THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

093 MOTOR VEHICLE MECHANICS

Time: 3 Hours **ANSWERS** **Year: 2000**

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. Mention the name of a device used to transform alternating current to direct current.
The device used to transform alternating current (AC) to direct current (DC) is called a rectifier. A rectifier works by allowing current to pass through it in only one direction. It uses diodes, which are electronic components that conduct electricity in one direction only, converting the AC waveform (which alternates between positive and negative) into a DC output, which flows in a single direction. Rectifiers are commonly found in vehicle charging systems to convert AC from the alternator to DC for charging the battery.

2. (a) Define the term piston clearance.
Piston clearance refers to the small space or gap between the piston and the inner wall of the engine cylinder. This gap is crucial because it allows the piston to expand freely when it heats up during engine operation. Without this clearance, the piston could get stuck or seize due to thermal expansion, leading to engine failure.

(b) What are the effects of small and big piston clearance?
If the piston clearance is too small, there will be insufficient space for the piston to expand when it gets hot, causing it to seize or stick against the cylinder wall. This can result in scoring of the cylinder and piston damage. On the other hand, if the piston clearance is too large, the piston may wobble or knock against the cylinder wall, causing piston slap noise, reduced compression, increased oil consumption, and poor engine performance due to poor sealing.

3. (a) Briefly explain the meaning of tappet clearance.
Tappet clearance is the small gap between the end of the valve stem and the rocker arm or cam follower in the engine valve mechanism. This clearance ensures that the valve completely closes when needed and compensates for the expansion of metal parts as the engine heats up. Proper tappet clearance helps maintain the correct valve timing and prevents valve leakage.

(b) What are the effects of small tappet (valve) clearance?
If tappet clearance is too small, the valve may not close completely, leading to loss of engine compression, power reduction, and overheating of the valve. It can also cause continuous contact between the rocker arm and valve stem, resulting in wear and damage. The engine may also become difficult to start, and misfiring can occur.

4. Name three items to be checked, for safety reasons, before an engine is started.
First, the engine oil level should be checked to ensure proper lubrication of moving parts and avoid engine damage. Second, the coolant level should be inspected to prevent engine overheating. Third, the battery terminals and wiring connections must be checked to ensure proper electrical starting and avoid short circuits or power loss.

5. State five types of locking devices that are used in the automobile industry.
Cotter pins are metal fasteners inserted through a hole to lock a nut or bolt in place, preventing loosening. Split pins are similar to cotter pins but have two prongs that bend apart after insertion for extra grip. Lock washers are specially designed washers that grip the bolt and nut tightly to prevent movement. Circlips are circular metal clips used to secure components like shafts and bearings in their positions. Locking strips are metal or plastic strips used to fasten and secure parts tightly and prevent vibration-induced loosening.

6. Name three main sections of a radiator.
The top tank or cap section holds coolant and contains the radiator cap which helps maintain pressure. The core or body is the central part made of thin tubes and fins where heat exchange takes place between the hot coolant and air. The bottom tank or drain plug section collects coolant after circulation and allows it to return to the engine; it also has a drain plug for emptying the radiator.

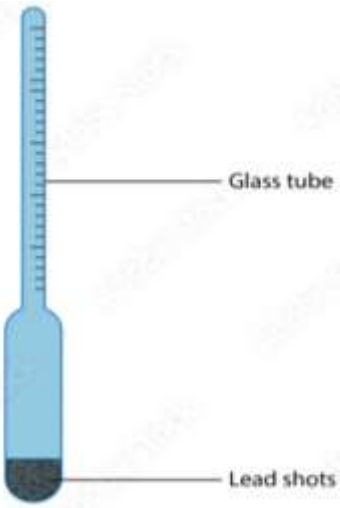
7. Why do front brake pads have a larger lining area than rear brake shoes?
During braking, the vehicle's weight shifts forward, placing more load on the front wheels. Therefore, front brakes need to provide more stopping power. To achieve this, front brake pads are designed with a larger lining area to increase friction and absorb more heat. This design ensures efficient braking and reduces the risk of overheating or fading under heavy braking.

8. State the three types of springs used on modern vehicles.
Coil springs are helical-shaped springs that compress and expand to absorb shocks from road irregularities. Leaf springs consist of several layers (leaves) of metal strips curved to form a spring and are commonly used in trucks. Torsion bars are metal rods that twist under load to act as springs, used in some suspension systems where space is limited.

9. Give three reasons why the front-end alignment must be correct.
Correct front-end alignment ensures that tyres wear evenly and last longer by preventing edge wear or feathering. It maintains proper steering control and handling, allowing the driver to keep the vehicle straight without pulling to one side. It also improves fuel efficiency by reducing rolling resistance and avoiding excessive drag caused by misaligned wheels.

10. What is the function of the fuel system?
The fuel system stores fuel, filters it, and delivers it in the proper quantity to the engine's combustion chamber. It includes components like the fuel tank, fuel pump, fuel filter, injectors or carburetor, and fuel lines. The system ensures that fuel is mixed correctly with air before combustion, resulting in efficient power production and smooth engine performance.

