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Department:  
Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 12**

**CIVIL TECHNOLOGY**

**NOVEMBER 2009**

**MARKS: 200**

**TIME: 3 hours**

**This question paper consists of 13 pages, 6 answer sheets and 1 formula sheet.**

**REQUIREMENTS:**

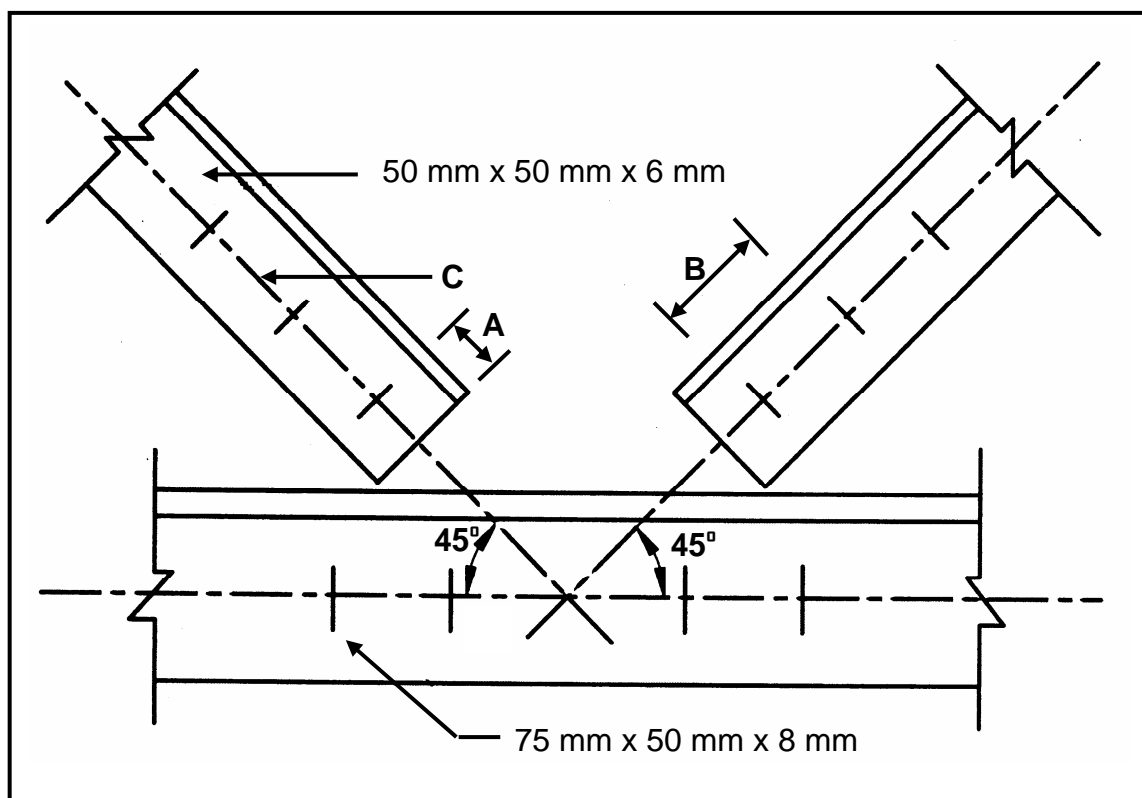
1. Drawing instruments
2. A non-programmable pocket calculator
3. ANSWER BOOK

**INSTRUCTIONS AND INFORMATION**

1. This question paper consists of SIX questions.
2. ALL questions are COMPULSORY.
3. Answer each question as a whole, do NOT separate sub-questions.
4. Start EACH question on a NEW page.
5. Sketches may be used to illustrate your answers.
6. ALL calculations and written answers must be done in the ANSWER BOOK or on the attached ANSWER SHEETS. (Show ALL steps of calculations.)
7. Use the mark allocation as a guide to the length of your answers.
8. Drawings and sketches must be in pencil, fully dimensioned and neatly finished off with descriptive titles and notes to conform to the SANS/SABS Recommended Practice for Building Drawings.
9. For the purpose of this question paper, the size of a brick should be taken as 220 mm x 110 mm x 75 mm.
10. Use your discretion where dimensions and/or details have been omitted.
11. Non-programmable pocket calculators may be used.
12. Answer QUESTIONS 1.2.2, 3.1.2, 4.4, 5.1.2, 6.1 and 6.2 on the attached ANSWER SHEETS using drawing instruments where necessary.
13. Write your examination number and centre number on every ANSWER SHEET and hand them in with your ANSWER BOOK.
14. Drawings on the question paper are not to scale due to electronic transfer.

