higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N3

30 JULY 2019

This marking guideline consists of 7 pages.

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QUESTION 1

1.1 It is the quantity of matter that a body possesses. (1)

1.2 Displacement is a vector quantity and distance is a scalar quantity. (1)

1.3 1.3.1 $v = u + at$

$20 = 0 + ax15$✓

$a = 1{,}333\ m.s^{-2}$✓ (2)

1.3.2 Distance = Δ + ■ + Δ

$= 0{,}5\ x\ 15\ x\ 20 + 15\ x\ 20 + 0{,}5\ x\ 10\ x\ 20$✓

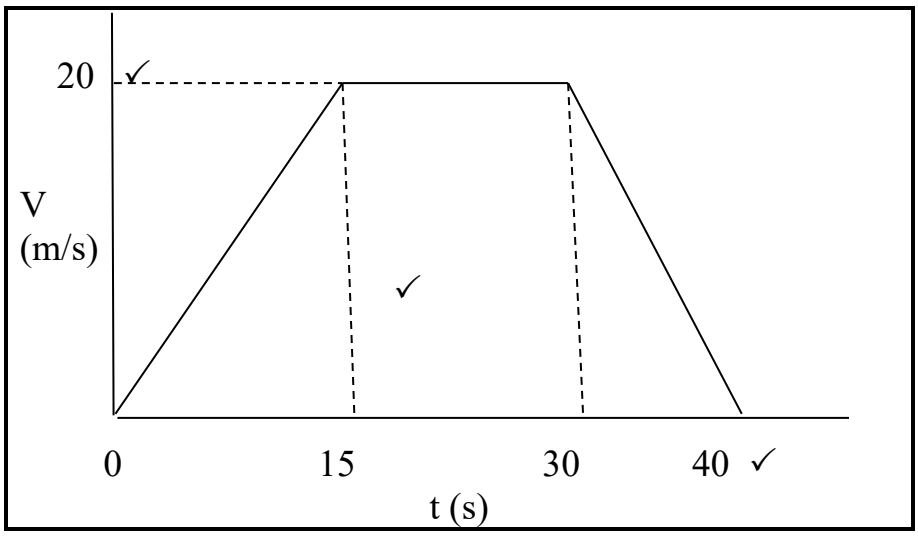
= 550 m✓ (2)

1.3.3 $v = \frac{\Delta s}{\Delta t}$

$= \frac{550\ m}{40\ s}$ ✓

= 13,76 m/s✓ (2)

1.4



(3)

1.5 1.5.1 $P = F_e x\ v$

= 423 N × 17,6 m/s✓

= 7 444,8 W √ (1/2)

$= 7{,}445\ kW$ √ (1/2) (2)

1.5.2 $T_1 = 9\ N\ x$ 180 mm

= 1 620 N✓ (1)

1.5.3 $v = \pi DN$

17,6 = $\pi\ (0{,}45)x\ N$✓

N = 12,45 r/s✓ (2)

[16]

QUESTION 2

2.1
- The sum of the upward forces is equal to the sum of the downward forces.
- The sum of the anticlockwise moments is equal to the sum of the clockwise moments. (2)

