higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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AUGUST EXAMINATION

NATIONAL CERTIFICATE

MECHANOTECHNICS N5

(8190225)

22 July 2014 (Y-Paper)
13:00–16:00

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 N5
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Write neatly and legibly.

QUESTION 1

1.1 State FOUR advantages of employing suspended electromagnet device to remove scrap irons from the conveyor belt transporting non metal load. (4)

1.2 The coefficient of friction between the driving pulley and the flat belt is 0,25 and the belt width is 120 mm. The diameter of the driving pulley is 700 mm and its speed is 750 r/min. The thickness of the belt is 4 mm and the maximum allowable tension exerted on the belt must not exceed 2,5 N/mm width. The density of the belt material is $1{,}2\times10^{3}\,kg/m^{3}$ and the angle of wrap between the belt and driving pulley is 160^{0}. The efficiency of the drive is 90%.

Calculate:

1.2.1 The speed of the belt (2)

1.2.2 The mass of the belt (2)

1.2.3 The centrifugal force (2)

1.2.4 Tension on both sides taking centrifugal force into account (6)

1.2.5 The output power transmitted by the drive (2)

[18]

QUESTION 2

2.1 List SIX examples of materials that can be transported by pipe conveyors. (6)

2.2 A bucket elevator is used to lift coal with a density of 900 at a rate of 400 ton/h through a vertical height of 50 m. If the chain speed is 0,4 m/s and the spacing between the buckets is 1 m, determine the volume of each bucket and the required power of the driving motor, if the head has an efficiency of 80%. (10)

[16]

QUESTION 3

3.1 State FOUR advantages of aerial ropeways over other means of transport. (4)

3.2 A ropeway on the monocable system carries 460 kg loads at 90 m intervals. The span is 90 m and the sag with the load in the middle is 2,6 m. The ultimate strength of the cable is 600 kN and the stress is not to exceed 1 300 MPa.

Calculate:

3.2.1 The diameter of the rope of a 6 / 7 construction (4)

3.2.2 The mass of the rope per meter (2)

3.2.3 The tension due to self-weight (2)

3.2.4 The tension due to one load (2)

3.2.5 The factor of safety (4)

[18]

QUESTION 4

A cage of a goods elevator carries a total load of 1 550 kg. The rope passes over a drum, 1m in diameter and then to a balance mass of 450 kg. The mass of the rope, including balance mass ropes is 300 kg. The frictional torque on the drum shaft is 850Nm. The maximum speed of the elevator is 6 m/s and it is accelerated to a maximum speed in 5 seconds.

Calculate the following:

4.1 The rope tensions (T_1 and T_2) during acceleration (6)

4.2 The torque to hold dead load (2)

4.3 The torque to accelerate the rope (2)

4.4 The total torque during acceleration (2)

4.5 The motor power (2)

[14]

QUESTION 5

An electric locomotive with a mass of 110 ton hauls trucks with a mass of 510 ton up an incline of 1 in 150. The locomotive has 84% of its mass on the driving wheels and has a rolling resistance of 140 N/ton. The rolling resistance of the trucks is 90N/ton. The coefficient of friction between the wheels and the rail is 0,3. Assume the tractive effort of the locomotive is 78% of its maximum during the accelerating period.

Calculate:

5.1 The tractive effort of the locomotive (2)

5.2 The force required to accelerate the locomotive up the incline (6)

5.3 The time taken for the locomotive and the trucks to accelerate from rest to 65 km/h (10)

5.4 The distance travelled during this time (2)
[20]

QUESTION 6

The speed of a flywheel is uniformly accelerated from 85 r/min to 105 r/min in 15 seconds by applying certain torque. The flywheel has a mass of 700 kg and a radius of gyration of 600 mm.

Calculate the following:

6.1 The angular acceleration (6)

6.2 The applied torque (2)

6.3 The revolutions that the flywheel rotates during this period (4)

6.4 The work done by the torque (2)
[14]

TOTAL: 100

MECHANOTECHNICS N5
FORMULAE

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. $v = \omega \times r$

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

PTO

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* $= FcCos\theta - mg\ Sin\theta$

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

77. $P_l = CmgL + mgh$