higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MECHANOTECHNICS N6

30 JULY 2018

This marking guideline consists of 7 pages.

QUESTION 1

1.1 $P = \frac{2\pi NT}{60}$

$= \frac{2\times\pi\times 1\,500\times 142}{60}$ ✓

$= 22{,}3\ kW$ ✓

(2)

1.2 $T = \mu \times F_A \times R_m \times n$

$F_A = \frac{T}{\pi \times R_m \times n}$ ✓

$= \frac{142 \times 2}{0{,}3 \times 0{,}095 \times 2}$ ✓

$= 4\,982\ N$ ✓

(3)

1.3 $I = mk^2$

$I_m = 63{,}5 \times 0{,}14^2 = 1{,}245\ kgm^2$ ✓

$I_r = 22{,}8 \times 0{,}075^2 = 0{,}128\ kgm^2$ ✓

$(I_m + I_r)N_3 = I_m N_m + I_r N_r$ ✓

$\therefore 1{,}373\ N_3 = 0 + 0{,}128 \times 1\,500$ ✓

$N_3 = 139{,}8\ r/min$ ✓

(5)

1.4 $\omega_1 = \frac{2\pi \times 1\,500}{60} = 157\ rad/s$ ✓

$\omega_2 = \frac{2\pi \times 139{,}8}{60} = 14{,}6\ rad/s$ ✓

$T = I\alpha$ **OR**

$\alpha_m = \frac{142}{1{,}245} = 114\ rad/s^2$ ✓

$t = \frac{\omega_1 - \omega_2}{\alpha}$

$= \frac{14{,}6 - 0}{114} = 0{,}128\ sec$ ✓

$\alpha_r = \frac{142}{0{,}128} = 1\,109\ rad/s^2$ ✓

$t = \frac{\omega_2 - \omega_1}{\alpha}$

$= \frac{157 - 14{,}6}{1\,109} = 0{,}128\ sec$ ✓

(4)

1.5 $E_{kloss} = E_{kin} - E_{kf}$

$= \frac{1}{2}I_1\omega_1^2 + \frac{1}{2}I_2\omega_2^2 - \frac{1}{2}(I_1 + I_2)\omega_3^2$ ✓

$= \frac{1}{2}(0{,}128)(157)^2 + 0 - \frac{1}{2}(0{,}128 + 1{,}245)(14{,}6)^2$ ✓

$= 1\,431\ J$ ✓

(3)

[17]

QUESTION 2

2.1 $v = \frac{\pi \times 0{,}85 \times 510}{60} = 22{,}698\ m/s$✓

$P = (T_1 - T_2) \times v$

$25\ 000 = (T_1 - T_2) \times 22{,}698$

$(T_1 - T_2) = 1\ 101{,}4\ N$✓

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

$= e^{0{,}27\pi}$

$= 2{,}335$✓

$1{,}335\ T_2 = 2\ 220\ N$✓

$T_2 = 825\ N \quad and \quad T_1 = 1\ 926\ N$✓

(5)

2.2 $T_s = (T_1 - T_2) \times r$

$= (1\ 962 - 825) \times 0{,}425$✓

$= 467{,}9\ Nm$✓

(2)

2.3 $T_p = \frac{T_s \times N_s}{N_p}$

$= \frac{467{,}9 \times 510}{10\ 200}$

$= 198{,}86\ N$✓

(1)

2.4 $F_t = \frac{T \times 2}{PCD}$

$= \frac{198{,}86 \times 2}{0{,}1}$✓

$= 3\ 977{,}2$✓

(2)

2.5 $F_n = F_t sec\theta$

$= 3\ 977{,}2\ sec20°$✓

$= 4\ 232{,}4\ N$✓

(2)

2.6 $\sum \curvearrowright M = \sum \curvearrowleft M$ About/Om L

$R \times 1{,}75 = (T_1 + T_2 + m \times g) \times 0{,}5$✓

$R \times 1{,}75 = (1\ 926 + 825 + 90 \times 9{,}81) \times 0{,}5$✓

$R = 1\ 038\ N$✓

$L + R = T_1 + T_2 + m \times g$✓

$L + 1\ 038 = 1\ 926 + 825 + 90 \times 9{,}81$✓

$L = 2\ 595\ N$✓

(6)

[18]

