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| **NATIONAL**  **SENIOR CERTIFICATE** | | | | | |
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|  | | | **GRADE 12** |  | |
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| **SEPTEMBER 2018** | | | | | |
|  | | | | | |
| **MECHANICAL TECHNOLOGY: WELDING AND METAL WORK**  **MARKING GUIDELINE** | | | | | |
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| **MARKS:** | **200** | | | | |
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|  | | This marking guideline consists of 16 pages. | | |  |

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| **QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)** | | |  |
|  | | |  |
| 1.1 | D ✓ | | (1) |
| 1.2 | C ✓ | | (1) |
| 1.3 | D ✓ | | (1) |
| 1.4 | D ✓ | | (1) |
| 1.5 | D ✓ | | (1) |
| 1.6 | B ✓ | | (1) |
|  | | | **[6]** |
|  | | |  |
| **QUESTION 2: SAFETY (GENERIC)** | | |  |
|  | | |  |
| 2.1 | **Unsafe conditions:** | |  |
|  | * Working at unsafe speeds. 🗸 * Grinding without goggles. 🗸 * Fooling and playing around workshop. 🗸 * Spilling liquids on floor. 🗸 * Lubricating/cleaning moving parts. 🗸 * Wearing loose clothing near moving parts. 🗸 * Grinding on the side of the grinding wheel. 🗸 (Any 4 x 1) | | (4) |
|  |  | |  |
| 2.2 | **Assessing a first aid situation:** | |  |
|  | * Environmental observation. 🗸 * Visible signs and symptoms. 🗸 * Indicators to diagnosis. 🗸 * Vital functions. 🗸 * Stopping any serious bleeding. 🗸 * Immediate treatment of cardiac arrest. 🗸 (Any 2 x 1) | | (2) |
|  |  | |  |
| 2.3 | 2.3.1 | **Advantages of product layout:** |  |
|  |  | * Handling of material is limited to a minimum. 🗸 * Time period of manufacturing cycle is less. 🗸 * Production control is almost automatic. 🗸 * Greater use of unskilled labour is possible. 🗸 * Less total inspection is required. 🗸 * Less total floor space is needed per unit of production. 🗸(Any 2 x 1) | (2) |
|  |  |  |  |
|  | 2.3.2 | **Advantages of the process layout of machines** |  |
|  |  | * High machine utilisation because more than one product is manufactured. 🗸 * Better supervision as a result of subdivision of processes. 🗸 * Less interruption in flow of work when machines become   defective. 🗸   * Lower equipment cost, since one machine can produce more than one product. 🗸 * Better control of total manufacturing cost. 🗸 * Greater flexibility in the production process. 🗸 (Any 2 x 1) | (2) |
|  |  |  | **[10]** |

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| **QUESTION 3: MATERIALS (GENERIC)** | | | | |  |
|  | | | | |  |
| 3.1 | **Purpose of case-hardening.** | | | |  |
|  | The objective is to produce a hard case over a tough core. 🗸🗸 | | | | (2) |
|  |  | | | |  |
| 3.2 | **Factors of hardness.** | | | |  |
|  | * Work piece size 🗸 * Quenching rate 🗸 * Carbon content 🗸 | | | | (3) |
|  |  | | | |  |
| 3.3 | **Four kinds of quenching mediums.** | | | |  |
|  | * Water and salt (brine) 🗸 * Tap water 🗸 * Liquid salts 🗸 * Molten lead 🗸 * Soluble oil and water 🗸 * Oil 🗸 (Any 4 x 1) | | | | (4) |
|  |  | | | |  |
| 3.4 | **Reason for hardened steel to be tempered:**  To reduce brittleness 🗸 and to give the workpiece a more fine-grained  structure 🗸 | | | | (2) |
|  |  | | | |  |
| 3.5 | **Test on materials:** | | | |  |
|  |  | | | |  |
|  | **Type of Test** | **Mild Steel** | **High Speed Steel** | **Cast Iron** |  |
|  | **Sound Test** | Medium metallic sound 🗸 | Low ring sound 🗸 | Dull sound 🗸 | (3) |
|  |  | | | | **[14]** |
|  | | | | |  |
| **QUESTION 4: MULTIPLE-CHOICE QUESTIONS (SPECIFIC)** | | | | |  |
|  | | | | |  |
| 4.1 | D ✓ | | | | (1) |
|  |  | | | |  |
| 4.2 | C ✓ | | | | (1) |
|  |  | | | |  |
| 4.3 | B ✓ | | | | (1) |
|  |  | | | |  |
| 4.4 | D ✓ | | | | (1) |
|  |  | | | |  |
| 4.5 | A ✓ | | | | (1) |
|  |  | | | |  |
| 4.6 | C ✓ | | | | (1) |
|  |  | | | |  |
| 4.7 | B ✓ | | | | (1) |
|  |  | | | |  |
| 4.8 | B ✓ | | | | (1) |
|  |  | | | |  |
| 4.9 | A ✓ | | | | (1) |
|  |  | | | |  |
| 4.10 | B ✓ | | | | (1) |
|  |  | | | |  |
| 4.11 | D ✓ | | | | (1) |
|  |  | | | |  |
| 4.12 | D ✓ | | | | (1) |

