



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1100(E)(N19)T

NATIONAL CERTIFICATE

MECHANOTECHNICS N4

(8190194)

19 November 2018 (X-Paper)

09:00–12:00

This question paper consists of 5 pages and 3 formula sheets.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
MECHANOTECHNICS N4
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. Sketches must be large, neat and fully labelled.
 5. Write neatly and legibly.
-

QUESTION 1

- 1.1 Briefly explain what is meant when reference is made to the following principles of a good workshop layout:
- 1.1.1 Clear transport rout
 - 1.1.2 Optimum use of space
 - 1.1.3 Flexible layout
 - 1.1.4 Minimum handling of material
 - 1.1.5 Pleasant working conditions
- (5 × 2) (10)
- 1.2 Indicate the difference between *air spray-painting* and *airless spray-painting* with the aid of labelled sketches. (10)
- 1.3 1.3.1 State FIVE ways in which roller bearings can be damaged.
- 1.3.2 State FIVE factors which may contribute to the failure of a journal bearing. (2 × 5) (10)
- [30]**

QUESTION 2

Calculate the quantity of rock in tonnes per hour which can be transported by a belt conveyor with the following specifications:

Maximum tension in the belt	= 35,3 kN
Contact angle of the belt on the driving pulley	= 185°
Friction force	= 2,5 kN
Belt speed	= 95 m/min
Delivery height	= 35 m
Coefficient of friction	= 0,3

[14]

QUESTION 3

- 3.1 A lathe is being driven by a motor providing a maximum input of 3 kW at 1 500 r/min. At the maximum power the machine efficiency is 80%. The maximum and minimum velocities of the lathe spindle are 3 600 r/min and 40 r/min respectively.

Find the torque of the maximum power at the:

- 3.1.1 Driving shaft of the motor (2)
- 3.1.2 Driving spindle of the lathe at maximum speed (4)
- 3.1.3 Driving spindle of the lathe at minimum speed (2)
- 3.2 Calculate the power in kW consumed by:
- 3.2.1 The operation of a shaping machine in which the cutting force is 1 200 N and the stroke length which is 275 mm, takes 13 s to complete
- 3.2.2 The operation of a lathe during which the cutting force applied to the cutting tool is 1 000 N and the rotational speed of a workpiece with a diameter of 350 mm is 350 r/min (2 × 3) (6)
- [14]**

QUESTION 4

- 4.1 An ISO 150 screw thread of 3,5 mm pitch has an effective diameter of 30 mm. The three-wire method is used for checking the effective diameter. The best wire size method is used for the test wires.

Calculate the micrometer reading over the three wires. (6)

- 4.2 4.2.1 Explain step-by-step, how you would go about checking the correctness of the teeth of a gear wheel, having a module of 10 mm and a pressure angle of 20°, using a gear tooth vernier calliper and applying the constant-chord method of checking. (3)
- 4.2.2 Make the necessary calculations for the above test by using the constant-chord method of checking. (5)
- [14]**

QUESTION 5

A set of spur gears has a velocity ratio of 3:1 and a module of 8 mm if the pinion has 40 teeth.

Calculate:

- | | | |
|-----|--|-------------|
| 5.1 | The pitch-circle diameter of both gears | (4) |
| 5.2 | The centre distance between the shafts | (3) |
| 5.3 | The outside diameter of both gears | (4) |
| 5.4 | The total depth that the milling cutter must be fed into the gear blank, in order to cut the teeth | (3) |
| | | [14] |

QUESTION 6

- 6.1 A horizontal pipeline with a diameter of 90 mm conveys water at 20 l/s with a pressure drop of 50 kPa per 20 m of pipeline.

Calculate the value of the coefficient of friction (f) for the abovementioned situation by using the Darcy formula. (5)

- 6.2 Use the Chezy formula for the abovementioned situation and calculate the values of:

6.2.1 The hydraulic mean depth 'm'

6.2.2 The hydraulic gradient 'i'

6.2.3 The Chezy coefficient 'c'

(3 × 3) (9)
[14]

TOTAL: 100

FORMULA SHEET

Any other applicable formula may also be used.

$$1. m = \frac{PCD}{T}$$

$$2. DO = m \times (T + 2)$$

$$3. C = \frac{m}{2} \times (TA + TB)$$

$$4. Ke = \frac{1}{2}mv^2$$

$$5. VR = \frac{TA}{TB}$$

$$6. VR = \frac{PCD \text{ of gear}}{PCD \text{ of pinion}}$$

$$7. VR = \frac{NB}{NA}$$

$$8. NA \times TA = NB \times TB$$

$$9. Ft = \frac{2 \times T}{PCD}$$

$$10. Fr = Ft \times \tan \phi$$

$$11. Fn = Ft \times \sec \phi$$

$$12. Ie = IA + (VR)^2 IB + (VR)^2 IC + (VR)^2 ID$$

$$13. T\alpha = Ie \times \alpha A$$

$$14. T\alpha = TA + \frac{(NB)}{(NA)} \frac{TBC}{\eta_1} + \frac{(ND)}{(NA)} \frac{TD}{\eta_1 \eta_2}$$

