



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N2

1 August 2025

This marking guideline consists of 8 pages.

QUESTION 1: DYNAMICS

1.1 129,6 km/h✓ (1)

1.2 1.2.1
$$a = \frac{v - u}{t}$$
$$= \frac{160 - 0}{6} \checkmark$$
$$= 26,667 \text{ m/s}^2 \checkmark$$
 (2)

1.2.2
$$S = \frac{1}{2}bh + lb + \frac{1}{2}bh$$
$$= \left(\frac{1}{2} \times 6 \times 160\right) \checkmark + (160 \times 6) \times \left(\frac{1}{2} \times 6 \times 160\right) \checkmark$$
$$= 480 + 960 + 480$$
$$= 1\,920 \text{ m} \checkmark$$
 (3)

1.2.3
$$V = \frac{S}{t}$$
$$= \frac{1920}{18} \checkmark$$
$$= 106,667 \text{ m/s} \checkmark$$
 (2)

1.2.4
$$a = \frac{v - u}{t}$$
$$= \frac{0 - 160}{6} \checkmark$$
$$= -26,667 \text{ m/s}^2 \checkmark \text{ OR } a = 26,667 \text{ m/s}^2 \text{ decelerating}$$
 (2)

1.3 1.3.1 Decelerate✓ (1)

1.3.2
$$t = \frac{v - u}{a}$$
$$= \frac{0 - 50}{-9,8} \checkmark$$
$$= 5,102 \text{ s} \checkmark$$
 (2)

1.3.3
$$S = \frac{v^2 - u^2}{2a}$$
$$= \frac{0^2 - 50^2}{2(-9,8)} \checkmark$$
$$= 127,551 \text{ m} \checkmark$$
 (2)

[15]

QUESTION 2: STATICS

- 2.1
- Wheel cross spanner✓
 - Water sprays✓
 - Door handles/knob✓
 - Wingnut spanner
 - Thread cutters
 - Twisting

(Any 3 relevant answers) (3)

- 2.2 2.2.1 Take moments about R

$$\begin{aligned}\sum \downarrow M &= \sum \uparrow M \\ (L \times 4,5) \checkmark &= (65 \times 1,5) + (35 \times 3,5) + (100 \times 5,5) \checkmark \\ 4,5L &= 770 \\ L &= 171,111 \text{ N} \checkmark\end{aligned}$$

Take moments about L

$$\begin{aligned}\sum \downarrow M &= \sum \uparrow M \\ (35 \times 1) + (65 \times 3) \checkmark &= (100 \times 1) + (R \times 4,5) \checkmark \\ 130 &= 4,5R \\ R &= 28,889 \text{ N} \checkmark\end{aligned}$$

(6)

2.2.2

$$\begin{aligned}\sum \uparrow &= \sum \downarrow \\ 171,111 + 28,889 &= 100 + 35 + 65 \checkmark \\ 200 \text{ N} &= 200 \text{ N}\end{aligned}$$

(1)

[10]

QUESTION 3 : ENERGY AND MOMENTUM

- 3.1 Energy is the ability of an object to do work.✓ (1)
- 3.2 3.2.1 $E_p = mgh$
 $= 4 \times 9,8 \times 90$ ✓
 $= 3\,528\,J$ ✓
- 3.2.2 $V = \sqrt{2gh}$
 $= \sqrt{2 \times 9,8 \times 30}$ ✓
 $= 24,249\,m/s$ ✓
- 3.2.3 $E_k = \frac{1}{2}mv^2$
 $= \frac{1}{2} \times 4 \times 24,249^2$ ✓
 $= 1\,176,028\,N$ ✓ accept = 1 176 N (2 × 3) (6)
[7]

QUESTION 4: WORK, POWER AND EFFICIENCY

- 4.1 Joule is the work done when the point of application of a force of one newton✓ moves through a distance of one metre.✓ (2)
- 4.2 Power✓ (1)
- 4.3 4.3.1 $V = 19,444\,m/s$ ✓
- $F = \frac{P}{V}$
 $= \frac{26000}{19,444}$ ✓
 $= 1\,337,173\,N$ ✓ (3)
- 4.3.2 $S = Vt$
 $= 19,444 \times 120$ ✓
 $= 2\,333,333\,m$ ✓ (2)
- 4.3.3 $W = F \times S$
 $= 1\,337,173 \times 2\,333,333$ ✓
 $= 3\,120,071\,kJ$ ✓ (2)
[10]

