higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1100**(E)**(J30)T

NATIONAL CERTIFICATE

MECHANOTECHNICS N4

(8190194)

30 July 2019 (X-Paper)
09:00–12:00

This question paper consists of 7 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 Briefly describe what is meant by the term *workshop layout*. (3)

1.2 Name FIVE important requirements that the placing of machinery on the workshop floor has to comply with. (5)

1.3 Name FOUR faults which may occur during spray-painting and state TWO causes of each of these painting faults. (6 × 2) (12)

1.4 Efficient bearing metals should have certain characteristics.

Name FIVE of the important characteristics that metals must have. (5)

1.5 Make a labelled sketch of a needle lubricator which can be used for oil lubrication on machine parts. (5)
[30]

QUESTION 2

The following specifications are applicable to an open flat-belt drive between a motor and a machine:

Contact angle on the driving pulley:	160°
Revolutions of the driving pulley:	600 r/min
Diameter of the driving pulley:	650 mm
Coefficient of friction between the belt and the pulley:	0,2
Safe working stress in the belt:	4 MPa
Thickness of the belt :	20 mm
Belt mass:	0,5 kg per metre length
Width of the belt:	155 mm

Calculate each of the following:

2.1 The centrifugal force (T_c) exerted on the belt (3)

2.2 The tension (T_1) in the tight side of the belt (2)

2.3 The tension (T_2) in the slack side of the belt (5)

2.4 The power transmitted by the belt (2)

2.5 The motor power required if the belt drive has an efficiency of 80% (2)
[14]

QUESTION 3

3.1 A lathe with a drive efficiency of 85% is used to machine a workpiece of 500 mm diameter at a spindle speed of 30 r/min. The cutting depth of the tool is 3,5 mm and the feed of the tool is 0,5 mm per revolution of the workpiece. The cutting pressure on the cutting tool is 1 000 N/mm^2.

Calculate each of the following:

3.1.1 The output power at the cutting tool (4)

3.1.2 The input power from the motor (3)

3.2 The ram of a shaping machine has a mass of 200 kg and moves in slides with a coefficient of friction of 0,07 between the ram and the slides.

Calculate of the following:

3.2.1 The horizontal force required to move the ram (3)

3.2.2 The coefficient of friction if the force to move the ram is increased by 30% (4)

[14]

QUESTION 4

4.1 FIGURE 1 shows pinion B with 30 teeth meshing internally with ring gear A. The centre distance between the shafts is 45 mm and the teeth have a module of 1,5 mm.

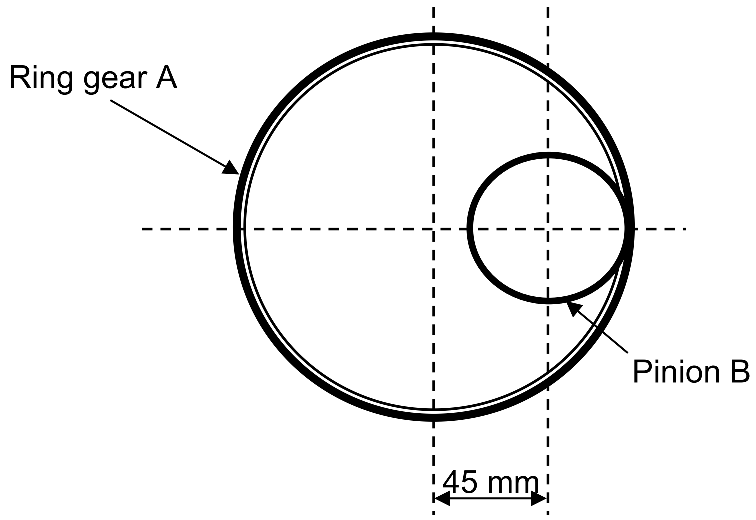

FIGURE 1

Calculate of the following:

4.1.1 The number of teeth on ring gear A

4.1.2 The pitch-circle diameter of ring gear A

(2 × 3) (6)

4.2 FIGURE 2 shows a simple epicyclic gear drive consisting of gear wheel B with 80 teeth and pinion A with 20 teeth. Assume that gear wheel B is fixed.

Find the speed and direction of rotation of pinion A mounted on arm C rotating clockwise at 100 r/min about the centre of gear wheel B.

