higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T210(E)(A7)T
NATIONAL CERTIFICATE

APRIL EXAMINATION

BUILDING SCIENCE N2

(15070012)

7 April 2015 (Y-Paper)
13:00–16:00

This question paper consists of 5 pages, 2 diagram sheets and 1 formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
BUILDING SCIENCE N2
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Write neatly and legibly.

QUESTION 1

1.1 Convert the following values:

1.1.1 30 °C to kelvin

1.1.2 293 kelvin to °C

(2 x 2) (4)

1.2 Make a neat sketch of the Celsius thermometer and Kelvin scale thermometer and clearly show the freezing and boiling points on each. (6)

1.3 What is the abbreviation used for *specific heat capacity*? (1)

1.4 Calculate the mass of steel required if 267,3 kJ heat energy is needed to raise the temperature of the steel from 283 K to 338 K.

The specific heat capacity of steel is 0,486 kJ/kg.K.
Let t_2 be the final temperature in kelvin and t the initial temperature in kelvin. (4)

[15]

QUESTION 2

2.1 What is meant by *capillarity*?
Explain by referring to voids in a burnt clay brick. (4)

2.2 Explain how the porosity of a material will influence its strength. (6)

2.3 Calculate the volume of the pores of a material for which the following information is given:

Saturation coefficient = 0,90
Volume of water absorbed = 0,036 cm^3 (4)

[14]

QUESTION 3

3.1 What can be deduced from Archimedes' discovery if a body that contains matter is immersed partially or wholly in a fluid? Keep in mind the properties of matter. (6)

3.2 Define the term *buoyed*. (2)

3.3 Describe the experiment used to prove that the volume of a body immersed in water is equal to the volume of the displaced water. (7)

[15]

QUESTION 4

4.1 Name any FIVE properties of lead as roof covering. (5)

4.2 What happens to copper if it is subjected to climatic change? (1)
[6]

QUESTION 5

5.1 What does the *triangle of forces* state? (4)

5.2 The system of coplanar, concurrent forces shown in FIGURE 1 on the attached DIAGRAM SHEET 1 is held in equilibrium by the force **F**.

Calculate the magnitude and direction of force **F** by adding the components of the given forces. (12)
[16]

QUESTION 6

The beam shown in FIGURE 2 on the attached DIAGRAM SHEET 1 is in equilibrium. It supports four point loads and one uniformly distributed load as indicated.

Ignore the weight of the beam and calculate the following:

6.1 6.1.1 The magnitude of the reaction at A by taking moments about the reaction at B (4)

6.1.2 The magnitude of the reaction at B by taking moments about the reaction at A (4)

6.2 Test the TWO answers in QUESTION 6.1. (2)
[10]

QUESTION 7

A metal piece of uniform thickness is shown in FIGURE 3 on the attached DIAGRAM SHEET 2. This workpiece has a round hole exactly in the centre of the top part.

Calculate the position of the centre of gravity by taking moments about X–X. Tabulate the solution neatly. **[9]**

QUESTION 8

FIGURE 4 on the attached DIAGRAM SHEET 2 depicts a roof truss that is loaded and supported symmetrically.

8.1 Redraw the given SPACE DIAGRAM to a scale of 1 : 100 in the ANSWER BOOK and show the nature of the forces. (1)

8.2 Determine the magnitude and nature of the force in each member of the roof truss by drawing a VECTOR DIAGRAM to scale 2 mm = 1 kN. (7)

8.3 Redraw and complete the TABLE below in the ANSWER BOOK.

MEMBER	MAGNITUDE	TIE	STRUT
BH; EN			
CK; DL			
FN; AH			
GM; GJ			
HJ; MN			
JK; LM			
KJ			

(7)
[15]

