higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

ENGINEERING SCIENCE N3

17 NOVEMBER 2016

17 This marking guideline consists of 9 pages.

QUESTION 5

See marking guideline for allocation of marks = 6 marks

QUESTION 1: MOVEMENT

1.1 $u = 60/3,6 = 16,667$ m/s✓
$v = u + at$
$v = 16,667 + (2).(4)$✓
$v = 24,667$ m/s✓ (3)

1.2 $m = 2,2$ tons $m = 2,2 \times 1000 = 2200$ kg
$N = 60$ rpm
$\varnothing = 750$ mm $= 0,75$ m
$r = 0,375$

1.2.1 $Torque = F \times r$
$T = 2200 \times 9,8 \times 0,375$√
$T = 8085$ Nm✓ (1½)

1.2.2 $v = \frac{\pi \times d \times n}{60}$
$v = \frac{\pi \times 0,75 \times 60}{60}$ √
$v = 2,357$ m/s ✓ (1½)

1.2.3 $Work\ done = Force \times 2 \times \pi \times n$
$Wd = 2200 \times 9,8 \times 2 \times \pi \times \frac{60}{60}$ √
$Wd = 135483,04$ J or 135,5 kJ ✓ (1½)

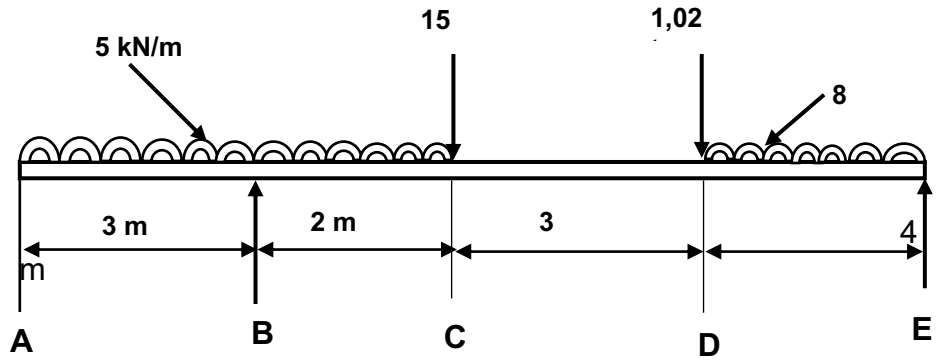
1.2.4 $Power = Force \times v$
$Wd = 2200 \times 9,8 \times 2,357$ √
Power = 50,817 kW✓ (1½)

1.2.5 $\eta = \frac{Po}{Pin} \times 100$
$\eta = \frac{50,7954}{60} \times 100$ ✓
$\eta = 84,7\%$✓ (2)

1.3 $M_1 \times u_1 + m_2 \times u_2 = (m_1 + m_2) \times v$
$10\ 000 \times V_3$✓ $+ 222,222 \times 50$✓ $= (50 + 10\ 0000)\ 0$✓
$V_3 = -1,1$ m/s or in the opposite direction✓ (4)
[15]

QUESTION 2: MOMENTS

2.1 2.1.1



(4)

2.1.2 Taking moments about B

Σ Anti-clockwise moments = Σ Clockwise moments
(E × 9) + (25 × 0,5) = (15 × 2) + (1020 × 9,8 × 5) + (32 × 7)✓

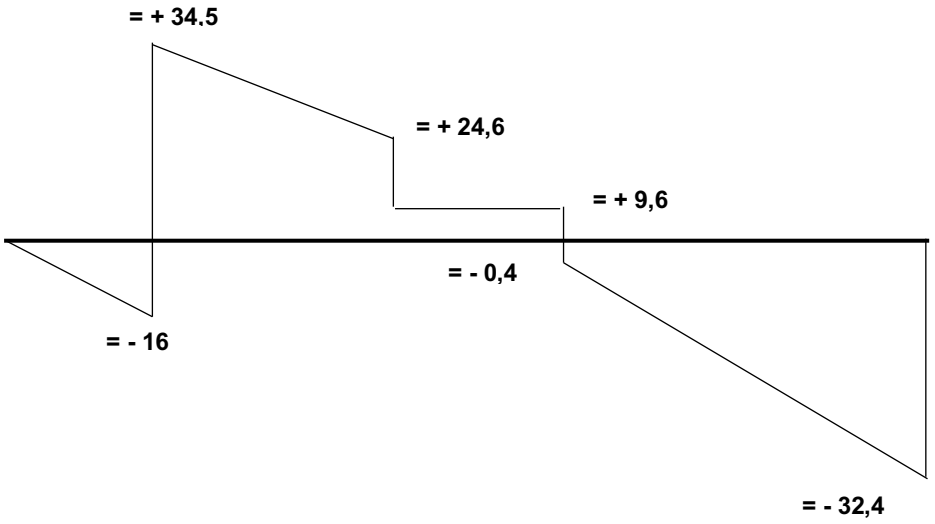
9E + 12,5 = 30 + 49,98 +224 ✓

R = 32,387 N✓ (3)

