



# higher education & training

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

T180(E)(N21)T  
**NOVEMBER EXAMINATION**

NATIONAL CERTIFICATE

**BUILDING SCIENCE N2**

(15070012)

**21 November 2016 (X-Paper)**  
**09:00–12:00**

**Candidates need drawing instruments. Calculators may be used.**

**This question paper consists of 6 pages and 1 formula sheet.**

**DEPARTMENT OF HIGHER EDUCATION AND TRAINING**  
**REPUBLIC OF SOUTH AFRICA**  
NATIONAL CERTIFICATE  
BUILDING SCIENCE N2  
TIME: 3 HOURS  
MARKS: 100

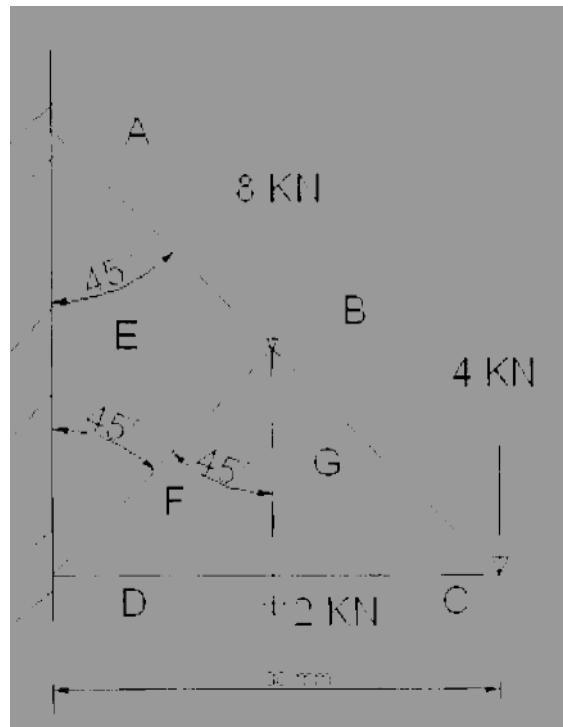
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**INSTRUCTIONS AND INFORMATION**

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. The sketches and/or diagrams must be neat and fully labelled.
  5. ALL the drawings must be drawn to the required scale.
  6. Use your discretion where dimensions are not given.
  7. Assume that 1 kg of mass exerts a force of 10 N.
  8. Write down the formula BEFORE you start your calculations.
  9. Work neatly.
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**QUESTION 1**

FIGURE 1 shows a cantilever frame fixed to the wall.

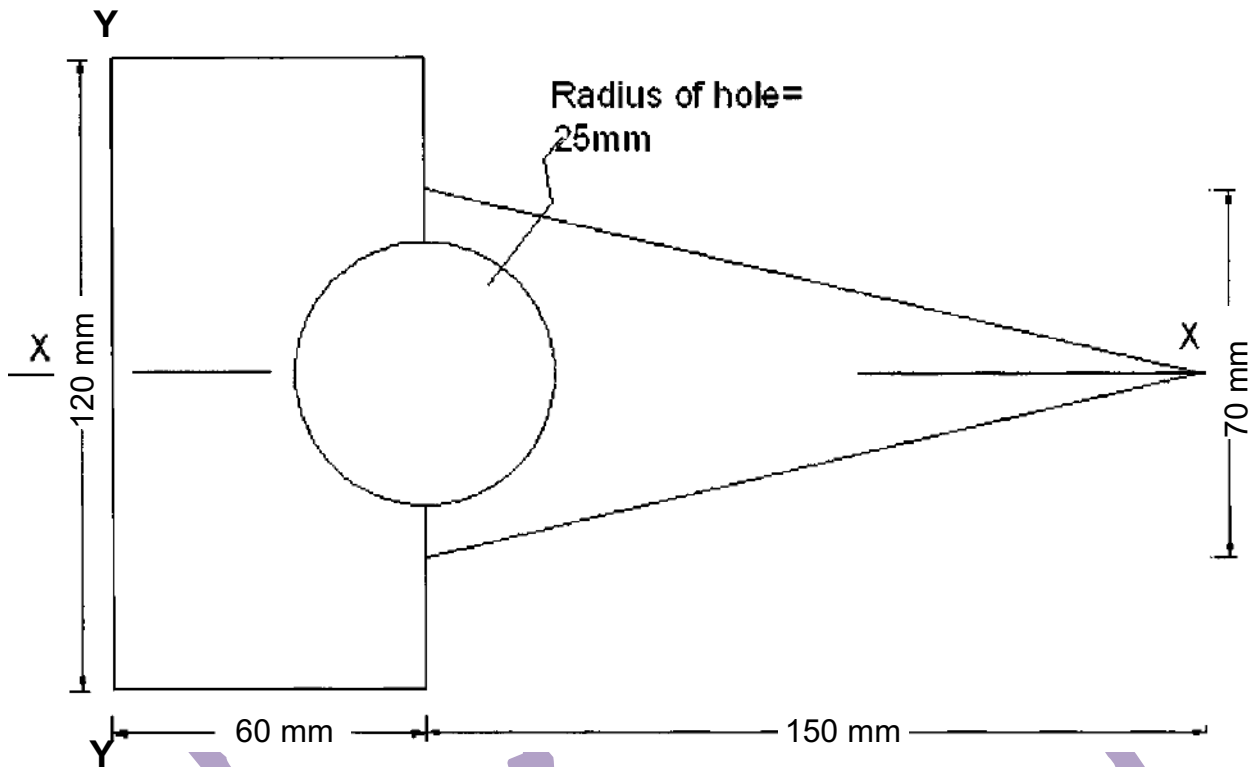
**FIGURE 1**

- 1.1 Draw the vector diagram to scale  $10 \text{ mm} = 1 \text{ kN}$ . (6)
- 1.2 Graphically find the following:
- 1.2.1 The magnitude of the members
- 1.2.2 The nature of the members (6)
- 1.3 Describe the term *polygon of forces*. (2)

**[14]**

**QUESTION 2**

A metal plate of even thickness is shown in FIGURE 2. The metal has one circular hole and the compound section is symmetrical about the X–X axis.

