THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

093 MOTOR VEHICLE MECHANICS

Time: 3 Hours **ANSWERS** **Year: 2020**

Instructions

1. This paper consists of section A, B and C.

2. Answer all questions in section A and B and three questions from section C.

1. (i) What do diesel engines require differently compared to petrol engines?
A Bigger flywheel
B Smaller flywheel
C Same size of flywheel
D Hollow flywheel
E Heavy flywheel

Answer: A – Diesel engines need bigger flywheels due to higher compression and power stroke intervals to maintain momentum.

(ii) What converts the rotary motion of steering wheel into lateral motion?
A Steering wheel
B Steering shaft
C Steering gear box
D Tie rod
E Steering belt

Answer: C – The steering gearbox converts the rotary motion from steering wheel to lateral motion for turning the wheels.

(iii) Which condition causes large quantities of CO emission?
A Clear air–fuel ratio combustion
B Insufficient fuel during combustion
C Low temperature combustion
D High temperature combustion
E Infiltration of air during combustion

Answer: C – Low temperature combustion leads to incomplete combustion, producing higher CO (carbon monoxide).

(iv) How can you attach clutch facings to the plate?
A By steel rivets
B By brass rivets
C By aluminium screws
D By steel screws
E By wood rivets

Answer: A – Clutch facings are commonly attached using steel rivets for strong mechanical bonding.

(v) How is the lower cylindrical portion of the piston which improves the effect of piston cooling called?
A Piston crown
B Piston lower
C Piston pin boss

D Piston skirt
E Piston end

Answer: D – The piston skirt dissipates heat and reduces friction in the lower cylinder area.

(vi) Which one is the correct arrangement of flow of power through the drive train?
A Engine drive shafts, clutch, main shaft, counter shaft, final driven gear, wheels
B Engine clutch, main shaft, counter shaft, final driven gear, drive shafts, wheels
C Engine clutch, counter shaft, main shaft, final driven gear, drive shafts, wheels
D Engine main shaft, counter shaft, clutch, final driven gear, drive shafts, wheels
E Engine clutch, main shaft, counter shaft, final driven gear, drive shafts, flywheel

Answer: B – Correct power transmission path: Engine → Clutch → Main shaft → Counter shaft → Final driven gear → Drive shaft → Wheels

(vii) Which meter measures the engine r.p.m. of a motor car?
A Speedometer
B Revometer
C Barometer
D Galvanometer
E Tachometer

Answer: E – A tachometer measures the engine's revolutions per minute (rpm).

(viii) Which of the following are factors of a brake power?
A Indicated Power (I.P) and Frictional Power (F.P)
B Indicated Power (I.P) and Consumed Power (C.P)
C Consumed Power (C.P) and Frictional Power (F.P)
D Wheel Power (W.P) and Frictional Power (F.P)
E Indicated Power (I.P) and Wheel Power (W.P)

Answer: D – Brake power depends on wheel power output and losses due to friction.

(ix) What are the two general types of tyres employed in motor vehicle?
A Solid and tubeless
B Tube type and tubeless
C Air and metallic
D Wire and rubber
E Solid and tube type

Answer: B – Tube type and tubeless tyres are the common types used in vehicles.

(x) What drives the oil pump in the motor car engine?

A Camshaft
B Pulley
C Sprockets
D Crankshaft
E Belt

Answer: D – The crankshaft drives the oil pump in most internal combustion engines.

2. (a) Why a cam shaft does not rotate the same speed as crank shaft?
Because in a four-stroke engine, camshaft rotates at half the speed of the crankshaft.

(b) What are the three factors which should be considered while designing a motor car body?
– Aerodynamics
– Structural strength
– Passenger safety and comfort

3. (a) State five portable types of fire extinguishers with their colour code.
– Water (Red)
– Foam (Cream)
– Dry Powder (Blue)
– Carbon Dioxide (Black)
– Halon or Clean Agent (Green)

(b) Give the type of fire extinguished by each type of fire extinguishers mentioned in part 3(a).
– Water: Class A (wood, paper)
– Foam: Class A and B (flammable liquids)
– Dry Powder: Class A, B, C (gas, electrical fires)
– CO_2: Class B and electrical fires
– Halon: Class B and electrical fires

4. Identify five important information which are found on the side of a tyre.
– Tyre size
– Load index
– Speed rating
– Manufacturing date
– Tread wear, traction, temperature grades
5. Give five types of handles and in each state how it is used with box or socket spanners.
– T-handle: Torque application
– Ratchet handle: Quick tightening/loosening
– Sliding T-bar: Better leverage

– Speed brace: High-speed turning
– Hinged handle: Access tight spots

6. (a) What is meant by ‘temporary fasteners’ in engineering processes?
Fasteners that can be removed and reused without damaging parts joined.

(b) Give four examples of temporary fasteners and their uses.
– Bolts and nuts: General assembly
– Screws: Light attachments
– Washers: Load distribution
– Keys: Shaft-to-hub connections

7. What are the five emission gases that can be obtained during test emission using exhaust gas analyser?
– Carbon monoxide (CO)
– Hydrocarbons (HC)
– Nitrogen oxides (NOx)
– Carbon dioxide (CO_2)
– Oxygen (O_2)

8. (a) Which type and size of the electric cooling fan motor is used in motor vehicle?
DC electric fan motor (usually 12V), size depends on radiator design.

