



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE ENGINEERING SCIENCE N2

18 November 2022

This marking guideline consists of 9 pages.

QUESTION 1: DYNAMICS

1.1 0,2 cm (1)

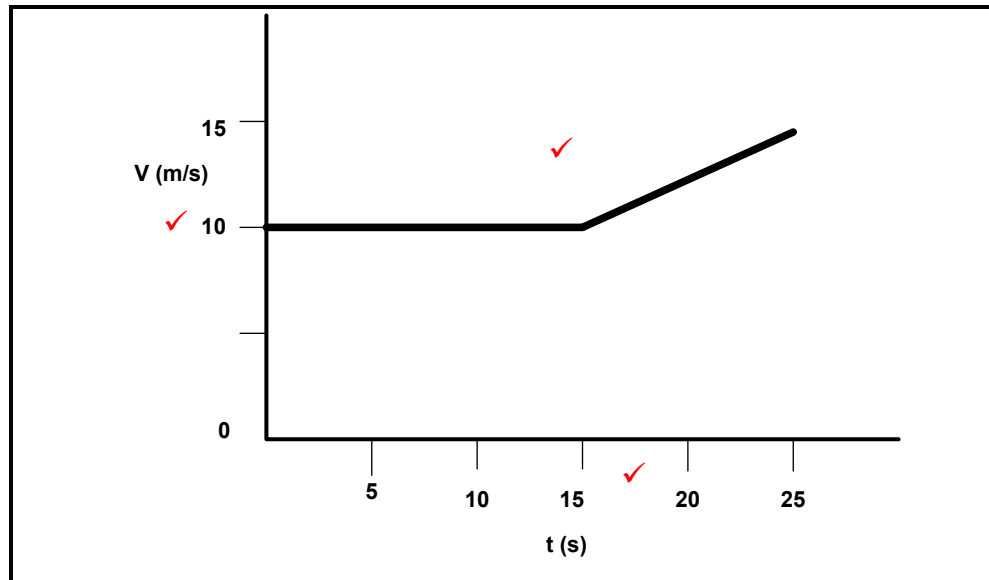
1.2 1.2.1 (2)

$\xrightarrow{\hspace{2cm}}$ 6 km east
 $\xleftarrow{\hspace{2cm}}$ 8 km west
 Displacement = 8 km – 6 km = 2 km ✓ west ✓

1.2.2 $v = \frac{s}{t} = \frac{14}{\left(\frac{47}{60}\right)} \checkmark = 17,872 \text{ km/h} \checkmark$ (2)

1.3 1.3.1 $V = u + at$
 $= 10 + (0,5)(10) \checkmark$
 $= 15 \text{ m/s} \checkmark$ (2)

1.3.2



(3)

1.4 1.4.1 $S = lb + \frac{1}{2}bh$
 $= (10 \times 25) + \left(\frac{1}{2} \times 10 \times 5\right) \checkmark$
 $= 250 + 25 \checkmark$
 $= 275 \text{ m} \checkmark$ (3)

1.4.2 $V = \frac{s}{t} = \frac{275}{25} \checkmark = 11 \text{ m/s} \checkmark$ (2)**[15]**

QUESTION 2: STATICS

2.1 A system of forces will be in equilibrium if the sum of the clockwise moments equals the sum of the anticlockwise moments✓ about the same turning point.✓ (2)

2.2 2.2.1 Take moments about B

$$\begin{aligned}\sum \text{CWM} &= \sum \text{ACWM} \\ (A \times 9,5) &= (168 \times 6) + (245 \times 11) \checkmark \\ 9,5A &= 1008 + 2695 \checkmark \\ 9,5A &= 3703 \\ A &= 389,789 \text{ N} \checkmark\end{aligned}$$

Take moments about A

$$\begin{aligned}\sum \text{CWM} &= \sum \text{ACWM} \\ (168 \times 3,5) + (200 \times 9,5) &= (245 \times 1,5) + (B \times 9,5) \checkmark \\ 588 + 1900 &= 367,5 + 9,5B \checkmark \\ B &= 223,211 \text{ N} \checkmark\end{aligned} \quad (6)$$

