



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N2

24 November 2023

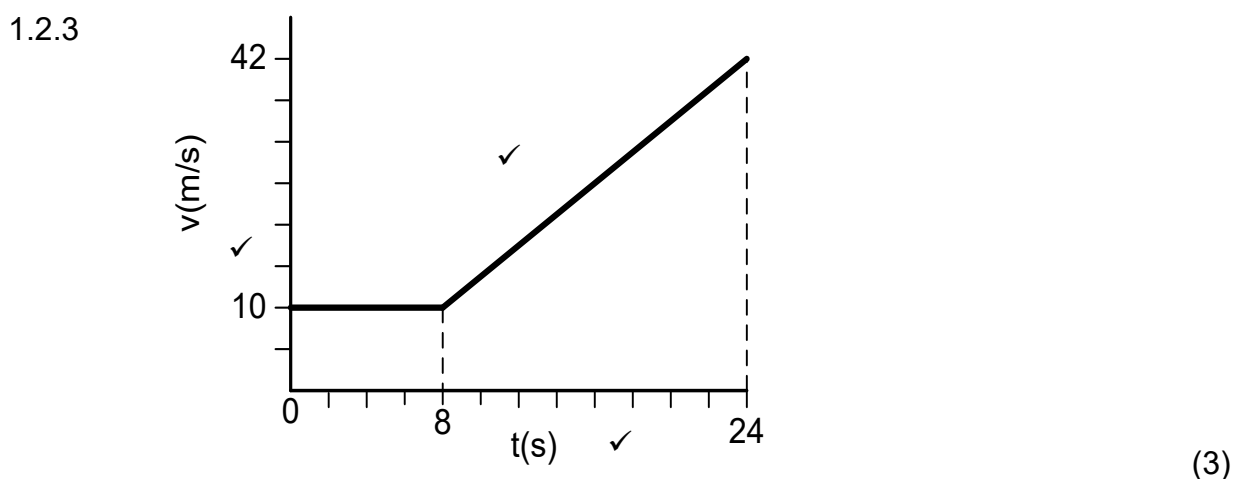
This marking guideline consists of 7 pages.

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



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

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

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

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

OR

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

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

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

(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 $F = 90 \sin 45^\circ \checkmark$
 $= 63,64 \text{ N} \checkmark$ (2)
- 2.3.2 Take moments about R
 $\sum \downarrow M = \sum \uparrow M$
- $124,728 \times (7 + x) = (80 \times 7) + (140 \times 4) + (63,64 \times 2) \checkmark$
 $124,728x = 374,184 \checkmark$
 $x = 3 \text{ m} \checkmark$ (3)
- [10]**

QUESTION 3

- 3.1 $E_p = mgh$
 $= 0,3 \times 9,8 \times 11 \checkmark$
 $= 32,34 \text{ J} \checkmark$ (2)
- 3.2 $V = \sqrt{2gh}$
 $= \sqrt{2 \times 9,8 \times 5}$
 $= 9,899 \text{ m/s} \checkmark$
- $\therefore E_k = \frac{1}{2}mv^2$
 $= \frac{1}{2} \times 0,3 \times (9,899)^2$
 $= 14,699 \text{ J} \checkmark$ (2)
- 3.3 $V = \sqrt{2 \times 9,8 \times 11} = 14,683 \text{ m/s}$
 $V = u + gt \checkmark$
 $14,683 = 0 + 9,8t \checkmark$
 $t = 1,498 \text{ s} \checkmark$ (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 $F = w \sin \theta$
 $= 1000 \times 9,8 \times \sin 20^\circ \checkmark$
 $= 3351,797 \text{ N} \checkmark$ (2)

4.2.2 $S = vt$
 $= 15 \times 8$
 $= 120\text{m} \checkmark$

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

4.2.3 $P = FV$
 $= 3351,797 \times 15 \checkmark$
 $= 50276,955 \text{ W} \checkmark$

OR
 $P = \frac{W}{t}$
 $= \frac{402215,955}{8}$
 $= 50276,955\text{W}$ **OR** 50276.961W (2)

4.3 $T = F \times r$ $r = 0,175\text{m}$
 $= 1650 \times 0,175 \checkmark$
 $= 288,75 \text{ N}\cdot\text{m} \checkmark$ (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
- (Any 3 × 1) (3)

5.2 5.2.1 $N_A \cdot T_A = N_B \cdot T_B$
 $N_B = \frac{11 \times 45}{90} \checkmark$
 $= 5,5 \text{ r/s} \checkmark$

