higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N3

26 JULY 2018

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QUESTION 1

1.1 The property of a body to keep its state of rest or motion (2)

1.2 1.2.1
$C = 2\pi r$
$D = 2\pi(140)/4$✓
$= 219,9$ m✓ (2)

1.2.2
$AB^2 = AO^2 + OB^2$✓
$= 140^2 + 140^2$✓
$AB = 197,99$ m✓ (3)

1.2.3
$V = \Delta s/t$
$= 197,99/180$✓
$= 1,1$ m/s✓ (2)

1.3 1.3.1
$\sum F_{up} = \sum F_{down}$
$mg + ma = mg - ma$✓
$6 \times 9,8 + 6a = 8 \times 9,8 - 8a$✓
$14a = 19,6$
$a = 1,4$ m/s^2, clockwise✓✓ (No direction 1 mark) (4)

1.3.2
$T = (m_A + m_B)xa$
$= (6 + 8) \times 1,4$✓
$= 19,6$ N✓ (2)

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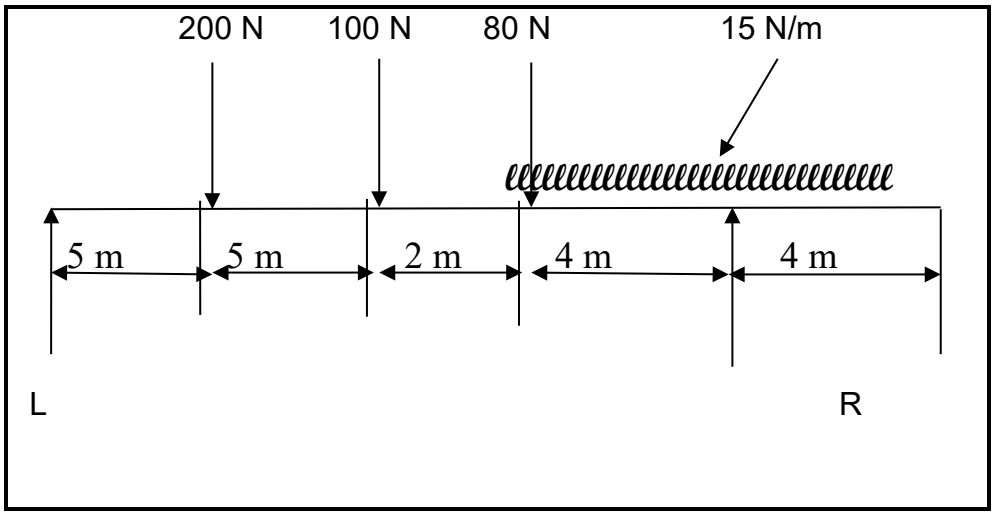
QUESTION 2

2.1 A load applied to a beam that is concentrated at one point. (1)

2.2 2.2.1



(Concentrated loads = 1 mark)
(Supports = 1 mark)
(NOTE: correct positions only) (2)

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2.2.2 Take moment about L

$\sum ACM = \sum CM$

$R \times 16 = 200 \times 5 + 100 \times 10 + 80 \times 12 + 60 \times 14 + 60 \times 18$✓