Taking moments about E

Σ Anti-clockwise moments = Σ Clockwise moments
(32 × 2) + (1020 × 9,8 × 4) + (15 × 7) + (25 × 9,5) = (B × 9)✓
64 + 39,984 + 105 237,5 ✓
B = 49,6 kN (3)

2.1.3



(3)
[13]

QUESTION 3: FORCES

3.1 The resultant of two or more forces is those single forces that can replace✓ the two or more force and still have the same effect.✓

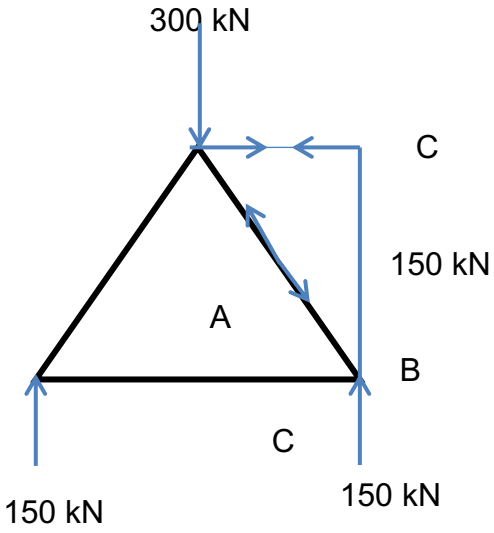
The equilibrant of a system of forces, on the same plane,✓ is that single force which will balance the system of forces.✓ (3)

3.2 ∑ HC = 0

600 = P × Cos50° + 500 × Sin25°✓
600 – 500 Sin25° = P × Cos50° ✓
600 – 211,309 = 0,643 × P ✓
P = $\frac{388,691}{0,643}$ P = 604,496 N ✓ (4)

3.2 ∑VC = 0
500 × Cos25° = P x Sin 50°**+** Q ✓
Q = - 604,496 × Sin50° + 500 × Cos 25°✓
Q = - 463,071 + 453,154✓
Q = - 9,917 N ✓ (4)

3.3



Tan 45° = AC/BC

AC = BC tan 45°
AC = 150 × tan 45°
AC = 150 kN tie

Cos 45° = BC/AB
AB = BC/cos 45°
AB = 212 kN strat (4)
[15]

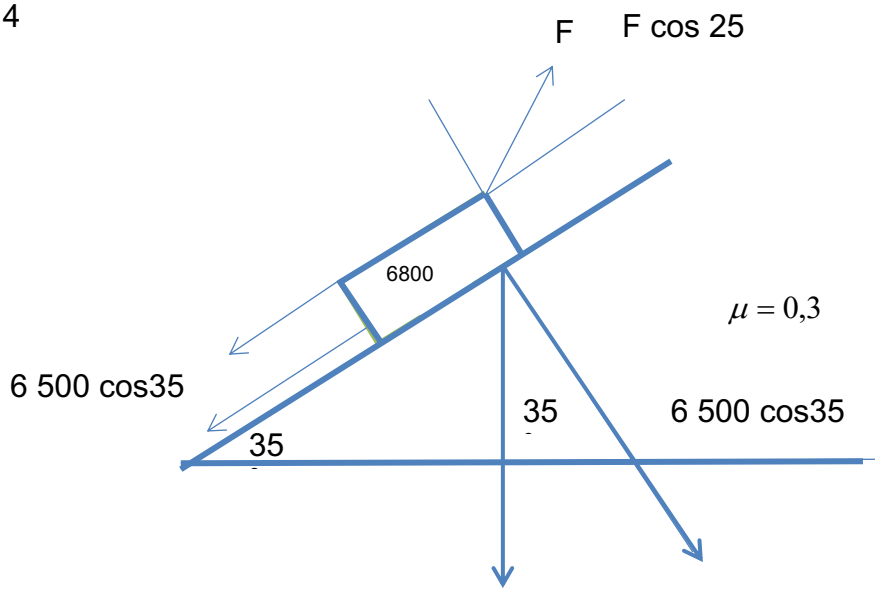
QUESTION 4: FRICTION

4.1
- Enable a vehicle to brake
- Transferring of power by means of a clutch or belt drives
- Can cause to drilling, or cutting of materials (Any 1 × 1) (1)

