higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MECHANOTECHNICS N6

4 APRIL 2018

This marking guideline consists of 6 pages.

QUESTION 1

1.1 1.1.1 $T = \frac{P \times 60}{2\pi N}$

$T = \frac{25\,000 \times 60}{2\pi \times 1\,200}$ ✓
$= 198{,}94\ Nm$✓ (2)

1.1.2 $R_f = \frac{100+75}{2}$
$= 87{,}5mm$✓
$T = \frac{\mu \times F_A \times R_f}{sin\theta}$
$F_A = \frac{198{,}94 \times sin15°}{0{,}28 \times 0{,}0875}$✓
$= 2\,101\ N$✓ (3)

1.1.3 $F_{eng} = F_A\left(1 + \frac{\mu}{tan\theta}\right)$
$= 2\,101\ \left(1 + \frac{0{,}4}{tan15°}\right)$✓
$= 5\,237\ N$✓ (2)

1.2 $\frac{T_1}{T_2} = \left[\frac{1+\mu \tan\theta}{1-\mu \tan\theta}\right]^n$
$= \left[\frac{1+0{,}35 \tan 5°}{1-0{,}35 \tan 5°}\right]^{15}$ ✓
$= 2{,}51$✓
$P = (T_1 - T_2) \times v$
$T_1 - T_2 = \frac{200 \times 10^3 \times 60}{\pi \times 0{,}6 \times 650}$✓
$= 9794\ N$✓
$\therefore 2{,}51T_2 - T_2 = 9794$✓
$T_2 = 6486\ N$✓
$T_1 = 16280\ N$✓

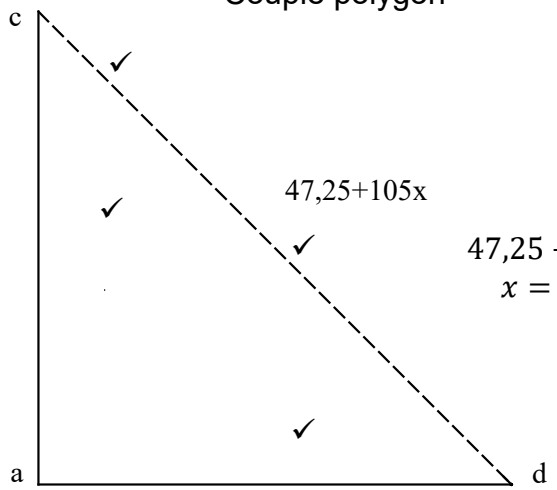
$\sum \curvearrowright M = \sum \curvearrowleft M$
$F \times 550 + T_2 \times 50 = T_1 \times 150$✓
$\therefore F \times 550 + 16280 \times 50 = 6486 \times 150$✓
$\therefore F = 288{,}9\ N$✓ (10)
[17]

QUESTION 2

2.1

Plane	$m\ (kg)$	$r\ (m)$	$mr\ (kg.m)$	$l\ (m)$	$mrl\ (kg.m^2)$
A	6	30	180	-0,4	0
B	m	42	42m	0	0,375
C	4	40	160	0,45	0,844
D	3	35	105	0,45 + x	47,25 + x
			✓	✓	✓

Couple polygon



$47{,}25 + 105x = 101{,}8$✓
$x = 0{,}52\ m = 520\ mm$✓

(9)

2.2 2.2.1

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

$T_1 - T_2 = \frac{35\times10^3\times60}{\pi\times0{,}9\times600}$

$T_1 - T_2 = 1238\ N$✓

$2{,}19T_2 - T_2 = 1238\ N$

$T_2 = 1040\ N$✓

$T_1 = 2278\ N$✓

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

$= e^{0{,}25\pi}$

$= 2{,}19$✓

(4)

2.2.2

$T_s = \frac{P\times60}{2\times\pi\times N}$

$= \frac{35\ 000\times60}{2\times\pi\times600}$ ✓

$= 557\ Nm$✓

(2)

2.2.3

$T_p = \frac{35\ 000\times60}{2\times\pi\times1500}$

$= 222{,}8\ Nm$✓

(1)

2.2.4

$F_t = \frac{T\times2}{PCD}$

$= \frac{222{,}8\times2}{0{,}12}$

$= 3713\ N$✓

$F_r = F_t sec\varphi$✓

$F_r = 3713 sec20°$

$= 3951\ N$✓

(3)

[19]

QUESTION 3

3.1 $m = \rho \times V$
$= \rho \times \pi(R^2 - r^2) \times w$✓
$= 7\,300 \times \pi(0{,}45^2 - 0{,}3^2) \times 0{,}2$✓
$= 516\ kg$✓ (3)

3.2 $I = mk^2$
$= 1/2m(R^2 + r^2)$✓
$= 1/2 \times 516(0{,}45^2 + 0{,}3^2)$✓
$= 75{,}465\ kgm^2$✓ (3)

3.3 $\omega_1 = \frac{2\pi \times 210}{60}$ $\omega_2 = \frac{2\pi \times 132}{60}$
$= 21{,}99\ rad/s$✓ $= 13{,}82\ rad/s$✓
$E_k = \frac{1}{2} I(\omega_1{}^2 - \omega_2{}^2)$
$E_k = \frac{1}{2} \times 75{,}465(21{,}99^2 - 13{,}82^2)$✓
$=$11,039 kJ✓ (4)

3.4 $t_a = \frac{60}{12} - 1{,}2$
$= 3{,}8\ seconds$✓
$\alpha = \frac{\omega_1 - \omega_2}{t}$
$= \frac{21{,}99 - 13{,}82}{3{,}8}$✓
$= 2{,}15\ rad/s^2$✓
$T = I \times \alpha$
$= 75{,}465 \times 2{,}15$✓
$= 162{,}2\ Nm$✓ (5)

