higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

ENGINEERING SCIENCE N2

1 APRIL 2016

This marking guideline consists of 9 pages.

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ALTERNATE CORRECT ANSWERS MUST BE CONSIDERED

QUESTION 1

1.1 1.1.1 $v = u + at$,
$t = (v - u) / t = (90 - 0) / 10 = 9$ s

1.1.2 $s = (v^2 - u^2) / (2a) = (90^2 - 0) / (2 \times 10) = 405$ m

(2 x 2) (4)

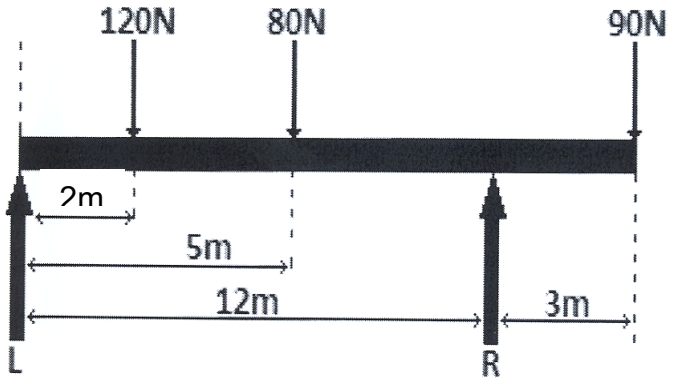
1.2

QUANTITY	BASIC SI UNIT
Force	**N**
Pressure	Pa or N/m^2✓
Acceleration	m/s^2✓
Resistivity	Ωm✓
Energy	J✓
Distance	m✓
Specific heat capacity	J/kg °C✓
Coefficient of linear expansion	/°C✓

(7)
[11]

QUESTION 2

2.1 2.1.1



Sketch of the beam ✓✓ (2)

2.1.2 ∑ML=0 Rx12 = 120x2 + 80 x 5 + 90 x15✓
12R =240 + 400 + 1 350✓
R = 165,83 N✓

∑MR = 0 120 x 10 + 80 x 7✓ = 90 x 3 + 12 L✓
L = 124,17 N✓ (2 x 3) (6)

2.1.3 $\sum F_{uo} = \sum F_{down}$

$124{,}17 + 165{,}83 = 120 + 80 + 90$

$290\ N = 290N$ (1)

2.2 Vc = 250 sin 40^0 ☑

= 160,7 N ☑ (2)
[11]

QUESTION 3

3.1 v = $\sqrt{2xgxh}$ = $\sqrt{2x9{,}8x50{,}5}$ = 31,46 m/s ✓✓ (2)

3.2 m = (2 486)/(9,8 x 50,5) = 5,02 kg✓✓

OR

m = 2 486 / (0,5 x $31{,}46^2$) = 5,02 kg✓✓ (2)

3.3 P.E. = 2 486 joules ✓ (1)

3.4 Momentum = m x v = 5,02 x 31,46 = 157,93 kg m/s ✓✓ (2)
[7]

QUESTION 4

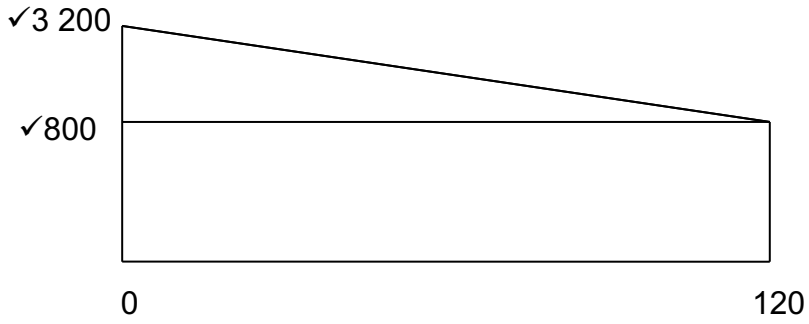
4.1 Power delivered at a rate of 1 joule per second. ✓ (1)

4.2 4.2.1 $W = w \times L$

$= 20 \times 120$

$= 2\,400$ N ✓ (1)

4.2.2



(2)

4.2.3 $W_{total} = W_{triangle} + W_{rectangle}$.

