higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N2

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This marking guideline consists of 8 pages.

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QUESTION 1: DYNAMICS

1.1 1.1.1 Acceleration is the rate of change✓ in velocity.✓

1.1.2 Speed is the rate✓ at which distance is covered.✓

(2 × 2) (4)

1.2 1.2.1

$$a = \frac{v-u}{t}$$
$$= \frac{15-5}{30}\checkmark$$
$$= 0{,}333\ \text{m/s}^2\checkmark$$

(2)

1.2.2

$$S = lb + \tfrac{1}{2}bh$$
$$= (30\times 5) + (\tfrac{1}{2}\times 30\times 10)\checkmark$$
$$= 300\,\text{m}\checkmark$$

OR

$$S = \left(\frac{15+5}{2}\right)30\checkmark = 300m\checkmark$$

(2)

1.2.3

$$S = A_1 + A_2$$
$$= 300 + (20\times 15)$$
$$= 600\,\text{m}\checkmark$$

$$V = \frac{s}{t}$$
$$= \frac{600}{50}\checkmark$$
$$= 12\ \text{m/s}\checkmark$$

(3)

1.3 1.3.1

$$t = \frac{v-u}{a}$$
$$= \frac{41{,}667-0}{12}\checkmark$$
$$= 3{,}472\,\text{s}\checkmark$$

1.3.2

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

$$S = \frac{41{,}667^2-0^2}{2(12)}\checkmark$$
$$= 72{,}339\text{m}\checkmark \text{ accept } 72.338\text{m}$$

(2 × 2) (4)

[15]

QUESTION 2: STATICS

2.1
- Tap wrench
- Torgue wrench
- Cross wheel spanner
- Water spray
- Door handle
- Wingnut spanner
- Thread cutters

(Any 2 × 1) (2)

2.2 For every action✓ there is an equal reaction in the opposite direction.✓ (2)

2.3 Take moments about L

$\Sigma \curvearrowleft M = \Sigma \curvearrowright M$

$(30 \times 3) + (55 \times 6) = (R \times 7) + (90 \times 1)$ ✓✓

$7R = 330$

$R = 47{,}143$ N✓

Take moments about R

$\Sigma \curvearrowleft M = \Sigma \curvearrowright M$

$(L \times 7) = (90 \times 8) + (30 \times 4) + (55 \times 1)$ ✓✓

$7L = 895$

$L = 127{,}857$ N✓

(6)
[10]

QUESTION 3: ENERGY AND MOMENTUM

3.1 Kinetic energy is the energy an object possesses:
- Due to its motion✓
- Due to its mass and velocity✓

(Any 1 × 1) (1)

3.2 3.2.1

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

$= (0 \times 2{,}5) + \frac{1}{2}(9{,}8)(2{,}5)^2$✓

$= 30{,}625$m✓

3.2.2

$v^2 = u^2 + 2gh$

$v = \sqrt{2 \times 9{,}8 \times 30{,}625}$✓

$= 24{,}5$m/s✓

OR

$v = u + gt$

$= 0 + 9.8 \times 2.5$✓

$= 24.5\ m/s$✓

3.2.3

$P = mv$

$= 20 \times 24{,}5$✓

$= 490$ kg.m/s✓

(3 × 2) (6)
[7]

QUESTION 4: WORK, POWER AND EFFICIENCY

4.1 Power is the rate at which work is done. (1)

4.2 4.2.1

$$W = \frac{445}{15}$$
$$= 29{,}667 \text{ N/m}\checkmark$$ (1)

4.2.2

$$W = F_{ave} \times S$$
$$= \left(1000 + \frac{0+445}{2}\right) \times 15 \checkmark\checkmark$$
$$= 18337{,}5 \text{ J}\checkmark$$ **OR**

$$W = lb + \tfrac{1}{2}bh$$
$$= (1000 \times 15) + (\tfrac{1}{2} \times 15 \times 445) \checkmark\checkmark$$
$$= 18337{,}5 \text{ J}\checkmark$$ (3)

4.2.3

$$P = F_{ave} \times V$$
$$= \left(1000 + \frac{0+445}{2}\right) \times 5 \checkmark$$
$$= 6112{,}5 \text{ W} \quad \checkmark$$ **OR**

$$t = \frac{S}{V} \qquad P = \frac{W}{t}$$
$$= \frac{15}{5} \qquad = \frac{18337{,}5}{3} \checkmark$$
$$= 3 \text{ s} \qquad = 6112{,}5 \text{ W}\checkmark$$

(2)

4.3 4.3.1

$$T_r = 30N/t \times 250t$$
$$= 7500 \text{ N}\checkmark$$ (1)

4.3.2

$$P = FV$$
$$= 7500 \times 15 \checkmark$$
$$= 112500 \text{ W}\checkmark$$ (2)

[10]

QUESTION 5: MECHANICAL DRIVES AND LIFTING MACHINES

5.1 $$Pab = Pg + Pa = 400 + 101.3 = 501.3\ kPa\checkmark$$ (1)

5.2 $$P = \frac{F}{A} = \frac{1450 \times 9.8 \times 4}{\pi \times 0.35^2}\checkmark = 147.696\ kPa\checkmark$$ (2)

