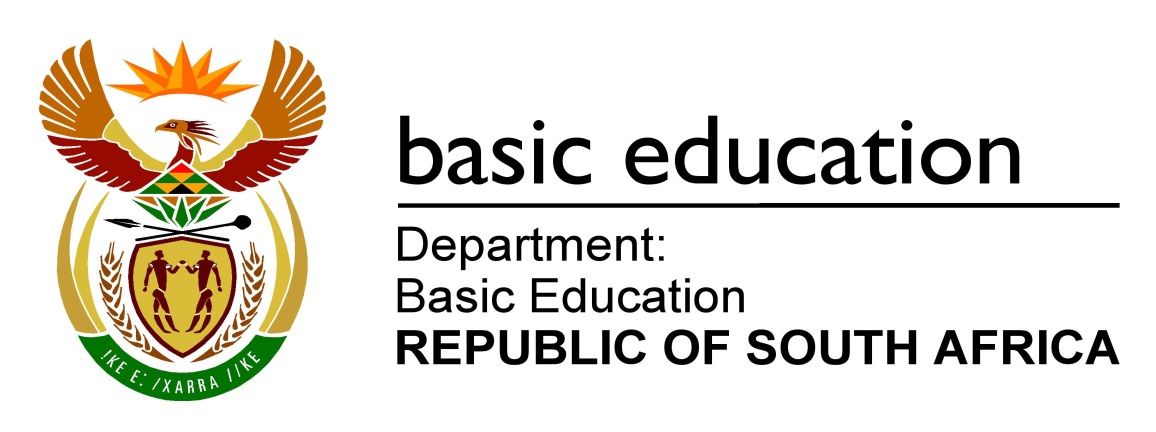
# MECHANICAL TECHNOLOGY: WELDING AND METALWORK

# EXEMPLAR 2018

**MARKING GUIDELINES**

# NATIONAL

# SENIOR CERTIFICATE



# GRADE 12

**MARKS: 200**

**These marking guidelines consist of 18 pages.**

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| **QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)** |  |  |

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| 1.1 | A ✓ |  | (1) |

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| 1.2 | B ✓ |  | (1) |

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| 1.3 | B ✓ |  | (1) |

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| 1.4 | B ✓ |  | (1) |

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| 1.5 | C ✓ |  | (1) |

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| 1.6 | C ✓ |  | (1) |
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| **QUESTION 2: SAFETY (GENERIC)** |  |  |

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| 2.1 | **Machine safety rule:**  Switch machine off after use. ✓ |  | (1) |

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| 2.2 | **Drill press safety precautions:**  Clamp the work piece securely to the table and do not hold it by hand. ✓ |  | (1) |

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| 2.3 | **Hydraulic press safety rules:**   * Predetermined pressure must not be exceeded. ✓ * Pressure gauge must be tested regularly and replaced if malfunction occurs. ✓ * The platform must be rigid and square to the cylinder. ✓ * Objects to be pressed must be placed in suitable jigs. ✓ * Ensure that the direction of pressure is always at 90° to the object. ✓ * Only prescribed equipment must be used. ✓ **(Any 2 x 1)** |  | (2) |

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| 2.4 | **Reasons for wearing surgical gloves:**   * To prevent HIV/Aids or any blood related infections. ✓ * To prevent contamination of the open wounds. ✓ |  | (2) |

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| 2.5 | **Gas cylinder safety precautions:**   * Always store and use gas cylinders in an upright position. ✓ * Never stack cylinders on top of one another. ✓ * Do not bang or work on the cylinders. ✓ * Never allow cylinders to fall. ✓ * No oil and grease should come into contact with gas cylinders or fittings. ✓ * Keep the caps on the cylinders for protection. ✓ **(Any 2 x 1)** |  | (2) |

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| 2.6 | **Responsibility of employer:**   * Provide and maintain working systems, work area, equipment and tools in a safe condition. ✓ * Eliminate or reduce any hazard or potential hazard. ✓ * Produce, handle, store and transport goods safely. ✓ * Ensure that every person employed complies with the requirements of this Act. ✓ * Enforce measures if necessary in the interest of health and safety. ✓ * Appoint a person who is trained and who have the authority to ensure that employee take precautionary measures. ✓ **(Any 1 x 1)** |  | (1) |

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| 2.7 | **Responsibility of employee:**   * Pay attention to your own and other people's health and safety. ✓ * Co-operate with the employer regarding the Act. ✓ * Carry out a lawful order given to them. ✓ * Report any situation that is unsafe or unhealthy. ✓ * Report all incidents and accidents. ✓ * Do not interfere with any safety equipment or misuse such equipment. ✓ * Obey all safety rules. ✓ **(Any 1 x 1)** |  | (1) | |
|  | |  | | **[10]** |