**QUESTION 1: CONSTRUCTION PROCESSES**

- 1.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.1.1 – 1.1.10) in the ANSWER BOOK.
- 1.1.1 In a rectangular house with a hipped roof all external walls will bear the load of the roof.
- 1.1.2 One of the purposes of a wall plate in roof construction is to distribute the load of the roof evenly over the load bearing walls.
- 1.1.3 The main purpose of a purlin measuring 76 mm x 50 mm is to keep roof tiles in place.
- 1.1.4 The tops of all door and window frames in a single-storey building should be at the same level.
- 1.1.5 The longest vertical member of a roof truss is the strut.
- 1.1.6 Wire nails are ideal to use for secret nailing to secure tongue and groove ceiling boards to brandering.
- 1.1.7 A rough gauged arch is one that will be plastered.
- 1.1.8 A haunched double mortice and tenon joint can be used to join the bottom rail and stile of a door.
- 1.1.9 Scaffolding is the only means of getting access to the roof of a building.
- 1.1.10 Gang nails can be used to join members of a steel roof truss. (10 x 1) (10)
- 1.2 FIGURE 1.2 on the next page shows the different members of an incomplete junction of a steel roof truss. Refer to the figure and answer the questions that follow.
- 1.2.1 Write down the letters A, B and C in the ANSWER BOOK and next to them what A, B and C indicate. (3)
- 1.2.2 Design on ANSWER SHEET 1.2.2 the gusset plate for this connection. The gusset plate ends 10 mm from the centre lines of the last holes on the outside, as indicated on the tie beam. (7)

**FIGURE 1.2**

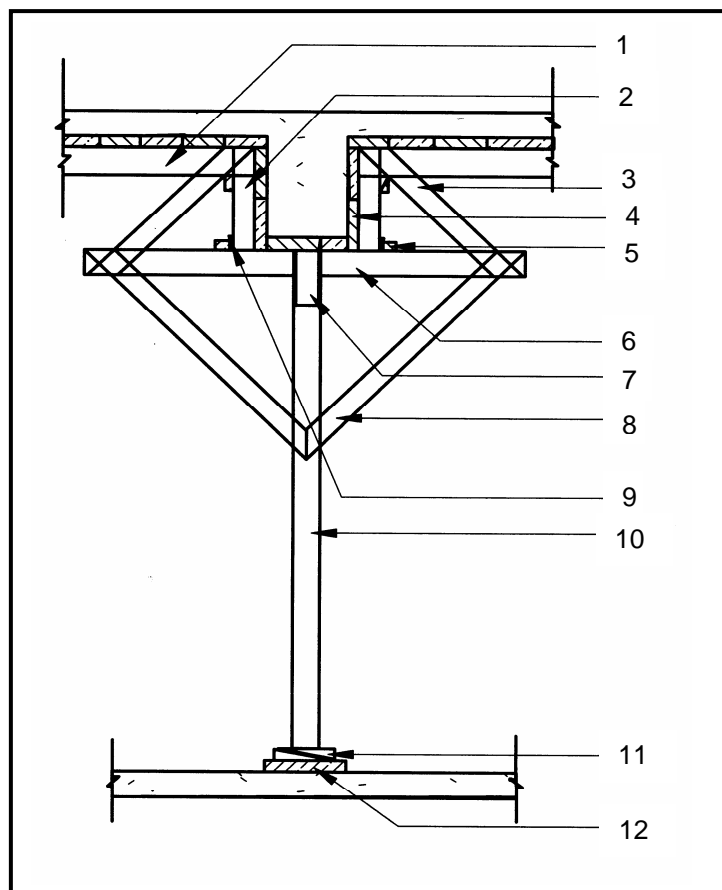
- 1.3 You are on site and a fellow worker is shocked by an electrical wire. Explain TWO precautionary measures you will take to prevent further electrocution. (2)
- 1.4 Hand tools are an asset to any tradesman. Assume you are a tradesman. Explain how you will take care of your hand tools to ensure that they serve you well in years to come. (5)
- 1.5 Explain THREE safety precautions to be adhered to when setting up a ladder to do maintenance work at high levels in a building. (3)
- [30]**

**QUESTION 2: ADVANCED CONSTRUCTION PROCESSES**

2.1 During the construction process of multi-storey buildings, formwork is used extensively.

2.1.1 Describe FOUR requirements that materials used for formwork must meet. (4)

2.1.2 FIGURE 2.1.2 below shows the sketch of a formwork of a beam with an attached floor. Write down the numbers 1 to 12 in your ANSWER BOOK and choose the correct name for each item from the list below the drawing. Write the name next to the corresponding number in your ANSWER BOOK.

