



# basic education

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

## **NATIONAL SENIOR CERTIFICATE**

**GRADE 12**

**CIVIL TECHNOLOGY**  
**FEBRUARY/MARCH 2014**

**MARKS: 200**

**TIME: 3 hours**

**This question paper consists of 13 pages, 9 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 subquestions.
4. Start the answer to EACH question on a NEW page.
5. Do NOT write in the margins 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 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 discretion where dimensions and/or details have been omitted.
12. Answer QUESTIONS 1.3, 2.4, 2.7, 3.2, 4.2, 5.2.1, 5.4, 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 an item in COLUMN A. Write only the letter (A–L) next to the question number (1.1.1–1.1.10), for example 1.1.11 M.

COLUMN A		COLUMN B	
1.1.1	Flammable material	A	resistance to wear
1.1.2	Tensile strength	B	this type of material must be stored close to a fire extinguisher
1.1.3	Durable	C	vertical member of a roof truss
1.1.4	Queen post	D	type of roof covering
1.1.5	Chipboard	E	accessory used with a dumpy level
1.1.6	Copper	F	material that measures 38 mm x 76 mm
1.1.7	Batten	G	protective material that is used to prolong the lifespan of materials
1.1.8	Paint	H	the collapse of structures
1.1.9	Telescopic staff	I	material that measures 38 mm x 38 mm
1.1.10	IBR sheeting	J	type of metal that will not rust
		K	material made of wood particles held together with adhesives
		L	the resistance of a material to break under tension

(10)

- 1.2 An arch is to be built inside a house.

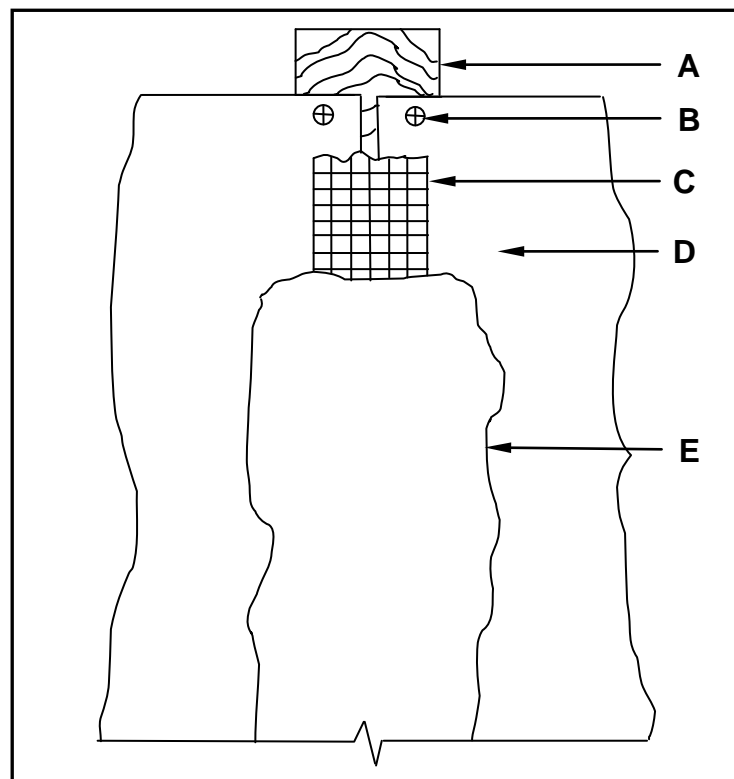
- 1.2.1 What type of arch would you recommend? (1)
- 1.2.2 Justify (Motivate) the use of a rough arch in a plastered wall. (1)

