



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MECHANOTECHNICS N4

30 July 2026

This marking guideline consists of 10 pages.

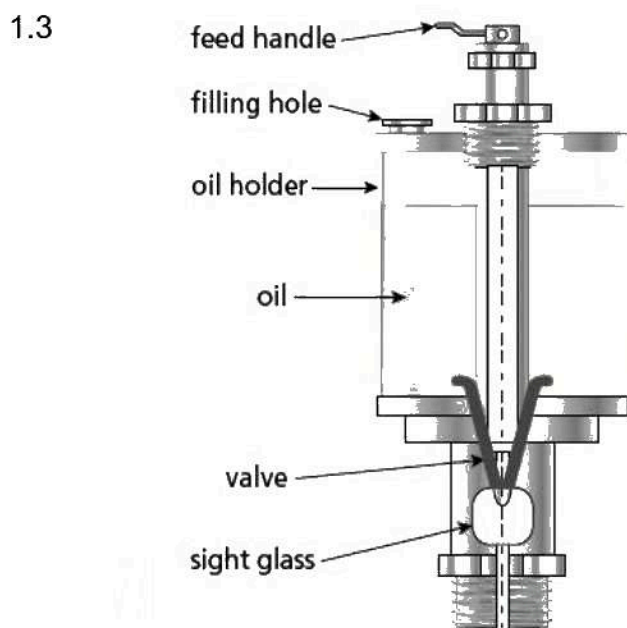
QUESTION 1

- 1.1
- Variable workflow depends on the nature of the job.
 - Careful planning is needed to keep a constant workflow to ensure that workers and machines do not idle.
 - Equipment is more general or multipurpose.
 - Skilled workers are required.
 - Inspection methods must be adaptable to suit different work pieces.
- (5)

- 1.2
- In product layout, all machines and equipment used to manufacture a product are grouped in a line or sequence in which the product will be produced.✓ The pace of the line is set by the slowest operation.✓ This layout is a characteristic of mass or continuous production.✓
- (3)

Advantages:

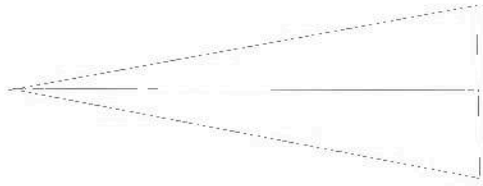
- Faster production cycle✓
 - No delays✓
 - Manual handling kept at minimum✓
 - Lower level of skill required from employees✓
- (2)



(2 marks for the correct sketch and 3 marks for any correct labelling.) (5)

[15]

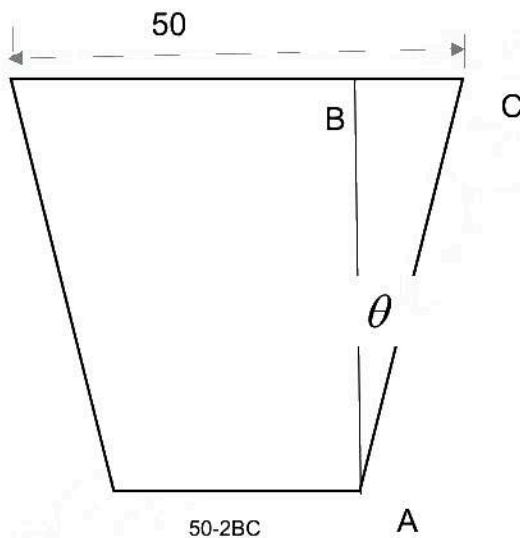
QUESTION 2



$$\begin{aligned}\tan \theta &= \frac{AC}{BC} \\ &= \frac{0.5}{5} \checkmark\end{aligned}$$

$$\theta = \tan^{-1}(0.1)$$

$$\begin{aligned}\text{Included angle} &= 2(5.711^\circ) \\ &= 11^\circ 25' \checkmark\end{aligned}$$



