



# higher education & training

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Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

T1060(E)(A7)T  
**APRIL EXAMINATION**

**NATIONAL CERTIFICATE**

**MECHANOTECHNICS N6**

(8190236)

**7 April 2016 (X-Paper)**  
**09:00–12:00**

**This question paper consists of 7 pages.**

**DEPARTMENT OF HIGHER EDUCATION AND TRAINING**  
**REPUBLIC OF SOUTH AFRICA**  
NATIONAL CERTIFICATE  
MECHANOTECHNICS N6  
TIME: 3 HOURS  
MARKS: 100

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**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**

- 1.1 A multi-plate friction clutch transmits 80 kW at 4 200 r/min. The coefficient of friction is 0,07 and the axial pressure between the plates is 245 kPa. The outer radius of the friction plates is 1,25 times the inner radius. The inner radius is 104 mm. Assume uniform pressure.

Calculate the number of contact pairs required.

(7)

- 1.2 A worm drive has a worm with a four-start screw thread and a pitch diameter of 40 mm. The worm gear has 35 teeth and the module for the worm and worm gear is 10 mm. The efficiency of the drive is 80%.

Calculate the following:

- 1.2.1 The pitch-circle diameter of the worm gear

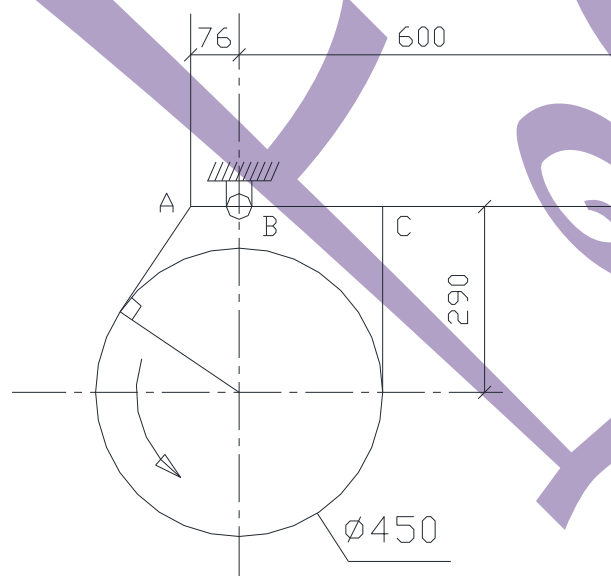
(2)

- 1.2.2 The centre distance between the shafts

(2)

- 1.2.3 The coefficient of friction between the worm axis and the worm gear

(8)

**[19]****QUESTION 2****FIGURE 1**

The band brake shown in FIGURE 1 is used on the brake drum of a hoist. The brake drum has a diameter of 450 mm and the ends of the band are connected to points A and C on a brake lever pivoted at B. The centre of the brake drum is 290 mm from B. A force of 250 N is applied to the brake lever, 600 mm from B. The coefficient of friction between the band and the brake is 0,25.

BC = 225 mm and AB = 76 mm

Calculate the following:

- 2.1 The angle of contact between the band and the brake drum (7)
- 2.2 The tight and slack side band tensions (8)
- 2.3 The torque applied to the brake drum which is rotating in an anti-clockwise direction (2)
- [17]**

### QUESTION 3

A flywheel and shaft assembly has a total mass of 1 ton and a radius of gyration of 1,2 m and rotates at 450 r/min. A plate clutch is used to connect this shaft to a driven shaft. The driven shaft has a mass of 500 kg and a radius of gyration of 800 mm and rotates at 250 r/min. As the clutch is engaged, the input supply to the driving motor is cut off. Ignore friction loss.

Calculate the following:

- 3.1 The combined speed after the clutch engages and no slip occurs (8)
- 3.2 The loss in kinetic energy (6)
- [14]**

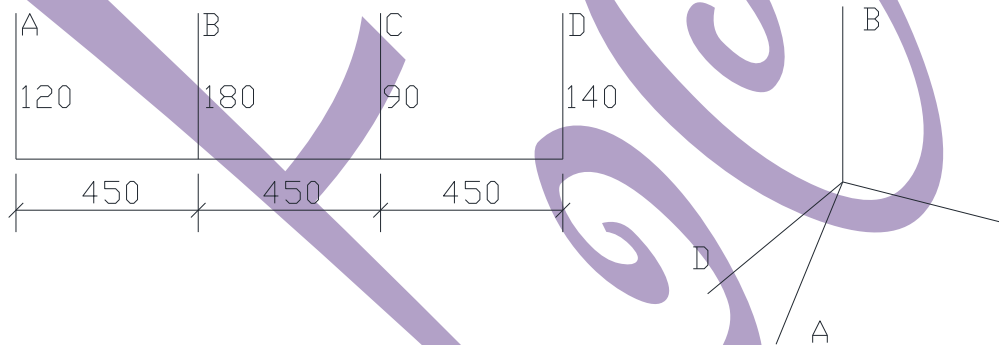
**QUESTION 4**

A number of trucks, with a total mass of 350 tonnes, are hauled up an incline of 1 in 80 at a constant speed of 45 km/h. The locomotive and trucks maintain a constant speed as they move around a curve, up the incline. At this speed, the rolling resistance for the locomotive is 60 N/ton and the curve resistance is 80 N/ton of the mass of the locomotive.

