MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N1

21 NOVEMBER 2012

This question paper consists of 9 pages.
QUESTION 1

1.1 **Actual route** √taken.

1.2

\[ R = 192 \text{ km/h N 11^\circ E} \]

1.3 1.3.1
\[
\begin{align*}
\alpha &= \frac{\Delta v}{\Delta t} \sqrt{\frac{15 - 5}{6 - 2\sqrt{3}}} \\
\alpha &= \frac{10}{4} \sqrt{\frac{9}{4}} \\
\alpha &= \frac{2.5}{s} 
\end{align*}
\]

1.3.2
\[
\begin{align*}
\alpha &= \frac{\Delta v}{\Delta t} \\
\alpha &= \frac{25 - 25}{18 - 10} \\
\alpha &= \frac{m^2}{s} \sqrt{\frac{9}{4}} \\
\alpha &= 0 \ 	ext{m}^2/s \sqrt{\frac{9}{4}}
\end{align*}
\]
1.3.3 Moves at constant velocity $\checkmark$

$$v = \frac{17.5 \text{m}}{s} \sqrt{s} \quad 1$$

Loose $\frac{1}{2}$ mark if answers is in m/s

$$v = 17.5 \times 3.6$$

$$v = 63 \frac{\text{km}}{h} \sqrt{3}$$

(1)

1.4 Scalar: Have only magnitude $\checkmark$

Vector: Have magnitude and direction $\checkmark$

Examples:

Scalar: Time, money, length, mass, distance, speed. $\checkmark$

Vector: Displacement, velocity, acceleration, weight, force $\checkmark$

[15]

**QUESTION 2**

2.1 2.1.1 A force is that influence which, when applied to a body, will change or tend to change its state of rest or uniform motion in a straight line.

(1)

2.1.2 A system of forces is in equilibrium when the sum of the clockwise moments about a point is equal to the sum of the anti-clockwise moments about the same point.

(1)

2.2

2.2.1 $\pm 185 \text{ N}$

2.2.2 $\pm E 15^\circ S$

(2)

(2)

PTO
2.3 \[ ACWM = CWM \]
\[ LM = RM \]
\[ x = \frac{13.6}{1.7} \]
\[ x = 8 N \]  

2.4 Similarity: Their length is the same/equal magnitude
Difference: Move in opposite directions

2.6 2.6.1
\[ MA = \frac{mg}{F} \]
\[ F = \frac{mg}{MA} \]
\[ F = \frac{300}{4} \]
\[ F = 75 N \]  

2.6.2
\[ LM = RM \]
\[ F \cdot x = (m \cdot g) \cdot y \]
\[ x = \frac{(mg) \cdot y}{F} \]
\[ x = \frac{300 \times 2}{75} \]
\[ x = 8 m \]
\[ VR = \frac{S_e}{S_l} \]
\[ VR = MA \]
\[ VR = 4 \]
\[ 4 = \frac{S_e}{2} \]
\[ S_e = 4 \times 2 \]
\[ S_e = 8 m \]  

2.7 A force has direction
A force has magnitude
QUESTION 3

3.1  3.1.1  D  √
3.1.2  F  √  Half mark each
3.1.3  B  √
3.1.4  E  √
3.1.5  C  √
3.1.6  A  √

3.2  Given:
F = 300 N
s = 15 m
t = 7s

\[ P = \frac{F \times s}{t} \sqrt{\square} \]
\[ P = \frac{300 \times 15}{7} \sqrt{\square} \]
\[ P = 642.9 W \quad \checkmark \]

3.3  Given:
P = 1.5 kW (1500W)
t = 1 minute (60 seconds)

\[ P = \frac{\text{W}}{t} \sqrt{\square} \]
\[ W = Pt \quad \checkmark \]
\[ W = 1500 \times 60 \quad \checkmark \]
\[ W = 90 \text{ kJ} \quad \checkmark \]

3.4  \[ W = \text{Area of rectangle} \quad \checkmark \]
\[ W = 196 \times 3.5 \quad \checkmark \]
\[ W = 686 \quad \checkmark \]

QUESTION 4

4.1  Temperatures changes // √
Colour changes // √
Volume changes // √
Change of phases // √
Change of resistance // √

ANY FOUR  (2)

HALF MARK EACH
4.2 Measuring temperatures in furnaces

They can be permanently inserted inside the windings of large electric motors

They can be permanently placed in hard to reach places of machines, e.g. To

measure the temperature of bearings

ANY TWO

4.3

IRON

COPPER

PIROMETER

4.4 4.4.1 Given:

\( l_0 = 47m \quad t_o = 21^\circ C \)
\( l_f = 46,983m \quad t_f = -7^\circ C \)

\( \Delta l = l_o - l_f \quad \sqrt{\ } \)
\( \Delta l = 47 - 46,983 \quad \sqrt{\ } \)
\( \Delta l = 0,017m \quad \sqrt{\ } \)
\( \Delta l = 17mm \quad \sqrt{\ } \)

4.4.2 \( \Delta t = t_o - t_f \quad \sqrt{\ } \)
\( \Delta t = 21 - (-7) \quad \sqrt{\ } \)
\( \Delta t = 28^\circ C \quad \sqrt{\ } \)

4.5 Given:

Mass of water =?