3.5 $P_m = E_k \times n/s$
$= 11{,}039 \times 12/60$✓
$= 2{,}21\ kW$✓ (2)
[17]

QUESTION 4

4.1 $\tan\theta = \frac{p \times n}{\pi \times D_m}$
$= \frac{15 \times 2}{\pi \times 75}$
$= 0{,}1273$✓
$\therefore\ \theta = 7{,}26°$✓
$\emptyset = \tan^{-1}\mu$✓
$= \tan^{-1} 0{,}03$✓
$=$1,72°✓
$\eta = \frac{\tan 7{,}26}{\tan(7{,}26 + 1{,}72)} \times 100$✓
80,6 %✓ (7)

4.2 $P_w = \frac{P_o \times 100}{\eta}$

$P_w = \frac{20 \times 100}{80,6}$✓

$= 24,8\ kW$✓ (2)

4.3 $1 rev\ of\ worm = 2 \times 15 = 30\ mm$✓

$1\ 200\ r/m = 20\ r/s$✓

$v = 20 \times 30 = 600\ mm/s$✓

$=0,6$ m/s

$P_o = F_w \times v$✓

$20 = F_w \times 0,6$✓

$F_w = 33,33\ kN$✓ (6)

[15]

QUESTION 5

5.1 $TE = mgsin\theta$

$= 1\ 500 \times 9,81 sin 20°$✓

$= 5\ 032,8\ N$✓

$w = \frac{TE \times h}{d}$✓

$= \frac{5\ 032,8 \times 0,8}{2,8}$✓

$= 1\ 438\ N$

$N_R = \frac{mg \times y}{d}$✓

$= \frac{1\ 500 \times 9,81 \times 1,2}{2,8}$✓

$= 6\ 306\ N$✓

Load on rear wheels

$= 6\ 306 + 1\ 438$✓

$= 7\ 744\ N$✓

$TE = \mu N$✓

$\mu = \frac{5\ 032,8}{7\ 744}$✓

$= 0,65$✓ (12)

5.2 $P = TE \times v \times \frac{100}{\eta}$✓

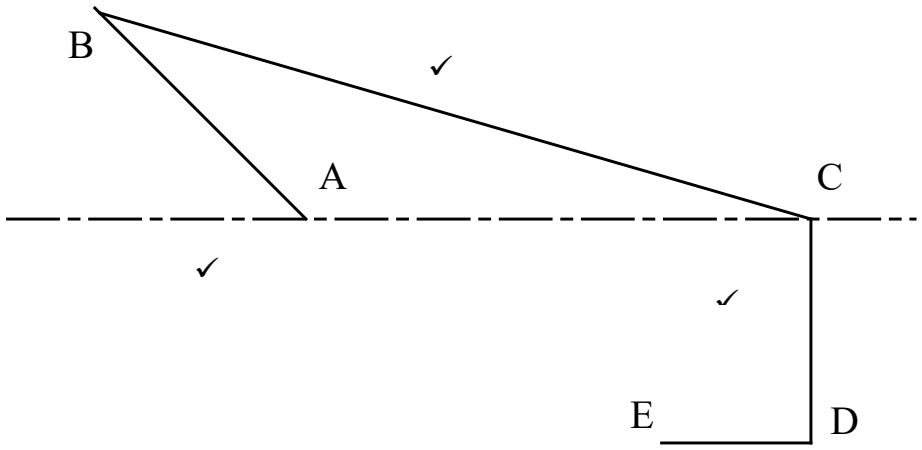
$= 5032,8 \times \frac{25}{3,6} \times \frac{100}{52}$✓

$= 67,212\ kW$✓ (3)

[15]

QUESTION 6

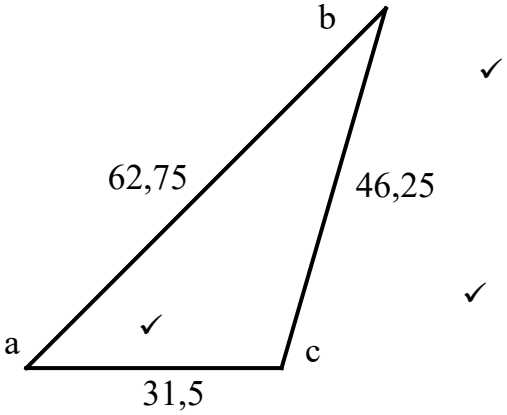
6.1



(3)

6.2 $v_B = 2\pi RN/60$
$= 2\pi \times 0{,}1 \times 240/60$
$= 2{,}51\ m/s$✓ (1)

6.3



(3)

6.4 6.4.1 $v_{BtoC} = 46{,}25 \times 0{,}04 = 1{,}85\ m/s$ ✓
$\omega_{BC} = \frac{v_{BtoC}}{BC} = \frac{1{,}85}{0{,}3}$✓
$= 6{,}17\ rad/s\ \ at\ 73{,}83°$✓ (3)

6.1.2 $v_{CtoD} = 31{,}5 \times 0{,}04 = 1{,}26\ m/s$✓
$\omega_{CD} = \frac{v_{BtoC}}{BC} = \frac{1{,}26}{0{,}1}$✓
$= 12{,}6\ rad/s\ \ at\ 73{,}83°$✓ (3)

6.4.3 Centripetal acceleration Bto C
$= \omega_{BC}{}^2 \times BC$
$= 6{,}17^2 \times 0{,}3$✓
$= 11{,}42\ m/s^2$✓ (2)

6.4.4 Centripetal acceleration B to C
$= \omega_{CD}{}^2 \times CD$
$= 12{,}6^2 \times 0{,}1$✓
$= 15{,}88\ m/s^2$✓ (2)

[17]

TOTAL: 100