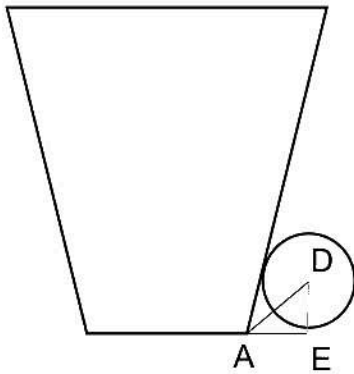
In triangle ABC

$$AB = 80$$

$$\tan \theta = \frac{BC}{AB}$$

$$\begin{aligned}BC &= AB \tan \theta \\ &= 80 \tan \theta \\ &= 80 \tan 5.711 \\ &= 8\text{mm} \checkmark\end{aligned}$$

$$\begin{aligned}\text{Small diameter} &= 50 - 2BC \checkmark \\ &= 50 - 2(8) \\ &= 34\text{mm} \checkmark\end{aligned}$$



In triangle ADE

$$\theta = \frac{(90 - 5.711)}{2} \checkmark$$

$$\theta = 42,145^\circ \checkmark$$

$$\tan 42,145 = \frac{9}{AE}$$

$$EF = AE = 9.944$$

$$HF = 80 - 55 \\ = 25\text{mm} \checkmark$$

$$\tan \theta = \frac{GH}{HF} \checkmark$$

$$GH = HF \tan \theta \\ = 2,5 \tan 5.711 \\ = 2,5\text{mm} \checkmark$$

$$X = 34 + 2AE + 2D$$

$$X = 34 + 2(9) + 2(9,945) \checkmark$$

$$X = 71,89\text{mm} \checkmark$$

$$X = 34 + 2AE + 2D$$

$$Y = (50 - 2GH) + 2 \times 9 \times 9.944 \checkmark$$

$$= (50 - 2 \times 2.5) + 2 \times 9 \times 9.944$$

$$= 82,89\text{mm} \checkmark$$

(15)
[15]

QUESTION 3

3.1

$$v = \frac{\pi D N}{60}$$

$$v = \frac{\pi(0,21) \times 190}{60}$$

$$v = 2,089 \text{ m/s} \checkmark$$

(1)

3.2

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

$$\frac{T_1}{T_2} = e^{0,2 \times \frac{180}{57,3}} \checkmark$$

$$T_1 = 1,874 T_2 \checkmark$$

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

$$28 \times 10^3 = (1,874 T_2 - T_2) \times 2,089$$

$$T_2 = 15335,86 \text{ N} \checkmark$$

$$T_1 = 1,874(15335,86)$$

$$T_1 = 28739,4 \text{ N} \checkmark$$

(4)

[5]

QUESTION 4

4.1

Condition	Gear A	Gear P	Gear S	Arm E
Fix arm E and rotate Gear A by +1 rev.	+1 ✓	$\frac{T_A}{T_P} = \frac{75}{15} = 5$ ✓	$\frac{75}{15} \times \frac{15}{-35} = -2,143$ ✓	0 ✓
Multiply by x and add y	$x + y$ ✓	$5x + y$ ✓	$-2,143x + y$ ✓	$+ y$ ✓
$N_A = 0$ $N_D = 65$	$N_A = 0$		$N_S = ?$	$N_D = 65$
$N_D = 35$ $N_S = 0$	$N_A = ?$		$N_S = 0$	$N_D = 35 ?$

(4 marks inside the table.)

$$N_s = -2,143x + y \checkmark$$

$$x + y = 0 \checkmark$$

$$x + 65 = 0$$

$$x = -65 \checkmark$$

$$N_s = -2,143(-65) + 65 \checkmark$$

$$N_s = +204,3 \text{ rpm} \checkmark$$

(9)

4.2

$$N_A = x + y \checkmark$$

$$-2,143x + y = 0 \checkmark$$

$$y = 35 \checkmark$$

So

$$-2,143x + 35 = 0$$

$$x = 16,33 \checkmark$$

$$N_A = 16,33 + 35 \checkmark$$

$$N_A = +51,33 \text{ rpm} \checkmark$$

(6)

[15]

QUESTION 5

5.1 5.1.1

$$\sin 25 = \frac{h_2}{12} \checkmark$$

$$h_2 = 12 \sin 25$$

$$h_2 = 5,07m \checkmark$$

Also

$$Q_1 = A_1 \times v_1$$

$$50 \times 10^{-3} = \frac{\pi(0,17)^2}{4} \times v_1 \checkmark$$

$$v_1 = 2,2m/s \checkmark$$

$$Q_2 = A_2 \times v_2$$

$$50 \times 10^{-3} = \frac{\pi(0,29)^2}{4} \times v_2 \checkmark$$

$$v_2 = 0,757m/s \checkmark$$

$$h_1 + \frac{P_1}{\rho g} + \frac{v_1^2}{2g} = h_2 + \frac{P_2}{\rho g} + \frac{v_2^2}{2g} \checkmark$$

$$0 + \frac{180 \times 10^3}{1000(9,81)} + \frac{2,2^2}{2(9,81)} = 5,07 + \frac{P_2}{1000(9,81)} + \frac{0,757^2}{2(9,81)} \checkmark$$

$$18,349 + 0,247 = 5,07 + \frac{P_2}{1000(9,81)} + 0,0292 \checkmark$$

$$\frac{P_2}{1000(9,81)} = 13,50 \checkmark$$

$$P_2 = 132,4kPa \checkmark$$

(11)

