higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

MEGANOTEGNIEK N6

30 Julie 2021

Hierdie nasienriglyn bestaan uit 12 bladsye.

VRAAG 1

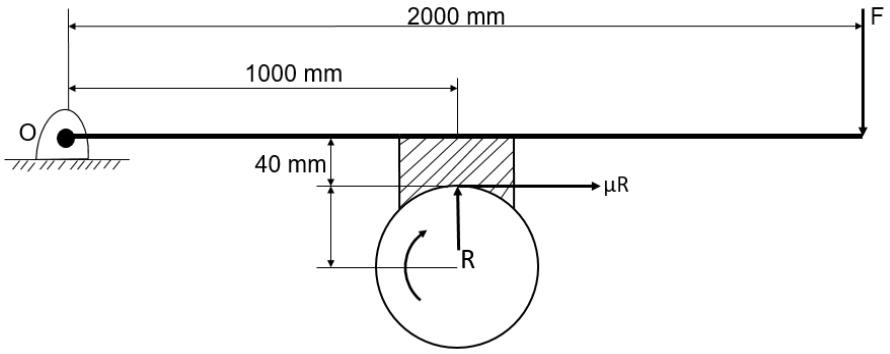
1.1
- Eenvormige-slytasie-teorie is gebaseer op die aanname dat slytasie eenvormig is oor die totale kontakoppervlak voorkom✓ en met die toestand van 'n ou, geslyte koppelaar ooreenkom.√
- Eenvormige-druk-teorie is gebaseer op die aanname dat die druk eenvormig oor die totale kontakoppervlak versprei is✓ en met die toestand van 'n nuwe koppelaar wat nie geslyt is nie, ooreenkom.√ (2 × 1½) (3)

1.2.1
$$= \frac{2\pi NT}{60}$$
$$220 \times 1000 = \frac{2\pi \times 900 \times T}{60}\checkmark$$
$$T = 2334{,}272N.m\checkmark$$
$$T = \frac{2334{,}272N.m}{2}$$
$$T = 1167{,}136N.m\checkmark \quad (3)$$

1.2.2
$$T = \mu \times p \times \frac{2}{3}\pi(R^3 - r^3)n$$
$$1167{,}136 = 0.3 \times 260000 \times \frac{2}{3}\pi(0.225^3 - r^3)\checkmark$$
$$r^3 = 4.246 \times 0.001\checkmark$$
$$r = 0.162\checkmark$$
d = 324 mm✓ (4)

[10]

VRAAG 2



2.1 $D = 400mm = 0{,}4\ m$
$T = 200\ Nm$
$N = 600\ r/mm$
$\mu = 0{,}3$
$T = \mu R \times r$
$200 = 0.3R \times 0{,}2$✓
$R = 3333.333N$✓ (2)

2.2 Neem momente om O:
$\sum$ *kloksgewyse momente* = $\sum$ *teenkloksgewyse momente*
$F \times 2 = 3333.333 \times 1) + (0{,}3 \times 3333{,}33) \times 0{,}04$✓
$F = \frac{3373{,}333}{2}$✓
$F = 1686{,}667N$✓ (3)

2.3 $P = \frac{2 \times \pi \times N \times T}{60}$

$P = \frac{2 \times \pi \times 600 \times 200}{60}$

$Krag = 12566{,}37\ N$ ✓

$= 12{,}566\ kN$ ✓

Alternatiewe antwoord

$v = \frac{\pi \times D \times N}{60}$

$= \frac{\pi \times 0{,}4 \times 600}{60}$

$= 12{,}566\ m/s$ ✓

$Krag = \mu R \times v = 1\,000 \times 12{,}566$

$= 12{,}566\ kW$✓ (2)