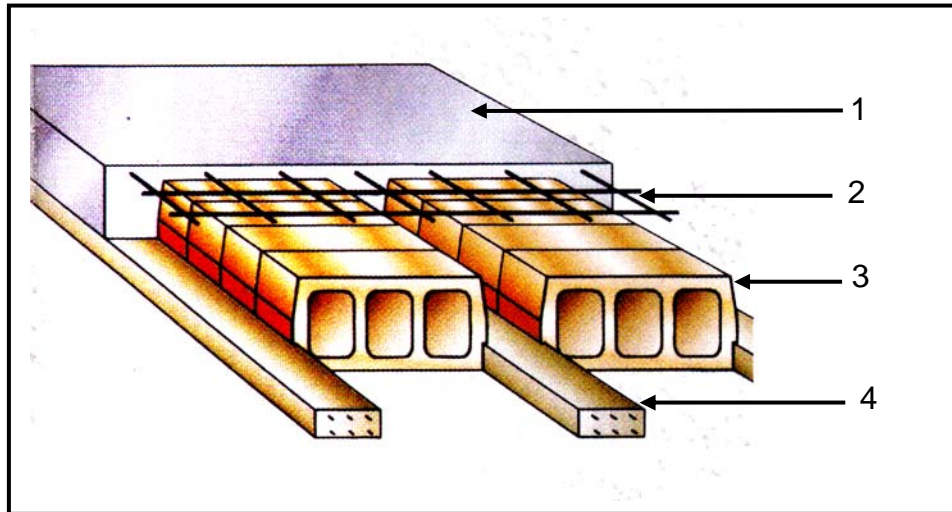


**FIGURE 2.1.2**

joist or bearer; cleats; head tree or head; fish plate/cleat; sole plate or sole piece; folding wedges; strut or stay; wedge; board shuttering; strut or brace; post or prop; fixing plate or kicker

(12)

- 2.2 FIGURE 2.2 below illustrates a vertical section through a rib and block floor. Write down the numbers 1 to 4 in your ANSWER BOOK and next to each the correct name of the part indicated on the drawing.



**FIGURE 2.2**

- (4)
- 2.3 State FOUR factors that must be taken into account during the planning stage of a rib and block floor. (4)
- 2.4 In a workshop, certain areas and equipment are colour-coded for safety reasons. What colour must be used to indicate the following?
- 2.4.1 Fire-fighting equipment, stop buttons and emergency stop buttons (1)
- 2.4.2 Places to be entered with caution and areas where there is a presence of radio-active rays (1)
- 2.4.3 First-aid equipment and start buttons to machines (1)
- 2.5 Draw a neatly labelled isometric free-hand sketch of formwork used to prevent the sides of a foundation trench from collapsing. (7)
- 2.6 Steel is used widely in the erection of warehouses and large buildings. Draw neat free-hand sketches of the cross section through any THREE metal sections that are used in the steel construction of buildings. Provide a title for each sketch. (6)

**[40]**

**QUESTION 3: CIVIL SERVICES**

- 3.1 FIGURE 3.1 on ANSWER SHEET 3.1 shows the floor plan of a dwelling that is to be erected on a new stand. Refer to the figure and answer the questions that follow.
- 3.1.1 Write down the numbers 1 to 6 in the ANSWER BOOK and write down the correct name of the corresponding sanitary fitting next to the appropriate number. (6)
- 3.1.2 Using ANSWER SHEET 3.1, design a drainage system and draw the drainage plan for the building. Take into consideration all regulations and design principles for a good drainage system. Indicate ALL drainage abbreviations, pipe details and slope where applicable. (15)
- 3.1.3 At what angle should branch pipes join the main residential sewer line? (1)
- 3.1.4 What is the pipe that conveys water from a gulley to the main residential sewer line called? (1)
- 3.2 Describe TWO factors that must be taken into consideration if a drainage system has to be installed under a building. (2)
- 3.3 As the occupant of a house, explain how you will ensure that the bacterial action in a septic tank is not destroyed. (1)
- 3.4 Discuss, in your own words, the purpose of a vacuum breaker that is used in a solar geyser. (1)
- 3.5 Coal is the primary energy source used in South Africa to generate electricity. List THREE other sources from which electricity can be generated. (3)
- [30]**

