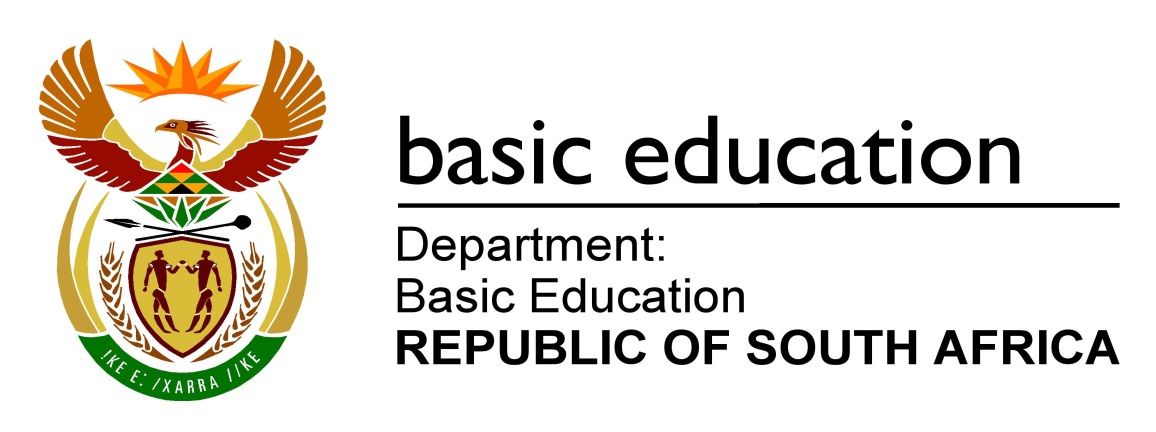
# MECHANICAL TECHNOLOGY: AUTOMATIVE

# 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 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) | |
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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 | D ✓ |  | (1) |

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| 4.2 | B ✓ |  | (1) |

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| 4.3 | D ✓ |  | (1) |

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| 4.4 | D ✓ |  | (1) |

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| 4.5 | A ✓ |  | (1) |

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| 4.6 | C ✓ |  | (1) |

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| 4.7 | D ✓ |  | (1) |

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| 4.8 | C ✓ |  | (1) |

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| 4.9 | C ✓ |  | (1) |

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| 4.10 | D ✓ |  | (1) |

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| 4.11 | A ✓ |  | (1) |

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| 4.12 | C ✓ |  | (1) |

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| 4.13 | A ✓ |  | (1) |

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| 4.14 | A ✓ |  | (1) |
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| **QUESTION 5: TOOLS AND EQUIPMENT (SPECIFIC)** |  |  |

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| 5.1 | **Computerised diagnostic scanner:**   * Easy to retrieve vehicle identification number. ✓ * High reliability and accurate. ✓ * Easy to read on its LCD display. ✓ * The diagnostic terminal fits in one direction only. ✓ **(Any 3 x 1)** |  | (3) |

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| 5.2 | **Reasons for balancing wheels:**   * When a tyre is replaced or repaired. ✓ * When a balancing weight is moved or falls off. ✓ * When vibration on the steering wheel is experienced. ✓ |  | (3) |

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| 5.3 | **Tools:** |  |  |

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|  | 5.3.1 | **Wheel balancer:**  To balance wheels to eliminate ✓ vibrations ✓ of vehicle wheels. |  | (2) |

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|  | 5.3.2 | **Gas analyser:**  To analyse exhaust gases ✓ to determine efficiency of the combustion process. ✓ |  | (2) |

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|  | 5.3.3 | **Compression tester:**  To determine whether the compression ✓ (pressure during compression stroke) in the cylinder is according to specification.✓ |  | (2) |

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|  | 5.3.4 | **Pressure tester:**  To test ✓ if there are any leaks ✓ in a system. |  | (2) |

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|  | 5.3.5 | **Wheel alignment equipment:**  To align the four wheels ✓ of a motor vehicle to ensure maximum tyre life and optimal road holding.✓ |  | (2) |