2.4 Bandremme√
Blok-en-bandremme √ (2 × ½) (1)
[8]

VRAAG 3

3.1 $P = \frac{2\pi NT}{60}$

$20 \times 10^3 = \frac{2\pi \times 300 \times T}{60}$

$T = 636{,}62\ N.m$✓

$T = (T_1 - T_2)r$

$T_1 = 2{,}5T_2$

$636.62 = 1{,}5T_2 \times 0.225$

$T_2 = 1886{,}28\ N$ ✓

$T_1 = 4715{,}70\ N$ ✓

Alternatiewe antwoord

$v = \frac{\pi \times D \times N}{60}$

$= \frac{\pi \times 0{,}45 \times 300}{60}$

$= 7{,}0686\ m/s$✓

$20 \times 10^3 = (T_1 - T_2)v$

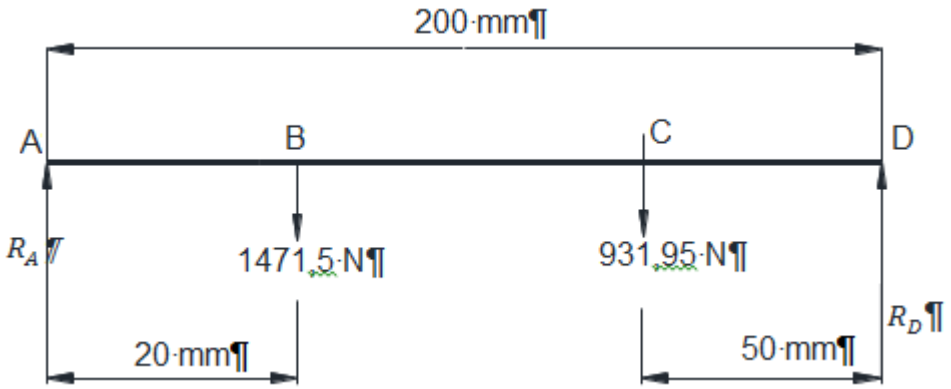
$20 \times 10^3 = 1{,}5T_2 \times 7{,}0686$

$T_2 = 1886{,}28\ N$✓

$T_1 = 4715{,}7\ N$✓

(3)

3.2



Neem momente om A:

$\sum$ *kloksgewyse momente* = $\sum$ *teenkloksgewyse momente*

$(1\,471{,}5 \times 20) + (931{,}95 \times 150) = R_D \times 200$ ✓

$29\,430 + 139\,792{,}5 = R_D \times 200$ ✓

$R_D = \frac{169\,222{,}5}{200}$

$R_D = 846{,}113N$✓

(3)

[6]

VRAAG 4

4.1 $m = \rho \times v$

$m = 7\,500 \times \pi(1{,}2^2 - 0{,}9^2) \times 0{,}15$

$m = \frac{2226{,}604}{4} = 556{,}65\ kg$✓

$I = mk^2$

$I = 556{,}65\left(\frac{0{,}6^2 + 0{,}45^2}{2}\right)$

$I = 156{,}558\ kg.m^2$✓ (2)

4.2 $E_K = \frac{1}{2}I(\omega_f^2 - \omega_i^2)$

$E_K = \frac{1}{2}(156{,}558\ )[(2\pi \times 6)^2 - (2\pi \times 4{,}5)^2]$✓

$E_K = 48\,672{,}714\ kJ$✓ (2)

4.3 $= E_K \times ponsslae(siklusse)/s$

$P = \frac{48\,672{,}714 \times 25}{60}$✓

$P = 20{,}280\ kW$ (2)

[6]

VRAAG 5

5.1 $Helikshoek\ \ tan\theta = \frac{leiding}{\pi \times gemiddelde\ middellyn}$

$tan\theta = \frac{2 \times 15}{\pi \times 80} = 0{,}1194$

$\theta = 6{,}807^o$✓

$Wrywingshoek\ tan\ \phi = 0{,}045$

$\phi = tan^{-1}0{,}045 = 2{,}577^o$ ✓

Die rendement van die wurm is:

$\eta_{wurm} = \frac{\tan\theta}{\tan(\theta+\phi)} \times 100\% = \frac{\tan 6{,}807}{\tan(6{,}807+2{,}577)} \times 100\%$ ✓

$= \frac{0{,}1194}{0{,}1653} \times 100\% = 72{,}23\ \%$✓ (4)

5.2 $Krag_{wurm} = \frac{P_{uit}}{\eta_{wurm}} \times 100\%$

$= \frac{28000}{0{,}7223} = 39{,}457\ kW$✓ (1)

5.3 $1\ rev\ van\ wurm = 2 \times 15 = 30\ mm\ op\ wurm$

$Draaispoed\ van\ die\ wurm\ in\ sekondes = \frac{1680}{60} = 28\ r/s$✓

$Lineêre\ snelheid\ van\ die\ wurm, v = 0{,}03 \times 28 = 0{,}84\ m/s$✓

$P_{uit} = F_{wurmrat} \times v$

$F_{wurmrat} = \frac{P_{uit}}{v} = \frac{28000}{0{,}84} = 33{,}929\ kN$✓ (3)