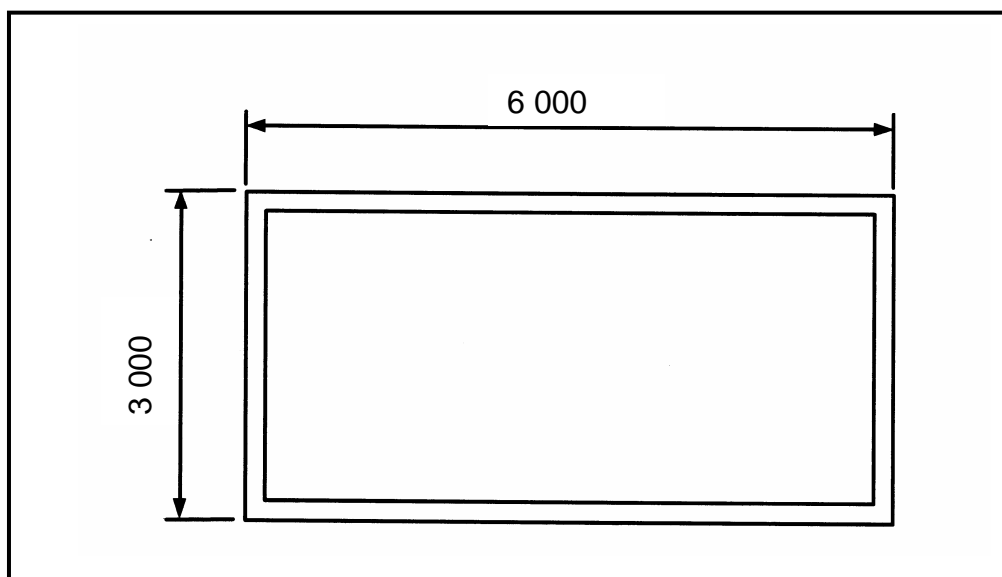


**QUESTION 4: MATERIALS**

- 4.1 Differentiate how *mechanical* and *visual grading* of timber is done. (2)
- 4.2 Explain what properties of timber are tested in:
- 4.2.1 Mechanical grading (1)
- 4.2.2 Visual grading (1)
- 4.3 Cement is an important material and has a limited shelf life. Explain how you will store cement for use on a building site. (3)
- 4.4 As a quantity surveyor you are required to calculate the quantity of concrete required for the foundation and the floor of a building as illustrated on the plan below. FIGURE 4.4 below illustrates the outside measurement for the foundation and not the wall. Answer the following questions on ANSWER SHEET 4.4.

**SPECIFICATIONS:**

- Outside measurements of the foundation = 6 000 mm (length) x 3 000 mm (width)
- Dimensions of the foundation = 600 mm (wide) x 250 mm (deep)
- Thickness of the floor slab = 75 mm
- The sub-structure is a one-brick wall (220 mm)

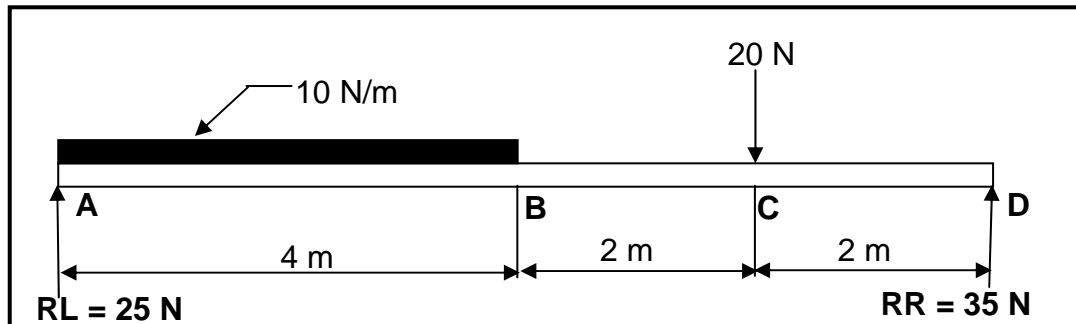
**FIGURE 4.4**

- 4.4.1 Calculate the volume of concrete required for the foundation. (9)
- 4.4.2 Calculate the volume of concrete required for the floor slab. (6)

