higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

MATERIAL TECHNOLOGY
NQF LEVEL 3

3 March 2020

This marking guideline consists of 6 pages.

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QUESTION 1

1.1	1.1.1	True		
	1.1.2	False		
	1.1.3	False		
	1.1.4	True		
	1.1.5	True		
	1.1.6	False		
	1.1.7	True		
	1.1.8	True		
	1.1.9	True		
	1.1.10	False		
			(10 × 1)	(10)
1.2	1.2.1	Nine		(1)
	1.2.2	Fourteen		(1)
	1.2.3	• Iron • Chromium • Vanadium • Tungsten	(Any 2 × 1)	(2)
	1.2.4	• Copper • Gold • Silver • Nickel • Platinum • Lead	(Any 2 × 1)	(2)
1.3	1.3.1	Galvanising prevents the iron from rusting.		(1)
	1.3.2	When the galvanised iron is exposed to a corrosive medium, it constitutes an electrolytic cell. Because of its higher electrode potential,✓ the zinc is attacked first✓ and the iron remains free from attack.✓		(4)
1.4	1.4.1	Cr		(1)
	1.4.2	• Increases hardness depth • Increases magnetic properties • Increases resistance to high temperatures • Increases resistance to wear • Increases resistance to corrosion	(Any 3 × 1)	(3)
				[25]

QUESTION 2

2.1
2.1.1 E
2.1.2 J
2.1.3 K
2.1.4 G
2.1.5 D
2.1.6 A
2.1.7 C
2.1.8 H
2.1.9 F
2.1.10 B

(10 × 1) (10)

2.2 2.2.1
- High strength to weight ratio
- High tensile strength
- High compressive strength
- Dimensional stability
- High resistance to corrosion
- Easy to fabricate

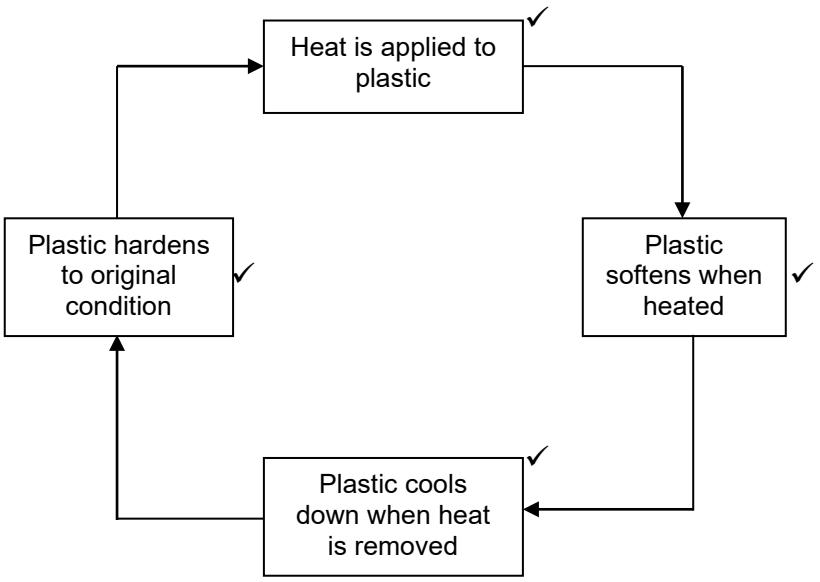
(Any 4 × 1) (4)

2.2.2
- Boats
- Surfboards
- Trailers
- Water tanks
- Fuel or petrol tanks
- Aircraft
- Easy to fabricate (NOTE: No marks will be allocated for household or vehicle components)

(Any 4 × 1) (4)

2.3 2.3.1 Thermosetting plastics become soft when heated, but after further heating, they become irrecoverably rigid and hence irreversible,✓ while thermoplastics is reversible when heated and cooled off as it returns to its previous condition before heating and cooling.✓ (2)

2.3.2



(ONE mark for use of arrows and in the correct direction)✓ (5)
[25]

QUESTION 3

3.1 3.1.1 carbon
3.1.2 base
3.1.3 limestone
3.1.4 refractory
3.1.5 tuyeres

(5 × 1) (5)

