higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# MARKING GUIDELINE

## NATIONAL CERTIFICATE

## MOTOR TRADE THEORY N3

## 22 November 2022

**This marking guideline consists of 6 pages.**

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## QUESTION 1

1.1
- The position of the cranks and big-end journals on the crankshaft.
- The arrangement of the lobes on the camshaft. (2)

1.2
- Remove the tappet cover and determine which are the intake valves and which the exhaust valves.✓
- Rotate the engine in the direction in which it runs.✓
- Watch the order in which one set of valves, either the inlet or the exhaust valves, operates.✓
- This will indicate the order in which the inlet stroke or exhaust stroke occurs.
- The power strokes occur in the same order. (3)

1.3 1.3.1 True (1)

1.3.2 False.✓ The cylinders of in-line engines are mounted in a straight line. **OR** The cylinders of flat/horizontally opposed engines are arranged in two banks on either side of the crankshaft.✓ (2)

1.3.3 False.✓ In single-cylinder engines there is one power impulse for every second revolution of the crankshaft.✓ (2)

1.3.4 True (1)

1.3.5 False.✓ To calculate the swept volume of a piston, the area of the cylinder ($cm^2$ ) must be multiplied by the length of the stroke (cm).✓ (2)

1.3.6 True (1)

1.3.7 True (1)

**[15]**

## QUESTION 2

2.1 It is a combination of an exhaust-driven turbocharger and an engine-driven supercharger.✓
The arrangement increases the net power and torque of an engine.✓ (2)

2.2 **Advantages:**

- Outstanding fuel economy
- Reduced lag at low revolutions
- Increased power across the entire power band, with high torque available at all revolutions
- Reduced power-sapping effect of supercharger pulley on the engine.

(Any 1) (1)

**Disadvantages:**

- Twin charging is complex; extra valves and clutches are required to switch between the two compressors.
- Expensive electronic and/or mechanical controls must be used.

(Any 1) (1)

2.3 The variable turbo charger uses variable vanes to control and direct exhaust flow onto the turbine blades.✓ The vane angles are adjusted by an actuator, allowing the angle of the vane to change in relation to the engine revolutions, optimising the engine performance.✓ (2)

**QUESTION 3**

3.1

- The main function of the camshaft is to convert the rotary movement of the crankshaft into the reciprocating movement of the valves and to open the valves at their predetermined intervals.
- It is also used to drive the ignition distributor and often the oil pump.
- In some engines, the camshaft serves as a mechanism to operate the mechanical fuel pump. (Any 2) (2)

3.2

- Mechanical, cylinder-type cam follower with adjustable screw and locknut, as used in the side-valve engine
- Mechanical open-cylinder type, as used in overhead-valve engines
- Mechanical, mushroom type, as used in overhead-valve as well as side-valve engines
- Hydraulic cam followers, as used in overhead-valve engines

(Any 1) (1)

3.3

- Very quiet operation is possible because zero valve clearance is maintained.
- Because wear is automatically compensated for, regular adjustment of valve clearance is not required.
- The cam follower is self-adjusting as temperature varies.
- With zero valve clearance, the engine idles more smoothly because there is less valve overlap.
- Valve timing remains accurately adjusted because zero valve clearance is maintained. (Any 2 × 1 correct answers) (2)

