higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1090**(E)**(A10)T

NATIONAL CERTIFICATE

MECHANICAL DRAWING AND DESIGN N6

(8090086)

10 April 2018 (X-Paper)
09:00–13:00

OPEN-BOOK EXAMINATION

Calculators, personal notes and textbooks may be used.

This question paper consists of 5 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
MECHANICAL DRAWING AND DESIGN N6
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. Show ALL steps to achieve as many marks as possible. An incorrect answer which must be carried forward will receive fair consideration.
5. Write neatly and legibly.

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QUESTION 1

Consider FIGURE 1. F is a flywheel with a mass of 200 kg. B is a driven gear. A is the driving pinion which transmits 40 kW from a motor rotating at 2 200 r/min. Pinion A has a PCD of 240 mm. The gear ratio is 2 : 1. C is a flat-belt pulley mounted at the extreme left end of the shaft and drives a machine situated below it. The PCD of the pulley is 500 mm and the angle of contact of the belt is 210°. The coefficient of friction between the belt and the pulley is 0,3. ALL distances are in mm.

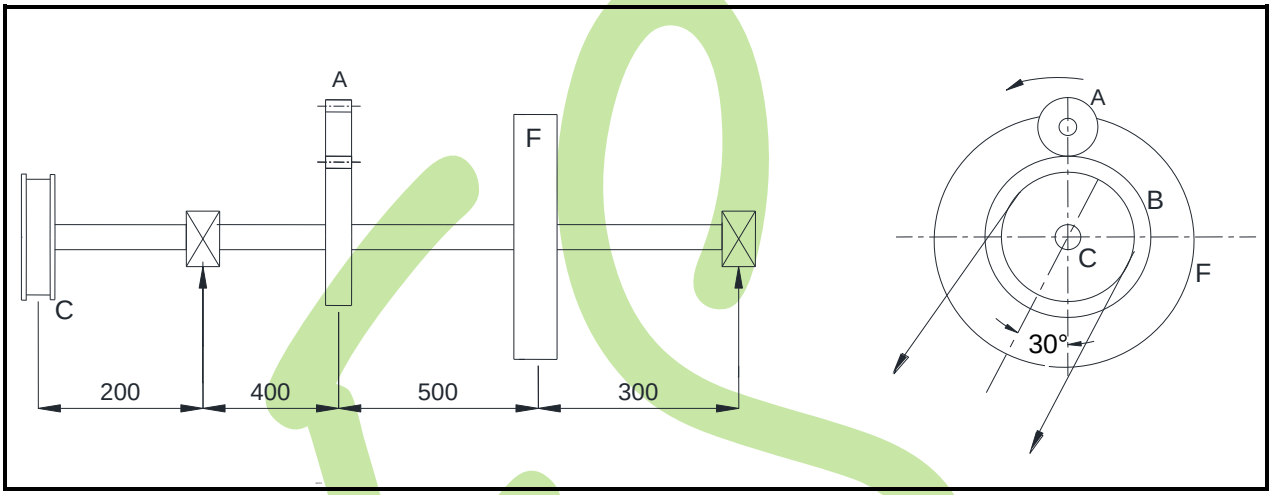


FIGURE 1

1.1 Calculate the number of teeth on both gears A and C if the module is 5 mm. (1)

1.2 Calculate the torque on the shaft. (1)

1.3 Calculate the face width of gears A and B assuming a basic stress of 112 MPa for cast steel (gear A) and a basic stress of 120 MPa for alloy steel (gear B). (10)

1.4 Calculate the forces of the flywheel, gear and flat pulley acting on the shaft. (14)

1.5 Calculate the values for the bending moments and draw the bending moment diagrams for the vertical and horizontal loading. (20)

1.6 Calculate the maximum combined bending moment. (3)

1.7 Calculate the diameters of the hollow shaft using (T_E) and (M_E) if D = 2 d. The safe tensile stress is 50 MPa and the safe shear stress is 40 MPa. (5)

1.8 Calculate the rectangular spoke sizes for the large gear with a ratio of 2 : 1. The bending stress is 40 MPa. (7)

[61]

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QUESTION 2

FIGURE 2 shows a cast-iron compression member. The 50 mm diameter pins each have a bearing surface length of 40 mm and when the member is in compression the bearing pressure in the eye portion is 95 MPa.

