higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T272**(E)**(N22)T
NOVEMBER 2010

NATIONAL CERTIFICATE

BUILDING SCIENCE N2

(15070012)

22 November (X-Paper)
09:00 – 12:00

Candidates will require drawing instruments, a pen and a ruler.

Calculators may be used.

This question paper consists of 4 pages, 1 diagram sheet and a 1-page formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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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 correctly according to the numbering system used in this question paper.
4. Rule off across the page on completion of each question.
5. ALL sketches and/or diagrams must be done in pencil. The sketches must be neat, reasonably large, in relation and fully labelled.
6. Assume that a 1 kg mass exerts a force of 10 N.
7. Write the formula before you start with the calculation.
8. Write neatly and legibly.

QUESTION 1

1.1 Describe the following terms as encountered in building science:

1.1.1	Resultant force	(3)
1.1.2	Triangle of forces	(3)
1.1.3	Law of moments	(3)
1.1.4	Archimedes' principle of flotation	(3)

1.2 Draw the space diagram in FIGURE 1, DIAGRAM SHEET (attached) as shown underneath the vector diagram to determine the magnitudes and directions of the two unknown forces R and S that keep the system in equilibrium. (11)
[23]

QUESTION 2

2.1 The beam is loaded as shown in FIGURE 2, DIAGRAM SHEET (attached) and is in equilibrium. Consider the weight of the beam and calculate the following:

2.1.1 The total weight of the beam (2)
2.1.2 The left reaction RL by taking moments about the right reaction RR (5)
2.1.3 The right reaction RR by taking moments about the left reaction RL (5)
2.1.4 Test the answers in QUESTIONS 2.1.2 and 2.1.3 for equilibrium. (2)

2.2 Name FOUR materials commonly used as roof coverings. (2)
[16]

QUESTION 3

3.1 The cantilever in FIGURE 3, DIAGRAM SHEET (attached) is in equilibrium. RT and RB hold it in position. Reproduce the given figure to scale 1:100 and complete the vector diagram to scale 1 mm: 2 kN. Tabulate the results neatly. (12)

3.2 Find, from the vector diagram completed in QUESTION 3.1, the magnitude and direction of the reactions at the wall (RT and RB). (3)
[15]

QUESTION 4

4.1 Describe, with the aid of sketches, any suitable experiment to prove that different metals have different coefficients of linear expansions. (5)

4.2 A steel bar has an original length of 6,7 m. The temperature of the bar is increased from 16 °C to 132 °C. Calculate the coefficient of linear expansion of the bar if the final length of the bar is 6,709 m. (6)

4.3 A steel ball with a mass of 8 kg and at an initial temperature of 210 °C is immersed in 35 litres of water at a temperature of 16 °C. Calculate the final temperature of the water and the steel ball. Assume that no heat was lost in the process.
SHC_{steel}= 550 J/kg °C and SHC_{water}= 4 187 J/kg °C (6)
[17]

QUESTION 5

5.1 FIGURE 4, DIAGRAM SHEET (attached) shows the dimensions (in millimetres) of a thin metal plate of uniform thickness. Calculate the position of the centroid measured from the base. NO marks will be given for a graphical solution. (11)

5.2 Name TWO absorbent and TWO non-absorbent building materials. (4)
[15]

QUESTION 6

6.1 The structure in FIGURE 5, DIAGRAM SHEET (attached) balances about the pivot at 'B'.
Calculate the magnitude of force 'F' by taking moments about the pivot. (5)

6.2 Determine the magnitude and direction of the reaction at the pivot 'B' by graphical means. (NO marks will be given to a calculation solution). (9)
[14]

