THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

093 MOTOR VEHICLE MECHANICS

Time: 3 Hours **ANSWERS** **Year: 2005**

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) The part of the vehicle that holds the passengers and the cargo to be transported is known as
A chassis
B hull
C aft
D sedan
E cabin

Answer: A – Chassis is the structural framework of a vehicle where the engine, body, transmission, and other components are mounted. It supports the vehicle and carries the load.

(ii) An opposed-cylinder engine has
A one crankshaft and one camshaft
B one crankshaft and two camshafts
C two crankshafts and two camshafts
D two crankshafts and four camshafts
E two crankshafts and one camshaft

Answer: A – Opposed-cylinder (or flat) engines have one crankshaft and one camshaft with pistons horizontally opposite to each other, reducing vibration and improving balance.

(iii) The device for smoothing out the power impulse from the engine is called
A clutch
B differential
C flywheel
D torque converter
E gear box

Answer: C – A flywheel stores rotational energy and smooths out power pulses by maintaining momentum between power strokes of the engine.

(iv) In S.I. engine if the spark plug deposit indicates black coating of soot, it indicates that the engine has been generally operating on
A too lean mixture
B stoichiometric mixture
C most economical mixture
D slightly rich mixture
E too rich mixture

Answer: E – A too rich mixture means excess fuel in the air-fuel mixture, resulting in incomplete combustion and black carbon deposits on the spark plug.

(v) At the first sight a petrol engine is identified by
A cylinder size

B power output
C operating speed
D spark plug
E size of air cleaner

Answer: D – A petrol engine uses spark plugs for ignition, unlike diesel engines which use compression ignition, making spark plugs a clear identifier.

(vi) The function of diesel feed pump (whenever provided) is to
A pump the fuel from the injector pump to the injector
B pump the fuel from the tank into the injector pump
C pump the oil into the main gallery
D send back the fuel to the injector into the tank
E pump the fuel to the injector

Answer: B – The diesel feed pump draws fuel from the tank and supplies it to the fuel injection pump for pressurization and delivery to the injector.

(vii) The device in the cooling system that increases the boiling point of the water in the system is called
A radiator
B drain plug
C water jacket
D pressure cap
E vacuum valve

Answer: D – A pressure cap raises the pressure inside the cooling system, which increases the boiling point of coolant, preventing boiling and overheating.

(viii) In an engine the probable cause for low oil pressure cannot be
A use of heavy engine oil
B use of diluted engine oil
C air leaks in oil pump suction line
D excessive clearances at valve pushers
E water, sludge, dirt etc restricting oil pump intake screen

Answer: A – Heavy engine oil increases pressure due to high viscosity. Other listed factors can cause low oil pressure.

(ix) In an automobile the probable cause for ineffective brakes could be
A grease on lining
B excessive lining wear
C drums scored
D grease and excessive lining wear

E none of the above

Answer: D – Both grease contamination and worn-out linings reduce braking efficiency by reducing friction between lining and drum/disc.

(x) When fully charged, the specific gravity of acid in a battery is usually
A 0.74
B 0.84
C 1.00
D 1.12
E 1.28

Answer: E – A fully charged lead-acid battery has a specific gravity around 1.28, indicating high acid concentration and good battery health.

2. State two (2) types of antifriction bearings used in automobile driving wheel.
– Ball bearings: Spherical balls reduce friction between moving parts.
– Taper roller bearings: Tapered rollers handle both axial and radial loads effectively.
3. List down four (4) causes of dragging brakes.
– Improper brake pedal free play adjustment
– Stuck brake caliper piston
– Faulty return spring
– Contaminated or swollen brake hose causing pressure lock

4. For a spark plug M14 × 1.25; what does the figure 1.25 stand for?
1.25 represents the pitch of the thread, meaning the distance between the threads is 1.25 mm.

5. What is the purpose of a suspension damper?
A suspension damper (shock absorber) controls spring oscillations, dampens road shocks, and improves ride comfort and vehicle handling.

6. Why is a compensation system incorporated in a modern fixed-choke carburettor?
A compensation system maintains the correct air-fuel ratio at varying engine speeds by supplying an additional air passage or compensating jet to prevent mixture richness at high speeds.