2.2.2

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

$$\begin{aligned}223,211 + 389,789 &= 245 + 168 + 200 \\ 613\text{N} &= 613\text{N} \checkmark\end{aligned} \quad (1)$$

2.3

- Tap wrench
- Wing nut
- Wheel spanner

(Any ONE) (1)
[10]

QUESTION 3: ENERGY AND MOMENTUM

3.1 Potential energy is the energy an object possesses due to its mass✓ and height.✓ (2)

3.2 3.2.1 $m = 3 \text{ t} = 3\,000 \text{ kg}$ $V = 92 \text{ km/h} = 25,556 \text{ m/s}$

$$\begin{aligned}E_k &= \frac{1}{2}mv^2 \\ &= \frac{1}{2}(3000)(25,556)^2 \checkmark \\ &= 979663,704 \text{ J} \text{ OR } 979\,629,63 \text{ J} \text{ OR } = 979,630 \text{ kJ} \checkmark\end{aligned} \quad (2)$$

3.2.2

$$\begin{aligned}P &= mv \\ &= 3000 \times 25,556 \\ &= 76\,668 \text{ kg.m/s} \checkmark \text{ OR } 76666,667 \text{ kg.m/s}\end{aligned} \quad (1)$$

3.3 $E_p = mgh$

$$h = \frac{E_p}{mg}$$

$$= \frac{10000}{25 \times 9,8} \checkmark$$

$$= 40,816 \text{ m} \checkmark$$

(2)

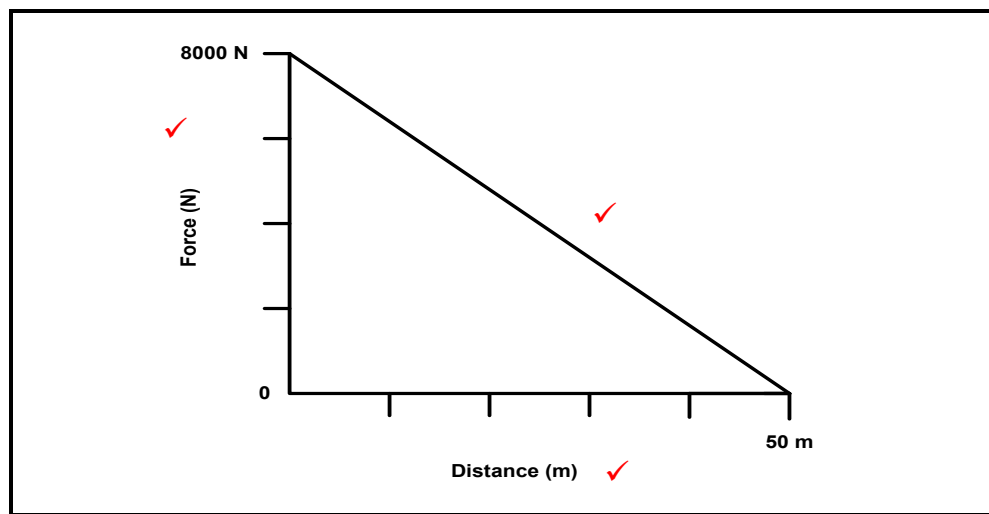
[7]

QUESTION 4: WORK, POWER AND EFFICIENCY

4.1 A joule is the work done when a force of 1 N is applied over 1 m distance in the direction of a force. $\checkmark$

(1)

4.2 4.2.1



(2)

4.2.2 $W = \frac{1}{2}bh$

$$= \frac{1}{2} \times 50 \times 8000 \checkmark$$

$$= 200\,000 \text{ J} \checkmark$$

(2)

4.2.3 $P = \frac{W}{t} = \frac{200000}{120} \checkmark = 1666,667 \text{ W} \checkmark$

(2)

