higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

MECHANOTECHNICS N6

25 NOVEMBER 2016

This marking guideline consists of 7 pages.

QUESTION 1

1.1

$$T = \mu \times F_A \times R_m \times n$$
$$F_A = \frac{T}{\pi \times R_m \times n} \quad \checkmark$$
$$= \frac{145 \times 2}{0{,}3 \times 0{,}095 \times 2} \checkmark$$
$$= 5088\ N \checkmark$$ (3)

1.2

$$P = \frac{2\pi NT}{60}$$
$$= \frac{2 \times \pi \times 750 \times 145}{60} \quad \checkmark$$
$$= 11{,}388\ kW \checkmark$$ (2)

1.3

$$I = mk^2$$
$$I_m = 63{,}5 \times 0{,}14^2 = 1{,}245\ kgm^2 \quad \checkmark$$
$$I_r = 22{,}8 \times 0{,}075^2 = 0{,}128\ kgm^2 \quad \checkmark$$
$$(I_m + I_r)N_3 = I_m N_m + I_r N_r \quad \checkmark$$
$$\therefore 1{,}373 N_3 = 0 + 0{,}128 \times 750 \quad \checkmark$$
$$N_3 = 70\ rpm \checkmark$$ (5)

1.4

$$\omega_1 = \frac{2\pi \times 750}{60} = 78{,}5\ rad/s \quad \checkmark$$
$$\omega_2 = \frac{2\pi \times 70}{60} = 7{,}33\ rad/s \quad \checkmark$$
$$T = I\alpha$$
$$\alpha_m = \frac{145}{1{,}245} = 116{,}5\ rad/s^2 \checkmark$$
$$t = \frac{\omega_1 - \omega_2}{\alpha}$$
$$= \frac{7{,}33 - 0}{116{,}5} = 0{,}063\ sec \checkmark$$

OR

$$\alpha_r = \frac{145}{0{,}128} = 1132{,}8\ rad/s^2 \checkmark$$
$$t = \frac{\omega_2 - \omega_1}{\alpha}$$
$$= \frac{78{,}5 - 7{,}33}{1132{,}8} = 0{,}063\ sec \quad \checkmark$$ (4)

1.5

$$E_{kloss} = E_{kin} - E_{kf}$$
$$= \frac{1}{2} I_1 \omega_1^2 + \frac{1}{2} I_2 \omega_2^2 - \frac{1}{2}(I_1 + I_2)\omega_3^2 \quad \checkmark$$
$$= \frac{1}{2}(0{,}128)(78{,}5)^2 + 0 - \frac{1}{2}(0{,}128 + 1{,}245)(7{,}33)^2 \checkmark$$
$$= 394.38 - 36{,}88$$
$$= 357{,}5\ J \checkmark$$ (3)

[17]

QUESTION 2

2.1

$$\frac{T_1}{T_2} = e^{\mu\theta} \qquad T_2 = 250\ N$$
$$= e^{0,3\times230\div57,3} \quad ✓$$
$$= 3,334$$
$$\therefore T_1 = 3,334 \times 250$$
$$= 833,5\ N \quad ✓$$
$$T_b = (T_1 - T_2) \times R$$
$$T_b = (833,5 - 250) \times 0,75/2 \quad ✓$$
$$= 218,84\ Nm ✓$$

(4)

2.2

$$\frac{T_1}{T_2} = e^{\mu\theta}$$
$$= e^{0,35\times230\div57,3} \quad ✓$$
$$= 4,075$$
$$\therefore T_2 = 5\,000 \div 4,075$$
$$= 1227\ N \quad ✓$$
$$T_b = (T_1 - T_2) \times R$$
$$T_b = (5000 - 1227) \times 0,6 \quad ✓$$
$$= 2263,8\ Nm ✓$$
$$T = F \times r$$
$$\therefore F = \frac{2263.8}{0,21}$$
$$= 10,78\ kN ✓$$

(5)
[9]