$= (0{,}5 \times 120 \times 2\,400) + (800 \times 120)$✓

$= 240\,000$ J ✓

$= 240$ KJ ✓ (3)

4.3 $T = F \times r$

$= 3\,500 \times 0{,}28$ ✓

$= 980$ Nm ✓

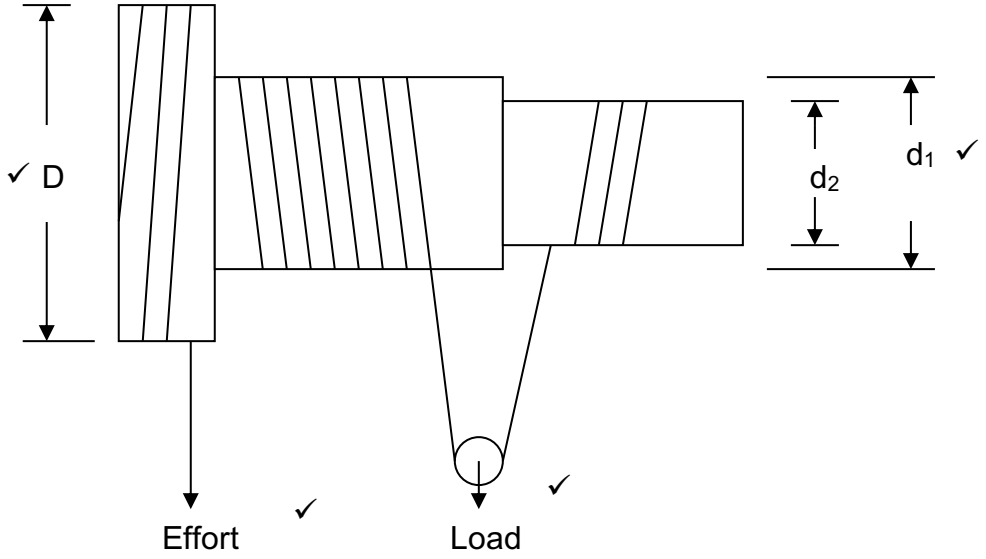
$r = D/2$
$= 0{,}56/2$
$= 0{,}28$ m ✓

(3)
[10]

QUESTION 5

5.1 Velocity ratio (also displacement ratio) is the ratio of the distance moved✓ by the effort as opposed to the distance moved by the load. ✓ (2)

5.2



(4)

5.3 5.3.1

$$Effort = \frac{Load}{MA}$$
$$= \frac{1100}{16}$$
$$= 68{,}75\ N \quad ✓$$

(1)

5.3.2

$$VR = \frac{2D}{(d_1 - d_2)}$$
$$= \frac{2 \times 520}{(340 - 290)} \quad ✓$$
$$= 20{,}8 \quad ✓$$

(2)

5.3.3 $\eta = \frac{MA}{VR}$

$= \frac{16}{20.8}$ X 100 ✓

= 0.77 X 100

= 76.92 % ✓

(2)

5.4 5.4.1

$$T_A = \frac{T_B \times N_B}{T_B}$$

$$= \frac{65 \times 750}{1\,950} \quad ✓$$

$$= 25 \ Teeth \quad ✓$$

(2)

5.4.2

$$N_D = \frac{T_C \times N_C}{T_D} \qquad NOTE \ \ N_B = N_C$$

$$= \frac{20 \times 750}{50} \quad ✓$$

$$= 300 \ r/m \quad ✓$$

(2)

5.5

$$P = \rho g h$$

$$h = \frac{\mathrm{P}}{\rho g}$$

$$= \frac{83{,}52 \times 10^3}{1\,000 \times 9{,}8} \quad ✓$$

$$= 8{,}52 \ m \quad ✓$$

(2)
[17]

QUESTION 6

6.1
- Applying lubricant✓
- Making the surfaces in contact as smooth as possible✓

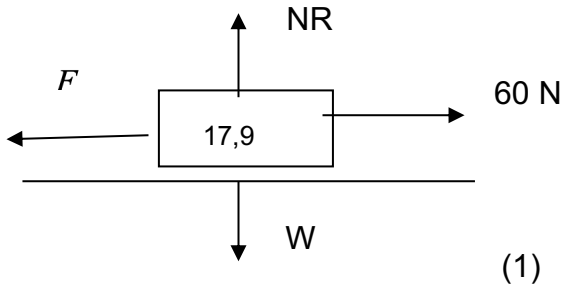
(2)

6.2 6.2.1

$$\mu = \frac{F_\mu}{NR} \qquad F_\mu = 60 \ N$$

$$= \frac{60}{175{,}42} \qquad and \ \ NR = W = mg = 17{,}9 \times 9{,}8$$

$$= 0{,}342 \qquad = 175{,}42 \ N✓$$



(1)

6.2.2

$$\mu = \tan\theta$$

$$\theta = \tan^{-1}\mu$$

$$= \tan^{-1}(0{,}342)$$

$$= 18{,}88° \quad ✓$$

(1)

6.3 6.3.1 $F_{\perp} = w\cos\theta$
$= 20 \times 9{,}8 \times \cos 11$
$= 192{,}4\ N$ ✓ (1)

6.3.2 $F_{//} = w\sin\theta$
$= 20 \times 9{,}8 \times \sin 11$
$= 37{,}4\ N$ ✓ (1)

