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higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N2

18 November 2020

This marking guideline consists of 7 pages.

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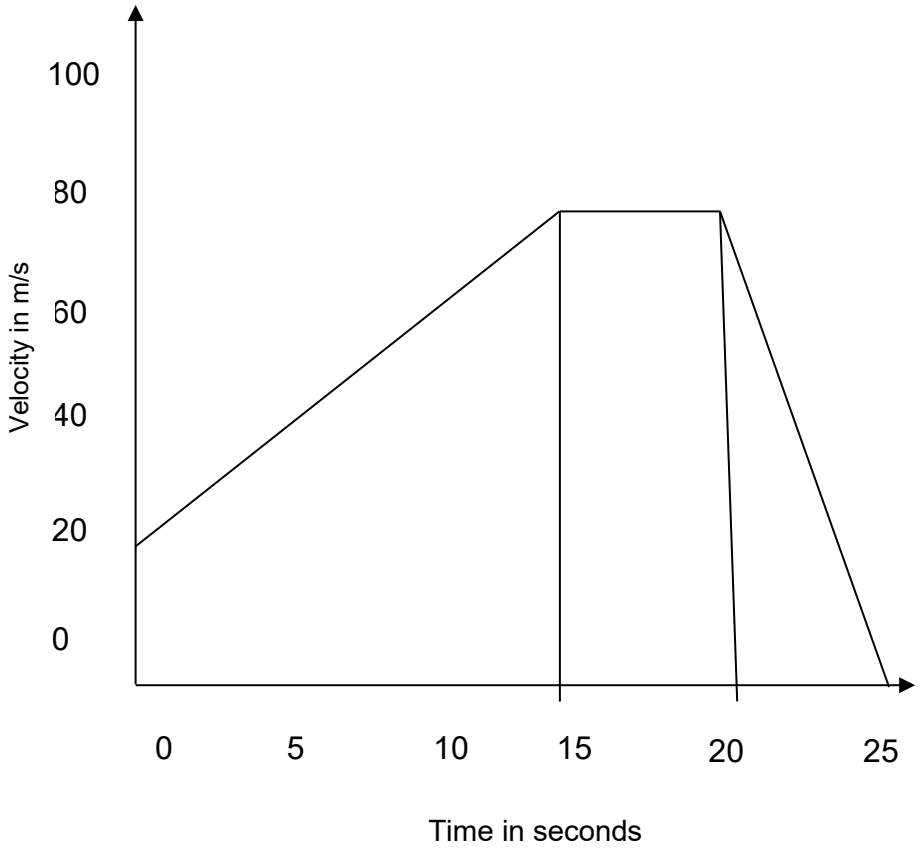
QUESTION 1

1.1 Rate of distance covered (1)

1.2
- Making stationary object move
- Bringing moving object to a standstill
- Changing direction of moving object (Any 2 × 1) (2)

1.3 1.3.1



Labels = (2 × ½) mark
Drawing = 3 marks (4)

1.3.2 $a = \Delta v/\Delta t$

$= \frac{80-20}{15-0}$ ✓

$= 4\ m/s^2$ ✓(any interval between 0 and 15s with corresponding velocities) (2)

1.3.3 $S = (½ \times b \times h) + (l \times b) + (l \times b)$

$= (½ \times 15 \times 60) + (20 \times 15) + (5 \times 80)$ ✓✓✓

$= 450 + 300 + 400$
$= 1\ 150\ m$ ✓ (4)

1.3.4 $a = \Delta v/\Delta t$

$= \frac{0 - 80}{25 - 20}$ ✓

$= -16\ m/s^2$ ✓ (2)

[15]

QUESTION 2

2.1 Single force representing or replacing two or more forces acting at a point (2)

2.2.1 Take moments about M:

$$\sum \curvearrowleft F = \sum \curvearrowright F$$
$$(30 \times 1{,}5) + (20 \times 6{,}5) + (40 \times 10) = (N \times 8)\ \checkmark\checkmark$$
$$P = 71{,}875\ N\ \checkmark$$

