higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MECHANOTECHNICS N6

1 AUGUST 2019

This marking guideline consists of 10 pages.

QUESTION 1: BRAKES

1.1 $10x + 9(\frac{x}{1,5}) = 288$✓

$10x + 6x = 288$

$x = 18°$✓

$\therefore \theta = \frac{18°}{2} = 9°$✓ (3)

1.2 $P = \frac{2\pi NT}{60}$

$150 \times 10^3 = \frac{2\pi(250)T}{60}$✓

$\therefore T = 5,73 \text{ kNm}$✓ (2)

1.3 $\frac{T_1}{T_2} = [\frac{1 + \mu tan\theta}{1 - \mu tan\theta}]^n$

$\frac{T_1}{T_2} = [\frac{1 + 0,2tan9}{1 - 0,2tan9}]^{10}$✓✓

$T_1 = 1,885\ T_2$✓ (3)

1.4 $T = (T_1 - T_2)R$

$5\ 730 = (1,885\ T_2 - T_2)0,4$✓

$T_2 = 16,186 \text{ kN}$✓

$T_1 = 30,51 \text{ kN}$✓

$T_1 \times 150 = T_2 \times 100 + F \times 600$✓

$30\ 510 \times 150 = 16\ 186 \times 100 + F \times 600$✓

$F = 4,93 \text{ kN}$✓ (6)

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QUESTION 2: FRICTION CLUTCH

2.1 $h = wsin\theta$

$= 80{,}9sin18°$✓

$= 25$ mm✓

$D = d + 2h$

$= 140 + 2(25)$

$= 190$ mm✓ (3)

2.2 $T = \frac{60P}{2\pi N}$

$= \frac{60(15 \times 10^3)}{2\pi(1\,440)}$✓

$= 99{,}472$ Nm✓

$R_f = \frac{R + r}{2} = \frac{95 + 70}{2} = 82{,}5$ mm✓

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

$99{,}472 = \frac{(0{,}3)F_A \times (82{,}5 \times 10^3)}{sin18°}$✓

$F_A = 1\,241{,}961$ N✓

$F_{engage} = F_A(1 + \frac{\mu}{tan\theta})$

$= 1\,241{,}961(1 + \frac{0{,}3}{tan18°})$✓

$= 2\,388{,}67$ N✓ (7)

2.3 $P_{MAX} = \frac{F_A}{2\pi(R - r)r}$

$= \frac{1\,241{,}961}{2\pi(0{,}095 - 0{,}07)0{,}07}$✓

$= 112{,}95$ kPa✓ (2)

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QUESTION 3: LINE SHAFTS

3.1 $P = \frac{2\pi N_A T_A}{60}$

$40 \times 10^3 = \frac{2\pi(1\,000)T_A}{60}$ ✓

$T_A = 381{,}972$ Nm✓ (2)

3.2 $D_A N_A = D_B N_B$

$(140)(1\,000) = (280)N_B$✓

$N_B = 500$ r/min✓

$P = \frac{2\pi N_B T_B}{60}$

$40 \times 10^3 = \frac{2\pi(500)T_B}{60}$ ✓

$T_B = 763{,}944$ Nm✓ (4)

3.3 $F_t = \frac{2 \times T}{PCD}$

$= \frac{2 \times 381{,}972}{0{,}14}$

$= 5{,}457$ kN✓ (1)

3.4 $\frac{T_1}{T_2} = e^{\mu\theta}$

$\frac{T_1}{T_2} = e^{(0{,}43)(\pi)}$ ✓

$T_1 = 3{,}861\ T_2$✓

$T = (T_1 - T_2)$

$763{,}944 = (3{,}861\ T_2 - T_2)0{,}175$✓

$T_2 = 1\,525{,}828$ N✓

$T_1 = 5\,891{,}222$ N✓ (5)

3.5 $\Sigma CWM = \Sigma ACWM$

$(882{,}9 \times 300) + (5\ 457 sin30° \times 800) + (196{,}2 \times 1\ 250) = R_R \times 1\ 000$✓

$R_R = 2\ 696{,}92$ N✓

$\Sigma CWM = \Sigma ACWM$

$(R_L \times 1\ 000) + (196{,}2 \times 250) = (882{,}9 \times 700) + (5\ 457 sin30° \times 200)$✓

$R_L = 1\ 114{,}68$ N✓ (4)

3.6 $\Sigma CWM = \Sigma ACWM$

$(5\ 457 cos30°)(800) + (R_R \times 1\ 000) = (1\ 525{,}828 + 5\ 891{,}222)(1\ 250)$✓

$R_R = 5\ 490{,}592$ N✓

$\Sigma CWM = \Sigma ACWM$

$(1\ 525{,}828 + 5\ 891{,}222)(250) + (R_L \times 1\ 000) + (5\ 457 cos30°)(200) = 0$✓

$R_L = -2\ 799{,}443$ N✓ (4)
[20]