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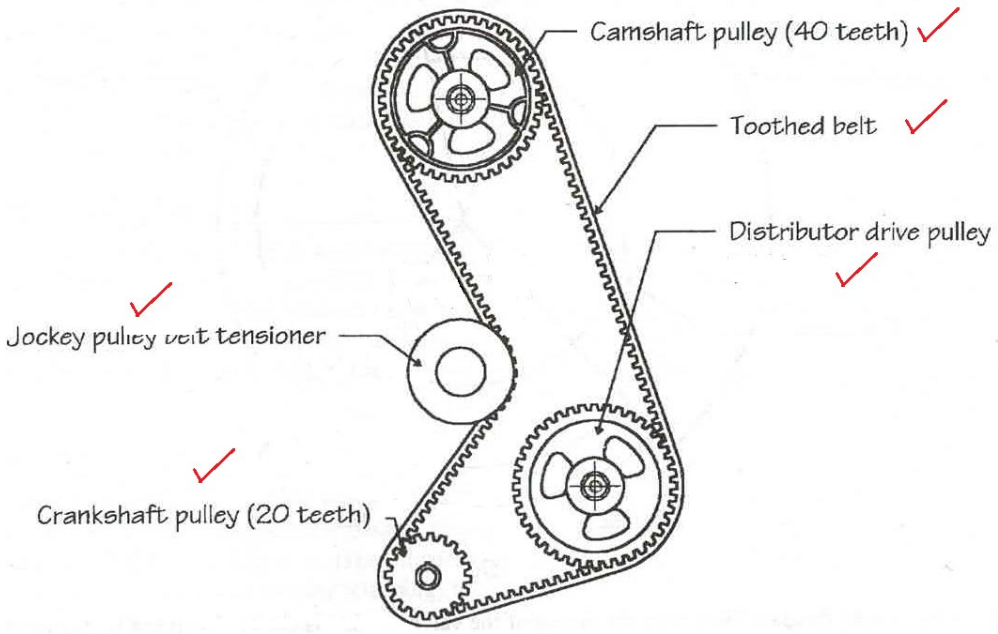
3.4




(5)
**[10]**

## QUESTION 4

4.1 The fuel pump feeds the fuel from the fuel tank to the injectors or carburettor at a predetermined pressure and at a rate higher than the maximum fuel consumption of the engine. (2)

4.2 A wet pump is an internal fuel pump/located inside the fuel tank. The electric motor operates while immersed in fuel. (2)

4.3 The fuel passing through the pump motor aids in the cooling and lubrication of the pump. (2)

4.4
- Immediate supply of fuel when the ignition switch is turned on
- Low operation noise
- Less discharge pulsation of fuel
- Compact and light design
- Ability to prevent fuel leak and locks vapour in (Any 2) (2)

4.5
- Pressure
- Injection time
- Size of the opening (orifice) of the injector (3)

4.6 1 Plunger
2 Needle valve
3 Coil (3)
**[14]**

**QUESTION 5**

5.1 Distributor-type and distributor less ignition system (DIS) (2)

5.2
- Electronic control unit (ECU)
- Crankshaft positioning sensor
- COP coil (3)

5.3
- Check the battery voltage first. It is extremely important to make sure the battery is in a good state of charge.
- Conduct a visual inspection and make sure that all connections are clean and tight. This includes high-tension leads, distributor cap, ignition coil, camshaft and/or crankshaft sensors (if part of the system) and the ECU assembly.
- Remove the high-tension lead from a spark plug, fit it to a dummy spark plug and check for sparking while cranking the engine (also check that the rotor is turning).
- If the abovementioned checks deliver satisfactory results, start the engine and check for engine misfire under load or while accelerating.
- Check the coil for continuity across the small input coil terminals.
- Check the plug wires with an ohmmeter. Check the vehicle specifications for the correct plug wire resistance.
- If the plug wires are fine, remove the cap assembly and check for moisture, cracks, chips, carbon tracks or any other high-voltage leads or failures. Replace the cap if any defects are found.
- Use a diagnostic scanner to carry out further testing.
- Connect the diagnostic scanner unit to the 16-pin OBD-II connector.
- Insert the correct data, e.g. the vehicle manufacturer, date of registration, etc., and begin the checks. (Any 5 × 1) (5)

**[10]**

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## QUESTION 6

6.1
- The activation or deactivation of the lockup clutch is made possible by oil pressure.
- When the turbine and impeller are up to speed, the fluid is channelled to the clutch piston.
- The movement of the piston pushes the friction discs/pads together, locking the turbine and impeller. They turn as a unit.
- This system improves efficiency and prevents slippage. (Any 3 × 1) (3)

