# MECHANICAL TECHNOLOGY: FITTING AND MACHINING

# EXEMPLAR 2018

**MARKING GUIDELINES**

# NATIONAL

# SENIOR CERTIFICATE


# GRADE 12

**MARKS: 200**

**These marking guidelines consist of 20 pages.**

|  |  |  |
| --- | --- | --- |
| **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) |
|  |  | **[14]** |

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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) |
|  |  | **[18]** |

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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) |
|  |  | **[18]** |

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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** |