(b) How can someone control the electrical fan in cooling system? Give three ways.
– Thermostat switch
– Electronic control unit (ECU)
– Manual switch

9. How does a cam operated ‘internal expanding brakes’ work?
A cam rotates and pushes brake shoes outward against the drum, creating friction to stop wheel motion.

10. Briefly explain ten safety rules that should be followed in the motor vehicle workshop.
– Wear personal protective equipment
– Use correct tools for jobs
– Maintain clean workspace
– Do not indulge in horseplay
– Proper ventilation
– Use jack stands for lifting vehicles
– Avoid loose clothing
– Follow fire safety protocols
– Disconnect battery before repairs
– Ensure proper lighting

11 (a) Briefly explain the following terms as used in the motor vehicle wheel dimension:

(i) Rim diameter – This is the distance measured across the wheel rim from bead seat to bead seat, usually expressed in inches, and it determines the size of the tire that fits the rim.

(ii) Wheel width – This is the distance between the inner and outer flanges of the rim. It affects tire fitting and contact area with the road.

(iii) Wheelbase – This is the distance between the centers of the front and rear wheels. It affects vehicle stability, handling, and comfort.

(b) What will be the effects on the tyre when the following conditions occur:

(i) Under-inflation – Causes excessive tire flexing, increased rolling resistance, overheating, reduced fuel economy, and uneven tread wear especially on edges.

(ii) Over-inflation – Leads to reduced tire contact area, harsh ride, increased wear in the center of the tread, and higher risk of tire damage from impact.

(c) (i) Differentiate static wheel imbalance from dynamic wheel imbalance.

Static imbalance occurs when one part of the tire is heavier, causing vertical vibration.
Dynamic imbalance occurs when there is unequal weight distribution on both sides of the tire centerline, causing side-to-side vibration.

(ii) What are the four advantages of the radial-ply?

Improved fuel efficiency due to lower rolling resistance.
Better traction and handling.
Longer tread life.
Improved ride comfort and heat dissipation.

(iii) What is the use of tyre valves?

Tyre valves allow air to be filled or released from the tire and maintain proper air pressure by preventing leakage.

12 (a) (i) Classify the radiators with respect to water flow in it.

Radiators can be classified as down-flow and cross-flow types.
In down-flow, water flows from top tank to bottom tank.

In cross-flow, water flows horizontally from one side to another.

(ii) Describe the working principle of a radiator.

Hot coolant from the engine flows through radiator tubes. Air flows across the tubes and fins to remove heat. The cooled fluid is then returned to the engine.

(b) (i) Why radiators are equipped with pressure cap?

Pressure caps increase the boiling point of the coolant by maintaining pressure in the system, reducing the risk of overheating and coolant loss.

(ii) Describe the working principle of a radiator pressure cap.

The pressure cap has a spring-loaded valve that opens only at a specified pressure, allowing excess coolant to flow into the overflow tank. As the system cools, vacuum created draws coolant back from the tank.

(c) (i) Explain the purpose of the expansion tank in the engine cooling system.

The expansion tank provides space for coolant expansion when heated and prevents loss of coolant due to overflow.

(ii) How is water drawn by the radiator from the expansion tank?

When the system cools, pressure drops, creating a vacuum which draws coolant back through the radiator cap's return valve.

13 (a) (i) What is a constant velocity joint?

A constant velocity (CV) joint is a mechanical joint that allows torque transmission at a constant speed regardless of the angle between the shafts.

(ii) Distinguish between a birfield plunge joint and a tripod plunge joint.

Birfield joint uses a ball-and-cage mechanism to allow angular and axial movement.
Tripod joint uses three rollers in a three-lobed housing for axial and angular flexibility.

(b) Briefly explain the uses of 'universal joint' and 'sliding joint' in a hotchkiss propeller shaft.

Universal joint accommodates angular movement between transmission and axle.
Sliding joint allows the shaft length to vary with suspension movement.

(c) (i) What is the effect of using a long hotchkiss propeller shaft?

It may cause vibrations, misalignment, and increased wear due to shaft deflection and imbalance.

(ii) How can the effect stated in 13(c)(i) be prevented?

Using a center bearing to support the shaft and reduce length of unsupported sections.

14 (a) How can the following actions be achieved by friction clutch?

(i) Engaging gears and vehicle engine smoothly when the vehicle is in motion – By gradually engaging the clutch plate with flywheel to avoid sudden jerk or shock.

(ii) Acting as positive brake – When clutch is fully engaged, it transmits full torque without slipping, acting as a solid mechanical link.

(b) Describe three symptoms and two causes of the following clutch faults:

(i) Clutch slip – Symptoms: Engine revs increase but speed doesn't match; poor acceleration; overheating clutch.
Causes: Worn clutch plate, weak pressure spring.

(ii) Clutch spin – Symptoms: Difficulty in gear engagement; abnormal noise; engine shakes at take-off.
Causes: Oil contamination on clutch plate, misaligned clutch components.