higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T250(E)(N21)T
NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

BUILDING SCIENCE N2

(15070012)

21 November 2013 (X-Paper)
09:00–12:00

Candidates will require drawing instruments.

Calculators may be used.

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

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. Rule off on completion of each answer.
5. ALL the sketches and/or diagrams must be done in pencil. The sketches and/or diagrams must be neat, reasonably large and fully labelled.
6. Untidy and/or illegible work will be strictly penalised.
7. Assume 1 kg mass exerts a force of 10 N.
8. Write down the formula before you start with the calculation.
9. Write neatly and legibly.

QUESTION 1

1.1 Define the following:

1.1.1 The equilibrant of a system of forces

1.1.2 The resultant of a system of forces

(2 × 2) (4)

1.2 Graphically find the magnitude and direction of the resultant force of the system of coplanar concurrent forces shown in FIGURE 1 on the attached DIAGRAM SHEET 1. (10)
[14]

QUESTION 2

2.1 Define the term *couple.* (2)

2.2 FIGURE 2, DIAGRAM SHEET 1 (attached), shows a lever held in position by a pivot at O and by a force F.

2.2.1 Graphically determine the magnitude of force F.

2.2.2 Graphically determine the magnitude and direction of the pivot at point O. (10)
[12]

QUESTION 3

3.1 Define the *centre of gravity of a lamina.* (3)

3.2 FIGURE 3, DIAGRAM SHEET 2 (attached), shows a lamina of which the triangle section has been removed that is symmetrical about its vertical axis X-X.

Calculate the distance of the centre of gravity from the side A-B. (11)
[14]

QUESTION 4

FIGURE 4, DIAGRAM SHEET 2 (attached), shows a simply supported beam 11 metres long supported at points C and D. The beam supports a 4 kN/m distributed load that stretches from points C to D and two point loads as shown.

Calculate the magnitude of the reactions R_L and R_R.

NB: Ignore the mass of the beam. **[10]**

QUESTION 5

A symmetrical roof truss loaded as shown in FIGURE 5, DIAGRAM SHEET 2 (attached) is in equilibrium.

5.1 Determine the support reactions. (1)

5.2 Draw, to a suitable scale, the frame. Indicate which members are in tension and which are in compression (4½)

5.3 Draw, to a suitable scale, the force/stress diagram. (4½)

5.4 Copy and complete the following TABLE in the ANSWER BOOK.

MEMBER	MAGNITUDE OF FORCE	NATURE
AF		
BG		
CH		
DJ		
EF		
FG		
GH		
HJ		
JE		

(5)
[15]

QUESTION 6

6.1 Define the difference between *heat* and *temperature.* (4)

6.2 Name at least THREE causes of heat. (3)

6.3 Give at least THREE effects of heat on a substance. (3)

6.4 Name the THREE ways in which heat is transmitted. (3)
[13]

QUESTION 7

7.1 State the difference between *density* and *relative density* (specific weight) of a substance. (5)

7.2 A material has a relative density (specific weight) of substance of 0,8.

Find the density of the substance in kg/m^2. (2)

7.3 A sample of 2 m^3 of a material has a mass of 4 200 kg.

Find the relative density of the material. (2)
[9]

QUESTION 8

8.1 Explain what *surface tension* is. (2)

8.2 Calculate the surface tension of a liquid with a density of 1 250 kg/m^3 which rose 40 mm up inside a capillarity tube with a radius of 8 mm. Use gravity as 9, 81 m/s^2. (3)

8.3 Briefly describe what is meant by *porosity of material.* (2)

8.4 Calculate the percentage porosity of a piece of brick material.

Given the following:

The bulk (apparent) volume of the brick = 7,46 cm^3
The solid (absolute) volume determined by crushing to powder = 6,2 cm^3 (3)

8.5 Determine the saturation of a brick when 0,035 cm^3 water is absorbed and the volume of voids is calculated to be 0,42 cm^3. (3)
[13]

TOTAL: 100

BUILDING SCIENCE N2

FORMULA SHEET

Any other applicable formula may also be used.

