



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N2

22 November 2024

This marking guideline consists of 8 pages.

QUESTION 1: DYNAMICS

- 1.1 1.1.1 Acceleration is the rate of change✓ in velocity.✓
 1.1.2 Speed is the rate✓ at which distance is covered.✓
 (2 × 2) (4)
- 1.2 1.2.1 $a = \frac{v - u}{t}$
 $= \frac{15 - 5}{30} \checkmark$
 $= 0,333 \text{ m/s}^2 \checkmark$ (2)
- 1.2.2 $S = lb + \frac{1}{2}bh$ OR $S = \left(\frac{15 + 5}{2}\right) 30 \checkmark = 300m \checkmark$
 $= (30 \times 5) + \left(\frac{1}{2} \times 30 \times 10\right) \checkmark$
 $= 300 \text{ m} \checkmark$ (2)
- 1.2.3 $S = A_1 + A_2$
 $= 300 + (20 \times 15)$
 $= 600 \text{ m} \checkmark$
 $V = \frac{s}{t}$
 $= \frac{600}{50} \checkmark$
 $= 12 \text{ m/s} \checkmark$ (3)
- 1.3 1.3.1 $t = \frac{v - u}{a}$
 $= \frac{41,667 - 0}{12} \checkmark$
 $= 3,472 \text{ s} \checkmark$
- 1.3.2 $S = \frac{v^2 - u^2}{2a}$
 $S = \frac{41,667^2 - 0^2}{2(12)} \checkmark$
 $= 72,339 \text{ m} \checkmark$ accept 72.338m
 (2 × 2) (4)
[15]

QUESTION 2: STATICS

- 2.1
- Tap wrench
 - Torque wrench
 - Cross wheel spanner
 - Water spray
 - Door handle
 - Wingnut spanner
 - Thread cutters
- (Any 2 × 1) (2)
- 2.2 For every action✓ there is an equal reaction in the opposite direction.✓ (2)
- 2.3 Take moments about L
 $\Sigma \curvearrowright M = \Sigma \curvearrowleft M$
 $(30 \times 3) + (55 \times 6) = (R \times 7) + (90 \times 1) \checkmark \checkmark$
 $7R = 330$
 $R = 47,143 \text{ N} \checkmark$
- Take moments about R
 $\Sigma \curvearrowright M = \Sigma \curvearrowleft M$
 $(L \times 7) = (90 \times 8) + (30 \times 4) + (55 \times 1) \checkmark \checkmark$
 $7L = 895$
 $L = 127,857 \text{ N} \checkmark$
- (6)
[10]

QUESTION 3: ENERGY AND MOMENTUM

- 3.1 Kinetic energy is the energy an object possesses:
 - Due to its motion✓
 - Due to its mass and velocity✓
(Any 1 × 1) (1)
- 3.2 3.2.1 $S = ut + \frac{1}{2}gt^2$
 $= (0 \times 2,5) + \frac{1}{2}(9,8)(2,5)^2 \checkmark$
 $= 30,625\text{m} \checkmark$
- 3.2.2 $v^2 = u^2 + 2gh$ **OR** $v = u + gt$
 $v = \sqrt{2 \times 9,8 \times 30,625} \checkmark$ $= 0 + 9,8 \times 2,5 \checkmark$
 $= 24,5\text{m/s} \checkmark$ $= 24,5 \text{ m/s} \checkmark$
- 3.2.3 $P = mv$
 $= 20 \times 24,5 \checkmark$
 $= 490 \text{ kg.m/s} \checkmark$
- (3 × 2)

QUESTION 4: WORK, POWER AND EFFICIENCY

4.1 Power is the rate at which work is done. (1)

4.2 4.2.1
$$W = \frac{445}{15}$$

$$= 29,667 \text{ N/m} \checkmark$$
 (1)

4.2.2
$$W = F_{ave} \times S$$

$$= \left(1000 + \frac{0 + 445}{2} \right) \times 15 \checkmark \checkmark$$

$$= 18337,5 \text{ J} \checkmark$$
 OR

$$W = lb + \frac{1}{2}bh$$

$$= (1000 \times 15) + \left(\frac{1}{2} \times 15 \times 445 \right) \checkmark \checkmark$$

$$= 18337,5 \text{ J} \checkmark$$
 (3)

4.2.3
$$P = F_{ave} \times V$$

$$= \left(1000 + \frac{0 + 445}{2} \right) \times 5 \checkmark$$

$$= 6112,5 \text{ W} \checkmark$$
 OR

$$t = \frac{S}{V} \quad P = \frac{W}{t}$$

$$= \frac{15}{5} \quad = \frac{18337,5}{3} \checkmark$$

$$= 3 \text{ s} \quad = 6112,5 \text{ W} \checkmark$$

(2)

4.3 4.3.1
$$T_r = 30 \text{ N/t} \times 250 \text{ t}$$

$$= 7500 \text{ N} \checkmark$$
 (1)

4.3.2
$$P = FV$$

$$= 7500 \times 15 \checkmark$$

$$= 112500 \text{ W} \checkmark$$
 (2)

[10]

QUESTION 5: MECHANICAL DRIVES AND LIFTING MACHINES

5.1 $P_{ab} = P_g + P_a = 400 + 101.3 = 501.3 \text{ kPa} \checkmark$ (1)

5.2 $P = \frac{F}{A} = \frac{1450 \times 9.8 \times 4}{\pi \times 0.35^2} \checkmark = 147.696 \text{ kPa} \checkmark$ (2)