4.3 $T = F \times r$

$$r = \frac{10,5}{130} \checkmark$$

$$r = 0,081 \text{ m} \checkmark$$

$$D = 0,081 \times 2$$

$$= 0,162 \text{ m} \checkmark \text{ OR } 161,538 \text{ m}$$

(3)

[10]

QUESTION 5: MECHANICAL DRIVES AND LIFTING MACHINES

- 5.1
- Need lubrication
 - Noisy
 - Short distance between shafts
 - Not flexible
 - Expensive
- (2)

- 5.2
- Idler gear
 - Intermediate gear
- (Any ONE) (1)

5.3

$$N_A T_A = N_B T_B \quad \text{OR} \quad N_a \times T_a = N_c \times T_c \checkmark$$

$$10 \times 70 = N_B \times 130 \quad N_c = \frac{10 \times 70}{65} \checkmark = 10,769 \text{ rev/s} \checkmark$$

$$N_B = 5,385 \text{ rev/s} \checkmark$$

$$N_B T_B = N_C T_C$$

$$130 \times 5,385 = N_C \times 65 \checkmark$$

$$N_C = 10,769 \text{ rev/s} \checkmark$$

(3)

5.4

5.4.1

$$V = \pi d n$$

$$= \pi (0,13) \left(\frac{625}{60} \right) \checkmark \checkmark$$

$$= 4,254 \text{ m/s} \checkmark$$

(3)

5.4.2

$$D = \frac{V}{\pi n}$$

$$= \frac{4,254}{\pi \times 15} \checkmark$$

$$= 0,090 \text{ m} \checkmark = 90 \text{ mm OR } 90,273 \text{ mm}$$

(2)

5.4.3

$$\frac{T_1}{T_2} = 1,5$$

$$T_2 = \frac{2300}{1,5} = 1533,333 \text{ N}$$

$$P = (T_1 - T_2) V$$

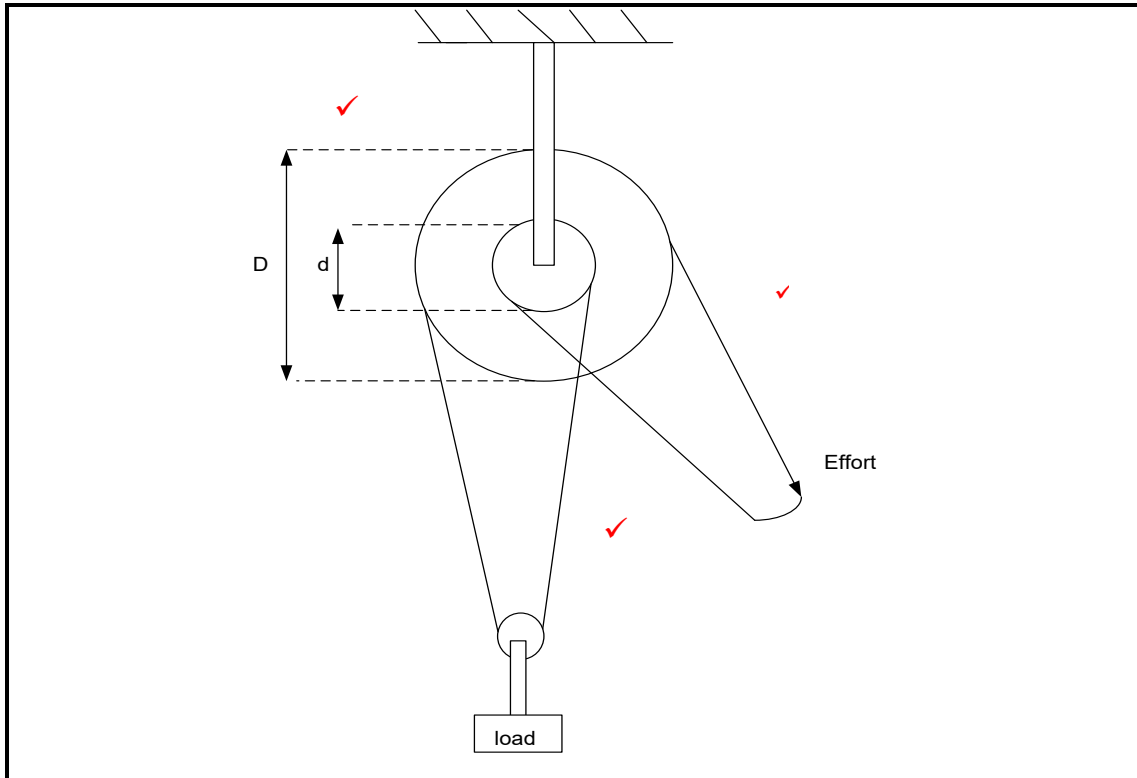
$$= (2300 - 1533,333) \times 4,254 \checkmark$$

