MARKING GUIDELINE

NATIONAL CERTIFICATE

AUGUST EXAMINATION

ENGINEERING SCIENCE N2

29 JULY 2014

This marking guideline consists of 9 pages.

NOTE: ☑ denotes half mark

QUESTION 1

1.1.1   Velocity is the rate✓ of displacement. ✓   (2)

1.1.2   Acceleration is the rate of change✓ of velocity. ✓   (2)

1.2   1.2.1

$$A = \frac{v - u}{t}$$

$$= \frac{0 - 25}{20} \checkmark$$

$$= 1{,}25 \text{ m/s}^2 \checkmark \qquad (2)$$

1.2.2

$$S_{total} = S_{rect} + S_{triangle}$$

$$= (25 \times 30) + (0.5 \times 20 \times 25) \checkmark$$

$$= 750 + 250 \checkmark$$

$$= 1\,000 \text{ m} \checkmark \qquad (3)$$

1.2.3

$$V_{av} = \frac{S_{tot}}{t_{tot}}$$

$$= \frac{1\,000}{50} \checkmark$$

$$= 20 \text{ m/s} \checkmark \qquad (2)$$

1.3   1.3.1

$$t = \frac{v - u}{a}$$

$$= \frac{0 - 55.555}{-15} \checkmark$$

$$= 3.704 \checkmark \qquad (2)$$

1.3.2   Min. distance

$$s = ut + \frac{1}{2}at^2 \qquad \checkmark$$
$$= 55{,}555 \times 3{,}704$$
$$+ \frac{1}{2}(-15)3{,}704^2$$
$$= 102{,}88 \text{ m} \qquad \checkmark$$

OR

$$v^2 = u^2 + 2aS$$
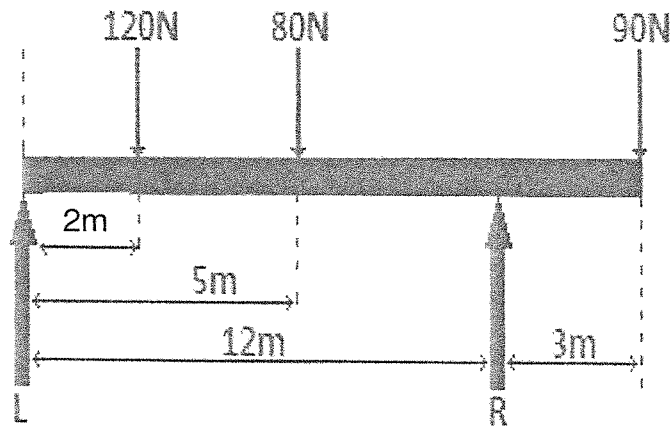$$0^2 = 55{,}555^2 + 2(-15)S$$
$$S = \frac{-3086{,}42}{-30} \qquad \checkmark$$
$$S = 102{,}88\text{m} \qquad \checkmark$$

(2)
[15]

QUESTION 2

2.1   2.1.1

(2)

2.1.2   About L / OM L

$$\sum ACM = \sum CM$$

$$R \times 12 = 120(2) + 80(5) + 90(15)$$ ✓ ✓

$$12R = 240 + 400 + 1350$$

$$R = 165,83N$$ ✓

About R / OM R

$$\sum ACM = \sum CM$$

$$(120)(10) + 80(7) = 90(3) + L(12)$$ ✓ ✓

$$560 + 1200 = 270 + 12L$$

$$L = 124,17N$$ ✓   (6)

2.1.3

$$\sum F_{up} = \sum F_{down}$$

$$124,17 + 165,83 = 120 + 80 + 90$$ ✓

$$290 = 290$$ ✓   (1)

2.2   Vc = 200 sin 30⁰ ☑
                                    (1)
        = 100 N ☑   **[10]**

QUESTION 3

3.1   3.1.1   Potential energy is the energy a body possesses due to its mass✓
                  and height.✓   (2)

        3.1.2   Law of conventional energy states that energy cannot be created
                  or destroyed✓ but can be changed from one form to another.✓   (2)

Please turn over

3.2   3.2.1 $E_p = m \times g \times h$

$= 1600 \times 9.8 \times 1250$ ✓

$= 19600000$ J ✓

$E_p = 19.6$ MJ   (2)

3.2.2   Ke at bottom = Pe at top

$= 19600000$ J ✓   (1)
                                             [7]

QUESTION 4

4.1   Work is done when a force is applied to an object ✓ and the object is moved over a distance. ✓   (2)

4.2   4.2.1   Weight of cable per metre

$W = w \times L$

$3\,000 = w \times 280$ ☑

$w = 3\,000 / 280$

$= 10.7143$ N/m ☑   (1)

4.2.2 $WD_{total} = WD_{rectangle} + WD_{triangle}$
                       ✓   ✓

$= (3\,000 \times 280) + (0.5 \times 280 \times 3\,000)$

$= 1260000$ J ✓   (3)

4.2.3 $F_C = W_L + W_C$

$= 3\,000 + (10.7143 \times 100)$ ☑

$= 4017.43$ N ☑

$P_o = F_c \times V$

$= 4017.43 \times 6$ ☑

$= 24\,428$ W ☑   (2)

4.3 $T = F \times r$

$800 = F \times 0.6$ ✓

$F = 1333.333 \text{ N}$ ✓   (2)

[10]

QUESTION 5

5.1
- Gear drives
- Belt drives
- Chain drives   (2)

5.2
- Tension the belt properly
- Increase the arc of contact
- Increase the coefficient of friction   (2)

5.3
- Gear drives have more torque
- There is no slip in gear drives
- Gear drives use a smaller space
- There is less maintenance in gear drives   (2)

