MECHANOTECHNICS N4

(8190194)

2 April 2020 (X-paper)
09:00–12:00

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

070Q1A2002

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.   Use only a black or blue pen.

5.   Write neatly and legibly.

QUESTION 1

1.1 Workshops differ with regard to design and layout.

State FOUR distinct phases through which all workshop designs pass. (4)

1.2 The layout of workshops depends on the type of product that is manufactured.

State SIX disadvantages of *process layout*. (6)

1.3 Lubrication devices are used to provide a regulated quantity of lubrication to machine parts.

Name FIVE methods of lubrication. (5)

1.4 State FIVE advantages of roller bearings. (5)

1.5 State FIVE disadvantages of the dip-painting method. (5)

1.6 Make a neat, labelled drawing of the *warm airless spray-painting system*. (5)

[30]

QUESTION 2

The following applies to a flat-belt drive:

The width is 300 mm.
The thickness is 6 mm.
The tension in the tight side of the belt is three and half times more than that in the slack side.
The safe working stress is 900 kPa.
The centre distance between two shaft-carrying pulleys with a diameter of 1 200 mm and 400 mm respectively, is 1,5 m.
The larger pulley rotates at 250 r/min.

Calculate the following:

2.1 The power transmitted (8)

2.2 The length of the open-belt drive (3)

2.3 The length of the belt in the drive is changed to a crossed-belt drive (3)

[14]

QUESTION 3

3.1   FIGURE 1 shows a workpiece being held on the table of a surface grinder by a magnetic chuck. A horizontal cutting force of 900 N is exerted on the workpiece with a mass of 12 kg and the coefficient of friction between the surfaces of the magnetic chuck and the workpiece is 0,25.

Calculate the minimum magnetic force required from the chuck to hold the workpiece.

$F_1 = 900N$

Magnetic table

Grinding-wheel table
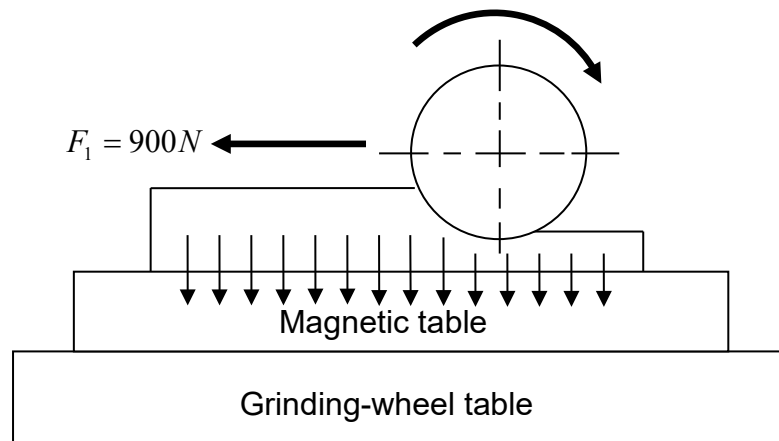
FIGURE 1   (6)

3.2   A shaft with a diameter of 500 mm is turning in a bearing, exerting a force of 90 kN on the bearing.

Calculate the power lost due friction, if the coefficient of friction between the shaft and the bearing is 0,03. The shaft rotates at 450 r/min.   (8)
                                                                                                [14]

QUESTION 4

4.1   Two rollers with a diameter of 20 mm are being used for checking the accuracy of the two inclined faces as shown in FIGURE 2.