4.2
- Surfaces to wear away
- Drilling, cutting of tools getting blunt
- Friction causes unnecessary heat (Any 2 × 1) (2)

4.3 The angle of rest is the biggest angle✓ that may be reached between an incline plane and the horizontal plane, before the body starts✓ moving freely down the incline plane. (2)

4.4



$F_{applied} = F\mu + W \times \sin\alpha$

$F \times \cos\theta = \mu(W \times \cos\alpha + F \times \sin\theta) + W \times \sin\alpha$ ✓

$F \times \cos(25°) = 0,3(6\,500 \times \cos35° - F \times \sin25°) + 6\,500 \times \sin35°$✓

$F \times 0,906 = 0,3(5324,488 + 0,4226 \times F) + 3728,2468$ ✓

$F \times 0,906 = 1597,3464 + 0,12678 \times F + 3535,539$✓

$F \times 0,906 - 0,12678 \times F = 5325,592$✓

$1,033 \times F = 5325,592$

$P = 5155,462$ N ✓

$P = 5,2$ kN (6)

[11]

QUESTION 5: HEAT

5.1 5.1.1 $\Delta t = t_2 - t_1$
$\Delta t = 87 - 20$ ✓
$\Delta t = 67\ °C$ ✓ (2)

5.1.2 $Q = m \times c \times \Delta t$
$= 200 \times 4187 \times (67)$ ✓
$Q = 56{,}11\ MJ$✓ (2)

5.1.3 $Q_{out} = m \times HV$
$m = \frac{56105800J}{26000000}$✓
$m = 2{,}158\ kg$ or use $2{,}2\ kg$✓ (2)

5.2 Q loss = Q gain

$m \times c \times \Delta t = m \times c \times \Delta t$
$1{,}5 \times c \times (81 - 25) = 2{,}2 \times 4187 \times (25 - 20)$ ✓
$1{,}5 \times c \times 56 = 2{,}2 \times 4187 \times 5$
$c = \frac{2{,}2 \times 4187 \times 5}{1{,}5 \times 56}$ ✓
$C = 548{,}3\ J/kg.°C$ material is steel✓ (3)

5.3 5.3.1 $m = 1\ kg$ $Pr = 1\ 400\ kPa$ $tsu = 240\ °C$ $ts = 195\ °C$
$hf = 830\ kJ/kg$ $hfg = 1\ 958\ kJ/kg$ and $hg = 2\ 788\ kJ/k$
$h_{(wet)} = [hf + x\ hfg] \times m$
$h_{(wet)} = [830 + 0{,}94 \times (1958)]$✓
$h_{(wet)} = 2\ 670{,}52\ kJ$ ✓ (2)

5.3.2 $h_{(dry)} = hg = 2788\ kJ$ (✓) (1)

5.3.3 $h_{ss} = hg + Css(tsu - ts)$
$= 2\ 788 + 2{,}85\ (240 - 195)$ ✓
$= 2\ 788 + 128{,}25$
$h_{wet} = 2\ 916{,}25\ kJ$ ✓ (2)
[14]

QUESTION 6: HYDRAULICS

6.1 6.1.1

$Pr = \rho \times g \times h$
$Pr = 15\,000 \times 9,8 \times 8$✓
$P = 1\,176$ kPa(✓)
$\eta = \frac{Wd_{out}}{Wd_{in}} \times 100$

$Wd_{in} = \frac{1176 \times 100}{80}$
Energy = 1470 kJ ✓ (3)

6.1.2

$Power = Pr \times V$
$= (600 \times 10^3) \times 15$✓
$P = 9000$ MJ✓

$Power = \frac{9\,000 \times 100}{80}$

Energy = 11,25 MW ✓ (3)

6.2 6.2.1

$f = \frac{d^2 \times W}{D^2}$

$= \frac{(20)^2 \times 1\,500 \times 9,8}{(80)^2}$✓
$f = 918,75$ N✓

$F_{in} = \frac{918,75 \times 100}{80}$
$F_{in} = 1148,4375$ N ✓

$MA = \frac{Load}{Effort}$

$Effort = \frac{Load}{MA} = \frac{1148,4375}{16}$

Effort = 71,77 N ✓ (4)

