higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N2

3 APRIL 2018

This marking guideline consists of 6 pages.

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QUESTION 1

1.1 1.1.1 It is the rate of change of displacement.
1.1.2 It is the rate of change of velocity.
(2 × 1) (2)

1.2 1.2.1 $a = \frac{\Delta V}{\Delta t}$
$= \frac{3}{6}$✓
$= 0,5\ m/s^2$✓ (2)

1.2.2 The velocity of the bus decreases in a forward direction. (2)

1.2.3 $S_{0-31s} = \frac{1}{2}bh + L \times B + \frac{1}{2}bh + \frac{1}{2}bh$
$= \frac{1}{2}(6)(3) + (9 \times 3) + \frac{1}{2}(8)(3) + \frac{1}{2}(8)(-3)$ ✓✓
$= 36\ m$✓ (3)

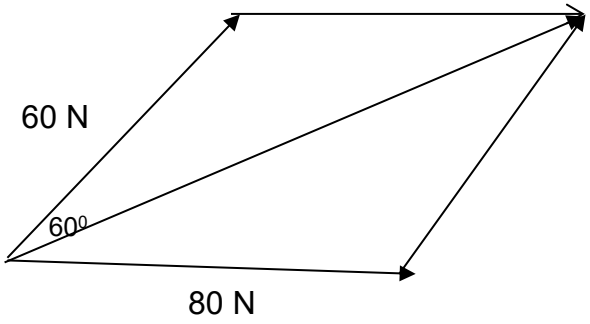
1.2.4 $v = \frac{\Delta s}{\Delta t}$
$= \frac{36}{31}$✓
$= 1,16\ m/s$✓ (2)

1.3 1.3.1 $v^2 = u^2\ 2as$ and $v = \frac{72}{3,6} = 20\ m/s$✓
$(20)^2 = (30)^2 + 2a(25)$ ✓
$a = -10\ m/s^2$✓✓ (4)
[15]

QUESTION 2

2.1 Parallelogram or triangle of forces method (2)

2.2 2.2.1 Scale: $1\ cm = 2\ N$



$R = 122\ N; N64°E$
Drawing = 2 marks
Resultant = 2 marks
Angle of resultant = 1 mark (5)

2.2.2 Equilibrant $= 122\ N; S64°W$ (1)

2.3 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)

2.4
- Water spray
- Door handles
- Wingnut spanner
- Thread cutters

(2)
[12]

QUESTION 3

3.1 Energy cannot be created nor destroyed but can be transformed from one form to another. (2)

3.2 3.2.1 $E_P = mgh$

$= 40 \times 9{,}8 \times 50$ and $\text{Sin}\theta = \frac{\text{OPP}}{\text{HYP}}$

$= 19\,600\ \text{J}/19{,}6\ \text{KJ}$ ✓ $h = 50\ \text{m}$✓ (2)

3.2.2 Gain in KE = Loss in PE✓

$=mg\Delta h$

$=40\times 9.8\times (h_1 - h_2)$✓

$=40\times 9.8\times (50 - 30)$✓

$= 7840\text{J}$✓ (4)

3.2.3 $E_{T(bot)} = E_{p(bot)} + E_{K(bot)}$

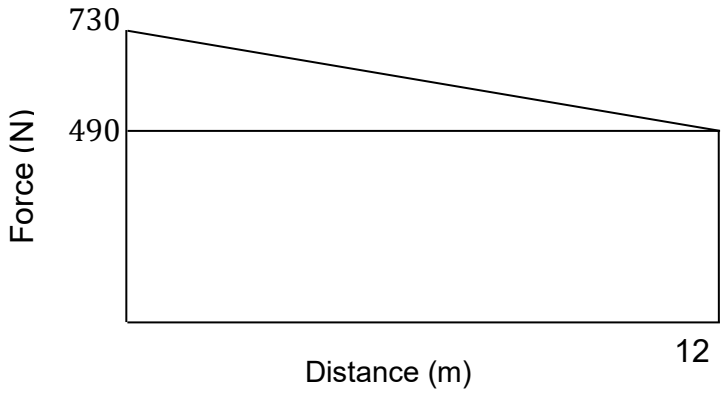
$= 0 + 19\,600$✓

$= 19\,600\ \text{J}$✓ (2)
[10]

QUESTION 4

4.1 The rate at which work is done (1)

4.2 4.2.1



(3)

4.2.2 $W_D = \frac{1}{2}bh + L \times B$ OR $W_D = W_{RP} + W_{BK}$

$= \frac{1}{2}(12)(240) + (12 \times 490)$✓✓ $= \left(\frac{0+240}{2}\right)(12) + (490 \times 12)$

$= 7\,320$ J ✓ $= 7\,320$ J (3)

4.3 4.3.1 $T = F \times r$

$= 1\,000 \times 0{,}4$✓

$= 400$ Nm✓ (2)

[9]

