



**higher education  
& training**

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

# **MARKING GUIDELINE**

**NATIONAL CERTIFICATE**

**ENGINEERING SCIENCE N2**

**24 November 2023**

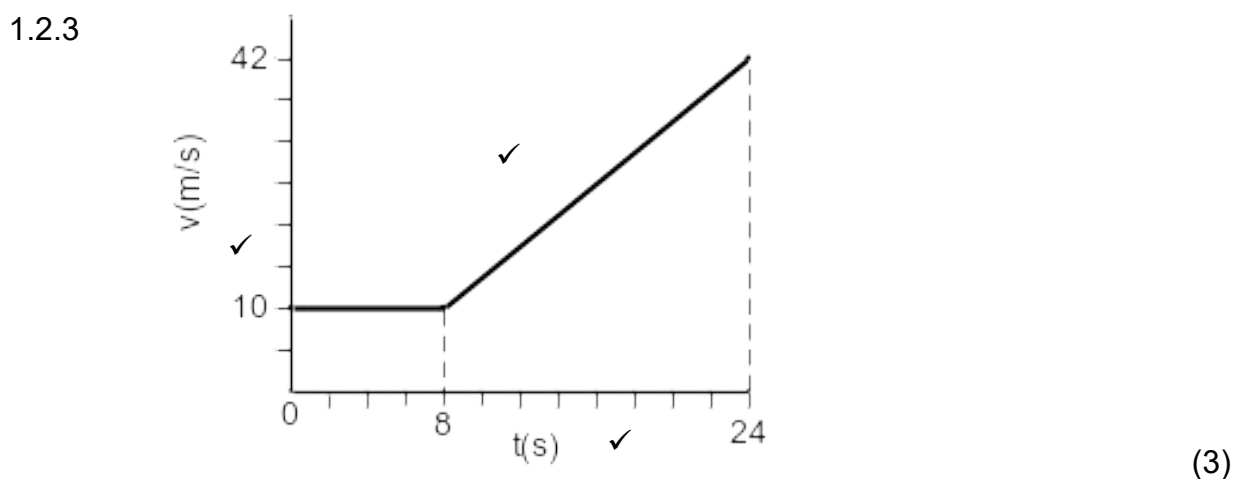
**This marking guideline consists of 7 pages.**

**QUESTION 1**

1.1 Acceleration is the rate of change in velocity. (1)

1.2 1.2.1  $u = \frac{36}{3.6} = 10 \text{ m/s}$  (1)

1.2.2  $V = u + at$   
 $\hookrightarrow 10 + 2(16) \checkmark$   
 $\hookrightarrow 42 \text{ m/s} \checkmark$  (2)



1.2.4  $S = lb + \frac{1}{2}bh$  OR  $S \hookrightarrow (10 \times 8) + \left(\frac{42+10}{2}\right) \times 16 \checkmark$   
 $\hookrightarrow (24 \times 10) + \left(\frac{1}{2} \times 16 \times 32\right) \checkmark \hookrightarrow 496 \text{ m} \checkmark$   
 $\hookrightarrow 240 + 256$   
 $\hookrightarrow 496 \text{ m} \checkmark$  (2)

1.2.5  $V = \frac{s}{t} \hookrightarrow \frac{496}{24} \checkmark \hookrightarrow 20,667 \text{ m/s} \checkmark$  (2)

1.3 1.3.1  $a = \frac{V-u}{t} \hookrightarrow \frac{25-30}{0,5} \checkmark \hookrightarrow -10 \text{ m/s}^2 \checkmark$

1.3.2  $S = ut + \frac{1}{2}at^2$   
 $\hookrightarrow 30(0,5) + \frac{1}{2}(-10) \hookrightarrow \checkmark$   
 $\hookrightarrow 13,75 \text{ m} \checkmark$

**OR**

$$S = \frac{V^2 - u^2}{2a} \quad \text{OR} \quad S = \left(\frac{V+u}{2}\right) \times t$$

$$\hookrightarrow \frac{25^2 - 30^2}{2(-10)} \quad \hookrightarrow \left(\frac{25+30}{2}\right) \times 0,5$$

$$13,75 \text{ m} \quad \hookrightarrow 13,75 \text{ m}$$

(2 × 2) (4)  
[15]

## QUESTION 2

- 2.1
- The algebraic sum of the forces in any direction is equal to zero.
  - The algebraic sum of the moments of forces about any point is equal to zero.
- (2)

- 2.2
- 2.2.1 adjacent sides
- 2.2.2 resultant
- 2.2.3 diagonal
- (3 × 1) (3)