- 1.3 The sketch on ANSWER SHEET 1.3 (attached) shows a plan course (top view) of a wall built in English bond.
- 1.3.1 Use ANSWER SHEET 1.3 (attached) to project and draw, from the given view, a front elevation of the wall, THREE courses high in good proportion. (4)
- 1.3.2 Print a title for the drawing. (1)
- 1.3.3 Indicate the following labels on your drawing:
- A header brick (1)
  - A stretcher brick (1)
  - A queen closer (1)
- 1.4 Explain in THREE steps what you would do if a colleague swallowed a poisonous chemical on site. (3)
- 1.5 Draw a neat freehand isometric sketch showing the tenon of a mortice and tenon joint. (4)
- 1.6 Give ONE reason why beam filling is done on a building. (1)
- 1.7 Would you use beam filling in your own house if closed eaves were going to be used? Motivate your answer. (2)
- [30]**

**QUESTION 2: ADVANCED CONSTRUCTION PROCESSES**

(ANSWER THIS QUESTION ON A NEW PAGE.)

- 2.1 Indicate whether the following statements are TRUE or FALSE. Write only 'true' or 'false' next to the question number (2.1.1–2.1.5) in the ANSWER BOOK.
- 2.1.1 A lintel is a temporary support for bricks while an arch is being built. (1)
- 2.1.2 Castors can be used on ladders to make them safe to use. (1)
- 2.1.3 Form oil is used on formwork to prevent concrete from sticking to the shutter material. (1)
- 2.1.4 Gypsum board is the only material used on concealed eaves. (1)
- 2.1.5 Bolts and nuts can be used to join adjacent members of a timber roof truss. (1)
- 2.2 FIGURE 2.2 below illustrates the front elevation of a joint between two gypsum boards of a dry wall and the method used to conceal the joint. Study the drawing and answer the questions that follow.

**FIGURE 2.2**

- 2.2.1 Name parts **A** to **E**. (5)
- 2.2.2 Name another fastener that can be used at **B**. (1)
- 2.2.3 Explain the purpose of **C**. (1)

- 2.3 Describe TWO advantages of using steel shuttering (formwork) instead of timber shuttering (formwork). (2)
- 2.4 FIGURE 2.4 on ANSWER SHEET 2.4 (attached) shows a dumpy level in two different positions. The incomplete level-book page (collimation table) is given.
- 2.4.1 Use the information in the table and calculate the difference in height from **C** to **D** and from **D** to **E**. (2)
- 2.4.2 Calculate the differences and show the results of your answers in the table. (4)
- 2.5 Show, by means of neat freehand sketches, the difference between the vertical section of a *short-bored pile foundation* and a *strip foundation*. (4)
- 2.6 Explain THREE advantages of using an oil-based paint on building material that will be exposed to weather conditions. (3)
- 2.7 FIGURE 2.7 on ANSWER SHEET 2.7 (attached) shows an incomplete vertical sectional drawing of the formwork through the centre of a concrete beam. Study the drawing and draw the following on ANSWER SHEET 2.7 to complete the sectional view:
- 2.7.1 Two main bars (2)
- 2.7.2 ONE shear bar (1)
- 2.7.3 TWO anchor bars (2)
- 2.7.4 Stirrup (Binder) (1)
- 2.7.5 The symbol for concrete (1)
- 2.7.6 Two spacers that are used to maintain the cover depth of concrete at the bottom (2)
- 2.7.7 Any THREE labels (3)
- 2.7.8 Correctness of sketch (1)
- [40]**

**QUESTION 3: CIVIL SERVICES**

(ANSWER THIS QUESTION ON A NEW PAGE.)

- 3.1 FIGURE 3A and FIGURE 3B below show alternative methods of generating electricity. Study the photographs and answer the questions that follow.