3.2 Molten iron is placed into the L-D converter.✓ The converter is set upright✓ and a water-cooled lance is lowered into it.✓ The lance blows 99% pure oxygen onto the steel and iron,✓ causing the temperature to rise to about 1 800°C.✓ This high temperature ensures that the scrap is melted.✓ It further ensures that the carbon content of the molten iron is reduced✓ and it helps to remove chemical impurities.✓ (8)

3.3 3.3.1
- Continuous melting
- Relatively low operating costs
- The bottom can drop away to aid cleaning and repairs
- Easy to operate (Any 3 × 1) (3)

3.3.2
- High pouring temperatures✓
- Good control of melt chemistry✓
- Rotation of shell avoids excessive heating of refractories✓
- Increases the melting efficiency✓ (Any 3 × 1) (3)

3.4 3.4.1 The steel will be soft again. (1)

3.4.2 The austenite will revert to ferrite and carbide,✓ and no martensitic structure will be formed.✓ (2)

3.4.3 If the heated steel is simply placed in the quenching liquid without swirling it around in the liquid, a layer of steam will form between the steel and the water,✓ and no rapid cooling will take place.✓ Hence, rapid quenching will be unsuccessful.✓ (3)

[25]

QUESTION 4

4.1 4.1.1 C
4.1.2 D
4.1.3 D
4.1.4 C
4.1.5 C

(5 × 1) (5)

4.2 4.2.1

$$\sigma_{Yield} = \frac{F_{Yield}}{A}$$

$$F_{Yield} = \sigma_{Yield} \times A = \sigma_{Yield} \times \frac{\pi}{4} D^2 \checkmark$$

$$F_{Yield} = 689{,}6714 \times 10^6 \times \frac{\pi}{4}(0{,}012)^2 \checkmark$$

$$\therefore F_{Yield} = 78\,000N \checkmark$$

$$\therefore F_{Yield} = 78kN \checkmark$$

(4)

4.2.2

$$\sigma_{Max} = \frac{F_{Max}}{A}$$

$$\sigma_{Max} = \frac{102 \times 10^3}{\frac{\pi}{4}(0{,}012)^2} \checkmark$$

$$\therefore \sigma_{Max} = 901\,878\,294{,}18Pa \checkmark$$

$$\therefore \sigma_{Max} = 901{,}878MPa \checkmark$$

(3)

4.2.3

$$\%\,Elongation = \frac{Elongation\ of\ gauge\ length}{Gauge\ length} \times 100$$

$$Elongation\ of\ gauge\ length = \%\,Elongation \times Gauge\ length \checkmark$$

$$Elongation\ of\ gauge\ length = \frac{23 \times 0{,}09}{100} = 0{,}0207\ m \checkmark$$

$$Final\ length\ of\ test\ piece = 90 + 20{,}7 = 110{,}7mm \checkmark$$

(3)

4.2.4 $$\%\ Reduction\ of\ Area = \frac{D^2 - d^2}{D^2} \times 100$$

$$\%\ Reduction\ of\ Area = \frac{(0{,}012)^2 - (0{,}0098)^2}{(0{,}012)^2} \times 100$$ ✓

$$\therefore \%\ Reduction\ of\ Area = 33{,}3\%$$ ✓ (2)

4.3 4.3.1 $$\varepsilon = \frac{\Delta L}{L_o}$$

$\Delta L = \varepsilon . L_o$ ✓

$\Delta L = 0{,}05 \times 120$ ✓

$\therefore \Delta L = 6\ mm$ ✓ (3)

4.3.2 $\sigma = E.\varepsilon$

$E = \frac{\sigma}{\varepsilon}$ ✓

$E = \frac{50 \times 10^6}{0{,}05}$ ✓

$\therefore E = 1\,000\ MPa$ ✓ (3)

4.3.3 $A = \frac{F}{\sigma} = \frac{1}{100}$ ✓

$\therefore A = 0{,}01\ m^2$ ✓ (2)

[25]

TOTAL: 100

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