- 2.3
- 2.3.1  $F = 90 \sin 45^\circ \checkmark$   
 $\hookrightarrow 63,64 \text{ N} \checkmark$
- (2)

- 2.3.2 Take moments about R  
 $\square \downarrow M = \square \downarrow M$
- $124,728 \times (7+x) = (80 \times 7) + (140 \times 4) + (63,64 \times 2) \checkmark$   
 $124,728 x = 374,184 \checkmark$   
 $x = 3 \text{ m} \checkmark$
- (3)  
[10]

## QUESTION 3

- 3.1  $E_p = mgh$   
 $\hookrightarrow 0,3 \times 9,8 \times 11 \checkmark$   
 $\hookrightarrow 32,34 \text{ J} \checkmark$
- (2)

- 3.2  $V = \sqrt{2gh}$   
 $\hookrightarrow \sqrt{2 \times 9,8 \times 5}$   
 $\hookrightarrow 9,899 \text{ m/s} \checkmark$
- $\therefore E_k = \frac{1}{2} m v^2$   
 $\hookrightarrow \frac{1}{2} \times 0,3 \times (9,899)^2$   
 $\hookrightarrow 14,699 \text{ J} \checkmark$
- (2)

- 3.3  $V = \sqrt{2 \times 9,8 \times 11} = 14,683 \text{ m/s} \quad V$   
 $\hookrightarrow u + \hookrightarrow \checkmark$   
 $14,683 = 0 + 9,8t \checkmark$   
 $t = 1,498 \text{ s} \checkmark$
- (3)  
[7]

**QUESTION 4**

4.1 Torque is the product of force and the perpendicular radius to the line of action. (1)

4.2 4.2.1  $F = w \sin \theta$   
 $\hookrightarrow 1000 \times 9,8 \times \sin 20^\circ \checkmark$   
 $\hookrightarrow 3351,797 \text{ N} \checkmark$  (2)

4.2.2  $S = vt$   
 $\hookrightarrow 15 \times 8$   
 $\hookrightarrow 120 \text{ m} \checkmark$   
 $W = F \times S$   
 $\hookrightarrow 3351,797 \times 120 \checkmark$   
 $\hookrightarrow 402215,64 \text{ J} \checkmark$  **OR** 402215.689J (using F as in equation 4.2.1) (3)

4.2.3  $P = FV$   
 $\hookrightarrow 3351,797 \times 15 \checkmark$   
 $\hookrightarrow 50276,955 \text{ W} \checkmark$   
**OR**  
 $P = \frac{W}{t}$   
 $\hookrightarrow \frac{402215,955}{8}$   
 $\hookrightarrow 50276,955 \text{ W} \text{ OR } 50276.961 \text{ W}$  (2)

4.3  $T = F \times r$   $r = 0,175 \text{ m}$   
 $\hookrightarrow 1650 \times 0,175 \checkmark$   
 $\hookrightarrow 288,75 \text{ N}\cdot\text{m} \checkmark$  (2)  
**[10]**

**QUESTION 5**

5.1

- Gear drives are noisy
- They are subjected to wear and tear
- Lubrication is required
- Resistance to shock is poor
- Fairly expensive to produce

1) (Any 3 × (3)

5.2 5.2.1  $N_A \cdot T_A = N_B \cdot T_B$   
 $N_B = \frac{11 \times 45}{90} \checkmark$

5,5 r/s ✓

5.2.2

$$VR = \frac{N_A}{N_B}$$

$$\hookrightarrow \frac{11}{5,5} \checkmark$$

$$\hookrightarrow 2 \checkmark$$

(2 × 2) (4)

5.3

5.3.1

$$L = MA \times E$$

$$\hookrightarrow 20 \times 800 \checkmark$$

$$= 16000 \text{ N} \checkmark$$

5.3.2

$$DR = MA \times \frac{100}{\eta}$$

$$\hookrightarrow 20 \times \frac{100}{75} \checkmark$$

$$\hookrightarrow 26,667 \checkmark$$

5.3.3

$$DR = \frac{2S}{S-s}$$

$$26,667(30-s) = 2(30) \checkmark$$

$$s = 27,75 \approx 28 \checkmark$$

(2 × 3) (6)

5.4

Pascal is the pressure that results when a force of 1 N is applied evenly and perpendicular to an area of 1 m<sup>2</sup>.

(1)

5.5

- Density
- Gravitational acceleration
- Depth of the liquid

(3)  
[17]**QUESTION 6**

6.1

Friction is the force that resists motion between two surfaces that are in contact.