QUESTION 5

5.1 The ratio between the distance moved by the effort and the distance moved by the load (2)

5.2
- Belt drives are quiet.
- Belt drives do not require lubrication.
- Belt drives give a certain amount of slip should the shaft jam or if it is slow to start.
- The direction of the driven shaft can easily be changed by crossing the belts.
- The driver and the driven need not be aligned in confined spaces.
- Belt drives can be used if the driver and the driven are not close to each other.
- The power output of the system may also be varied. (3)

5.3 5.3.1 $MA = \frac{LOAD}{EFFORT}$

$= \frac{5\,880}{600}$✓

$= 9{,}8$✓ (2)

5.3.2 $VR = \frac{2D}{d_1 - d_2}$

$= \frac{2(0{,}6)}{0{,}3 - 0{,}2}$✓

$= 12$✓ (3)

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

$= \frac{9{,}8}{12}$✓

$81{,}67\%$✓ (2)

5.4 5.4.1 $P = pgh$

$= 1\,000 \times 9{,}8 \times 0{,}5$✓

$= 4\,900$ Pa/4,9 KPa✓✓ (3)

[15]

QUESTION 6

6.1 The ratio between the maximum friction force and the normal reaction force (1)

6.2 6.2.1 $F_{\parallel} = mg \text{ Sin } \theta$
$= 5 \times 9{,}8 \times \text{Sin}40°$✓
$= 31{,}5 \text{ N}$✓

6.2.2 $F_{\perp} = mg \text{ Cos}\theta$
$= 5 \times 9{,}8 \times \text{Cos}40°$✓
$= 37{,}54 \text{ N}$✓

6.2.3 $\mu = \frac{F_{\mu}}{N}$
$0{,}25 = \frac{F_{\mu}}{37{,}54}$ ✓
$F_{\mu} = 9{,}84 \text{ N}$ ✓

6.2.4 $F_{UP} = F_{\parallel} + F_{\mu}$
$= 31{,}5 + 9{,}84$✓
$= 41{,}34 \text{ N}$✓

(4 × 2) (8)
[9]

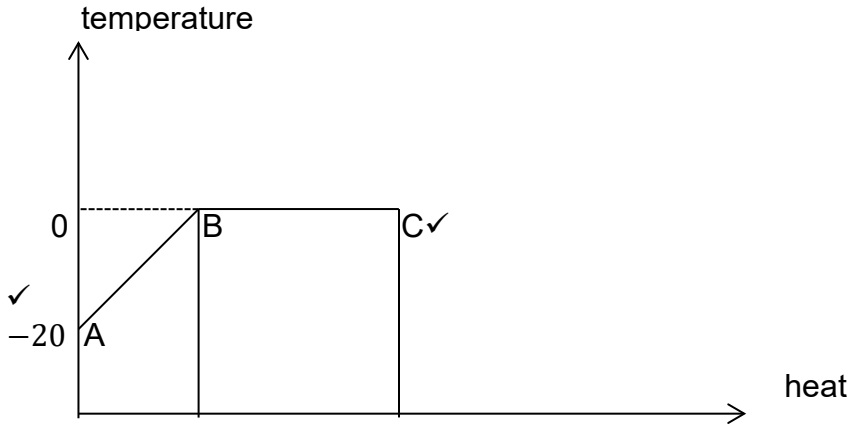
QUESTION 7

7.1
- Solids
- Fluids
- Gases

(Any 2 × 1) (2)

7.2 $m_1 \times shc_1 \times \Delta t_{ST} = m_2 \times shc_2 \times \Delta t_{WT}$ ✓
$40 \times 500 \times (80 - 60) = m_2 \times 4\,187 \times (60 - 20)$ ✓
$m_2 = 2{,}388 \text{ kg}$✓ (3)

7.3



- Phase AB $(-20℃ \text{ to } 0℃)$ is at the ice stage as water can only become ice at $0℃$ and below temperatures✓✓
- Phase BC is when the ice dissolves into water at constant temperature.✓✓ (6)

[11]

QUESTION 8

8.1
- Protons✓ – Positively charged✓
- Neutrons✓ – Neutral or no charge✓
- Electrons✓ – Negatively charged✓ (6)

8.2 Distilled water can be converted to electrolytes by adding any substance that dissociates in water to form ions. (2)

[8]

QUESTION 9

9.1 9.1.1
- R_1 = The current will be less than in R_2 as the current is indirectly proportional to the resistance.✓
- R_2 = The current will be greater than in R_1 as the current is indirectly proportional to the resistance.✓ (2)

9.1.2
$$R_T = \frac{R_1 \times R_2}{R_1 + R_2} + R_3$$
$$= \frac{4 \times 3}{4 + 3} + 2 ✓✓$$
$$= 3,71\ \Omega ✓$$ (3)

9.2
$$R_{20℃} = \frac{p \times l}{A}$$
$$= \frac{0,018 \times 10^{-6} \times 25}{\frac{\pi (0,0015)^2}{4}} ✓✓$$
$$= 0,25\ \Omega ✓$$ (3)

9.3
- Transformer (3)

- Induction motor
- Prevention of sudden overloading

[11]

TOTAL: 100