



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

MECHANOTECHNICS N5

(8190225)

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

This question paper consists of 5 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
MECHANOTECHNICS 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.
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QUESTION 1

A flywheel, initially at rest, is subjected to a constant angular acceleration of $2,5 \text{ rad/s}^2$ for 50 seconds. The flywheel is then decelerated until it comes to rest 65 seconds later.

Calculate the following:

- 1.1 The maximum angular velocity attained (2)
 - 1.2 The angular deceleration (2)
 - 1.3 The number of revolutions made by the flywheel during the acceleration period (5)
 - 1.4 The number of revolutions made by the flywheel during the deceleration period (5)
 - 1.5 The total number of revolutions made by the flywheel (2)
- [16]**

QUESTION 2

- 2.1 Name any methods that are used to prevent rope haulage from reversing when stopped. (3)
- 2.2 An endless rope haulage is required to convey 1 300 tonnes of ore up an incline of 1 : 10 and 1 400 m long in an effective shift of 7 hours. The mass of the rope is 1,5 kg/m and the tractive resistance of the tubs and contents is 200 N/tonne. The rope resistance is 350 N/tonne. Take the rope speed as 3,5 km/h and the mass of an empty tub as 800 kg while the upgoing tubs carry a load of 1 tonne. The factor of safety is 7 and the ultimate stress for the rope is 1 200 MPa. The efficiency of the haulage is 77%.

Calculate the following:

- 2.2.1 The number of tubs required (5)
 - 2.2.2 The motor power (8)
- [16]**

QUESTION 3

- 3.1 Give THREE advantages of placing the driving machine of an elevator on top of the hatchway. (3)
- 3.2 The loaded cage of a goods hoist has a mass of 1 400 kg. The rope passes over a drum at the top of the shaft and then to a balanced mass of 500 kg. The cage and balanced mass move in guides and the friction force at each guide is 500 N. The drum has a diameter of 1,6 m, a mass of 700 kg and a radius of gyration of 0,5 m. The maximum acceleration attained is $2,1 \text{ m/s}^2$, which occurs at a speed of $2,5 \text{ m/s}$.
- Calculate the following:
- 3.2.1 The motor power required to drive the drum at maximum acceleration (9)
- 3.2.2 The rope tensions during deceleration if the maximum velocity is 5 m/s and deceleration is at a uniform rate from maximum velocity to rest over the last 7 m of travel (6)
- [18]

QUESTION 4

An epicyclic gear train has a sun wheel with 24 teeth and two planet wheels of 46 teeth each, the latter meshing with the internal teeth of a fixed annulus. The input shaft, carrying the sun wheel, transmits $4,5 \text{ kW}$ at 280 r/min . The output shaft is connected to an arm that carries the planet wheels.

What is the speed of the output shaft and the torque transmitted if the overall efficiency is 80%? If the annulus is rotated independently, what should its speed be in order to make the output shaft rotate at 10 r/min ?

[16]

QUESTION 5

The thickness of a 4-ply leather belt is 14 mm and it transmits power from a pulley that is 1,4 m in diameter. The speed of this pulley is 260 r/min . The angle of wrap is 170° and the coefficient of friction between the belt and pulley is 0,3. The density of the belt material is 800 kg/m^3 . Take the maximum allowable belt tension as $7,8 \text{ kN/m}$ width per ply.

Calculate the following:

- 5.1 The belt speed (2)
- 5.2 The mass of the belt in kg/m (2)
- 5.3 The centrifugal force (2)

- 5.4 The tensions T_1 and T_2 (take centrifugal force into account) (6)
- 5.5 The power transmitted by the drive if the efficiency of the drive is 83% (4)
- 5.6 The power transmitted if 5% slip occurs (2)
- [18]**

QUESTION 6

A bucket elevator used to transport coal has the following details:

Centre distance between the head and the tail pulley is 80 m with bucket spacing of 750 mm. At a chain speed of 90 m/min a mass of 1 350 tonnes is transported in an effective shift time of 7,5 hours. The discharge of the coal takes place at 30° after top dead centre.

Calculate the following:

- 6.1 The diameter of the head pulley (4)
- 6.2 The total length of the chain. Assume the same diameter for both the head and tail pulleys. Ignore also the deflection of the chain given by the tensioning device (2)
- 6.3 The driving motor power required if the drive is 81% efficient (10)

[16]

TOTAL: 100