THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

093 MOTOR VEHICLE MECHANICS

Time: 3 Hours **ANSWERS** **Year: 2002**

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) In commercial vehicle layouts engine is located forward, rear or under floor mainly
A for better utilization of space
B to increase in fuel economy
C to have a better weight
D to reduce the weight of chassis
E to minimise the tendency of overturn.

Answer: A – In commercial vehicles, engine positioning helps utilize space effectively, improving vehicle layout and cargo accommodation.

(ii) Which one of the following is mounted between the engine and gearbox?
A Propeller shaft
B Differential gear
C Reductor fan
D Clutch
E Radiator

Answer: D – The clutch is mounted between the engine and gearbox to connect and disconnect power transmission between the two during gear shifting.

(iii) If brake wheels get locked before the vehicle stops, the vehicle is said to be
A slipping
B rubbing
C sliding
D rolling
E skidding

Answer: E – Skidding occurs when the wheels lock and slide over the road surface without rotation, causing loss of control.

(iv) The flow of petrol from fuel tank to the carburettor involves
A an accelerator pump
B a vacuum pump
C a fuel pump
D a suction pump
E a float

Answer: C – The fuel pump draws petrol from the tank and delivers it under pressure to the carburettor for mixing with air.

(v) One reason of fitting a gear box is to overcome the following drawback of I.C. engine:
A Low torque at low speed

B High torque at low speed
C Low torque at high speed
D High power at low speed
E High torque at high speed

Answer: C – Gearbox compensates for low torque at high speeds by enabling torque multiplication at various gear ratios to suit driving conditions.

(vi) An axle is located on a leaf spring by a
A U-bolt
B spring clip
C centre bolt
D shackle pin
E spring eye

Answer: C – The centre bolt passes through the spring leaves and aligns with the axle seat to hold and locate the axle position.

(vii) Rotary motion of the steering wheel is converted to a reciprocating motion by
A track arm
B track rod
C stub axle
D steering box
E king pin

Answer: D – The steering box converts the rotary motion from the steering wheel into a reciprocating motion to move the steering linkages.

(viii) On a beam axle the stub axle pivots about a
A king pin
B ball joint
C track rod
D track arm
E steering column

Answer: A – The stub axle rotates around the king pin, which serves as the pivot point in beam axle systems.

(ix) Water circulation in a thermo-syphon cooling system is caused by
A conduction currents
B a belt driven water impeller
C a gear driven water pump
D the change in density of the water
E water pump circulation

Answer: D – In thermo-syphon systems, circulation is caused by natural convection due to the density difference between hot and cold water.

(x) In a force feed lubrication system the device used to guard against excessive oil pressure is known as
A release chamber
B balancer
C relief valve
D stop valve
E pressure actuator

Answer: C – The relief valve regulates oil pressure by releasing excess oil back to the sump when pressure exceeds a set limit.

2. What is scavenging?
Scavenging is the process of removing burnt exhaust gases from the engine cylinder and replacing them with a fresh charge of air-fuel mixture (in spark ignition engines) or air (in compression ignition engines). It occurs at the end of the exhaust stroke and beginning of the intake stroke. Proper scavenging ensures complete removal of waste gases, better combustion, and improved engine efficiency.

3. Name the water-cooling system in which water pump is not needed for water circulation.
The water-cooling system in which a water pump is not needed is called the thermo-syphon cooling system. This system relies on the natural convection of water caused by differences in temperature and density. Hot water rises from the engine to the radiator, cools down, and the cooled water returns to the engine by gravity.

4. Describe the factors which bring a moving vehicle to rest (halt).
A moving vehicle comes to rest due to several factors including: – Braking force applied through the braking system which slows down the wheels.
– Friction between tyres and road surface which resists motion.
– Air resistance acting against the vehicle's motion.
– Engine braking, which occurs when the driver decelerates and the engine's resistance slows down the vehicle.
– Transmission drag and rolling resistance from wheels and axles.

5. List down three causes of high oil pressure in the lubrication system.
– Blocked oil passages which restrict oil flow and increase pressure.
– A faulty or stuck relief valve that fails to release excess oil pressure.
– Oil too thick due to low temperature or using high viscosity oil, causing high resistance to flow.

6. What is the difference between constant-mesh and synchromesh transmission?
In constant-mesh transmission, all gears are always in mesh, but gears are engaged using dog clutches. It requires more skill to operate and is prone to gear clashing.

In synchromesh transmission, synchronizer rings match the speed of the gears before engagement, allowing smooth and silent gear shifting without clashing. It is more user-friendly and used in most modern vehicles.

