higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1090**(E)**(A8)T

NATIONAL CERTIFICATE

MECHANICAL DRAWING AND DESIGN N6

(8090086)

8 August 2019 (X-Paper)
09:00–13:00

OPEN-BOOK EXAMINATION

This question paper consists of 4 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. 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. All work you do not want to be marked must be clearly crossed out.
6. Candidates may use personal notes.
7. Write neatly and legibly.

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QUESTION 1

In FIGURE 1 below, (A), is a flywheel with a mass of 150 kg. (B) is a driven gear. (D) is the driving pinion which transmits 30 kW from a motor rotating at 2 100 r/min. Pinion (D) has a PCD of 180 mm. The gear ratio is 3:1. (C) is a V-belt pulley, mounted on the overhanging part of the shaft and drives a machine situated below it. The PCD of the pulley is 480 mm and T_1/T_2 is 4:1.

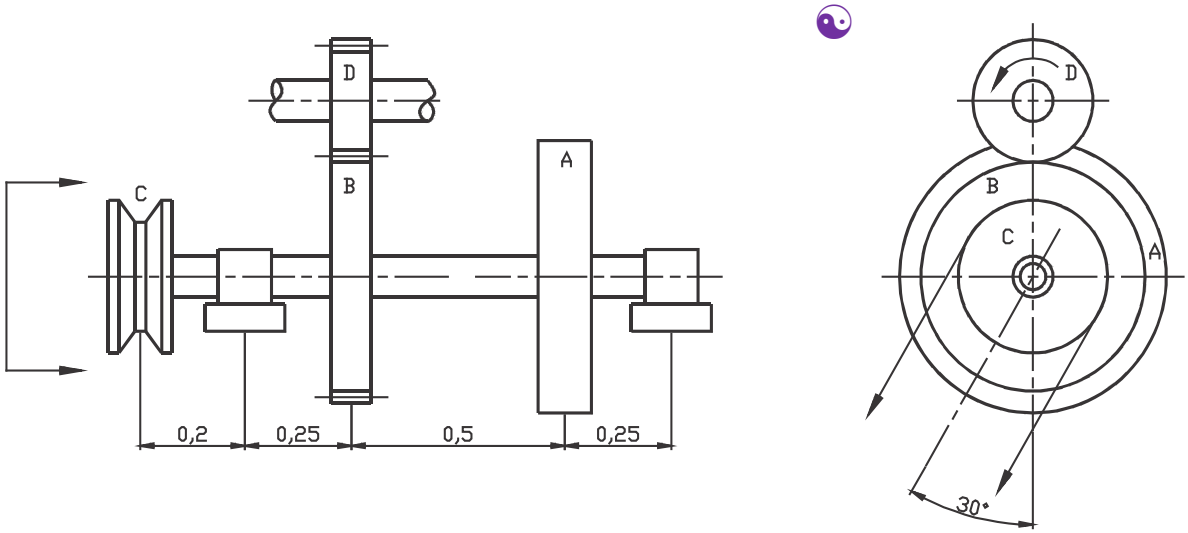


FIGURE 1

Calculate the diameters of the hollow shaft if D = 2 d. The safe tensile stress is 60 MPa and the safe shear stress is 50 MPa. Use the following steps:

1.1 Calculate the flywheel, gear and V-pulley forces acting on the shaft. (14)

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

1.3 Calculate the maximum combined bending moment. (2)

1.4 Calculate the shaft torsion. (1)

1.5 Calculate the shaft diameters using (T_E) and (M_E). (5)

1.6 Calculate the number of teeth on gears B and D if the module is 4 mm. (1)

1.7 Calculate the face width of gears B and D assuming a basic stress of 110 MPa for cast steel (gear B) and a basic stress of 120 MPa for alloy steel (gear D). (10)

1.8 Calculate the elliptical spoke sizes for the large gear with a ratio of 2:1. The bending stress is 30 MPa. (8)

[61]

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QUESTION 2

A cone clutch shown in FIGURE 2 transmits 28 kW at 1 400 r/min. The large diameter of the cone is 250 mm and the enclosed cone angle is 12°.

The friction face width is 65 mm and the coefficient of friction between the faces is 0,2.

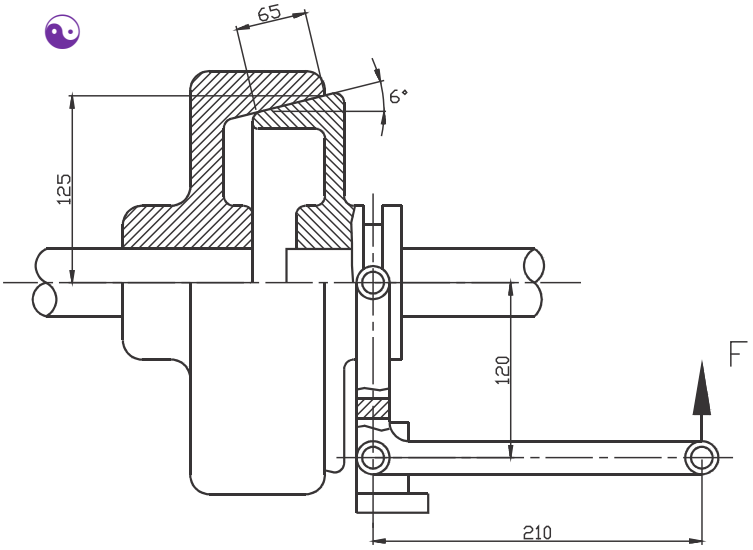


FIGURE 2

Calculate the following:

2.1 Axial force required to transmit the power (6)

2.2 Axial force required to engage the clutch, assuming that there is no relative movement between the faces during engagement (2)

2.3 Average normal pressure on the contact surfaces for maximum power (2)

2.4 Maximum normal pressure assuming uniform wear condition (1)

2.5 Dimensions of the operating lever to keep the clutch engaged

The allowable stress in the rectangular arms (ratio 2:1) is 30 MPa. (6)

2.6 Stress induced in the lever during engagement (2)

[19]

QUESTION 3

A hollow cast-iron column has a square cross section with an outside length of 250 mm and the column length is 4 500 mm. The column carries an axial load of 600 kN.

Calculate the thickness of the metal required for the column by using the Rankine formula with $\frac{1}{6400}$ as the constant.

A safety factor of 8 is allowed on a stress of 500 MPa. **[20]**

TOTAL: 100

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