QUESTION 4: FLYWHEEL

4.1 $\propto = \frac{w_2 - w_1}{t}$

$= \frac{47{,}124 - 0}{8}$ ✓

$= 5{,}89 \text{ rad/s}^2$ ✓

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

$= \frac{2\pi(450)}{60}$

$= 47{,}124 \text{ rad/s}$ ✓ (3)

4.2 $T = I \propto$

$= (45)(5{,}89)$ ✓

$= 265{,}05 \text{ Nm}$ ✓

$I = mk^2$

$= (500)(0{,}3)^2$

$= 4{,}5 \text{ kg.m}^2$ ✓ (3)

4.3 $E_k = \frac{1}{2} I w^2$

$= \frac{1}{2}(45)(47{,}124)^2$ ✓

$= 49{,}965 \text{ kJ}$ ✓ (2)

4.4 $V = wr$

$= 47{,}124 \times 0{,}6$ ✓

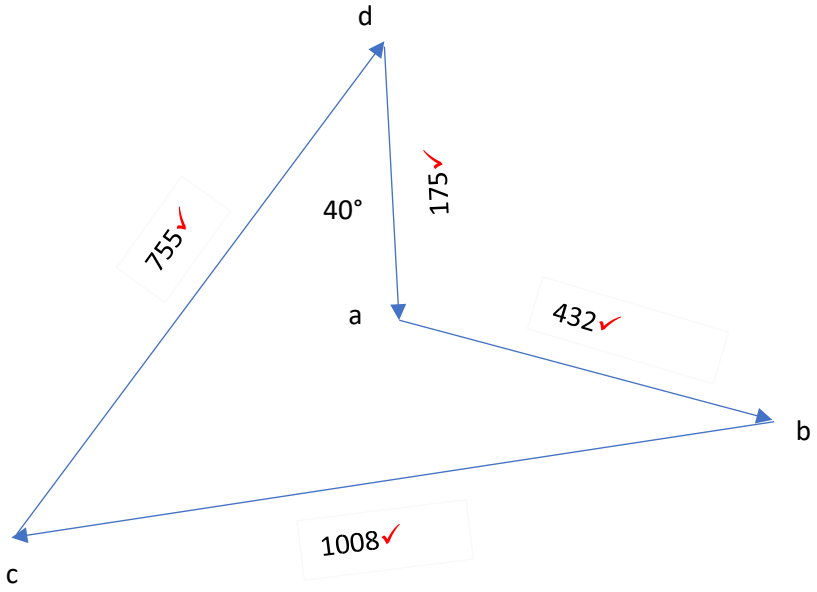
$= 28{,}274 \text{ m/s}$ ✓ (2)

[10]

QUESTION 5: BALANCING

5.1

	m(kg)	r(mm)	mr(kg.mm)	ℓ(m)	mrℓ(kg. mm. m)
A	10	70	700√	-0,25	-175√
B	8	90	720√	0,6	432√
C	12	60	720√	1,4	1 008√
x	-	-	R_x	0	0
y	-	-	R_y	1,2√	1,2R_y√



$755 = 1{,}2R_y$

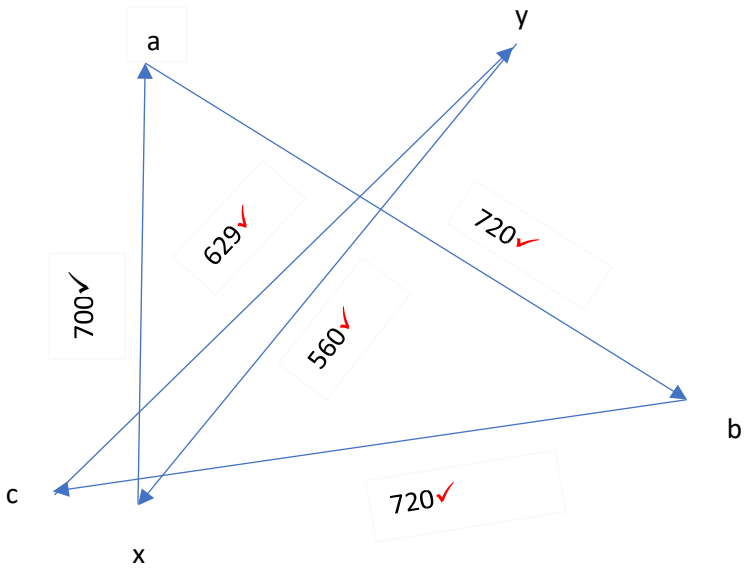
$R_y = 629{,}167$ kg. mm✓

dynamic reaction at y $= \frac{629{,}167}{1\,000}(\frac{2\pi N}{60})^2$

$= \frac{629{,}167}{1\,000}[\frac{2\pi(120)}{60}]^2$✓

$= 99{,}354$ N✓ (11)

5.2



$R_x = 560$ kg. mm✓

dynamic reaction at $x = \frac{560}{1\,000}(\frac{2\pi N}{60})^2$✓

$= \frac{560}{1\,000}(\frac{2\pi 120}{60})^2$✓

$= 88{,}432$ N✓ (9)