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| **QUESTION 3: MATERIALS (GENERIC)** |  |  |

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| 3.1 | **Metal tests:** |  |  |

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|  | 3.1.1 | **Filing test:**  Filing should be done on the tip or near the edge ✓ of the material to establish the relative hardness. ✓ |  | (2) |

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|  | 3.1.2 | **Machining test:**  This test is used on two unknown samples, identical in appearance and size, which is cut with a machine tool at the same speed and feed. ✓ The ease of cutting should be compared and the chips observed for heating colour and curl. ✓ |  | (2) |

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| 3.2 | **Sound test on the steel:** |  |  |

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|  | 3.2.1 | **High carbon steel (Hard):**  Loud and clear ✓✓ |  | (2) |

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|  | 3.2.2 | **Low carbon steel (Soft):**  Dull sound ✓✓ |  | (2) |

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| 3.3 | **Heat treatment processes on steel:** |  |  |

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|  | 3.3.2 | **Case hardening:**  To produce a hard case ✓ over a tough core. ✓ |  | (2) |

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|  | 3.3.3 | **Hardening:**  To enable the steel to resist wear ✓ and indentation ✓ |  | (2) |

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|  | 3.3.5 | **Normalising:**  To relieve ✓ the internal stress ✓ produced by machining. |  | (2) | |
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| **QUESTION 4: MULTIPLE-CHOICE QUESTIONS (SPECIFIC)** |  |  |

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| 4.1 | C ✓ |  | (1) |

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| 4.2 | B ✓ |  | (1) |

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| 4.3 | A ✓ |  | (1) |

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| 4.4 | C ✓ |  | (1) |

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| 4.5 | A ✓ |  | (1) |

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| 4.6 | C ✓ |  | (1) |

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| 4.7 | B ✓ |  | (1) |

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| 4.8 | D ✓ |  | (1) |

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| 4.9 | A ✓ |  | (1) |

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| 4.10 | D ✓ |  | (1) |

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| 4.11 | B ✓ |  | (1) |

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| 4.12 | D ✓ |  | (1) |

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| 4.13 | A ✓ |  | (1) |

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| 4.14 | C ✓ |  | (1) |
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| **QUESTION 5: TERMINOLOGY (TEMPLATES) (SPECIFIC)** |  |  |

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| 5.1 | **Roof truss:**  A – Principal rafter ✓  B – Cleat ✓  C – Purlin ✓  D – Internal bracing members ✓  E – Gusset plate ✓ |  | (5) |

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| 5.2 | **Fillet weld on T-joint:**  Arc  5  50 – 100  ✓  ✓  ✓  ✓  ✓  ✓  ✓  ✓ |  | (8) |

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| 5.3 | **Dimensions of the material:** |  |  |

✓

✓

✓

✓

✓

✓

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|  | 5.3.1 |  |  | (6) |

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|  | 5.3.2 | 16 mm  230 mm  246 mm  ✓  ✓  ✓  ✓ |  | (4) | |
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| **QUESTION 6: TOOLS AND EQUIPMENT (SPECIFIC)** |  |  |

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| 6.1 | **Working principle of the following machines:** |  |  |

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|  | 6.1.1 | **Punch and cropping machine:**  Cropping machines are electrically driven ✓ and use a heavy fly wheel and clutches ✓ to engage various shearing blades/punches ✓ to shear/punch the various profiles. ✓ |  | (4) |

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|  | 6.1.2 | **Spot welding equipment:**  This method uses the heating effect, ✓ which occurs when a current flows ✓ through a resistance, ✓ to fuse two plates together. ✓ |  | (4) |

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|  | 6.1.3 | **Power-driven guillotine:**  An electric motor ✓ drives a fly wheel in a gearbox ✓ that is activated through the electric pedal and clutch ✓ to turn an axle that lowers the blade by eccentric motion/action. ✓ |  | (4) |

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| 6.2 | **Uses of the bench grinder:**   * To sharpen cutting tools and drill bits. ✓ * To remove rough edges. ✓ * To remove excess material. ✓ |  | (3) |

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| 6.3 | **Types of rolling machines:**   * Horizontal pyramid rolls ✓ * Off-set pinch rolls ✓ * Vertical rolls ✓ |  | (3) | |
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| **QUESTION 7: FORCES (SPECIFIC)** |  |  |