2.2 2.2.1 Moment about B

$\sum ACM = \sum CM$

$5\ x\ 1 + C\ x\ 4 = 40\ x\ 2 + 8\ x\ 5 + 5\ x\ 6$✓

$4C = 150 - 5$

C = 36,25 kN✓

Moment about C

$\sum ACM = \sum CM$

$5\ x\ 5 + 40\ x\ 2 = B\ x\ 4 + 8\ x\ 1 + 5\ x\ 2$✓

4B = 105 – 18

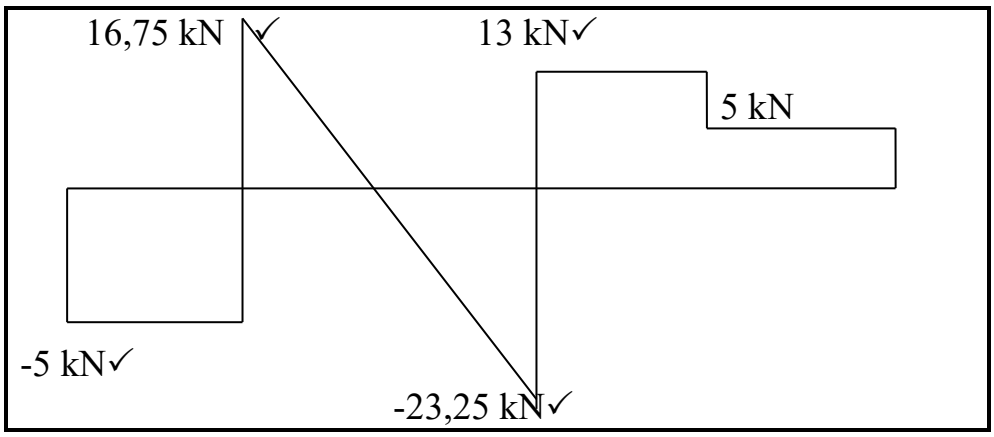
B = 21,75 kN✓

$\sum Fup = \sum Fdown$ ✓

36,25 + 21,75 = 5 + 40 + 8 + 5

58 kN = 58 kN✓ (6)

2.2.2



(4)
[12]

QUESTION 3

3.1 If three forces acting on a point are in equilibrium,✓ they can be represented in magnitude and direction by the sides of a triangle.✓ (2)

3.2 3.2.1 $\sum H_x = 100cos50° + 80cos40° - 60$ ✓

= 65,562 N✓, East✓ (3)

3.2.2 $\sum V_y = 100sin50° - 80sin40° - 70$ ✓

= - 44,819 N,✓ South✓ (3)

3.2.3 $R = \sqrt{65{,}562^2 + 44{,}819^2}$ ✓
$\theta = tan^{-1}(44{,}819/65{,}562)$
= 79,417 N,✓ E 34,36° S✓
= 34,36° ✓
E = 79,417 N ✓ W34,36°N✓ (6)
[14]

QUESTION 4

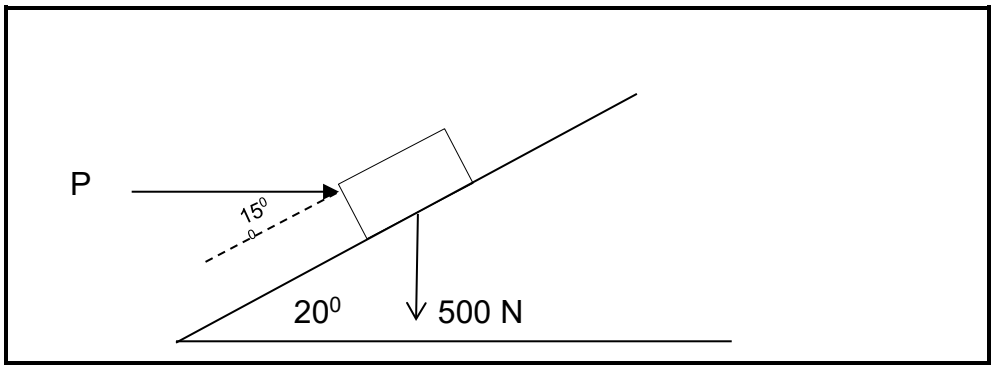
4.1
- Dependent on the nature of the surfaces in contact
- Independent of the slip speed
- Independent of the size of the area in contact
- Proportional to the perpendicular force between the surfaces (4)

4.2 4.2.1 $F = mg$

$m = \frac{500}{9{,}8}\surd$ (1/2)

m = 51,02 kg√ (1/2) (1)

4.2.2



$F_n = 500cos20° - Psin15°$✓
$F_\mu = Pcos15° - 500sin20°$✓

$\mu = \frac{F_\mu}{F_n}$

$0{,}2 = \frac{P\ x\ 0{,}966 - 171{,}01}{469{,}846 + P\ x\ 0{,}259}$ ✓
$93{,}969 + 0{,}052P = 0{,}966P - 171{,}01$✓
$0.9142P = 263{,}979$
$P = 288{,}574\ N$✓✓ (6)

4.3
- Vehicles are tested against a specified angle of repose to ascertain whether they can come to a stop and then start again
- In the design of chutes in silos to convey grain
- In the design of scoops for power shovels
- In the design of railway carriages that transport iron ore (Any 2 × 1) (2)

[13]

QUESTION 5

5.1
- Acts as a power source for locomotives, ships and hoists
- Generates electricity
- Used to heat buildings
- Cook canned food in factories
- Medical equipment, cans and bottles are sterilised with steam

(Any 2 × 1) (2)

5.2 5.2.1
$\beta = 2\alpha$
$= 2\ x\ 20\ x\ 10^{-6}$
$= 40 \times 10^{-6}/°C$✓ (1)

