THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

093 MOTOR VEHICLE MECHANICS

Time: 3 Hours **ANSWERS** **Year: 2014**

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.

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1. (i) The purpose of a torque wrench as used in motor vehicle is to
A provide the standard readings
B control the pressure being applied
C check nuts and bolts if they are weak
D provide lightening energy
E ensure standard tightening

Answer: E – A torque wrench ensures that bolts and nuts are tightened to the manufacturer's specified torque value.

(ii) The electric drill jaws are opened and closed when gripping and releasing the drill bit by using
A hammer
B key chuck
C bench vice
D chisel
E grip plier

Answer: B – A key chuck is used to open or close the jaws of a drill to insert or remove bits.

(iii) The task of a hydraulic press in the motor vehicle workshop is to
A press bolts in and out
B rise up heavy vehicles
C press out strong bars and bushes
D press bushes/sleeve and pins in and out
E rise engine sleeves and bushes out of the chassis

Answer: D – A hydraulic press is used to press bushings, pins, and sleeves in and out of components.

(iv) From which materials is the motor vehicle's body made of?
A Steel pressings
B Iron pressings
C Plastic pressings
D Fibre pressings
E Rubber pressings

Answer: A – Vehicle bodies are commonly made from steel pressings due to strength and durability.

(v) The engine and the gearbox are supported in the chassis by
A rigid bolts and nuts
B strong steel mountings
C springs controlled by chassis frame
D mountings of special form of rubber
E mountings of special form of brass

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Answer: D – Engine and gearbox are mounted on rubber mountings to absorb vibration and reduce noise.

(vi) What types of washers are used at excessive vibrations?
A Flat washers
B Round washers
C Spring washers
D Slit washers
E Castle washers

Answer: C – Spring washers are used in vibrating conditions to maintain tension and prevent loosening.

(vii) Which of the following is one of the frictional locking devices?
A Locking plate
B Damper pin
C Wired nut
D Fibre inserted nut
E Tab washer with drilled hole

Answer: D – Fibre inserted nuts (e.g. nyloc nuts) provide frictional resistance to prevent loosening.

(viii) When engine is cold, the thermostat prevent circulation of coolant between the
A Engine and radiator
B Steam engine
C Water pump and engine
D Cylinder block and water pump
E Radiator and lower tank

Answer: A – Thermostat prevents flow from engine to radiator until engine reaches operating temperature.

(ix) The internal combustion engine which uses external ignition source is known as
A Diesel engine
B Steam engine
C Petrol engine
D Hydraulic engine
E Pneumatic engine

Answer: C – Petrol engines use external ignition sources like spark plugs to ignite air-fuel mixture.

(x) The liquid fuel which is used for compression ignition engine is called
A Diesel
B Petrol
C Kerosene

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D Paraffin
E Bio gas

Answer: A – Compression ignition engines (diesel engines) operate on diesel fuel.

2. (a) Why the workshop exit must be kept free from all obstructions?
To ensure safe and quick evacuation in case of emergency or fire.

(b) Briefly, explain how safety stands should be placed before mechanic works under a car.
Place jack stands on a firm surface and under strong chassis points after jacking the vehicle to prevent accidental collapse.

(c) What is to be done if chemicals splash into eyes?
Rinse the eyes immediately with plenty of clean water and seek medical attention urgently.

3. (a) State three tools which are used to turn nuts and bolts with hexagonal heads.
– Spanner
– Socket wrench
– Box wrench

(b) Outline three uses of the 'puller' as used in a motor vehicle workshops.
– Removing bearings
– Removing gears
– Pulling off pulleys or bushes from shafts

4. (a) Name the two types of a motor vehicle chassis.
– Conventional (ladder) frame
– Integral (monocoque) frame

(b) What is the function of motor vehicle body?
It provides space for passengers and cargo and supports the vehicle's accessories and safety systems.

(c) Mention two common engine location/arrangement in motor vehicles.
– Front engine
– Rear engine

5. (a) Provide two classifications of locking devices.
– Positive locking
– Frictional locking

(b) Briefly explain how the following nut locking devices secure a nut:
(i) Lock nut – A second nut is tightened against the main nut to prevent loosening.
(ii) Spring washers – Exert pressure on the nut, maintaining tension and resisting loosening due to vibrations.