Regard the member as a column with the end fixation conditions as follows:

a) Relative to the x-x axis the end may be regarded as pivoted (hinged)

b) Relative to the y-y axis the end may be regarded as fixed

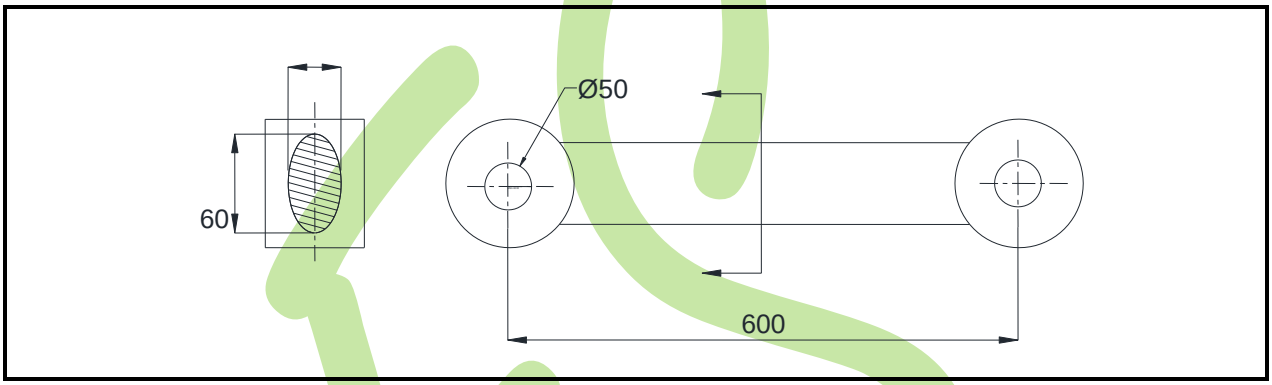


FIGURE 2

Use the Rankine formula with appropriate constants 1/1 600 and determine the stresses induced in the material for the conditions a) and b) respectively. **[19]**

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QUESTION 3

The conical pivot shown in FIGURE 3 has an included angle of 120° and rests on a bearing surface having an outer diameter to inner diameter ratio of 3 : 1. The pivot supports an axial load of 35 kN while rotating at 350 r/min. The coefficient of friction of the material is 0,09 and the bearing pressure is 450 kPa. The temperatures of cooling oil entering and leaving the bearing are 20 °C and 85 °C respectively. The specific heat capacity of the oil is 3,14 kJ/kg.°C and the density is 0,85 kg/litre.

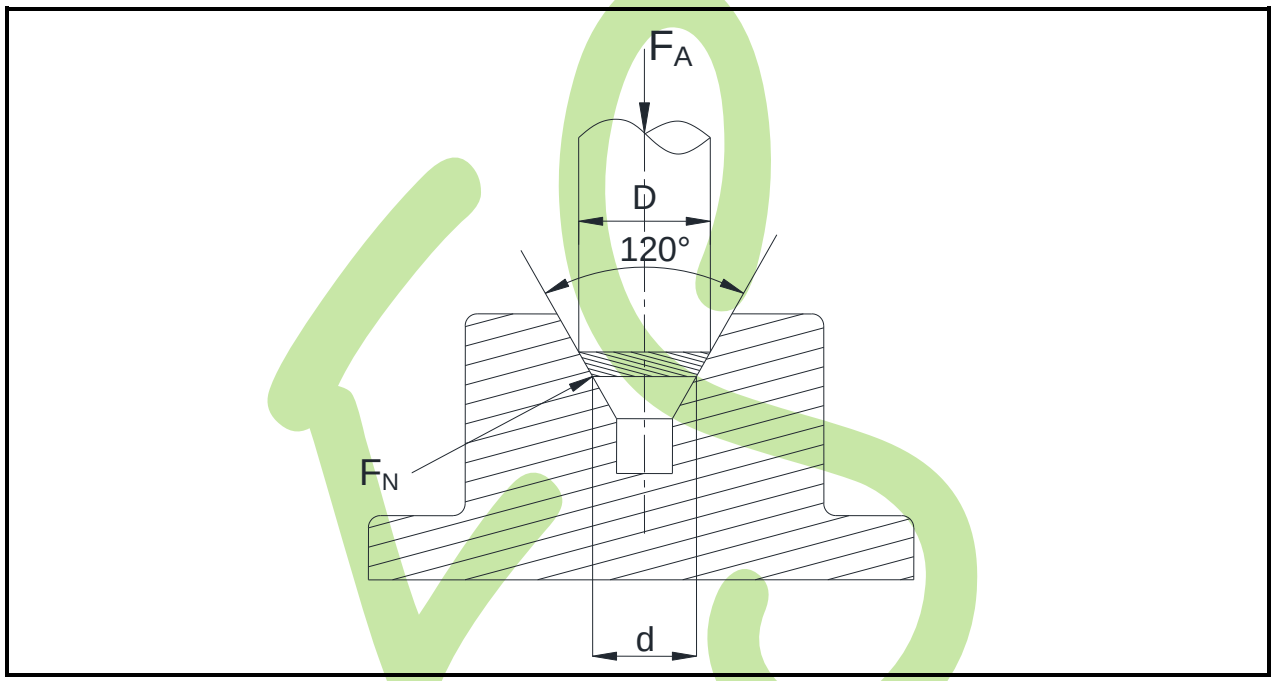


FIGURE 3

Calculate:

3.1	The normal force between the surfaces	(3)
3.2	The inner diameter of the bearing assuming pressure wear	(6)
3.3	The outer diameter of the bearing assuming uniform wear	(2)
3.4	The power lost to friction assuming uniform pressure theory	(4)
3.5	The quantity of cooling oil required in litres/min to the bearing surface	(5)
		[20]

TOTAL: 100

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