higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

ENGINEERING SCIENCE N2

7 APRIL 2015

This marking guideline consists of 9 pages.

QUESTION 1

1.1 1.1.1 Distance= 100+50+60
=210km ✓ (1)

1.1.2 Displacement
$a^2 = b^2 + c^2$ ✓

$a = \sqrt{50^2 + 40^2}$ ✓

a = 64, 031km ✓ (3)

1.1.3 Speed

V = s/t

$= \frac{210}{5,5}$ ✓

= 38,1818km / hr

= 10,606 m / s ✓ (2)

1.1.4 Velocity

V = s/t

$= \frac{64, 031}{5,5}$ ✓

= 11, 642 km /h

= 3, 2328 m/s ✓ (2)

1.2 1.2.1 Time to come to rest

$t = \frac{v - u}{a}$

$= \frac{0 - 33,33}{-15}$ ✓

= 2, 222 s ✓ (2)

1.2.2 $S = ut + \frac{1}{2}at^2$

$= 33{,}33 \times 2{,}222 + \frac{1}{2}(-15)(2, 222)^2$ ✓

$= 37, 0296$ m ✓

OR

$S = \frac{v^2 - u^2}{2a}$

$= \frac{(0)^2 + (33{,}33)^2}{2(-15)}$ (2)

$= 37{,}02963$ m

1.3 Velocity is speed in given direction✓ or rate of change in displacement ✓while acceleration is the rate of change of velocity. ✓

(3)
[15]

QUESTION 2

2.1 A single force that replaces a system of forces✓ and still has the same effect as the forces acting together.✓ (2)

2.2 2.2.1 Take moments about L

$\sum cwm = \sum Acwm$

$60(6) = 15(1) + 20(4) + F(7)$ ✓

$360 = 15 + 80\ 7(F)$ ✓

$F = 37, 857$ kN ✓ (3)

2.2.2 Reaction L

$\sum F = \sum F$

$L + R = 15 + 20 + 37, 857$

$L + 60 = 72, 857$ ✓

$L = 12, 857$ kN ✓ (2)

2.3 Equilibrant
E = 300 – 180
= 120 N WEST / LEFT (3)
[10]

QUESTION 3

3.1 Potential energy is the energy a body possesses due to its mass and height✓
and kinetic energy is energy a body possesses due to its mass and velocity.✓ (2)

3.2 3.2.1 $V = u + gt$

$0 = u + (-9,8)\ 3,5$

$U = 34,3$ m/s

$S = ut + ½\ at^2$

$S = 34,3\ (3,5) + ½\ (-9,8)\ 3,5^2$ ✓

$S = 60,025$ m ✓

OR

$V^2 = U^2 + 2as$

$0^2 = 34,3^2 + 2\ (-9,8)\ S$

$S = 60,025$ m (2)

3.2.2 S Total = S up + S down

= 60, 025 + 60, 025

= 120, 05 m ✓ (1)

3.3 h = 210 x Sin 15°

= 54, 352 m ✓

Ep = m x g x h

Ep = 1000 x 9,8 x 54, 352 ✓

Ep = 532649, 6 J ✓

(3)

3.4 3.4.1 $Ek = ½ mv^2$

$Ek = ½ \times 0,27 \times 180^2$ ✓

$Ek = 4374$ J ✓ (2)

3.4.2 $P = m \times v$

$= 0,27 \times 180$ ✓

$= 48,6$ kg m/s ✓ (2)
[12]