TOTAL: 100

DIAGRAM SHEET 1

QUESTION 5.2

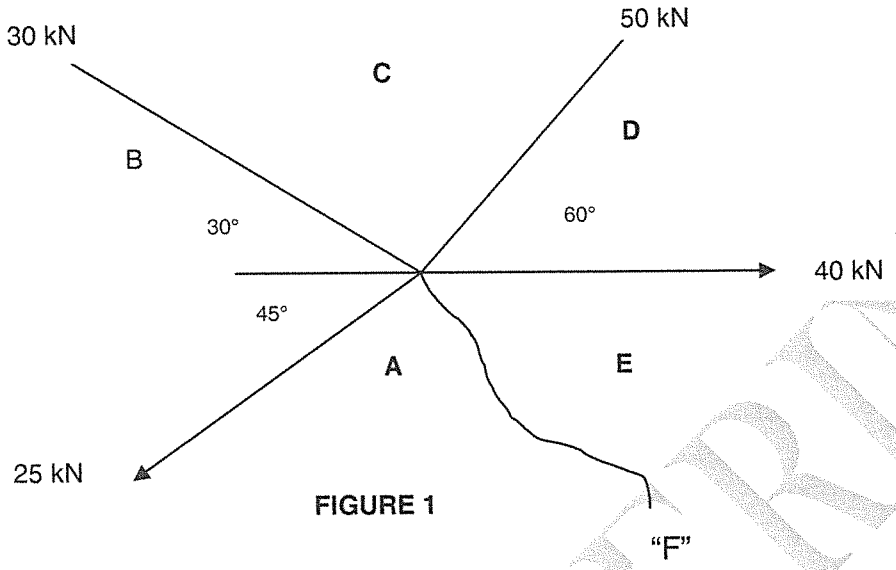


FIGURE 1

QUESTION 6

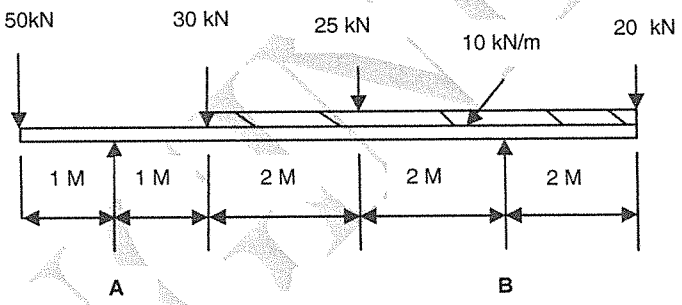


FIGURE 2

DRAWINGS NOT TO SCALE

DIAGRAM SHEET 2

QUESTION 7

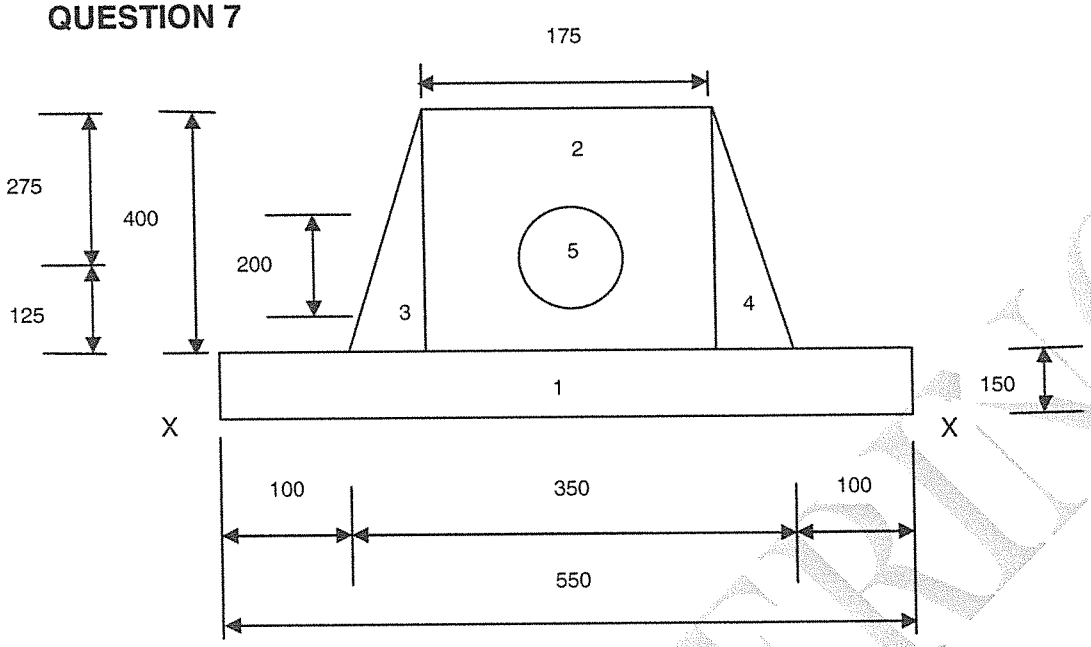


FIGURE 3

QUESTION 8

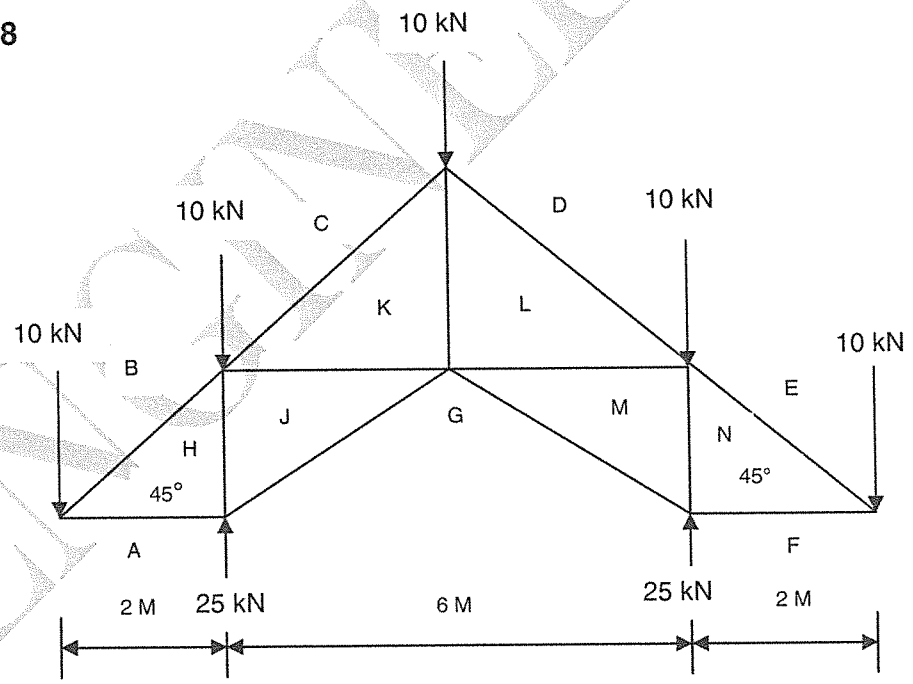


FIGURE 4

DRAWINGS NOT TO SCALE

BUILDING SCIENCE N2

FORMULA SHEET

Any other applicable formula may also be used.

1. $F = m \times g$

2. $VC = R \sin 2$
   $HC = R \cos 2$

3. $R = \sqrt{VC^2 + HC^2}$

4. $M = F \times s$

5. $\Gamma\ CWM = \Gamma\ ACWM$

6. $\Gamma[F = \Gamma\ .\!:F$

7. $x = \dfrac{\Sigma Ax}{\Sigma A}$

8. $T = \dfrac{g.\rho.h.r}{2}$

9. $\tau = r.F.\ \sin 2$

10. $\%\ Porosity = \dfrac{Bulk\ Volume - Solid\ Volume}{Bulk\ Volume} \times 100$

11. $Saturation\ coefficient = \dfrac{Volume\ of\ \ water\ absorbed}{Bulk\ Volume - Solid\ Volume}$