TOTAL: 100

DIAGRAM SHEET

QUESTION 1.2

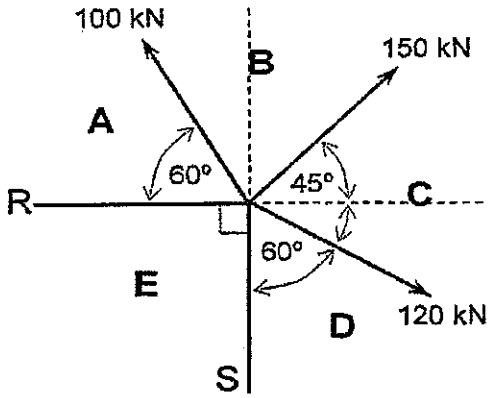

FIGURE 1

QUESTION 2.1

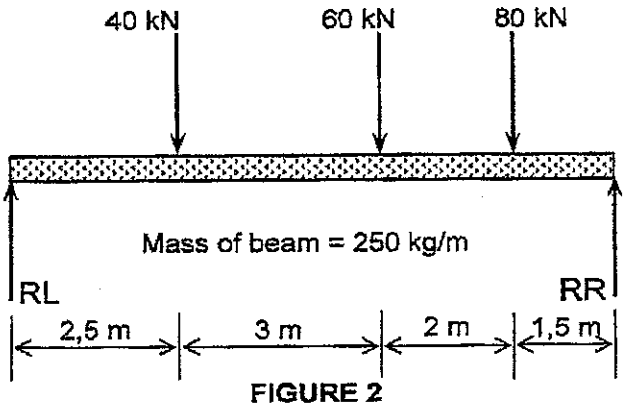

FIGURE 2

QUESTION 3.1

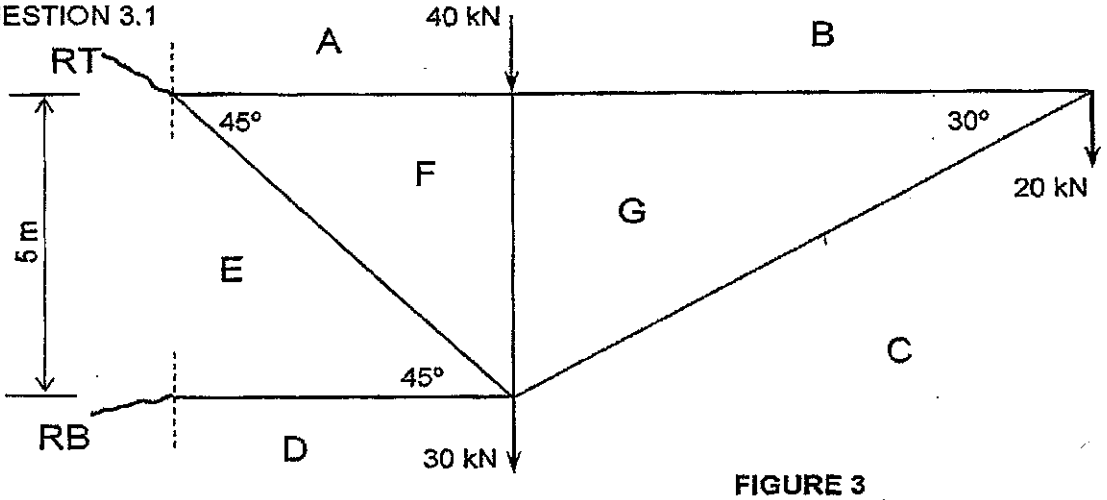

FIGURE 3

QUESTION 5.1

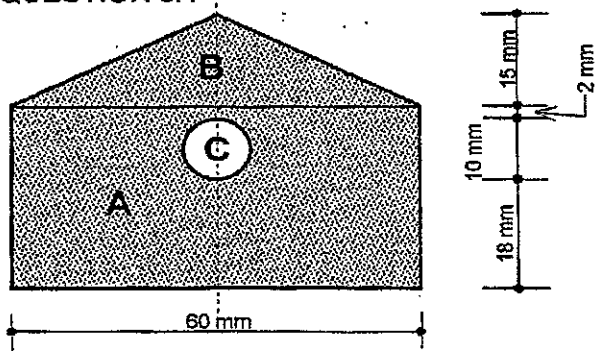

FIGURE 4

QUESTION 6

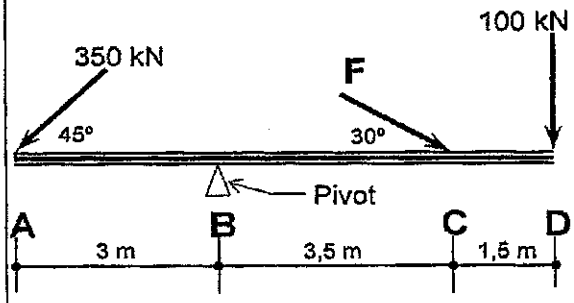

FIGURE 5

FORMULA SHEET

Any other applicable formula may also be used.

1. $F = m \times g$

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

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

4. $M = F \times s$

5. $\Sigma\ CWM = \Sigma\ ACWM$

6. $\Sigma\ \text{//}F = \Sigma\ \text{//}F$

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

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

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

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. $Lu = Lo \times \Delta t \times \alpha$

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

17. $Heat\ Gain = Heat\ Loss$

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