



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N2

3 April 2024

This marking guideline consists of 10 pages.

QUESTION 1: DYNAMICS

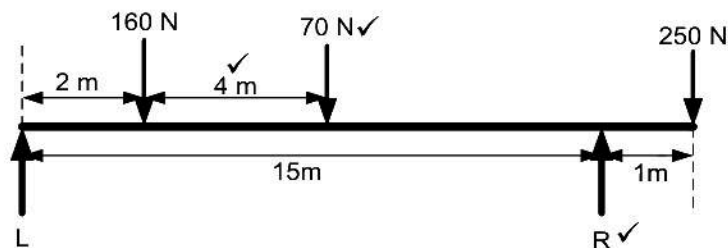
- 1.1 A scalar quantity has magnitude only, while a vector quantity has both magnitude and direction. (2)
- 1.2 Velocity is the rate of change in displacement. (1)
- 1.3 1.3.1 $v = \frac{s}{t}$
 $= \frac{160}{8} \checkmark$
 $= 20 \text{ m/s} \checkmark$ (2)
- 1.3.2 No movement/Stationary/Zero displacement (1)
- 1.3.3 Distance = $160 + 160 + 80$
 $= 400 \text{ m} \checkmark$ (1)
- 1.3.4 Displacement = $80 \text{ m} \checkmark$ in the opposite direction $\checkmark$ (2)
- 1.4 $S = ut + \frac{1}{2}at^2$
 $= (3 \times 5) \checkmark + \frac{1}{2} \times 9,8 \times 5^2 \checkmark$
 $= 137,5 \text{ m} \checkmark$ (3)
- 1.5 $a = \frac{v - u}{t}$
 $= \frac{29,167 - 9,722}{12} \checkmark \checkmark$
 $= 1,62 \text{ m/s}^2 \checkmark$ (3)

[15]

QUESTION 2: STATICS

2.1 The resultant of forces is a single force that can replace two or more forces and still have same effect as all the applied forces. (1)

2.2 2.2.1



(3)

2.2.2 Take moments about R:

$$\sum \downarrow M = \sum \uparrow M$$

$$(L \times 15) + (250 \times 1) = (70 \times 9) + (160 \times 13) \checkmark \checkmark$$

$$15L = 2\,460$$

$$L = 164\text{ N} \checkmark$$

Take moments about L:

$$\sum \downarrow M = \sum \uparrow M$$

$$(160 \times 2) + (70 \times 6) + (250 \times 16) = R \times 15 \checkmark \checkmark$$

$$4\,740 = 15R$$

$$R = 316\text{ N} \checkmark$$

(6)

[10]

QUESTION 3: ENERGY AND MOMENTUM

3.1 Energy cannot be created nor destroyed but can be converted or transformed from one form to another. (1)

3.2 3.2.1
$$a = \frac{v - u}{t}$$
$$= \frac{0 - 15}{6} \checkmark$$
$$= -2,5 \text{ m/s}^2 \checkmark$$
 (2)

3.2.2
$$s = \left(\frac{u + v}{2} \right) t$$
$$= \left(\frac{15 + 0}{2} \right) 6 \checkmark$$
$$= 45 \text{ m} \checkmark$$
 (2)

Or
$$s = ut + \frac{1}{2}at^2$$
$$= 15 \times 6 - \frac{1}{2} \times 2,5 \times 6^2 \checkmark$$
$$= 45 \text{ m} \checkmark$$

3.2.3
$$E = \frac{1}{2}mv^2$$
$$= \frac{1}{2}(20)(15)^2$$
$$= 2\,250 \text{ J} \checkmark$$
 (1)