QUESTION 3

3.1

$$WD = F \times s$$
$$= 25000 \times 0,028 \times 100/75 \quad ✓$$
$$= 933\ J = \Delta E_k \quad ✓$$
$$\omega = \frac{2\pi N}{60}$$
$$\omega_1 = \frac{2\pi\times560}{60} \qquad \omega_2 = \frac{2\pi\times240}{60}$$
$$= 58,6\ rad/s \quad ✓ \qquad = 25,3\ rad/s \quad ✓$$

$$\Delta E_k = E_{k1} - E_{k2}$$
$$= \frac{1}{2} I(\omega_1{}^2 - \omega_2{}^2)$$
$$5000 \times \frac{100}{72} = \frac{1}{2} I(58,6^2 - 25,3^2) \quad ✓$$
$$\therefore I = 4,971\ kgm^2 ✓$$

(6)

3.2

$W = 1\,400 \times 9{,}81 = 13\,734$ ✓

$N_F = \frac{W \times y}{d}$

$= \frac{13734 \times 1{,}8}{3} = 8\,240\ N$ ✓

$N_R = 13\,734 - 8\,240$

$= 5\,494\ N$ ✓

$w = \mu W \times \frac{h}{d}$

$= 0{,}5 \times 13\,734 \times \frac{0{,}6}{3}$

$= 1373{,}4N$ ✓

$\therefore\ N_F = 8\,240 + 1373.4$

$= 9613{,}4$ ✓

$\therefore\ N_R = 5\ 494 - 1373{,}4$

$= 4120{,}6\ N$ ✓ (6)

[12]

QUESTION 4

4.1

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

$30\,000 = \frac{2\pi \times 600 \times T}{60}$

$T_s = 477{,}5\ Nm$ ✓ (1)

4.2

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

$= \frac{477{,}5 \times 600}{1200}$

$= 238{,}75\ Nm$ ✓ (1)

4.3

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

$= \frac{238{,}75 \times 2}{0{,}085}$ ✓

$= 5618\ N$ ✓ (2)

4.4

$F_n = F_t \sec \emptyset$

$= 5618 \sec 20°$ ✓

$= 5977\ N$ ✓ (2)

4.5

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

$T_1 = e^{0{,}3 \times 180\,/57{,}3}$ ✓

$= 2{,}566\ T_2$ ✓

$T = (T_1 - T_2) \times r$

$477{,}5 = (2{,}566T_2 - T_2) \times 0{,}75/2$ ✓

$\therefore\ 1{,}566T_2 = 1273N$

$\therefore\ T_2 = 813\ N$ ✓ (5)

$T_1 = 2086\ N$✓

4.6

$$\sum \curvearrowright M = \sum \curvearrowleft M$$
$$(T_1 + T_2 - mg) \times 0{,}5 = R_R \times 1{,}75 \quad ✓$$
$$(2\,086 + 813 - 80 \times 9{,}81) \times 0{,}5 = R_R \times 1{,}75 \quad ✓$$
$$R_R = 604\ N \quad ✓$$
$$\sum F \uparrow = \sum F \downarrow$$
$$R_L + R_R = T_1 + T_2 + mg \quad ✓$$
$$R_L + 604 = 2\,086 + 813 - 80 \times 9{,}81 \quad ✓$$
$$R_L = 1510\ N ✓$$

(6)
[17]

QUESTION 5

$I = mk^2$
$I = 80 \times 0{,}15^2$ ✓
$= 1{,}8\ kgm^2$ ✓
$T_D = T_A \times VR$
$= \frac{5{,}6 \times 42 \times 57}{25 \times 32}$ ✓
$= 16{,}758\ Nm$ ✓
$I_{D\ total} = I_A \times VR^2 + (I_B + I_C) \times VR^2 + I_D + I_{drum}$ ✓✓
$= 0{,}23 \times \left(\frac{25 \times 32}{42 \times 57}\right)^2 + (0{,}75 + 0{,}3) \times \left(\frac{32}{57}\right)^2 + 1{,}2 + 1{,}8$ ✓✓
$= 3{,}408\ kgm^2$ ✓
$T = I\alpha$
$\alpha = 16{,}758 \div 3{,}408$ ✓
$= 4{,}917\ rad/s$ ✓
$\omega_2 = \omega_2 + \alpha t$
$= 0 + 4{,}917 \times 30$ ✓
$= 147.51 rad/s^2$ ✓
$N = \frac{\omega \times 60}{2\pi}$
$= \frac{147.51 \times 60}{2\pi}$ ✓
$= 1\,408{,}6\ r/min$ ✓