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| 4.13 | B ✓ | (1) |
|  |  |  |
| 4.14 | D ✓ | (1) |
|  |  | **[14]** |

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| **QUESTION 5: TERMINOLOGY (TEMPLATES, ROLLING AND BENDING)**  **(SPECIFIC)** | | |  |
|  | | |  |
| 5.1 | **Advantages of lattice girders:**  Lattice girders tend to be very rigid 🗸 and give good strength to weight ratios over long spans. 🗸 | | (2) |
|  |  | |  |
| 5.2 | **Calculation on basketball hoop:**  Mean Ø = Outside Ø – Bar thickness  Mean Ø = Inside Ø + Plate thickness  Mean Ø = 380 + 16 mm  = 396 mm  Mean circumference = 🗸  = 🗸  = 1 244,23 🗸  = 1 244 mm 🗸 | | (4) |
|  |  | |  |
| 5.3 | **Weld symbol:** | |  |
|  |  | |  |
|  | 🗸🗸🗸🗸  🗸🗸🗸🗸 | | (2) |
|  |  | |  |
| 5.4 | **Template loft:**  It is a very important section of a structural workshop, 🗸 usually away from the main workshop where quietness and better light facilities are available. 🗸 | | (2) |
|  |  | |  |
| 5.5 | **Purpose of purlins:**  To support the roof coverings 🗸🗸 | | (2) |
|  |  | |  |
| 5.6 | **Sketches of different templates:** | |  |
|  |  | |  |
|  | 5.6.1 | **Flange template** |  |
|  |  |  |  |
|  |  | 🗸🗸🗸 | (3) |

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|  | 5.6.2 | **Strip template** |  |
|  |  |  |  |
|  |  | 🗸🗸🗸 | (3) |
|  |  |  |  |
|  | 5.6.3 | **Web template** |  |
|  |  |  |  |
|  |  | 🗸🗸🗸 | (3) |
|  |  | |  |
| 5.7 | **Basic principles of marking-off:** | |  |
|  | * Measure accurately 🗸 * Show all detail 🗸 * Scribe lines must be clearly visible * Use a prick punch to make lines clearer and permanent (Any 2 x 1) | | (2) |
|  |  | | **[23]** |

