higher education
& training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

## MECHANOTECHNICS N4

7 April 2021

This marking guideline consists of 9 pages.

QUESTION 1

1.1
- Flexible layout
- Coordinated service
- Clear transport route
- Optimum use of space
- Accessible service and maintenance points
- Pleasant working conditions
- Minimum handling of materials
- Minimum travelling distance for staff and materials
- One-way flow of materials and products
- Safety of workers and security of equipment   (Any 5 × 1)   (5)

1.2
- Anodising
- Galvanising
- Electroplating
- Phosphating
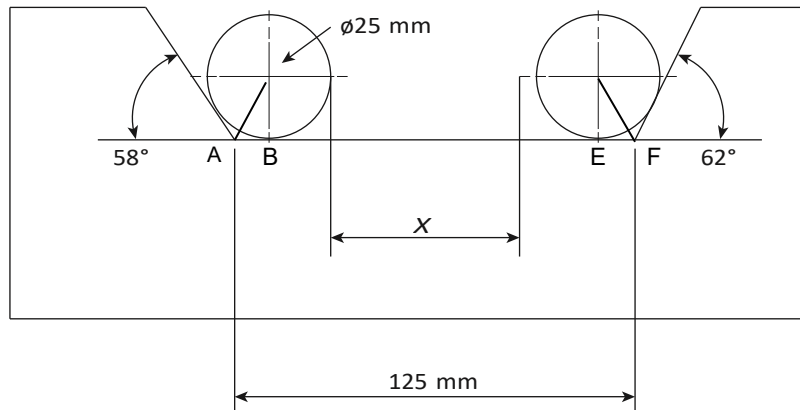- Cathodic protection   (5)

1.5

oil container

wick

oil

(5)
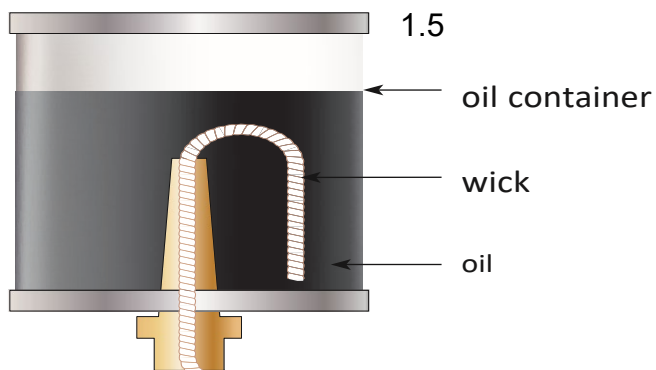
(2 marks for sketch and 3 marks for labelling)

[15]

QUESTION 2

2.1

$$\tan 61° = \frac{12,5}{AB} ✓$$

$$AB = \frac{12,5}{\tan 61°} ✓$$
$$AB = 6,929mm ✓$$

Also
$$\tan 59° = \frac{12,5}{EF} ✓$$

$$EF = \frac{12,5}{\tan 59°} ✓$$
$$EF = 7,511mm ✓$$
$$EF = 125 - AB - EF - 2(r)$$
$$EF = 125 - 6,929 - 7,511 - 2(12,5) ✓$$
$$EF = 85,56mm ✓$$ (8)

