higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

MECHANOTECHNICS N4

11 APRIL 2016

This marking guideline consists of 9 pages.

QUESTION1

1.1
- Flexibility of layout
- Coordination of services
- Accessibility of service and maintenance points
- Transport routes
- Optimal use of space
- Minimising travelling distances of staff and material
- Minimum handling of material
- One-way flow of material and products
- Pleasant working conditions
- Safety of workers and security of equipment (10 × 1) (10)

1.2 1.2.1
- Viscosity of the paint is too low
- Atomising air pressure is too high
- Distance between the spray gun and the work piece is too great

1.2.2
- Insufficient air pressure
- Blocked pipes reduce paint supply
- Spray nozzle is no longer effective

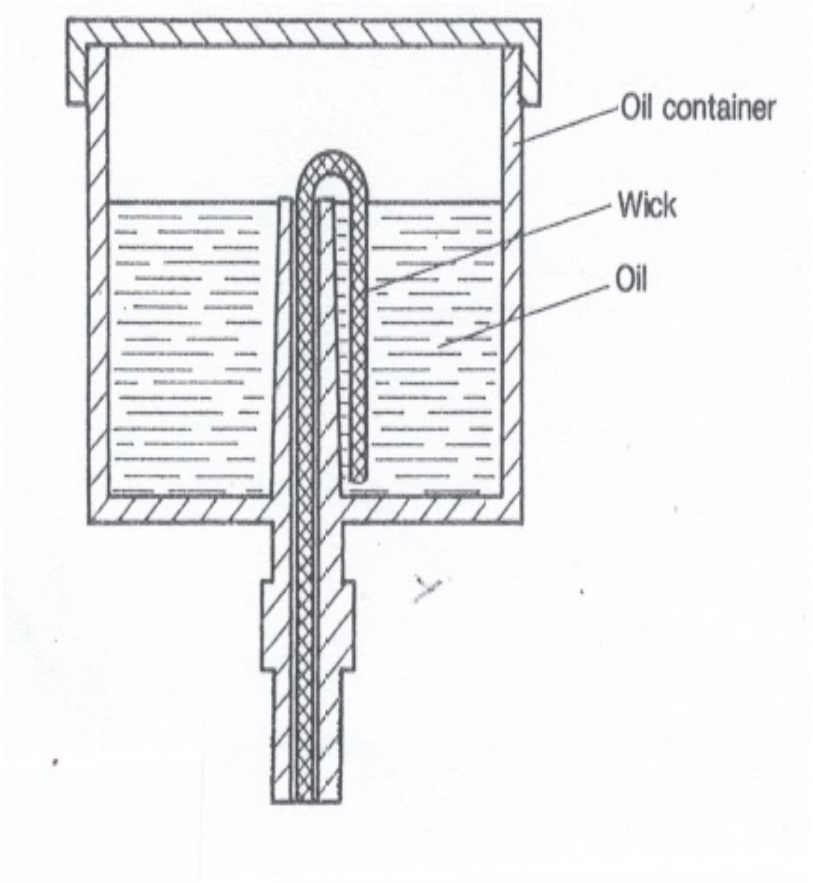
1.2.3
- Spray gun moves too slow
- Applying too much paint to the surface
- Paint is too thin
- Holding the spray gun too close to the surface (Any 3)

1.2.4
- We use the wrong thinners or solvents.
- We do not mix the paint properly before use.
- The air pressure is wrong.
- We prepare the surface incorrectly.
(Any 3)

(3 × 4) (12)

1.3
- Gravity feed
- Grease lubrication
- Splash lubrication
- Forced lubrication
- Pressure-feed lubrication (Any 3 × 1) (3)

1.4



NOTE: TWO marks for the drawing
THREE marks for any three appropriate labels (5)
[30]

QUESTION 2

2.1
$$V = \pi \frac{(D + t)}{60} N$$
$$= \pi \times \frac{(1{,}3 + 0{,}013)}{60} \times 255 \quad ✓$$
$$= 17{,}53 \text{ m/s} \quad ✓$$
(2)

2.2
$$T_C = Mv^2$$
$$= 9{,}75 \times 17{,}53^2 \quad ✓$$
$$= 2996{,}183 \text{ kg/m} \quad ✓$$
$$= 2\,996{,}2 \text{ kg/m}$$
(2)

2.3
$$T_1 = w \times n \times f_t$$
$$= 1 \times 4 \times 8 \times 1\,000 \quad ✓$$
$$= 32\,000 \text{ N} \quad ✓$$
(2)