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| 5.4 | **Benefits of well-balanced wheels:**   * Reduces tyre wear ✓ * Improves fuel efficiency ✓ * Reduces stress in vehicle parts ✓ * Eliminates vibrations ✓ * Improves road holding ✓ **(Any 2 x 1)** |  | (2) |

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| 5.5 | **Wheel dimensions:** |  |  |

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|  | 5.5.1 | **Offset:**  The distance between the wheel balancer and the inner plane of the wheel rim. ✓ |  | (1) |

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|  | 5.5.2 | **Width:**  Width of the wheel at the wheel flanges, measured with a outside caliper. ✓ |  | (1) |

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|  | 5.5.3 | **Diameter:**  It is the outside diameter of the rim. ✓ |  | (1) |

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| 5.6 | **Static balancing:**  Static balancing is the equal distribution of all weights ✓ around the axis of rotation in the rotation plane. ✓ |  | (2) | |
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| **QUESTION 6: ENGINES (SPECIFIC)** |  |  |

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| 6.1 | **Causes of vibration:**   * Mechanical unbalance because of unbalanced moving parts. ✓ * Power unbalance because of disproportionate pressure on the pistons and crankshaft. ✓ |  | (2) |

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| 6.2 | **Angle of balancing weight:**  180° ✓✓ |  | (2) |

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| 6.3 | **Dynamic balancing:**  Balancing in all planes ✓ while the crankshaft is in motion. ✓ |  | (2) |

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| 6.4 | **Static and dynamic balancing:** |  | (8) |

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| 6.5 | **Mechanical balance:**  To overcome the differences ✓ that causes unbalance. ✓ |  | (2) |

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| 6.6 | **Crankshaft areas:**   * Crank arms ✓ * Counter weights ✓ * Flywheel ✓ |  | (3) |

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| 6.7 | **Vibration damper:**  To counteract the twisting ✓of the crankshaft during the power stroke. ✓ |  | (2) |

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| 6.8 | **Crankshaft layout:**   * Number of cylinders ✓ * Position of cylinders ✓ * Firing order ✓ * Firing periods ✓ |  | (4) |

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| 6.9 | **Firing order:** |  |  |

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|  | 6.9.1 | 1, 3, 4, 2 ✓ |  | (1) |

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|  | 6.9.2 | 1, 4, 3, 2 ✓ |  | (1) |

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|  | 6.9.3 | 1, 5, 3, 6, 2, 4 ✓ or 1, 4, 2, 6, 3, 5 ✓ **(Any 1 x 1)** |  | (1) | |
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| **QUESTION 7: FORCES (SPECIFIC)** |  |  |

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| 7.1 | **Compression ratio:**  The compression ratio of an internal combustion engine is the ratio of compression of the inlet charge during the compression stroke ✓ to the total volume of the cylinder. ✓ |  | (2) |

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| 7.2 | **Compression ratio:** |  |  |

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|  | 7.2.1 | **Swept volume:**    ✓  ✓  ✓ |  | (3) |

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|  | 7.2.2 | **Compression ratio:**    ✓  ✓  ✓ |  | (3) |

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|  | 7.2.3 | **New bore diameter:**    ✓  ✓  ✓  ✓  ✓  ✓ |  | (6) |

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| 7.3 | **Power:** |  |  |

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|  | 7.3.1 | **Torque:**    ✓  ✓  ✓ |  | (3) |

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|  | 7.3.2 | ✓  ✓  ✓  ✓  ✓  ✓    ✓  ✓  ✓ |  | (9) |

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|  | 7.3.3 | ✓  ✓  ✓  ✓ |  | (4) |

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|  | 7.3.4 | ✓  ✓ |  | (2) | |
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| **QUESTION 8: MAINTENANCE (SPECIFIC)** |  |  |

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| 8.1 | **Oil pressure test:**   * Because the oil pressure warning light is on. ✓ * To determine the location of an oil leak. ✓ |  | (2) |

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| 8.2 | **Reasons for high CO (carbon monoxide) reading:**   * Rich air fuel mixture ✓ * Incorrect idle speed ✓ * Clogged air filter ✓ * Faulty choke ✓ **(Any 2 x 1)** |  | (2) |