Take moments about N:

$$\sum \curvearrowleft F = \sum \curvearrowright F$$
$$(40 \times 2) + (M \times 8) = (20 \times 1{,}5) + (30 \times 6{,}5)\checkmark\checkmark$$
$$M = 18{,}125\ N\checkmark$$ (6)

2.2.2 $\sum \uparrow F = \sum \downarrow F$

$18{,}125 + 71{,}875 = 30 + 20 + 40$

$90\ N = 90\ N\checkmark$ (1)

2.3 Nm (1)

[10]

QUESTION 3

3.1 Energy an object possesses as a result of its motion (2)

3.2

$v^2 = u^2 + 2gs$

$= (0)^2 + 2(9{,}8)(12)\checkmark$

$v^2 = 235{,}2$

$= 15{,}336\checkmark$

$E_K = \frac{1}{2}mv^2$

$= \frac{1}{2}(10)(15{,}336)^2\checkmark$

$= 1\ 175{,}964\ J\ OR\ 1{,}176\ KJ\checkmark$

$p = mv$

$= 10 \times 15{,}336$

$= 153{,}36\ kg.m/s\checkmark$

OR

K_E gain= P_E loss

= mgh

= 10× 9.8× 12✓

= 1176 J ✓

$p = m(2gh)^{\frac{1}{2}}$ ✓

$= 10\times (2 \times 9.8 \times 12)^{\frac{1}{2}}$ ✓

= 153.362 kg.m/s✓ (5)

[7]

QUESTION 4

4.1 A push or a pull upon an object (1)

4.2 4.2.1

$$W_C = 30 \times 40$$
$$= 1\,200\text{N}\checkmark$$

$$W_D = \frac{1}{2}bh + L \times B$$
$$= \frac{1}{2}(40)(1\,200) + (40 \times 1\,800)\ \checkmark$$
$$= 96\,000\ J\ OR\ 96\ KJ\ \checkmark$$

OR

$$W_D = F_{AVE} \times s$$
$$= \frac{3\,000+1\,800}{2} \times 40\checkmark\checkmark$$
$$= 96\,000\ J\ OR\ 96\ KJ\checkmark$$ (3)

4.2.2

$$P = \frac{W}{t}$$
$$= \frac{96\,000}{150}\checkmark$$
$$= 640\ W\checkmark$$ (2)

4.3

$$F_{UP} = F_{\parallel} = mgSin\theta$$
$$= 4 \times 9{,}8 \times Sin15°\checkmark$$
$$= 10{,}146\ N\checkmark$$ (2)

[8]

QUESTION 5

5.1
- Simple gear system
- Compound gear system (2)

5.2 5.2.1

$$N_A T_A = N_B T_B$$
$$975 \times 13 = N_B \times 33\checkmark$$
$$N_B = 384{,}091\ r/min\checkmark$$ (2)

5.2.2

$$N_C T_C = T_D N_D$$
$$384.091 \times 40 = 25 \times N_D\checkmark$$
$$N_D = 614{,}546\ r/min\checkmark$$
$$N_D = 10.24\ r/s\checkmark$$ (3)

5.3
- No slip takes place or occurs with chain drives.
- Chain drives are more durable and requires less replacement.
- More power/torque can be transmitted with chain drives. (2)

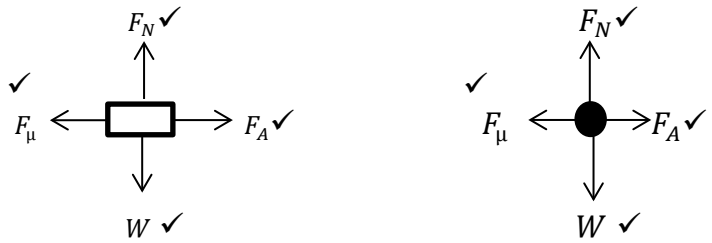
5.4
- Differential wheel and axle lifting device
- Differential winch
- Weston differential pulley or block and tackle (3)