**FIGURE 3A****FIGURE 3B**

- 3.1.1 Identify the primary source for generating electricity in FIGURE 3A. (1)
- 3.1.2 Identify the primary source for generating electricity in FIGURE 3B. (1)
- 3.1.3 Name TWO other sources that can be used to generate electricity. (2)
- 3.1.4 Explain TWO advantages of generating electricity as shown in FIGURE 3A. (2)
- 3.2 FIGURE 3.2 on ANSWER SHEET 3.2 (attached) shows a line diagram of the floor plan of an L-shaped office that is to be erected on a vacant stand.
- 3.2.1 Write the abbreviations for the sanitary fittings indicated by numbers 1 to 4 next to the numbers on ANSWER SHEET 3.2. (4)
- 3.2.2 On ANSWER SHEET 3.2, design a sewerage system and draw the sewerage plan for the building. All regulations and design principles of a good sewerage system must be considered. Indicate the following on your drawing:
- A manhole near the connection to the conservancy tank
  - A gully at 1
  - A vent pipe at 3
  - A rodding eye at the highest point of the sewerage system and another one where there is a change in direction
  - Inspection eyes where branch and main pipes meet
  - Indicate all sewerage abbreviations where applicable (11)
- 3.2.3 On the drawing, indicate the diameter of the pipe, type of pipe and the slope of the main sewer line. (3)

3.2.4 Draw the electrical symbols indicated by **A** to **F** on ANSWER SHEET 3.2 next to the letter:

- A – One-way switch, double pole
- B – Electrical meter
- C – Distribution box
- D – Fluorescent light (single tube)
- E – Socket outlet (power point with a switch)
- F – Light (ceiling-mounted)

(6)  
**[30]**

#### **QUESTION 4: MATERIALS AND QUANTITIES**

(ANSWER THIS QUESTION ON A NEW PAGE.)

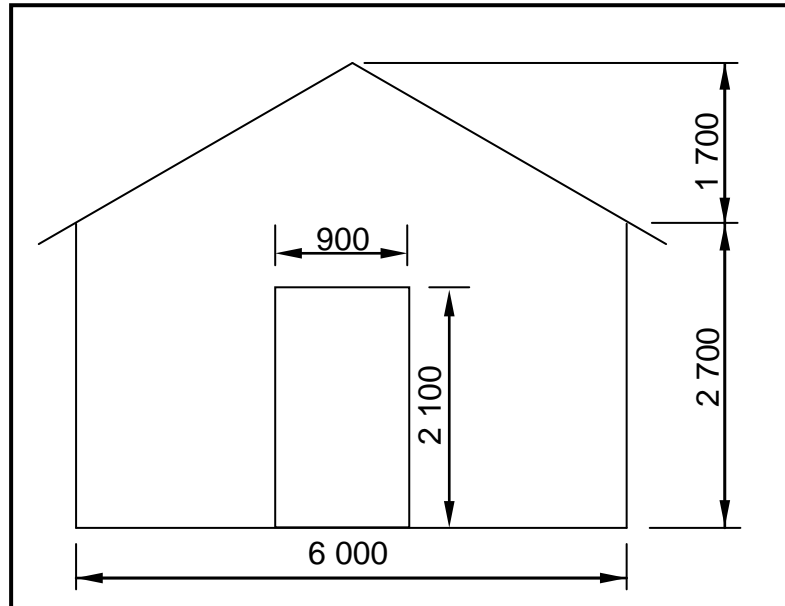
4.1 You are provided with the following equipment and material:

- Three steel moulds of 150 mm x 150 mm x 150 mm
- 25 mm diameter x 575 mm long steel rod
- Form oil (Release oil)
- Water tank
- Fresh concrete

- 4.1.1 You are expected to conduct a test using the equipment and material above. Name the test that you will conduct. (1)
- 4.1.2 What is the purpose of the test? (1)
- 4.1.3 Draw THREE front views showing the different stages of filling the moulds with concrete. (3)
- 4.1.4 How many times should each layer be compacted? (1)
- 4.1.5 How should the specimen be stored after it has set properly? (1)
- 4.1.6 At what temperature must the specimens be stored? (1)
- 4.1.7 Describe TWO details that must appear on the label of the specimens. (2)



- 4.2 FIGURE 4.2 below shows the elevation of a gable wall of a building. The wall is 220 mm thick. Use ANSWER SHEET 4.2 (attached) to calculate the following:



**FIGURE 4.2**

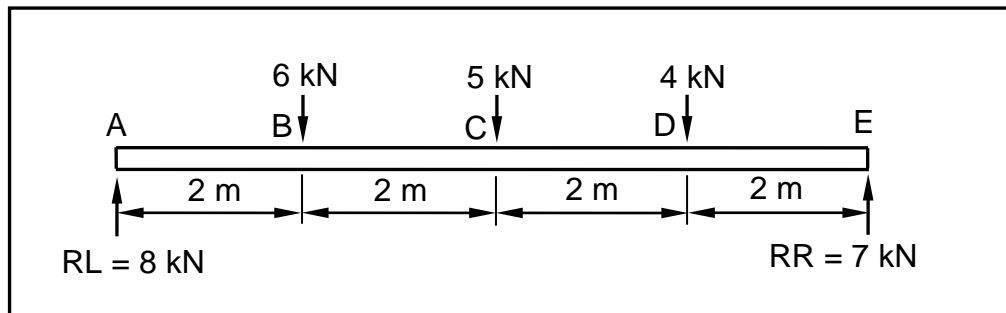
- 4.2.1 The number of bricks required to build the wall if 110 bricks are used to build one square metre of a 220 mm thick wall. (15)
- 4.2.2 5% for breakages and cutting of bricks (2)
- 4.3 You have to make a cabinet for a kitchen for a client. You recommend using melamine board for the construction of the cabinet. Give ONE reason why you recommend melamine board. (1)
- 4.4 Cast-iron and PVC pipes can be used in sewerage systems. Describe TWO characteristics of PVC pipes which will make it the better option to use in sewerage systems. (2)

**[30]**

**QUESTION 5: APPLIED MECHANICS**

(ANSWER THIS QUESTION ON A NEW PAGE.)

- 5.1 A beam with a length of 8 m is subjected to three point loads as shown in the space diagram in FIGURE 5.1 below.

**FIGURE 5.1**

- 5.1.1 Prove, by means of calculation, that the shear force at A ( $SF_A$ ) = 8 kN. (1)
- 5.1.2 Prove, by means of calculation, that the shear force at B ( $SF_B$ ) = 2 kN. (1)
- 5.1.3 Prove, by means of calculation, that the shear force at C ( $SF_C$ ) = -3 kN. (1)
- 5.1.4 Prove, by means of calculation, that the shear force at D ( $SF_D$ ) = -7 kN. (1)
- 5.1.5 Prove, by means of calculation, that the shear force at E ( $SF_E$ ) = 0 kN. (1)
- 5.2 Use the information in QUESTION 5.1 and draw the following on ANSWER SHEET 5.2.1 (attached):
- 5.2.1 The space diagram to scale 10 mm = 1 m (1)
- 5.2.2 The shear force diagram to scale 5 mm = 1 kN (5)

5.3 FIGURE 5.3 below shows a lamina of a triangle with a rectangular hole in it. Prove, by means of calculation, that the position of the centroid of the lamina from A–A is 50 mm. Show ALL steps of the calculation.

HINT: Use the formula on the attached FORMULA SHEET.