QUESTION 5: MECHANICAL DRIVES AND LIFTING MACHINES

- 5.1
- No lubrication required✓
 - Fairly quiet/not noisy✓
 - Inexpensive when compared to other drives (Any 2 relevant answers) (2)
- 5.2
- Motorcycles✓
 - Bicycles✓
 - Timing chains of motor cars (Any 2 relevant answers) (2)
- 5.3
- 5.3.1
- $$T_2 = \frac{1}{4} \times T_1$$
- $$= \frac{1}{4} \times 950 \checkmark$$
- $$= 237,5 \text{ N} \checkmark \quad (2)$$
- 5.3.2
- $$F_e = T_1 - T_2$$
- $$= 950 - 237,5$$
- $$= 712,5 \text{ N} \checkmark \quad (1)$$
- 5.3.3
- $$P = F_e \times V$$
- $$= 712,5 \times 15 \checkmark$$
- $$= 10\,687,5 \text{ W} \checkmark \quad (2)$$
- 5.4
- 5.4.1
- $$MA = \frac{L}{E}$$
- $$= \frac{73 \times 9,8}{53} \checkmark$$
- $$= 13,498 \checkmark$$
- 5.4.2
- $$VR = \frac{2D}{d_1 - d_2}$$
- $$= \frac{2(0,35)}{0,2 - 0,15} \checkmark$$
- $$= 14 \checkmark$$
- 5.4.3
- $$\eta = \frac{MA}{VR} \times 100 \%$$
- $$= \frac{13,498}{14} \times 100 \% \checkmark$$
- $$= 96,414 \%$$
- $$\approx 96 \% \checkmark$$
- 5.4.4
- $$W = mgh$$
- $$= 73 \times 9,8 \times 1 \checkmark$$
- $$= 715,4 \text{ J} \checkmark$$

(4 × 2) (8)

QUESTION 6: FRICTION

6.1 6.1.1 $F_s = w \sin \theta$
 $= 32 \times 9,8 \times \sin 15^\circ \checkmark$
 $= 81.166 \text{ N} \checkmark$

6.1.2 $F_c = w \cos \theta$
 $= 32 \times 9,8 \times \cos 15^\circ \checkmark$
 $= 302.914 \text{ N} \checkmark$

6.1.3 $\mu = \frac{F_\mu}{w \cos \theta}$
 $= \frac{118}{302,914} \checkmark$
 $= 0,39 \checkmark$
 Accept 0,3895

6.1.4 $F_{up} = F_\mu + w \sin \theta$
 $= 118 + 302.914 \checkmark$
 $= 420,914 \text{ N} \checkmark$

(4 × 2) (8)

- 6.2
 - Prevents slip between two contact planes ✓
 - Makes movement possible
 - Brings moving objects to standstill
 - Remove materials

(Any 1 relevant answer) (1)
[9]

QUESTION 7: HEAT

7.1 Specific heat capacity is the amount of heat energy ✓ required to raise the temperature of 1 kg of a substance by a temperature of 1 °C or 1 K. ✓ (2)

7.2 $Q = mc\Delta t$
 $= 30 \times 4187 \times (22 - 11) \checkmark$
 $= 1,256 \text{ MJ} \checkmark$ (2)

7.3 $\Delta L = L_o \alpha \Delta t$
 $= 7 \times 17 \times 10^{-6} \times (85 - 15) \checkmark$
 $= 0,00833 \text{ m} \checkmark$ **OR** $= 8,33 \times 10^{-3} \text{ m} \checkmark$ **OR** $= 8,33 \text{ mm} \checkmark$
 $L_f = 8.33 + 0,007$
 $= 8,337 \text{ mm} \checkmark$ **OR** $= 8,337 \times 10^{-3} \text{ m} \checkmark$ (3)

- 7.4
- To heat buildings✓
 - To sterilise utensils✓
 - To cook✓
 - To generate electricity
 - To clean dirty components
- (Any 3 applicable answers) (3)
- 7.5 Saturation temperature is the temperature at which liquid boils at a given pressure.✓ (1)
- [11]

QUESTION 8: PARTICLE STRUCTURE OF MATTER

- 8.1
- | | |
|-------|--------|
| 8.1.1 | False✓ |
| 8.1.2 | True✓ |
| 8.1.3 | True✓ |
| 8.1.4 | False✓ |
| 8.1.5 | True✓ |
- (5 × 1) (5)
- 8.2
- Painting✓
 - Lubricating/Oiling✓
 - Galvanizing✓
 - Coating/Anodising
 - Electroplate
 - Cathodic protection
 - Removing moisture/water
- (Any 3 relevant answers) (3)
- [8]

QUESTION 9: ELECTRICITY

- 9.1 In an electrical circuit, the current flowing in a circuit is directly proportional to the voltage✓ and inversely proportional to the resistance.✓ (2)
- 9.2
- $$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$
- $$\frac{1}{2,5} = \frac{1}{5} + \frac{1}{R_2}$$
- $$\frac{1}{2,5} - \frac{1}{5} = \frac{1}{R_2}✓$$
- $$\frac{1}{R_2} = \frac{1}{5}✓$$
- $$R_2 = 5\Omega✓$$
- (3)

- 9.3
- Length✓ – directly proportional to the resistance✓
 - Cross-sectional area✓ – indirectly proportional to the resistance✓
 - Resistivity – directly proportional to the resistance
 - Temperature – directly proportional to the resistance
- (Any 2 relevant effects or examples) (4)
- 9.4
- Generating electrical energy✓
 - Increasing or decreasing voltage✓
 - Heat objects
 - Electromagnetic braking
- (Any 2 relevant answers) (2)
- 9.5
- Transformer✓
 - Electric motors✓
 - Generators
 - Induction cookers
- (Any 2 relevant answers) (2)
- [13]
- TOTAL: 100**