higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N2

3 April 2020

This marking guideline consists of 7 pages.

QUESTION 1

1.1 1.1.1 D- it accounts for displacement due to acceleration in given a period.

1.1.2 A- fundamentally the product of velocity and time is displacement

1.1.3 C-since the car is moving, $0\,m/s^2$ can only represent constant velocity.

(2 × 3) (6)

1.2 1.2.1

$$S_{10\,s} = ut + \frac{1}{2}at^2$$
$$= (60 \times 10) + \frac{1}{2}(2)(10)^2 ✓$$
$$= 700\,m ✓$$

(2)

1.2.2

$$v = u + at$$
$$= 60 + 2(10) ✓$$
$$= 80\,m/s ✓$$

(2)

1.2.3

$$v^2 = u^2 + 2as$$
$$(0)^2 = (80)^2 + 2(-10)s ✓✓$$
$$s = 320\,m ✓$$

(3)

1.3

$$v = u + gt$$
$$= 0 + 9{,}8(3) ✓$$
$$= 29{,}4\,m/s ✓$$

(2)
[15]

QUESTION 2

2.1 A couple is a pair of forces of equal magnitude, turning in the same direction about a fulcrum, but are situated on opposite sides of the couple arm. (2)

2.2
- Wingnut spanner
- Water sprays
- Doorhandles
- Thread cutters

(Any 2 × 1) (2)

2.3 T = 2F × r
16 = (2 x 9) × r
r = 0,889 m✓ (2)
The forces are then 1.778m apart. ✓

2.4 H= R× cos Φ
R = $\frac{69{,}539}{\cos 22}$ ✓
= 75N✓

$V_{(vertical)}$ = H × tanΦ
= 69.539 × tan22✓
= 28,096 N✓

(4)
[10]

QUESTION 3

3.1 $E_P = mgh$
$= 15 \times 9{,}8 \times 10Sin30°$✓✓
$= 735\ J$✓ (3)

3.2 $E_{Kbot} = E_{Ptop}$
$\frac{1}{2}(15)(v)^2 = 735$✓
$v^2 = \frac{735}{7{,}5}$
$v^2 = 98$✓
$= 9{,}899\ m/s$✓ (3)

3.3 $p = mv$
$= 15 \times 9{,}899$
$= 148{,}485\ kg.m/s$✓ (1)
[7]

QUESTION 4

4.1 4.1.1 $W_c = \frac{800}{50}$
$= 16\ N/m$✓ (1)

4.1.2 $W_D = \frac{1}{2}bh$
$= \frac{1}{2}(40)$✓(40×16)✓
$= 12800\ J$ ***OR*** $12.8\ kJ$✓

OR

$W_D = F_{AVE} \times s$

$= \frac{0+640}{2}$✓ $\times 40$✓
$= 128\ 00\ J$ ***OR*** $12.8\ kJ$✓ (3)

4.1.3 $P = F_{ave} \times v$
= [((16 × 30) + 2 800) +2800)] ÷2 × 0,25✓
$= 3\ 040 \times 0{,}25$
$= 760\ W$✓ (2)

4.2 4.2.1 $T = F \times r$
$4\ 500 = F \times 0{,}75$✓
$F = 6\ 000\ N$ ***OR*** $6\ kN$✓

4.2.2 $W = T \times 2\pi$
$= 4\ 500 \times 2 \times 3{,}142$✓
$= 28\ 274{,}334\ J$ ***OR*** $28{,}274\ kJ$✓

(2 × 2) (4)
[10]

QUESTION 5

5.1
- Open-belt drive
- Belt drive around the corner
- Idler pulley
- Quarter-turn drive (Any 3 × 1) (3)

5.2 The advantage of a lifting device is that small effort may be used to lift heavy objects/loads. (1)

5.3 5.3.1
$$v = \pi Dn$$
$$= 3{,}142 \times 0{,}5 \times 45 \checkmark$$
$$= 70{,}686\ m/s \checkmark$$ (2)

5.3.2
$$\frac{T_1}{T_2} = 4$$
$$\frac{2\,000}{T_2} = 4 \checkmark$$
$$T_2 = 500\ N \checkmark$$ (2)

5.3.3
$$P = (T_1 - T_2)v$$
$$= (2\,000 - 500) \checkmark (70{,}686) \checkmark$$
$$= 106\,029\ W\ \boldsymbol{OR}\ 106{,}209\ kW \checkmark$$ (3)