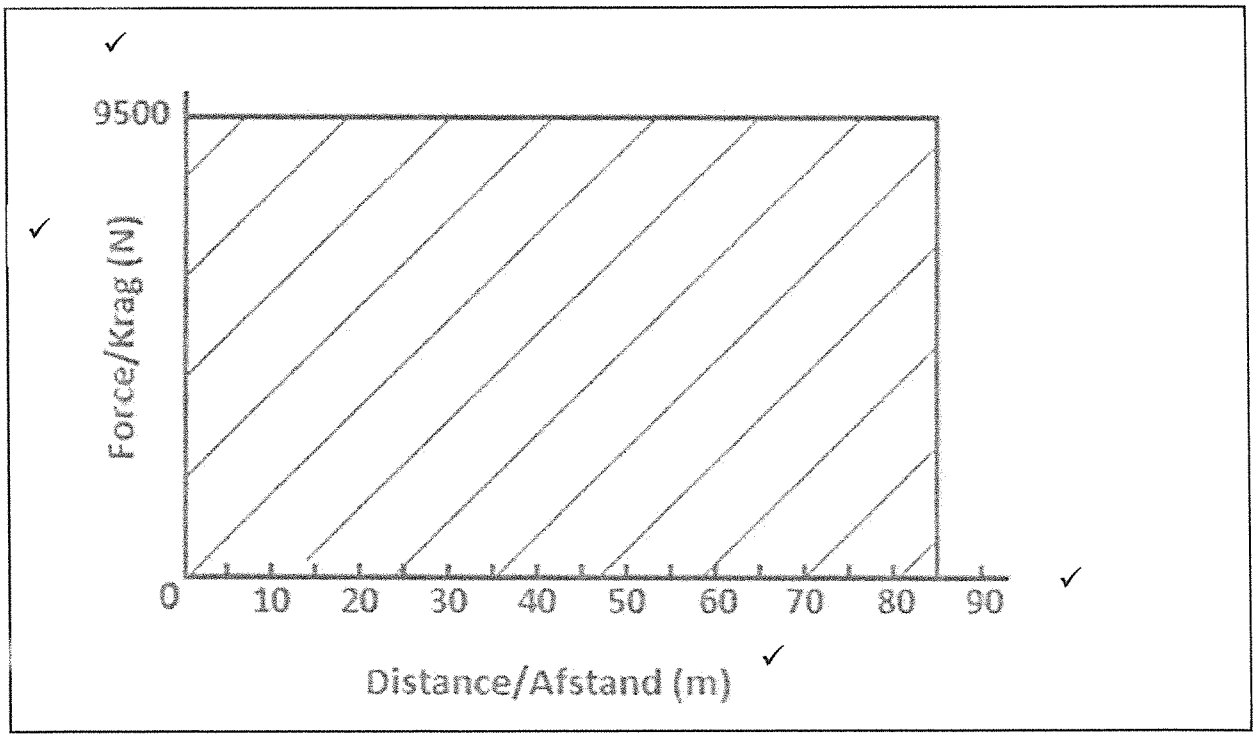
QUESTION 4

4.1 Rate at which work is done ✓per second. ✓ (2)

4.2 4.2.1 Force / Distance

(2)

Force / Distance Graph



4.2.2 $WD = F \times S$

$= 9500 \times 90$ ✓

$= 855\,000$ J or 855 kJ ✓ (2)

4.3 $Po = \frac{F \times S}{t}$

$= \frac{(2\,000 \times 9{,}8) \times 20}{40}$ ✓ ✓

$= 9\,800$ W ✓ (3)

[9]

QUESTION 5

5.1
- Use smaller space ✓
- More torque (power) ✓
- Less maintenance
- No slip

any two (2)

5.2 5.2.1 $TA \times NA = TB \times NB$

$60 \times NA = 75 \times 140$ ✓

$NA = 175$ r/s ✓ (2)

5.2.2 $Tc \times Nc = ND \times TD$ $N_8 = Nc = 140$

$110 \times 140 = TD \times 340$ ✓

To = 45, 29 T use To = 45 T ✓ (2)

5.3 5.3.1 $T1 = 4T2$

$600 = 4 \times T2$ ✓

$T2 = 150$ N ✓ (2)

5.3.2 $Fe = T1 - T2$

$= 600 - 150$

$= 450$ N ✓ (1)

5.3.3 $Po = Fe \times V$

450×20 ✓

$= 9\,000$ W ✓ (2)

[11]