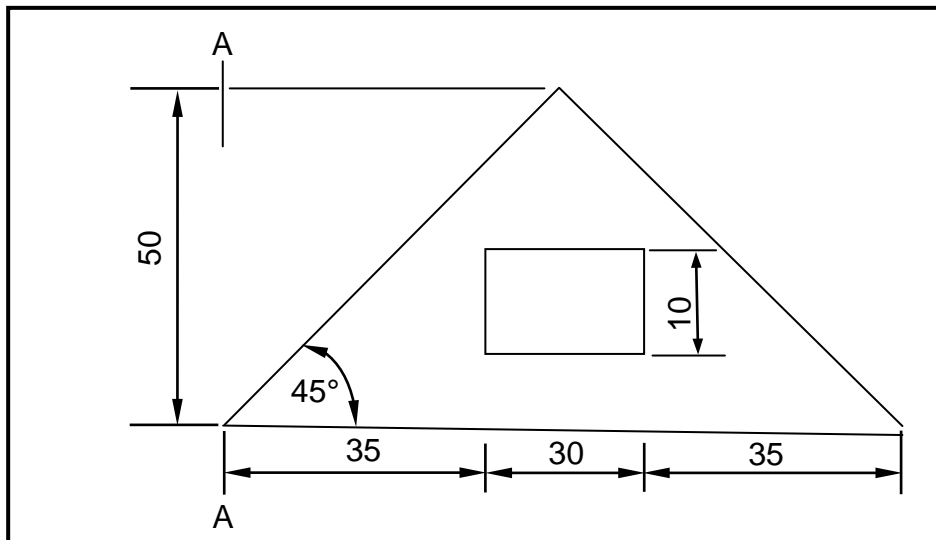


FIGURE 5.3

(8)

5.4 FIGURE 5.4 below shows the space diagram of a roof truss with a span of 8 metres and two point loads of 30 N and 90 N.

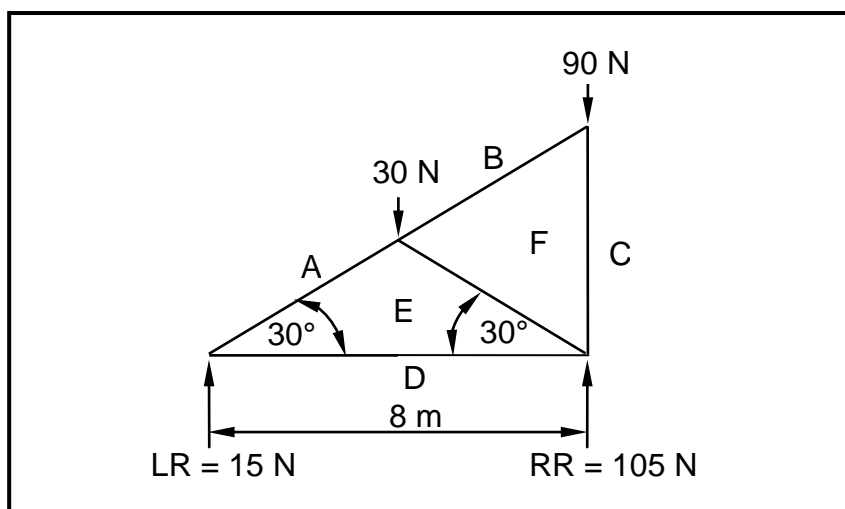


FIGURE 5.4

5.4.1 On ANSWER SHEET 5.4 (attached) develop and draw a vector diagram to graphically determine the magnitude and nature of the forces in each member (part) of the truss. Use scale 1 mm = 1 N.

(5)

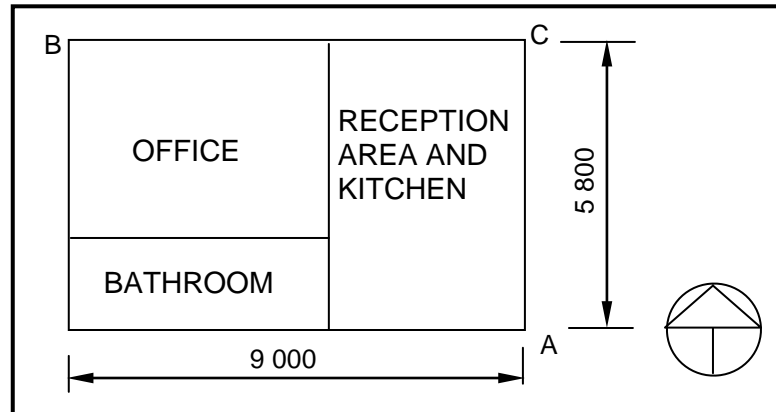
5.4.2 Use the information from the space and vector diagrams and complete the table on ANSWER SHEET 5.4.