2.4 $$\frac{T_1 - T_C}{T_2 - T_C} = e^{\frac{\theta \times \mu}{57.3}}$$

$$\frac{32\,000 - 2\,996,2}{T_2 - 2\,996,2} = e^{\frac{0.25 \times 172^0}{57.3}}$$ ✓

$$29\,003,8 = 2,2479(T_2 - 2\,996,2)$$ ✓

$$T_2 = 15\,898,82 \text{ N}$$ ✓✓ (4)

2.5 $$P = (T_1 - T_2)V$$

$$= (32\,000 - 15\,898,82) \times 17,$$ ✓

$$= 16\,101,18 \text{ x } 17,53$$ ✓

$$= 282\,253,685 \text{ W}$$

$$= 282,254 \text{ KW}$$ (2)

2.6 $$w = \frac{\text{Total power}}{\text{power per width}}$$

$$= \frac{45}{282,254}$$ ✓

$$= 0,15943 \text{ mm}$$

$$= 159,43 \text{ m}$$ ✓

$$= 160 \text{ m}$$ (2)

[10]

QUESTION 3

3.1 $$F_f = \mu mg$$

$$= 0,3 \times 150 \times 9,81$$

$$= 441,45 \text{ N}$$ ✓

$$\text{work done} = \text{Force} \times \text{Distance}$$

$$= 441,45 \times 0,15$$ ✓

$$= 66,218 \text{ J}$$ ✓ (3)

3.2 $$\text{Work done} = 175 - 66,218$$

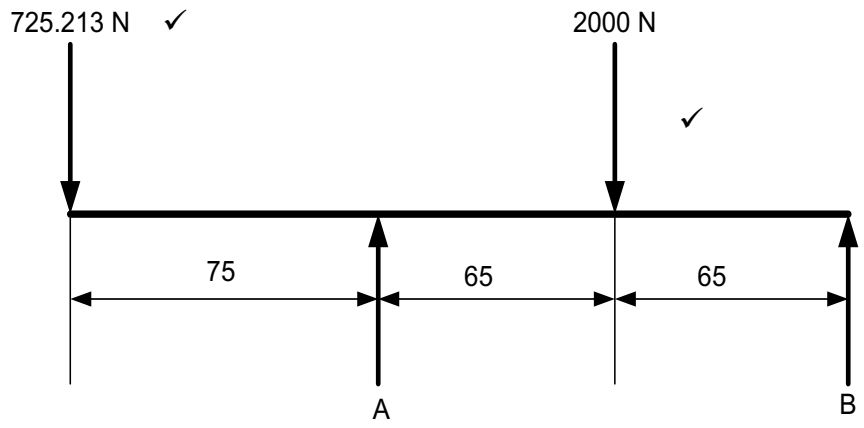
$$= 108,783 \text{ J}$$ ✓

$$\text{Force} = \frac{\text{Work done}}{\text{Distance}}$$

$$= \frac{108,783}{0,15}$$ ✓

$$= 725,213 \text{ N}$$ ✓ (3)

3.3



Calculate A, Take moments about point B:

$$\text{CWN} = \text{ACWN}$$
$$\text{A} \times 130 = 2\,000 \times 65 + 725{,}213 \times 205 \quad ✓$$
$$\text{A} = \frac{2\,000 \times 65 + 725{,}213 \times 205}{130} \quad ✓$$
$$= 2143{,}605 \text{ N} \quad ✓$$

Calculate B, Take moments about A

$$\text{CWN} = \text{ACWN}$$
$$2\,000 \times 65 = 725{,}213 \times 75 + \text{B} \times 130 \quad ✓$$
$$\text{B} = \frac{2\,000 \times 65 - 725{,}213 \times 75}{130} \quad ✓$$
$$= 581{,}6079 \text{ N} \quad ✓$$

ALTERNATIVE METHOD:

Upwards = Downwards

A+B = 725,213 + 2 000

2 143,605 + B = 2 725,213

B = 2 725,213 – 2 143,605

B = 581,608 N (8)
[14]

QUESTION 4

4.1 Micrometer reading:

$d = 0,577\ p$ ✓
$= 0,577 \times 3,5$ ✓
$= 2,02\ mm$ ✓

$w = D + 3\ d + 1,516\ p$
$= 30 + 3 \times 2,02 + 1,516 \times 3,5$ ✓
$= 41,366\ mm$ ✓ (5)