**FIGURE 2**

- 2.1 Calculate the total area of the compound section. (2)
- 2.2 Determine the distance of the centroid of each section from Y–Y. (3)
- 2.3 Calculate the sum of the moments of sections about Y–Y. (5)
- 2.4 Calculate the position of the centroid of the compound section from Y–Y. (4)

**[14]****QUESTION 3**

State the SI units of measurement and the symbols used for each of the following quantities:

- 3.1 Density
  - 3.2 Force
  - 3.3 Weight
  - 3.4 Moment of a force
  - 3.5 Torque
- Copyright reserved

Please turn over

3.6 Pressure

3.7 Stress

3.8 Velocity

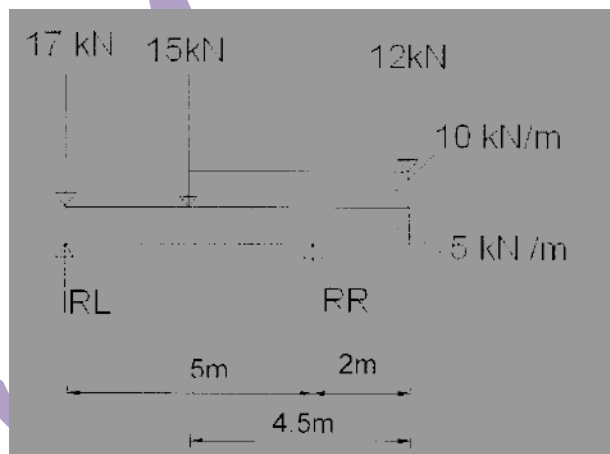
3.9 Heat energy

3.10 Specific heat capacity

(10 × 1) [10]

#### QUESTION 4

The beam shown in FIGURE 3 is held in equilibrium by the reactions RL and RR.



**FIGURE 3**

4.1 Take moments about RR to calculate the magnitude of RL. (4)

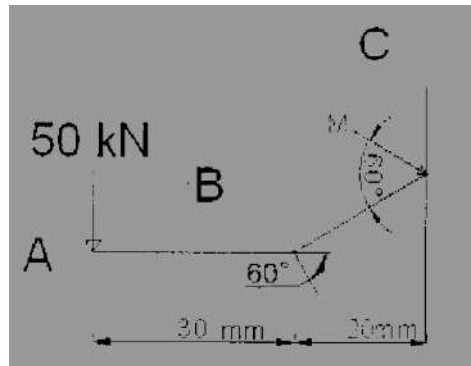
4.2 Take moments about RL to calculate the magnitude of RR. (4)

4.3 Test your answers to prove equilibrium. (2)

[10]

**QUESTION 5**

The lever arm in FIGURE 4 is in equilibrium with a turning point at the pivot. The lever arm is under the influence of applied force M and a 50 kN force.



**FIGURE 4**

- 5.1 Calculate the magnitude of force M. (7)
  - 5.2 Determine the magnitude of the force at the hinge. Draw the vector diagram to scale 2 mm = 1 kN. (7)
- [14]**

**QUESTION 6**

- 6.1 Describe an experiment that explains the principle of Archimedes. Use a 5 cm × 5 cm × 3 cm piece of metal, a measuring cylinder, a string, water and a 100 cm<sup>3</sup> mark for your experiment. Include a summary of the experiment to illustrate your answer. (12)
  - 6.2 Name THREE types of hydrometers. (6)
- [18]**

**QUESTION 7**

- 7.1 Name the properties of each of the following:
    - 7.1.1 Thatch roof
    - 7.1.2 Harvey tiles

(2 × 7) (14)
  - 7.2 State the maximum centre to centre spacing, in millimetres, of roof trusses relevant to the following roof coverings:
    - 7.2.1 Roof sheets, either metal or fibre cement
    - 7.2.2 Concrete roof tiles, clay tiles
    - 7.2.3 Metal tiles

(3 × 2) (6)
- [20]**

**TOTAL: 100**

**BUILDING SCIENCE N2****FORMULA SHEET**

Any other applicable formula may also be used.

$$1. \quad F = m \times g$$

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

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

$$4. \quad M = F \times s$$

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

$$6. \quad \Gamma F = \Gamma \therefore F$$

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

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

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

$$10. \quad \% \text{ Porosity} = \frac{\text{Bulk volume} - \text{Solid volume}}{\text{Bulk volume}} \times 100$$

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

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

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

$$14. \quad 0^\circ\text{C} = 273 \text{ K}$$

$$15. \quad Lu = Lo \times t \times \nabla$$

$$16. \quad \text{Heat required} = Lo \times t \times SHC$$

$$17. \quad \text{Heat gain} = \text{Heat loss}$$