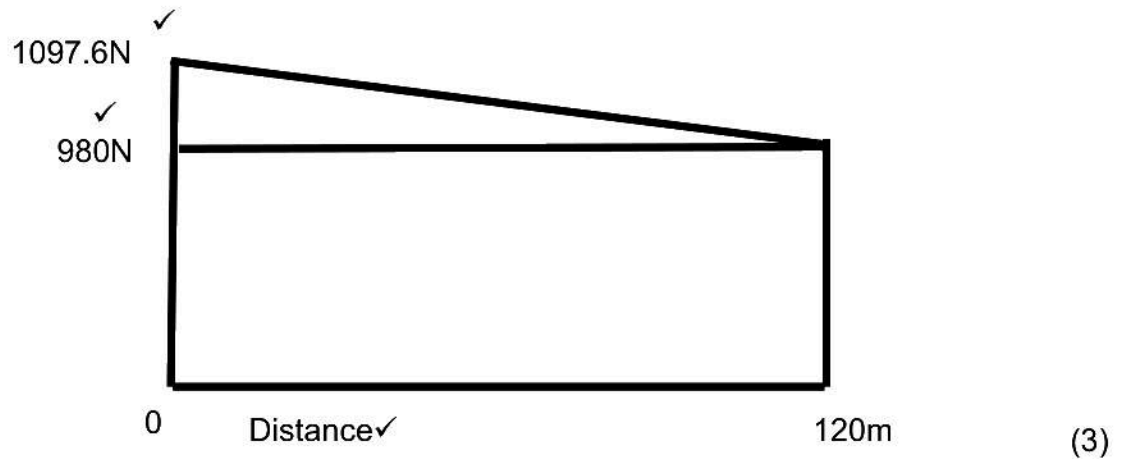
3.2.4
$$P = mv$$
$$= 20 \times 15$$
$$= 300 \text{ kg.m/s} \checkmark$$
 (1)

[7]

QUESTION 4: WORK, POWER AND EFFICIENCY

4.1 4.1.1 Weight of the cable = $0.98 \text{ N/m} \times 120 \text{ m}$
 $= 1\,176 \text{ N}$ ✓ (1)

4.1.2



4.1.3 $W = lb + \frac{1}{2}bh$
 $= (120 \times 980) + (\frac{1}{2} \times 120 \times 117.6)$ ✓
 $= 117\,600 + 7056$
 $= 124\,656 \text{ J}$ ✓ (2)

OR

$W = \left(\frac{1097.6 + 980}{2} \right) \times 120$ ✓
 $= 124\,656 \text{ J}$ ✓

4.2 4.2.1 $P = FV$
 $= 2\,800 \times \frac{43.2}{3.6}$ ✓
 $= 33\,600 \text{ W}$
 $= 33.6 \text{ kW}$ ✓

4.2.2 $\eta = \frac{\text{output}}{\text{input}} \times 100$
 $= \frac{33.6}{190} \times 100\%$ ✓
 $= 17.684\%$ ✓

(2 × 2) (4)
1101

QUESTION 5: MECHANICAL DRIVES AND LIFTING MACHINES

5.1 When pressure is exerted on the surface of an enclosed liquid, ✓ the pressure is transmitted equally in magnitude throughout the liquid in all directions. ✓ (2)

5.2 Pressure is directly proportional to the depth and density of the liquid. (1)

5.3 5.3.1 $N_A \cdot T_A = N_B \cdot T_B$

$$N_B = \frac{25 \times 300}{60} \checkmark$$

$$= 125 \text{ rpm} \checkmark$$

5.3.2 $N_C T_C = N_D T_D$ OR $\frac{N_D}{N_A} = \frac{T_A \times T_C}{T_B \times T_D}$

$$N_D = \frac{36 \times 125}{75} \checkmark$$

$$= 60 \text{ rpm} \checkmark$$

$$N_D = \frac{25 \times 36}{60 \times 75} \times 300 \checkmark$$

$$= 60 \text{ rpm} \checkmark$$

(2 × 2) (4)

5.4 $P = (T_1 - T_2) \pi D N$

$$8\,000 = \left(T_1 - \frac{T_1}{4}\right) \pi \times 0,18 \times \frac{600}{60} \checkmark \checkmark$$

$$1\,414,711 = 0,75 T_1 \checkmark$$

$$T_1 = 1\,886,281 \text{ N} \checkmark$$

(4)

5.5 5.5.1 $VR = \frac{2D}{d_1 - d_2}$

$$= \frac{2(0,32)}{0,28 - 0,19} \checkmark$$

$$= 7,111 \checkmark$$

5.5.2 $M_A = \frac{L}{E}$

$$= \frac{190 \times 9,8}{400} \checkmark$$

$$= 4,655 \checkmark$$

$$\begin{aligned} 5.5.3 \quad \eta &= \frac{M_A}{VR} \times 100\% \\ &= \frac{4,655}{7,111} \times 100\% \checkmark \\ &= 65,462\% \checkmark \end{aligned}$$

(3 × 2) (6)
[17]