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6. (a) Why is the baffle plates fitted into the oil sump?
To prevent oil from sloshing during vehicle movement and maintain consistent oil pickup by the pump.

(b) What is the purpose of fins on air cooled engine?
To increase surface area for better heat dissipation into the atmosphere.

7. (a) What is ignition timing in spark ignition engines?
It is the point at which the spark plug ignites the air-fuel mixture relative to the piston position (usually before TDC).

(b) Specify two types of fuel injection pumps in diesel engines.
– Inline pump
– Distributor (rotary) pump

(c) What are the related engines for the following fuel mixture formations?
(i) External fuel mixture – Spark ignition engine
(ii) Internal fuel mixture – Compression ignition engine

8. Explain three functions of the final drive.
– Transmits power to wheels
– Provides torque multiplication by reducing speed
– Allows differential action during turning

9. (a) What is the use of ‘bench vice’ in a motor vehicle workshop?
It holds parts firmly during cutting, filing, or drilling work.

(b) Give the two types of thermostats.
– Bellows type
– Wax pellet type

(c) Briefly, explain the function of a water pump in motor vehicle engine.
It circulates coolant through the engine block and radiator to maintain optimal operating temperature.

10. (a) State the main function of a carburettor float system.
To maintain constant fuel level in the float chamber for consistent mixture supply to the engine.

(b) Name two types of carburettor.
– Updraft carburettor
– Downdraft carburettor

(c) What is the use of an engine fuel pump?
It delivers fuel from the fuel tank to the carburettor or injector system at required pressure.

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11 (a) What is the importance of brake testing?

Brake testing ensures the efficiency, safety, and reliability of a vehicle's braking system. It helps to identify worn-out components, check braking force balance, and verify proper brake fluid pressure and response time.

(b) Enumerate the two categories of fuel pump testing.

Static pressure test – checks fuel delivery pressure without flow.
Flow test – measures the volume of fuel delivered per unit time under working conditions.

(c) Mention the two types of pressure plate springs.

Coil springs
Diaphragm springs

12 (a) (i) Name the parts indicated by numbers in Figure 1:

1 – Brake caliper
2 – Brake pads
3 – Disc (Rotor)
4 – Hydraulic piston

(ii) Briefly explain the principle of operation of the system shown in Figure 1.

This is a disc brake system. When the driver presses the brake pedal, hydraulic pressure from the master cylinder is transmitted to the brake caliper piston. The piston pushes the brake pads against the rotating disc, creating friction that slows down or stops the wheel.

(b) Briefly, explain the following terms with regard to their meaning, causes and curative as associated with ignition system:

(i) Misfiring – Occurs when the air-fuel mixture in the cylinder fails to ignite or burns incompletely. Causes include faulty spark plugs, poor fuel quality, or weak ignition coil. Cure: Replace defective parts and tune ignition system.

(ii) Pre-ignition – Air-fuel mixture ignites before the spark occurs due to hot spots like carbon deposits or overheated spark plugs. Cure: Use correct spark plug type, remove deposits, ensure proper cooling.

(iii) Running on – Engine continues running after ignition is switched off, often due to carbon buildup or high engine temperature. Cure: Use better fuel, clean engine internals, check idle speed.

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13 (a) (i) What does ‘atomization of petrol’ in the internal combustion engine mean?

Atomization is the process of breaking petrol into tiny droplets to mix effectively with air for proper combustion.

(ii) Why is it important for the petrol to be atomized before it is burnt in combustion chamber?

It ensures even distribution of fuel-air mixture, faster ignition, complete combustion, and efficient power generation.

(b) Briefly, state three points of safety precautions to be observed when the following activities are conducted:

(i) Welding a petrol tank – Ensure tank is drained, cleaned, and ventilated. Use non-sparking tools and fire safety equipment nearby.

(ii) Preparing to work under vehicle with one or more wheels removed – Use jack stands, chock wheels, ensure solid support to prevent collapse.

(iii) Using hammer and bench vice – Wear safety goggles, secure workpiece properly, use appropriate tools in good condition.

(c) Explain two points to illustrate why safety precautions should be observed when conducting activities mentioned in 13(b) (i-iii) above.

Safety precautions prevent fire and explosion risks especially during tank welding.
They also protect from mechanical injury due to falling vehicle or tool misuse.

14 (a) (i) Which part of the motor vehicle engine is used to accommodate water and assists the cooling process of engine?