[15]

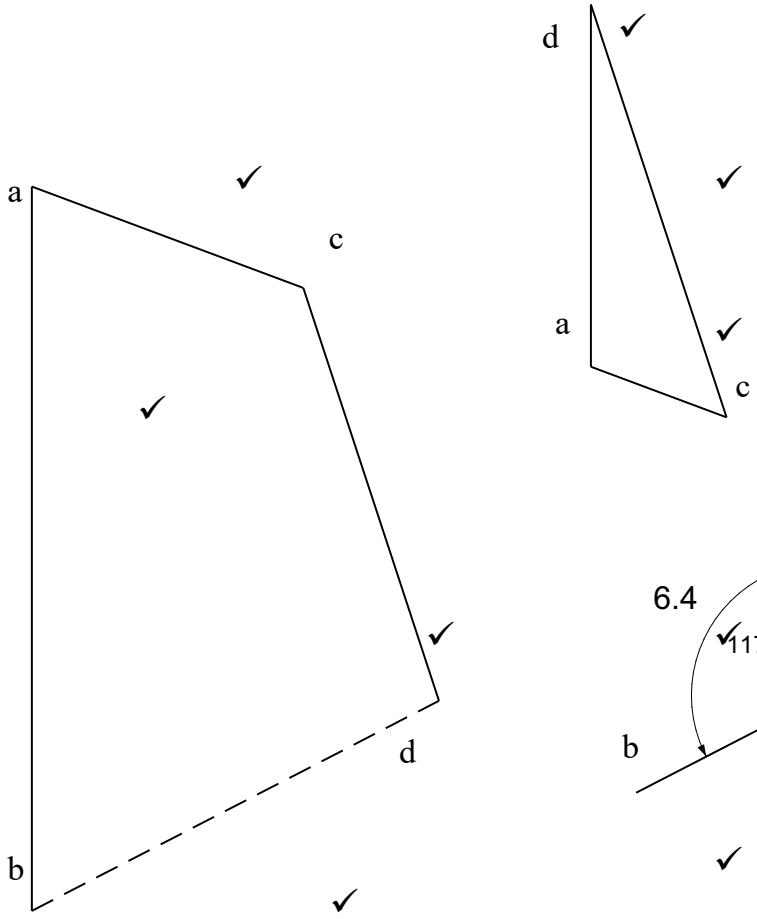
QUESTION 6

6.1

Plane	m(kg)	r(m)	mr(kgm)	l(m)	mrl(kgm^2)
A	10	0,15	1,5	-0,5	-0,75
B	m	0,125	0,125m	0	0
C	6	0,18	1,08	0,5	0,54
D	5	0,1	0,5	1,0	0,5

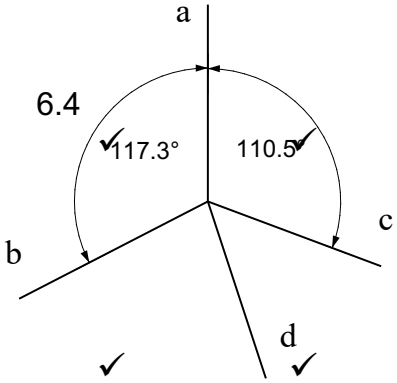
(6)

6.2



(4)

6.4



(5)