QUESTION 6: FRICTION

6.1 Static friction is the maximum friction taking place just before the object starts moving or sliding over the plane on which it is resting. (1)

$$\begin{aligned} 6.2 \quad 6.2.1 \quad F_s &= w \sin \theta \\ &= 1\,440 \sin 25^\circ \checkmark \\ &= 608,57 \text{ N} \checkmark \end{aligned}$$

$$\begin{aligned} 6.2.2 \quad F_c &= w \cos \theta \\ &= 1\,440 \cos 25^\circ \checkmark \\ &= 1\,305,083 \text{ N} \checkmark \end{aligned}$$

$$\begin{aligned} 6.2.3 \quad F_\mu &= \mu \times w \cos \theta \\ &= 0,43 \times 1\,305,083 \checkmark \\ &= 561,186 \text{ N} \checkmark \end{aligned}$$

$$\begin{aligned} 6.2.4 \quad F_{up} &= F_\mu + w \sin \theta \\ &= 561,186 + 608,57 \checkmark \\ &= 1\,169,756 \text{ N} \checkmark \end{aligned}$$

(4 × 2) (8)
[9]

QUESTION 7: HEAT

7.1 Heat capacity is the amount of heat required to raise the temperature of the entire mass of a substance by 1 °C or 1 K. (1)

7.2 7.2.1 $Q = m \times hv$

$$= \frac{25}{1000} \times 740 \times 30 \checkmark$$
$$= 555 \text{ MJ} \checkmark$$

7.2.2 $P = \frac{Q}{t}$

$$= \frac{555 \times 10^6}{2 \times 3\,600} \checkmark$$
$$= 77\,083.333 \text{ W}$$
$$= 77.083 \text{ kW} \checkmark$$

(2 × 2) (4)

7.3 $\alpha = \frac{\Delta l}{l_o \Delta t}$

$$= \frac{0,015}{35 \times (20 - 11)} \checkmark$$
$$= 47,619 \times 10^{-6} / ^\circ\text{C} \checkmark$$

(2)

7.4 Saturation temperature is the constant temperature at which liquid changes in phase from liquid to vapour at a given pressure. (1)

7.5 7.5.1 Wet steam
7.5.2 Dry steam
7.5.3 Superheated steam

(3 × 1) (3)
[11]

QUESTION 8: PARTICLE STRUCTURE OF MATTER

- 8.1 A compound is a pure substance made from different elements. (1)
- 8.2
- Cathode – negative
 - Anode – positive
- (2)
- 8.3 Protons✓ and neutrons✓ (2)
- 8.4
- Electroplating
 - Extracting materials from ore
 - Refining metals
 - Preparing chemicals
 - Corrosion
 - Purification of metals
- (Any 3 × 1) (3)
- [8]**

QUESTION 9: ELECTRICITY

- 9.1 Resistivity is the resistance measured between two opposite faces of a unit cube of the material at a certain temperature. (1)
- 9.2 The longer the length of the conductor, the more the resistance. (The length of the conductor is directly proportional to the resistance). The bigger the cross-sectional area, the less the resistance. (The cross-sectional area of a conductor is inversely proportional to the resistance). (2)
- 9.3
- 9.3.1
- $$\frac{1}{R_p} = \frac{1}{R_2} + \frac{1}{R_3}$$
- $$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{3}$$
- $$\frac{1}{R_p} = \frac{3 + 2}{3 \times 2} \checkmark$$
- $$R_p = \frac{6}{5}$$
- $$R_p = 1.2 \, \Omega \checkmark$$
- 9.3.2
- $$R_T = R_p + R_1$$
- $$= 1.2 + 3 \checkmark$$
- $$= 4.2 \, \Omega \checkmark$$

9.3.3 $I_t = I_2 + I_3$ or

$$I_3 = 2 - 1.2 \checkmark$$

$$= 0.8 \text{ A} \checkmark$$

$$I_3 = \frac{1.2 \times 2}{3}$$
$$= 0.8 \text{ A}$$

(3 × 2) (6)

9.4

- Generators
- Transformers
- Electric motors

(Any 2 × 1) (2)

9.5

- Plastic
- Rubber
- Glass
- Paper
- Pure water
- Oil
- Wood
- Ceramic
- Porcelain

(Any 2 × 1) (2)

[13]

TOTAL: 100