higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N3

29 MARCH 2018

This marking guideline consists of 6 pages.

QUESTION 1

1.1 A vector quantity has magnitude and direction✓ while a scalar quantity has only magnitude. ✓ (2)

1.2 1.2.1 $S = ut + ½ at^2$
$=(0)(25) + ½(2)(25)^2$✓
$= 625$ m✓ (2)

1.2.2 $V = u + at = 0 + 2(50) = 50$ m/s✓
$S = v\,t$
$= 50(2 \times 60)$✓
$= 6000$ m✓ (3)

1.2.3 Total distance $= 625 + 6000 + 100$
$= 6725$ m✓ (1)

1.2.4 $V^2 = u^2 + 2as$

$$a = \frac{v^2 - u^2}{2s}$$

$= (0^2 - 50^2)/2(100)$✓

$= -12{,}5\text{m/s}^2$✓

$V = u + at$

$t = (v - u)/a$

$= (0 - 50)/-12{,}5$

$= 4$s✓

Total time $= 25 + 120 + 4$

$= 149$s✓ (4)

1.3 $E_K = E_P$✓

$½\,mv^2 = mgh$

$½(25)^2 = 9{,}8 \times h$✓

$h = 31{,}89$ m✓

$S = h/\text{Sin } 10^0$

$= 31.89/\text{Sin } 10^0$ ✓

$= 183.647$ m ✓ (4)

[16]

QUESTION 2

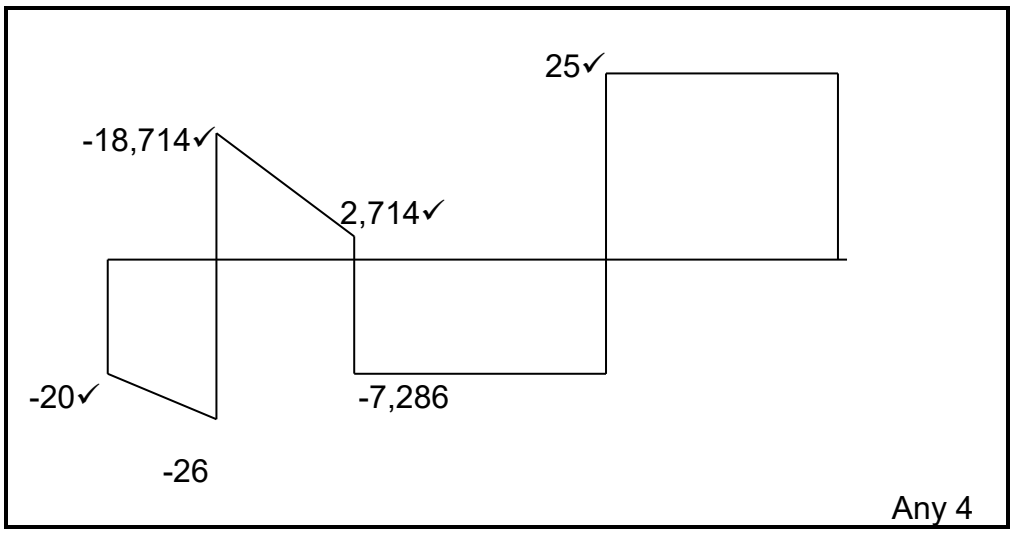
2.1
- It is a force pushing one part of a body in one direction and another part of the body in another direction.
- It is the algebraic sum of all the forces on a particular side of a section.

(Any 1 × 1) (1)

2.2 2.2.1

Moment about B
∑ACM = ∑CM
D × 7 + 6 × 1 + 20 × 2
=16 × 2 +10 × 4 +25 × 8✓✓
7D = 272 – 46
D = 32,286kN✓
Moment about D
∑ACM = ∑CM
10 × 3 + 16 × 5 + 6 × 8 + 20 × 9 = B × 7 + 25 × 1✓✓
7B = 338 – 25
B = 44,714 kN✓ (6)

2.2.2



Any 4 (4)

[11]

QUESTION 3

3.1 It is a single force that can replace two or more forces and still have the same effect. (2)

3.2 3.2.1

H_X = -40 – 30cos45° + 60cos60°✓✓
= -31,213 N✓ (3)

3.2.2

V_Y = 50 – 30sin45 –60sin60°✓✓
= – 23,175 N✓ (3)

3.2.3

$$R = \sqrt{{H_x}^2 + {V_y}^2}$$
$$= \sqrt{(-31{,}213)^2 + (-23{,}175)^2}\checkmark$$
= 38,876 N✓ (2)