5.1.2

$$\Delta K_E = \frac{v_1^2}{2} - \frac{v_2^2}{2} \checkmark$$

$$\Delta K_E = \frac{2,2^2}{2} - \frac{0,757^2}{2} \checkmark$$

$$\Delta K_E = 2,134J \checkmark$$

(3)

5.2

$$Q_A = \frac{45000}{1000 \times 60 \times 60} \checkmark$$

$$Q_A = 0,0125 m^3 / s \checkmark$$

$$Q_t = A_t \times v_t$$

$$Q_t = \frac{\pi(0,05)^2}{4} \times \sqrt{2 \times 9,81 \times 3} \checkmark$$

$$Q_t = 0,015 m^3 / s \checkmark$$

$$C_D = \frac{Q_A}{Q_t}$$

$$C_D = \frac{0,0125}{0,015} \checkmark$$

$$C_D = 0,83 \checkmark$$

(6)
[20]

QUESTION 6

6.1

- Radial load
- Axial load

(2)

6.2

- Rotational speed
- Bearing load
- Vibration and impact
- Rigidity

(4)

6.3

$$L_{10} = \left(\frac{C_r}{P_r} \right)^p$$

$$\text{For ball bearing } p = \frac{10}{3} \checkmark$$

$$L_{10} = \left(\frac{44,3 \times 10^3}{4100} \right)^{\frac{10}{3}} \checkmark$$

$$L_{10} = 2788,7 \text{ hours} \checkmark$$

(3)

$$6.4 \quad F_r = F_T \times \tan \theta$$

But

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

$$200 \times 10^3 = \frac{2\pi(1100)T}{60} \checkmark$$

$$T = 1736,24 \text{ N.m} \checkmark$$

Also:

$$T = F_T \times \frac{PCD}{2}$$

$$F_T = \frac{T \times 2}{PCD}$$

$$F_T = \frac{1736,24 \times 2}{0,142} \checkmark$$

$$F_T = 24454,1 \text{ N} \checkmark$$

Therefore:

$$F_r = F_T \times \tan \theta$$

$$F_r = 24454,1 \times \tan 20 \checkmark$$

$$F_r = 8,9 \text{ kN} \checkmark$$

(6)
[15]

QUESTION 7

$$\begin{aligned} 7.1 \quad P_o &= \eta \times P_{in} \\ &= 0,7 \times 6000 \checkmark \\ &= 4200 \text{ W} \checkmark \end{aligned}$$

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

$$4200 = \frac{2\pi \times 120 \times T}{60} \checkmark$$

$$T = 334 \text{ Nm} \checkmark$$

$$T = F \times R$$

$$334 = F \times 0,07 \checkmark$$

$$F = 4771,43 \text{ N} \checkmark$$

(6)

- 7.2 $T = F \times R$
 $0,4 \times 40 = F \times 0,007 \checkmark$
 $F = 2285,7N \checkmark$ (2)
- 7.3 7.3.1 $F = \text{cutting.pressure} \times \text{cutting.depth} \times \text{feed / revolution} \checkmark$
 $1400 = \text{cutting.pressure} \times 3 \times 0,65 \checkmark$
 $\text{Cutting.Pressure} = 717,95N / mm^2 \checkmark$ (3)
- 7.3.2 $P = F \times v$
 $P = F \times \frac{\pi \times d \times n}{60}$
 $P = 1400 \times \frac{\pi \times 0,2 \times 110}{60} \checkmark$
 $P_m = 1,613kW \checkmark$ (2)
- 7.3.3 $P_o = \eta \times P_{in}$
 $1613 = 0,65 \times P_{in} \checkmark$
 $P_{in} = 2,482kW \checkmark$ (2)
- [15]

TOTAL: 100