2.2

12,75mm

70mm
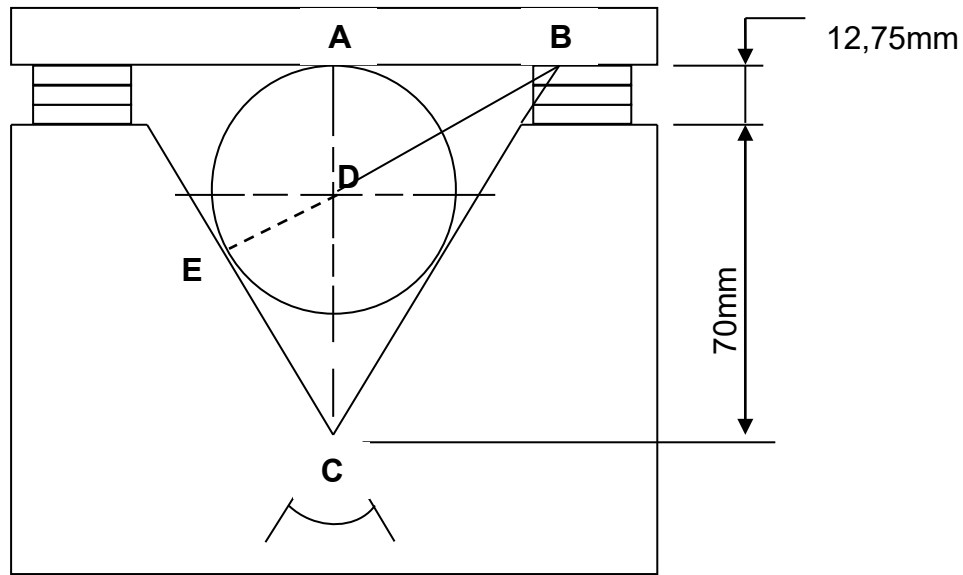
$in\Delta ABC$

$\tan\theta = \dfrac{AB}{AC}$

$\quad AB = 82,75\tan 30°\checkmark$

$\qquad = 47,776mm\checkmark$

$in\Delta ABD$

$\tan 30° = \dfrac{AD}{47,776}\checkmark$

$\quad AD = 47,776\tan 30°\checkmark$

$\qquad = 27,583mm\checkmark$

$Diameter = 2\times AD$

$Diameter = 2\times 27,583\checkmark$

$\qquad\quad = 55,166mm\checkmark$

OR

$AC = AD + CD$

$AD = r\ and\ \ AD = ED$

$in\Delta CDE$

$\quad \sin 30° = \dfrac{ED}{CD}$

$CD = \dfrac{r}{\sin 30}\checkmark$

$\qquad = 2r\checkmark$

$\quad AC = AD + CD$

$82,75 = r + 2r\checkmark$

$\quad r = \dfrac{82,75}{3}\checkmark$

$\qquad = 27,583mm\checkmark$

$Diameter = 2\times 27,583\checkmark$

$\qquad\quad = 55,166mm\checkmark$

(7)

[15]

Please turn over

QUESTION 3

3.1 $T_A = T_S + 2T_P$
        $T_A = 60 + 2 \times 20$
        $T_A = 100 \, teeth$✓

No	Condition	Gear A	Gear P	Gear S	Arm D
1	Fix arm D and rotate Gear A by +1rev	$+1$ √	$\frac{100}{20} = 5$ √	$= \frac{100}{20} \times \frac{20}{-60}$ √ $= -1,667$	0 √
2	Multiply by x and add y	$x + y$ √	$5x + y$ √	$-1,667x + y$ √	$+ y$ √
3	$N_A = 0$ $N_S = 450r/\min$ $N_D = ?$	$N_A = 0$ √		$N_S = 450$ √	$N_D = ?$ √
4	$N_A = ?$ $N_S = 450r/\min$ $N_D = -15$	$N_A = ?$ √		$N_S = 450$ √	$N_D = -15$ √

$x + y = 0$
$\qquad x = -y$...................1
$-1,667x + y = 450$..............2

substitute ...1 in 2
$-1,667(-y) + y = 450$ ✓
$\qquad y = \dfrac{450}{2,667}$ ✓
$\qquad y = 168,729$
$\qquad N_D = 168,729r/\min \quad clockwise/positive \, direction$✓   (11)

3.2 $\qquad y = -15$......................1
        $-1,667x + y = 450$..............2

substitute ...1 in 2
$-1,667x - 15 = 450$
$\qquad x = \dfrac{465}{-1,667}$ ✓
$\qquad x = -278,944$ ✓

$N_A = x + y$
$N_A = -278,944 - 15$ ✓
$N_A = -293,944$
$N_A = 293,944r/\min \quad anti-clockwise/opposite \, direction$✓

                                                                              (4)
                                                                            [15]

QUESTION 4

$D_e = D + t$

$D_e = 1,2 + 0,012$ ✔

$D_e = 1,212m$ ✔

$v = \dfrac{\pi D_e N}{60}$

$v = \dfrac{\pi 1,212 \times 240}{60}$ ✔✔

$v = 15,23 m/s$ ✔

[5]

QUESTION 5

5.1   5.1.1

$h_f = \dfrac{f \times l \times Q^2}{3,026 \times d^5}$

$h_f = \dfrac{p}{Rhoxg}$

$h_f = \dfrac{60 \times 10^3}{1000x9,81}$ ✔

$= 6,116m$ ✔

$f = \dfrac{h_f \times 3,026 \times d^5}{l \times Q^2}$

$= \dfrac{6,116 \times 3,026 \times (0,09)^5}{20 \times (0,03)^2}$ ✔✔

$= 0,00607$ ✔

(5)

5.1.2

$m = \dfrac{d}{4}$

$= \dfrac{0,09}{4}$ ✔

$= 0,023$ ✔

(2)

5.1.3

$i = \dfrac{h_f}{l}$

$= \dfrac{6,116}{20}$ ✔

$= 0,306$ ✔

(2)

5.1.4

$$C = \frac{v}{\sqrt{mi}}$$

$$v = \frac{Q}{A}$$

$$= \frac{0,03}{6,361 \times 10^{-3}} \quad \sqrt{}$$

$$= 4,716 m/s \checkmark$$

$$C = \frac{v}{\sqrt{mi}}$$

$$= \frac{4,716}{\sqrt{0,023 \times 0,306}} \checkmark$$

$$= 56,215 \checkmark$$

$$A = \frac{\pi d^2}{4}$$

$$= \frac{\pi (0,09)^2}{4} \sqrt{}$$

$$= 6,361 x 10^{-3} m^2 \checkmark$$

(5)