6.2.2

$d^2 \times h \times$ no of strokes $= D^2H$
$(20)^2 \times 25 \times no = (80)^2 \times 51,5$✓

No of strokes = 32,96 use 33✓ (2)
[12]

QUESTION 7: ELECTRICITY

7.1 7.1.1

$$R_P = \frac{R_1 R_2}{R_1 + R_2}$$

1 M substitution

1 M R parallel

$$= \frac{3 \times 6}{6 + 3}$$

$$= 2\ \Omega$$

$$R_T = R_P + R_{\text{int}}$$

1 M sub

$$R_T = 2 + 0{,}9$$

$$R_T = 2{,}9\ \Omega$$

1 M answer (4)

7.1.2

$$V = 6 \times 1{,}5 = 9\ Volts$$

$$I = \frac{V}{R}$$

1 M sub

$$I = \frac{9\ V}{2{,}9\ \Omega}$$

1 M answer

$$= 3{,}103\ A$$

(2)

7.1.3

$$V = IR_{\text{int}}$$

$$= 3{,}103\ A \times 0{,}9$$

$$= 2{,}793\ Volts$$

(2)

7.2

$$\frac{10 \times 60 \times 4}{1000} = 2{,}4\ kWh$$

½ M ten lamb

$$\frac{5 \times 100 \times 6}{1\ 000} = 3\ kWh$$

½ M five lamps

$$\frac{2\ 000 \times 1}{1\ 000} = 2\ kWh$$

½ M Stove

$$\frac{2 \times 75 \times 3}{1\ 000} = 0{,}45\ kWh$$

½ M Computers

$$2{,}4 + 3 + 2 + 0{,}45 = 7{,}85\ kWh$$

1 M 7,85 kWh

$$7{,}85\ kWh \times 7 days$$

$$54{,}95\ kWh \times R1{,}63$$

$$R89{,}57$$

1 M R89,57

(3)

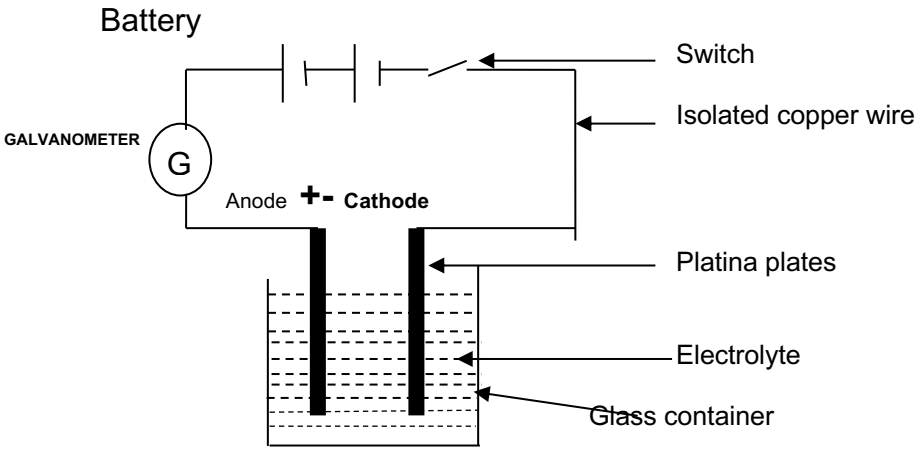
7.3 I = 100 A
t = 2 hours = 2 × 60 × 60 = 7200 sec
z = 3,294 × 10^{-4}g/c

Calculate the mass = I × t × z

m = 100 × 7200 × 3,294 × 10^{-4} ✓

m = 237,168 g ✓ (2)
[14]

QUESTION 8: CHEMISTRY



TWO marks for sketch and labels

The electrolytic process requires that an electrolyte,✓ an ionized solution or molten metallic salt, complete an electric circuit between two electrodes. When the electrodes are connected to a source of direct current one, called the cathode, becomes negatively (-) charged while the other, called the anode, becomes positively (+) charged.✓ The positive ions in the electrolyte will move toward the cathode and the negatively charged ions toward the anode. This migration of ions through the electrolyte constitutes the electric current in that part of the circuit.✓ The migration of electrons into the anode, through the wiring and an electric generator, and then back to the cathode, constitutes the current in the external circuit.✓

[6]

TOTAL: 100