higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N2

31 JULY 2019

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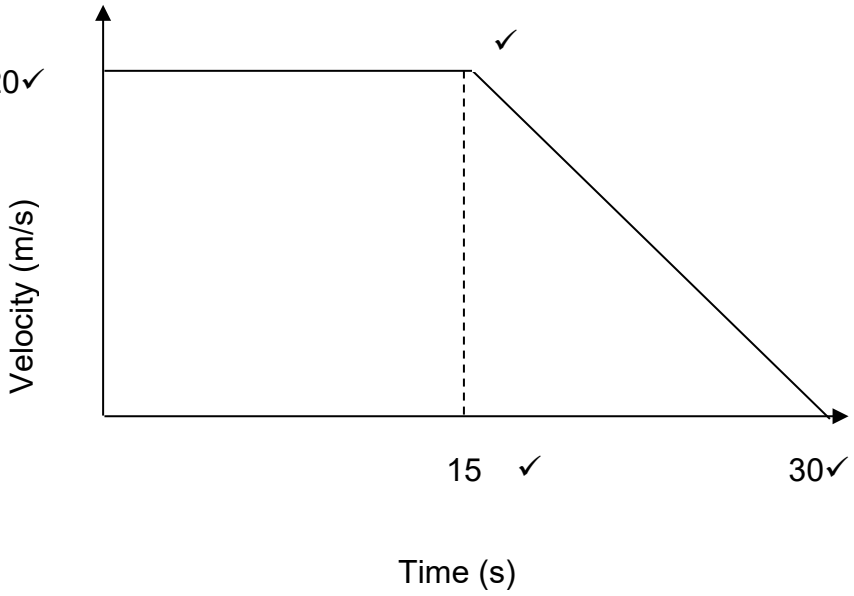
QUESTION 1: DYNAMICS

1.1 It is a path length covered✓ by an object or a body irrespective of direction✓. (2)

1.2 Vector✓: It has both magnitude and direction✓. (2)

1.3



2 marks for labels
2 marks for graph (4)

1.4 1.4.1 $a = \frac{\Delta v}{\Delta t}$

$\frac{= 0 - 20}{30 - 15}$✓

$= -1{,}333\ m/s^2$✓ (2)

1.4.2 $s = \left(\frac{1}{2}\ b\ h\right) + (lb)$✓

$= \left(\frac{1}{2}\ x\ 15\ x\ 20\right) + (20\ x15)$✓

$= 450\ m$✓ (3)

.4.3 $v = \frac{s}{t}$✓

$= \frac{450}{30}$

$= 15\ m/s$✓ (2)

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QUESTION 2: STATICS

2.1 2.1.1

$$\sum M \curvearrowleft = \sum M \curvearrowright$$
$$(200 \times 1) + (400 \times 4) + (150 \times 8) = (R \times 7) \checkmark\checkmark$$
$$200 + 1\,600 + 1\,200 = 7R$$
$$R = 428{,}571\ N \checkmark$$ (3)

2.1.2

$$\sum M \curvearrowleft = \sum M \curvearrowright$$
$$(150 \times 1) + (M \times 7) = (400 \times 3) + (200 \times 6) \checkmark\checkmark$$
$$150 + 7M = 1\,200 + 1\,200$$
$$M = 321{,}429\ N \checkmark$$ (3)

2.1.3

$$\sum \uparrow F = \sum \downarrow F$$
$$428{,}571 + 321{,}429 = 200 + 400 + 150$$
$$750\ N = 750\ N \checkmark$$ (1)

2.2 It is a pair of forces equal in magnitude✓, turning in the same direction about a fulcrum or turning point, but situated on opposite sides of the couple arm. ✓ (2)

2.3
- Water spray
- Door handles
- Wingnut spanner
- Thread cutters

(Any 1 x 1) (1)

[10]

QUESTION 3: ENERGY AND MOMENTUM

3.1 Energy cannot be created or destroyed, but it can be changed or converted from one form to another. (2)

3.2 3.2.1

$$E_P = mgh$$
$$= 50 \times 9{,}8 \times 12 \checkmark$$
$$= 5\,880\ J / 5{,}88\ kJ \checkmark$$ (2)

3.2.2

$$E_K = \frac{1}{2}mv^2$$
$$= \frac{1}{2}(50)(3)^2 \checkmark$$
$$= 225\ J \checkmark$$ (2)