12. $D = \dfrac{m}{V}$

13. $RD = \dfrac{DS}{D.W} = \dfrac{mS}{mW}$

14. $0°C = 273\ K$

15. $Lu = Lo \times)t \times \forall$

16. $Heat\ Required\ = Lo \times)t \times SHC$

17. $Heat\ Gain = Heat\ Loss$

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

BUILDING SCIENCE N2

7 April 2015

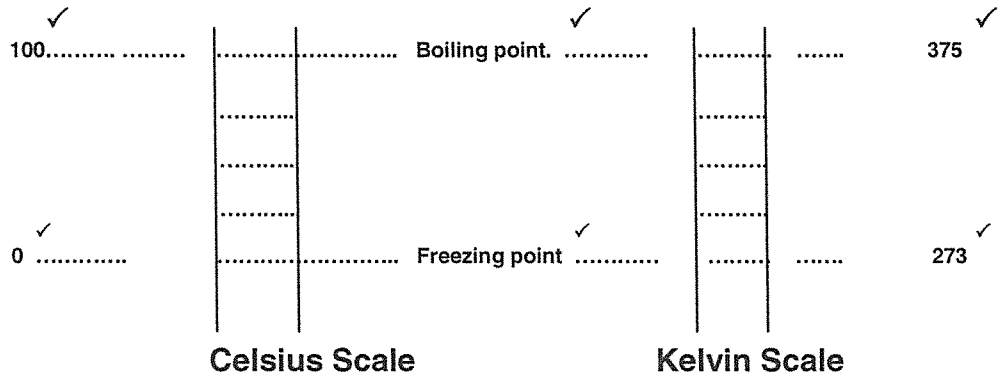
This marking guideline consists of 8 pages.

QUESTION 1

1.1 1.1.1 $T = t + 273$
$T = (273 + 30)K$✓
$T = 303\ K$✓ (2)

1.1.2 $T = t + 273$
$t = T - 273$
$t = 293 - 273$✓
$t = 20\ °C$✓ (2)

1.2



(6)

1.3 s.h.c. (1)

1.4 Given: Q = 267,3 kJ
$T1 = 283\ K$
$T_2 = 338\ K$
Specific heat capacity = 0,486 kJ/kg.K
M = ?

267,3 kJ = m × 0,486 kJ/kg.K × (338 – 283) ✓
267,3 kJ = m × 26,73 kJ/kg✓
m = (267,3/26,73) kg✓
m = 10 kg✓ (4)
[15]

QUESTION 2

2.1 A burnt clay brick has many pores or voids✓ which are interconnected.✓ The rising of water into these pores✓ or voids is called capillarity.✓ (4)

2.2 The more pores there are✓ in a material, the less compressive strength it has✓ because the pores are filled with air.✓ If the density of the material increases✓, that is if there are less pores✓, then the compressive strength increases. ✓ (6)

2.3 Volume of pores = Volume of water absorbed✓ ÷ saturated coefficient✓
Volume of pores = 0,036 cm^3 ÷ 0, 90✓
Volume of pores = 0,040 cm^3✓ (4)
[14]

QUESTION 3

3.1
- The water displaced will be equal✓ to the volume of the body immersed in water.✓
- An object in a fluid is buoyed up✓ by a force equal to the weight of the displaced fluid. ✓
- If a body is immersed partially or wholly in a fluid✓ it apparently loses weight equal to that of the displaced liquid. ✓ (6)

3.2 Buoyed = pushed up✓, keep up or bring to the surface✓ (2)

3.3
- Use a measuring cylinder and fill it up to the 100 cm^3 mark.✓
- Lower a piece of metal, 5 cm × 5 cm × 3 cm, attached to a string✓ into the cylinder, shake gently to remove all air bubbles.✓
- Write down the new reading and subtract the 100 cm^3.✓
- The end result should be 75 cm^3✓ which is the volume of the piece of metal.✓
- Therefore: The volume of liquid displaced is equal to the volume of the object immersed in the liquid.✓ (7)

[15]

QUESTION 4

4.1
- Durable✓
- Low tensile strength✓
- High coefficient of expansion and contraction✓
- Soft and easy to work with✓
- Very expensive✓
- Very malleable✓
- Tough and flexible✓ (Any 5 x 1) (5)

4.2 It tends to become greenish in colour ✓ (1)

[6]

QUESTION 5

5.1 If three forces acting on a point✓ are in equilibrium✓ then the forces can be represented in magnitude and direction✓ by the sides of a triangle when taken in order.✓ (4)

