



**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.

QUESTION 1

- 1.1 $\sin 20^\circ = \frac{R-r}{W}$
 $\sin 20^\circ = \frac{R-r}{40}$
 $R-r = 13,681 \dots \dots \dots eq 1$ 1 mark for sub
 $R_f = \frac{R+r}{2}$
 $300 = \frac{R+r}{2}$
 $R+r = 600 \dots \dots \dots eq 2$ 1 mark for sub
 $eq 1 + eq 2$
 $2R = 613,681$ 1 mark for solving simultaneously
 $R = 306,841$ Half mark for R and r each
 $D = 614 \text{ mm}$ 1 mark for D and d each
 $r = 293,16$ Half mark for r each
 $d = 586 \text{ mm}$ (6)
- 1.2 $T = \frac{\mu \times F_A \times R_f}{\sin \theta}$
 $T = \frac{0,25 \times 60 \times 1000 \times \pi (0,614^2 - 0,586^2) \times 0,3}{\sin 20}$ 5 marks for sub
 $T = 1388,833 \text{ Nm}$ 1 mark for answer (6)
- 1.3 $P = \frac{2\pi NT}{60}$
 $P = \frac{2\pi \times 1200 \times 1388,833}{60}$ 2 marks for sub
 $P = 174,526 \text{ kW}$ 1 mark for answer (3)

[15]

QUESTION 2

2.1

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

$$T_1 = e^{\frac{0,3 \times \pi \times 210}{180}} \times 150$$

2 marks for sub

$$T_1 = 450,426 \text{ kN}$$

1 mark for answer

$$T = (450,426 - 150)(0,375)$$

2 marks for sub

$$T = 112,660 \text{ Nm}$$

1 mark for answer

(6)

2.2

$$T = Ia$$

$$112,660 = 450 \times 0,3^2 \times a$$

2 marks for sub

$$a = 2,781 \text{ rad/s}^2$$

1 mark for answer

$$\omega_2 = \omega_1 + at$$

$$t = \frac{0 - \frac{2\pi \times 370}{60}}{2,781}$$

2 marks for sub

$$t = 13,933 \text{ s}$$

1 mark for answer

(6)

2.3

$$\theta = \omega_1 t + 0,5 a t^2$$

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

2 marks for sub

$$\theta = 809,788 \text{ rev}$$

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

$$T = 1\,091,348 \text{ N} \cdot \text{m}$$

1 mark for answer

(4)

3.2 $T_1 = 3T_2$

$$1\,091,348 = 2T_2 \times 0,175$$

3 marks for sub

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

1 mark for answer

$$T_1 = 9\,354,411 \text{ N}$$

(4)

3.3 Moments about O

Clockwise moments = anti-clockwise moments

$$(140 \times 9,81 \times 50) + (740 \times 225) = R_B \times 300$$

3 marks for sub

$$R_B = 577,89 \text{ N}$$

1 mark each for the two reactions ✓✓

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

$$R_A = 1\,535,51 \text{ N}$$

(5)

3.4 Moments about A

Clockwise moments = anti-clockwise moments

$$(T_1 + T_2)(225) = R_B \times 300$$

2 marks for sub

$$R_B = 9\,354,411 \text{ N}$$

1 mark for answer

Moments about A

Clockwise moments = anti-clockwise moments

$$(T_1 + T_2)(75) = R_B \times 300$$

2 marks for sub

$$R_A = 3\,118,137 \text{ N}$$

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

$$a = 1,164 \frac{\text{rad}}{\text{s}^2}$$

(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

$$\theta = 754,055 \text{ rad}$$

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

$$v_2 = 52,360 \text{ m/s}$$

1 mark for answer

(3)

4.4 $v = u + at$

$$52,360 = 31,416 + a(18)$$

2 marks for sub

$$a = 1,164 \text{ rad/s}^2$$

1 mark for answer

(3)

[14]

QUESTION 5

5.1 Displacement moved by the effort = $\pi \times 0,065 = 0,204$

Load wheel rotates on tooth = $1/40 = 0,025$

Distance moved by the load = $0,025 \times \pi \times 0,1 = 0,0079$

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

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

$$V.R = 25,823$$

1 mark for each step excluding the formula (5)

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

$$MA = 0,3 \times 25,823$$

1 mark for sub

$$MA = 7,747$$

1 mark for MA answer

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

$$\text{effort} = \frac{2000}{7,747}$$

1 mark for sub

$$\text{effort} = 258,168 \text{ N}$$

1 mark for effort answer

(4)
[9]

QUESTION 6

$$\text{Efficiency} = \frac{P_{OUT}}{P_i}$$

$$P_{OUT} = 75\% \times 95$$

1 mark for sub

$$P_{OUT} = 71,25 \text{ kW}$$

1 mark for output power

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

$$T = \frac{71,25 \times 1000 \times 60}{2\pi \times 1100}$$

1 mark for sub

$$T = 618,534 \text{ N} \cdot \text{m}$$

1 mark for torque

$$T = Fr$$

$$F = \frac{618,534}{0,4}$$

1 mark for sub

$$F = 1546,335 \text{ N}$$

1 mark for force

$$F_a = ma$$

$$a = \frac{1546,335}{35 \times 1000}$$

1 mark for sub

$$a = 0,04 \frac{\text{m}}{\text{s}^2}$$

1 mark for acceleration

$$V = u + at$$

$$46,077 = 0 + (0,04)t$$

1 mark for sub

$$t = 1151,917 \text{ s}$$

1 mark for final answer ✓✓

[10]

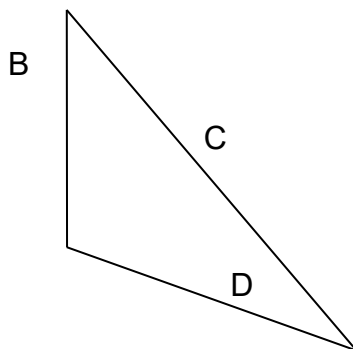
QUESTION 7

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

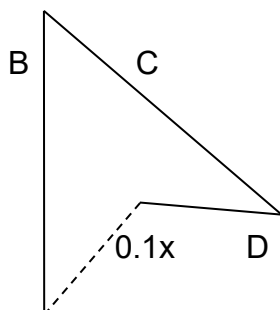
6 marks for the table

3 marks for the couple polygon

Using scale 1 mm = 0,05kg.m²

(9)

7.2



1 mark for each side

1 mark for the correct diagram

(4)

7.3

$$0,1x = 1,4$$

$$x = 14 \text{ kg}$$

1 mark for sub

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]

