higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MECHANOTECHNICS N5

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This marking guideline consists of 10 pages.

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QUESTION 1

1.1

No	Condition	Gear A	Gear B	Gear C	Gear D	Arm E
1.	*Fix arm E and rotate A+1rev*	$+1$	$\frac{T_A}{T_B}=\frac{120}{30}$ $=+4$	$+4$	$=\frac{120}{30}\times\frac{38}{-32}$ $=-4{,}75$	0
2.	*Multiply by x and add y*	$x+y$	$4x+y$	$4x+y$	$-4{,}75x+y$	$+y$
3.	$N_E=0$ $N_D=1200r/\min$ $N_A=?$	$N_A=?$			$1200r/\min$	$N_E=0$
4.	$N_A=0$ $N_D=1200r/\min$ $N_E=?$	$N_A=0$			$1200r/\min$	$N_E=?$

$x+y=N_A$
$-4{,}75x+y=1200$.....1
$y=0$.....2 ✓
Sub 2 in 1
$-4{,}75x+0=1200$
$x=\frac{1200}{-4{,}75}$ ✓
$=-252{,}632$
$N_A=x+y$
$=-252{,}632+0$ ✓
$=-252{,}632r/\min$ *Anticlockwise / Oppositedirection* ✓ (8)

1.2
$x+y=0$
$-4{,}75x+y=1200$.....1
$x=-y$.....2 ✓
Sub 2 in 1
$-4{,}75(-y)+y=1200$
$y=\frac{1200}{5{,}75}$ ✓
$=208{,}696$ ✓
$N_E=y$
$=208{,}696r/\min$ *Clockwisedirection / Positivedirection* ✓ (4)
[12]

QUESTION 2

2.1
- Increase the leverage of the engine on the driving shaft.
- Generates power to carry the load more effectively from rest.
- Provides a medium through which the engine can be disengaged from the driving shaft.
- Provides a reverse gear that allows the engine to continue to run in the same direction. (4 × 1) (4)

2.2 2.2.1

$1\ tun = 2\ teeth$ ✓

$1200\ turns = 1200 \times 2$ ✓

$= 2400\ teeth$ ✓

$$N_E = \frac{2400}{32}$$ ✓

$$= 75r/\min$$ ✓

(5)

2.2.2

$$\frac{N_A}{N_D} = \frac{T_B \times T_D}{T_A \times T_C}$$

$$N_D = \frac{T_A \times T_C \times N_A}{T_B \times T_D}$$

$$= \frac{26 \times 22 \times 75}{46 \times 74}$$ ✓✓

$$= 12{,}603r/\min$$ ✓

(3)

2.2.3

$$V_F = \frac{N_{in}}{N_{out}}$$

$$= \frac{1200}{12{,}603}$$ ✓✓

$$= 95{,}216:1$$ ✓

(3)

[15]

QUESTION 3

3.1
- Roller type holdback.
- Differential band brake hold-back.
- Ratchet and pawl hold-back.

(3 × 1) (3)

3.2 3.2.1

$$v = \frac{\pi DN}{60}$$
$$= \frac{\pi \times 0,5 \times 1050}{60}$$
$$= 27,489 m/s \checkmark$$
$$T_e = \frac{P}{v}$$
$$T_e = \frac{175 \times 10^3}{27,489} \checkmark$$
$$= 6366,183 N \checkmark$$

(3)

3.2.2

$$\frac{T_1}{T_2} = e^{\mu\theta}$$
$$\frac{T_1}{T_2} = e^{0,3 \times 2,967} \checkmark$$
$$T_1 = 2,435 T_2 \checkmark$$
$$T_e = T_1 - T_2$$
$$6366,183_e = 2,435 T_2 - T_2 \checkmark$$
$$T_2 = \frac{6366,183}{1,435}$$
$$T_2 = 4436,364 N \checkmark$$
$$T_1 = 2,435 T_2$$
$$T_1 = 2,435 T \times 4436,364 \checkmark$$
$$T_1 = 10802,547 N \checkmark$$

(6)

3.2.3

$$load = T_1 + T_2$$
$$= 4436,364 + 10802,547 \checkmark\checkmark$$
$$= 15238,911 N \checkmark$$

(3)

3.2.4

$$\eta = \frac{P_o}{P_i} \times 100$$

$$P_i = \frac{P_o}{\eta} \times 100$$

$$= \frac{175000}{80} \times 100 \checkmark\checkmark$$

$$= 218750W$$

$$= 218{,}75kW \checkmark$$ (3)

[18]

QUESTION 4

$$P_o = P_o \times \eta$$

$$= 80 \times 0{,}75$$

$$= 60kW \checkmark$$

$$P_o = T_e \times v$$

$$v = \frac{5 \times 1000}{3600}$$

$$= 1{,}389m/s \checkmark$$

$$F_e = \frac{P_o}{v}$$

$$F_e = \frac{60 \times 10^3}{1{,}389} \checkmark$$

$$= 43196{,}544N \checkmark$$

$$F_e = Pull\ against\ gravity + Total\ rolling\ resis\tan ce$$

Let the number of trucks be x

$$Pull\ against\ gravity = 700 \times 9{,}81 \times x \times \frac{1}{10} \checkmark$$

$$= 686{,}7x \checkmark$$

$$total\ rolling\ resis\tan ce = total\ moving\ mass \times resis\tan ce$$

$$F_R = (mass\ loaded\ cars + empty\ cars + rope\ mass) \times resis\tan ce/ton$$

$$F_R = [(0{,}99x) + (0{,}29x) + (2 \times 950 \times 0{,}0035)] \times 290 \checkmark$$