5.5 5.5.1 $v = \pi DN$
$= 3{,}142 \times 0{,}28 \times 40$✓
$= 35{,}186\ m/s\ \ OR\ 35{,}190\ m/s$✓ (2)

5.5.2 $P = (T_1 - T_2)v$
$= (1\,600 - 400)(35{,}190)$ OR $(1\,600 - 400)(35{,}186)$✓✓
$= 42{,}223\ KW$✓ (3)
[17]

QUESTION 6

6.1 6.1.1



- $F_N = Normal\ Force$
- $F_\mu = Frictional\ Force$
- $W = Weight$

$F_A = Force\ Applied\ OR\ Applied\ Force$ (4)

6.1.2 $F_N = W = mg$
$= 25 \times 9{,}8$✓
$= 245\ N$ ✓ (2)

6.1.3 $\mu = \frac{F_\mu}{F_N}$
$= \frac{40}{245}$✓
$= 0{,}16$✓ (2)

6.2 $density = \frac{mass}{volume}$
$1\,000 = \frac{10}{volume}$
$volume = 0{,}01\ m^3$✓
$volume = (0{,}5h)^2 \times h$✓
$0.01 = (0{,}5h)^2 \times h$✓
h=342mm✓ (4)
[12]

QUESTION 7

7.1 Heat gained equals heat lost. (1)

7.2 7.2.1
$$E = m \times HV$$
$$= 150 \times 30 \checkmark$$
$$= 4500\ MJ \checkmark$$ (2)

7.2.2
$$Q = m.c.\Delta t$$
$$= 2\,400 \times 4187 \times 80 \checkmark$$
$$= 803{,}904\ MJ \checkmark$$ (2)

7.2.3
$$\eta = \frac{OUTPUT}{INPUT} \times 100\%$$
$$= \frac{803{,}904}{4500} \times 100\% \checkmark$$
$$= 17{,}864\% \checkmark$$ (2)

7.3
$$\Delta l = l_o.\alpha.\Delta t$$
$$0{,}02415 = 15 \times \alpha \times 70 \checkmark$$
$$\alpha = 0{,}000023/℃ \checkmark$$
- Aluminium rod✓ (3)

[10]

QUESTION 8

8.1 Solution able to conduct electric current or able to transfer electrons (2)

8.2
- Electroplating
- Batteries
- Production of chemicals
- Purifying metals
- Corrosion
- Safeguarding cathode (2)

8.3
- Hardens surface hard and increases wear resistance
- Increases corrosion resistance
- Aesthetic value (Any 2 × 1) (2)

8.4
- Electroplating
- Greasing
- Painting
- Galvanising
- Sacrificial coating (Any 2 × 1) (2)

[8]

QUESTION 9

9.1 Directly proportional (1)

9.2 9.2.1 A (1)

9.2.2 C (1)

9.3 9.3.1

$$R_{\parallel} = \frac{R_2 \times R_3}{R_2 \times R_3}$$
$$= \frac{12 \times 6}{12 + 6} \checkmark$$
$$= 4\ \Omega\ \checkmark$$ (2)

9.3.2

$$R_T = R_1 + R_{\parallel}$$
$$= 8 + 4$$
$$= 12\ \Omega\ \checkmark$$

$$R_T = \frac{V_T}{I_T}$$
$$12 = \frac{18}{I_T} \checkmark$$
$$I_T = 1{,}5\ A \checkmark$$ (3)

9.3.3

$$V_{8\Omega} = I_T R_1$$
$$= 1{,}5 \times 8 \checkmark$$
$$= 12\ V \checkmark$$ (2)

9.3.4

$$V_T = V_{8\Omega} + V_{\parallel}$$
$$18 = 12 + V_{\parallel}$$
$$V_{\parallel} = 6\ V \checkmark$$

$$V_{\parallel} = I_{12\Omega} R_{12\Omega}$$
$$6 = I_{12\Omega} \times 12 \checkmark$$
$$I_{12\Omega} = 0{,}5\ A \checkmark$$ (3)

[13]

TOTAL: 100

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