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| 8.3 | **Reasons for high HC (hydro-carbon) reading:**   * Incorrect ignition timing ✓ * Faulty high-tension leads ✓ * Low compression ✓ * Very rich mixture ✓ * Leaking gasket ✓ * Worn valves ✓ * Worn valve lifter ✓ * Worn rings and piston ✓ **(Any 3 x 1)** |  | (3) |

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| 8.4 | **Reasons for compression lost:**   * Worn cylinder ✓ * Cracked cylinder ✓ * Worn rings ✓ * Worn piston ✓ * Cracked piston ✓ * Leaking inlet valve ✓ * Leaking exhaust valve ✓ * Leaking cylinder head gasket ✓ **(Any 3 x 1)** |  | (3) |

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| 8.5 | **Wet compression test-procedure:**   * Add a little oil to the cylinder which has a low reading. ✓ * Execute the compression test as for dry test; if the reading increases it indicates that the piston rings are worn. ✓ |  | (2) |

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| 8.6 | **Cooling-system pressure tester:**   * Run engine to heat up the cooling system. Fit radiator pressure tester to radiator. ✓ * Pressurise the cooling system. (118 kPa). ✓ * Watch the pressure, if it drops there is a leak. ✓ * Make a visual check for leaks. ✓ * Install radiator cap to tester and pump the tester. The cap should release air at its rated pressure. ✓ * Check the rubber seal for cracks and damages. ✓ * Check the vacuum valve for free movement and operation. ✓ |  | (7) |

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| 8.7 | **Compression test:** |  |  |

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|  | 8.7.1 | **High tension lead:**   * The ignition system will be disabled. ✓ * To prevent electrical shock. ✓ **(Any 1 x 1)** |  | (1) |

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|  | 8.7.2 | **Fuel injectors disconnected:**   * To prevent unburned fuel entering the exhaust system. ✓ * To prevent fuel entering the tester. ✓ **(Any 1 x 1)** |  | (1) |

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|  | 8.7.3 | **Throttle valve fully open:**  To let the correct amount of air into the cylinder to obtain a correct reading. ✓ |  | (1) |

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|  | 8.7.4 | **Record the readings:**   * To compare readings with the specifications. ✓ * To determine the reading differences between the cylinders. ✓ **(Any 1 x 1)** |  | (1) | |
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| **QUESTION 9: SYSTEMS AND CONTROL (AUTOMATIC GEARBOX) (SPECIFIC)** |  |  |

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| 9.1 | **Transmission':**  The transmission is a device that is connected to the back of the engine ✓ and it transmits the power from the engine to the drive wheels. ✓ |  | (2) |

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| 9.2 | **Types of transmission layout:** |  |  |

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|  | 9.2.1 | Rear-wheel drive ✓ |  | (1) |

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|  | 9.2.2 | Front-wheel drive ✓ |  | (1) |

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| 9.3 | **Function of the torque converter:**  To multiply the engine torque automatically ✓according to road and engine speeds. ✓ |  | (2) |

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| 9.4 | **Components of the torque converter:**   * Impeller (pump) ✓ * Reactor (stator) ✓ * Turbine ✓ |  | (3) |

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| 9.5 | **Advantages of fluid coupling:**   * Acceleration and the transfer of torque is smoother as vehicle pulls away. ✓ * It does not require a foot-operated clutch pedal. ✓ * It serves as a flywheel. ✓ * It helps to reduce power unbalance. ✓ **(Any 3 x 1)** |  | (3) |

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| 9.6 | **Rotate in the same direction as the pump:**  One-way clutch ✓ |  | (1) |

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| 9.7 | **Gear ratio in relation to the road speed:**   * Higher gear ratio decreases the engine speed. ✓ * Low gear ratio increases the engine torque. ✓ |  | (2) |

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| 9.8 | **Locking sequence of the epicyclic gear trains:**  By hydraulic pressure operating brake bands and/or multiplate clutches. ✓ |  | (1) |