The rolling resistance of the trucks is 24 N/ton and the curve resistance is 50 N/ton of the mass of the trucks. 70% of the mass of the locomotive is carried on the driving wheels and the coefficient of friction between the wheels of the locomotive and the rails is 0,26.

Calculate the following:

- 4.1 The mass of the locomotive (10)
- 4.2 The power developed by the locomotive if the transmission efficiency is 75% (4)
- 4.3 The number of drive axles if the load per drive axle is 8 tonnes (2)
- [16]**

**QUESTION 5**

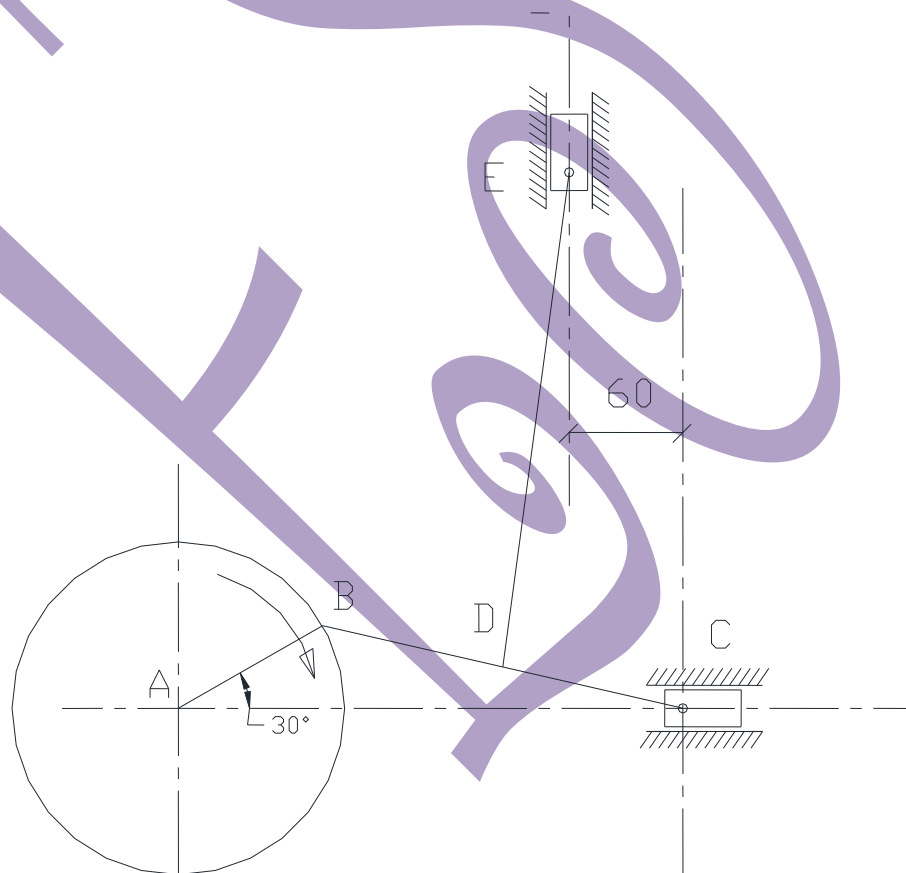
**FIGURE 2**

Four masses (A, B, C and D) are rigidly attached to a rotating shaft as shown in FIGURE 2. The mass centres are at 120 mm, 180 mm, 90 mm and 140 mm respectively from the axis of rotation. Masses B, C and D are 12 kg, 6 kg and 5 kg respectively and the axial distance between the masses is 450 mm.

- 5.1 Choose A as reference plane and using the given data, compile the required table. (4)
  - 5.2 Draw a couple diagram using a scale of  $0,1 \text{ kg.m}^2 = 5 \text{ mm}$ . (3)
  - 5.3 Draw a force diagram using a scale of  $0,1 \text{ kg.m} = 5 \text{ mm}$ . (4)
  - 5.4 Calculate the minimum value of mass A. (2)
  - 5.5 Use a space diagram to indicate the relative angular positions of the centre of mass A, C and D with respect to mass B for complete dynamic balance. (4)
- [17]**

**QUESTION 6**

AB = 90 mm  
BC = 200 mm  
DE = 270 mm



**FIGURE 3**

FIGURE 3 shows the configuration of a slider crank mechanism. The crank AB rotates clockwise at 1 800 r/min about the fixed centre A. The slide block E is driven by link DE which is attached at midpoint D on the connection rod BC. The slide block C reciprocates horizontally and the slide block E reciprocates vertically.

- 6.1 Draw the space diagram to scale 5 : 1. (3)
- 6.2 Draw the vector diagram to scale 0,3 m/s = 1 mm. (4)
- 6.3 Calculate the following:
- 6.3.1 The angular velocity of crank AB
- 6.3.2 The velocity of D relative to A
- 6.3.3 The velocity of C relative to B
- 6.3.4 The velocity of E relative to D
- 6.3.5 The centripetal acceleration of B relative to A (5 × 2) (10)
- TOTAL: 100** [17]