$$= 766,667 \times 4,254 \checkmark$$

$$= 3261,401 \text{ W} \checkmark$$

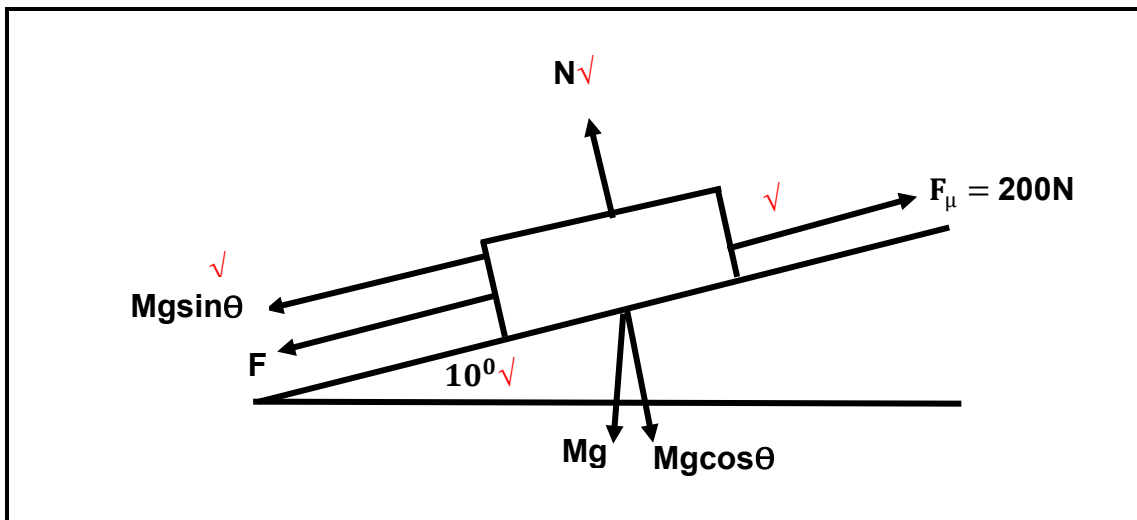
(3)

5.5

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

- 6.1
- Friction can bring linear and rotational movement to a standstill.
 - Friction is used to drive devices, components and machines.
 - Friction is used to clamp a workpiece.
- (Any ONE) (1)

6.2



(½ mark for correct diagram)
 (½ mark for perpendicular forces)
 (½ mark for downward forces)
 (½ mark for opposing force) (2)

6.3 6.3.1
$$\mu = \frac{F_\mu}{W}$$

$$= \frac{200}{70 \times 9,8 \cos 10^\circ} \checkmark$$

$$= 0,296 \checkmark$$
(2)

6.3.2
$$F_s = w \sin \theta$$

$$= 686 \sin 10^\circ \checkmark$$

$$= 119,123 \text{ N} \checkmark$$
(2)

6.3.3
$$F_d = F_\mu - w \sin \theta$$

$$= 200 - 119,123 \checkmark$$

$$= 80,877 \text{ N} \checkmark$$
(2)

[9]**QUESTION 7: HEAT**

7.1 Heat capacity of a substance is the quantity of heat required to raise the temperature of a substance by 1 kelvin or 1 °C. (1)

7.2

- Solid fuels – wood, coal, etc.
- Liquid fuels – petrol, paraffin, etc.
- Gas fuels – methane, butane, etc.