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| 9.9 | **Kickdown in automatic gearbox:**  Activates the change down for rapid acceleration. ✓ |  | (1) |

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| 9.10 | **Mechanical systems in automatic transmission:**  Planetary gear system ✓ |  | (1) | |
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| **QUESTION 10:** | **SYSTEMS AND CONTROL (AXLES, STEERING GEOMETRY AND ELECTRONICS) (SPECIFIC)** |  |  |

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| 10.1 | **Dynamic balance of a wheel and tyre assembly:**  This is the equal distribution of all weights ✓around the axis of rotation in all rotation parts ✓ |  | (2) |

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| 10.2 | **Preliminary wheel alignment check:**   * Check tyre condition and size. ✓ * Check tyre pressure. ✓ * Check the run out on rim. ✓ * Check wheel bearing for play. ✓ * No spring sag (vehicle must stand level). ✓ * Check suspension rubbers. ✓ * Check shock absorbers. ✓ * Check suspension springs. ✓ * Check if steering gear if in good order and centralised. ✓ * Check steering linkages. ✓ * Check ball-joint or king pin movement. ✓ * Ensure that the wheels are balanced. ✓ **(Any 5 x 1)** |  | (5) |

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| 10.3 | **Toe-in:** |  |  |

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|  | ✓  **Steering wheel**  ✓  **FRONT**  ✓  **Wheel**  **Motor vehicle**  ✓ |  | (3) |

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| 10.4 | **Camber:** |  |  |

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|  | 10.4.1 | **Wheel alignment angle:**  Positive ✓ camber angle ✓ |  | (2) |

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|  | 10.4.2 | **Camber angle:**  A – Wheel ✓  B – Perpendicular line ✓  C – Centre line of wheel ✓  D – Positive camber angle ✓ |  | (4) |

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|  | 10.4.3 | **Camber angle definition:**  Positive camber angle is the outward tilt ✓ of the wheel at the top away from the vehicle ✓ when viewed from the front. ✓ |  | (3) |

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| 10.5 | **Purpose of the speed control system:**  To control the throttle and to keep the vehicle speed constant. ✓ |  | (1) |

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| 10.6 | **Advantage of speed control:**   * Driver fatigue is decreased because it is not necessary to control the throttle with his/her foot. ✓ * The set speed is controlled. ✓ * Improved fuel consumption. ✓ * A consistently controlled speed prevents speeding fines. ✓ **(Any 1 x 1)** |  | (1) |

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| 10.7 | **Disadvantage of speed control:**   * The system is expensive. ✓ * High maintenance costs if the system becomes faulty. ✓ **(Any 1 x 1)** |  | (1) |

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| 10.8 | **Diode:**  To change alternating current to direct current. ✓ |  | (1) |

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| 10.9 | **Stator and stator windings:**   * To provide a core that concentrates the magnetic lines of force onto the stator windings. ✓ * To provide a coil into which voltage is induced which is used to charge the battery. ✓ **(Any 1 x 1)** |  | (1) |

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| 10.10 | **Operation of electric fuel pump:**   * As soon as ignition is switched on, the battery current flows through the electromagnet's coil windings and through the closed contact points to the earth. ✓ * The current flow in the coil windings produces a magnet field which magnetises the soft iron core of the electromagnet. ✓ * The armature on the diaphragm is attracted to the electromagnet moving the diaphragm down against the pressure of its spring. ✓ * This downwards movement of the diaphragm creates a partial vacuum in the float chamber causing the outlet valve to close more tightly. ✓ * Atmospheric pressure outside and inside the fuel tank allows petrol to flow through the inlet valve into the float chamber. ✓ * When the diaphragm is about to complete its downward stroke a trip mechanism opens the contact points and this interrupts the current flow. ✓ * The electromagnet then loses its attraction force and the diaphragm is pushed upwards by the diaphragm spring and the inlet valve closes. ✓ * Fuel is forced out of the float chamber through the outlet valve to the fuel line. ✓ |  | (8) | |
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| **TOTAL:** |  | **200** |