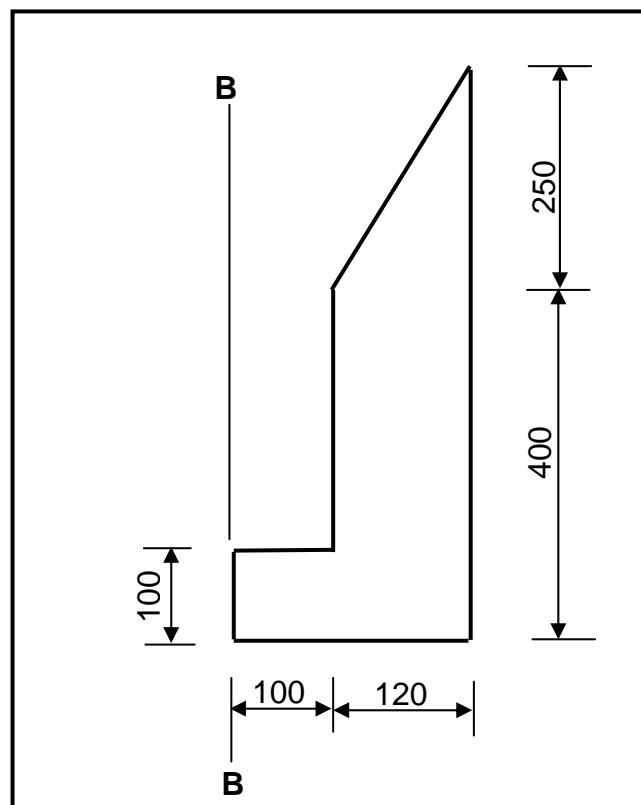
- 4.5 Glass is used extensively in the building industry. Name TWO types of glass that can be used in the building industry and indicate ONE place where each can be used. (4)
- 4.6 Give FOUR reasons why it is advantageous to use plastic pipe (polycop) for the cold-water supply in a house. (4)
- [30]**

**QUESTION 5: APPLIED MECHANICS**

- 5.1 FIGURE 5.1 below illustrates a beam with a span of 8 metres which is subjected to a uniformly distributed load of 10 N/m over 4 metres and a point load of 20 N, 2 metres from the right-hand side.

**FIGURE 5.1**

- 5.1.1 Calculate the shear forces at points A, B, C and D. (7)
- 5.1.2 Draw the shear-force diagram on ANSWER SHEET 5.1.2. Use a scale of 2 mm = 1 N. (7)
- 5.2 FIGURE 5.2 shows the lamina of a figure. All dimensions are in millimetres.

**FIGURE 5.2**

- 5.2.1 Calculate the total area of the lamina. (7)
- 5.2.2 Calculate the position of the centroid from B-B. (9)
- [30]**

**QUESTION 6: GRAPHIC COMMUNICATION**

- 6.1 FIGURE 6.1 (next page) shows the floor plan of a proposed building. Draw to scale 1:50 on ANSWER SHEET 6.1 the NORTH ELEVATION of the building. This building has a gabled roof with a pitch of 30°.

Use the following specifications:

- The entrance door is 2 000 mm high and 800 mm wide.
- The roll-up garage door is 2 100 mm high and 2 400 mm wide.
- The roof is covered with galvanised sheeting and is finished with 220 mm wide barge boards at the gable walls.
- Rainwater pipes are 75 mm in diameter.
- Height between top level of floor slab and underside of wall plate is 2 600 mm.
- Height between natural ground level and top level of floor slab is 150 mm.
- The eaves overhang is 500 mm.

WINDOW SCHEDULE		
WINDOW	WIDTH	HEIGHT
W1	1 500 mm	900 mm
W2	2 100 mm	900 mm
W3	3 000 mm	450 mm

