higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N2

27 JULY 2018

This marking guideline consists of 7 pages.

QUESTION 1

1.1 1.1.1 Speed – It is the rate of change of distance

1.1.2 Displacement – It is the straight-line distance between two points and has direction.

(2 × 1) (2)

1.2 1.2.1 $a = \frac{v_{4s} - u_{0s}}{t_{4s} - t_{0s}}$

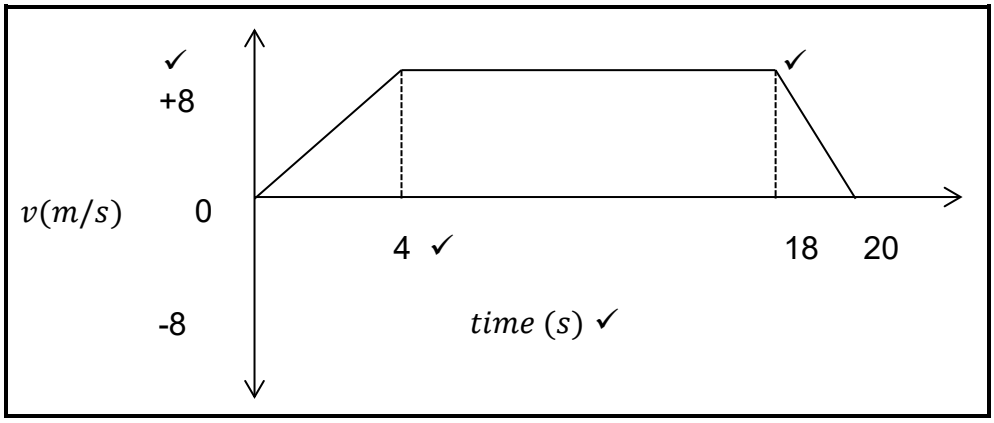
$2 = \frac{v_{4s} - 0}{4 - 0}$ ✓

$v_{4s} = 8\ m/s$ ✓

(2)

1.2.2 There is an increase in the velocity at constant rate from $0\ m/s$ to $8\ m/s$ (1)

1.2.3



(4)

1.2.4 $a = \frac{\Delta v}{\Delta t}$

$= \frac{0 - 8}{20 - 18}$ ✓

$= -4\ m/s$ ✓

(2)

1.2.5 $s = \frac{1}{2}bh + L \times B + \frac{1}{2}bh$

$= \frac{1}{2}(4)(8) + (14 \times 8) + \frac{1}{2}(2)(8)$ ✓

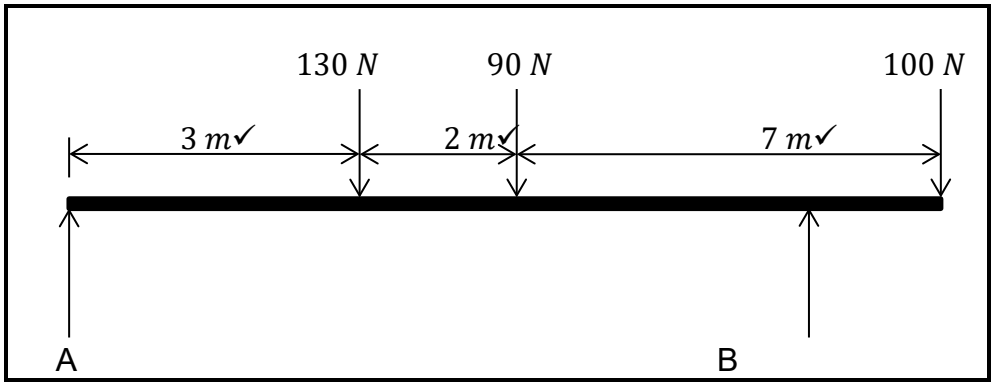
$= 136\ m$ ✓

(2)
[13]

QUESTION 2

2.1 The equilibrant of forces is a single force that keeps a system of unbalanced forces in equilibrium and is equal to the resultant but in the opposite direction. (2)

2.2 2.2.1



(3)