5.3 5.3.1
$$\begin{aligned} T_2 &= \frac{T_1}{3} \\ &= \frac{642}{3} \checkmark \\ &= 214 \text{ N} \checkmark \end{aligned}$$

5.3.2
$$\begin{aligned} F_e &= T_1 - T_2 \\ &= 642 - 214 \checkmark \\ &= 428 \text{ N} \checkmark \end{aligned}$$

5.3.3
$$\begin{aligned} V &= \pi D N \\ &= \pi (0.15) \left(\frac{200}{60} \right) \checkmark \\ &= 1.571 \text{ m/s} \checkmark \end{aligned}$$

5.3.4
$$\begin{aligned} P &= F_e V \checkmark \\ &= 672,301 \text{ W} \checkmark \end{aligned}$$

(4 × 2) (8)

5.4 5.4.1
$$\begin{aligned} E &= \frac{L}{MA} \\ &= \frac{300 \times 9.8}{5} \checkmark \\ &= 588 \text{ N} \checkmark \end{aligned}$$
 (2)

$$\begin{aligned}
 5.4.2 \quad \eta &= \frac{MA}{DR} \times 100\% \\
 DR &= MA \times \frac{100}{\eta} \\
 &= 5 \times \frac{100}{25} \checkmark \\
 &= 20 \checkmark \\
 DR &= \frac{2D}{D-d} \\
 d &= \frac{(D \times DR) - 2D}{DR} \\
 d &= \frac{(0,5 \times 20) - 2(0,5)}{20} \checkmark \\
 &= 0,45 \text{ m} \checkmark
 \end{aligned}$$

(4)
[17]

QUESTION 6: FRICTION

6.1 Kinetic friction is the frictional force applicable on a moving object. (1)

- 6.2
- Makes movement possible.
 - Prevents slip.
 - Brings moving parts to a standstill.
 - Removes unwanted materials.
- (Any 2 × 1) (2)

6.3

$$\begin{aligned}
 F_{down} &= F_{\mu} - w \sin \theta \\
 &= 200 - (11 \times 9,8 \times \sin 35^\circ) \checkmark \\
 &= 138,168 \text{ N} \checkmark
 \end{aligned}$$

(2)

6.4 6.4.1

$$\mu = \frac{F}{N}$$

$$\mu = \frac{30}{176,4} \checkmark = 0,17 \checkmark$$

$$\tan \phi = \mu$$

6.4.2

$$\begin{aligned}
 \phi &= \tan^{-1} 0,17 \checkmark \\
 \phi &= 9,652^\circ \checkmark
 \end{aligned}$$

(2 × 2) (4)
[9]

QUESTION 7: HEAT

- 7.1 7.1.1 False
 7.1.2 False
 7.1.3 True
(3 × 1) (3)
- 7.2 $Q = mc\Delta t$
 $= \frac{5}{1000} \times 1025 \times 3850 \times (90 - (-1.8)) \checkmark$
 $= 1811328.75\text{J} \checkmark$
(2)
- 7.3 $Q_{\text{lost}} = Q_{\text{gained}}$
 $mc\Delta t = mc\Delta t$
 $m \times 500 \times (130 - 65) = 4,5 \times 4187 \times (65 - 12) \checkmark \checkmark$
 $m = 30,726 \text{ kg} \checkmark$
(3)
- 7.4 $\alpha = \frac{\Delta L}{L_o \Delta t}$
 $= \frac{15}{25000 \times (36 - 17)} \checkmark \checkmark$
 $31,578 \times 10^{-6} / ^\circ\text{C} \checkmark$ OR $0,000031578 / ^\circ\text{C}$
(3)
[11]

QUESTION 8: PARTICLE STRUCTURE OF MATTER

- 8.1 8.1.1
 - A compound is a substance made of two or more elements chemically bonded to one another. ✓
 - A compound is a substance formed when two or more chemical elements are chemically bonded together. ✓
 - A compound is a chemical species that is formed when two or more atoms join together chemically with covalent or ionic bonds. ✓(Any 1 × 1)
- 8.1.2 An ion is an atom that has gained or lost an electron.
- 8.1.3 Electroplating is the covering of one metal with a thin layer of another metal using an electric current.
- 8.1.4 An atom is the smallest part of an element.
(4 × 1) (4)
- 8.2
 - Protons – positive
 - Electrons- negative
 - Neutron – neutral
 - Nucleus -positive(4)
[8]

QUESTION 9 : ELECTRICITY

- 9.1 Potential difference is the difference in the amount of energy✓ that a charge carries between two points in a circuit.✓ (2)
- 9.2 9.2.1 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_1} + \frac{1}{R_1}$
 $\frac{1}{9} = \frac{3}{R_1} \checkmark$
 $R_1 = 27 \Omega \checkmark$
 $\therefore$ The resistance in each resistor is equal to 27 Ω .
- 9.2.2 $I_T = I_1 + I_2 + I_3$
 $= 0,5 \times 3 \checkmark$
 $= 1,5 \text{ A} \checkmark$
- 9.2.3 $V = IR$ OR $V = IR$
 $= 1,5 \times 9 \checkmark$ $= 0,5 \times 27 \checkmark$
 $V = 13,5 \text{ V} \checkmark$
(3 × 2) (6)
- 9.3
 - Generators
 - Transformers
 - Electric motors (Any 1 × 1) (1)
- 9.4
 - Resistivity
 - Length
 - Cross-sectional area
 - Temperature (4)
[13]
- TOTAL: 100**