5.4 $T_c = F_{wurm} \times R \times \mu$

$T_c = 33{,}929 \times \frac{0.075}{2} \times 0{,}045$ ✓

$= 57{,}255\ n.m$ ✓ (2)

[10]

VRAAG 6

6.1.1 Die kantingshoek θ

$Kanting\ van\ die\ draai = sin\theta \times spoorwydte$

$sin\theta = \frac{kanting\ van\ die\ draai}{spoorwydte}$

$= \frac{0{,}1}{1{,}2}$

$\theta = 4{,}78^o$✓ (1)

6.1.2 Die maksimum snelheid

$v = \sqrt{tan\theta \times rg}$

$v = 31km/h = \frac{31\times1000}{60\times60} = 8.611m/s$✓

$8{,}611 = \sqrt{\tan(4{,}78) \times r \times 9{,}81}$

$8{,}611^2 = \tan(4{,}78) \times r \times 9{,}81$✓

$r = \frac{8{,}611^2}{\tan(4{,}78)\times9{,}81} = 90{,}39\ m$✓ (3)

6.1.3 $F_g + mgsin\theta = F_c cos\theta$

$F_g = F_c cos\theta - mgsin\theta$

$F_g = \frac{m \times v^2}{r} cos\theta - mgsin\theta$

$v = \frac{72\times1000}{60\times60} = 20m/s$✓

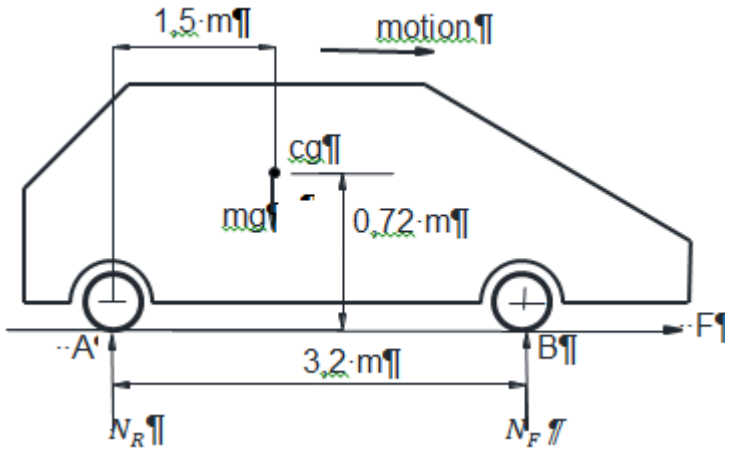
$F_g = \frac{3000\times20^2}{90{,}39} cos4{,}78 - 3000 \times 9{,}81 \times sin4{,}78 = 10{,}78\ kN$✓✓✓ (4)

6.2 6.2.1 Lokomotieftrekkrag is die krag wat die lokomotief by die dryfwiele moet uitoefen om self en die waens of die trein te beweeg.

6.2.2 Trekstangkrag is die krag wat aan die agterkant van die lokomotief vir die trek van die trokke beskikbaar is.

(2 × 1) (2)

6.3 6.3.1



Neem momente om A:

$$\sum kloksgewyse\ momente = \sum teenkloksgewyse\ momente$$

$$mg \times 1{,}5 = N_F \times 3{,}2$$

$$N_F = \frac{1{,}5 \times mg}{3{,}2} = 0{,}469\ mg \checkmark$$

$$F_{rem} = \mu N_F$$

$$ma = 0{,}35 \times 0{,}468\ mg$$

$$a = 0{,}35 \times 0{,}468\ \times 9{,}81 = 1{,}607\ m/s^2$$

$$= -1{,}607\ m/s^2 \checkmark$$

$$s = \frac{v^2 - u^2}{2a}$$

$$maar\ \ u = \frac{97{,}2\ km}{h} = \frac{97{,}2 \times 1000}{60 \times 60} = 27\ m/s$$

Die afstand word gegee as:

$$s = \frac{0^2 - 27^2}{2 \times (-1{,}607)} = 226{,}82\ m \checkmark$$

(3)