5.2

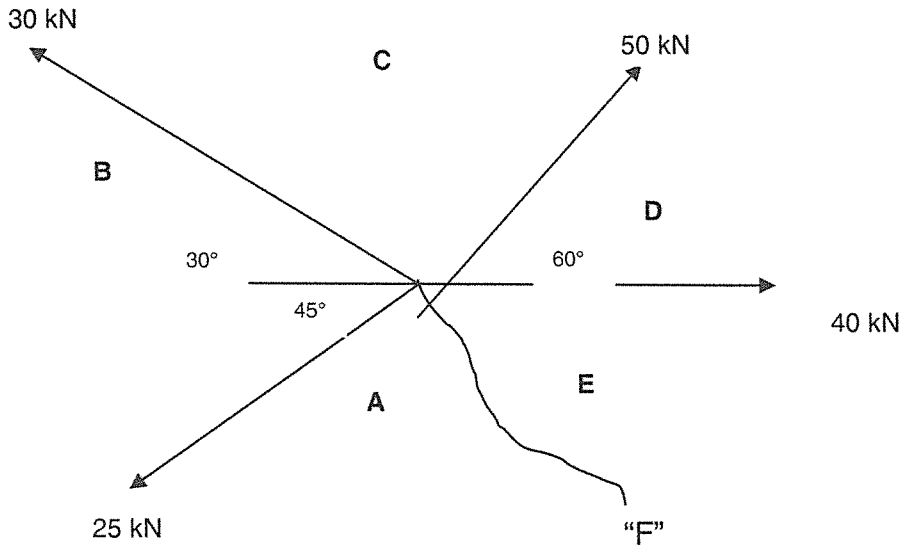


FIGURE 1

FORCE	VERTICAL COMPONENT		HORIZONTAL COMPONENT	
AB	25 × Sin 45°✓	-17,678✓	25 × Cos 45°✓	- 17,678✓
BC	30 × Sin 30 °✓	+ 15,0✓	30 × Cos 30°✓	- 25,981✓
CD	50 × Sin 60° ✓	+ 43,301✓	50 × Cos 60°✓	+ 25,0✓
DE	40 × Sin 0° ✓	0✓	40 × Cos 0°✓	+ 40,0✓

$\sum$ VC = 40,623 kN north ✓ $\sum$ HC = 21,341 kN east✓

$F = VC^2 + HC^2$
$= 40{,}623^2 + 21{,}341^2$✓
$= 45{,}888$ kN✓

$\text{Tan } \alpha = \sum VC \div \sum HC$
$= 40{,}623 \div 21{,}341$✓
$= 1{,}9035 \div \text{Tan}$✓
$= 62{,}285°$✓
45,888 kN @ 62,285° south of east✓

(24 x ½) (12)
[16]

QUESTION 6

6.1 6.1.1 Take moments about Rb to calculate Ra

$\sum$ O right moments = $\sum$ O left moments

$(20 \times 20) + (Ra \times 5) = (25 \times 2) + (30 \times 4) + (50 \times 6) + (10 \times 6 \times 1)$ ✓

$40 + 5\,Ra = 50 + 120 + 300 + 60$

$5\,Ra = 530 - 40$ ✓

$Ra = 490/5$ ✓

$Ra = 98$ kN ✓ (4)

6.1.2 Take moments about Ra to calculate Rb

$\sum$ O left moments = $\sum$ O right moments

$(50 \times 1) + (Rb \times 5) = (30 \times 1) + (25 \times 3) + (20 \times 7) + (10 \times 6 \times 4)$ ✓

$50 + 5\,Rb = 30 + 75 + 140 + 240$

$5\,Rb = 485 - 50$ ✓

$Rb = 435 / 5$ ✓

$Rb = 87$ kN ✓ (4)