5.3 5.3.1
$$T_2 = \frac{T_1}{3}$$
$$= \frac{642}{3}\checkmark$$
$$= 214\ \text{N}\checkmark$$

5.3.2
$$F_e = T_1 - T_2$$
$$= 642 - 214\checkmark$$
$$= 428\ \text{N}\checkmark$$

5.3.3
$$V = \pi DN$$
$$= \pi(0{,}15)(\tfrac{200}{60})\checkmark$$
$$= 1{,}571\ \text{m/s}\checkmark$$

5.3.4
$$P = F_e V \quad \checkmark$$
$$= 672{,}301\text{W}\checkmark$$

(4 × 2) (8)

5.4 5.4.1
$$E = \frac{L}{MA}$$
$$= \frac{300 \times 9{,}8}{5}\checkmark$$
$$= 588\ \text{N}\checkmark$$ (2)

5.4.2

$$\eta = \frac{MA}{DR} \times 100\%$$

$$DR = MA \times \frac{100}{\eta}$$

$$= 5 \times \frac{100}{25} \checkmark$$

$$= 20 \checkmark$$

$$DR = \frac{2D}{D-d}$$

$$d = \frac{(D \times DR) - 2D}{DR}$$

$$d = \frac{(0{,}5 \times 20) - 2(0{,}5)}{20} \checkmark$$

$$= 0{,}45\,\text{m} \checkmark$$

(4)
[17]

QUESTION 6: FRICTION

6.1 Kinetic friction is the frictional force applicable on a moving object. (1)

6.2
- Makes movement possible.
- Prevents slip.
- Brings moving parts to a standstill.
- Removes unwanted materials.

(Any 2 × 1) (2)

6.3

$$F_{down} = F_{\mu} - w\sin\theta$$

$$= 200 - (11 \times 9{,}8 \times \sin 35^0) \checkmark$$

$$= 138{,}168\,\text{N} \checkmark$$

(2)

6.4 6.4.1

$$\mu = \frac{F}{N}$$

$$\mu = \frac{30}{176.4} \checkmark = 0.17 \checkmark$$

$$tan\,\phi = \mu$$

6.4.2

$$\emptyset = tan^{-1}\,0{,}17 \checkmark$$

$$\emptyset = 9.652^0 \checkmark$$

(2 × 2) (4)
[9]

QUESTION 7: HEAT

7.1 7.1.1 False
7.1.2 False
7.1.3 True

(3 × 1) (3)

7.2 $Q = mc\Delta t$
$= \frac{5}{1000} \times 1025 \times 3850 \times (90 - (-1.8)\ )$ ✓
$= 1811328.75\text{J}$✓ (2)

7.3 $Q_{lost} = Q_{gained}$
$mc\Delta t = mc\Delta t$
$m \times 500 \times (130 - 65) = 4{,}5 \times 4187 \times (65 - 12)$✓✓
$m = 30{,}726\ \text{kg}$✓ (3)

7.4 $\alpha = \frac{\Delta L}{L_o \Delta t}$
$= \frac{15}{25000 \times (36 - 17)}$ ✓✓
$31{,}578 \times 10^{-6}/^0C$ ✓ OR $0{,}000031578/^0C$ (3)
[11]

QUESTION 8: PARTICLE STRUCTURE OF MATTER

8.1 8.1.1
- A compound is a substance made of two or more elements chemically bonded to one another.✓
- A compound is a substance formed when two or more chemical elements are chemically bonded together.✓
- A compound is a chemical species that is formed when two or more atoms join together chemically with covalent or ionic bonds.✓ (Any 1 × 1)

8.1.2 An ion is an atom that has gained or lost an electron.

8.1.3 Electroplating is the covering of one metal with a thin layer of another metal using an electric current.

8.1.4 An atom is the smallest part of an element.

(4 × 1) (4)

8.2
- Protons – positive
- Electrons- negative
- Neutron – neutral
- Nucleus -positive (4)

[8]

QUESTION 9 : ELECTRICITY

9.1 Potential difference is the difference in the amount of energy✓ that a charge carries between two points in a circuit.✓ (2)

9.2 9.2.1

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_1} + \frac{1}{R_1}$$

$$\frac{1}{9} = \frac{3}{R_1} \checkmark$$

$$R_1 = 27\,\Omega \checkmark$$

$\therefore$ The resistance in each resistor is equal to 27 Ω.

9.2.2

$$I_T = I_1 + I_2 + I_3$$
$$= 0{,}5 \times 3 \checkmark$$
$$= 1{,}5\,\text{A} \checkmark$$

9.2.3

$$V = IR$$
$$= 1{,}5 \times 9 \checkmark$$
$$V = IR\,\text{V} \checkmark$$

OR

$$V = IR$$
$$= 0{,}5 \times 27 \checkmark$$
$$= 13{,}5\,\text{V} \checkmark$$

(3 × 2) (6)

9.3
- Generators
- Transformers
- Electric motors

(Any 1 × 1) (1)

9.4
- Resistivity
- Length
- Cross-sectional area
- Temperature

(4)
[13]

TOTAL: 100

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