11. (a) Draw a well labelled diagram of a hydrometer.
A hydrometer is a cylindrical instrument with a weighted bulb at the bottom and a calibrated stem at the top. It is usually enclosed in a transparent glass tube and sometimes has rubber suction bulbs to draw electrolyte into it. The calibration scale shows the specific gravity.



(b) Describe how to use a hydrometer to measure the specific gravity of an electrolyte of a battery.
To measure specific gravity using a hydrometer, squeeze the rubber bulb to expel air, insert the nozzle into the battery cell, and slowly release the bulb to draw electrolyte into the tube. The float inside the hydrometer rises and settles based on the electrolyte's density. The point where the electrolyte level touches the float scale indicates the specific gravity. This value shows the state of battery charge—higher values mean a fully charged battery, while lower values indicate discharge.

12. (a) What is the main purpose of the cooling system?
The main purpose of the cooling system is to remove excess heat from the engine to prevent overheating. It maintains the engine at the optimal operating temperature by circulating coolant around the engine block, absorbing heat, and transferring it to the radiator where it is dissipated into the air. This ensures smooth engine performance and prevents damage due to high temperature.

(b) Name any four abnormalities caused by poor engine cooling.
Poor engine cooling can cause engine overheating, leading to cylinder head warping and gasket failure. It can result in piston seizure due to excessive temperature. It also leads to engine knocking because of abnormal combustion temperatures. Lastly, poor cooling may cause reduced lubrication efficiency as oil breaks down at high temperatures, resulting in wear and tear of engine parts.

13. (a) Explain briefly why shock absorbers are necessary.
Shock absorbers are necessary to dampen and control the rebound motion of springs and suspension. They absorb the kinetic energy produced by bumps and road irregularities, preventing excessive oscillation and providing a smooth, stable ride. They help keep the tyres in contact with the road surface, which improves braking, steering, and overall safety.

(b) Why are stabilizer bars used in modern vehicles?
Stabilizer bars, also known as anti-roll bars, are used to reduce body roll during cornering or when driving over uneven surfaces. They connect the left and right suspension systems, allowing load distribution across the axle. This improves vehicle stability, enhances handling, and ensures better road grip during turns.

14. Give the purpose of each one of the following parts of a brake master cylinder.
(a) Primary cup: The primary cup creates hydraulic pressure when the brake pedal is pressed. It seals the fluid chamber and pushes brake fluid through the brake lines toward the wheels to activate the brakes.
(b) Secondary cup: The secondary cup acts as a seal behind the primary cup. It maintains residual pressure in the brake line to prevent air entry and helps in returning fluid to the reservoir after brake application.

15. Define the following terms:
(a) Volatility: Volatility refers to the ability of a fuel to vaporize or evaporate. High volatility means the fuel evaporates easily, aiding in easy engine starting and combustion. Low volatility can result in hard starting and poor combustion.
(b) Anti-knock value: Anti-knock value, also known as octane number, is a measure of a fuel's resistance to knocking or pre-ignition. A higher anti-knock value means the fuel can withstand higher compression without detonating prematurely, improving engine performance and preventing damage.

16. (a) State two main causes of tyre wear.
One cause is incorrect camber, which means the wheels are not vertically aligned, causing uneven wear on the inside or outside of the tyre. Another cause is incorrect tyre inflation; overinflation causes center tread wear, while underinflation causes shoulder wear.

(b) Mention and draw three types of spring suspension systems used in a motor vehicle.
Three types of spring suspension systems are:

- Leaf spring suspension: Made of multiple metal strips stacked together, used in heavy vehicles.
- Coil spring suspension: Made of helical-shaped coils, used in modern passenger cars.
- Torsion bar suspension: Uses a bar that twists under load, suitable for compact spaces.

17. Mention three functions of the automobile gearbox.
The gearbox allows the driver to vary the speed and torque according to driving needs. It helps in transmitting power from the engine to the wheels efficiently. It also provides reverse motion for the vehicle and disconnects the engine from the wheels when the vehicle is stationary.

18. (a) What is clutch pedal free travel?
Clutch pedal free travel is the distance the clutch pedal moves before the release bearing contacts the pressure plate. It ensures that the clutch is fully engaged without partial disengagement.

(b) Give two reasons for having clutch pedal free travel.
It prevents continuous contact between the release bearing and pressure plate, avoiding premature wear. It also ensures full engagement of the clutch for effective power transmission.

(b) How is clutch pedal free travel adjusted?
Clutch pedal free travel is adjusted by altering the clutch cable or adjusting bolt at the clutch linkage. Increasing or decreasing the length of the cable or linkage arm sets the correct gap.

(d) What is clutch pedal riding and why is it prohibited?
Clutch pedal riding is when the driver rests the foot on the clutch pedal partially during driving. It is prohibited because it leads to partial disengagement of the clutch, causing excessive wear of the clutch components and loss of power efficiency.