higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

MECHANICAL DRAWING AND DESIGN N5

(8090075)

23 July 2021 (X-paper)
09:00–13:00

OPEN-BOOK EXAMINATION

Nonprogrammable calculators may be used.

This question paper consists of 5 pages.

015Q1G2123

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
MECHANICAL DRAWING AND DESIGN N5
TIME: 4 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. A correct answer is worth only one mark. Show all the steps to achieve as many marks as possible. (An incorrect answer which must be carried forward will receive fair consideration.)
5. Do all sketches FREEHAND and in good proportion in the ANSWER BOOK.
6. Use standard size items where applicable.
7. Approximate all answers accurately to THREE decimal places.
8. Write neatly and legibly.

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QUESTION 1

A shaft is 20 mm in diameter and 380 mm long. When running at 2 000 r/min under a certain load, the torsion meter shows a deflection of 3,06°. The modulus of rigidity of the shaft material is 82 × 109 Pa.

What power is being transmitted and what will the shear stress in the shaft be? **[7]**

QUESTION 2

Two steel plates, each 15 mm thick, are joined by a double-riveted lap joint with rivets of diameter $d = 6\sqrt{t}$, using the nearest standard size rivet.

Given:

- Tensile stress of steel is 463 MPa
- Shear stress of steel is 386 MPa
- Crushing stress of steel is 618 MPa

Determine a suitable pitch for the rivets. Calculate the efficiencies relative to tearing, shear and crushing. State the efficiency of the joint. **[20]**

QUESTION 3

The particulars of a steam engine are as follows:

- Cylinder diameter 500 mm
- Stroke 600 mm
- Length of connecting rod 1,5 m

At the moment when the crank is at right angles to the connecting rod, the effective steam pressure on the piston is 550 kPa.

Determine the following for this position:

3.1 The thrust on the crosshead guide (9)

3.2 The force in the connecting rod (2)

[11]

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QUESTION 4

A tapered cotter joint joins two round rods which carry a safe tensile load of 50 kN.

Use the following safe stresses in the materials:

- Tensile stress is 72 MPa
- Shear stress is 60 MPa
- Compressive stress is 180 MPa

Assume the thickness of the cotter as t = 9 mm

4.1 Calculate the following:

4.1.1	The diameter of the rod	(3)
4.1.2	The diameter of the rod end at the cotter hole	(5)
4.1.3	The outside diameter of the socket end at the cotter hole	(5)
4.1.4	The mean width of the cotter	(3)

4.2 Test the following:

4.2.1	Crushing strength between cotter and rod	(2)
4.2.2	Crushing strength between cotter and socket flange	(3)

[21]

QUESTION 5

A knuckle joint has to carry a pull of 80 kN and the shear stress in the pin is not to exceed 85 MPa. The eye is 28 mm wide and the forks are 16 mm wide.

Calculate the following

5.1	What diameter pin must be used?	(4)
5.2	What will the crushing stresses between the pin and the eye be?	(3)
5.3	What will the crushing stresses between the pin and the fork be when the joint is carrying the 80 kN pull?	(3)

[10]

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QUESTION 6

Two 60 mm diameter shafts are to be connected by a claw coupling. The coupling has an external diameter of 160 mm, an internal diameter of 80 mm, and a depth of 32 mm. There are three claws on each half of the coupling. The shear stress in the shaft due to torsion is 62 MPa.

6.1 Calculate the shear and compressive stresses in the claws. (18)

6.2 Calculate the minimum length of the key in one half of the coupling.

NOTE: The shear stress in the key may not exceed 50 MPa. The compressive stress in the key may not exceed 148 MPa. (7)

[25]

QUESTION 7

The FIGURE below shows a welded lap joint of two plates. All dimensions are given in mm. A weld shear stress of 90 MPa is to be used. The total effective length of the weld is 252 mm and the weld thickness is 6 mm.

Calculate the tensile load F.

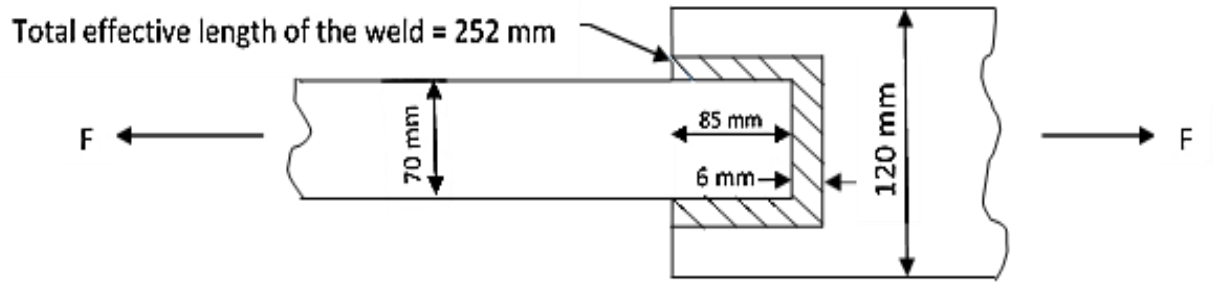

FIGURE **[6]**

TOTAL: 100

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