(6)

[30]

**QUESTION 6: GRAPHIC COMMUNICATION**

- 6.1 6.1.1 FIGURE 6.1 below shows a line diagram of a plan of a home office. The external measurements of the building are shown. On ANSWER SHEET 6.1 (attached) develop and draw, to scale 1 : 50, the floor plan for the home office. Use the specifications given below.

**FIGURE 6.1**

Specifications:

- External walls are 220 mm thick.
- Internal walls are 110 mm thick.
- All door openings are 900 mm wide.
- The internal measurements of the rooms are:
  - Reception area and kitchen: 4 450 mm x 5 360 mm
  - Office: 4 450 mm x 3 000 mm
  - Bathroom: 4 000 mm x 2 250 mm

Show the following in your drawing:

**ON THE NORTHERN SIDE OF THE BUILDING**

- An entrance door to the reception area and kitchen, 500 mm from point **C**
- A window 1 800 mm wide in the office placed 1 500 mm from point **B**

**ON THE SOUTHERN SIDE**

- A window 1 200 mm wide placed in the centre of the reception area and kitchen wall
- A window 1 200 mm wide placed in the centre of the bathroom wall

**ON THE EASTERN SIDE**

- A window 2 400 mm wide in the reception area and kitchen wall placed 1 000 mm from point **A**

**IN THE RECEPTION AREA AND KITCHEN**

- A door that leads from the reception area and kitchen into the office
- A door that leads from the office into the bathroom

**IN THE RECEPTION AREA AND KITCHEN**

- A single kitchen sink under the smaller window

**IN THE BATHROOM**

- A water closet
- A shower of 1 000 mm x 1 000 mm
- A wash basin of 500 mm x 350 mm (21)

6.1.2 Indicate the dimensions of the overall length and width of the building. (2)

6.1.3 Print the title and scale below the drawing. (2)

6.2 The drawing on ANSWER SHEET 6.2 (attached) shows the east elevation of a building. Use ANSWER SHEET 6.2 and answer the questions that follow.

6.2.1 Complete the table to indicate the description of members **A** to **H** and **J** and **K**. (10)

6.2.2 What is the function of the dashed lines shown on the windows? (1)

6.2.3 Recommend THREE types of exterior finishes for the wall. (3)

6.2.4 What type of roof structure is used on the elevation on ANSWER SHEET 6.2? (1)  
**[40]**

**TOTAL: 200**

<b>CENTRE NUMBER:</b>									
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<b>EXAMINATION NUMBER:</b>													
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**QUESTION 1.3****ANSWER SHEET 1.3**

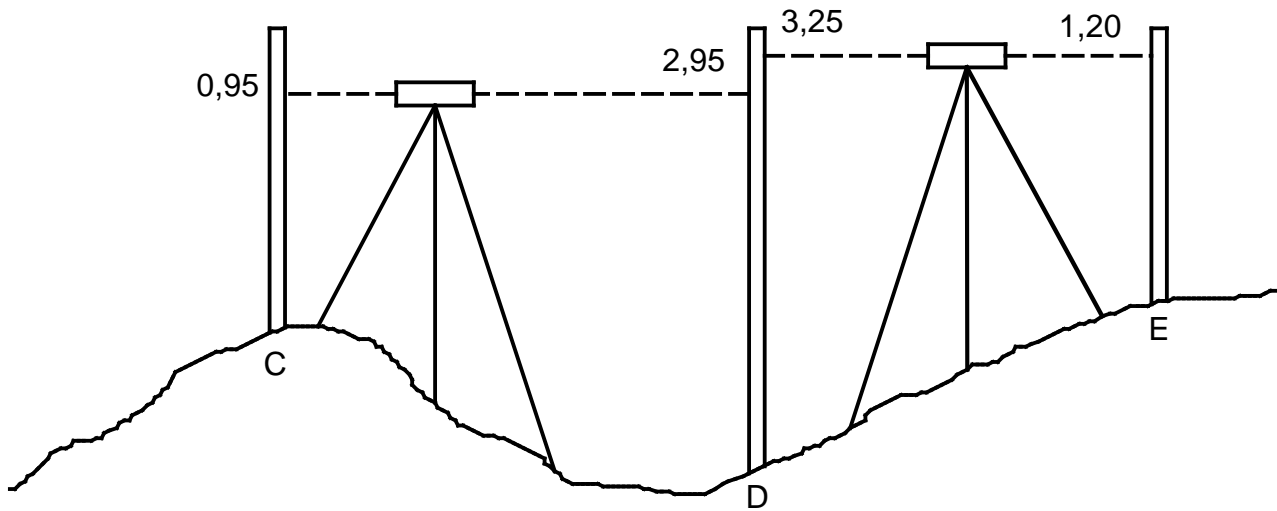
<b>Assessment criteria</b>	<b>Marks</b>	<b>L M</b>
1st course correctly drawn	1	
2nd course correctly drawn	1	
3rd course correctly drawn	1	
Proportion	1	
Header	1	
Stretcher	1	
Queen closer	1	
Title	1	
<b>Total</b>	<b>8</b>	