1. $F = m \times g$

2. $VC = R\ sin2$
   $HC = R\ cos2$

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

4. $M = F \times s$

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

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

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

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

9. $\tau = r.F.\ sin2$

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

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

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

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

14. $0°C = 273\ K$

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

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

17. $Heat\ Gain = Heat\ Loss$

18. $\%\ Porosity = \frac{Bulk\ volume - Solid\ volume}{Bulk\ volume} \times \frac{100}{1}$

DIAGRAM SHEET 1

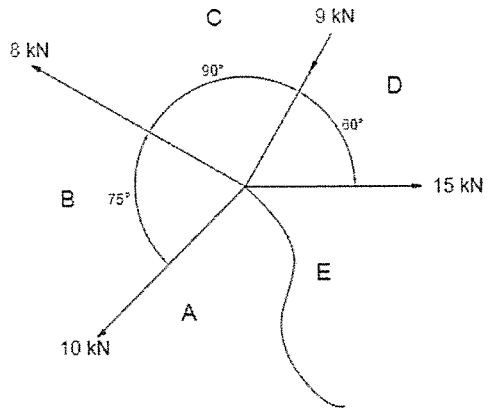

FIGURE 1

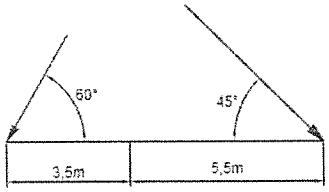

FIGURE 2

DIAGRAM SHEET 2

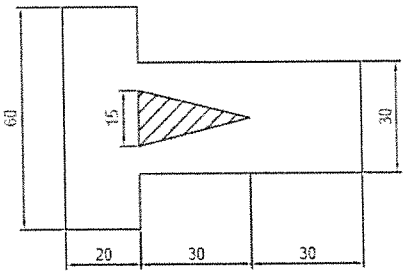

FIGURE 3

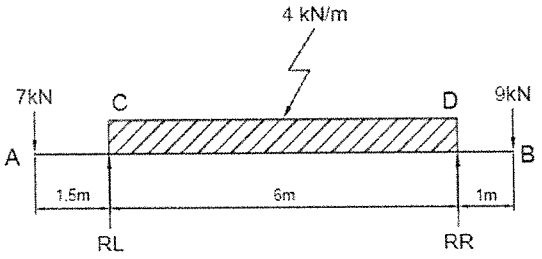

FIGURE 4

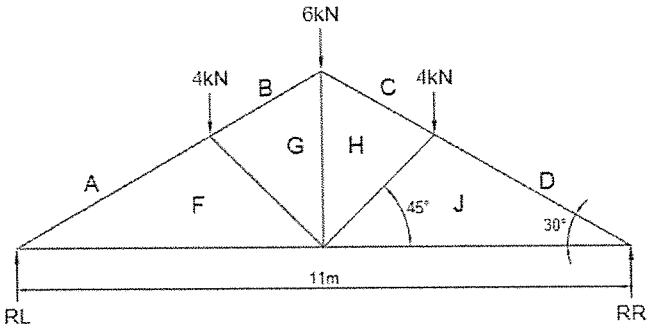

FIGURE 5

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MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

BUILDING SCIENCE N2

21 NOVEMBER 2013

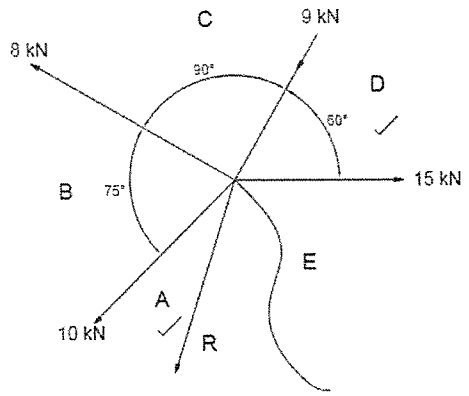
This marking guideline consists of 7 pages.

