higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MOTOR TRADE THEORY N3

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This marking guideline consists of 6 pages.

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QUESTION 1

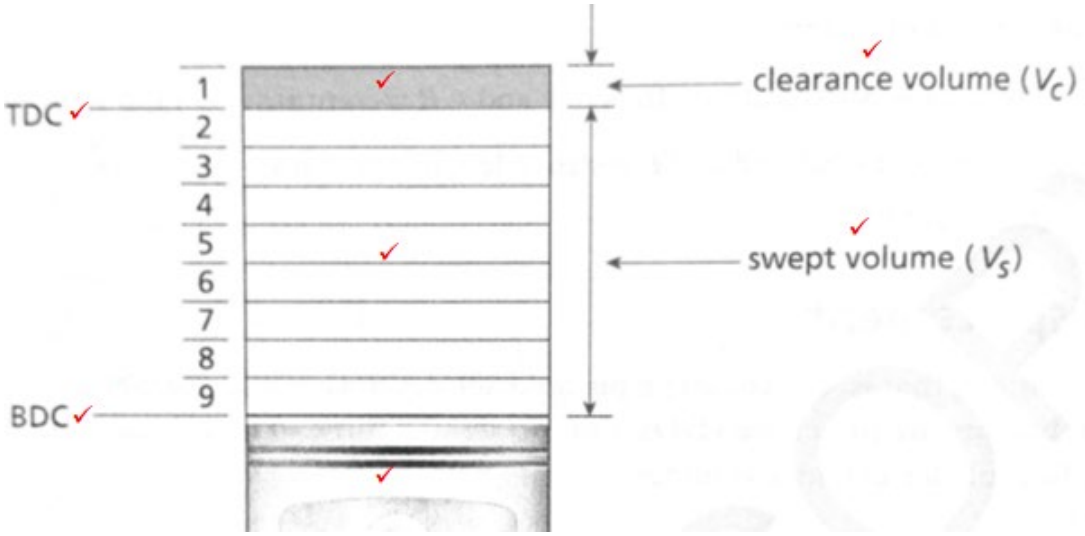
1.1 $V = \frac{\pi}{4} \times d^2 \times h$ ✓

$V = \frac{\pi}{4} \times 6{,}5^2 \times 7{,}4$ ✓ ✓

$V = 245{,}554\ cm^3$ ✓ (4)

1.2 The firing order of an engine is determined by the position of the connecting rod journals on the crankshaft in relation to each other. (2)

1.3



(Any correct sketch × 3 and correct labels × 4) (7)

1.4 The physical law which tends to keep a motionless body at rest✓ or a moving body in motion✓ is known as the law of inertia. (2)

1.5 An actuator operates the waste gate.✓ When the pressure in the compressor area becomes too high, it acts against the diaphragm which pushes against the internal spring.✓ The diaphragm is connected to the actuator lever that is connected to the waste gate valve on the exhaust side.✓ The change in pressure and actuator movement open the waste gate valve✓ that reduces the amount of exhaust air passing over the turbine fins, reducing the turbo impeller shaft speed.✓ (5)

1.6
1.6.1 Camshaft actuator rotor
1.6.2 Variable cam timing actuator
1.6.3 Camshaft actuator vane
1.6.4 Timing chain sprocket
1.6.5 Cam follower
1.6.6 Oil pressure port

(6 × 1) (6)

1.7
- Overhead valve
- Single overhead camshaft
- Double or multiple overhead camshafts
- Cam-less engines (4)

[30]

QUESTION 2

2.1 In the CFI system the fuel injectors deliver fuel to the intake port in a continuous spray.✓ The amount of fuel injected is regulated by an airflow sensor plate✓ that controls the volume of fuel passing through the fuel distributer.✓ (3)

2.2
- The intake manifold of a petrol injection engine allows the air to flow freely with one injector at each cylinder, preventing cylinders from receiving different air fuel ratios.
- Hot spots for pre-heating the cold air and fuel mixture is used on carburettor engines. This is eliminated on petrol injection engines so that denser air enters the cylinder when the engine has reached operating conditions.
- On fuel injection systems the fuel has been taken out of the air stream, allowing the manifold designer to concentrate on velocity of the air stream, thus increasing the volumetric efficiency.
- A common problem on carburettor engines is that fuel overshoots to the next cylinder. On fuel injection systems there is no need to allow for overshoot because of a very accurate controlled air fuel ratio, giving good fuel consumption.
- Carburettor engines often experience air locks in the fuel system due to heat. On fuel injection systems high pressure in the fuel lines eliminates this problem.
- In the past the high cost of fuel injection systems was considered prohibitive. Nowadays the rising cost of the extra carburettor refinements needed to meet current standards is rapidly narrowing the financial gap between the carburettor and the fuel injection systems.
- On a carburettor engine fuel passes a tortuous route through the carburettor and manifold to the cylinders. On fuel injection the fuel has been taken out of this route giving better engine response.
- The problem of icing up a carburettor engine manifold is eliminated because of the simple design of the manifold on fuel injection systems. Icing up the manifold occurs because of the pressure drop at the venturi which causes a drop in temperature. (Any 6 × 1) (6)

