# 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) |
|  |  | **[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. ✓
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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) |
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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) |
|  |  | **[23]** |

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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 ✓
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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) |
|  |  | **[28]** |

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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) |
|  |  | **[32]** |

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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) |
|  |  | **[23]** |

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

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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) |
|  |  | **[32]** |

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