[20]

QUESTION 6: DYNAMICS

6.1 6.1.1 $N_f = 1{,}8 \times 10^3$

$= 7\,063{,}2$✓

$N_R = 1{,}8 \times 10^3$

$= 10\,594{,}8$ N✓

$F_a = \mu(mg)\frac{h}{d}$

$W_1 = 0{,}4(1\,800 \times 9{,}81)\frac{0{,}7}{3{,}2}$✓

$W_1 = 1\,545{,}075$ N✓

$\therefore$ Normal reaction rear wheel $= N_R - W_1$

$= 10\,594{,}8 - 1\,545{,}075$✓

$= 9\,049{,}725$ N✓ (6)

6.1.2 $F_a = \mu(N_f + W_2)\frac{h}{d}$

$\therefore W_2 = \mu(N_f + W_2)\frac{h}{d}$

$W_2 = 0{,}4(7\ 063{,}2 + W_2)\frac{0{,}7}{3{,}2}$ ✓

$W_2 = 2\ 825{,}28 + 87{,}5 \times 10^{-3} W_2$

$W_2 = 3\ 096{,}197$ N✓

Normal reaction rear wheel $= N_R - W_1$

$= 10\ 594{,}8 - 3\ 096{,}197$✓

$= 7\ 498{,}603$ N✓ (4)

6.2 $W_3 = \mu(N_R - W_3)\frac{h}{d}$

$W_3 = 0{,}4(10\ 594{,}8 - W_3)\frac{0{,}7}{3{,}2}$ ✓

$W_3 = 4\ 237{,}92 - 87{,}5 \times 10^{-3} W_3$

$W_3 = 3\ 896{,}938$ N✓

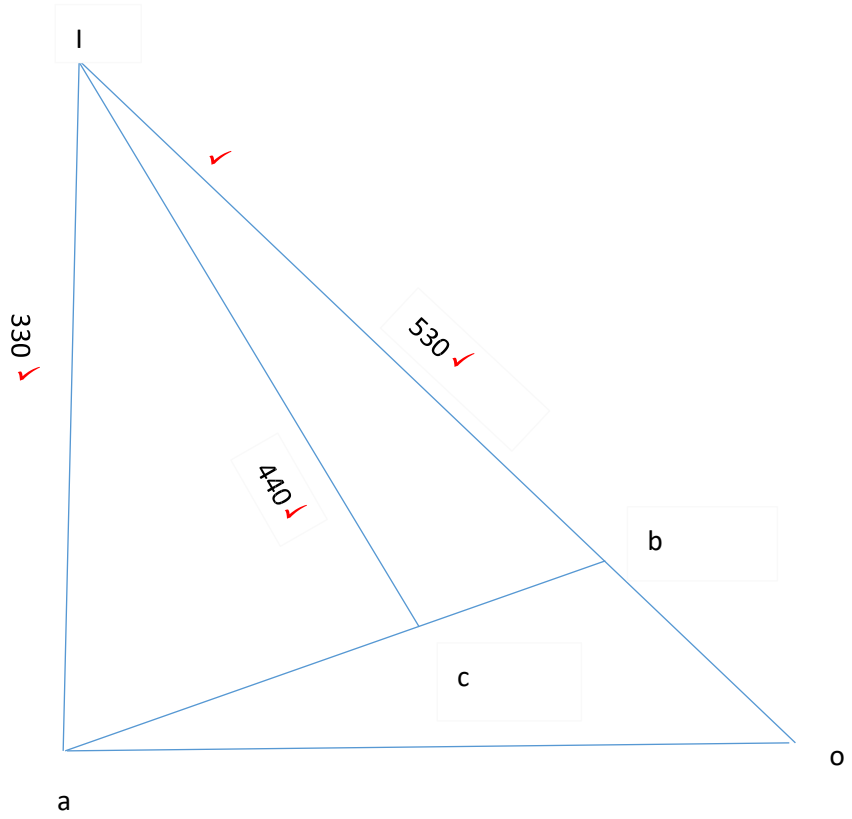
Normal reaction on front wheel $= N_f + W_3$

$= 7\ 063{,}2 + 3\ 896{,}938$✓

$= 10\ 960{,}138$ N✓ (4)

[14]

QUESTION 7: KINEMATICS



$V_B = wr$

$= (\frac{2\pi(100)}{60})(0{,}12)$✓

$= 1{,}257 \text{ m/s}$✓

$V_A = \frac{V_B}{I_B} \times I_A$

$= \frac{1{,}257}{530} \times 330$✓

$= 0{,}783 \text{ m/s}$✓

$V_C = \frac{V_B}{I_B} \times I_C$ **OR** $V_C = \frac{V_A}{I_A} \times I_C$

$= \frac{1{,}257}{530} \times 440$✓ $= \frac{0{,}783}{330} \times 440$✓

$= 1{,}044 \text{ m/s}$✓ $= 1{,}044 \text{ m/s}$✓ **[10]**

TOTAL: 100