higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1100**(E)**(A1)T

NATIONAL CERTIFICATE

MECHANOTECHNICS N4

(8190194)

1 April 2019 (X-Paper)
09:00–12:00

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

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 What is meant by *individual production*? (3)

1.2 Give TWO examples where the individual production method could be applied. (2)

1.3 Name FIVE characteristics of individual production. (5)

1.4 Name FIVE ways in which a roller bearing can be damaged. (5)

1.5 Make a labelled sketch of a siphon wick lubricator which can be used for oil lubrication of machine parts. (5)

1.6 Make a labelled drawing of the dip-painting method. (5)

1.7 State FIVE disadvantages of the dip-painting method. (5)
[30]

QUESTION 2

The driving pulley of a V-belt drive has an effective diameter of 250 mm and a speed of 1 800 r/min. The angle of the V-groove of the driving pulley is 46° and the contact angle of the belt is 160°. The coefficient of friction is 0,3 and the mass of the belt is 0,5 kg/m length.

Calculate the number of V-belts required for this drive if the maximum allowable tension per belt is 900 N and the belt has to transmit 30 kW. **[14]**

QUESTION 3

FIGURE 1 below shows the setup of a cutting tool held in the tool holder of a shaping machine:

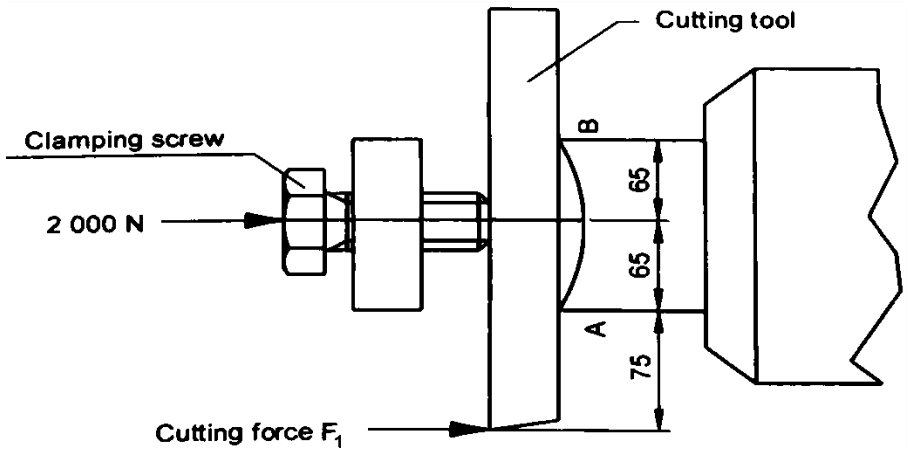

FIGURE 1

The ram of the shaping machine has a mass of 150 kg and is operating with a cutting stroke length of 150 mm. The total work done during the cutting stroke is equal to 175 J and the coefficient of friction between the ram and the slides is 0,3.

Calculate the following:

3.1 The work done to overcome the friction between the ram and the slides (3)

3.2 The cutting force exerted on the cutting tool (3)

3.3 The forces exerted on the two contact points A and B if the clamping force in the clamping screw is 2 000 N (8)

[14]

QUESTION 4

FIGURE 2 below shows a workpiece with a V-groove which has a 60° included angle and a depth of 50 mm.