6.2
- When the oil pressure is applied between the friction plate and the impeller, the friction plate is pushed backward.
- The lockup clutch is then released. (2)

**[5]**

## QUESTION 7

7.1
- To adjust the engine speed and therefore also the engine power to meet varying road and load conditions.
- To provide a parking device that locks the transmission so that the vehicle is held stationary. (2)

7.2
- It allows smoother, easier driving.
- It reduces driver fatigue.
- Automatic gear changing plus the use of fluid coupling results in less transmission and tyre wear.
- Torque multiplication is provided automatically.
- It reduces wheel spin in bad road conditions, e.g. on ice, snow, mud and sand.
- The vehicle can be stopped suddenly without the engine's stalling.
- The system dampens all torsional vibrations of the engine. (Any 4 × 1) (4)

7.3
- The DSG comprises two independent transmission units. Each unit is constructed much like a manual gearbox and connected by a multiplate clutch.
- Both multiplate clutches work in oil (i.e. the wet type).
- The clutches are regulated, opened and closed by a mechatronics system. (3)

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7.4
- Check the ATF level regularly. (A vehicle should not lose automatic gearbox oil under normal operation.)
- Check for possible oil leaks on the gearbox.
- Check the engine light on the dashboard. If it is on, it could indicate automatic transmission problems.
- When test driving the car, check the following: – Delayed engagement when shifting gears – vehicle takes a few seconds to respond – Harsh shifting – transmission makes a clunking/grinding sound when you switch gears or the car lurches – Slippage – when you depress the accelerator, the engine noise and revolution count increases, but the car does not accelerate. (Any 4 × 1) (4)

**[13]**

## QUESTION 8

8.1
- Driver is able to steer the vehicle when only one wheel has traction
- Better acceleration (even though one wheel may be airborne)
- Reduction in shock load on the driving shaft and axles when an airborne wheel returns to the ground
- Easier and more effective handling of the vehicle on bumpy roads (4)

8.2
- Requires the use of special differential lubricant
- Care should be taken to avoid sudden acceleration when both driving wheels are on a slippery surface; this causes both wheels to spin and allows the vehicle to slide sideways on the curved surface of a road on a turn (2)

**[6]**

## QUESTION 9

9.1 Power steering is designed to make steering swift and easy, thereby assisting the driver of the vehicle. (1)

9.2 When the vehicle is in neutral. (1)

9.3
- Less effort is required to turn the steering wheel, especially in city traffic and when parking a vehicle.
- A more favourable gear ratio is achieved in the steering box, resulting in more direct steering. Considerable leverage on the steering wheel is not required.
- Power steering acts as a damper, preventing the transfer of road shocks to the steering wheel. (3)

9.4
- Engine power is absorbed, because the hydraulic pump is driven by the engine of the vehicle.
- As a result of the indirect connection between the steering wheel and front wheels of the vehicle, the 'road feeling' on the steering wheel is lost.
- More moving parts are subjected to wear and may develop faults.
- Manufacturing costs are high, making power steering an expensive system. (4)

9.5
- Electric systems are more fuel-efficient, because they have no belt-driven hydraulic power-steering pump that is constantly running, whether assistance is required or not.
- Because there is no pump, there are no hydraulic hoses, hydraulic fluid or drive belt and pulley – therefore fewer parts that can wear or be damaged. This greatly simplifies manufacturing and maintenance.
- By incorporating electronic stability control, electric power-steering systems can instantly vary torque-assist levels to aid the driver in corrective manoeuvres. (3)

**[12]**

**QUESTION 10**

10.1
- Full hybrids – full hybrid electric vehicles
- Mild hybrids (light hybrids)
- Plug-In Hybrids (3)

**[3]**

**QUESTION 11**

11.1 P = Powertrain
0 = Generic OBD code
3 = Ignition system or misfire (3)

11.2 C = Chassis
I = Vehicle manufacturer specific code
6 = Computer output circuit (3)

**[6]**

**TOTAL: 100**

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