$$= (1{,}28x + 6{,}65) \times 290 \checkmark$$

$$= 371{,}2x + 1928{,}5 \checkmark$$

$$F_e = F_g + F_R$$

$$43196{,}544 = 686{,}7x + 371{,}2x + 1928{,}5 \checkmark$$

$$x = \frac{42138{,}644}{1057{,}9} \checkmark$$

$$x = 39{,}832 \checkmark$$

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$say = 40\ \ cars$ ✓

$$no\ \ of\ \ cars/side = \frac{length\ \ haulage}{spacing}$$

$$spacing = \frac{haulage\ \ length}{no\ \ of\ \ cars}$$

$$spacing = \frac{950}{40}$$ ✓

$$spacing = 23{,}75m$$ ✓

$$no\ \ of\ \ trucks/\min = \frac{rope\ \ speed(m/\min)}{spacing}$$

$$= \frac{5000}{60 \times 23{,}75}$$ ✓

$$= 3{,}508$$ ✓

$$no\ \ of\ \ trucks/\min = \frac{ton/shift}{60 \times hous \times ton/car}$$

$$ton/shift = no\ \ of\ \ trucks/\min \times 60 \times hours \times tton/car$$

$$= 3{,}508 \times 60 \times 7 \times 0{,}7$$ ✓

$$= 1031{,}352ton$$ ✓

[19]

QUESTION 5

5.1 5.1.1

$$s = v \times t$$

$$= \frac{75 \times 1000}{3600} \times 15 \times 60$$ ✓

$$= 18750m$$ ✓

$$W_d = F \times s$$

$$= 850 \times 18750$$ ✓

$$= 15937{,}5kJ$$ ✓ (4)

5.1.2

$$P = F \times v$$

$$= 850 \times \frac{75 \times 1000}{3600}$$ ✓

$$= 17708{,}333W$$ ✓ (2)

5.2 5.2.1

$$T_e = F_R$$
$$= \frac{0,8}{100} \times 260 \times 10^3 \times 9,81 \checkmark$$
$$= 20404,8N \checkmark$$

(2)

5.2.2

$$F_g = m \times 10^3 \times g \times incline$$
$$= 260 \times 10^3 \times 9,81 \times \frac{1}{120} \checkmark$$
$$= 21255N \checkmark$$

(2)

5.2.3

$$F_a = m \times 10^3 \times a$$
$$= 260 \times 10^3 \times 0,066 \checkmark$$
$$= 15600N \checkmark$$

(2)

5.2.4

$$T_E = F_a + F_R + F_g$$
$$= 15600 + 20404,8 + 21255 \checkmark$$
$$= 57259,8 \checkmark$$
$$P = T_E \times v$$
$$= 57259,8 \times 20 \checkmark$$
$$= 1145,196kW \checkmark$$

(4)

5.2.5

$$E_k = \tfrac{1}{2} mv^2$$
$$= \tfrac{1}{2} \times 260 \times 10^3 \times (20)^2 \checkmark$$
$$= 52MJ \checkmark$$

(2)
[18]

QUESTION 6

6.1 **Goods elevators.**

- Doors may open vertically.
- Cars require only roof over the portion of the car occupied by the operator.
- Goods elevators are constructed for moving heavy loads.
- Goods elevators have a capacity of up to 3000 kg.
- Goods elevators may either be closed on three sides with one door or closed on two sides with two doors on opposite sides. (Any 2 × 1) (2)

Passenger elevators.

- Door may open horizontally.
- Cars must be covered with substantial roof without sunglass.
- Passenger elevators are designed mainly for transport of people and are either in operated by people or entirely automatic.
- Passenger elevators usually travel faster than goods elevators.
- Passenger elevators must be closed on three sides and may only have one door. (Any 2 × 1) (2)

6.2 6.2.1

$$T_1 = m_1(g + a) + f\mu$$
$$= 1500(9{,}81 + 1{,}6) + 600$$
$$= 17715N \checkmark$$

$$T_2 = m_2(g - a) - f\mu$$
$$= 600(9{,}81 - 1{,}6) - 600 \checkmark$$
$$= 4326N \checkmark$$

$$T_L = (T_1 - T_2)r$$
$$= (17715 - 4326)0{,}8$$
$$= 10711{,}2Nm \checkmark$$

$$I = m \times k^2$$
$$= 700 \times (0{,}6)^2$$
$$= 252kgm^2 \checkmark$$
$$T = I \times \alpha$$
$$= I \times \frac{a}{r}$$
$$= 252 \times \frac{1{,}6}{0{,}8}$$
$$= 504Nm \checkmark$$

$$T_{TOTAL} = T_L + T_d$$
$$= 10711{,}2 + 504$$
$$T_{TOTAL} = 11215{,}2Nm \checkmark$$

$$P = T_{tot} x\omega$$
$$P = T_{tot} \times 2 \times \pi \times N$$
$$P = 11215{,}2 \times 2 \times \pi \times 2{,}4$$
$$P = 169121{,}232W \checkmark$$

(8)

6.2.2

$$a = \frac{v^2}{2s}$$
$$= \frac{(5)^2}{2 \times 4} \checkmark$$
$$= 3{,}125 m/s^2 \checkmark$$

$$T_1 = m_1(g - a) + f\mu$$
$$= 1500(9{,}81 - 3{,}125) + 600 \checkmark$$
$$= 10627{,}5N \checkmark$$

$$T_2 = m_2(g + a) - f\mu$$
$$= 600(9{,}81 + 3{,}125) - 600 \checkmark$$
$$= 7161N \checkmark$$

(6)
[18]

TOTAL: 100

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