6.2 $\sum$ upward forces = $\sum$ downward forces

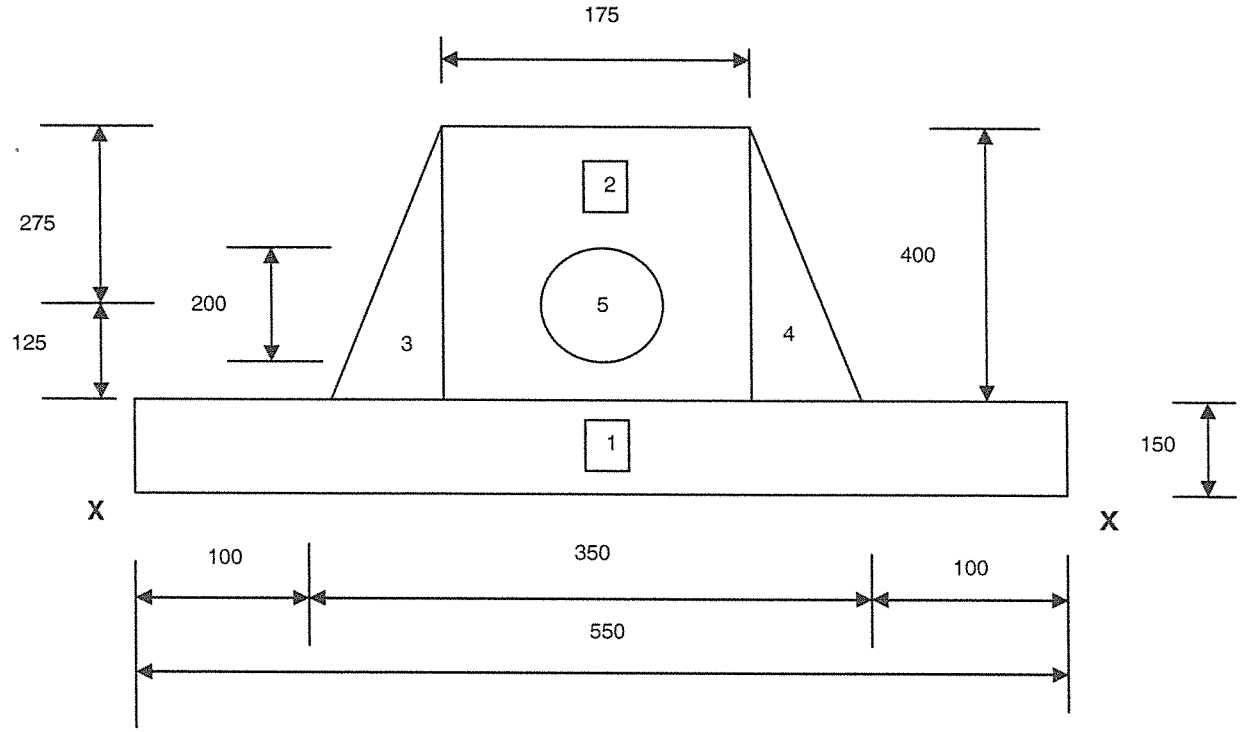
$Ra + Rb = 50 + 30 + 25 + 20 + (10 \times 6)$ ✓

$(98 + 87) = 50 + 30 + 25 + 20 + 60$ ✓

185 kN = 185 kN (2)

[10]