7. What is a reversible steering?
Reversible steering is a steering mechanism in which the movement of the road wheels is transmitted back to the steering wheel. It allows the driver to feel road shocks and steering feedback, improving vehicle control and safety.

8. What is the function of a choke or venturi in a carburettor?
The choke is used during cold starting to restrict the air supply, enriching the fuel-air mixture to aid combustion. The venturi is a narrow section in the carburettor where air speed increases and pressure drops, drawing fuel from the float chamber for mixing with air.

9. How is the repair of a tubeless tyre with a small puncture done?
A tubeless tyre puncture is repaired by first locating the puncture, removing the object, cleaning the hole using a reamer, and inserting a rubber plug or repair strip using an insertion tool. The plug seals the hole, and the tyre is reinflated and checked for leaks.

10. Between which two members is the coil spring retained on most front suspension systems? State two methods of retaining the coil spring.
The coil spring in most front suspension systems is retained between the lower control arm and the upper spring seat (or strut mount).
Two methods of retaining coil springs are: – Using spring seats or cups designed to hold the spring ends firmly in place.
– Using spring retainers or clamps that secure the spring from moving out of position during operation.

11. Give three causes of car wanders.
– Improper wheel alignment, especially incorrect toe or camber angle.
– Unequal tyre pressure or uneven tyre wear.
– Worn or loose steering and suspension components such as tie rods, ball joints, or control arm bushings.

12. What is the purpose of a gasket? Name places where gaskets are used in the engine.

A gasket serves the purpose of sealing the joint between two surfaces to prevent the leakage of fluids or gases under pressure. It ensures a tight and secure fit between engine parts. Gaskets are commonly used in places such as between the cylinder head and engine block (cylinder head gasket), intake and exhaust manifolds, oil pan, valve covers, water pump, and thermostat housing.

13. An engine cylinder has a swept volume of 225 cm^3 and a clearance volume of 25 cm^3.
(a) Calculate the compression ratio.

Compression ratio = (Swept volume + Clearance volume) ÷ Clearance volume
= (225 + 25) ÷ 25

= 250 ÷ 25
= 10:1

(b) During a compression test five shots of oil from an oil can decrease the clearance volume by 5 cm^3. Calculate the compression ratio when the oil is in the cylinder.

New clearance volume = 25 - 5 = 20 cm^3
New compression ratio = (225 + 20) ÷ 20
= 245 ÷ 20
= 12.25:1

14. Some water-cooled engines do not employ a water pump to assist circulation in the system.
(a) What is the name given to this type of a system?

This type of system is called a thermo-syphon system.

(b) Under what principles does this system operate?

The thermo-syphon system operates on the principle of natural convection. As the coolant in the engine absorbs heat, it becomes lighter and rises toward the radiator. The cooler, denser coolant in the radiator then flows down into the engine block, creating a natural circulation cycle without the need for a water pump.

15. State three functions of a steering box.

The steering box converts the rotary motion of the steering wheel into linear motion required to turn the vehicle's wheels. When the driver rotates the steering wheel, the steering box transforms this rotational movement into a push or pull action that is transmitted through the steering linkage to the wheels, enabling directional control of the vehicle.

The steering box also acts as a mechanical advantage device by increasing the driver's steering effort through a gear reduction mechanism. This gearing allows the driver to steer the vehicle more easily with minimal physical effort, especially at low speeds or when maneuvering in tight spaces.

Another vital function of the steering box is to transmit the steering movement accurately and effectively to the rest of the steering components. It ensures that any motion from the steering wheel is correctly delivered to the linkages and ultimately to the road wheels, maintaining smooth control, stability, and proper vehicle alignment.

16. State four causes of noisy gearbox defect.

One cause of noisy gearbox operation is worn or damaged gear teeth. When the gears are chipped, pitted, or excessively worn, they fail to mesh smoothly, leading to grinding, whining, or clunking sounds during gear changes or while driving in gear.

Another common cause is inadequate or contaminated gearbox oil. Low oil levels or oil that contains debris and metal particles reduce lubrication efficiency, increasing friction and wear, which generates noise during operation. Contaminated oil also accelerates component deterioration within the gearbox.

Worn or defective bearings inside the gearbox can also lead to abnormal noise. Bearings support the rotating shafts and allow smooth movement. When these bearings become loose, worn, or fail entirely, they cause vibration and produce a humming or rumbling sound, especially at certain engine speeds or gear positions.

Improper gear alignment or faulty assembly is another major cause of gearbox noise. Misaligned gears do not engage properly, resulting in harsh contact and vibration. This misalignment can originate from poor installation, worn shafts, or structural deformation, causing continuous noise during gear operation.