higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N3

2 April 2020

This marking guideline consists of 7 pages.

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QUESTION 1: MOTION, ENERGY AND POWER

1.1 Rate at which velocity changes (1)

1.2 1.2.1 $a = \frac{v-u}{t}$
$a = \frac{30-15}{20}$✓
$a = 0,75\ m/s^2$✓ (2)

1.2.2 $S = \Delta + \blacksquare + \blacksquare$
$= 0,5 \times 20 \times 15$✓ $+ 15 \times 20 + 30 \times 30$✓
$= 1350\ m$✓ (3)

1.3 1.3.1 $\theta = 120°/57,3$
$= 2,094\ rad$✓ (1)

1.3.2 $T = Fx\ r$
$= 250\ x\ 0,2$✓
$= 50\ N.m$✓ (2)

1.3.3 $W = T \times \theta$
$= 50 \times 2,094$✓
$= 104,7J$✓ (2)

1.4 1.4.1 $P = F_e \times v$
$= 420 \times 18,7$✓
$= 7,854\ kW$✓ (2)

1.4.2 $T_1 = 5\ x\ 210$
$= 1050\ N$ ✓ (1)

1.4.3 $v = \pi DN$
$18,7 = \pi\ x0,38x\ N$✓
$N = 15,66\ r/s$✓ (2)
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QUESTION 2: MOMENTS

2.1 Product of the perpendicular force✓ and the distance of the force from the fulcrum✓ (2)

2.2 2.2.1 Moment about B

$$\sum ACM = \sum CM$$

35 × 2 + C × 6 = 90 × 3 + 28 × 8 + 25 × 11✓

6C = 769 – 70

C = 116,5 kN✓

Moment about C

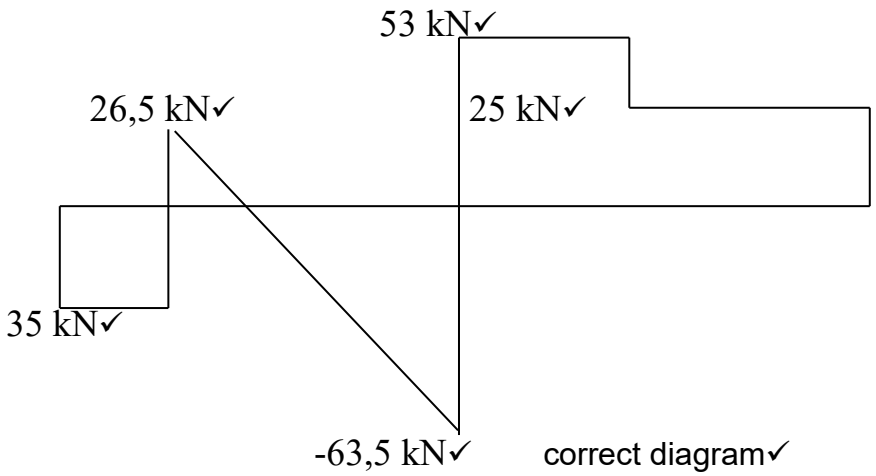
$$\sum ACM = \sum CM$$

90 × 3 + 35 × 8 = 6B + 28 × 2 + 25 × 5✓

6B = 369

B = 61,5 kN✓ (4)

2.2.2



correct diagram✓ (6)

[12]

QUESTION 3: FORCES

3.1 If two pulling forces acting at a point are represented in magnitude and direction by two adjacent sides of a parallelogram,✓ the resultant of the two forces is represented in magnitude and direction by the diagonal of the completed parallelogram drawn from the point where the forces act.✓ (2)

3.2 $\sum F_{up} = \sum F_{down}$

70 sin 45° + L sin 30°+ M = 50 sin 60°✓

$M = -6{,}196 - 0{,}5L$✓

$\sum F_{right} = \sum F_{left}$

$70cos45° + 50cos60° = 80 + Lcos30°$✓

0,866 L = -5,5 N

L = -6,35 N ✓

M = $-6{,}196 - 0{,}5(-6{,}35)$✓

= -3,021 N ✓ (6)

3.3
- The sum of all the forces in any direction must be zero.
- The sum of all the moments of the forces about any fulcrum must be zero. (2)