3.2.3

$$p = mv$$
$$= 50 \times 3$$
$$= 150\ kg.m/s \checkmark$$ (1)

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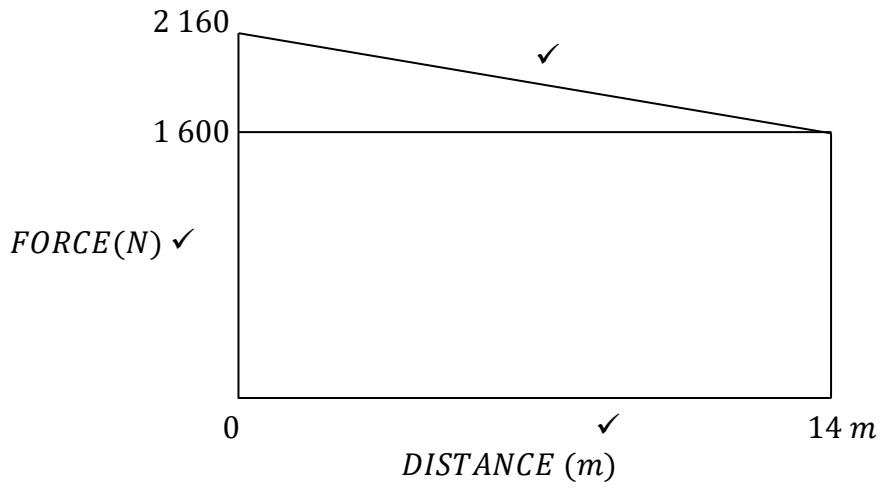
QUESTION 4: WORK, POWER AND EFFICIENCY

4.2 4.1.1



(3)

4.1.2 $W_D = \frac{1}{2}bh + L \times B$

$= \frac{1}{2}(14)(560)\checkmark + (14 \times 1600)\checkmark$

$= 26\,320\ J\checkmark$

OR

$W_D = W_{RP} + W_{BK}$

$= \left(\frac{0 + 560}{2}\right)(14) + (1600 \times 14)$

$= 26\,320\ J$ (3)

4.2 4.2.1 $T = F \times r$

$1\,200 = F \times 0{,}6\checkmark$

$F = 2\,000\ N\checkmark$ (2)

4.2.2 $W = T \times 2\pi$

$= 1\,200 \times 2\pi\checkmark$

$= 7\,539{,}822\ J\checkmark$ (2)

[10]

QUESTION 5: MECHANICAL DRIVES AND LIFTING MACHINES

5.1
- No slip occurs with chain drives.
- Chain drives are more durable. (2 x 1) (2)

5.2 5.2.1 $P = F_e \times v$

$= 350 \times 15\checkmark$

$= 5250W\checkmark$

5.2.2 $60v = \pi DN$

$900 = \pi \times 0{,}5 \times N\checkmark$

$N = 572{,}96rpm\checkmark$

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5.2.3 $N_A D_A = N_B D_B$ OR $900 = \pi DN$
$N_A \times 0{,}100 = 572{,}96 \times 0{,}5$✓ $900 = \pi \times 0{,}1 \times N$✓
$N_A = 2864{,}8rpm$✓ N = 2864,8rpm✓

(3 × 2) (6)

5.3 5.3.1 $MA = \frac{LOAD}{EFFORT}$
$= \frac{15}{9}$✓
$= 1{,}67$✓

5.3.2 $VR = \frac{effort\ distance}{load\ distance}$
$= \frac{2{,}4}{0{,}75}$✓
$= 3{,}2$ ✓

(2 × 2) (4)

5.4 A confined fluid transmits externally applied pressure uniformly in all direction (2)

5.5 P = ρgh
h= P✓
ρg

= 350 000 ✓
1 025 × 9,8
= 34,84 m✓ (3)
[17]

QUESTION 6: FRICTION

6.1 Static friction✓ (1)

6.2 6.2.1 $F_{\parallel} = mg\ Sin\ \theta$
$= 10 \times 9{,}8 \times Sin60°$ ✓
$= 84{,}87\ N$ ✓

6.2.2 $F_{\perp} = mg\ Cos\theta$
$= 10 \times 9{,}8 \times Cos60°$ ✓
$= 49\ N$ ✓