QUESTION 1

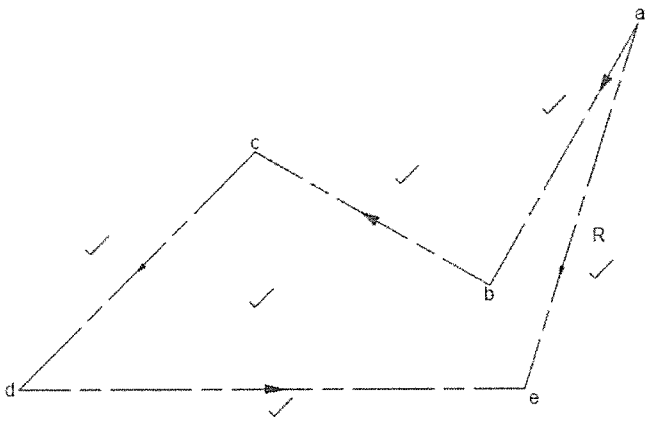
1.1 1.1.1 When a single force keeps a system of forces at rest, that single force is called the equilibrant. (2 × 1) (2)

1.1.2 When a single force can be found to replace a number of forces that single force is called the resultant. (2 × 1) (2)

1.2



SPACE DIAGRAM



VECTOR DIAGRAM

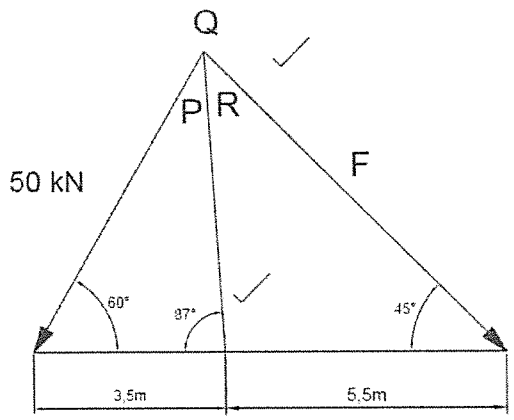
RESULTANT = AE = 12kN ✓
DOWNWARDS AT 74° ✓ (10)

[14]

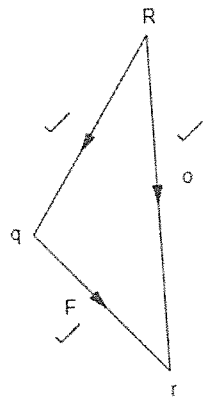
QUESTION 2

2.1 When two equal parallel forces are working in opposite direction it is known as a couple. (2 × 1) (2)

2.2



SPACE DIAGRAM
SCALE: 1 cm = 1 m



VECTOR DIAGRAM
SCALE: 1cm =10kN

F= QR= 38 kN
O= RP = 70 kN ACTING UPWARDS AT 36°

(10)

[12]

QUESTION 3

3.1 The centre of gravity of a body/lamina is that centre in space through which the resultant pulls of the earth, the weight of the body for all possible positions of the body apply. (3 × 1) (3)

3.2

Areas	x distance from side AB	Moments about AB
60 × 20 = 1 200√	20 ÷ 2 = 10 √	1 200 × 10 = 12 000 √
60 × 30 = 1800 √	60 ÷ 2 +20 = 50 √	1 800 × 50 = 90 000 √
–7,5 × 30 = –225 √	⅓ × 30 + 20 = 30 √	-225 × 30 = –6750 √
= 2775		= 95 250

$$= \frac{95\ 250\ \surd}{2\ 775}$$

= 34,324 units √

(11)
[14]

QUESTION 4

To find R_L – Taking moments about R_R

√½ √½ √½ √½
$(R_L \times 6) + (9 \times 1) = (4 \times 6 \times 3) + (7 \times 7{,}5)$

$6\ R_L = 72 + 52{,}5 - 9$ √

$R_L = 115{,}5 \div 6$ √

R_L = 19,25 kN √ (5)

To find R_R – Taking moments about R_L

√½ √½ √½ √½
$(R_R \times 6) + (7 \times 1{,}5) = (4 \times 6 \times 3) + (9 \times 7)$

$6\ R_R = 72 + 63 - 10{,}5$ √

$R_R = 124{,}5 \div 6$ √

R_R = 20,75 kN √ (5)
[10]

