higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MECHANOTECHNICS N6

21 November 2022

This marking guideline consists of 8 pages.

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QUESTION 1

1.1

$$sin20^0 = \frac{R-r}{W}$$

$$sin20^0 = \frac{R-r}{40}$$

$$R - r = 13{,}681 \ldots\ldots\ldots\ldots eq1$$ 1 mark for sub

$$R_f = \frac{R+r}{2}$$

$$300 = \frac{R+r}{2}$$

$$R + r = 600 \ldots\ldots\ldots\ldots eq2$$ 1 mark for sub

$$eq1 + eq2$$

$$2R = 613{,}681$$ 1 mark for solving simultaneously

$$R = 306{,}841 \quad D = 614\ mm$$ Half mark for R and r each

$$r = 293{,}16 \quad d = 586\ mm$$ 1 mark for D and d each (6)

1.2

$$T = \frac{\mu \times F_A \times R_f}{sin\theta}$$

$$T = \frac{0{,}25 \times 60 \times 1\,000 \times \pi(0{,}614^2 - 0{,}586^2) \times 0{,}3}{sin20}$$ 5 marks for sub

1 mark for answer

$$T = 1\,388{,}833\ Nm$$ (6)

1.3

$$P = \frac{2\pi NT}{60}$$

$$P = \frac{2\pi \times 1\,200 \times 1\,388{,}833}{60}$$ 2 marks for sub

$$P = 174{,}526\ kW$$ 1 mark for answer (3)

[15]

QUESTION 2

2.1 $\frac{T_1}{T_2} = e^{\mu\theta}$

$T_1 = e^{\frac{0.3\times\pi\times210}{180}} \times 150$ 2 marks for sub

$T_1 = 450{,}426\ kN$ 1 mark for answer

$T = (450{,}426 - 150)(0{,}375)$ 2 marks for sub

$T = 112{,}660\ Nm$ 1 mark for answer (6)

2.2 $T = Ia$

$112{,}660 = 450 \times 0{,}3^2 \times a$ 2 marks for sub

$a = 2{,}781\ rad/s^2$ 1 mark for answer

$\omega_2 = \omega_1 + at$

$t = \frac{0 - \frac{2\pi\times370}{60}}{2{,}781}$ 2 marks for sub

$t = 13{,}933\ s$ 1 mark for answer (6)

2.3 $\theta = \omega_1 t + 0{,}5at^2$

$\theta = \frac{2\pi \times 370}{60}(13{,}9333) + 0{,}5(2{,}781)(13{,}933)^2$ 2 marks for sub

$\theta = 809{,}788\ rev$ 1 mark for answer (3)

[15]

QUESTION 3

3.1 $P = \frac{2\pi NT}{60}$

$32 \times 10^3 = \frac{2\pi \times 280 \times T}{60}$ 3 marks for sub

$T = 1\,091{,}348\ N.m$ 1 mark for answer (4)

3.2 $T_1 = 3T_2$

$1\,091{,}348 = 2T_2 \times 0{,}175$ 3 marks for sub

$T_2 = 3\,118{,}137\ N$

$T_1 = 9\,354{,}411\ N$ 1 mark for answer (4)

3.3 Moments about O

Clockwise moments = anti-clockwise moments

$(140 \times 9{,}81 \times 50) + (740 \times 225) = \mathrm{R_B} \times 300$ 3 marks for sub

$\mathrm{R_B} = 577{,}89\ N$ 1 mark each for the two reactions✓✓

$\sum F \uparrow = \sum F \downarrow$

$\mathrm{R_A} = 1\,535{,}51\ N$ (5)

3.4 Moments about A

Clockwise moments = anti-clockwise moments

$(T_1 + T_2)(225) = \mathrm{R_B} \times 300$ 2 marks for sub
$\mathrm{R_B} = 9\,354{,}411\ N$ 1 mark for answer

Moments about A

Clockwise moments = anti-clockwise moments

$(T_1 + T_2)(75) = \mathrm{R_B} \times 300$ 2 marks for sub
$\mathrm{R_A} = 3\,118{,}137\ N$ 1 mark for answer (6)

[19]

QUESTION 4

4.1 $\omega_2 = \omega_1 + at$ 3 marks for sub

$\frac{2\pi \times 500}{60} = \frac{2\pi \times 300}{60} + a(18)$

1 mark for answer

$a = 1{,}164\ {}^{rad}/_{s^2}$ (4)