(3)

7.3

- Mass
- Specific heat capacity
- Change in temperature

(3)

7.4
$$m = \frac{Q}{c \Delta t}$$

$$= \frac{\div 93730}{4187 \times (-10 - 15)} \checkmark$$

$$= 0,895 \text{ kg} \checkmark$$
(2)

NB: Heat rejected is negative

7.5
$$\Delta L = L_0 \alpha \Delta t$$

$$= 2,3 \times 0,000017 \times (33 - 12)$$

$$= 8,211 \times 10^{-4} \text{ m} \checkmark$$

$$L_f = \Delta L + L_0$$

$$= 8,211 \times 10^{-4} + 2,3$$

$$= 2,3008 \text{ m} \checkmark$$
(2)

[11]

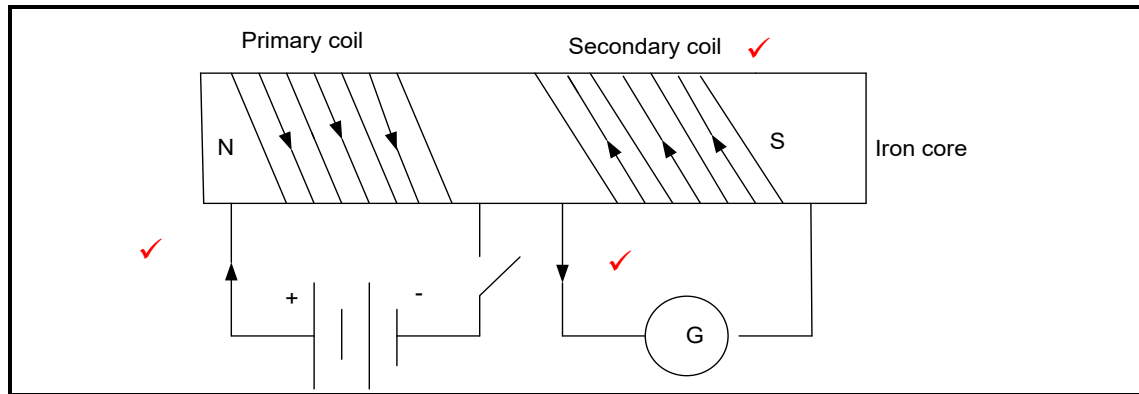
QUESTION 8: PARTICLE STRUCTURE OF MATTER

- 8.1 An ion is an atom that gained or lost an electron. (1)
- 8.2
- Protons – positive
 - Neutrons – neutral
 - Electrons – negative
- (3)
- 8.3 There are no charged ions in pure water to conduct electricity, therefore pure water is a good insulator. (2)
- 8.4
- Electroplating
 - Refining of materials
 - Preparation of chemicals
 - Corrosion
 - To extract materials from ore
- (Any 2 × 1) (2)
- [8]**

QUESTION 9 : ELECTRICITY

- 9.1
- Fixed resistors
 - Adjustable resistors
- (2)
- 9.2 The current flowing in a circuit is directly proportional to the voltage✓ and inversely proportional to the resistance.✓ (2)
- 9.3
- $$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$
- $$\frac{1}{R_1} = \frac{1}{2} - \frac{1}{3} \checkmark$$
- $$\frac{1}{R_1} = \frac{1}{6} \checkmark$$
- $$R_1 = 6 \Omega \checkmark$$
- (3)
- 9.4
- $$R = \frac{\rho l}{A}$$
- $$A = \frac{\pi d^2}{4} = \frac{\pi \times (1,3 \times 10^{-3})^2}{4} = 1,327 \times 10^{-6} \text{ m}^2 \checkmark$$
- $$l = \frac{3 \times 1,327 \times 10^{-6}}{0,000000018} \checkmark$$
- $$= 221,167 \text{ m} \checkmark$$
- (3)

9.5



(3)
[13]

TOTAL: 100