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.

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QUESTION 1

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

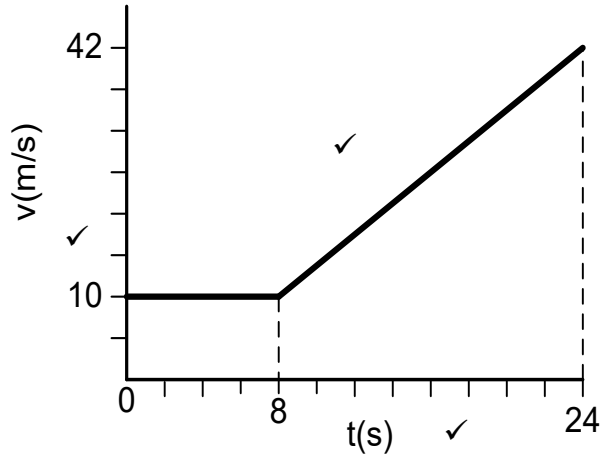
1.2 1.2.1 $u = \frac{36}{3.6} = 10$ m/s (1)

1.2.2 $V = u + at$

$= 10 + 2(16)$ ✓

$= 42$ m/s ✓ (2)

1.2.3



(3)

1.2.4 $S = lb + \frac{1}{2}bh$

$= (24 \times 10) + \left(\frac{1}{2} \times 16 \times 32\right)$ ✓

$= 240 + 256$

$= 496$m ✓

OR $S = (10 \times 8) + \left(\frac{42+10}{2}\right) \times 16$✓

=496m✓ (2)

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

1.3 1.3.1 $a = \frac{V-u}{t} = \frac{25-30}{0{,}5}$ ✓ $= -10$ m/s² ✓

1.3.2 $S = ut + \frac{1}{2}at^2$

$= 30(0{,}5) + \frac{1}{2}(-10)(0{,}5)^2$ ✓

$= 13.75$m ✓

OR

$S = \frac{V^2-u^2}{2a}$

$= \frac{25^2-30^2}{2(-10)}$

13.75 m

OR

$S = \left(\frac{V+u}{2}\right) \times t$

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

$= 13.75$ 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 $F = 90\ sin\ 45^0$ ✓
$= 63{,}64$ N ✓ (2)

2.3.2 Take moments about R
$\Sigma \circlearrowleft M = \Sigma \circlearrowright M$

$124{,}728 \times (7 + x) = (80 \times 7) + (140 \times 4) + (63{,}64 \times 2)$ ✓
$124{,}728x = 374{,}184$✓
$x = 3$ m✓ (3)
[10]

QUESTION 3

3.1 $E_P = mgh$
$= 0{,}3 \times 9{,}8 \times 11$✓
$= 32{,}34$J✓ (2)

3.2 $V = \sqrt{2gh}$
$= \sqrt{2 \times 9{,}8 \times 5}$
$= 9{,}899$ m/s✓

$\therefore E_k = \frac{1}{2}mv^2$
$= \frac{1}{2} \times 0{,}3 \times (9{,}899)^2$
$= 14{,}699$J✓ (2)

3.3 $V = \sqrt{2 \times 9{,}8 \times 11} \quad = 14.683 m/s$
$V = u + gt$ ✓
$14.683 = 0 + 9.8t$ ✓
$t = 1.498\ s$ ✓ (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
$F = w \sin\theta$
$= 1000 \times 9{,}8 \times \sin 2\,0^0$ ✓
$= 3351{,}797$ N ✓ (2)

4.2.2
$S = vt$
$= 15 \times 8$
$= 120$m ✓

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

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

OR

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

4.3 $T = F \times r$ $r = 0{,}175m$
$= 1650 \times 0{,}175$ ✓
$= 288{,}75$ N·m ✓ (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
$N_A \,.\, T_A = N_B \,.\, T_B$
$N_B = \frac{11 \times 45}{90}$ ✓
$= 5{,}5$ r/s ✓

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 m^2. (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 $$F_c = w \cos\theta$$
$$= 784 \times cos\, 2\, 3^0 \checkmark$$
$$= 721,676 \text{ N} \checkmark$$

6.2.2 $$F_s = w \sin\theta$$
$$= 784 \times sin\, 2\, 3^0 \checkmark$$
$$= 306,333 \text{ N} \checkmark$$

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 $Q = mc\Delta t$
$= 500 \times 4187 \times (90 - 8)$ ✓
$= 171667000$ J✓

$m = \frac{Q}{h_v}$
$= \frac{171,667}{30}$
$= 5,722$ kg ✓
(3)

7.4 7.4.1 $\Delta t = t_2 - t_1$
$= 36,7 - 13$
$= 23,7\ ^0$C ✓ (1)

7.4.2 $\Delta h = h_o \alpha \Delta t$
$= 2200 \times 0,000012 \times 23,7$ ✓
$= 0,626$ mm ✓ (2)

7.4.3 $h_f = \Delta h + h_o$
$= 0,626 + 2200$
$= 2200,626$ mm ✓ (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
$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$
$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{6}$ ✓
$$\frac{1}{R_p} = \frac{8}{12}$$
$R_p = 1{,}5\ \Omega$ ✓ (2)

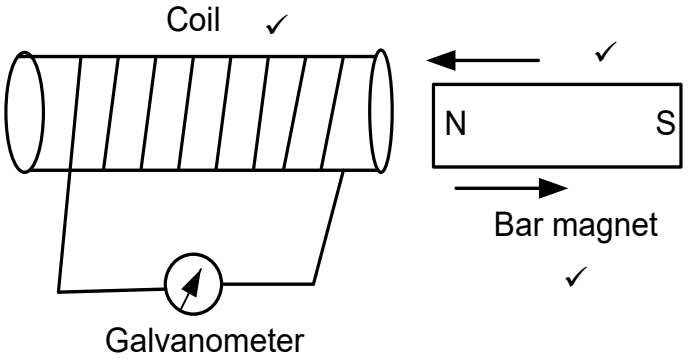
9.2
$R_s = 3 + 4$
$= 7\ \Omega$ ✓

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

$$\frac{1}{R_p} = \frac{39}{244}$$
$R_p = 5.744\ \Omega$
$\therefore R_t = 5{,}744\ \Omega$ ✓ (3)

9.3
- Resistivity
- Length
- Cross-sectional area
- Temperature (Any 2 × 1) (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)
[13]
TOTAL: 100

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