6.3.2

Agterwielremme

Neem momente aangaande B

$\sum$ Kloksgewyse momente $\sum$ Antikloksgewyse momente

$N_R \times 3,2 = mg \times (3,2 - 1,5)$

$N_R = \frac{mg \times 1,7}{3,2} = 0,531mg$ ✓

$F_{brake} = \mu N_R$

$ma = 0,35 \times 0,531 \times m \times 9,81$

$a = 0,35 \times 0,531 \times 9,81 = 1,823\ m/s^2$

$= -1,823\ m/s^2$✓

Die afstand is gegee as:

$s = \frac{v^2 - u^2}{2a} = \frac{0^2 - 27^2}{2 \times (-1,823)} = 199,945m$ ✓

(3)

6.3.3 Voor- en agterwiele rem:

$F_{rem} = \mu N_F + \mu N_R = \mu(N_F + N_R)$

$\boldsymbol{maar}\ \ mg = N_F + N_R$

$ma = \mu mg$

$a = \mu g = 0{,}35 \times 9{,}81 = 3{,}435\ m/s^2$ ✓

$a = -3{,}435\ m/s^2$

Die afstand word gegee as:

$s = \frac{v^2 - u^2}{2a} = \frac{0^2 - 27^2}{2\times(-3{,}435)} = 106{,}114\ m$ ✓ (2)

6.3.4 Vir verhouding: $N_F : N_R$

$F_{rem} = \mu(N_F + N_R)$

Neem momente om die ewewigspunt:

$\sum kloksgewyse\ momente = \sum teenkloksgewyse\ momente$

$(F_{rem} \times afstand\ vanaf\ ep\ na\ die\ pad) + (N_R \times 1{,}5) = (N_F \times 1{,}7)$

$\mu(N_F + N_R)0{,}72 + 1{,}5N_R = 1{,}7N_F$

$0{,}35(N_F + N_R)0{,}72 + 1{,}5N_R = 1{,}7N_F$ ✓

$0{,}252N_F + 1{,}752N_R = 1{,}7N_F$

$1{,}7N_F - 0{,}252N_F = 1{,}752N_R$

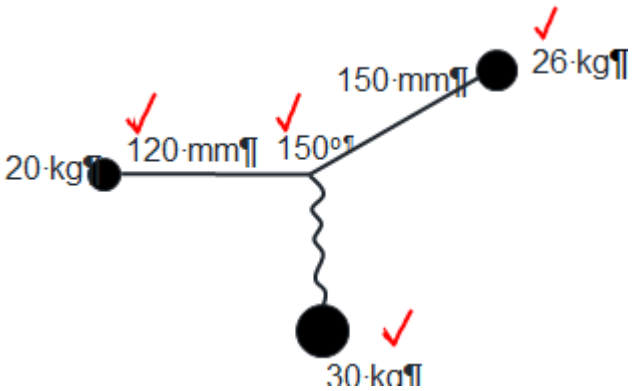
$1{,}5N_F = 1{,}752N_R$

$\frac{N_F}{N_R} = \frac{1{,}752}{1{,}5} = \frac{1{,}168}{1}$ ✓ (2)

[20]

VRAAG 7

7.1.



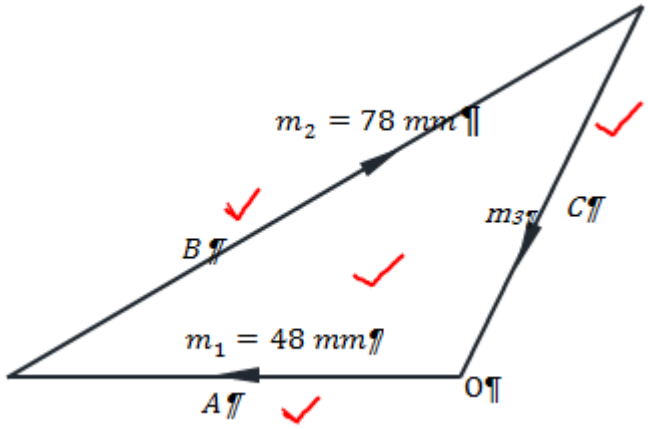
(4)

7.2

Vlak	Massa (kg)	r(m)	mr(kg.m)	
A	20	0,12	2,4	✓
B	26	0,15	3,9	✓
C	30	x	30x	✓

(3)

7.2



(4)