QUESTION 3

3.1 3.1.1

$$WD = F \times s$$
$$= 23\,000 \times 9{,}81 \times 0{,}03 \times 100/75 \checkmark$$
$$= 9\,025\,J = \Delta E_k \checkmark$$
$$\omega = \frac{2\pi N}{60}$$
$$\omega_1 = \frac{2\pi \times 296}{60} \qquad \omega_2 = \frac{2\pi \times 248}{60}$$
$$= 31\,rad/s \qquad = 26\,rad/s \checkmark$$
$$\Delta E_k = E_{k1} - E_{k2}$$
$$= \frac{1}{2} I(\omega_1{}^2 - \omega_2{}^2)$$
$$9\,025 = \tfrac{1}{2} \times 9\,025(31^2 - 26^2) \checkmark$$
$$\therefore I = 63{,}33\,kgm^2 \checkmark$$

(5)

3.1.2

$$P = \frac{WD}{t}$$
$$= \frac{9\,025 \times 10}{60} \checkmark$$
$$= 1\,504\,W \checkmark$$

(2)

3.2

$$\frac{T_1}{T_2} = e^{\mu\theta} \qquad T_2 = 250\,N$$
$$= e^{0{,}3 \times 225 \div 57{,}3} \checkmark$$
$$= 3{,}248 \checkmark$$
$$\therefore T_1 = 3{,}248 \times 250 \checkmark$$
$$= 812\,N \checkmark$$
$$T_b = (T_1 - T_2) \times R$$
$$T_b = (812 - 250) \times 0{,}2 \checkmark$$
$$= 112{,}4\,Nm \checkmark$$

(6)
[13]

QUESTION 4

4.1 $I = mk^2$

$I = 80 \times 0{,}2^2$✓

$= 3{,}2\ kgm^2$✓ (2)

4.2 $T_D = T_A \times VR$

$= \frac{3{,}5 \times 52 \times 55}{25 \times 30}$✓

$= 13{,}35\ Nm$✓

$I_{D\ total} = I_A \times VR^2 + (I_B + I_C) \times VR^2 + I_D + I_{drum}$✓✓

$= 0{,}23 \times \left(\frac{52 \times 55}{25 \times 30}\right)^2 + (0{,}75 + 0{,}3) \times \left(\frac{55}{30}\right)^2 + 1{,}2 + 3{,}2$

✓ ✓ ✓ ✓ ✓ ✓

$= 11{,}27\ kgm^2$✓✓

$T = I\alpha$

$\alpha = 13{,}35 \div 11{,}27$✓

$= 1{,}185\ rad/s^2$✓ (14)

[16]

QUESTION 5

5.1 Maximum skidding speed:

$v = \sqrt{gr\left(\frac{\mu + tan\theta}{1 - \mu tan\theta}\right)}$

$= \sqrt{9{,}81 \times 130\left(\frac{0{,}6 + tan20°}{1 - 0{,}6tan20°}\right)}$✓

$v =$ 39,65 m/s

$= 142{,}77\ km/h$✓

Maximum overturning speed:

$v = \sqrt{gr\left(\frac{htan\theta + \frac{b}{2}}{h - \frac{b}{2}tan\theta}\right)}$

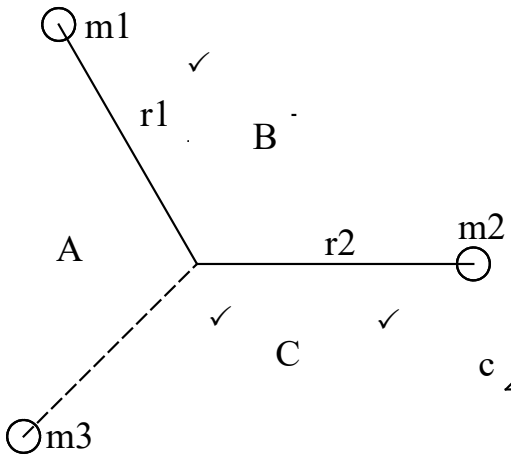
$= \sqrt{9{,}81 \times 130\left(\frac{0{,}65tan20° + \frac{1{,}5}{2}}{0{,}65 - \frac{1{,}5}{2}tan20°}\right)}$✓

$v =$ 57,77 m/s

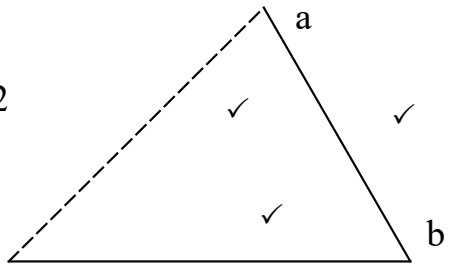
$= 207{,}9\ km/h$✓

The maximum safe speed is 142,77 km/h to prevent skidding.✓✓ (6)