**CENTRE NUMBER:**

**EXAMINATION NUMBER:**

**QUESTION 2.4**

**ANSWER SHEET 2.4**



BS	FS	RISE	FALL	REMARK
0,95				Peg C
	2,95		C-D	Peg D
3,25				Peg D
	1,20	D-E		Peg E
				<b>TOTAL</b>
				<b>DIFFERENCE</b>
				<b>RESULT</b>

**COLLOMATION TABLE**

(6)

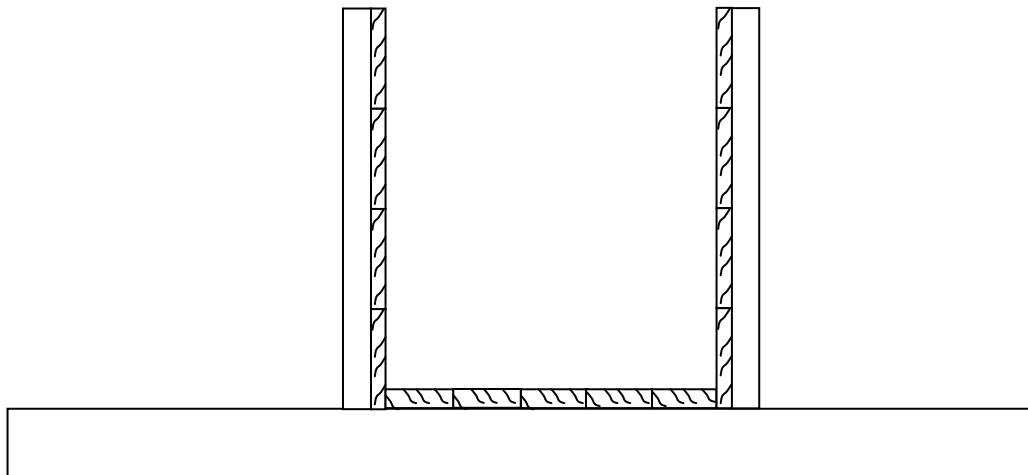
**CENTRE NUMBER:**

**EXAMINATION NUMBER:**

**QUESTION 2.7**

**ANSWER SHEET 2.7**

Assessment criteria	Marks	L M
Two main bars	2	
One shear bar	1	
Two anchor bars	2	
Stirrup (binder)	1	
Symbol for concrete	1	
Two spacers	2	
Any three labels	3	
Correctness of sketch	1	
<b>Total</b>	<b>13</b>	



**FIGURE 2.7**





**CENTRE NUMBER:**

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**EXAMINATION NUMBER:**

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**QUESTION 4.2**

**ANSWER SHEET 4.2**

4.2

A	B	C	D
1/			Area of rectangular wall up to wall plate level. (Door included.)
1/			Area of gable (triangular) part of wall
			Total area of wall including the door opening
1/			Area of door
			Area of wall with door opening deducted
1/			Number of bricks 110 bricks per m <sup>2</sup> for a 220 mm wall
			5% for breakages and cutting of bricks