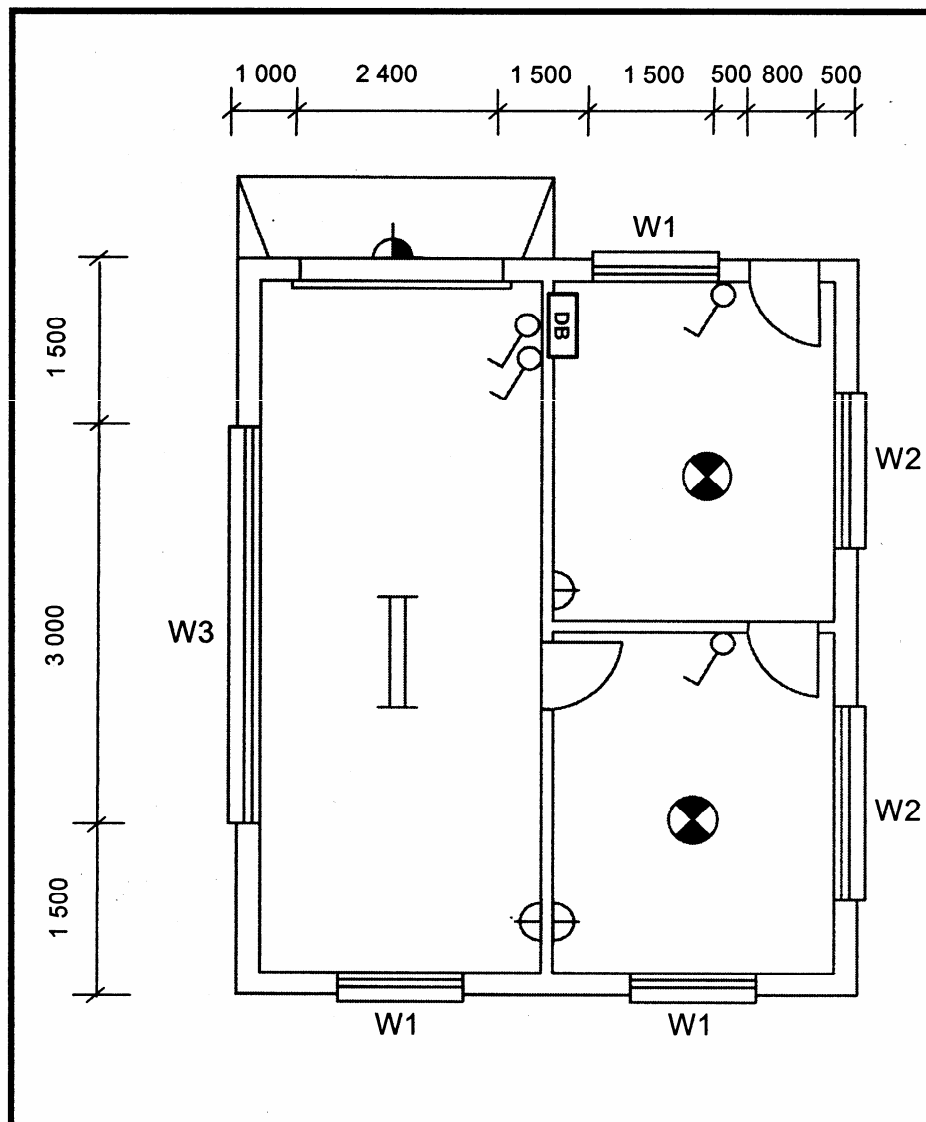


FIGURE 6.1

(20)

- 6.2 The migration of swallows from the north to the south in the summer months creates a big problem for home owners, because the birds build their nests in the eaves of the roof.

To solve this problem, draw on ANSWER SHEET 6.2 to scale 1:10 a detailed sectional view of a closed (concealed) eaves overhang of a roof truss.

Show the following details in your drawing:

- Upper part of the brick wall
- Wall plate 114 mm x 38 mm
- Part of the 114 mm x 38 mm tie beam
- Part of the 114 mm x 38 mm rafter
- Roof pitch 30°
- Beam filling
- One ceiling batten (brandering) 38 mm x 38 mm
- 6 mm thick ceiling board
- 75 mm coved cornice
- Purlins 76 mm x 50 mm
- Galvanised corrugated iron roof sheeting
- 38 mm x 38 mm bearer (joist)
- 38 mm x 38 mm hanger
- Covering material for closing of the eaves (e.g. slats, soffit board)
- 225 mm x 30 mm fascia board
- 100 mm x 100 mm square gutter
- 75 mm outlet from gutter
- 500 mm eaves overhang

(20)  
[40]