5.2

$$A = \frac{\pi D^2}{4}$$

$$A = \frac{\pi 0,18^2}{4}$$

$$A = 0,025 m^2 \checkmark$$

$$m^2 = \frac{D^4}{d^4}$$

$$m^2 = \frac{0,18^4}{0,11^4}$$

$$m^2 = 7,170 \checkmark$$

$$h = 12,6 h_1$$

$$h = 12,6(0,86)$$

$$h = 10,836 m \checkmark$$

$$Q = C_d \times A \times \sqrt{\frac{2gh}{(m^2 - 1)}}$$

$$Q = 0,97 \times 0,025 \times \sqrt{\frac{2(9,81) \times 10,836}{(7,170 - 1)}} \checkmark\checkmark$$
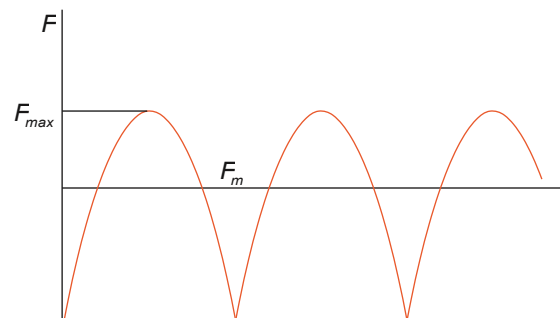
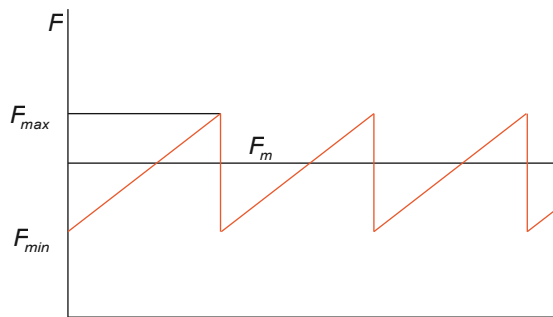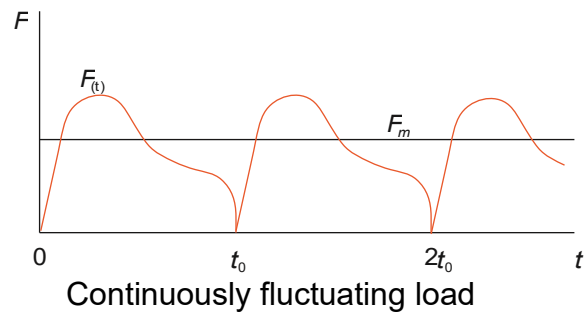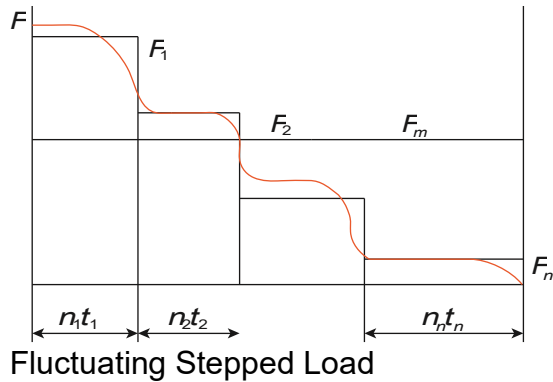$$Q = 0,142 m^3/s \checkmark$$

(6)

[20]

QUESTION 6

6.1
- Fluctuating stepped load
- Linear fluctuating load
- Sinusoidal fluctuating load
- Continuously fluctuating load (Any 3 × 1) (3)

6.2

Fluctuating Stepped Load

Continuously fluctuating load

Linear fluctuating load

Sinusoidal fluctuating load (12)

[15]

QUESTION 7

7.1
$$\mu = \frac{F_f}{N_R}$$
$$F_f = \mu \times N_R$$
$$= 0,02 \times 80 \times 10^3 \checkmark$$
$$= 1600N \checkmark$$
$$v = \frac{\pi.D.N}{60}$$
$$= \frac{\pi \times 0,3 \times 350}{60} \checkmark$$
$$= 5,498 m/s \checkmark$$
$$P_f = F_f \times v$$
$$= 1600 \times 5,498 \checkmark$$
$$= 8796,8W \checkmark$$

(6)

7.2   7.2.1

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

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

$$= \frac{3,5 \times 10^3 \times 60}{2\pi 1750} \checkmark\checkmark$$

$$= 19,098 N.m \checkmark$$

7.2.2

$$\eta = \frac{P_O}{P_1} \times 100$$

$$P_O = P_i \times \eta$$

$$= 3,5 \times 10^3 \times 0,8$$

$$= 2800 W \checkmark$$

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

$$= \frac{2800 \times 60}{2\pi 3500} \checkmark$$

$$= 7,63 N.m \checkmark$$

7.2.3

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

$$= \frac{2800 \times 60}{2\pi \times 25} \checkmark\checkmark$$

$$= 1069,521 N.m \checkmark$$

(3 × 3)   (9)
[15]

TOTAL: 100