(15)

(2)







CENTRE NUMBER: 

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EXAMINATION NUMBER: 

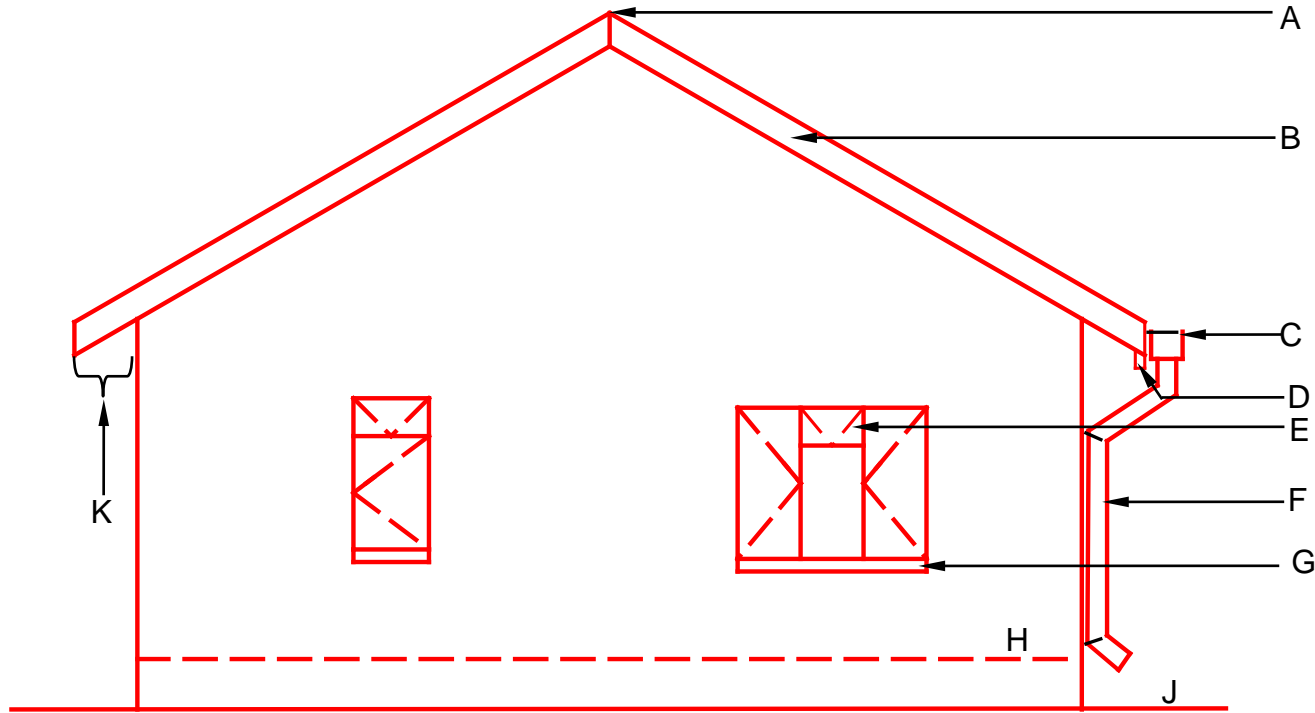
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**ANSWER SHEET 6.2**

**QUESTION 6.2**

No.	Answer	Marks	L M
6.2.2		1	
6.2.3		1	
		1	
		1	
6.2.4		1	

6.2.1	Description	Marks	L M
A		1	
B		1	
C		1	
D		1	
E		1	
F		1	
G		1	
H		1	
J		1	
K		1	



## FORMULA SHEET

### IMPORTANT SYMBOLS

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 = $\frac{22}{7} = 3,142$	∅	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	$\frac{\ell}{2}$	$\frac{b}{2}$
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	πr <sup>2</sup>	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	

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

OR

$$X = \frac{\sum Ax}{\sum A} \quad \text{OR} \quad Y = \frac{\sum Ay}{\sum A}$$