5.4 5.4.1
$$VR = \frac{EFFORT\ DISTANCE}{LOAD\ DISTANCE}$$
$$= \frac{4}{0{,}3} \checkmark$$
$$= 13{,}333 \checkmark$$

5.4.2
$$\eta = \frac{MA}{VR}$$
$$0.75 = \frac{MA}{13{,}33} \checkmark$$
$$MA = 9.9975\ \boldsymbol{OR}\ 10 \checkmark$$

5.4.3
$$MA = \frac{LOAD}{EFFORT}$$
$$1\,0 = \frac{1\,200}{EFFORT} \checkmark$$
$$EFFORT = 120\ N \checkmark$$

(3 × 2) (6)

[17]

QUESTION 6

6.1 $P = \rho gh$
$= 13600 \times 9.8 \times 0.72$
$= 95961.6Pa$✓
Since 1bar =100KPa
$P = 0.9596bar$✓ (2)

6.2 6.2.1 $F_{\parallel} = mgSin\theta$
$= 10 \times 9{,}8 \times Sin25°$✓
$= 41{,}417\ N$✓ (2)

6.2.2 $F_{\perp} = mgCos\theta$
$= 10 \times 9{,}8 \times Cos25$✓
$= 88{,}818\ N$✓ (2)

6.2.3 $\mu = \frac{F_{\mu}}{F_N}$

$0{,}35 = \frac{F_{\mu}}{88{,}818}$
$F_{\mu} = 31{,}086\ N$✓

$F_A = F_{\parallel} + F_{\mu}$
$= 41{,}4173 + 31{,}086$✓
$= 72{,}503\ N$✓ (3)
[9]

QUESTION 7

7.1 It is the quantity of heat required to raise the temperature of $1\ kg$ of a substance by 1 ℃. (2)

7.2
- Petrol
- Paraffin
- Diesel
- Oil

(Any 2 × 1) (2)

7.3 7.3.1 $E = m \times HV$
$= 15 \times 30 \times \frac{75}{100}$✓
$= 337{,}50\ MJ$✓

7.3.2 $P = \frac{E}{t}$
$= \frac{337{,}50}{3\ 600}$✓
$= 93{,}750\ kW$ ✓

(2 × 2) (4)

7.4 $Q_{GAINED} = Q_{LOST}$
$m_w \times 4\ 187 \times (55 - 20) = 10 \times 500 \times (190 - 55)$✓✓
$m_w = 4{,}606\ kg$✓ (3)
[11]

QUESTION 8

8.1 It is an atom or group of atoms in which the number of electrons is different from the number of protons. (1)

8.2
- Electrons – negatively charge
- Protons – positively charge
- Neutrons – no charge/neutral charge (3 × 2) (6)

8.3 A substance is added that can dissociate in water to form ions. (1)
[8]

QUESTION 9

9.1 9.1.1 Series connection – current is the same
9.1.2 Parallel connection – current branches
(2 × 1) (2)

9.2 9.2.1

$$R_T = R_1 + \frac{R_2 \times R_3}{R_2 + R_3}$$
$$= 4 + \frac{6 \times 3}{6 + 3}\checkmark\checkmark\checkmark$$
$$= 6\ \Omega\checkmark$$

(4)

9.2.2

$$R_T = \frac{V_T}{I_T}$$
$$6 = \frac{12}{I_T}\checkmark$$
$$I_T = 2\ A\checkmark$$

$$V_{\|} = I_T R_{\|}$$
$$= 2 \times 2\checkmark$$
$$= 4\ V\checkmark$$

$$V_{\|} = I_{R_2} R_2$$
$$4 = I_{R_2} \times 6\checkmark$$
$$I_{R_2} = 0{,}667\ A\checkmark$$

OR

$$V_{R_1} = I_T R_1$$
$$= 2 \times 4$$
$$= 8\ V\checkmark$$

$$V_T = V_{R_1} + V_{\|}$$
$$12 = 8 + V_{\|}$$
$$V_{\|} = 4\ V\checkmark$$

$$V_{\|} = I_{R_2} R_2$$
$$4 = I_{R_2} \times 6\checkmark$$
$$I_{R_2} = 0{,}667\ A\checkmark$$

(6)

9.3
- Transformer
- Induction motor
- Prevention of sudden overloading (Any 1 × 1) (1)

[13]

TOTAL: 100