higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1300**(E)**(N24)T

NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

STRENGTH OF MATERIALS AND STRUCTURES N5

(8060065)

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

REQUIREMENTS: Hot-rolled structural steel sections BOE8/2

Calculators may be used.

This question paper consists of 5 pages and 3 diagram sheets.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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NATIONAL CERTIFICATE
STRENGTH OF MATERIALS AND STRUCTURES N5
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

The following results were obtained by means of a tensile test on a mild-steel specimen having an original diameter of 25 mm and a length between the gauge points of 50 mm. The load at yield points was 86 kN and at the limit proportionality was 78 kN with the corresponding extension of 0,051 mm. The maximum load recorded was 158 kN. After fracture the length of the next piece was 60,1 mm and the neck diameter was 18 mm.

Calculate the following:

1.1 The stress at the limit proportionality

1.2 Young's modulus for the mild steel

1.3 The maximum tensile stress

1.4 The percentage elongation

1.5 The percentage reduction in area

(5 × 2) **[10]**

QUESTION 2

A steel rod 22 mm in diameter is provided with a screw thread on each end and also nuts having a pitch of 1,5 mm. A pipe of the same material and 1,3 m long with an internal diameter of 26 mm and thickness of 6 mm, is positioned between the two nuts and necessary washers of negligible thickness. The nuts are tightened to produce an initial stress of 13 kPa in the pipe.

Calculate the initial stress in the rod and the increase in the stress in each rod and pipe, when the nut is lightened through one revolution.

Take E = 200 GPa **[10]**

QUESTION 3

A compound bar consists of a steel pipe with a cross-sectional area of 1 480 mm^2 and a copper rod with a cross-sectional area of 500 mm^2. The rod fits inside the steel pipe with the ends rigidly fixed together, both having the same length. The initial length of the compound bar was 860 mm.

$E_s = 200\ GPa;\ E_c = 110\ GPa;\ \alpha_s = 12 \times 10^{-6}\ ^\circ C\ and\ \alpha_c = 18 \times 10^{-6}/^\circ C$

Calculate the following:

3.1 The magnitude and nature of stresses induced in the tube and the rod due to temperature change of 90 °C (6)

3.2 The final length of the compound bar (4)
[10]

QUESTION 4

A load of 95 N falls through a height of 200 mm onto a collar which is attached to the lower end of a rod as shown in FIGURE 1, DIAGRAM SHEET 1 (attached).

Calculate the maximum stress induced in the rod as well as the total strain energy. Take the instantaneous extension into consideration.

E = 210 GPa **[13]**

QUESTION 5

A solid shaft of 30 mm in diameter and a length of 450 mm is to transmit power at 1 200 r/min. The limitations are that the angle of twist should not exceed 1° and the shear stress should not exceed 56 MPa. The modulus of rigidity is 85 GPa.

Determine the following:

5.1 The torque that can be transmitted (6)

5.2 The actual stress or angle of twist of the shaft (2)

5.3 The power transmitted (2)
[10]

QUESTION 6

A cast-iron column is 5,4 m high and has an inside diameter of 18 mm and is 98 mm thick. The end of this column is hinged. The critical stress is 520 MPa and the Rankine constant a = 1/1 600.

Determine the buckling load for the column. Use a factor of safety of 3. **[10]**

QUESTION 7

FIGURE 2, DIAGRAM SHEET 2 (attached), shows a shear-force diagram of a certain beam.

Determine the following:

7.1 The loading diagram (6)

7.2 The bending-moment diagram (8)

7.3 The position of the points of inflection (6)

7.4 The suitable I-parallel flange beam that could be used if the maximum stress is limited to 60 MPa in both compression and tension (3)

7.5 The actual stress in the beam (2)
[25]

QUESTION 8

A roof truss is loaded as shown in FIGURE 3, DIAGRAM SHEET 3 (attached).

Determine the following:

8.1 The vector diagram for the truss (7)

8.2 The magnitude and nature of forces in members AF, FG, BG, GH and FE (5)
[12]

TOTAL: 100

DIAGRAM SHEET 1

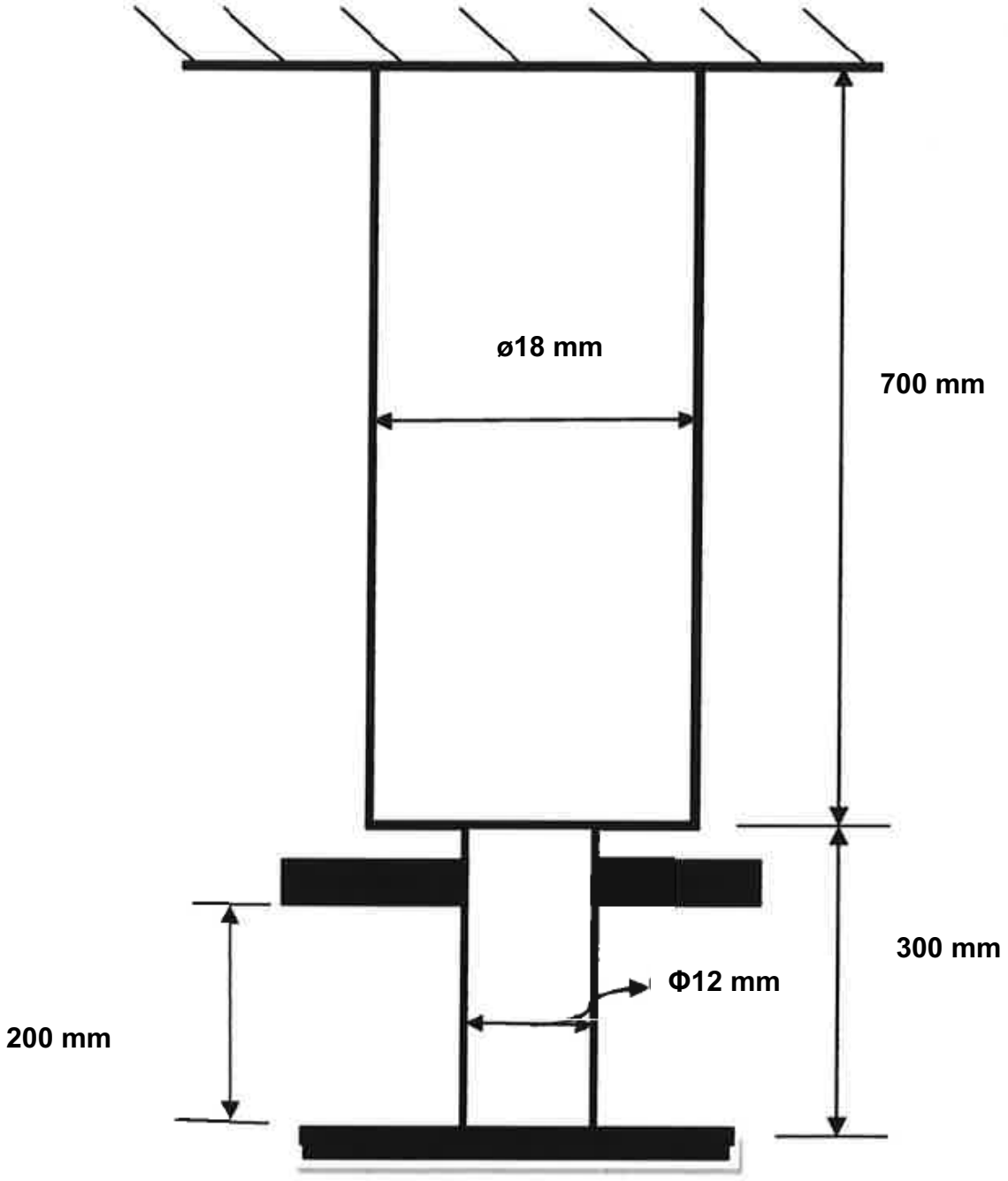

FIGURE 1

DIAGRAM SHEET 2

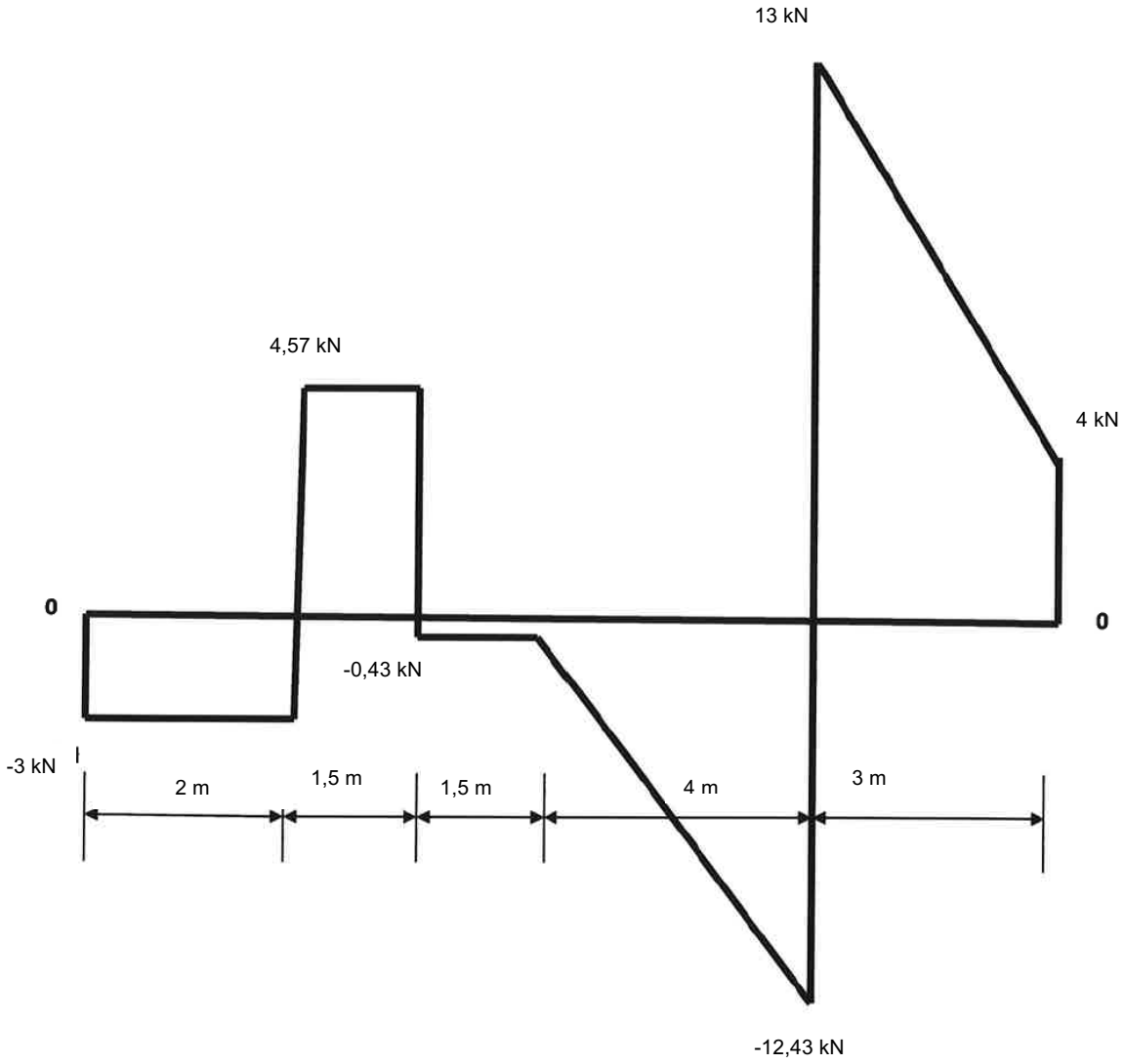

FIGURE 2

DIAGRAM SHEET 3

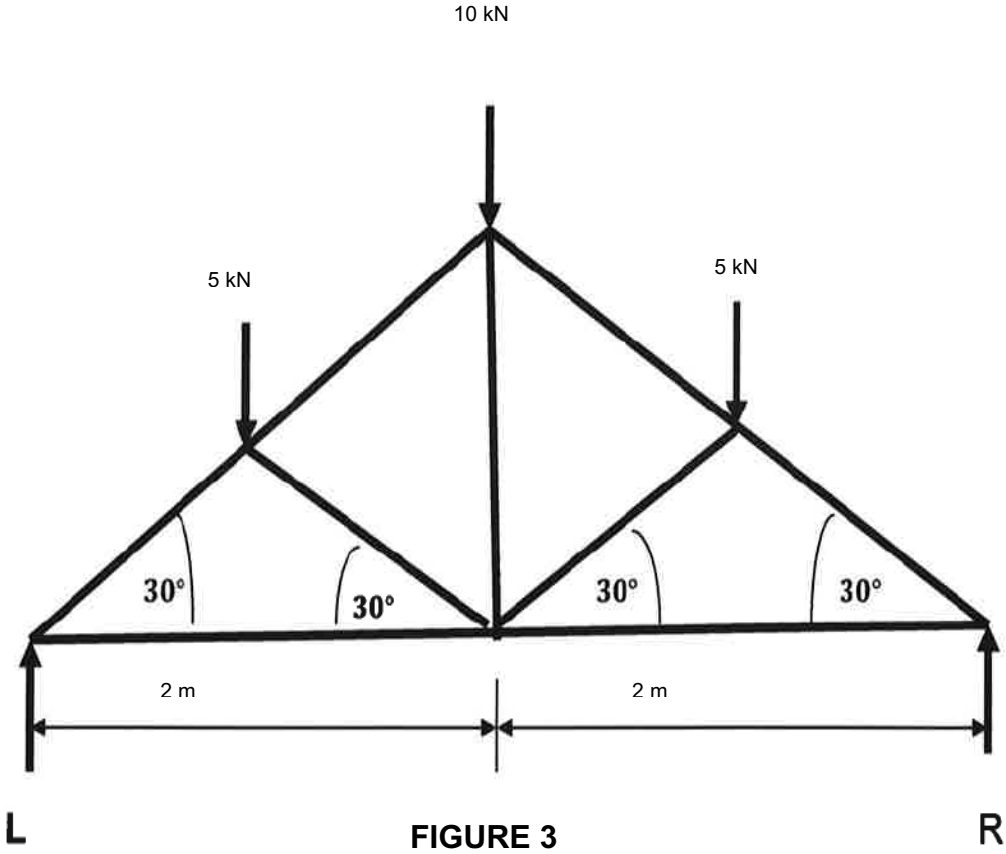

FIGURE 3