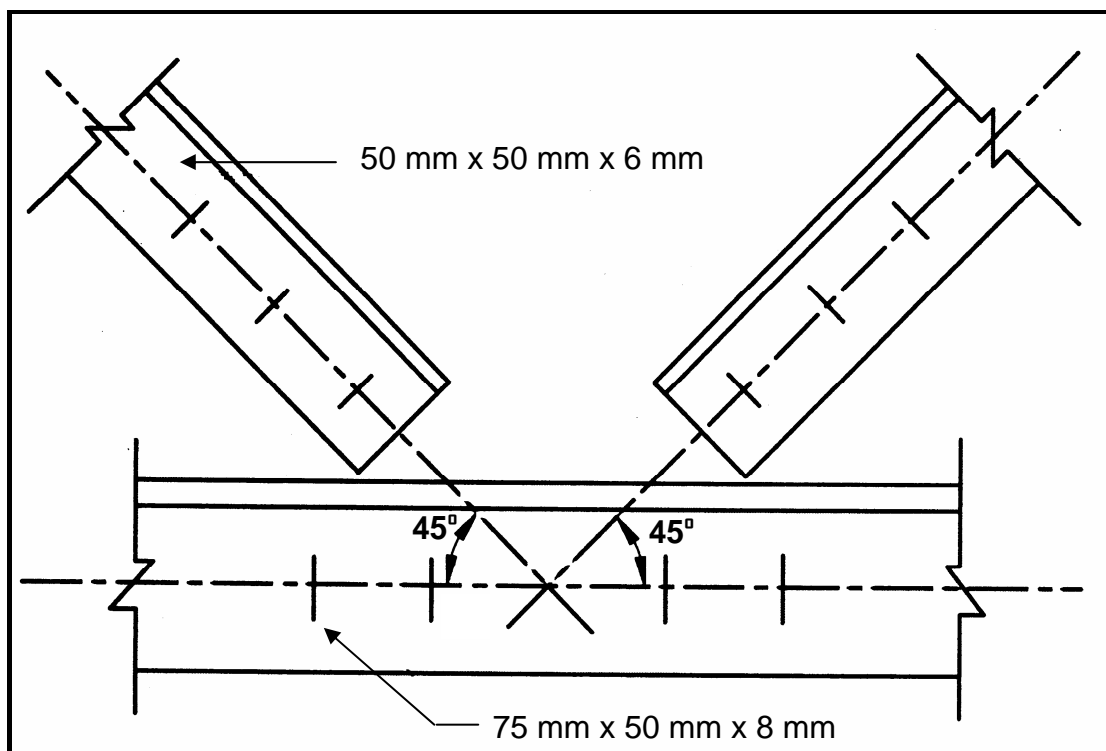
**TOTAL: 200**

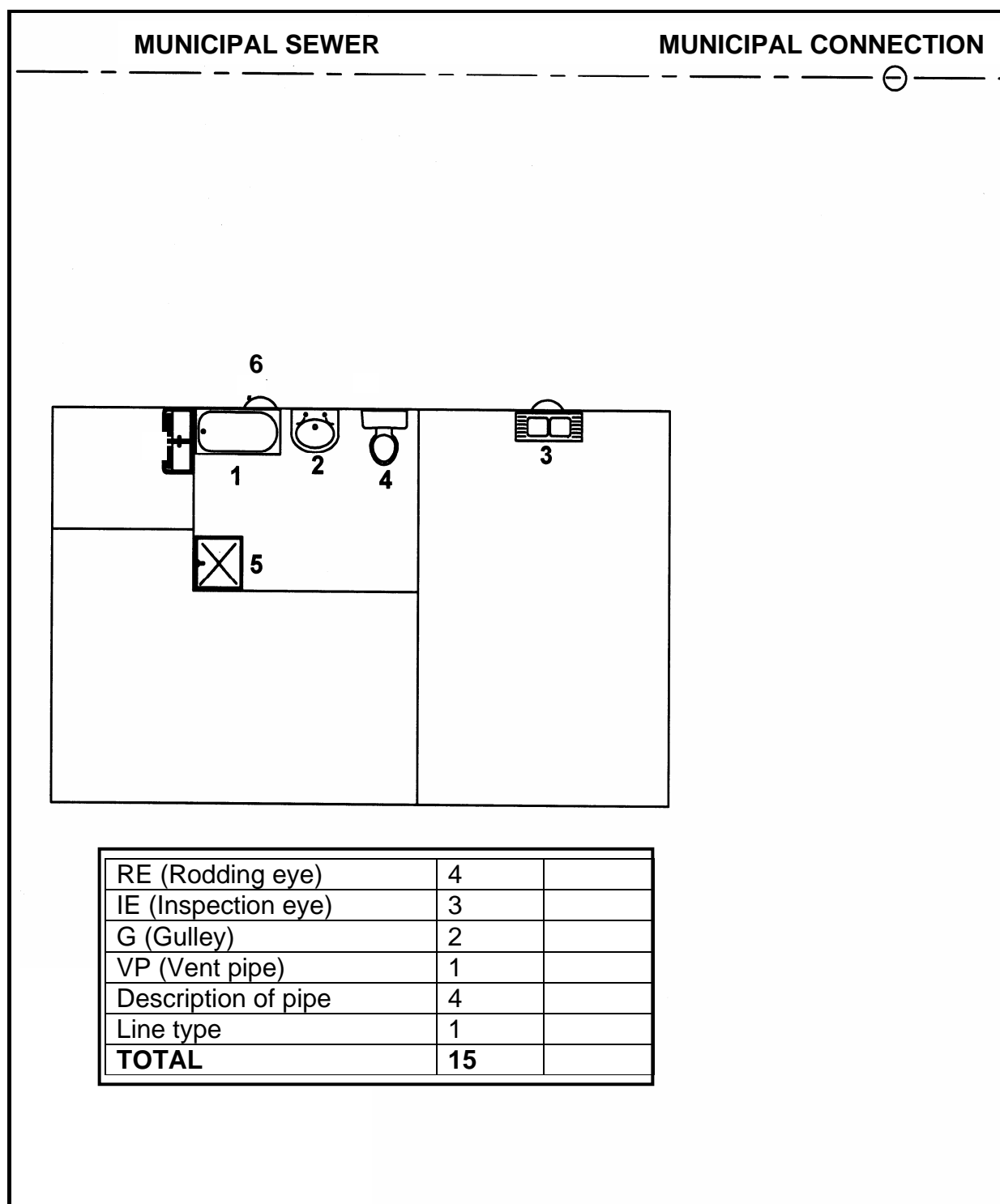
**ANSWER SHEET 1.2.2****QUESTION 1.2.2****EXAMINATION NUMBER**

