higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1080**(E)**(J25)T

NATIONAL CERTIFICATE

MECHANICAL DRAWING AND DESIGN N5

(8090075)

25 July 2019 (X-Paper)
09:00–13:00

OPEN-BOOK EXAMINATION

Candidates may use textbooks and personal notes.

Calculators and mathematical tables may be used.

This question paper consists of 6 pages.

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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. Questions may be answered in any order, but subsections of questions must be kept together.
5. Show ALL intermediate steps.
6. Sketches must be made FREEHAND and in good proportion in the ANSWER BOOK.
7. ALL the answers must be approximated to THREE decimal.
8. Write neatly and legibly.

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QUESTION 1: WELDING

1.1 Welding symbols are described in SABS 044 (REF. 7).

Make a neat, freehand drawing of a standard weld symbol in the ANSWER BOOK. Show the instructions below on the drawing and write the question number (1.1.1–1.1.6) next to each symbol or indication that you make:

1.1.1 Arrow

1.1.2 Weld-all-round symbol

1.1.3 Site weld symbol

1.1.4 Size of the weld is 6 mm

1.1.5 Basic symbol for a fillet weld on the arrow side

1.1.6 Surface contour is concave

(6 × 1) (6)

1.2 A fillet weld design has unequal leg lengths of 10 mm and 20 mm.

Calculate the throat thickness of the weld. (4)

[10]

QUESTION 2: LAP AND BUTT JOINTS

The following is applicable to a single riveted lap joint that joins two 12 mm thick steel plates:

Tensile stress of steel = 480 MPa
Shear stress of steel = 384 MPa
Crushing stress of steel = 618 MPa
Factor of safety = 6

2.1 Calculate a suitable pitch for the rivets. (9)

2.2 Calculate the failing loads per pitch length for tension, shear and crushing. (6)

2.3 How would the joint in all probability fail and at what load? (1)

[16]

QUESTION 3: BELT DRIVES

Calculate the power that can be transmitted by a leather belt, 100 mm wide by 10 mm thick from a 250 mm diameter pulley at 800 r/min if the allowable tensile stress in the belt is 1,38 MPa and it is assumed that the force on the tight side of the belt is 2,2 times the force on the slack side. **[6]**

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QUESTION 4: KNUCKLE JOINT

4.1 A knuckle joint connecting two 40 mm diameter rods, is subjected to a load of 90 kN. The pin is 40 mm in diameter and the outside diameter of the eye and the fork is 80 mm. The eye thickness is 30 mm and the fork thickness is 15 mm. A safety factor of 5 is used and all the parts are made of the same material.

Calculate the following:

4.1.1 The ultimate tensile stress (4)

4.1.2 The ultimate shear stress (2)

4.1.3 The ultimate compressive stress (2)

4.2 Make freehand sketches of THREE views of the knuckle joint mentioned in QUESTION 4.1 and insert dimensions. (6)

4.3 State the purpose of a knuckle joint and state THREE applications of this type of joint. (4)
[18]

QUESTION 5: PISTON

5.1 A steam engine cylinder has a bore of 762 mm and the maximum steam pressure is 1,03 MPa.

Find the diameter of the piston rod for a direct stress of 27,5 MPa. (4)

5.2 At the piston end the rod is tapered 1 in 4 on the diameter for a length of 152 mm and then runs parallel for 38 mm beyond which it is threaded for the piston nut. The nominal diameter of the threaded part is 102 mm and the total thickness of the piston boss is 202 mm.

Calculate the maximum tensile stress in the threaded portion. (6)
[10]

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QUESTION 6: COUPLINGS

Two shafts have to be connected by a claw coupling. There are THREE claws on each half of the coupling and their external and internal diameters are 160 mm and 80 mm respectively. The shaft on which the coupling is positioned transmits 80 kW at 290 r/min.

Calculate the following:

6.1 The diameter of the shaft (6)

6.2 The length (depth) of the claws if the compressive stress in the claws is 12 MPa (4)

[10]

QUESTION 7: STEAM COVER

A steam engine cylinder is 0,45 m in diameter and uses steam at 1,24 MPa.

Calculate:

7.1 The thickness of the cylinder walls, which are made of cast iron (3)

7.2 The thickness of the flanges (2)

7.3 The thickness of the cylinder cover (2)

7.4 The number of M16 studs needed and the circular pitch of the studs (6)

7.5 The width of the flange (2)

[15]

QUESTION 8: KEYS AND KEYWAYS

A spline connection in an automobile transmission consists of 10 splines cut in a shaft of 58 mm in diameter. The height of each spline is 5,5 mm and the keyways in the hub are 45 mm long.

Determine:

8.1 The power that may be transmitted at 2 500 r/min if the allowable normal pressure on the splines is limited to 5 MPa (5)

8.2 The force required to slide the hub axially under full load ($\mu = 0{,}1$) (2)

[7]

QUESTION 9: BEARINGS

A horizontal shaft is subjected to an axial thrust of 60 kN taken up by a collar. The mean friction diameter is 150 mm and the width is 25 mm measured radially. The coefficient of friction is 0,06.



Find the work absorbed per minute if the speed is 60 r/min and find the power. **[8]**

TOTAL: 100

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