- 5.2.2
$$VR = \frac{N_A}{N_B}$$

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

$$= 2 \checkmark$$
 (2 × 2) (4)
- 5.3 5.3.1
$$L = MA \times E$$

$$= 20 \times 800 \checkmark$$

$$= 16000 \text{ N} \checkmark$$
- 5.3.2
$$DR = MA \times \frac{100}{\eta}$$

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

$$= 26,667 \checkmark$$
- 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 m². (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
$$F_c = w \cos \theta$$

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

$$= 721,676 \text{ N} \checkmark$$
- 6.2.2
$$F_s = w \sin \theta$$

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

$$= 306,333 \text{ N} \checkmark$$
- 6.2.3
$$F_\mu = \mu \times w \cos \theta$$

$$= 0.3 \times 721,676 \checkmark$$

$$= 216,503 \text{ N} \checkmark$$
- 6.2.4
$$F_{up} = F_\mu + w \sin \theta$$

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

$$= 522,836 \text{ N} \checkmark$$
 (4 × 2) (8)
[9]

QUESTION 7

- 7.1 Thermometer (1)
- 7.2
- Original length
 - Type of material (coefficient of linear expansion)
 - Change in temperature
- (3)
- 7.3 $Q = mc\Delta t$
 $= 500 \times 4187 \times (90 - 8) \checkmark$
 $= 171667000 \text{ J} \checkmark$
- $$m = \frac{Q}{h_v}$$
- $$= \frac{171,667}{30}$$
- $$= 5,722 \text{ kg} \checkmark$$
- (3)
- 7.4 7.4.1 $\Delta t = t_2 - t_1$
 $= 36,7 - 13$
 $= 23,7 \text{ } ^\circ\text{C} \checkmark$ (1)
- 7.4.2 $\Delta h = h_o \alpha \Delta t$
 $= 2200 \times 0,000012 \times 23,7 \checkmark$
 $= 0,626 \text{ mm} \checkmark$ (2)
- 7.4.3 $h_f = \Delta h + h_o$
 $= 0,626 + 2200$
 $= 2200,626 \text{ mm} \checkmark$ (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
 - To prevent friction
 - To conduct electricity
- (Any 3 × 1) (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
$$R_s = 3 + 4$$

$$= 7 \, \Omega \checkmark$$

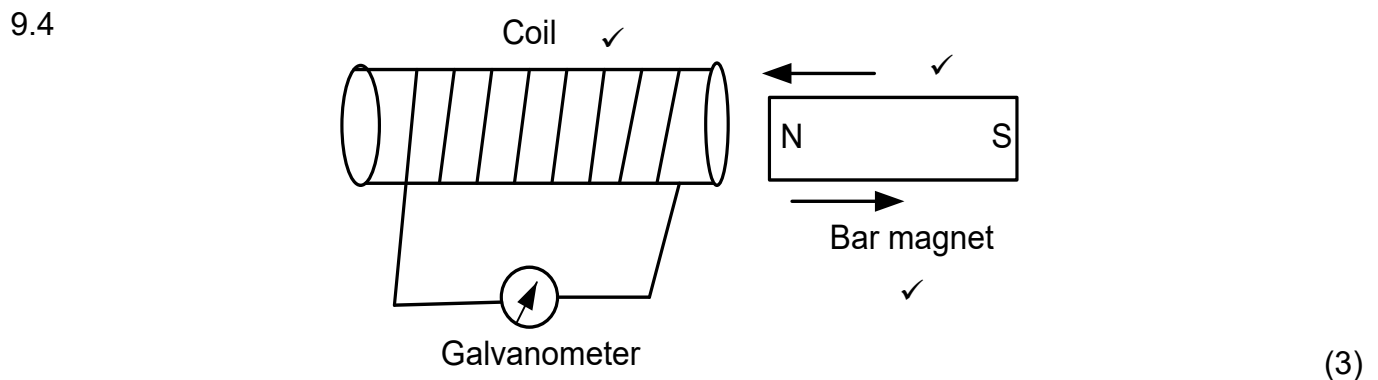
$$\frac{1}{R_p} = \frac{1}{7} + \frac{1}{32} \checkmark$$

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

$$R_p = 5.744 \, \Omega$$

$$\therefore R_t = 5,744 \, \Omega \checkmark$$
 (3)

- 9.3
- Resistivity
 - Length
 - Cross-sectional area
 - Temperature
- (Any 2 × 1) (2)



- 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)
[13]
TOTAL: 100