



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE MECHANOTECHNICS N4

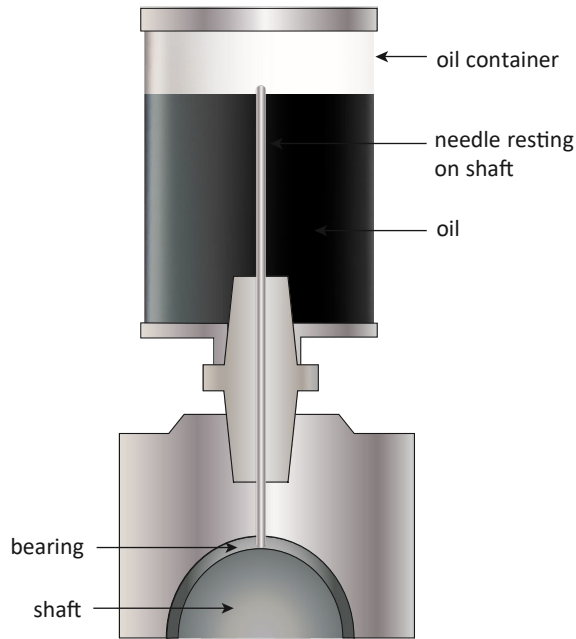
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This marking guideline consists of 8 pages.

QUESTION 1

- 1.1 1.1.1 Individual means single. So, with this type of production, you concentrate all manufacturing process efforts on one item.✓
Workers complete all operations on this single item before going to the next one. (2)
- 1.1.2 Manufacture of a boiler (1)
- 1.1.3 • It takes place in batches.
• Work is divided into different operations.
• There is considerable degree of specialisation.
• Process layout is used.
• Production is on a small scale.
• Machines are multi-purpose.
• Production methods are flexible and adaptable.
• Workers have a higher degree of skill and training. (Any 7 × 1) (7)
- 1.2 Excessive paint spray✓
• Viscosity of the paint too low✓
• Atomizing air pressure is too high
• Great distance between spray gun and work piece
(Any ONE of the given will be correct)
- Uneven spray painting✓
• Insufficient air pressure✓
• Spray nozzle no longer effective
• Blocked pipes reduce paint supply
(Any ONE of the given will be correct)
- Sagging surfaces✓
• Spray gun moves too slowly✓
• Too much paint is applied
• Paint too thin
• Spray gun too close to the surface
(Any ONE of the given will be correct)
- Speckle or orange-peel effect✓
• Wrong thinners or solvents are used✓
• Paint is not mixed properly
• Air pressure is wrong
• Surface is incorrectly prepared (Any ONE of the given will be correct)
(4 × 2) (8)
- 1.3 • There is less wastage of paint compared to other processes of painting.
• Wrap-around effect is possible only with this method.
• There are no problems with overlapping paint layers.
(Any 2 × 1) (2)

1.4



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

1.5

- Minimal frictional resistance
- Strength
- Resistance to wear
- Thermal conductivity
- Resistance of corrosion

(5)
[30]**QUESTION 2**

2.1

$$P_t = P_g + P_f$$

$$\text{and } P_g = mgh$$

$$\text{also } h = 115 \sin 14^\circ \checkmark$$

$$h = 27,82m \checkmark$$

$$\text{Therefore } P_g = 0,117 \times 10^3 \times 9,81 \times 27,82 \checkmark$$

$$= 31840W$$

$$= 31,84kW \checkmark$$

$$\text{and } P_t = P_f \times v$$

$$= 4100 \times 2,2 \checkmark$$

$$= 9020W$$

$$= 9,02kW \checkmark$$

$$\text{so } P_t = P_g + P_f$$

$$= 31,84 + 9,02$$

$$= 40,86kW \checkmark$$

(7)

2.2

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

$$\frac{T_1}{T_2} = e^{0,2 \times \frac{2160}{57,3}} \quad \checkmark$$

$$T_1 = 2,081T_2 \quad \checkmark$$

$$P_i = (T_1 - T_2)v$$

$$40,86 \times 10^3 = (2,081T_2 - T_2) \times 2,2 \quad \checkmark$$

$$18573 = 1,081T_2 \quad \checkmark$$

$$T_2 = 17181,1N \quad \checkmark$$

$$\begin{aligned} \text{so } T_1 &= 2,081T_2 \\ &= 2,081(17181,1) \quad \checkmark \\ &= 35754N \quad \checkmark \end{aligned}$$

(7)
[14]**QUESTION 3**

3.1

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

$$\begin{aligned} P_o &= \eta \times P_i \\ &= 0,7 \times 700 \\ &= 490N \quad \checkmark \end{aligned}$$

$$\text{and } P_o = F_o \times v$$

$$\begin{aligned} F_o &= \frac{P_o}{v} \\ v &= \frac{\pi \times d \times n}{60} \\ &= \frac{\pi \times 0,02 \times 1500}{60} \quad \checkmark \\ v &= 1,571m/s \quad \checkmark \end{aligned}$$

$$\begin{aligned} F_o &= \frac{490}{1,571} \quad \checkmark \\ &= 311,9N \quad \checkmark \end{aligned}$$

$$\begin{aligned} \text{Thus, per cutting edge} \quad &= \frac{311,9}{2} \quad \checkmark \\ &= 155,95N \quad \checkmark \end{aligned}$$

(7)