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| 7.1 | ✓  ✓  ✓  ✓  ✓  ✓  ✓  ✓   |  |  |  | | --- | --- | --- | | **Member** | **Force** | **Nature** | | AE | 20 kN ✓ | Strut ✓ | | EF | 40 kN ✓ | Strut ✓ | | FC | 34 kN ✓ | Strut ✓ | | BF | 20 kN ✓ | Tie ✓ | | DE | 17 kN ✓ | Tie ✓ |   Space diagram  1 : 100  Vector diagram  2 mm = 1 kN | | | |  |  |
|  |  |  |  | (20) | | | |

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| 7.2 | **4 kN**  **5 kN**  **6 kN**  **3 m**  **3 m**  **3 m**  **3 m**  **D**  **C**  **B**    **A**  **E**  **D**  **C**  **B**  **A**  **E**  **RR**  **RL** |  |  |

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|  | 7.2.1 | ✓  ✓  ✓  ✓  ✓  ✓ |  | (6) |

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|  | 7.2.2 | **Shear forces:**  ✓    ✓  ✓  ✓  ✓ |  | (5) |

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|  | 7.2.3 | **Bending moments:**    ✓  ✓  ✓  ✓  ✓ |  | (5) |

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|  | 7.2.4  **+**  **=**  **A**  **0** | **Shear force diagram:**  **B**  **E**  **D**  **C**  ✓  ✓  **–**  **=**  ✓  ✓ | **0** | (4) |

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|  | 7.2.5  **0**  **A** | **Bending moment diagram:**  **B**  **C**  **D**  **E**  ✓  ✓  ✓  **0**  ✓  ✓ |  | (5) | |
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| **QUESTION 8: JOINING METHODS (INSPECTION OF WELD) (SPECIFIC)** |  |  |

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| 8.1 | **Inspection during arc welding:**   * Amount of penetration and fusion ✓ * Rate of electrode burning and progress of the weld ✓ * The way the weld metal is flowing (no slag inclusion) ✓ * The sound of the arc, indicating correct current and voltage for the particular weld ✓ **(Any 3 x 1)** |  | (3) |

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| 8.2 | **Causes of weld defects:** |  |  |

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|  | 8.2.1 | **Welding spatter:**   * Too high current ✓ * Too long arc ✓ * Not applying anti-spatter spray ✓ * Electrode angle too small ✓ * Welding speed too fast ✓ **(Any 2 x 1)** |  | (2) |

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|  | 8.2.2 | **Incomplete penetration:**   * Too low current ✓ * Too slow welding speed ✓ * Electrode angle too small ✓ * Poor joint preparation ✓ * Insufficient root gap ✓ **(Any 2 x 1)** |  | (2) |

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| 8.3 | **Prevention of weld defects:** |  |  |

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|  | 8.3.1 | **Porosity:**   * Ensure that the surface is clean. ✓ * Prevent atmospheric contamination. ✓ * Use dry electrodes. ✓  **(Any 1 x 1)** |  | (1) |

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|  | 8.3.2 | **Slag inclusion:**   * Remove slag from previous run before doing the next run. ✓ * Ensure that the surface is clean. ✓ * Use the correct current. ✓ **(Any 1 x 1)** |  | (1) |

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| 8.4 | **Nick-break test**:  To determine the internal ✓ quality/defects ✓ of the weld metal. |  | (2) |

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| 8.5 | **Guided bend test:**   * Lack of fusion of the base metal and weld metal. ✓ * Incomplete penetration of the weld metal. ✓ |  | (2) |

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| 8.6 | **Free-bend test:**  Ductility ✓ |  | (1) |

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| 8.7 | **Visual inspection process:**   * Shape of profile ✓ * Uniformity of the surface ✓ * Overlap ✓ * Undercutting ✓ * Penetration bead ✓ * Root groove ✓ **(Any 3 x 1)** |  | (3) |

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| 8.8 | **Liquid dye penetration test:**   * Clean the surface tested. ✓ * Spray the liquid dye penetrant onto the surface. ✓ * Allow liquid dye to penetrate. ✓ * Remove excess dye with cleaner. ✓ * Spray a developer onto the surface to bring out the colour. ✓ * Areas where the dye has penetrated (defects) will show up clearly. ✓ |  | (6) | |
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| **QUESTION 9: JOINING METHODS (STRESSES AND DISTORTION) (SPECIFIC)** |  |  |

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| 9.1 | **Distortion:**  Weld distortion is the warping of the base metal ✓ caused by heat from the welding arc/flame. ✓ |  | (2) |

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| 9.2 | **Residual stress:**  As the weld proceeds, ✓ the surrounding areas expand and contract ✓ at varied rates, which set up stresses ✓ in the welded joint. These stresses remain when the weld has cooled ✓ and are known as residual stresses. |  | (4) |

