



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE MECHANOTECHNICS N5

12 July 2022

This marking guideline consists of 8 pages.

1.1 $T_A = 2T_P + T_S$
 2 (36) + 14
 86 Teeth

1.2	Condition	A	P	S	L
	Fix arm L and rotate A + 1 rev	1	$\frac{TA}{TP} = \frac{86}{36} = 2,389 \checkmark$	$\frac{TA}{TS} = \frac{86}{14} = -6,123 \checkmark$	0
	Multiply by x and add y	x + y	2,389x + y	-6,123x + y	y
		0		230	

$$\begin{array}{rcl} -6,123x + y & = & 230 \dots\dots\dots 1 \\ x + y & = & 0 \dots\dots\dots 2 \\ x = -y & & \dots\dots\dots 3 \end{array}$$

$$\begin{aligned} -6,123(-y) + y &= 230 \quad \checkmark \\ 7,123y &= 230 \\ y &= 32,299 \quad \checkmark \end{aligned}$$

$$P_i = \frac{2 \pi N T}{60}$$

$$T_i = \frac{3800 \times 60}{2 \times \pi \times 230}$$

$$(T_{in} \times N_{in}) + (T_{out} \times N_{out}) + (T_{hold} \times N_{hold}) = 0$$

$$(157,771 \times 230) + (T_{out} \times 32,289) = 0$$

$$T_{out} = -1123,829 \text{ N.m} \quad \checkmark$$

$$T_{out} = -1123,829 \times 0,92 = 1033,923 \text{ N.m} \quad \checkmark$$

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QUESTION 2

$$VR = \frac{TA}{TB} = \frac{48}{1} \checkmark$$

$\checkmark 48$

And

$$VR = \frac{NB}{NA}$$

$$48 = \frac{240}{NA} \checkmark$$

$$NA = 5 \text{ r/min}$$

$$Ft = \frac{2 \times T}{PCD}$$

$$1350 = \frac{2 \times T}{0,2} \checkmark \checkmark$$

$$T_{out} = 135 \text{ Nm} \checkmark$$

$$T_i = \frac{135}{48 \times 0,86} \checkmark \checkmark$$

$$T_i = 3,27 \text{ Nm} \checkmark$$

[10]**QUESTION 3**

$$T_1 = w \times n \times ft$$

$$\checkmark w \times 1 \times 25000$$

$$\checkmark 25000 w \text{ N} \checkmark$$

$$V = w \times t \times L$$

$$\checkmark w \times 0,015 \times 1$$

$$\checkmark 0,015 w \text{ m}^3$$

$$m = p \times V$$

$$m = 860 \times 0,015 w \checkmark$$

$$m = 12,9 w \text{ kg}$$

$$v = \frac{\pi(D+t)N}{60}$$

$$\checkmark \frac{\pi(1+0,015) \times 320}{60} \checkmark \checkmark$$

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Please turn over

$$\dot{=} 17,006 \text{ m/s} \checkmark$$

$$T_C = m v^2$$

$$\dot{=} 12,9 \text{ w} \times 17,006^2 \checkmark$$

$$\dot{=} 3\,730,732 \text{ w N} \checkmark$$

$$\theta = \frac{155}{57,3} = 2,705 \text{ rad} \checkmark$$

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

$$\frac{25\,000 \text{ w} - 3\,730,732 \text{ w}}{T_2 - 3\,730,732 \text{ w}} = e^{0,32 \times 2,705}$$

$$\frac{21\,269,268 \text{ w}}{T_2 - 3\,730,732 \text{ w}} = 2,376$$

$$T_2 = 12\,680,817 \text{ w N} \checkmark \checkmark$$

$$P = (T \dot{=} 1 - T_C) \times v \dot{=}$$

$$42\,500 = (25\,000 \text{ w} - 12\,680,817 \text{ w})(17,006) \checkmark$$

$$w = 0,2028 \text{ m} \checkmark$$

$$\dot{=} 202,8 \text{ mm}$$

[20]**QUESTION 4**

$$4.1 \quad v = \frac{75}{60} = 1,25 \text{ m/s} \checkmark$$

$$v = \sqrt{g \times \cos \theta \times r}$$

$$1,25 = \sqrt{9,81 \times \cos 30^\circ \times r} \checkmark$$

$$1,25^2 = 9,81 \times \cos 30^\circ \times r$$

$$r = 0,183 \text{ m} \checkmark$$

$$D = 2 \times 0,184 \text{ m}$$

$$D = 0,368 \text{ m} \checkmark$$

$$D = 368 \text{ mm}$$

(4)

$$4.2 \quad L = 2\pi r + 2C$$

$$\dot{=} 2\pi(0,184) + 2(100) \checkmark$$

$$\dot{=} 201,156 \text{ m} \checkmark$$

(2)

4.3 $\text{no of buckets} = \frac{\text{speed}}{\text{spacing}}$

$$\hat{=} \frac{1,25}{0,7}$$

$$\hat{=} 1,786 \text{ bucket/s}$$

$$\text{say} = 2 \text{ buckets/s} \checkmark \checkmark$$

$$m = \frac{1200 \times 10^3}{8 \times 3600}$$

$$\hat{=} 41,667 \text{ kg/s} \checkmark \checkmark$$

$$h = \frac{201,156}{2}$$

$$\hat{=} 100,578 \text{ m} \checkmark$$

$$P_g = mgh$$

$$\hat{=} 41,667 \times 9,81 \times 100,578 \checkmark$$

$$\hat{=} 41,112 \text{ kW} \checkmark$$

$$P_m = \frac{P_g}{\eta}$$

$$\hat{=} \frac{41,112 \times 10^3}{0,81} \checkmark$$

$$\hat{=} 50,756 \text{ kW}$$

(9)
[15]