The water jacket, which surrounds the engine cylinders, absorbs heat and circulates coolant.

(ii) Briefly, explain how water circulates and cooled in the engine when a cold engine of a motor vehicle is started.

When engine starts, thermostat remains closed and water circulates within the engine only. As temperature rises, thermostat opens allowing coolant to flow through radiator where it is cooled by air and returned to engine.

(b) Elaborate two merits and three demerits of using water as cooling medium in motor vehicle engine cooling system.

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Merits:
Water is cheap and readily available.
It has good heat absorbing capacity.

Demerits:
Water can freeze or boil easily.
It causes corrosion in engine components.
It lacks lubrication properties for water pump and seals.

(c) Briefly explain five effects of running the motor vehicle engine at too high temperature.

Overheating causes oil breakdown and loss of lubrication.
Cylinder head warping or engine seizure.
Increased wear and tear on engine parts.
Fuel combustion becomes inefficient.
Damage to gaskets and seals.

15 (a) With the aid of sketches, explain the operational cycle of the single cylinder two-stroke petrol engine, stating clearly the event below and above the piston.

In a two-stroke engine:
First stroke – Combustion gases push the piston down (power stroke). Simultaneously, air-fuel mixture is drawn into crankcase.
Second stroke – As piston moves up, it compresses the mixture in combustion chamber. At the same time, the crankcase pressurizes fresh charge. When piston uncovers ports, fresh charge enters cylinder and exhaust gases exit.

(b) With regard to the types of arrangement of the cylinders of a vehicle engine briefly state:

(i) How the in-line cylinders and vee-cylinders are arranged.

In-line cylinders are arranged in a single row vertically or slanted.
Vee-cylinders are arranged in two banks forming a V shape from crankshaft centerline.

(ii) Two advantages of the in-line cylinders and vee-cylinders.

In-line: Simple design, easier maintenance, compact width.
Vee: Compact length, better engine balance and performance.

16 (a) (i) An engine has a cylinder bore diameter of 84 mm and a stroke of 75 mm with a compression ratio of 8.5:1. Compute the clearance volume in cubic centimeters, using $\pi = 22/7$.

Swept Volume = $(\pi \times D^2 \times L) \div 4$

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$= (22/7 \times 84^2 \times 75) \div 4$
$= (22/7 \times 7056 \times 75) \div 4$
$= (22 \times 7056 \times 75) \div (7 \times 4)$
$= 11616000 \div 28 = 414857.1\ mm^3 = 414.9\ cm^3$

Compression ratio = (Swept Volume + Clearance Volume) ÷ Clearance Volume
$8.5 = (414.9 + Vc) \div Vc$
$8.5Vc = 414.9 + Vc$
$8.5Vc - Vc = 414.9$
$7.5Vc = 414.9$
$Vc = 414.9 \div 7.5 = 55.32\ cm^3$

(ii) State whether the compression ratio in 16 (a)(i) will be raised, lowered or remain the same when the following modifications are made:

Fitting a thicker cylinder head gasket – Lowered
Machining the top face of the cylinder block – Raised
Reboring the cylinders oversize – Raised
Fitting pistons having a convex crown instead of a flat top – Raised

(b) (i) What is the name of the component of the motor vehicle engine Figure 2?

Crankshaft

(ii) From which material is the component in Figure 2 made?

Cast iron or forged steel

(iii) Name the parts of the component of the motor vehicle engine in Figure 2 indicated by numbers 1 - 3:

1 – Crank pin
2 – Main journal
3 – Counterweight

(c) Briefly explain three functions of the flywheel as used in motor car.

Flywheel stores rotational energy and smooths engine power delivery between power strokes.
It assists in starting the engine by mounting the starter ring gear.
It helps in maintaining engine speed by reducing fluctuations in crankshaft rotation.

(d) (i) Identify the mechanism of the part of engine indicated by letter a.

Rocker arm

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(ii) What is the name of the instrument indicated by letter b?

Feeler gauge

(iii) What is the operation being carried out as indicated in Figure 3?

Tappet (valve clearance) adjustment

(iv) What happens if the operations in Figure 3 are wrongly done?

Incorrect clearance may lead to poor valve timing, engine noise, power loss, valve damage, or overheating. Tight clearance can prevent valve seating properly, while loose clearance reduces efficiency and causes knocking.

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