\( V = 50 - 20 = 30^\circ C \)

\( Q = 180,000 \times 8 = 1440,000J \quad \sqrt{\ } \)

\( Q = mc\Delta t \quad \sqrt{\ } \)
\( 1440000 = m \times 4187 \times 30 \quad \sqrt{\ } \)
\( 1440000 = m \times 125610 \quad \sqrt{\ } \)
\( 1440000 \quad m \quad \sqrt{\ } \)
\( 125610 \quad m \quad \sqrt{\ } \)
\( m = 11,464kg \quad \sqrt{\ } \)
4.3  4.3.1 Solids: conduction \( \checkmark \)
4.3.2 Liquids: convection \( \checkmark \)
4.3.3 Gases: convection currents \( \checkmark \)
4.3.4 Vacuum: radiation \( \checkmark \)

Point each \( \frac{1}{2} \) (2)

QUESTION 5

5.1  5.1.1 Material that consist out of only \textbf{one type of atom}. \( \checkmark \)
5.1.2 Material that consists out of \textbf{more than one type of atom}. \( \checkmark \)
5.1.3 Everything that occupies \textit{space} \( \checkmark \) and has \textit{mass} \( \checkmark \). (3)
5.2.1 Melting \( \checkmark \)
5.3.2 Evaporation \( \checkmark \) (2)

5.3

\begin{center}
\begin{tikzpicture}[scale=0.5]
\draw (0,0) circle (2);
\draw (0,0) circle (1);
\node at (0,0) {P};
\node at (0,2) {e};
\node at (0,-2) {N};
\node at (1.5,0) {PROTON (POSITIVE)};
\node at (-1.5,0) {NEUTRON (NEUTRAL)};
\node at (0,1) {NUCLEUS (POSITIVE)};
\node at (0,-1) {ELECTRON (NEGATIVE)};
\end{tikzpicture}
\end{center}

Electron \( \checkmark \)
Proton \( \checkmark \)
Neutron \( \checkmark \)
Nucleus \( \checkmark \) (4)

5.4 Solids: Steel \( \checkmark \), Carbon \( \checkmark \).
Liquids: Mercury \( \checkmark \), Water \( \checkmark \)
Gasses: Oxygen \( \checkmark \), Hydrogen \( \checkmark \). (3) [12]
QUESTION 6

6.1 6.1.1 Opposition √ against the flow of current √. (1)

6.1.2 Material that does not allow current to flow. (1)

6.1.3 If the fingers of the right hand curl around a coil in the direction in which the current is flowing √ through the conductor, the thumb will point the direction of the north pole √. (1)

6.2 6.2.1 Resistor √ (½)

6.2.2 Battery √ (½)

6.2.3 Galvano meter √ (½)

6.2.4 Volt meter √ (½)

6.3 6.3.1 Conductor √ (½)

6.3.2 Insulator √ (½)

6.3.3 Conductor √ (½)

6.3.4 Insulator √ (½)

6.4 \[ V = I \times R \]
\[ V = 19 \times 60 \] √
\[ V = 114V \] √ (2)

6.5 6.5.1 \[ R_z = R_1 + R_2 + R_3 \]
\[ R_z = 6 + 4 + 12 \] √
\[ R_z = 22Ω \] √ (2)

6.5.2 \[ I = \frac{V}{R} \]
\[ I = \frac{24}{22} \]
\[ I = 1.091A \] √ (2)

6.5.3 \[ V_4 = I \times R_z \]
\[ V_4 = 1,091 \times 6 \] √
\[ V_4 = 6.546V \] √ (2)

6.6 The smaller the diameter (or cross-sectional area) √ of a conductor, the higher the resistance √ of the conductor. (1)
6.7  6.7.1  Resistance will **increase**. \(\checkmark\)  
6.7.2  Resistance will **decrease**. \(\checkmark\)  

6.8  6.8.1  
\[
I = \frac{V}{R} \quad I = \frac{220}{500} = 0.44 A \quad \checkmark
\]

6.8.2  
\[
Q = I^2 \times R \times t \\
Q = (0.44)^2 \times 500 \times (2 \times 60 \times 60) \\
Q = 696960 W \quad \checkmark
\]
\[
Q = 696.96 kW \quad \checkmark
\]

6.9  
\[
P = \frac{V^2}{R} \\
R = \frac{V^2}{P} \\
R = \frac{12^2}{60} = 2.4 \Omega \quad \checkmark
\]

**TOTAL:** 100