



higher education & training

Department:
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REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
MECHANOTECHNICS N4

(8190194)

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09:00–12:00



This question paper consists of 5 pages and a formula sheet of 3 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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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.
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QUESTION 1

- 1.1 The placing of machinery on a workshop floor must comply with six important requirements. 
- Name and briefly discuss these SIX requirements. (6 × 2) (12)
- 1.2 When corrosion tests are completed, certain factors must be taken into consideration for evaluation.
- State FIVE factors to be considered after completion of corrosion tests. (5)
- 1.3 Name THREE methods that can be used to prepare a surface for painting to protect it against corrosion. (3)
- 1.4 Name FIVE ways in which roller bearings can be damaged.  (5)
- 1.5 Make a neat, labelled sketch of the telltale or spring-loaded grease cup, which can be used for grease lubrication on machine parts. (5)
- [30]**

QUESTION 2


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

Maximum tension in the belt	= 35,5 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 The ram of a shaper has a mass of 200 kg and is moving in slides. The coefficient of friction between the ram and the slides may be taken as 0,08.

Calculate the following:

- 3.1.1 The horizontal force needed to move the ram  (3)
- 3.1.2 The coefficient of friction if the force, which is moving the ram, is reduced by 25% (4)

- 3.2 A lathe is driven by a motor with a maximum output power of 3,5 kW at 1 750 r/min. When driven at maximum power, the efficiency of the machine is 80%. The maximum and minimum speed of the lathe spindle is 3 500 r/min and 25 r/min respectively.

Calculate the torque at maximum power at the following:

- 3.2.1 Driving shaft of the motor (2)
 3.2.2 Lathe driving spindle at maximum speed (3)
 3.2.3 Lathe driving spindle at minimum speed (2)

[14]

QUESTION 4

A tapered hole with an included angle of 20° is tested by means of a precision steel ball of 10 mm diameter, as shown in FIGURE 1.

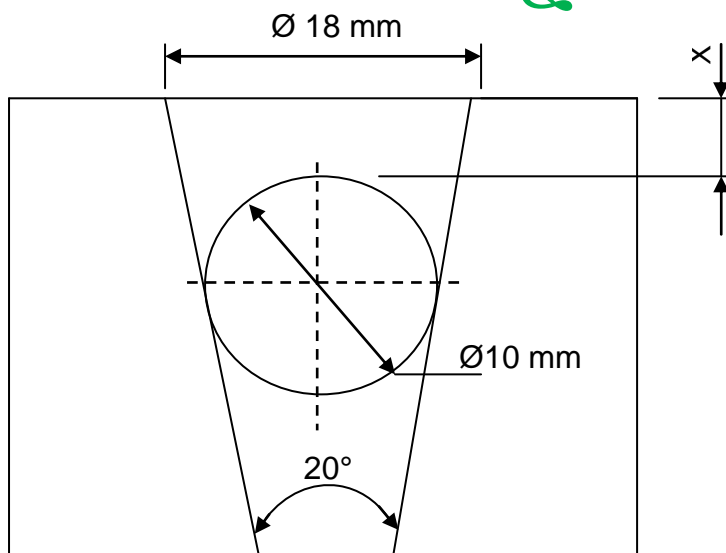


FIGURE 1

Refer to FIGURE 1 and calculate the distance 'X' for the hole to be machined accurately.

[14]

QUESTION 5

The compound gear system of a reduction gearbox is shown in FIGURE 2. It consists of an input gear P with 60 teeth, rotating at 900 r/min. It also has an intermediate shaft on which gears Q and R are mounted, having 140 and 70 teeth respectively. Gear S has 110 teeth. The gear system has a module of 3,5 mm.

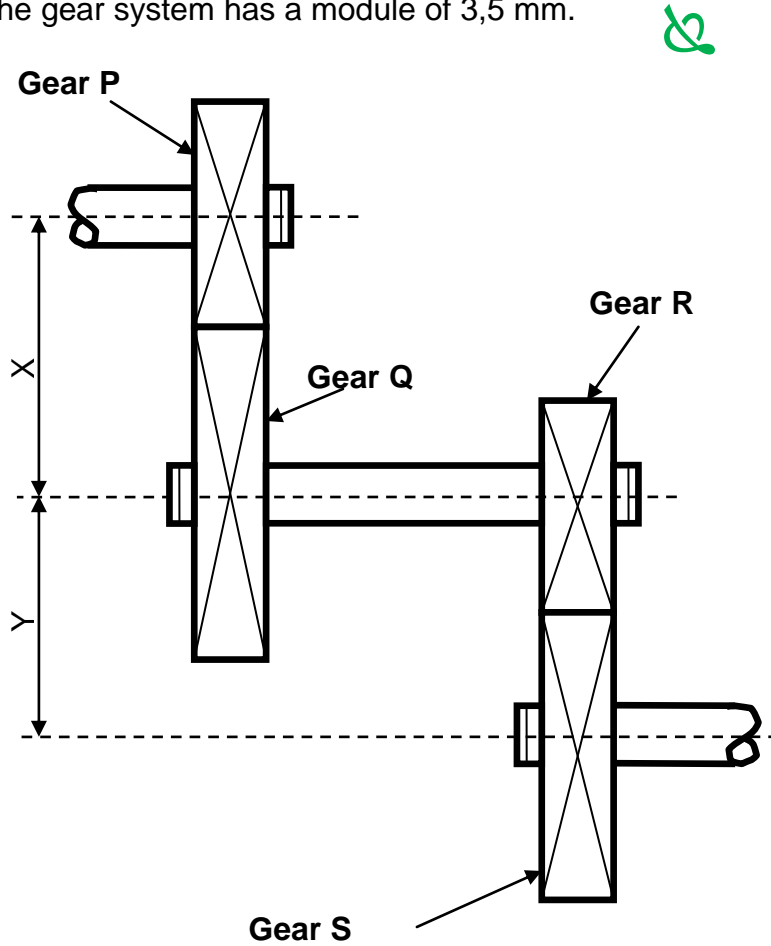


FIGURE 2

Calculate the following:

- 5.1 The rotating speed of gears Q, R and S (8)
 - 5.2 The centre distance X and Y (6)
- [14]

QUESTION 6

Water with a density of 1 000 kg/m³ flows through a tapered pipe with a diameter of 135 mm and a small diameter of 110 mm. At the small diameter, the water pressure is 135 kPa and at the large diameter, the water pressure is 160 kPa.

Determine the rate of flow in the pipe in litres per second. [14]

TOTAL: 100

MECHANOTECHNICS N4**FORMULA SHEET**

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. $F_n = Ft \times \sec \phi$

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

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

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. $T_i + T_o + T_h = 0$

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. $\frac{T_1}{T_2} = e^{\mu\theta}$

24. $Tl = \delta \times A$

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

26. $\frac{T_1 - TC}{T_2 - TC} = e^{\mu\theta \csc \alpha}$

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

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

29. $v = T \times r$

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

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

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

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

$$38. T1 = w \times n \times ft$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$77. P_l = CmgL + mgh$$

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

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

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

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

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

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