$$15. \frac{NB}{NA} = \frac{\omega B}{\omega A} = \frac{\alpha B}{\alpha A} = \frac{IA}{IB}$$

$$16. T_{OUTPUT} = T_{INPUT} \times GR \times \eta$$

$$17. P = \frac{\pi \times PCD}{n}$$

$$18. Ti + To + Th = 0$$

$$19. TA = TS + 2TP$$

$$20. \frac{\text{Input speed}}{\text{Output speed}} = \frac{\text{Teeth on driven gears}}{\text{Teeth on driving gears}}$$

$$21. v = \pi \times (d + t) \times N$$

$$22. P = Te \times v$$

$$23. \frac{T1}{T2} = e^{\mu\theta}$$

$$24. T1 = \delta \times A$$

$$25. Tc = m \times v^2$$

$$26. \frac{T1 - TC}{T2 - TC} = e^{\mu\theta \cos \alpha}$$

$$27. L = \frac{\pi}{2} \times (D + d) + \frac{(D \pm d)^2}{4 \times C} + 2C$$

$$28. Tg = m \times g \times \sin \phi$$

$$30. v = \sqrt{\mu \times g \times r}$$

$$32. v = \sqrt{gr \left[\frac{\mu + \tan \theta}{1 - \mu \tan \theta} \right]}$$

$$34. \frac{T1}{T2} = \left[\frac{1 + \mu \tan \theta}{1 - \mu \tan \theta} \right]^n$$

$$36. \cos \frac{\phi}{2} = \frac{R+r}{C}$$

$$38. Tl = w \times n \times ft$$

$$40. t = \frac{I \times \omega}{T}$$

$$42. T = F \times r$$

$$44. do = de + 0,65P$$

$$46. h = m \left[1 - \frac{\pi}{4} (\sin \theta \cos \theta) \right]$$

$$47. \frac{p1}{Rho} + \frac{(v1)^2}{2} + gh1 = \frac{p2}{Rho} + \frac{(v2)^2}{2} + gh2$$

$$48. Vw (Va) = \sqrt{\frac{gx^2}{2y}}$$

$$50. hf = \frac{4 \times f \times \ell \times v^2}{2 \times g \times d}$$

$$52. Q = \frac{Cd \times A \times a \times \sqrt{(2gh)}}{\sqrt{(A^2 - a^2)}}$$

$$54. V = \sqrt{(g \times R \times \cos \theta)}$$

$$56. L = 2C + \pi D$$

$$58. \text{One load} = \frac{m2 \times g \times S}{4 \times h}$$

$$29. v = T \times r$$

$$31. v = \sqrt{\frac{g \times b \times r}{2 \times h}}$$

$$33. v = \sqrt{gr \left[\frac{h \tan \theta + b/2}{h - b/2 \tan \theta} \right]}$$

$$35. \cos \frac{\theta}{2} = \frac{R-r}{C}$$

$$37. m = w \times t \times L \times \Delta$$

$$39. P = Pg + P\mu$$

$$41. P = \frac{2 \times \pi \times N \times T}{60}$$

$$43. w = do + 3d - 1,5155P$$

$$45. w = \frac{\pi \times m}{2} (\cos^2 \theta)$$

$$49. v = C\sqrt{mi}$$

$$51. hf = \frac{f \times \ell \times O^2}{3,026 \times d^5}$$

$$53. Q = Cd \times A \times \frac{\sqrt{(2gh)}}{\sqrt{(m^2 - 1)}}$$

$$55. \text{Vol. bucket} = \frac{m \times s}{\rho \times v}$$

$$57. \text{Self-weight} = \frac{m1 \times g \times S^2}{8 \times h}$$

$$59. T(\text{acc load}) = (T1 - T2)R$$

$$60. T (\text{acc drum}) = I \times \alpha = mk^2 \times \frac{a}{R}$$

$$61. P = T \times T$$

$$63. Ke = \frac{1}{2} I \times \omega^2$$

$$65. P = Ke \times \text{operations/sec}$$

$$67. \mu = \tan \theta$$

$$69. T = \mu \times F \times Re \times n$$

$$71. T = \mu \times n \times (Fc - S)R$$

$$73. Fc = \frac{mv^2}{\gamma}$$

$$74. \text{Tractive effort} = \text{mass on driving wheels} \times \mu \times g$$

$$75. \text{Side thrust} = Fc \cos \theta - mg \sin \theta$$

$$76. \mu = \frac{Fc \cos \theta - mg \sin \theta}{mg \cos \theta + Fc \sin \theta}$$

$$77. P_1 = CmgL + mgh$$

$$62. T = 2\pi \times N$$

$$64. Ke = \frac{\text{work done}}{\text{efficiency}}$$

$$66. (I_1 + I_2) \omega_3 = I_1 \omega_1 + I_2 \omega_2$$

$$68. \eta = \frac{\tan \theta}{\tan (\theta + \phi)}$$

$$70. T = \frac{\mu \times F \times Re}{\sin \theta}$$

$$72. Fc = m \times \omega^2 \times \gamma$$