2.2.2 Take moments about A:

$$\sum M \curvearrowleft = \sum M \curvearrowright$$
$$130 \times 3 + 90 \times 5 + 100 \times 12 = B \times 10\checkmark$$
$$\frac{10B}{10} = \frac{2040}{10}\checkmark$$
$$B = 204\ N\checkmark$$

Take moments about B:

$$\sum M \curvearrowleft = \sum M \curvearrowright$$
$$(A \times 10) + (100 \times 2) = (90 \times 5) + (130 \times 7)\checkmark$$
$$\frac{10A}{10} = \frac{1160}{10}\checkmark$$
$$A = 116\ N\checkmark$$

(6)

2.2.3
$$\sum \uparrow F = \sum \downarrow F$$
$$116 + 204 = 130 + 90 + 100$$
$$320\ N = 320\ N\checkmark$$

(1)

[12]

QUESTION 3

3.1 It states that energy cannot be created or destroyed but it can be converted or changed from one form to another. (2)

3.2 3.2.1 $E_{P(TOP)} = mgh$
$= 5 \times 9{,}8 \times 10$✓
$= 490\ J$✓

3.2.2 $E_{k(BOT)} = E_{P(TOP)}$
$\frac{1}{2}(5)(v)^2 = 490$
$v^2 = \frac{490}{2{,}5}$✓
$v = 14\ m/s$✓

3.2.3 $p = mv$
$= 5 \times 14$✓
$= 70\ kg$✓

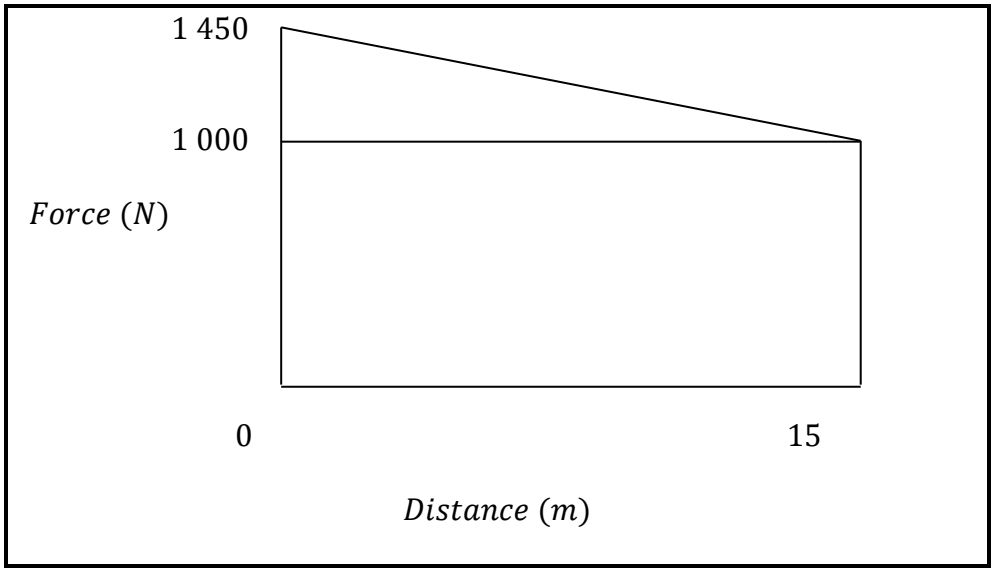
(3 × 2) (6)
[8]

QUESTION 4

4.1 Work done is when a force is applied to an object or body and it moves the object or body in the direction of the applied force. (2)

4.2 4.2.1 $W_{CH} = 30N/m \times 15$
$= 450\ N$ (1)

4.2.2



(Labelling) (1)
(Graph) (2)

4.2.3 $W_D = \frac{1}{2}bh + L \times B$
$= \frac{1}{2} \times 15 \times 450 + 15 \times 1\,000$✓✓
$= 18\,375\ J$✓ (3)

4.3 $T = F \times R$
$= 400 \times 0{,}3$✓
$= 120\ Nm$✓ (2)
[11]

QUESTION 5

5.1
- Tighten the belt.
- Use belt material with a high friction coefficient.
- Increase the angle of contact between the belt and the pulleys. (3)

5.2 The velocity ratio is the ratio between the distance moved by the effort (F) and the distance moved by the load (w). (1)

5.3
- No slip occurs with chain drives
- Chain drives are more durable (2)