3.2

$$P_o = F_o \times v$$

$$\mu = \frac{F_f}{N.R}$$

Normal reaction (N.R) = total mass x g

$$N.R = (500 + 13 + 4) \times 9.81 \checkmark$$

$$= 517 \times 9.81 \checkmark$$

$$= 5071,77 \text{ N} \checkmark$$

$$F_f = \mu \times N.R$$

$$= 0,06 \times 5071,77 \checkmark$$

$$= 304,31 \checkmark$$

$$P_f = F_f \times v$$

$$P_f = 304,31 \times \frac{250}{(1000 \times 60)} \checkmark$$

$$P_f = 1,268 \text{ W} \checkmark$$

(7)
[14]**QUESTION 4**

4.1

$$AD = AB + BC + CD \checkmark$$

$$65 = AB + BC + CD$$

$$AB = r \checkmark$$

In triangle BCG $\tan 30^\circ = \frac{r}{BC} \checkmark$

$$BC = 1,732r \checkmark$$

In triangle CEF $\tan 30^\circ = \frac{EF}{35}$

$$EF = 20,21 \text{ mm} \checkmark$$

And $CD = 45 - EF$

$$= 45 - 20,21$$

$$= 24,79 \text{ mm} \checkmark$$

So $65 = AB + BC + CD$

$$65 = r + 1,732 + 24,79$$

$$r = 14,72 \text{ mm} \checkmark$$

$$d = 2(14,72)$$

$$d = 2(14,72)$$

$$d = 29,44 \text{ mm} \checkmark$$

(8)

4.2

In triangle ABD

$$\tan 30^\circ = \frac{AB}{40} \checkmark$$

$$AB = 40 \tan 30^\circ \checkmark$$

And in triangle CDE

$$CD = \frac{10}{\tan 30^\circ} \checkmark$$

$$CD = 17,321 \text{ mm} \checkmark$$

$$\begin{aligned} X &= 125 - 2(AB) + 2(CD) + 2(r) \\ &= 125 - 2(23,094) + 2(17,321) + 2(10) \checkmark \\ &= 133,45 \text{ mm} \checkmark \end{aligned}$$

(6)
[14]**QUESTION 5**

5.1

No	Condition	Gear A	Gear B	Arm C
1.	Fix arm, rotate Gear B one revolution clockwise	$= \frac{100}{-30} = -3,333 \checkmark$	$+1 \checkmark$	$0 \checkmark$
2.	Multiply by x and add y	$-3,333x + y \checkmark$	$x + y \checkmark$	$y \checkmark$
3.	$N_B = 0$ $N_c = 120$	$N_A = ?$	$N_B = 0$	$N_c = 120$

$$\begin{aligned} x + y &= 0 & y &= 120 \\ x &= -120 \checkmark \end{aligned}$$

$$\begin{aligned} N_A &= -3,333x + y \\ &= -3,333(-120) + 120 \checkmark \\ N_A &= 520 \text{ r / m (clockwise)} \checkmark \end{aligned}$$

(6)

5.2

5.2.1

$$V.R = 2,5 : 1$$

$$\begin{aligned} T_A &= 2,5 T_B \checkmark \\ &= 2,5(35) \\ &= 87,5 \checkmark \end{aligned}$$

Use 88 teeth

$$m = \frac{PCD}{T}$$

$$\begin{aligned} PCD_A &= m \times T_A \\ &= 6 \times 88 \\ &= 528 \text{ mm} \checkmark \end{aligned}$$

$$\begin{aligned} PCD_B &= m \times T_B \\ &= 6 \times 35 \end{aligned}$$

(4)

$$= 210\text{mm} \checkmark$$

$$\begin{aligned}
 5.2.2 \quad OD_A &= m \times (T_A + 2) \\
 &= 6 \times (88 + 2) \checkmark \\
 &= 540 \text{ mm} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 OD_B &= m \times (T_B + 2) \\
 &= 6 \times (35 + 2) \checkmark \\
 &= 222 \text{ mm} \checkmark
 \end{aligned}$$

(4)

[14]**QUESTION 6**

6.1 6.1.1

$$\begin{aligned}
 h_f &= \frac{f \times l \times Q^2}{3,026 \times d^5} \\
 d &= \sqrt[5]{\frac{f \times l \times Q^2}{3,026 \times h_f}} \\
 d &= \sqrt[5]{\frac{0,004 \times 3,2 \times 10^3 \times 0,65^2}{3,026 \times 35}} \checkmark \\
 d &= 0,552 \text{ m} \checkmark
 \end{aligned}$$

6.1.2

$$\begin{aligned}
 i &= \frac{h_f}{l} \\
 &= \frac{35}{3,2 \times 10^3} \checkmark \\
 &= 0,011 \checkmark
 \end{aligned}$$

(2 × 2)

(4)

6.2

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

$$= \frac{\pi(0.23)^2}{4}$$

$$A = 0.042 m^2 \quad \checkmark$$

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

$$= \frac{\pi(0.14)^2}{4}$$

$$a = 0.0154 m^2 \quad \checkmark$$

$$Q = Cd \times \frac{A \times a}{\sqrt{A^2 - a^2}} \times \sqrt{2gh}$$

$$\sqrt{2g} = 4.429 \checkmark$$

$$0.12 = 0.96 \times \frac{0.042 \times 0.0154 \times \sqrt{2gh}}{\sqrt{0.042^2 - 0.0154^2}}$$

$$0.12 = 0.96 \times \frac{0.042 \times 0.0154 \times 4.429 \sqrt{h}}{0.0391} \quad \checkmark$$

$$0.12 = \frac{0.0028 \sqrt{h}}{0.0391} \quad \checkmark$$

$$0.12 = 0.070 \sqrt{h} \quad \checkmark$$

$$h = \frac{0.12^2}{0.07^2}$$

$$h_{(water)} = 2.939 m \quad \checkmark$$

$$h_{(mercury)} = \frac{2.939}{12.6}$$

$$= 0.233 m$$

$$h_{(mercury)} = 233 mm \quad \checkmark$$

(10)

[14]**TOTAL: 100**