7. State the purpose of double declutching when changing down a gear.
Double declutching matches engine speed with gear speed when downshifting in non-synchromesh transmissions, ensuring smoother gear engagement and reducing gear wear.

8. State the name given to crown wheel and pinion.
The assembly of crown wheel and pinion is called the final drive. It transmits power from the drive shaft to the wheels and reduces speed while increasing torque.

9. Give a reason why a laminated spring is made up of a series of leaves.
Using a series of leaves allows load distribution along the length, increases strength, provides progressive stiffness, and improves flexibility without compromising support.

10. What is the function of a "well" in a wheel rim?
The "well" in a wheel rim allows the tyre bead to be compressed during tyre fitting or removal. It provides clearance for the tyre to slip over the rim flange.

11. How is the front wheel alignment adjusted?
Front wheel alignment is adjusted by altering toe, camber, and caster angles using adjustment bolts, tie rods, or shims to ensure proper wheel positioning, even tyre wear, and stable steering.

12 (a) A simple plate clutch transmits a torque of 80 Nm. Six springs supply the clamping force. What force must each spring exert if the mean radius of the friction plate is 200 mm? Take the coefficient of friction to be 0.4.

Torque (T) = $\mu \times F \times r$
Where T = 80 Nm, $\mu = 0.4$, r = 0.2 m
Total clamping force $F = T \div (\mu \times r)$
$= 80 \div (0.4 \times 0.2) = 80 \div 0.08 = 1000$ N
Since there are 6 springs:
Force per spring = 1000 ÷ 6 = 166.67 N

(b) Brake efficiency tends to fall after a prolonged steep inclined descent because of overheating. Continuous braking generates heat in the brake drums or discs, which reduces friction between the brake surfaces. This leads to a condition known as brake fade, where braking power becomes weak and ineffective due to heat-affected components losing their friction properties.

13. Explain briefly each of the following terms in connection with batteries:

(a) Sulphation is the formation of lead sulfate crystals on the battery plates when a lead-acid battery is left discharged for long periods. This reduces battery capacity and can become irreversible if not corrected in time.

(b) Battery capacity refers to the total amount of electrical energy a battery can store and deliver, measured in ampere-hours (Ah). It indicates how long a battery can power a device before requiring recharging.

(c) Gasing in a battery refers to the release of hydrogen and oxygen gases during overcharging of a lead-acid battery. It results from the electrolysis of water in the electrolyte and can be dangerous if not vented properly.

14 (a) State three (3) steering faults that may be due to a faulty suspension system.

Excessive or uneven tire wear may occur due to poor alignment caused by worn suspension parts, leading to poor road contact.

Vehicle pulling to one side during driving can be caused by a collapsed spring or unequal suspension height, affecting steering balance.

Steering wheel vibration or shimmying may result from worn suspension bushings or faulty shock absorbers, disturbing the steering stability.

(b) Laminated leaf springs are said to be "self damping" because the friction between the individual leaves of the spring helps to absorb shocks and vibrations. This internal friction acts as a natural damping mechanism, reducing the need for additional damping components.

15. With the help of a simple sketch, explain the following:

(a) Camber angle is the tilt of the wheels from the vertical when viewed from the front. Positive camber means the top of the wheel tilts outward, while negative camber means it tilts inward. It affects tire wear and cornering performance.

(b) Caster angle is the forward or backward tilt of the steering axis when viewed from the side. Positive caster provides better directional stability and helps in returning the wheels to a straight position after turning.

(c) King pin inclination (KPI) is the inward tilt of the steering axis towards the vertical plane of the wheel when viewed from the front. It aids in steering ease, self-centering, and reduces tire scrub.

16. List down the causes of large quantities of blue smoke emitted from the exhaust.

Worn piston rings allow engine oil to enter the combustion chamber where it burns, producing blue smoke.

Worn valve stem seals can cause oil leakage into the combustion area, resulting in blue exhaust smoke.

Excessive oil in the crankcase leads to oil being sucked into the intake manifold and burned during combustion.

Damaged or worn turbocharger seals allow oil to enter the engine intake and be burned along with the air-fuel mixture.

Cylinder wall wear or scoring may allow oil to bypass the piston rings and enter the combustion chamber, contributing to blue smoke.