6.3

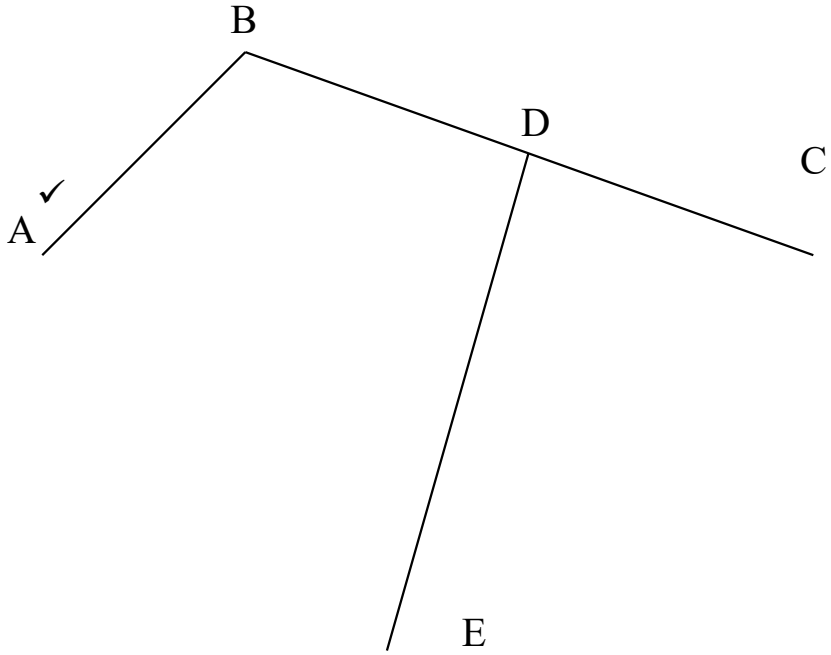
$$0{,}125m_B = 1{,}0\ kg\ m \quad ✓$$
$$\therefore \quad m_B = 1{,}0 \div 0{,}125 \quad ✓$$
$$= 8\ kg$$

(3)
[18]

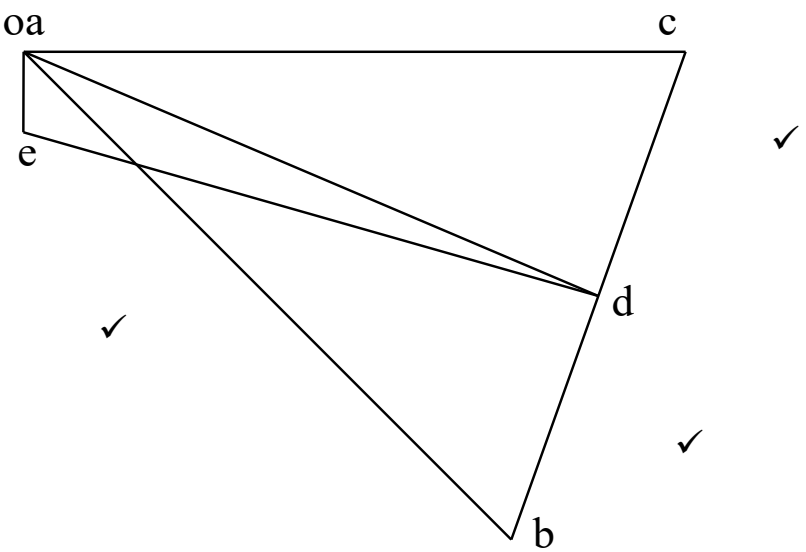
QUESTION 7

7.1

$$v_B = \frac{2\pi rN}{60}$$
$$= \frac{2\pi \times 0,1 \times 210}{60}$$
$$= 2,2\ m/s$$



Space diagram



Velocity diagram (6)

7.2 7.2.1 $v_c = 2,11\ m/s$ ✓✓

7.2.2 $v_c = 0,26\ m/s$ ✓✓

7.2.3
$$a_B = \frac{(v_B)^2}{AB}$$
$$= \frac{(2,2)^2}{0,1} \checkmark$$
$$= 48,4\ rad/s^2 \checkmark$$

(3 × 2) (6)
[12]

TOTAL: 100