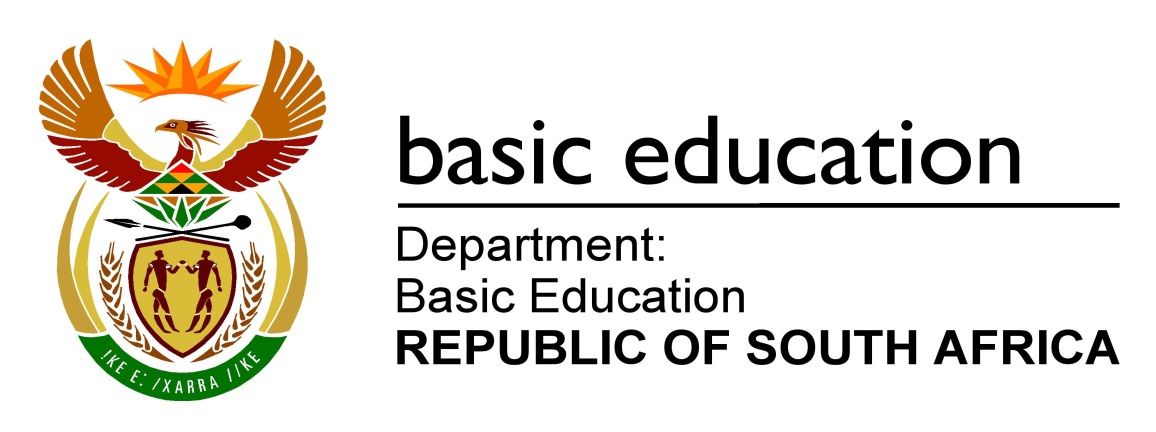
# MECHANICAL TECHNOLOGY: FITTING AND MACHINING

# EXEMPLAR 2018

**MARKING GUIDELINES**

# NATIONAL

# SENIOR CERTIFICATE



# GRADE 12

**MARKS: 200**

**These marking guidelines consist of 20 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) |
|  | |  | **[6]** |

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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 his/her 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) | |
|  | | | |  | | **[14]** |

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| **QUESTION 4: MULTIPLE-CHOICE QUESTIONS (SPECIFIC)** |  |  |

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| 4.1 | A ✓ |  | (1) |

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| 4.2 | D ✓ |  | (1) |

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| 4.3 | A ✓ |  | (1) |

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| 4.4 | C ✓ |  | (1) |

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| 4.5 | B ✓ |  | (1) |

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| 4.6 | B ✓ |  | (1) |

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| 4.7 | C ✓ |  | (1) |

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| 4.8 | A ✓ |  | (1) |

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| 4.9 | C ✓ |  | (1) |

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| 4.10 | B ✓ |  | (1) |

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| 4.11 | B ✓ |  | (1) |

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| 4.12 | B ✓ |  | (1) |

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| 4.13 | A ✓ |  | (1) |

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| 4.14 | A ✓ |  | (1) |
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| **QUESTION 5: TERMINOLOGY (LATHE AND MILLING MACHINE) (SPECIFIC)** |  |  |

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| 5.1 | **Calculate the tailstock set-over:**  **8°**  **X**  **300**  ✓  ✓  ✓ |  | (3) |

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| 5.2 | **Method to cut multiple-start threads:**   * Move the tool with the compound-slide ✓ * Turn the change-gears ✓ * Use a driving plate with accurately cut slots ✓ * Use a graduated driving plate ✓ **(Any 3 x 1)** |  | (3) |

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| 5.3 | **Parallel key:** |  |  |

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|  | 5.3.1 | **Width:**    ✓  ✓ |  | (2) |

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|  | 5.3.2 | **Thickness:**    ✓  ✓ |  | (2) |

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| 5.4 | **Advantages of using the compound slide method to cut an external V-thread on the centre lathe:**   * Left side of the tool cuts the thread and the right side gives a smooth finish ✓ * The force on the tool is evenly distributed along the cutting edge ✓ * The cutting chips curl away from the thread ✓ * If the tool needs to be removed, the thread can easily be picked up again with the new tool ✓ **(Any 2 x 1)** |  | (2) |

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| 5.5 | **Advantages of down-cut milling:**   * Smooth cutting through thin pipes and tubes ✓ * Coolant is carried down to the teeth where it is required ✓ * Better finish is produced as chip is cut from maximum to minimum ✓ * Tends to force the work piece onto the machine table✓ **(Any 3 x 1)** |  | (3) |

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| 5.6 | **Factors that may be responsible for chatter marks on milling work:**   * Incorrect cutter for the process ✓ * A blunt cutter ✓ * Incorrect cutting speed ✓ * Incorrect feed tempo ✓ * Inadequate machine capacity for the process ✓ **(Any 3 x 1)** |  | (3) | |
|  | |  | | **[18]** |