QUESTION 5

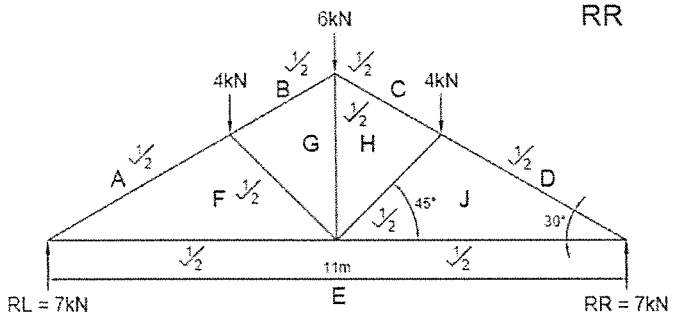
REACTIONS

RR + RL = 4 + 6 + 12

= 14 + 2

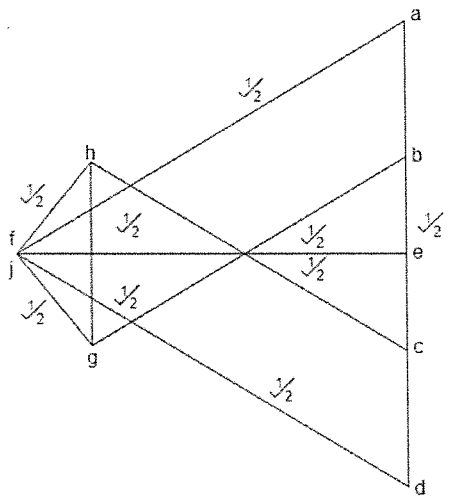
RL = 7kN ½

RR = 7kN ½ (1)



SPACE DIAGRAM
SCALE: 1 cm = 1 m

(9 x ½ = 4½)



FORCE DIAGRAM
SCALE: 1cm =1kN

(9 x ½ = 4½)

(10)

MEMBER	MAGNITUDE OF FORCE	NATURE
AF	14 kN √½	STRUT
BG	11 kN√½	STRUT
CH	11 kN √½	STRUT
DJ	14 kN √½	STRUT
EF	12,25 kN √½	TIE
FG	3,25 kN √½	STRUT
GH	5 ,0 kN √½½	TIE
HJ	3,25 kN √½	STRUT
JE	12,25 kN √½	TIE

(5)
[15]

QUESTION 6

6.1 Heat is a form of energy which causes the molecules in a substance to vibrate and move more freely whereas (Any 2 × 1)
Temperature is the degree of hotness or coldness of a body. (Any 2 × 1) (4)

6.2
- Sun
- Fuels
- Electricity
- Friction
- Chemical reaction
- Internal heat of the earth
- Change of state of aggregation (Any 3 × 1) (3)

6.3
- Temperature
- Condition
- Dimensions
- Colour
- Phase
- Composition (Any 3 × 1) (3)

6.4
- Convection
- Conduction
- Radiation (3)

[13]

QUESTION 7

7.1 Density is the mass per unit volume of a substance whereas
Relative density (specific weight) is the ratio between the mass of any volume of a substance to the mass of an equal volume of water, expressed as a number. (5 × 1)

OR

Relative density expresses the number of times the material is heavier than water when comparing equal volumes of each. (5)

7.2 R.D = Density of material / Density of water (density of water = 1 000 kg/m)³
Density of material = R.D x Density of water √½
Density of material = 0,8 x 1 000 √½
Density of material = 800 kg/m³ √ (0,8 g/cm³) (2)

7.3 R.D = Mass of material / Mass of an equal vol. water
R.D = 4 200 kg / 2 000 kg
R.D = 2,1 (no unit) (2)
[9]

QUESTION 8

8.1 The surface of a fluid and the outside of the water drop of this cohesion causes an inward or downward attraction called surface tension (2)

8.2 Surface tension.= T.= p g h r √ / 2
T = 1250 x 9,81 x 0,04 x 0,008 √ / 2
T = 1,962 N/m √ (3)

8.3 Porosity is the amount of pore spaces or voids present in a material.
OR
Porosity is the total volume of pore spaces compared with the total volume of a body. (2)

8.4 % Porosity = (Bulk volume – Solid volume / Bulk volume) x 100 / 1
√½ √ ½ √½
% Porosity = (7,46 – 6,20 / 7,64 √½) x 100 / 1
% Porosity = 18,85 % √ (3)

8.5 Saturation coefficient = volume of the water absorbed / Volume of the pores

Saturation coefficient = 0,035 √ / 0,42 √

Saturation coefficient = 0,0833√ (3)
[13]

TOTAL: 100