2.3
- High fuel consumption
- Low performance
- Idling problems
- Poor ignition (Backfiring) (4)

2.4 The current is first delivered to an inverter to change DC to AC and then it is passed to a transformer to raise the voltage.✓ When the spark is required, the trigger releases the energy to the coil primary windings by 'firing' a thyristor.✓ Sudden discharge of the high voltage energy to the primary windings of the coil✓ causes rapid build-up in the magnetic flux✓ of the coil and induces a voltage more than 40 kV in the secondary circuit to give a high intensity short duration spark.✓ (5)

2.5 The function of the sensor is to indicate the crankshaft position✓ to the electronic control unit (ECU).✓ (2)

2.6
- Clutch cover toothed disc
- Flywheel ring gear
- Crankshaft phonic wheel (3)

2.7 When the crankshaft turns, the driving member carries oil around it and throws it✓ onto the driving member✓ by centrifugal force. The oil hits the face of the vanes in the driven member, thus causing the driven member to turn.✓ When the engine is idling and the gearbox is in gear, no power is transmitted✓ because the centrifugal force of the oil leaving the pump vanes is too weak to drive the turbine.✓ (5)
[28]

QUESTION 3

3.1
3.1.1 Front clutch
3.1.2 Large sun gear
3.1.3 Front band
3.1.4 Rear band
3.1.5 Planetary carrier
3.1.6 Annulus
3.1.7 Small sun gear
3.1.8 Small planetary gear
3.1.9 Large planetary gear
3.1.10 Rear clutch
(10 × 1) (10)

3.2
- Automated manual transmission
- Semi-automated manual transmission
- Continuous variable transmission
- Tiptronic transmission
- Direct shift transmission
- Duel clutch transmission
- Multi clutch transmission (Any 5 × 1) (5)

3.3 Engagement of the differential lock is obtained when the sleeve sliding on the extended external splines of the side gear is pushed to the right to mesh with the corresponding dog teeth formed on the clutch member fixed to the differential housing.✓ Locking one side gear to the differential housing prevents the planet pinions from revolving independently within the differential housing.✓ Therefore, the side shafts and housing will be compelled to revolve as one with the final drive crown wheel.✓ The lock should be applied when the vehicle is just in motion to enable the teeth to align.✓ (4)

3.4
3.4.1 Pivot
3.4.2 Selector fork arm
3.4.3 Splines
3.4.4 Actuating sleeve dog clutch member
3.4.5 Crown wheel
3.4.6 Differential housing/carrier

(6 × 1) (6)
[25]

QUESTION 4

4.1 Hydraulic rotary valve:
A rotary valve senses steering force and controls the direction of hydraulic pressure for the power steering. The torsion bar twists when torque is applied from the steering shaft.✓ At the top, the torsion bar is connected to the steering shaft and at the bottom to the worm gear and the outer part of the spool valve.✓ The amount that the torsion bar twists depends on how much the steering is turned.✓ As the torsion bar is twisted, the inner part of the spool valve, connected to the steering shaft, is rotated to open the ports and supply high pressure to the correct side of the ball nut piston.✓

Torque sensor:
A torque sensor measures steering force and sends a signal to the ECU. The steering shaft has a slider with two coils stacked on top of each other around the slider. Current from the control unit creates a magnetic field in the coils. With the slider centred when driving straight ahead, the current flow is the same in both coils.✓ When the steering is turned, the slider moves up or down. The movement alters the magnetic field and disturbs the current flow through the two coils.✓ The more the slider moves up or down, the larger the change or disturbance of the current. The ECU monitors the coil currents to determine the magnitude and direction of turning force in the steering shaft.✓ (7)

4.2
- Alkaline fuel cell
- Hydrogen fuel cell
- Proton exchange membrane fuel cell
- Solid oxide fuel cell
- Molten carbonate fuel cell
- Phosphoric acid fuel cell

(Any 5 × 1) (5)

4.3 P: Indicates general system power train code (engine and gearbox) ✓
0: Indicates what assigned the code, universal to all vehicles✓
0: Indicates the specific system that malfunctioned, entire system faulty✓
16: Indicates specific malfunctioning circuit, crank position censor✓✓ (5)
[17]

TOTAL: 100

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