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| **QUESTION 6: TERMINOLOGY (INDEXING) (SPECIFIC)** |  |  |

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| 6.1 | **Spur gear:** |  |  |

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|  | 6.1.1 | **Number of teeth:**    ✓  ✓ |  | (2) |

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|  | 6.1.2 | **Outside diameter:**    ✓  ✓ |  | (2) |

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|  | 6.1.3 | **Cutting depth:**    ✓  ✓ |  | (2) |

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|  | 6.1.4 | **Addendum:**    ✓ |  | (1) |

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|  | 6.1.5 | **Dedendum:**    ✓ |  | (1) |

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|  | 6.1.6 | **Circular pitch:**    ✓  ✓ |  | (2) |

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| 6.2 | **Angular indexing:**    ✓  ✓  ✓  ✓  ✓  ✓  ✓ |  | (4) |

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| 6.3 | **Differential indexing:**    ✓  ✓  ✓  ✓  ✓  ✓ |  | (6) |

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| 6.4 | **Calculate distance X across rollers:**    **B**  **A**  **C**  **12,5**  **30°**  ✓  ✓  **E**  **30°**  **32**  **D**    ✓  ✓  **A**  ✓  ✓    ✓  ✓ |  | (8) |
|  | |  | **[28]** |

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| **QUESTION 7: TOOLS AND EQUIPMENT (SPECIFIC)** |  |  |

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| 7.1 | **Brinell hardness tester:**    **INDENTATION**  ✓  ✓  **LOAD**  **STEEL BALL**  **Rockwell hardness tester:**  ✓  ✓  **LOAD**  **DIAMOND CONE**  **INDENTATION** |  | (4) |

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| 7.2 | **Force tester:**  Apparatus to illustrate ✓ the concept of the triangle or parallelogram ✓ of forces. |  | (2) |

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| 7.3 | **Tensile tester:**   * Tensile strength ✓ * Elasticity ✓ * Ductility ✓ * Plasticity ✓ **(Any 2 x 1)** |  | (2) |

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| 7.4 | **Depth micrometer:**  50 ✓ + 16,00 + 0,5 ✓ + 0,11 = 66,61 mm ✓ |  | (3) |

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| 7.5 | Screw thread ✓ micrometer ✓ |  | (2) | |
|  | |  | | **[13]** |

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| **QUESTION 8: FORCES AND MOMENTS (SPECIFIC)** |  |  |

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| 8.1 | **Resultant:**  **250cos50°**  **250 N**  ✓  **250sin50°**  ✓  **300cos30°**  **300 N**  **300sin30°**  **50°**  **30°**  **350 N**  **150 N**    ✓  ✓  ✓    ✓  ✓  ✓  **OR**   |  |  |  |  | | --- | --- | --- | --- | | **Horizontal components** | **Magnitudes** | **Vertical components** | **Magnitudes** | | -300Cos30° | -259,81 N ✓ | 300Sin30° | 150 N ✓ | | 250Cos50° | 160,97 N ✓ | 250Sin50° | 191,51 N ✓ | | 350 | 350 N | -150 | -150 N | | **TOTAL** | **251,16 N** ✓ | **TOTAL** | **191,51 N** ✓ |   ✓    ✓  ✓  ✓  ✓  ✓  **Ɵ**  **R**  **HC**  **VC** |  | (14) |

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| 8.2 | **Moments:** |  |  |

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|  | **308 N**  **800 N**  **300 N**  **1 m**  **1,4 m**  **1,2 m**  **0,8 m**  **4,4 m**  **B**  **A** |  |  |

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|  | **Single acting force:**    ✓  **Calculate A.:**  **Moments about B.**    ✓  ✓  ✓  **Calculate B:.**  **Moments about A.**  ✓  ✓  ✓ |  | (7) |

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| 8.3 | **Stress and Strain:** |  |  |

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|  | 8.3.1 | **Stress:**  ✓  ✓  ✓  ✓  ✓ |  | (5) |

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|  | 8.3.2 | **Strain:**    ✓  ✓  ✓  ✓ |  | (4) |

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|  | 8.3.3 | **Safe working stress:**    ✓  ✓  ✓ | |  | (3) |
| **(A)(B)** | | |  | | **[33]** | |

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| **QUESTION 9: MAINTENANCE (SPECIFIC)** |  |  |

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| 9.1 | **Preventative maintenance:**   * Risk of injury or death ✓ * Financial loss due to damage suffered as a result of part failure ✓ * Loss of valuable production time ✓ |  | (3) |

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| 9.2 | **Malfunctioning of chain drives:**   * Lack of lubrication ✓ * Sprockets not properly secured to shafts ✓ * Incorrect sprocket alignment ✓ * Overloading ✓ * Incorrect tension ✓ **(Any 2 x 1)** |  | (2) |