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| 9.3 | **Distortion and residual stress:**   * If expansion, which occurs when a metal is heated, is resisted then deformation occurs. ✓ * When contraction, which occurs on cooling, is resisted then a stress will be applied. ✓ * If the applied stress causes movement, then distortion occurs. ✓ * If the applied stress does not cause movement, then there will be residual stress in the welded joint. ✓ **(Any 3 x 1)** |  | (3) |

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| 9.4 | **Methods to reduce distortion:**   * Do not overweld. ✓ * Apply intermittent welding. ✓ * Place welds near the neutral axis. ✓ * Use as few passes as possible. ✓ * Use back-step welding. ✓ * Anticipate the shrinkage forces. ✓ * Plan the welding sequence. ✓ * Use strongbacks. ✓ * Use clamps, jigs and fixtures. ✓ **(Any 3 x 1)** |  | (3) |

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| 9.5 | **Difference between cold working and hot working of steel:**  Cold working is when deformation of steel takes place below ✓ the recrystallisation temperature ✓ of the steel.  Hot working is when deformation of steel takes place above ✓ the recrystallisation temperature ✓ of the steel. |  | (4) |

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| 9.6 | **Factors that affect the grain size of steel:**   * The prior amount of cold work. ✓ * The temperature and time of the annealing process. ✓ * The composition. ✓ * The melting point. ✓ **(Any 2 x 1)** |  | (2) | |
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| **QUESTION 10: MAINTENANCE (SPECIFIC)** |  |  |

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| 10.1 | **Locking out of large machines before maintenance:**   * Due to the danger associated with large machines ✓ * To ensure that isolation switches are switched off ✓ * To ensure that switches are locked out and tagged to inform others that maintenance work is being done ✓ * To ensure that nobody can turn on the machine while maintenance is being done ✓ **(Any 2 x 1)** |  | (2) |

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| 10.2 | **Tagging plates:**  It has multiple holes so that more than one technician can lock out the machine simultaneously. ✓ |  | (1) |

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| 10.3 | **Major and minor services for power-driven guillotine:**  **Major** service allows for on-going service procedures that are designed to maintain the guillotines in premium working conditions. ✓  **Minor** service is designed to minimise major mechanical and electrical failures, by employing the principle of preventative maintenance. ✓ |  | (2) |

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| 10.4 | **Maintenance guidelines for a pedestal drilling machine:**   * Visual checks of electrical wiring, switches, etc. ✓ * Verify that all guards are secure and function correctly. ✓ * Ensure workspace is clear. ✓ * Confirm availability and conditions of PPE. ✓ * Lubricate moving parts. ✓ * Use moisture-penetrating oil spray to prevent rust. ✓ * Check for availability of specific tools. ✓ * Check the run-out of the spindle. ✓ * Inspect belts for wear. ✓ * Ensure the drive belt is correctly tensioned. ✓ * Check the condition of the rack and pinion mechanisms and lubricate. ✓ * Ensure cuttings are removed. ✓ * Inspect the Morse taper sleeves for burrs/scratches. ✓ * Check the security of machine mountings. ✓ **(Any 2 x 1)** |  | (2) |

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| 10.5 | **Overloading a punch and shearing machine:**   * Dulling or breaking blades/punches. ✓ * Putting strain on the motor and drive mechanism. ✓ **(Any 1 x 1)** |  | (1) |
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| **QUESTION 11: TERMINOLOGY (DEVELOPMENT) (SPECIFIC)** |  |  |

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| 11.1 | **Conical hopper:** |  |  |

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|  | 11.1.1 | **Vertical height (DE):**  ✓  ✓ |  | (2) |

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|  | 11.1.2 | **Main radius (AC):**  ✓  ✓ |  | (2) |

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|  | 11.1.3 | **Small radius (AD):**  ✓  ✓  ✓ |  | (3) |

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|  | 11.1.4 | **Circumference:**  ✓  ✓ |  | (2) |

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| 11.2 | **Square-to-round transition piece:** |  |  |

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|  | 11.2.1 | **The true length FG is firstly needed to draw the pattern:**      ✓  ✓  ✓  ✓  ✓ |  | (5) |

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|  | 11.2.2 | **To determine the plan length CI, the sides CE and EI of triangle CEI must be calculated.**    ✓  ✓  ✓  ✓ |  | (4) |

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|  | 11.2.3 | **JI is one-twelfth of the circumference**    ✓  ✓  ✓ |  | (3) |
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| **TOTAL:** |  | **200** |