5.2 $m_1r_1 = 114{,}5 \times 91 = 1\,312\ kg.mm$✓
$m_2r_2 = 17{,}91 \times 101 = 1\,809\ kg.mm$✓



Space diagram



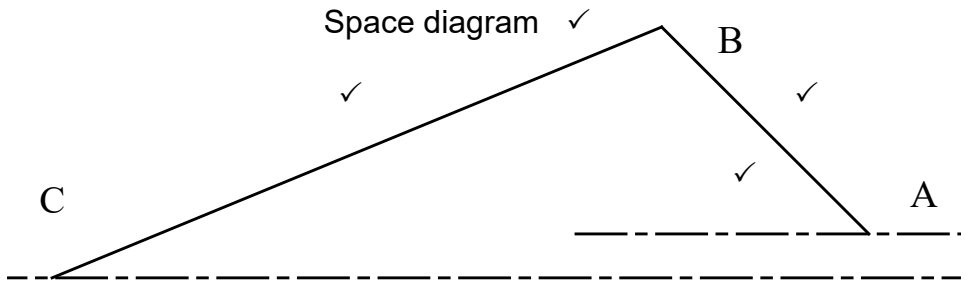
Vector diagram

$m_3r_3 = 54 \times 30$✓
$= 1\,620$✓
$r = \frac{1\,620}{15}$✓
$= 108\ mm$✓

(12)
[18]

QUESTION 6

6.1

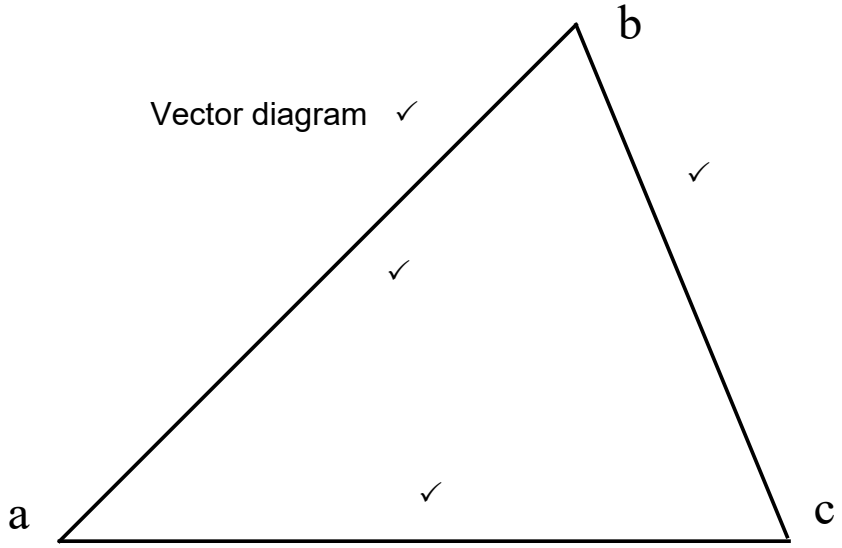


(3)

6.2 $v_b = \frac{2\pi rN}{60}$
$= \frac{2\pi \times 0{,}2 \times 150}{60}$✓
$= 3{,}14\ m/s$✓

(2)

6.3



(3)

6.4 6.4.1 $v_c = ac \times 0{,}04$

$= 78{,}4 \times 0{,}04$

$= 3{,}136\ m/s$ (3)

6.4.2 $\omega_{BC} = \frac{v_{BC}}{BC}$

$= \frac{60 \times 0{,}04}{0.45}$✓

$= 5{,}33\ rad/s$✓

In an anticlockwise direction at 67,6° to the horizontzal ✓ (3)

6.4.3 $a_{B\ rel\ to\ C} = \frac{{v_{BC}}^2}{BC}$

$= \frac{(60 \times 0{,}04)^2}{0{,}45}$✓

$= 12{,}8\ m/s^2$✓ (2)

6.4.4 $a_{B\ rel\ to\ A} = \frac{{v_{BA}}^2}{AB}$

$= \frac{(3{,}14)^2}{0{,}2}$✓

$= 49{,}298\ m/s^2$✓ (2)

[18]

TOTAL: 100