higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

AUGUST EXAMINATION

MECHANOTECHNICS N5

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This marking guideline consists of 9 pages.

DHGT

QUESTION 1

1.1 (a) Lower installation costs
(b) Installation is easier
(c) Cheaper maintenance
(d) Does not require stronger bearings to support the head pulley shaft (4)

1.2 1.2.1

$$v = \frac{\pi(D+t)N}{60}$$
$$= \frac{\pi(0,7+0,004)750}{60}$$
$$= 27,65 m/s$$ (2)

1.2.2

$$m = w \times t \times l \times \rho$$
$$= 0,12 \times 0,004 \times 1 \times 1,2 \times 10^3$$
$$= 0,576 kg/m$$ (2)

1.2.3

$$T_C = m.v^2$$
$$= 0,576 \times (27,65)^2$$
$$= 440,365 N$$ (2)

1.2.4

$$T_1 = w \times t \times ft$$
$$= 120 \times 4 \times 2,5$$
$$= 1200 N$$

$$\frac{T_1 - T_C}{T_2 - T_C} = e^{\mu\theta}$$
$$\frac{1200 - 440,365}{T_2 - 440,365} = 2,718^{0,25 \times \frac{160}{57,3}}$$
$$\frac{759,635}{T_2 - 440,365} = 2,01$$
$$2,01T_2 - 885,085 = 759,635$$
$$T_2 = 818,313 N$$ (6)

1.2.5

$$P = (T_1 - T_2)v \times \eta$$
$$= (1200\text{-}818,313) * 27,65 * 0,9$$
$$= 9,5 KW$$ (2)

[18]

QUESTION 2

2.1 (a) Gravel
(b) Flour.
(c) Sugar
(d) Fertiliser
(e) Lime
(f) Coke
(g) Sand

(Any 6 x 1) (6)

2.2

$$m_{/h} = \frac{400 \times 10^3}{3600}$$
$$= 111{,}111 kg/s$$

$$V_{/s} = \frac{M_L}{\rho}$$
$$= \frac{111{,}111}{900}$$
$$= 0{,}123 m^3$$

$$B_{/s} = \frac{0{,}4}{1}$$
$$= 0{,}4/s$$

$$v = \frac{v_{/s}}{B_{/s}}$$
$$= \frac{0{,}123}{0{,}4}$$
$$= 0{,}308 m^3$$

$$P_g = mgh$$
$$= 111{,}111 \times 9{,}81 \times 50$$
$$= 54{,}5 kw$$

$$\eta = \frac{P_g}{P_i}$$

$$P_i = \frac{P_g}{\eta}$$
$$= \frac{54{,}5}{0{,}8}$$
$$= 68{,}125 kw$$

(10)
(10)
[16]

QUESTION 3

3.1 (a) It could be more economical than the building of roads or railways
(b) It is more efficient since loading and unloading can be fully automatic
(c) Transport is possible where no tracks or railway lines can be provided
(d) It does not interfere with other forms of transport, such as road or rail transport
(e) It is independent of terrain difficulties
(f) The shortest route between terminals can be taken (Any 4 x 1)

(4)

3.2.1
$$D^2 = \frac{F_{Ultimate}}{0,36 \times \delta_{max}}$$
$$= \frac{600 \times 10^3}{0,36 \times 1300 \times 10^6}$$
$$D = \sqrt{1,282 \times 10^{-3}}$$
$$= 0,0358m$$
$$= 35,8mm$$

(4)

3.2.2
$$M_{Rope} = \frac{d^2}{250}$$
$$= \frac{(35,8)^2}{250}$$
$$= 5,127kg/m$$

(2)

3.2.3
$$T_{self-weight} = \frac{M \times g \times S^2}{8.h}$$
$$= \frac{5,127 \times 9,81 \times (90)^2}{8 \times 2,6}$$
$$= 19586,37N$$

(2)

3.2.4
$$T_L = \frac{M \times g \times S}{4.h}$$
$$= \frac{460 \times 9,81 \times 90}{4 \times 2,6}$$
$$= 39051,35N$$

(2)