5.4   5.4.1

Tight side tension

$T_1 = 3 \times T_2$ ☑

$= 3 \times 300$ ☑

$= 900 N$ ✓   (2)

5.4.2 $P_0 = (T_1 - T_2)V$ ☑

$= (900 - 300)35$ ☑

$= 21\,000 W$ ✓   (2)

5.5   5.5.1 $D1 \times N1 = D2 \times N2$ ✓

$N2 = \dfrac{20 \times 20}{60}$ ✓

$= 6.67 \text{ r/s}$ ✓   (3)

5.5.2 $N1/N2 = 20/6.67$ ✓

$= 3:1$ ✓   (2)

5.5   The unit pascal is when a load of 1 Newton is applied over an area of 1 m^2.   (2)

[17]

QUESTION 6

6.1   • Make the surfaces smoother ✓
         • Use lubricants ✓
         • Use bearings ✓   (3)

6.2   6.2.1 $Fs = mg \times \sin\theta$

                   $= 600 \times \sin 12^0$ ✓

                   $= 124.74$ N ✓   (2)

     6.2.2 $Fc = mg \times \cos\theta$

                   $= 600 \times \cos 12^0$ ✓

                   $= 586.888$ N ✓   (2)

     6.2.3 $Fup = Fu - FS$ ✓

                   $= 75 + 124.74$ ✓

                   $= 199.747$ N ✓   (3)
                                         [10]

QUESTION 7

7.1   The amount of heat energy (in joules) required to heat a body with a mass of
        1 kg at a temperature of 1 ^{0}C   (2)

7.2   7.2.1   Heat energy from coal

                   $Q = m \times HV$
                      $= 075 \times 30$ ✓
                      $= 22.5$ MJ ✓   (2)

     7.2.2   Heat to rod

                   Q rod $= 40\%$ (Q coal)
                        $= 0.4 \times 22.5$ ✓
                        $= 9$ MJ ✓   (2)

     7.2.3 $Q = m \times c \times \Delta t$
             $9000\,000 = 10 \times 900 \times \Delta t$
                $\Delta t = 1\,000\ ^0$C ✓

            $\Delta t = 25 + tf$
            $tf = 1\,000 - 25$
                $= 975\ ^0$C ✓   (2)

7.2.4 $\Delta L = L_o \times \alpha \times \Delta t$
            $= 2\,000 \times 0.000017 \times 1\,000$
            $= 46$ mm ✓

         $L_f = L_o + \Delta L$
            $= 2\,000 + 46$
            $= 2\,034$ mm
            $= 2.043$ m   (2)

7.3   • Steam is relatively cheap ✓
       • Steam is clean – pollution free.
       • Steam can be used repeatedly   (Any 1 x 1)   (1)
                                                                       [11]

QUESTION 8

8.1   8.1.1   Positive

      8.1.2   Neutral (no charge)

      8.1.3   Negative   (3)

8.2   An electrolyte is a solution that is able to conduct an electric current.   (1)

8.3   Electroplating is the process of covering metal with a hard, durable coating.   (1)

8.4   Electroplating makes the surface hard and wear-resistant. ✓
       Electroplating makes the material corrosion-resistant. ✓   (Any 2 x 1)   (2)
       Electroplating beautifies the object.   [7]

QUESTION 9

9.1   • Resistivity/type of material ✓
       • Length diameter/thickness ✓   (2)
       • Temperature

                                                           (1)

9.2   9.2.1   Increase   ✓

      9.2.2   Total Resistance

                $R_p = \frac{R_A \times R_B}{R_A + R_B}$ ✓

                      $= \frac{5 \times 9}{5 + 9}$

                      $= 3.214\ \Omega$ ✓

              $R_{total} = R_p + R_c$

                    $= 3.214 + 10$
                          ✓
                    $= 13.214\ \Omega$ (3)

9.3

$$R = \frac{\rho \times l}{A}$$

$$= \frac{18 \times 10^{-9} \times 5500}{176,714 \times 10^{-6}} \quad \checkmark$$

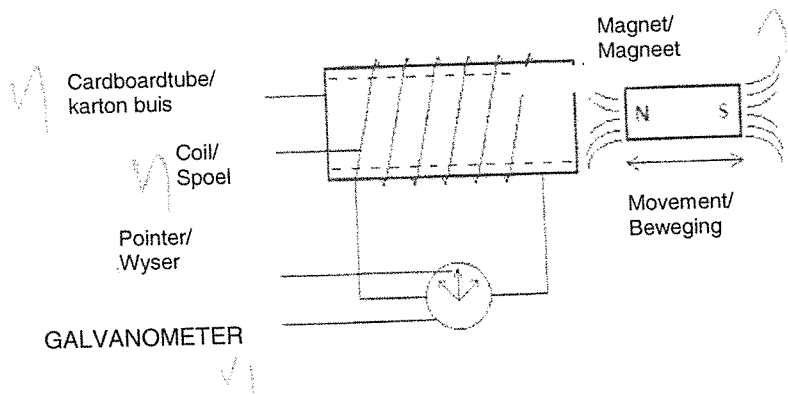$$= 0,56 \, \Omega \quad \checkmark$$

$$A = \frac{\pi}{4} d^2$$

$$= \frac{\pi}{4}(0,015)^2$$

$$= 176,714 \times 10^{-6} \, m^2 \quad \checkmark$$

(3)

9.4

SELF-INDUCTION/SELF-INDUKSIE

Cardboardtube/
karton buis

Coil/
Spoel

Pointer/
Wyser

GALVANOMETER

Magnet/
Magneet

N   S

Movement/
Beweging

(3)

9.5
- Transformers ✓
- Generators
- Electric motors

(1)
[13]

TOTAL: 100