$= 4\ 880/16$

$R = 305$ N✓

Moment about R

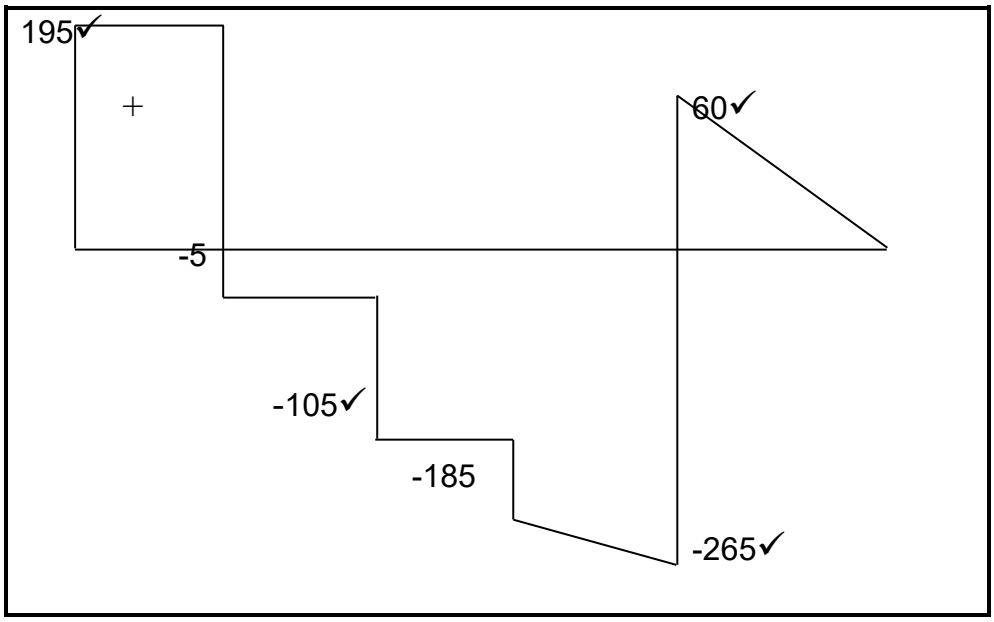
$\sum CM = \sum ACM$

$L \times 16 + 60 \times 2 = 60 \times 2 + 80 \times 4 + 100 \times 6 + 200 \times 11$✓

$16L = 3\ 120$

$L = 195$ N✓ (4)

2.2.3



(4)

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QUESTION 3

3.1
- The sum of the clockwise moments should be equal to the sum of the anticlockwise moments.
- The sum of the upward forces must be equal to the sum of the downward forces. (2 × 1) (2)

3.2 3.2.1 $\sum Vy = -3,5 + 2\sin45^o + 2,5\sin30^o$✓✓

$= -0,836$ kN✓ south✓ (4)

3.2.2 $\sum H_x = -3 - 2\cos45^o + 2,5\cos30^o$✓✓

$= -2,249$ kN✓ west✓ (4)

3.2.3 $R^2 = 0,836^2$✓ $+ 2,249^2$✓

$R = 2,399$ kN✓
$E = 2,399$ kN✓
(4)

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QUESTION 4

4.1
- Kinetic friction depends on the nature of the surfaces in contact
- Kinetic friction is independent of speed
- Kinetic friction is independent of the size of the area in contact
- Kinetic friction is proportional to the perpendicular force between the surfaces (Any 3 × 1) (3)

4.2 4.2.1 $F = W\cos\theta$

$= 500 \times 9,8\cos20^o$✓

$= 4\,604,49$ N✓ (2)

4.2.2 $F = W\sin\theta$

$= 500 \times 9,8\sin20^0$✓

$= 1\,675,9$ N✓ (2)

4.2.3 $F\mu = \mu W\cos\theta$

$= 0,25 \times 500 \times 9,8\cos20^o$✓

$= 1\,151,12$ N✓ (2)

4.2.4 $F_{down} = F\mu - W\sin\theta$

$= 1\,151,12 - 1\,675,9$✓

$= -524,78$ N✓✓ (3)

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QUESTION 5

5.1 The saturation temperature increases with an increase in pressure.

OR

The saturation temperature decreases with a decrease in pressure. (1)

5.2
- Steam tends to cause corrosion.
- A lot of insulation is needed to prevent loss of heat.
- The high temperature and pressure of steam causes complications.
- It takes a long time to generate steam from a cold start-up. (Any 2 × 1) (2)

5.3 5.3.1 $\Delta t = 75\ ℃ - 25\ ℃$

$= 50^{o}$✓ (1)

5.3.2 $E = hv \times m$

$= 35 \times 32$✓

$= 1\ 120\ MJ \times 0,45$✓

$= 504\ MJ$✓ (3)