Ø20

58°   62°

X

125
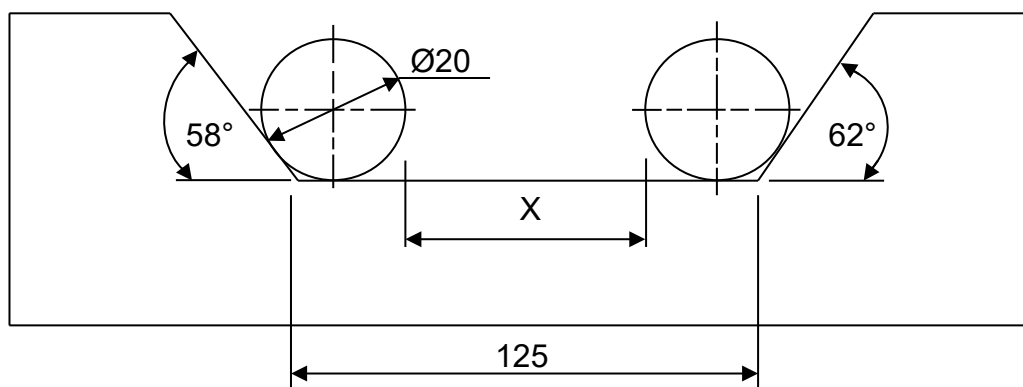
FIGURE 2

Use the given dimensions and calculate the distance X.   (7)

4.2   A tapered hole with an included angle of 30° is tested by means of a precision steel ball of 12 mm diameter as shown in FIGURE 3.
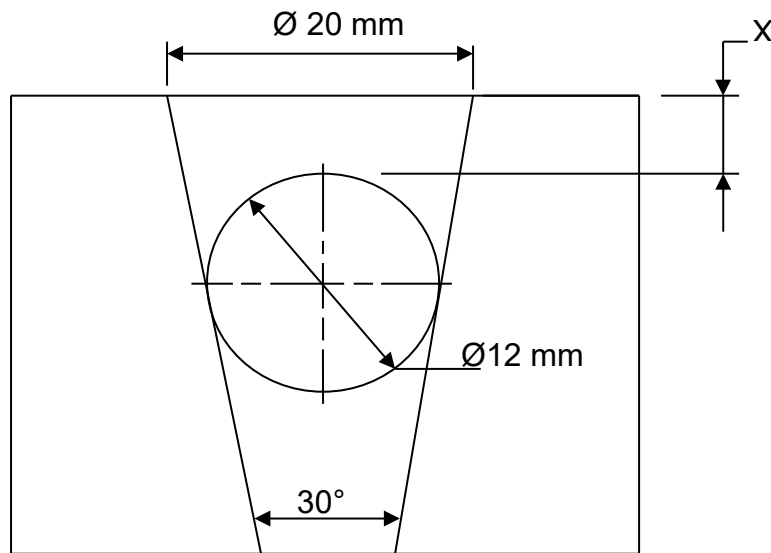

FIGURE 3

Refer to FIGURE 3 and calculate the distance 'X' for the hole to be accurately machined.   (7)
[14]

QUESTION 5

A set of spur gears (pinion B and gearwheel A) has a velocity ratio of 3,5:1 and a module of 8 mm. The pinion has 40 teeth.

Calculate the following:

5.1   The pitch circle diameters 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 must be fed into the blank in order to cut the teeth   (3)
[14]

QUESTION 6

Water with a density of 1 000 kg/m^3 is being pumped through a vertical pipe that is 15 m long. The tapered pipe has a diameter of 180 mm at the upper end while the lower end is 100 mm in diameter. 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. $m = \dfrac{PCD}{T}$

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

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

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

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

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

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

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

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

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. $T\alpha = TA + \dfrac{(NB)}{(NA)}\dfrac{TBC}{\eta 1} + \dfrac{(ND)}{(NA)}\dfrac{TD}{\eta 1 \eta 2}$

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

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

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

18. $Ti + To + Th = 0$

19. $TA = TS + 2TP$

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

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

22. $P = Te \times v$

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

24. $T1 = \delta \times A$

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

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

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

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

29. $v = T \times r$

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

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

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

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

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

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

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

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

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

39. $P = Pg + P\mu$

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

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

42. $T = F \times r$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

61. $P = \omega \times T$

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

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. $Fc = \dfrac{mv^2}{\gamma}$

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

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

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

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

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

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

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

75. Side thrust $= FcCos\,\theta - mg\ Sin\theta$

76. $\mu = \dfrac{FcCos\,\theta - mgSin\theta}{mgCos\,\theta + FcSin\theta}$

77. $P_l = CmgL + mgh$