3.4 $sin60° = \frac{47{,}5}{AB}$ ✓ and $tan60° = \frac{47{,}5}{BC}$ ✓

$AB = 54{,}848\ kN$ ✓ strut BC = 27,424 kN✓ Tie (4)

[14]

QUESTION 4: FRICTION

4.1
- Independent of speed
- Depends on nature of surface in contact
- Independent of size of area in contact
- Proportional and perpendicular to the normal force (Any 3 × 1) (3)

4.2 4.2.1 $F_c = 200x9{,}8cos25°$✓

= 1776,363 N✓ (2)

4.2.2 $F_s = 200x9{,}8sin25°$✓

= 828,332 N✓ (2)

4.2.3 $F_\mu = \mu x\ Wcos25°$

$= 0{,}36x1776{,}363N$ ✓ ✓

$= 639{,}491N$ ✓ (3)

4.2.4 $F_{down} = F_\mu - F_s$

= 639,491 -828,332✓

= -188,841 N✓ (2)

[12]

QUESTION 5: HEAT

5.1
- Type of the metal
- Rise in temperature
- Original length of rod (3)

5.2 5.2.1 $\Delta t = 107 - 17 = 90\ °C$✓ (1)

5.2.2 $\Delta L = L_o x\alpha\ x\Delta t$
= 2000 × 23 × 10^{-6} × 90✓✓
= 4,14 mm✓ (3)

5.2.3 $A = 2x\ 0{,}1\ = 0{,}2m^2$✓
$\Delta A = 2A_o x\beta\ x\Delta t$
= 2 × 0,2 × 23 × 10^{-6} × 90✓
= 0,000828 m^2✓ (3)

5.3 Temperature increases with an increase in pressure
OR Temperature decreases with a decrease in pressure (1)

5.4 $H_{wet} = h_f + qH_{fg}$
= 838 + 0,9 × (1951) ✓
= 2593,9 × 2✓
= 5,188 MJ✓✓ (4)
[15]

QUESTION 6: HYDRAULICS

6.1 Delivery head = static head – suction head✓✓ (2)

6.2 6.2.1 $P = \rho gh$
$0{,}45x10^6$ =1000 × 9,8 × h✓✓
$h = 0{,}45x10^6/9800$
h = 45,918 m✓ (3)

6.2.2 $W = Px\ V$✓
W = $0{,}45x10^6x45/3600$✓✓
W = 5625 J/s✓ (4)

6.2.3 P = 5625 W (1)

6.2.4 $\vartheta = \frac{output\ power}{input\ power} x100$
= $\frac{5625}{7350} x100$✓
= 76,5%✓ (2)
[12]

QUESTION 7: ELECTRICITY

7.1 Voltage measured at the poles of a cell when current flows through it (1)

7.2 7.2.1
$$I = \frac{V}{r}$$
$$= \frac{12.6\ v}{5\Omega}\checkmark$$
$$= 2{,}52\ A\checkmark$$ (2)

7.2.2
$$R = \frac{V}{I}$$
$$= \frac{11{,}4V}{2{,}52A}\checkmark$$
$$= 4{,}523\ \Omega\checkmark$$ (2)

7.3 7.3.1
$$Q = It$$
$$= 10 \times 60 \times 60\checkmark$$
$$= 36\,000\ C\checkmark$$ (2)

7.3.2
$$m = Qx\ ece$$
$$m = 36000x\ 0{,}001118\checkmark$$
$$m\ = 40{,}248\ g\checkmark$$ (2)

7.4 7.4.1
$$\frac{N_p}{N_s} = \frac{I_s}{I_p}$$
$$\frac{N_p}{N_s} = \frac{0{,}4\checkmark}{6}$$
Ratio 1: 15✓ (2)

7.4.2
$$\frac{N_p}{N_s} = \frac{I_s}{I_p}$$
$$\frac{600}{N_s} = \frac{0{,}4}{6}\checkmark$$
$$N_s = 9000\ turns\checkmark$$ (2)

[13]

QUESTION 8: CHEMISTRY

8.1 Two (1)

8.2 Metals✓ and non-metals✓ (2)

8.3
- Easily machinable
- Corrosion resistant

(Any 1 × 1) (1)

8.4 $CaCO_3$ -limestone✓ and HCl – hydrochloric acid✓ (2)

[6]

TOTAL: 100

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