4.2 $\theta = \omega_1 t + 0{,}5at^2$

$\theta = \frac{300 \times 2\pi}{60}(18) + 0{,}5(1{,}164)(18)(18)$ 3 marks for sub

$\theta = 754{,}055\ rad$ 1 mark for answer (4)

4.3 $v_2 = \omega_2 r$

$v_2 = \frac{2\pi \times 500}{60} \times 1$ 2 marks for sub

$v_2 = 52{,}360\ m/s$ 1 mark for answer (3)

4.4 v = u + at

52,360 = 31,416 + a(18) 2 marks for sub

$a = 1{,}164\ rad/s^2$ 1 mark for answer (3)

[14]

QUESTION 5

5.1 Displacement moved by the effort = π × 0,065 = 0,204

Load wheel rotates on tooth = 1/40 = 0,023

Distance moved by the load = 0,025 × π × 0,1 = 0,0079

$$V.R = \frac{effort\ distance}{load\ distance}$$

$$V.R = \frac{0{,}204}{0{,}0079}$$

$$V.R = 25{,}823$$

1 mark for each step excluding the formula (5)

5.2 $efficiency = \frac{MA}{VR}$

$MA = 0{,}3 \times 25{,}823$ 1 mark for sub

$MA = 7{,}747$ 1 mark for MA answer

$MA = \frac{load}{effort}$

$effort = \frac{2000}{7{,}747}$ 1 mark for sub

$effort = 258{,}168\ N$ 1 mark for effort answer (4)

[9]

QUESTION 6

$$Efficiency = \frac{P_{OUT}}{P_{IN}}$$

$P_{OUT} = 75\% \times 95$ 1 mark for sub

$P_{OUT} = 71{,}25\ kW$ 1 mark for output power

$$P = \frac{2\pi NT}{60}$$

$$T = \frac{71{,}25 \times 1\,000 \times 60}{2\pi \times 1\,100}$$ 1 mark for sub

$T = 618{,}534\ N.m$ 1 mark for torque

$T = Fr$

$$F = \frac{618{,}534}{0{,}4}$$ 1 mark for sub

$F = 1\,546{,}335\ N$ 1 mark for force

$F_a = ma$

$$a = \frac{1\,546{,}335}{35 \times 1\,000}$$ 1 mark for sub

$a = 0{,}04\ {}^{m}/_{s^2}$ 1 mark for acceleration

V = u + at

46,077 = 0 + (0,04)t 1 mark for sub

t = 1 151,917 s 1 mark for final answer✓✓ **[10]**

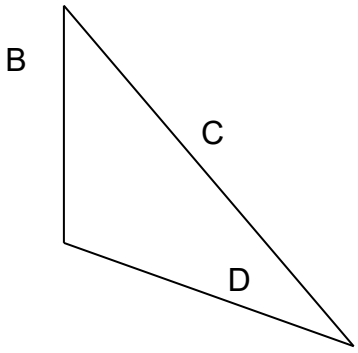
QUESTION 7

7.1 Take Mass A as a reference plane:

Plane	M (kg)	R (m)	mr (kg.m)	L (m)	Mrl ($kg.m^2$)
A	X	0.1	0,1x	0	0
B	21	0,13	2,73	0,25	0,6825
C	30	0,085	2,55	0,5	1,2750
D	6	0,2	1,2	0,75	0,9

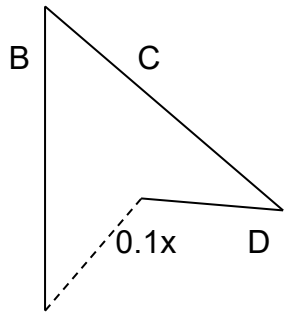
6 marks for the table
3 marks for the couple polygon

Using scale 1 mm = 0,05 $kg.m^2$



(9)

7.2



1 mark for each side
1 mark for the correct diagram (4)

7.3 $0{,}1x = 1{,}4$ 1 mark for sub
$x = 14\ kg$ 1 mark for answer (2)

7.4 $AD = 102^\circ$ 3 marks for the answers

$BC = 138^\circ$

$BA = 208^\circ$

$BD = 87^\circ$ (3)

[18]

TOTAL: 100

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