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| 9.3 | **Wear on a belt drive system:**   * Check for wear and tear ✓ * Check belt/pulley alignment ✓ * Check tension setting ✓ * Check tensioning devices, e.g. jockeys ✓ **(Any 2 x 1)** |  | (2) |

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| 9.4 | **Replace the belt on a belt drive system:**   * Release the tension on the belt and remove from pulleys ✓ * Check the condition and alignment of the pulleys ✓ * Fit the new specified belt ✓ * Apply adequate tension to the belt ✓ * Check for proper operation ✓ |  | (5) |

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| 9.5 | **Materials** |  |  |

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|  | 9.5.1 | **Polyvinyl chloride (PVC):**   * It is a thermoplastic composite ✓ * Flexible ✓ * Gives a dull sound ✓ * It is a tough material ✓ * It can be welded or bonded with an adhesive ✓ * Good electrical insulation ✓ **(Any 1 x 1)** |  | (1) |

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|  | 9.5.2 | **Carbon fibre:**   * It is a thermo hardened (thermosetting) composite ✓ * It is a strong and tough material ✓ * It is a light weight material ✓ * It is water resistant ✓ * It is UV resistant ✓ * It is a good electrical insulation ✓ **(Any 1 x 1)** |  | (1) |

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| 9.6 | **Thermoplastic or Thermo hardened composites:** |  |  |

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|  | 9.6.1 | **Teflon:**  Thermoplastic ✓ |  | (1) |

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|  | 9.6.2 | **Vesconite:**  Thermoplastic ✓ |  | (1) |

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|  | 9.6.3 | **Bakelite:**  Thermo hardened ✓ |  | (1) |

**(A)(B)**

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| 9.7 | **Coefficient of friction:**  Thermo composites ✓ | |  | (1) | | |
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| **QUESTION 10: JOINING METHODS (SPECIFIC)** |  |  |

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| 10.1 | **Square screw thread:** |  |  |

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|  | 10.1.1 | **Screw thread lead:**  ✓  ✓ |  | (2) |

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|  | 10.1.2 | **Helix angle:**    ✓  ✓  ✓  ✓  ✓  ✓ |  | (6) |

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|  | 10.1.3 | **Leading angle:**    ✓  ✓ |  | (2) |

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|  | 10.1.4 | **Following angle:**    ✓  ✓ |  | (2) |

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| --- | --- | --- | --- |
| 10.2 | **Diameter of drill:**  ✓  ✓ |  | (2) |

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| 10.3 | **V-screw thread:** |  |  |

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|  | **10.3.4**    **10.3.2**  **10.3.1**  **10.3.3** |  |  |

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|  | 10.3.1 | Root diameter ✓ |  | (1) |

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|  | 10.3.2 | Crest diameter ✓ |  | (1) |

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|  | 10.3.3 | Effective diameter ✓ |  | (1) |

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|  | 10.3.4 | Pitch ✓ |  | (1) | |
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| **QUESTION 11: SYSTEMS AND CONTROL (DRIVE SYSTEMS) (SPECIFIC)** |  |  |

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| 11.1 | **Advantages of a belt drive:**   * Needs no lubrication ✓ * Silent operation ✓ * Cheaper parts ✓ * Can change direction without additional components ✓ * Easy to replace ✓ * Transmit power over a longer distance ✓ **(Any 3 x 1)** |  | (3) |

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| 11.2 | **Hydraulics:**    ✓  ✓  ✓    ✓  ✓  ✓  ✓ |  | (7) |

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| 11.3 | **Hydraulic symbols:** |  |  |

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|  | 11.3.1 | **Electrical motor:**  **M**  ✓  ✓ |  | (2) |

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|  | 11.3.2 | **Pressure gauge:**  ✓  ✓ |  | (2) |

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| 11.4 | **Belt-drive system:** |  |  |

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|  | 11.4.1 | **Belt speed:**    ✓  ✓  ✓ |  | (3) |

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| --- | --- | --- | --- | --- |
|  | 11.4.2 | **Power transmitted:**  ✓  ✓  ✓ |  | (3) |

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| 11.5 | **Gear drive system:** |  |  |

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|  | 11.5.1 | Driven gear C will rotate in the same direction (clockwise) ✓ |  | (1) |

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|  | 11.5.2 | **Number of teeth on gear C:**    ✓  ✓  ✓  ✓ |  | (4) |

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| 11.6 | **Chain drive system:** |  |  |

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|  | **Gear ratio:**  **OR**  ✓  ✓  ✓  ✓  ✓  ✓ |  | (3) | |
|  | |  | | **[28]** |

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| **TOTAL:** |  | **200** |