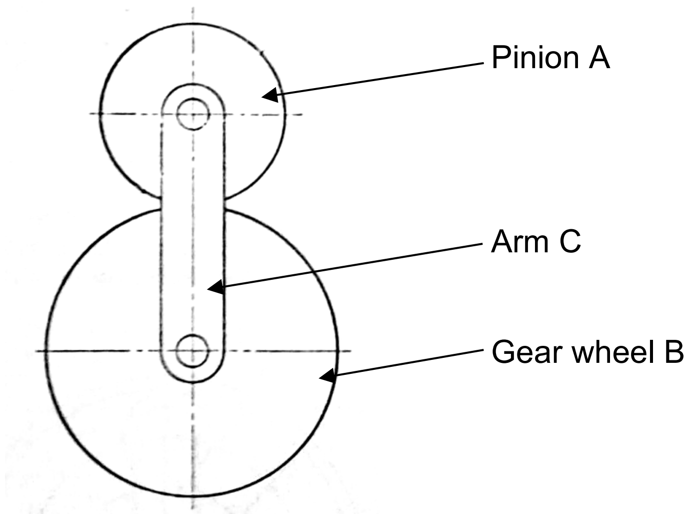

FIGURE 2

(8)
[14]

QUESTION 5

5.1 Use the dimension of an internal dovetail shown in FIGURE 3 to calculate the diameter of the roller used in the test.

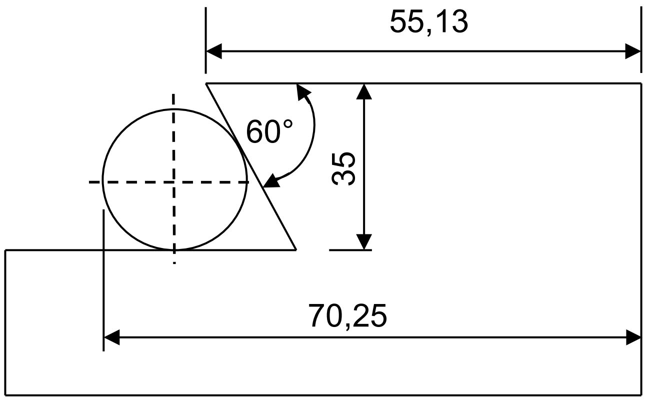

FIGURE 3 (7)

5.2 FIGURE 4 shows an external dovetail machined to an angle of 40°. Two precision rollers each of 15 mm diameter are used to test the angles for correctness.

Use the given dimensions and calculate the distance X between the inside faces of the rollers to determine if the two angles were correctly machined.

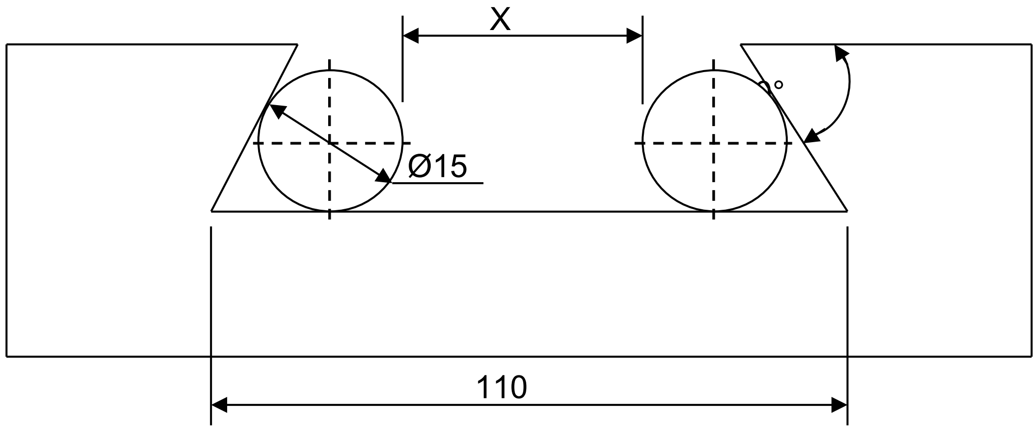

FIGURE 4 (7)

[14]

QUESTION 6

The following particulars apply to an orifice provided in the side of a tank:

Diameter of the orifice:	32 mm
Delivery of water:	0,77 m^3/min
Diameter of the vena contracta:	27 mm
Pressure head:	35,5 m

Calculate the following:

6.1 The coefficient of delivery C_d (4)

6.2 The coefficient of contraction C_c (3)

6.3 The coefficient of velocity C_v (4)

6.4 Loss of pressure head due to fluid resistance (3)
[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. $h = m\left[1 - \dfrac{\pi}{4}\left(sin\,\theta\ Cos\theta\right)\right]$

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

61. $P = \omega \times T$

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

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

67. $\mu = Tan\ \theta$

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

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

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

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

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

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

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

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

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

77. $P_l = CmgL + mgh$