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| **QUESTION 6: TOOLS AND EQUIPMENT (SPECIFIC)** | | |  |
|  | | |  |
| 6.1 | 6.1.1 | **Bench grinder** 🗸 |  |
|  |  |  |  |
|  |  | **Function:** |  |
|  |  | It is used to drive abrasive wheels, which hand grind cutting tools and  perform other rough grinding. 🗸 | (2) |
|  |  |  |  |
|  | 6.1.2 | **Power-driven guillotine** 🗸 |  |
|  |  |  |  |
|  |  | **Function:** |  |
|  |  | To cut plates. 🗸 | (2) |
|  |  |  |  |
|  | 6.1.3 | **Power saw 🗸** |  |
|  |  |  |  |
|  |  | **Function:** |  |
|  |  | It is used to roughly cut large sections of metal before they are further machined or used in manufacturing. 🗸 | (2) |
|  |  |  |  |
|  | 6.1.4 | **Pedestal drill press** 🗸 |  |
|  |  |  |  |
|  |  | **Function:** |  |
|  |  | Used to drill a wide variety of materials including ferrous and non-ferrous metals and composite plastics. 🗸 | (2) |
|  |  |  |  |
|  | 6.1.5 | **Hydraulic press** 🗸 |  |
|  |  |  |  |
|  |  | **Function:** |  |
|  |  | To install or remove components, such as bearings or bushes, in  mechanical devices 🗸 | (2) |
|  |  |  |  |
|  | 6.1.6 | **Oxy- acetylene equipment:** 🗸 |  |
|  |  |  |  |
|  |  | **Function:** |  |
|  |  | To enable gas welding or cutting, by means of the oxy-acetylene flame 🗸 | (2) |
|  |  | |  |
| 6.2 | **Drill bit sizes** | |  |
|  |  | |  |
|  | 6.2.1 | 8 mm 6, 8 mm to be drilled 🗸 | (1) |
|  |  |  |  |
|  | 6.2.2 | 10 mm 8, 5 mm to be drilled 🗸 | (1) |
|  |  | |  |
| 6.3 | **Power saw** | |  |
|  |  | |  |
|  | The blade is tensioned in the frame and cuts in a forward and backwards (reciprocating) motion similar to that of a hacksaw. 🗸 | | (1) |
|  |  | |  |
| 6.4 | **Type of roller** | |  |
|  |  | |  |
|  | Pyramid bending rolls 🗸 | | (1) |

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| 6.5 | **Cutting limitations of plasma cutters:** |  |
|  |  |  |
|  | Hand held torches can cut up to 38 mm thick 🗸 |  |
|  | Computer controlled torches can cut up to 150 mm thick plates 🗸 | (2) |
|  |  | **[18]** |

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| **QUESTION 7: FORCES (SPECIFIC)** | | |  |
|  | | |  |
| 7.1 | 7.1.1 | RR: RL X 8  = (10 x 2) + ( (6 x 5) 🗸 |  |
|  |  | = 20 + 30 |  |
|  |  | = 50 🗸 |  |
|  |  | RL = 6,25 N🗸 |  |
|  |  |  |  |
|  |  | RL: RR X 8  = (6 x 3) + (10 x 6) 🗸  = 18 + 60  = 78 🗸  RR = 9,75 N 🗸 | (6) |
|  |  |  |  |
|  |  | 10 N  B    E  A  G  6 N  F  C  H  2000 2000 4000  D  RL RR |  |
|  |  | **DIAGRAM 7.1** |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  | 7.1.2 | 🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸 | (10) |
|  |  | |  |
| 7.2 | **Definitions:** | |  |
|  |  | |  |
|  | **Strain:** Is the ratio between the change in length and the original length and is  expressed as a constant. 🗸🗸 | | (2) |
|  |  | |  |
|  | **Stress:** It is an external force applied to an object. Force per unit area. 🗸🗸 | | (2) |

|  |  |  |
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| 7.3 | Stress = 🗸  = 🗸🗸  = 🗸  = 🗸  = 29 629 629,63 Pa 🗸  **OR**  = 29,63 MPa  E = 🗸  = 🗸  Strain = 1,975308 x 🗸  STRAIN = 🗸  = 1,975308 x x 2 m 🗸  Change in Length = 3,95 X 🗸  = 0,395 mm 🗸 | (13) |
|  |  | **[33]** |