6.3.3 $\mu = \frac{F_{\mu}}{NR}$
$F_{\mu} = \mu \times NR$ $N_R = mgCos\Theta$✓
$= 0{,}32 \times 20 \times 9{,}8 \times Cos11$ ✓
$= 61{,}568\ N$ (2)

6.3.4 $\sum F_{up} = \sum F_{down}$
$F_{\mu} = F + W\sin\theta$
$61{,}568 = F + 37{,}4$ ✓
$F = 24{,}168\ N$✓ (2)
[10]

QUESTION 7

7.1 Specific heat capacity: This is the heat energy needed to change the temperature of unit mass (1 kg) ✓of a substance by unit temperature (1 ºC).✓ (2)

7.2 Boiler input: = 50/0,8 = 62,5 megawatt ✓
Coal input = 62,5/30 = 2,08 kg/sec.✓
Coal input = 2,08 x 60 = 124,8 kg/min✓ (3)

7.3 ΔL = L x α x Δt $\Delta t = \frac{\Delta L}{L \times \alpha} = \frac{0{,}004}{6 \times 17 \times 10^{-6}} = 39{,}22$ ºC✓✓
t_{warm} = 39,22 + 20 = 59,22 ºC ✓ (3)

7.4 Sensible heat is the heat added or removed from water✓ which will cause a temperature change (water in the liquid form) ✓ (2)

7.5 Q = m x C x Δt Q = 50 x 4187 x (85 – 16)✓
Q = 14,445 MJ ✓ (2)
[12]

QUESTION 8

8.1 When an atom gains or loses one or more electrons it is said to be ionised with a negative or positive charge. It is referred to as an ion. ✓ (1)

8.2 When electrons ✓are removed or lost✓ (2)

8.3 Protons✓ – positive✓
Electrons✓– negative✓
Neutrons✓– neutral✓ (6)
[9]

QUESTION 9

9.1 9.1.1

$$R_{AB} = \frac{R_A \times R_B}{R_A + R_B}$$
$$= \frac{30 \times 6}{30 + 6} \checkmark$$
$$= 5\ \Omega \checkmark$$

OR

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{30} \checkmark$$
$$\frac{1}{R_P} = \frac{6}{30}$$
$$R_P = 5\ \Omega \checkmark$$

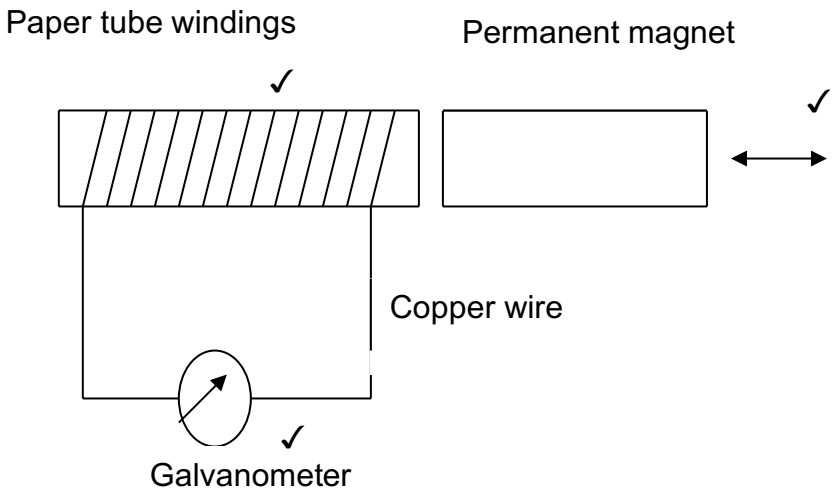
1 substitution

1 correct answer (minus ½ units) (2)

9.1.2
$$R_{AC} = R_{AB} + R_{BC}$$
$$= 5 + 10 \checkmark$$
$$= 15\Omega \checkmark$$

1 answer (mark with error 9.1.1) (2)

9.2 Minus 1 for incorrect diagram or diagram without labelling



(3)

9.3
- Number of turns in the coil
- Speed of the relative motion
- Strength of the magnet (3 × 1) (3)

9.4
- Generators
- Transformers
- Electrical motors (Any 1 × 1) (1)

9.5 $l = ?$

$a = 7{,}07 \times 10^{-3}\ m^2$

$R = 2\ \Omega$

$t = 20°C$

$\rho = 0{,}000\ 000\ 028\ \Omega m = 0{,}028 \times 10^{-6}$

$$R = \frac{\rho \times l}{a}$$

$$l = \frac{R \times a}{\rho}$$

$$= \frac{2 \times 7{,}07 \times 10^{-3}}{0.028 \times 10^{-6}}$$ ✓ 1 substitution

$$= 505000\ m$$ ✓ 1 correct answer (2)

[13]

TOTAL: 100

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