5.4 5.4.1 $v = \pi D N_D$
$= \pi \times 0,5 \times 70$✓
$= 110\ m/s$✓

5.4.2 $\frac{T_1}{T_2} = \frac{8}{1}$

$\frac{T_1}{1\,000} = \frac{8}{1}$✓

$T_1 = 8\,000\ N$✓

5.4.3 $P = (T_1 - T_2) \times v$
$= (8\,000 - 1\,000) \times 110$✓
$= 770\,000\ W/770\ kW$✓

(3 × 2) (6)

5.5
- Differential wheel and axle lifting device
- Differential winch
- Weston differential pulley (Any 1 × 1) (1)

5.6 It states that the pressure exerted upon the surface of a fluid in a closed system acts with the same magnitude in all directions. (2)
[15]

QUESTION 6

6.1 Kinetic friction is the friction experience once the body is in motion and is less than the static friction. (1)

6.2 6.2.1 $F_{\parallel} = mg\ Sin\ \theta$
$= 40 \times 9{,}8\ Sin25°$✓
$= 165{,}66\ N$✓ (2)

6.2.2 $F_{\perp} = mgCos\ \theta$
$= 40 \times 9{,}8\ Cos25°$✓
$= 355{,}27\ N$✓ (2)

6.2.3 $\mu = \frac{F_{\mu}}{N}$
$0{,}3 = \frac{F_{\mu}}{355{,}27}$✓
$F_{\mu} = 106{,}58\ N$✓ (2)

6.2.4 $F_{UP} = F_{\parallel}$✓ $+ F_{\mu}$
$= 165{,}67 + 106{,}58$✓
$= 272{,}25\ N$✓ (3)
[10]

QUESTION 7

7.1 Specific heat capacity is the quantity of heat required to raise the temperature of $1\ kg$ of a substance by 1°C. (2)

7.2 7.2.1 $E = mass \times energy\ value \times 80\%$
$= 50 \times 100 \times (\frac{80}{100})$ ✓✓
$= 4000\ MJ/h$✓

7.2.2 $P = \frac{E}{t}$
$= \frac{4000}{3\,600}$✓
$= 1{,}111MW$✓✓

(2 × 3) (6)

7.3 $\Delta l = l \times \alpha \times \Delta t$
$= 20 \times 12 \times 10^{-6} \times 270$✓
$= 64{,}8\ mm$✓✓ (3)
[11]

QUESTION 8

8.1 An atom is a smallest particle from which an element is made. (2)

8.2
- A nucleus consists of protons with a positive charge.
- A nucleus consists of neutrons with no charge or a neutral charge. (2)

8.3
- It is used for the production of many metals and non-metals (e.g. aluminium, magnesium, chlorine, etc.)
- It is used for coating one metal with another. (2)

8.4
- Protect metals against corrosion
- Produce more durable surfaces
- Beautify certain articles (Any 2 × 1) (2)

[8]

QUESTION 9

9.1
- Length is directly proportional to the resistance of a resistor.
- The cross-sectional area is indirectly proportional to the resistance of the resistor. (2)

9.2 9.2.1
- The current flowing in R_1 will be more than the current flowing in R_2 since R_1 offers least resistance
- The voltage across each of the parallel resistors will be the same.

9.2.2
$$R_T = \frac{R_1 \times R_2}{R_1 + R_2} + R_3$$
$$= \frac{9 \times 18}{9 + 18} + 36 \checkmark$$
$$= 42\ \Omega \checkmark$$

(2 × 2) (4)

9.3
$$R_{20℃} = \frac{p \times l}{\frac{\pi d^2}{4}}$$
$$= \frac{0{,}028 \times 10^{-6} \times 3\,000}{\frac{\pi \times (1{,}50 \times 10^{-1})^2}{4}} \checkmark \checkmark$$
$$= 0.004\ 75343\ \Omega \checkmark$$ (3)

9.4 9.4.1 When moving the magnet towards the coil, the deflection of the pointer will be to the right.

9.4.2 When moving the magnet away from the coil, the deflection of the pointer will be to the left.

9.4.3 When both the magnet and the coil are stationary, there will be no deflection.

(3 × 1) (3)

[12]

TOTAL : 100