3.2.5
$$f = \frac{F_{Ultimate}}{T_{Self-weight} + T_{Load}}$$
$$= \frac{600 \times 10^3}{19586,37 + 39051.35}$$
$$= \frac{600 \times 10^3}{5637.72}$$
$$= 10.23$$
(4)
[18]

QUESTION 4

4.1
$$v = u + at$$
$$a = \frac{v - u}{t}$$
$$= \frac{6}{5}$$
$$= 1,2 m/s^2$$

$$T_1 = M_1(g + a)$$
$$= 1550(9,81 + 1,2)$$
$$= 17065,5N$$

$$T_2 = M_2(g - a)$$
$$= 450(9,81 - 1,2)$$
$$= 3874,5N$$
(6)

4.2
$$T_{Load} = (T_1 - T_2).r$$
$$= (17065,5 - 3874,5) \times 0,5$$
$$= 6595,5N$$
(2)

4.3
$$T_{Rope} = M_{Rope} \times a \times r$$
$$= 300 \times 1,2 \times 0,5$$
$$= 180 N.m$$
(2)

4.4 $T_{Total} = T_L + T_R + T_\mu$
$= 6595,5 + 180 + 850$
$= 7625,5N.m$ (2)

4.5 $P = T_{Total} \times \frac{v}{r}$
$= 7625,5 \times \frac{6}{0,5}$
$= 91,506kW$ (2)
[14]

QUESTION 5

5.1 $T_E = m_1 \times 10^3 \times g \times \mu \times \eta$
$= 110 \times 10^3 \times 9,81 \times 0,3 \times 0,84$
$= 271,933kN$ (2)

5.2 $F_R = (M_L \times R_L) + (M_T \times R_T)$
$= (110 \times 140) + (510 \times 90)$
$= 15400 + 45900$
$= 61300N$

$F_g = (M_L + M_T) \times 10^3 \times g \times \frac{1}{150}$
$= (110 + 510) \times 10^3 \times 9,81 \times \frac{1}{150}$
$= 40548N$

$T_E = F_R + F_g + F_a$
$F_a = T_E - F_R - F_a$
$= 271933 - 61300 - 40548$
$= 170,085kN$ (6)

5.3 $T_E = 271933 \times \eta$

$= 271933 \times 0,78$

$= 212107,74N$

$F_a = T_E - F_R - F_g$

$= 212107,74 - 61300 - 40548$

$= 110,26KN$

Also

$F_a = m.a$

$a = \frac{F_a}{m}$

$= \frac{110259}{(110+510)\times 10^3}$

$= 0,178m/s^2$

$V = \frac{65 \times 10^3}{3600}$

$= 18,06m/s$

$V = u + a.t$

$t = \frac{v-u}{a}$

$= \frac{18,06 - 0}{0,178}$

$= 101,46 \text{ seconds}$ (10)

5.4 $v^2 = u^2 + 2.a.s$

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

$= \frac{(18,06)^2 - 0}{2 \times 0,178}$

$= 916,19m$ (2)

[20]

QUESTION 6

6.1

$$w_1 = \frac{2.\pi \times N}{60}$$
$$= \frac{2 \times \pi \times 85}{60}$$
$$= 8,901 rad/s$$

$$w_2 = \frac{2.\pi \times N}{60}$$
$$= \frac{2 \times \pi \times 105}{60}$$
$$= 11 rad/s$$

$$\alpha = \frac{w_2 - w_1}{t}$$
$$= \frac{11 - 8,901}{15}$$
$$= 0,14 rad/s^2$$

(6)

6.2

$$T = M \times a \times k^2$$
$$= 700 \times 0,14 \times (0,6)^2$$
$$= 35,28 N.m$$

(2)

6.3

$$\theta = \omega_1 \times t + \tfrac{1}{2} \times a \times t^2$$
$$= 8,901 \times 15 + \tfrac{1}{2} \times 0,14 \times (15)^2$$
$$= 133,515 + 15,75$$
$$= 149,265 rads$$

But

$$1 rev = 2 \times \pi rads$$
$$\therefore N_{rev} = \frac{\theta}{2.\pi}$$
$$= \frac{149,265}{2 \times \pi}$$
$$= 23,756$$

(4)

6.4 $Wd = T \times rads$

$= 35,28 \times 149,265$

$= 5,266kJ$

(2)
[14]

TOTAL: 100