5.2.2
$A_0 = 0{,}45\ x\ 0{,}35 = 0{,}1\ 575\ m^2$✓
$\Delta A = 2\ x\ A_0\ x\ \alpha\ x\ \Delta t$
$= 0{,}1\ 575 \times 40 \times 10^{-6} x\ (120\ °C - 10\ °C)$✓
$= 6{,}93 \times 10^{-4}\ m^2$✓ (3)

5.2.3
$\Delta l = l_o\ x\ \alpha\ x\ \Delta t$
$= 0{,}45 \times 20 \times 10^{-6} \times 110$✓
$= 9{,}9\ x\ 10^{-4}\ m$✓
$l_2 = 0{,}45 + 9{,}9\ x\ 10^{-4}$
$= 0{,}45099$ m✓
$\Delta b = b_o\ x\ \alpha\ x\ \Delta t$
$= 0{,}35 \times 20 \times 10^{-6} \times 110$
$= 7{,}7\ x\ 10^{-4}$✓
$\therefore b_2 = 0{,}35 + 7{,}7\ x\ 10^{-4}$
$= 0{,}35077\ m$✓ (5)

5.3
$\Delta H_{gained} = \Delta H_{lost}$
$m\ x\ 4\ 187(100\ °C - 35\ °C) = 13{,}5\ x\ 500\ x\ (800\ °C - 100\ °C)$✓✓
$m = 17{,}361\ kg$✓
$v = 17{,}361\ l$ ✓ (4)
[15]

QUESTION 6

6.1 6.1.1
$\frac{F}{D^2} = \frac{f}{d^2}$
$F = 400\ x\ 0{,}055^2/0{,}012^2$✓
$F = 8\ 402{,}778\ N$✓ (2)

6.1.2
$D^2\ x\ H = d^2 x\ h\ x\ n$
$5{,}5^2\ x\ H = 1{,}2^2\ x\ 20\ x\ 20$✓
H = 19,041 cm✓
H = 190,41 mm✓ (3)

6.1.3 $V = \frac{\pi d^2}{4} x\ h\ x\ n$

$= \frac{\pi\ x\ 0{,}012^2}{4} x\ 0{,}2\ x\ 20$✓

$= 4{,}524\ x\ 10^{-4}\ m^3$✓

$= 0{,}452\ l$✓ (3)

6.2
- Experiment to show that pressure in a liquid is directly proportional to depth
- Experiment to show upward and downward pressure at a point in a liquid
- Experiment on the relationship between directional pressure in a liquid
- Experiment to show that pressure in a liquid is independent of the shape and size of the container (Any 3 × 1) (3)

6.3 True (1)
[12]

QUESTION 7

7.1
- Coats low-cost metals with a thin layer of precious metals
- Chromes tips, hub caps and lettering on cars
- Protects metals against rust, blemish and wear
- Plates the contact points of electric conductors with metals
- Builds up worn components by plating metals onto them (Any 2 × 1) (2)

7.2 7.2.1 $R_T = R_{P+}\ R_S$

$= [1/4 + 1/6]^{-1} + 0{,}6\ \Omega$ ✓

$= 2{,}4\ \Omega + 0{,}6$

$= 3\ \Omega$✓ (2)

7.2.2 $I_T = \frac{V}{R}$

$= \frac{6\ V}{3\ \Omega}$✓

$= 2$ A✓ (2)

7.2.3 $V_{parallel} = I_t\ x\ R_p$

$= 2$ A × 2,4 Ω

$= 4{,}8$ V✓

$I_4 = \frac{v}{r}$

$= \frac{4{,}8\ v}{4\ \Omega}$✓

$= 1{,}2$ A✓ (3)

7.3 7.3.1 $\frac{N_p}{N_s} = \frac{V_p}{V_s}$

$\frac{50}{280} = \frac{220}{V_s}$ ✓

$V_s = 1\ 232$ V✓ (2)

7.3.2 Voltage per turn = $\frac{220\ V}{50}$ OR $= \frac{1\ 232\ V}{280}$

= 4,4✓ = 4,4✓

(1)
[12]

QUESTION 8

8.1
- Structure of their core
- The number of electrons outside the core
- The arrangement of the outermost electrons (Any 2 × 1) (2)

8.2
- Surface corrosion
- Pure corrosion
- Intergranular corrosion
- Pure electrochemical corrosion (Any 2 × 1) (2)

8.3 8.3.1 Cu and Zn
8.3.2 Ca, C and O

(2 × 1) (2)
[6]

TOTAL: 100

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