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| **QUESTION 8: JOINING METHODS (SPECIFIC)** | |  |
|  | |  |
| 8.1 | **Non-destructive tests:**   * Liquid dye penetrant test 🗸 * X-Ray test 🗸 * Ultrasonic test 🗸 | (3) |
|  |  |  |
| 8.2 | **Nick-break test:**   * Make a hacksaw cut through the centre of the weld. 🗸 * Cut should be about 6,5 mm deep. 🗸 * Place the saw-nicked specimen on two steel supports. 🗸 * Use a sledgehammer to break the specimen by striking it in the zone where you made the saw cuts. 🗸 * The weld metal exposed in the break should be completely fused and should be free from slag inclusions and contain no gas pockets greater than 1,6 mm.🗸 * There should be not more than one pore or gas pocket per square centimetre. | (5) |
|  |  |  |
| 8.3 | **Factors of a good arc:**   * The surface condition 🗸 * The travel speed 🗸 * The welding current 🗸 * The arc voltage 🗸 * The angle of the torch/electrode/shroud (Any 4 x 1) | (4) |
|  |  |  |
| 8.4 | **Welding defects:**   * Incomplete penetration 🗸 * Lack of fusion 🗸 * Porosity 🗸 * Undercutting 🗸 * Distortion * Cracks * Spatter * Slag inclusion (Any 4 x 1) | (4) |
|  |  |  |
| 8.5 | **Methods to reduce stress:**  Peening 🗸  Controlled heating, followed by controlled cooling 🗸 | (2) |
|  |  |  |
| 8.6 | **Welding spatter:**  It is the little droplets of molten material that are generated at or near the welding arc. 🗸🗸  It is generally regarded as a nuisance and is a critical factor to consider when developing an application. | (2) |
|  |  |  |
| 8.7 | **Cause of spatter:**  A disturbance in the molten weld pool during the transfer of wire into the  weld, 🗸caused by voltage being too low or amperage being too high. 🗸 | (2) |
|  |  |  |
| 8.8 | **Oxy-acetylene mild steel flame:**  Neutral flame 🗸 | (1) |
|  |  | **[23]** |

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| **QUESTION 9: JOINING METHODS (STRESSES AND DISTORTION) (SPECIFIC)** | |  |
|  | |  |
| 9.1 | 🗸🗸🗸 | (9) |
|  |  |  |
|  | 🗸🗸🗸 🗸🗸🗸 |  |
|  |  |  |
| 9.2 | **Types of cracks:**  HAZ(Heat affected zone)cracks 🗸  Centre line cracks 🗸  Crater cracks 🗸  Transverse cracks 🗸 | (4) |
|  |  |  |
| 9.3 | **Criteria for free bend test:**  It measures the ductility of the weld deposit and the heat affected area adjacent to the weld. 🗸  It is used to determine the percentage of elongation of the weld metal. 🗸 | (2) |
|  |  |  |
| 9.4 | **Advantages of liquid dye over X-ray or ultra-sonic test:**   * Good for ferrous and non-ferrous metals 🗸 * Low cost 🗸 * Easy to apply and interpret 🗸 * Minimal training required (Any 3 x 1) | (3) |

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| **QUESTION 10: MAINTENANCE (SPECIFIC)** | |  |
|  | |  |
| 10.1 | **Results of a lack of lubrication:**  Overloading 🗸  Friction 🗸 | (2) |
|  |  |  |
| 10.2 | **Definition of friction:**  Rubbing of one part 🗸 against another 🗸 | (2) |
|  |  |  |
| 10.3 | **Overloading:** |  |
|  | Excessive loads on machine parts 🗸  Running a machine or device at a rate higher than at which it was designed to operate 🗸 | (2) |
|  |  |  |
| 10.4 | **Consequences of overloading –guillotine:**  Cutting plate of excessive thickness or hardness will damage both the  blade 🗸and hydraulic system, resulting in costly damage 🗸 | (2) |
|  |  | **[8]** |

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| **QUESTION 11: TERMINOLOGY (DEVELOPMENT) (SPECIFIC)** | | |  |
|  | | |  |
| 11.1 |  | |  |
|  |  | |  |
|  | 11.1.1 | A – B : (1 – 2) = 🗸    = 7,85 🗸 | (3) |
|  |  |  |  |
|  | 11.1.2 | (A – 1) : X – 1 = 🗸  = 🗸  = 73,65 🗸 | (3) |
|  |  |  |  |
|  | 11.1.3 | (1 – a) = 🗸🗸  = 70,2 🗸🗸 | (4) |
|  |  |  |  |
|  | 11.1.4 | 2 – a = + (45 – 15 Sin + 🗸  = + + 🗸  = 🗸  = 70,2 🗸 | (4) |
|  |  |  |  |
|  | 11.1.5 | a - 3 = + (45 – 15 Sin + 🗸  = + + 🗸  = 🗸  = 70,2 🗸 | (4) |

|  |  |  |
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|  |  |  |
|  | 🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸  🗸 | (15) |
|  |  | **[33]** |
|  |  |  |
|  | **TOTAL:** | **200** |