7.2. Kragtediagram

Die sentrifugale krag van m_3 is:

$20\ mm\ =\ 1\ kg.m$

$$43{,}9\ mm\ = \frac{43{,}9mm}{20\ mm} \times 1\ kg.m$$
$$= 2{,}195\ kg,m\checkmark$$

Die afstand van m_3 vanaf senter O van die vlakplaat:

$30x = 2{,}193$

$x = \frac{2{,}193}{30} = 0{,}0731\ m = 73{,}1\ mm\checkmark\checkmark$

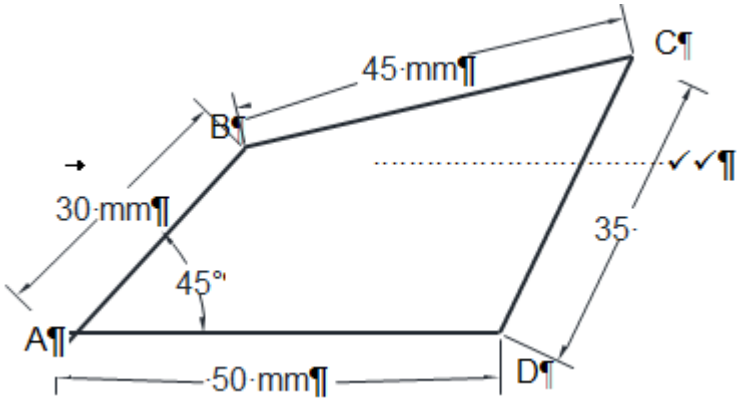
Die posisie van m_3 tot vlak A is 244° kloksgewys en 116° tot A.✓ (4)

[15]

VRAAG 8

8.1 $AB = 30\ mm\ BC = 45\ mm\ \ CB = 30\ mm\ DA = 50\ mm$
$V_B = \omega_{AB} \times AB = 5 \times 0{,}03 = 0{,}15\ m/s$✓ (1)

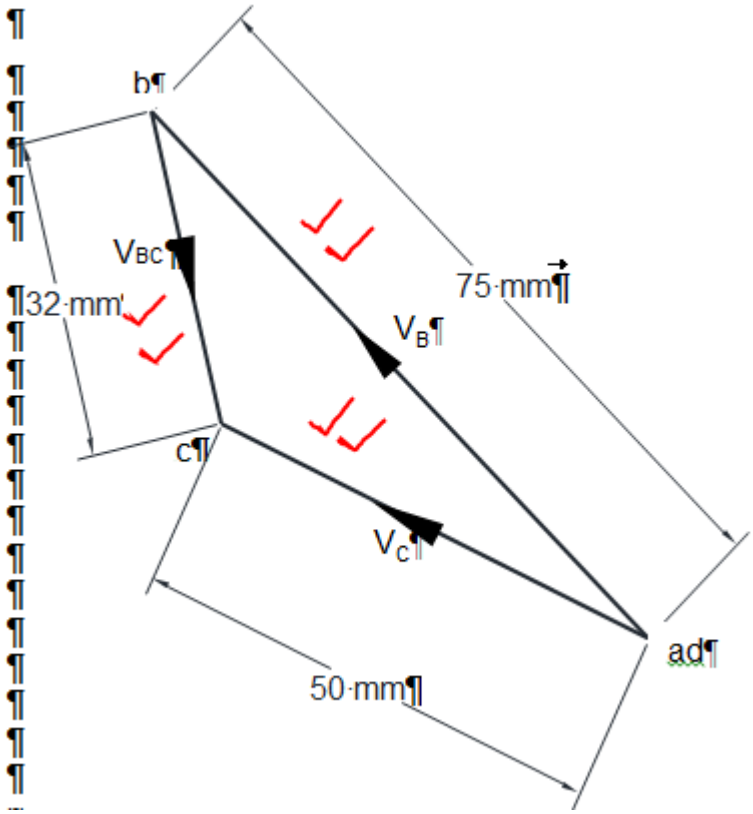
8.2



(2)

Ruimtediagram

Skaal = 0,1 m/s = 50 mm



(6)

Snelheidsdiagram:

$Skaal \quad 0{,}1\ m/s\ =\ 5\ mm$

$ab\ = 75\ mm$

Vanaf die snelheidsdiagram:

$Meting\ bc = 32\ mm = 0{,}064\ m/s$

$\omega_{BC} = \frac{0{,}064}{0{,}046} = 1.422\ rad/s$✓

$Meting\ cd = 35\ mm\ = 0{,}07\ m/s$

$\omega_{CD} = \frac{0{,}07}{0{,}035} = 2\ rad/s$✓ (2)

8.2 $Sentripetale\ skv\ van\ A\ relatief\ tot\ B = {\omega_{AB}}^2 \times AB$
$= 5^2 \times 0{,}03 = 0{,}75\ m/s^2$✓

$Raaklynige\ skv\ van\ A\ \ relatief tot\ B = \alpha_{AB} \times B$
$= \alpha_{AB} \times B = 19 \times 0{,}03 = 0{,}57 m/s^2$✓

$Skaal\ 0{,}75\ \frac{m}{s^2} = 75\ mm$

$Sentripetale\ skv\ van\ B\ relatief\ tot\ C = {\omega_{BC}}^2 \times BC$
$= 1{,}422 \times 0{,}045 = 0{,}09o\ \ m/s^2$✓

$Sentripetale\ skv\ van\ C\ relatief\ tot\ D = {\omega_{CD}}^2 \times CD$
$= 2^2 \times 0{,}035 = 0{,}14\ m/s^2$

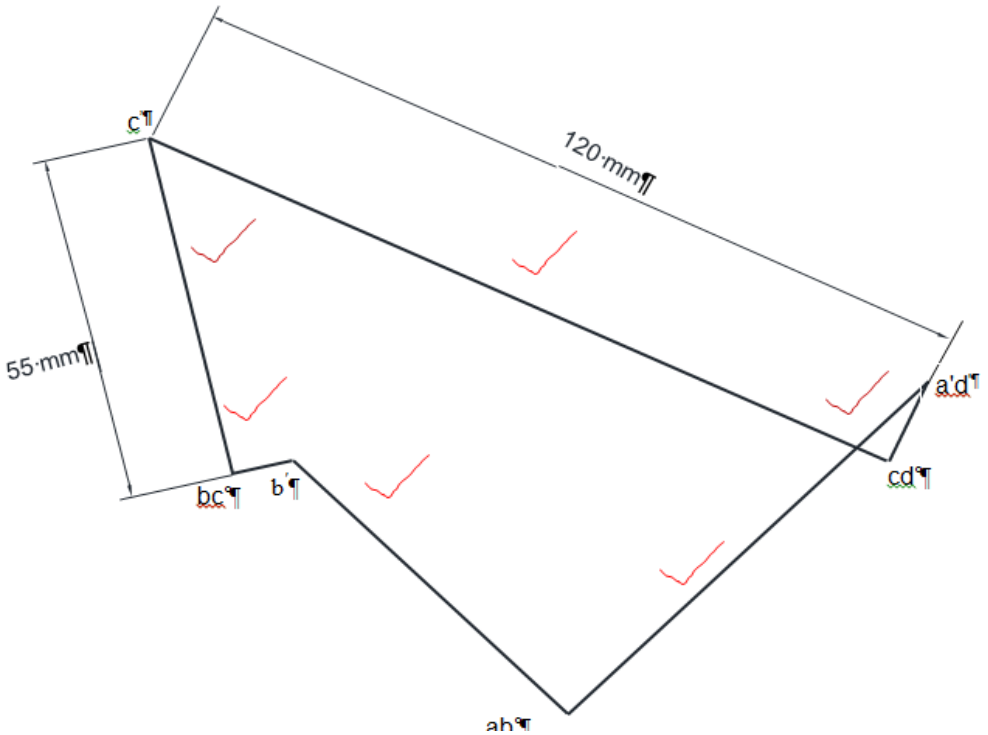
Vanaf die versnellingsdiagram:

$Meting\ c'bc\ = 55\ mm = \frac{0{,}75}{75} \times 55 = 0{,}55\ m/s^2$✓

$Meting\ c'dc\ = 120\ mm = \frac{0{,}75}{75} \times 120 = 1{,}2\ m/s^2$✓

$\alpha_{BC} = \frac{0{,}55}{0{,}045} = 12{,}22\ rad/s^2$✓

$\alpha_{CD} = \frac{1{,}2}{0{,}035} = 34{,}29\ rad/s^2$✓ (7)



(7)
(14)
[25]

TOTAAL: 100