6.2.3 $F_{up} = F_{\parallel} + F_{\mu}$
$= 84{,}87 + 10$ ✓
$= 94{,}87\ N$ ✓

6.2.4 $\mu = \frac{F_{\mu}}{N}$
$= \frac{10}{49}$ ✓
$= 0{,}2$ ✓

(4 × 2) (8)
[9]

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QUESTION 7: HEAT

7.1
- Solids – coal, wood
- Fluids – oil, petrol, paraffin, diesel
- Gases – acetylene, hydrogen, propane (3 × 2) (6)

7.2 7.2.1
$$Heat\ energy = mass \times energy\ heat\ value$$
$$= 20 \times 25 \checkmark$$
$$= 500 \times \frac{65}{100} \checkmark$$
$$= 325\ MJ \checkmark$$ (3)

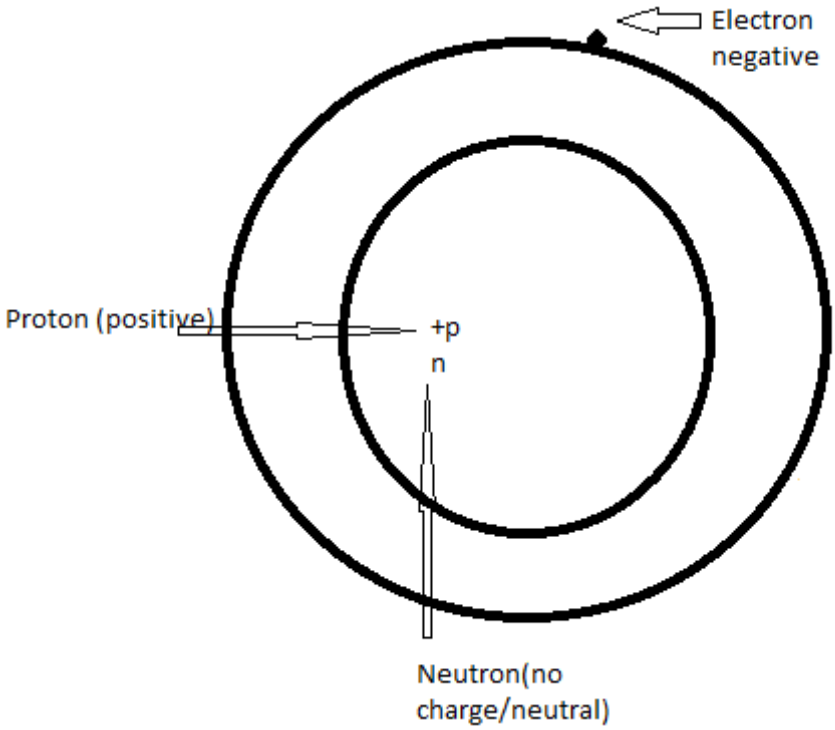
7.2.2
$$Power = \frac{Energy}{Time}$$
$$= \frac{325}{(2 \times 3\ 600)} \checkmark$$
$$= 0{,}0451\ MW \checkmark$$ (2)

[11]

QUESTION 8: PARTICLE STRUCTURE OF MATTER

8.1 It is the smallest part of an element that can function on its own and still contain the properties of that specific element. (1)

8.2



(6)

8.3
- Cells and batteries
- Electroplating
- Electro-refining processes (Any 1 × 1) (1)

[8]

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QUESTION 9: ELECTRICITY

9.1 9.1.1 $R_T = R_1 + \frac{R_2 \times R_3}{R_2 + R_3}$

$= 3 + \frac{2 \times 2}{2+2}$ ✓

$= 4\ \Omega$ ✓

$I_T = \frac{V_T}{R_T}$

$= \frac{12}{4}$ ✓

$= 3\ A$✓ (4)

9.1.2 $V_{\parallel} = I_T R_{\parallel}$
$= 3 \times 1$ ✓
$= 3\ \Omega$ ✓ (2)

9.2 The resistance of the circuit will drop,✓ causing the current to increase✓ as the current and resistance are indirectly or inversely proportional to each other.✓ (3)

9.2 When a magnetic field cuts through the conductor or a conductor cuts through the magnetic field, an electromotive force (EMF) is induced in the conductor. (2)

9.3
- Transformer
- Induction motor
- Prevention of sudden overloading (Any 2 × 1) (2)

[13]

TOTAL: 100

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