(1)

6.2

6.2.1

$$F_c = w \cos \theta$$

$$\hookrightarrow 784 \times \cos 23^\circ \checkmark$$

$$\hookrightarrow 721,676 \text{ N} \checkmark$$

6.2.2

$$F_s = w \sin \theta$$

$$\hookrightarrow 784 \times \sin 23^\circ \checkmark$$

$$\hookrightarrow 306,333 \text{ N} \checkmark$$

6.2.3

$$F_\mu = \mu \times w \cos \theta$$

$$\hookrightarrow 0,3 \times 721,676 \checkmark$$

$$\hookrightarrow 216,503 \text{ N} \checkmark$$

6.2.4

$$F_{up} = F_\mu + w \sin \theta$$

$$\hookrightarrow 216,503 + 306,333 \checkmark$$

$$\hookrightarrow 522,836 \text{ N} \checkmark$$

(4 × 2) (8)

**QUESTION 7**

- 7.1 Thermometer (1)
- 7.2
- Original length
  - Type of material (coefficient of linear expansion)
  - Change in temperature (3)
- 7.3  $Q = mc\Delta t$   
 $\hookrightarrow 500 \times 4187 \times (90 - 8) \checkmark$   
 $\hookrightarrow 171667000 \text{ J} \checkmark$
- $$m = \frac{Q}{h_v}$$
- $$\hookrightarrow \frac{171,667}{30}$$
- $$\hookrightarrow 5,722 \text{ kg} \checkmark$$
- (3)
- 7.4 7.4.1  $\Delta t = t_2 - t_1$   
 $\hookrightarrow 36,7 - 13$   
 $\hookrightarrow 23,7 \text{ }^\circ\text{C} \checkmark$  (1)
- 7.4.2  $\Delta h = h_o \alpha \Delta t$   
 $\hookrightarrow 2200 \times 0,000012 \times 23,7 \checkmark$   
 $\hookrightarrow 0,626 \text{ mm} \checkmark$  (2)
- 7.4.3  $h_f = \Delta h + h_o$   
 $\hookrightarrow 0,626 + 2200$   
 $\hookrightarrow 2200,626 \text{ mm} \checkmark$  (1)
- [11]**

**QUESTION 8**

- 8.1 8.1.1 False – the phenomenon is called dissociation.  
 8.1.2 True – an atom that has gained electron is known as anion (negative ion).  
 8.1.3 True – protons (positive) and neutrons (neutral) in the nucleus makes it to be positively charged.  
 8.1.4 False – distilled water has a high resistance as it has no ion, so is classified as insulator. (4 × 1) (4)
- 8.2 Negative charge (1)
- 8.3
- For aesthetic reasons
  - To prevent tarnishing
  - To increase thickness
  - To protect barriers (3)

- To prevent friction
  - To conduct electricity
- 1)

(Any 3 ×

**[8]****QUESTION 9**

9.1

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{6} \checkmark$$

$$\frac{1}{R_p} = \frac{8}{12}$$

$$R_p = 1,5 \, \Omega \checkmark$$

(2)

9.2

$$R_s = 3 + 4$$

$$7 \, \Omega \checkmark$$

$$\frac{1}{R_p} = \frac{1}{7} + \frac{1}{32} \checkmark$$

$$\frac{1}{R_p} = \frac{39}{244}$$

$$R_p = 5,744 \, \Omega$$

$$\therefore R_t = 5,744 \, \Omega \checkmark$$

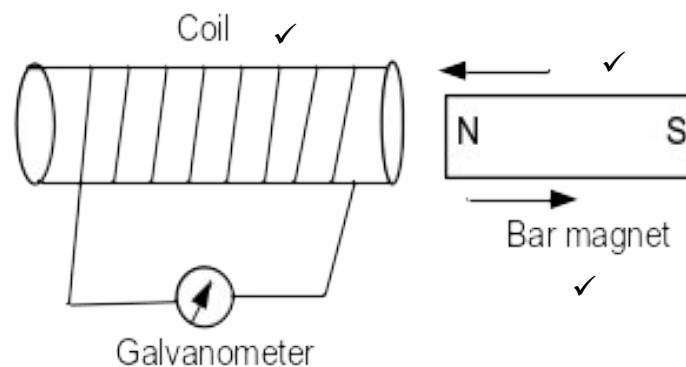
(3)

- 9.3
- Resistivity
  - Length
  - Cross-sectional area
  - Temperature
- 1)

(Any 2 ×

(2)

9.4



(3)

- 9.5
- Transformers
  - Electric motors
  - Generators

(Any 2 × 1)

(2)

9.6 Self-induction is the property of a coil to induce an electromotive force in itself as a result of the magnetic coupling between the windings.

(1)

