Draw a neat freehand line diagram of a kingpost roof truss.		3
		<b>TOTAL:</b>	<b>15</b>

<b>CENTRE NUMBER:</b>									
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<b>EXAMINATION NUMBER:</b>														
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**ANSWER SHEET 6.2**

ASSESSMENT CRITERIA	MARKS	LM	ASSESSMENT CRITERIA	MARKS	LM
External walls	3		Ridge capping	1	
NGL (correctly indicated)	1		Determine roof height	1	
FFL (correctly indicated)	1		Any two labels	2	
Window	1		Application of scale	3	
Window sill	1		One or two incorrect = 3		
Door opening	1		Three or four incorrect = 2		
Step	1		More than five incorrect = 1		
Fascia board	1		No measurement correct = 0		
Rain-water down pipes	3				
Roof (correctly drawn)	4				
Gutter	1		<b>TOTAL:</b>	<b>25</b>	



A

## FORMULA SHEET

### IMPORTANT ABBREVIATIONS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
c	Centroid	b	Breadth/Width	r	Radius
l	Length	s	Side	A	Area

### FORMULAE

AREA OF	FORMULA (in words)	FORMULA (in symbols)	FORMULA FOR THE POSITION OF CENTROIDS	
			X-axis	Y-axis
Square	side x side	s x s	$\frac{s}{2}$	$\frac{s}{2}$
Rectangle	length x breadth	l x b	$\frac{l}{2}$	$\frac{b}{2}$
Right-angled triangle	$\frac{1}{2}$ x base x height	$\frac{1}{2}b \times h$	$\frac{b}{3}$	$\frac{h}{3}$
Equilateral triangle/ Isosceles triangle	$\frac{1}{2}$ x base x height	$\frac{1}{2}b \times h$	$\frac{b}{2}$	$\frac{h}{3}$

$$\text{Position of centroid} = \frac{(A1 \times d) \pm (A2 \times d)}{\text{Total area}}$$

OR

$$Y = \frac{\sum Ay}{\sum A}$$

OR

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