5.3.3 $E = mc\Delta t$

$504 \times 10^{6} = m \times 4\ 187 \times 50$✓✓

$m = 2\ 407,45\ kg$✓

Volume = 2 407,45 litres✓ (4)

5.4 5.4.1 $\beta = 2\alpha$

$= 2 \times 20 \times 10^{-6}$

$= 40 \times 10^{-6}/^{o}C$✓ (1)

5.4.2 $\Delta A = A_0\beta\Delta t$ $A_0 = 0,15 \times 0,15 = 0,0225\ m^2$✓

$= 0,0225 \times 40 \times 10^{-6} \times 110$✓

$\Delta A = 0,000099\ m^2$✓

Final area = 0,0225 + 0,000099

$= 0,022599\ m^2$✓ (4)

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QUESTION 6

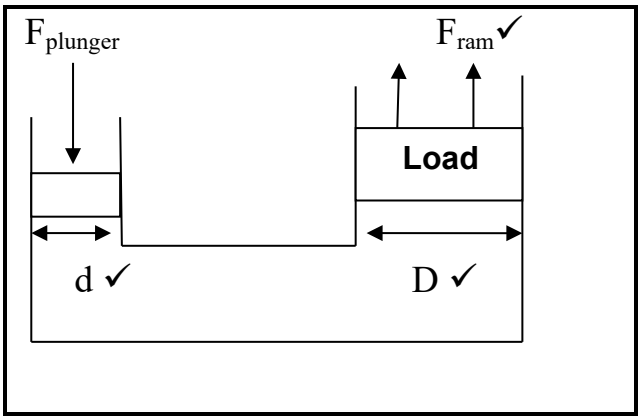
6.1 $P = \rho gh$

$30 \times 10^3 = \rho \times 9{,}8 \times 3{,}875$

$\rho = 790\ kg/m^3$✓

$\therefore The\ liquid\ is\ alcohol(ethyl)$✓ (2)

6.2



(3)

6.3 6.3.1 $F/D^2 = f/d^2$

$D = \sqrt{Fd^2/f}$

$D = \sqrt{5\ 200\ x\ 0{,}08^2/346}$✓

$= 0{,}31\ m$✓ (2)

6.3.2 $d^2 x\ hx\ n = D^2 \times H$

$H = (0{,}08^2 \times 0{,}1 \times 30)/0.31^2$✓✓

$H = 0.1997\ m$

$= 0.2\ m$ ✓ (2)

6.3.3 $P = F/A$ $A = \pi d^2/4$

$P = 346/(\pi\ x\ 0{,}08^2/4)$✓✓

$= 68{,}835\ kPa$✓ (3)

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QUESTION 7

7.1 The EMF of different substances liberated by a given quantity of electricity is proportional to the chemical equivalent mass. (2)

7.2 7.2.1 $R_T = R_p + R_s$ + internal resistance
$= (1/6 + 1/4)^{-1}$✓ + 0,4 + $(1/0,6 + 1/0,6 + 1/0,6)^{-1}$✓
= 2,4 + 0,4 + 0.2✓
= 3 Ω✓ (4)

7.2.2 $I_T = V_T / R_T$
$= 6/3$✓✓
= 2 A✓ (3)

7.2.3 $V_p = I_T \times R_p$
$= 2 \times 2,4$✓
= 4.8 V✓ (2)

7.3

E = P x t		**OR**	E = P x t
= 200 × 3			= 200 × 3 × 60 × 60
= 0,6 kWh ✓			E = 2,16 MJ✓
Cost = 0,6 kWh/1 kWh × (25 cents)✓			cost = 2,16 MJ/3,6 MJ x (25)✓
= R0,15 ✓			= R0,15✓

(3)

[14]

QUESTION 8

8.1 Loss of electrons by a substance (1)

8.2
- Galvanising
- Electroplating
- Painting
- Oil and grease (Any 2 × 1) (2)

8.3.1 Copper and zinc

8.3.2 Sodium and chlorine

8.3.3 Lead and phosphor (3)

[14]

TOTAL: 100

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