QUESTION 7

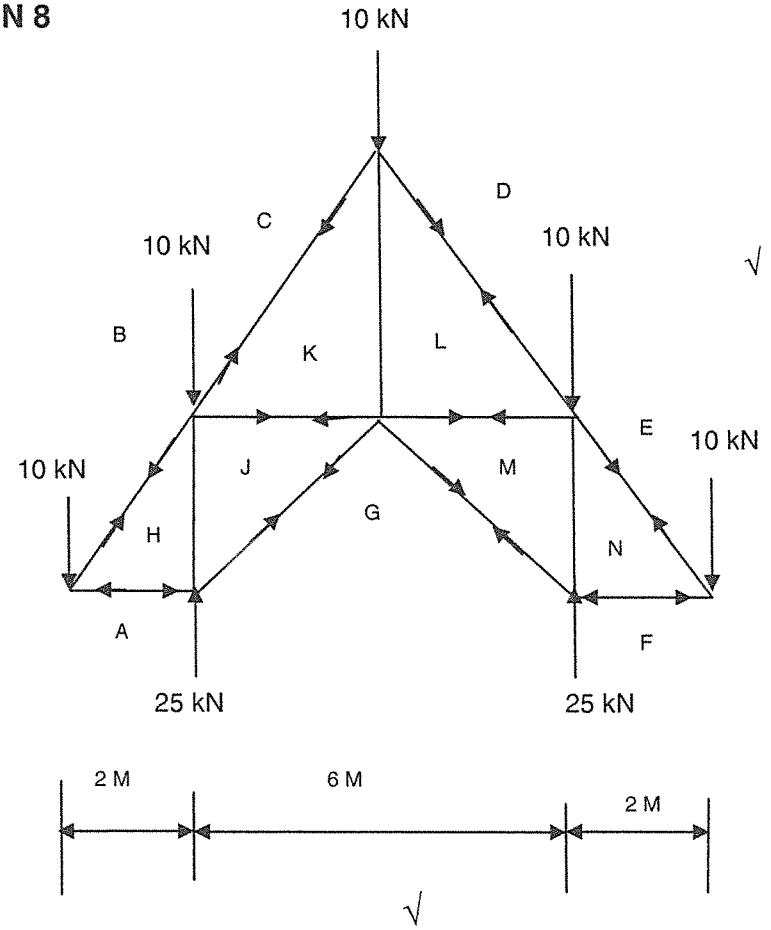


Member	Area	Distance	Area × Distance
1	L × b 550 × 150 = 82 500 mm²	150 ÷ 2 = 75 mm	6187500 mm³✓
2	L × b 400 × 175 = 70 000 mm²	200 + 150 = 350 mm	24500 000 mm³✓
3	½ × 87,5 (275 + 125) = 17 500 mm²	(400 × 1/3) + 150 = 283,333 mm	4958327,5 mm³✓
4	½ × 87,5 (275 + 125) = 17 500 mm	(400 × 1/3) + 150 = 283,333 mm	4958327,5 mm³✓
5	- πr² = - 3,14 × 100² = - 31 400 mm²	100 + 25 + 150 = 275 mm	- 8635000 mm³✓
	TOT: 156 100 mm²✓		TOT: 31969155 mm³✓

y = (TOT. Area × Distance) ÷ TOT. Area
= 31969155 mm³ ÷ 156100 mm²✓
= 204,799 mm from x-x✓

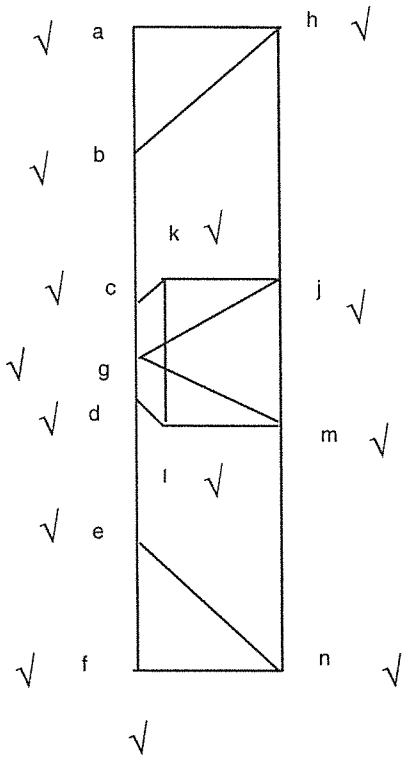
[9]

QUESTION 8



√

SPACE DIAGRAM SCALE 1 : 100 (2 x ½) = 1



(14 x ½) = 7

VECTOR DIAGRAM SCALE 2 mm = 1 kN

MEMBER	MAGNITUDE	TIE	STRUT
BH; EN	14 kN✓	✓	
CK; DL	22 kN✓	✓	
FN; AH	10 kN✓		✓
GM; GJ	17,5 kN✓		✓
HJ; MN	10 kN✓		✓
JK; LM	15 kN✓	✓	
KL	15 kN ✓		✓

(14 x ½) 7
[15]

TOTAL: 100