[10]

QUESTION 4

4.1 It is the angle between the resultant force and the normal force. (1)

4.2 4.2.1 $F = P\cos60°$ (1)

4.2.2 $F = W\sin\theta$
$=80 \times 9{,}8\sin30°$✓
$= 392$ N✓ (2)

4.2.3 $F = W\cos30°$
$= 80 \times 9{,}8\cos30°$✓
$=678{,}96$ N✓ (2)

4.2.4 $F_N = W\cos30° - P\sin60°$✓

$F\mu = P\cos60° - W\sin30°$✓

$\mu = F\mu / F_N$
$0{,}4 = (0{,}5P - 392)/(678{,}96 - 0{,}866P)$✓
$271{,}584 - 0{,}346P = 0{,}5P - 392$✓
$0{,}846P = 663{,}584$
$P = 784{,}378$ N✓ (5)

4.3
- Prevents slip between two contact surfaces
- Removes material
- Transmits movement by means of belts
- Brings movement to a standstill
- Enables movement (Any 3 × 1) (3)

[14]

QUESTION 5

5.1
- Steam can be used repeatedly.
- Coal and water are reasonably cheap and readily available.
- A steam installation has a long life. (Any 2 × 1) (2)

5.2 5.2.1 $\eta = P_{out}/Pin$
$45\% = 15/P_{in}$✓
$P_{in} = 15/0{,}45$
$= 33{,}33$ kW✓ (2)

5.2.2 $E = P \times t$
$= 33{,}33 \times 10^3 \times 45 \times 60$✓
$=89{,}991$ MJ✓ (2)

5.2.3 $E = hv \times m$
$M = E/hv$
$= 89{,}991$ MJ/42 MJ✓
$= 2{,}143$ kg✓ (2)

5.3 5.3.1 $Q = mh_v$
$= 30 \times 0{,}75 \times 0{,}6$✓✓
$= 13{,}5\ MJ$✓ (3)

5.3.2 $Q = mc\Delta t$
$13{,}5 \times 10^6 = 10 \times 900(t_2 - 25°C)$✓
$t_2 = 1525°C$✓ (2)

5.3.3 $\Delta L = L_0 \times \alpha\ \Delta t$
$= 2 \times 23 \times 10^{-6} \times (1525)$✓
=0,0702 m

Final length = 2 + 0,0702
= 2,0702 m✓ (2)

[15]

QUESTION 6

6.1 Suction head = static head – delivery head (1)

6.2 6.2.1 P = ρgh
$345 \times 10^3 = 1000 \times 9{,}8 \times h$✓✓
h = 35,2 m✓ (3)

6.2.2 W = P × V
$= 345 \times 10^3 \times 25/60$✓✓
= 143,75 kJ✓ (3)

6.2.3 P = E /t
$= 143{,}75 \times 10^3/3600$✓
= 39,93 W✓ (2)

6.3 If pressure is applied on an enclosed system, the pressure will spread evenly✓ through the enclosed liquid (or fluid)✓ and is the same throughout.✓ (3)

[12]

QUESTION 7

7.1 The mass of a given substance liberated at an electrode of a cell is directly proportional✓ to the quantity of electricity passed through the cell.✓ (2)

7.2 7.2.1 $1/Rp = 1/3 + 1/6$

$$= \frac{2 + 1}{6} \checkmark$$

$Rp = 2\ \Omega$ ✓

$Rt = Rp + R\ int + Rseries$

$= 2 = 4(0.5) + 4 + 2$ ✓

$= 10\ \Omega$ ✓ (4)

7.2.2 $I_T = V_T/R_T$
$= 6/10$✓
$=0,6$ A✓ (2)

7.2.3 $V = I_T \times r$
$= 0,6 \times 2$✓
$=1,2$ V✓ (2)

7.3 7.3.1 $N_p/N_s = Is/Ip$
$Ns = (600 \times 6)/0,4$✓
$= 9000$✓ (2)

7.3.2 $Np/Ns = Vp/Vs$
$Vs = (240 \times 9000)/600$✓
$=3600$ V✓ (2)

7.3.3 $Ps = Vs.Is$
$=3600 \times 0,4$✓
$= 1,44$ kW✓ (2)

[16]

QUESTION 8

8.1 An ion is a charged atom. (1)

8.2
- Lithium
- Sodium
- Potassium
- Rubium
- Cesium (Any 2 × 1) (2)

8.3 8.3.1 Harder (1)
8.3.2 Softer (1)
8.3.3 79% (1)

[6]

TOTAL: 100