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**CENTRE NUMBER:**

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**FIGURE 1.2**

**ANSWER SHEET 3.1****QUESTION 3.1.2****EXAMINATION NUMBER****CENTRE NUMBER:****FIGURE 3.1****(15)**



#### QUESTION 4.4

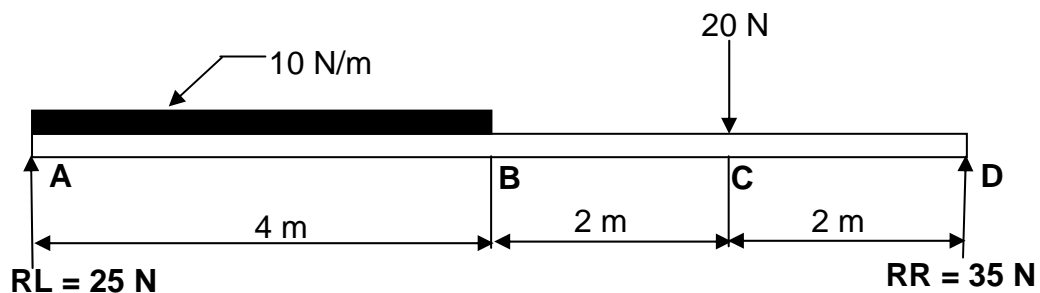
[illegible][illegible]

**ANSWER SHEET 5.1.2****QUESTION 5.1.2****EXAMINATION NUMBER:**

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**CENTRE NUMBER:**

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(7)

**ANSWER SHEET 6.1****QUESTION 6.1**

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

<b>EXAMINATION NUMBER:</b>														
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<b>CENTRE NUMBER:</b>														
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## 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
$\pi$	Pi = $\frac{22}{7} = 3,142$	$\emptyset$	Diameter	V	Volume

### 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/ Pyramid	$\frac{1}{2}$ x base x height	$\frac{1}{2}b \times h$	$\frac{b}{2}$	$\frac{h}{3}$
Circle	$\pi$ x radius x radius	$\pi r^2$	Centroid is in the centre	
Circle	$\pi$ x diameter x diameter divided by 4	$\frac{\pi d^2}{4}$		
Semi-circle	$\pi$ x radius x radius divided by 2	$\frac{\pi r^2}{2}$	Centroid is 0,424r on the centre line	

$$\text{Position of centroid} = \frac{(A_1 \times d) + (A_2 \times d) + (A_3 \times d)}{\text{Total area}}$$

OR

$$\text{Position of centroid } X = \frac{\sum Ax}{\sum A}$$