QUESTION 6

6.1 6.1.1 $Fc = m.g.Cos\ \theta$

$= 70 \times 9,8 \times Cos\ 34° \checkmark$

$= 568, 719\ N \checkmark$ (2)

6.1.2 $Fs = mg\ Sin\ \theta$

$= 70 \times 9,8 \times Sin\ 34° \checkmark$

$= 383, 6\ N \checkmark$ (2)

6.1.3 $F\mu = \mu (NR)$

$= 0, 27\ X\ 568, 719 \checkmark$

$= 153, 554\ N \checkmark$ (2)

6.1.4 $F + F\mu = F\ S$

$F = F\ S - F\ \mu$

$= 383, 6 - 153, 554 \checkmark$

$= 230, 046\ N \checkmark$ (2)

6.2 6.2.1 False ✓ (1)

6.2.2 True ✓ (1)

6.2.3 False ✓ (1)
[11]

QUESTION 7

7.1 Amount of heat energy released✓ when 1 kg of a fuel is completely burnt. ✓ (2)

7.2 7.2.1 $Q = m \times HV$

$= 50 \times 30 \checkmark$

$= 1500\ MJ \checkmark$ (2)

7.2.2 $\Delta t = T_2 - T_1$

$= 200 - 10$

$= 190$

$Q = m \times c \times \Delta t$

$= 50 \times 500 \times 190$

$= 4750\ 000\ J$

$= 4,75\ MJ$ (2)

7.2.3 $\eta\ \% = \frac{\text{output}}{\text{Input}} \times \frac{100}{1}$

$= \frac{475}{1500} \times 100$

$= 0,32\%$ (2)

7.3 The amount of heat energy required to heat 1 kg✓ of a substance by 1 °C.✓ (2)

7.4 Heat lost steel nut = Heat gained (water)
$m \times c \times \Delta t = m \times c \times \Delta t$
$ms \times 500 \times 721$ ✓ $= 0,79 \times 4\ 187 \times 11$ ✓
$ms = 0,1$ kg ✓ (3)

7.5 Final length

$\Delta L = Lo \times \propto \times \Delta t$
$\Delta L = 29\ 000 \times 0,000017 \times 49$
$\Delta L = 24,157$ mm
$= 0,024157$ m

$LF = Lo + \Delta L$
$= 29000 + 24,157$ ✓ $= 29\ m + 0,024157\ m$
$= 29024,157$ mm ✓ $= 29,024\ m$ (2)
[15]

QUESTION 8

8.1
- Neutron ✓
- Proton ✓ (2)

8.2
- Cathode - Negative (-) ✓
- Anode - Positive (+) ✓ (2)

8.3 • Electroplating ✓
• Electrorefining ✓ (2)

8.4 An electrolyte is a solution that is able to conduct electric current ✓ (1) [7]

QUESTION 9

9.1 Material has a high resistance to electron flow,✓ e.g. wood ✓ (any relevant answer) (2)

9.2 Resistance of one resistor

$$\frac{1}{Rp} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$$

$$\frac{1}{Rp} = \frac{1}{R1} + \frac{1}{R1} + \frac{1}{R1} \checkmark$$

$$\frac{1}{5} = \frac{1+1+1}{R1}$$

R1 = 3 x 2,5 ✓
R1 = 7,5 Ω ✓ (3)

9.3 • Generate ignition spark ✓
• Transformers
• Generators (Any 1 x 1) (1)

9.4 Calculate resistivity

$A = \frac{\pi}{4} d^2$

$= \frac{\pi}{4} 0,01^2$

$= 78,539 \times 10^{-6} m^2$ ✓

OR

$A = \pi r^2$

$= \pi (0,005)^2$

$= 7,8539 \times 10^{-5} m^2$

$R = \frac{p \times l}{A}$

$P = \frac{R \times A}{L}$

$P = \frac{20 \times 78,539 \times 10^{-6}}{10\,000}$ ✓

$= 0,157078 \times 10^{-6}$

$= 1,5708 \times 10^{-7}\ \Omega m$ ✓ (4) [10]

TOTAL: 100