QUESTION 5

- 5.1
- Trip wire
 - Drop rail
 - Cut-out rails
 - Self-locking worm gears
 - Beacon derailment device
 - Pivoted prop stopping devices
- (6)

5.2 5.2.1 $T_{\text{Tubs/min}} = \frac{\text{Ton}_{\hat{=} \text{shift}}}{60 \times \text{hrs} \times \text{ton}_{\hat{=} \text{tub}}}$

$$\hat{=} \frac{600}{60 \times 7 \times 1}$$

$$\hat{=} 1,429 \text{ tub}_{/\text{min}}$$

(2)

$$Spacing = \frac{Vr}{Tubs/\min}$$

$$\hookrightarrow \frac{70}{1,429}$$

$$\hookrightarrow 48,985 m$$

(2)

5.2.2

$$No_{tubs} = \frac{L}{Spacing}$$

$$\hookrightarrow \frac{650}{48,985}$$

$$\hookrightarrow 13,27$$

$$say = 13 tub / min$$

(3)

5.2.3

$$F_{tub} = F_g + F_R$$

$$\hookrightarrow (M_{tub} \times N_{tubs} \times g \sin 15^\circ) + (M_{tub} \times N_{tub} \times F_R)$$

$$\hookrightarrow (1500 \times 13 \times 9,81 \sin 15^\circ) + (1,5 \times 13 \times 180)$$

$$\hookrightarrow 49510,789 + 3510$$

$$\hookrightarrow 53,02 kN$$

$$F_{Total} = F_{tubs} + F_\mu$$

$$\hookrightarrow 53,02 + \frac{16}{2}$$

$$\hookrightarrow 61,02 kN$$

$$F_{break} = F_{Total} \times ft$$

$$\hookrightarrow 61,02 \times 5$$

$$\hookrightarrow 305,1 kN$$

(7)

[20]

QUESTION 6

$$6.1 \quad v_f = v_i + at$$

$$\hookrightarrow 0 + (12 \times 2,2)$$

$$\hookrightarrow 2,64 m/s$$

(2)

$$6.2 \quad T_1 = m_1(g + a) + F_u$$

$$\hookrightarrow 950(9,81 + 1,2) + 520$$

$$\hookrightarrow 10\,979,5 \text{ N} \checkmark \checkmark$$

$$T_2 = m_2(g - a) - F_u$$

$$\hookrightarrow 680(9,81 - 1,2) - 520$$

$$\hookrightarrow 5\,334,8 \text{ N} \checkmark$$

$$T_{load} = (T_1 - T_2) R$$

$$\hookrightarrow (10979,5 - 5334,8) 0,375$$

$$\hookrightarrow 2\,116,763 \text{ N.m} \checkmark$$

$$I = mk^2$$

$$\hookrightarrow 350 \times 0,48^2$$

$$\hookrightarrow 80,64 \text{ kg} \cdot \text{m}^2 \checkmark \checkmark$$

$$\alpha = \frac{a}{r} = \frac{1,2}{0,375} = 3,2 \text{ rad/s}^2 \checkmark$$

$$T_{drum} = I \times \alpha$$

$$\hookrightarrow (80,64 \times 3,2)$$

$$\hookrightarrow 258,05 \text{ N.m} \checkmark$$

(8)
[10]**QUESTION 7**

7.1

$$w_1 = \frac{2\pi N}{60}$$

$$\hookrightarrow \frac{2\pi \times 60}{60} \checkmark \checkmark$$

$$\hookrightarrow 6,283 \text{ rad/s} \checkmark$$

$$w_2 = \frac{2\pi N}{60}$$

$$\hookrightarrow \frac{2\pi \times 1200}{60} \checkmark \checkmark$$

$$\hookrightarrow 125,664 \text{ rad/s} \checkmark$$

$$\alpha = \frac{w_2 - w_1}{t}$$

$$\hookrightarrow \frac{125,64 - 6,283}{50} \checkmark$$

$$\hookrightarrow 2,388 \text{ rad/s}^2 \checkmark \quad (8)$$

7.2

$$a = \alpha \times r$$

$$\hookrightarrow 2,388 \times 0,325 \checkmark$$

$$\hookrightarrow 0,776 \text{ m/s}^2 \checkmark$$

(2)
[10]

QUESTION 8

$$\frac{E_{K1}}{E_{K2}} = \frac{N_1^2}{N_2^2}$$
$$E_{K2} = \frac{150\,000 \times 120^2}{160^2} \checkmark$$

$$E_{K2} = 84,375 \text{ kJ} \checkmark$$

$$\text{Energy lost} = E_{K1} - E_{K2}$$

$$\hookrightarrow 150 - 84,375$$

$$\hookrightarrow 65,625 \text{ kJ} \checkmark$$

$$\text{Energy lost} = \text{work done}$$

$$F = \frac{\text{work done}}{\text{distance}}$$

$$\hookrightarrow \frac{65\,625\,000}{0,03} \checkmark$$

$$\hookrightarrow 2\,187,5 \text{ kN} \checkmark$$

[5]**TOTAL: 100**