4.2 4.2.1

- Calculate the chord height
- Set the vertical scale of the gear tooth vernier calliper
- Measure the chord width and compare it
- Compare the chord width with the calculation and measure it (4)

4.2.2

$$h = m\left(1 - \frac{\pi}{4}\sin\theta\cos\theta\right) \quad ✓$$
$$= 10 \times \left(1 - \frac{\pi}{4}\sin 20^0 \cos 20^0\right) \quad ✓$$
$$= 7,476\ mm \quad ✓$$

$$w = \frac{\pi m}{2}\cos^2\theta$$
$$= \frac{\pi \times 10}{2}\cos^2 20^0 \quad ✓$$
$$= 13,872\ mm \quad ✓$$

(5)
[14]

QUESTION 5

5.1 5.1.1

$$VR = \frac{T_A}{T_B}$$
$$= \frac{130}{40}$$
$$= 3,25 \quad ✓$$ (1)

5.1.2

$$VR = \frac{T_A}{T_B} \times \frac{T_B}{T_C}$$
$$= -\frac{130}{50}$$
$$= -2,6 \quad ✓$$ (1)

5.1.3

$$y = 50 \quad ✓$$
$$x + y = 0$$
$$x = -y$$
$$= -50 \quad ✓$$

$$N_C = -2,6x + y$$
$$= -2,6 \times (-50) + 50 \quad ✓$$
$$= 180 \text{ r/min} \quad ✓$$

N_c rotates 180 r/min in the clockwise/positive direction (4)

5.1.4

$$y = 50$$
$$-2,6x + 50 = 0 \quad ✓$$
$$x = \frac{-50}{-2,6}$$
$$= 19,231 \quad ✓$$

$$N_A = x + y$$
$$= 19,231 + 50 \quad ✓$$
$$= 69,231 \text{ r/min} \quad ✓$$

N_c rotates 69,23 r/min in the clockwise/positive direction (4)

5.2 $T_B = \frac{5}{3} T_A$

$= \frac{5}{3} \times 30$ ✓

$= 50$ teet ✓

$PCDA = m \times T_A$

$= 6 \times 30$

$= 180$ mm ✓

$PCDB = m \times T_B$

$= 6 \times 50$

$= 300$ mm ✓ (4)

[14]

QUESTION 6

6.1 $A = \frac{\pi D^2}{4}$

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

$= 0{,}031\,m^2$ ✓

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

$= \frac{0{,}2^4}{0{,}13^4}$

$= 5{,}59$ ✓

$h = 12{,}6\,L$

$= 12{,}6 \times 0{,}88$

$= 11{,}09$ m ✓

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

$= 0{,}97 \times 0{,}031 \times \sqrt{\frac{2 \times 9{,}81 \times 11{,}09}{5{,}59 - 1}}$ ✓

$= 0{,}207\,m^3 s^{-1}$ ✓

$= 207\ Ls^{-1}$ ✓ (7)

6.2

$$A_1 = \frac{\pi D^2}{4}$$
$$= \frac{\pi \times 0{,}2^2}{4}$$
$$= 0{,}0314\ m^2 \quad ✓$$

$$A_2 = \frac{\pi D^2}{4}$$
$$= \frac{\pi \times 0{,}4^2}{4}$$
$$= 0{,}1256\ m^2 \quad ✓$$

$$Q_1 = Q_2$$

$$V_2 = \frac{A_1}{A_2} \times V_1$$
$$= \frac{20}{0{,}1256} \times 0{,}0314$$
$$= 5\ ms^{-1} \quad ✓$$

$$\frac{P_1}{Rh_0 \times g} + \frac{V_1^2}{2g} + h_1 = \frac{P_2}{Rh_0 \times g} + \frac{V_2^2}{2g} + h_2$$
✓ ✓

$$\frac{16 \times 10^3}{1\,000 \times 9{,}81} + \frac{20^2}{2 \times 9{,}81} + 0 = \frac{P_2}{1\,000 \times 9{,}81} + \frac{5^2}{2 \times 9{,}81} + 1{,}274$$

$$1{,}631 + 20{,}387 = 102 \times 10^{-6}\ P_2 + 1{,}274$$

$$P_2 = \frac{1{,}631 + 20{,}387 - 1{,}274}{102 \times 10^{-6}} \quad ✓$$

$$= 203\ 284{,}314\ \text{Pa} \quad ✓$$
$$= 203{,}284\ \text{kPa}$$

(7)
[14]

TOTAL: 100