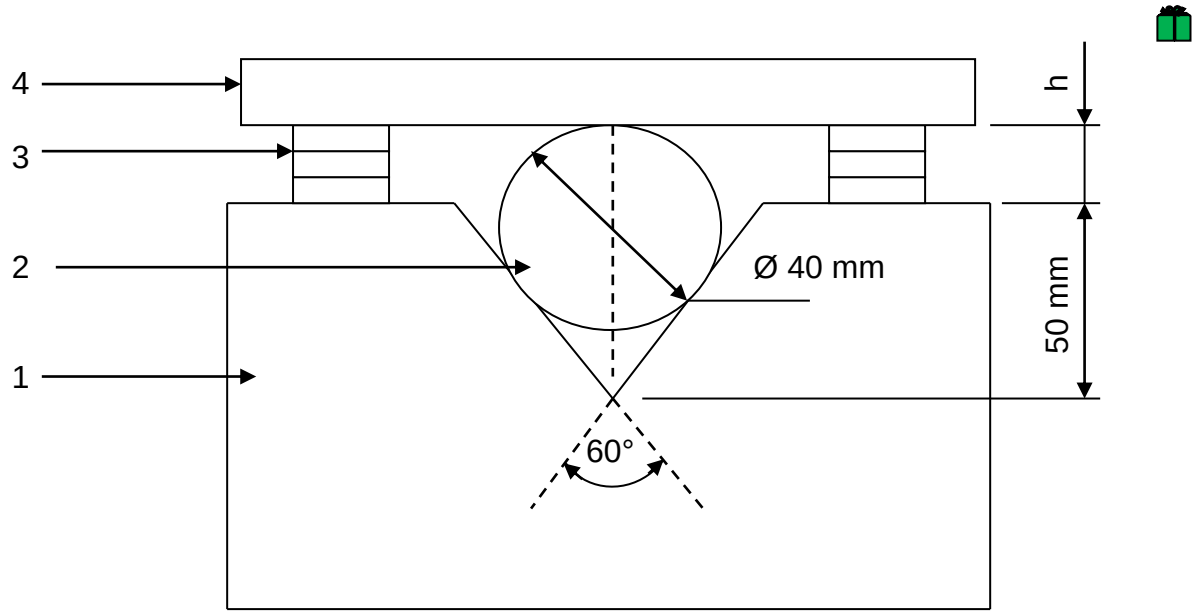

FIGURE 2

4.1 Refer to FIGURE 2 above and name the numbered components. Write only the answer next to the number (1–4) in the ANSWER BOOK. (4)

4.2 Use FIGURE 2 to calculate the distance 'h'. (6)

4.3 Describe how you would test the magnitude of the angle on the workpiece. (4)

[14]

QUESTION 5

An epicyclic gear train is shown in FIGURE 3 below. Gear wheel D rotates at 1 000r/min. Gear B and gear C are keyed to the same shaft.

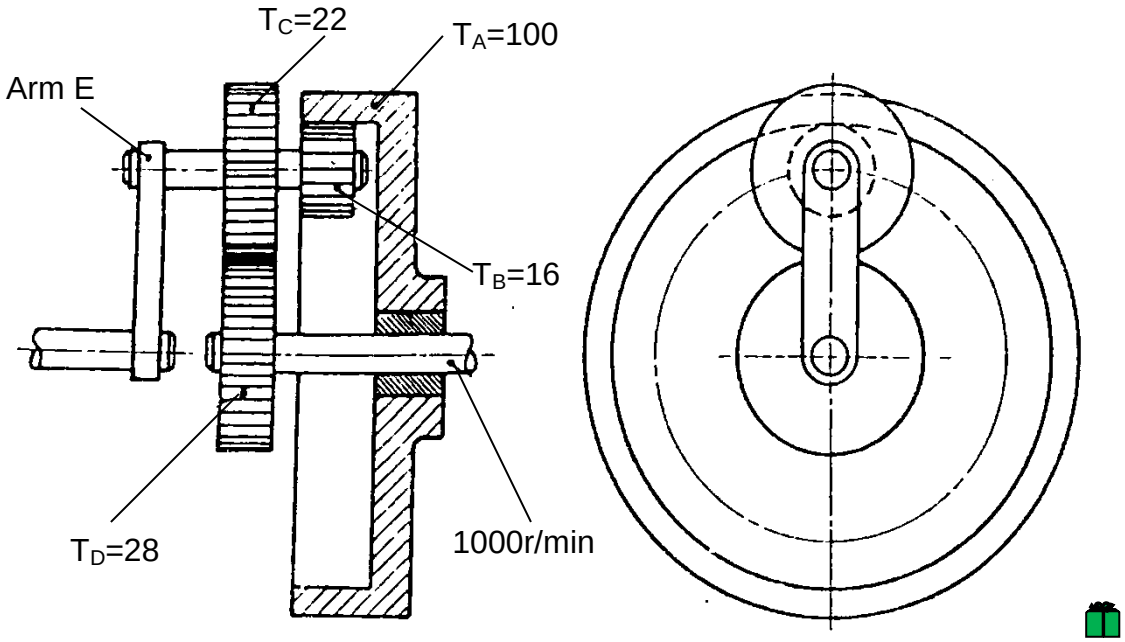

FIGURE 3

5.1 Determine the speed of gear wheel A if arm E is stationery. (10)

5.2 Determine the speed of arm E if gear wheel A is fixed. (4)
[14]

QUESTION 6

Water with a density of 1 000 kg/m^3 is pumped through a vertical pipe that is 15 m long. The tapered pipe has a diameter of 180 mm at the upper end and 100 mm at the lower end. When 90 l/s is pumped upwards through the pipe, a reading of 230 kPa is registered on the pressure gauge at the lower end.

Calculate the pressure gauge reading at the upper end of the pipe. **[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. $VR = \frac{PCD\ of\ gear}{PCD\ of\ pinion}$

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

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

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

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

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

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

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

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

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

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

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

39. $P = Pg + P\mu$

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

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

42. $T = F \times r$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

61. $P = \omega \times T$

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

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

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

65. $P = Ke \times operations/sec$

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

67. $\mu = Tan\ \theta$

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

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

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

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

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

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

74. *Tractive effort = mass on driving wheels* $\times \mu \times g$

75. *Side thrust* $= Fc\cos\theta - mg\ \sin\theta$

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

77. $P_l = CmgL + mgh$