THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

093 MOTOR VEHICLE MECHANICS

Time: 3 Hours **ANSWERS** **Year: 2010**

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) Petrol is obtained by
A refining crude oil
B processing vegetable products
C fractionizing coal
D heating wooden substances
E vaporizing coal

Answer: A – Petrol is obtained by refining crude oil in refineries through fractional distillation which separates it from other hydrocarbons.

(ii) The input and output torque of a gearbox is 70 Nm and 210 Nm respectively. If the efficiency is 70 percent, the gear ratio is
A 2:5:1
B 3:1
C 4:1
D 2.25:1
E 0.3:1

Efficiency = Output torque / (Input torque × Gear ratio)
Rearranged: Gear ratio = Output torque / (Input torque × Efficiency)
= 210 / (70 × 0.70) = 210 / 49 = 4.29 ≈ 4:1
Answer: C

(iii) In an automobile engine the temperature of piston will be more at
A the crown of the piston
B the skirt of the piston
C the piston pin
D the piston rings
E gudgeon pin

Answer: A – The piston crown is directly exposed to combustion gases and therefore experiences the highest temperature.

(iv) Water in lubricating oil aids in
A decomposition
B oxidation
C formation of sludge
D dilution
E burning

Answer: C – Water in oil reacts with contaminants and oxidized particles forming sludge that reduces lubrication efficiency.

(v) The fuel is injected into the cylinder in diesel engine when the piston is
A exactly at TDC after compression stroke
B exactly at BDC before compression stroke
C approaching TDC during compression stroke
D approaching TDC during exhaust stroke
E just after TDC during compression stroke

Answer: C – In diesel engines, fuel is injected just before TDC during compression when air is hot and ready to ignite fuel.

(vi) In case of clutch plate weak, the remedy is to
A replace the pressure spring
B tighten further the springs
C re-temper the springs
D replace the springs
E loosen the springs

Answer: D – Worn out or weakened clutch springs must be replaced to restore proper pressure and engagement.

(vii) The pressure of air in case of heavy duty trucks
A is usually of the order of 1 to 2 atm
B is usually of the order of 2 to 3 atm
C is usually of the order of 4 to 7 atm
D is usually of the order of 14 to 17 atm
E depends upon the road conditions

Answer: C – Heavy trucks require higher pressure due to their heavy load, usually ranging from 4 to 7 atm.

(viii) The king pin inclination is usually
A less than 1°
B between 1° and 2°
C between 1° and 5°
D more than 7°
E 10° ± 2°

Answer: C – King pin inclination is typically kept between 1° and 5° for better vehicle control and self-centering of steering.

(ix) The provision made to allow a leaf spring to vary its length is a
A swinging shackle
B rubber u-bolt mounting
C sliding centre bolt

D spline in the spring eye
E universal joint

Answer: A – Swinging shackles accommodate the increase or decrease in effective length of leaf springs as they flex during suspension movement.

(x) The term “brake fade” as applied to a braking system means
A decrease in friction due to wear
B fall-off in efficiency due to heat
C increase in effort as the shoe clearance increases
D discolouration of the lining when it is soaked
E decrease of brake fluid in master cylinder

Answer: B – Brake fade is loss of braking efficiency due to overheating, reducing friction between lining and drum/disc.

2. State the purpose of oil
(a) dip stick
It is used to measure the oil level in the engine sump for proper lubrication.

(b) pressure relief valve
It maintains safe oil pressure by allowing excess oil to return to the sump.

(c) pressure gauge
It displays the oil pressure in the engine to monitor lubrication system performance.

3. Give advantages of a four stroke engine compared to a two stroke engine.
– More fuel-efficient due to complete combustion.
– Cleaner emissions.
– Less wear and longer engine life.
– Quieter operation and better cooling.

4. A customer’s car fitted with a single plate clutch experiences clutch drag. What are the three (3) probable causes?
– Worn or damaged clutch plate.
– Incorrect clutch pedal free play.
– Warped clutch disc or pressure plate.

5. Name three (3) angles which are often used to describe the steering geometry.
– Camber angle
– Caster angle
– Toe angle

6. What is the effect of too big valve clearance?
– Noisy engine operation.
– Reduced valve opening time affecting engine breathing.
– Power loss and incomplete combustion.

7. The following are the conditions of tyre wear due to improper inflation.
(a) Rapid wear at tyre shoulder.
Caused by underinflation, where sidewalls bear more load and edges wear faster.

(b) Rapid wear at centre.
Caused by overinflation, where central part of tyre carries most load and wears faster.

What are the causes of each condition?
– Incorrect tyre pressure setting
– Poor maintenance
– Overloading

8. About 70% of accidents in the workshops are due to negligence and carelessness on the part of workers. Explain important points to watch on 'tidiness' in practicing good house keeping when working in a workshop.
– Keep tools and equipment in their place.
– Clean oil spills and waste materials.
– Use dustbins and clean work areas regularly.
– Ensure proper lighting and ventilation.
– Remove unnecessary items from walkways and working space.

9. Explain briefly why in modern cars the rear wheels are filled with one "leading" and one "trailing" down shoe brakes.
– Leading shoe offers higher braking force due to rotation-assisted engagement.
– Trailing shoe provides stability.
– Combination ensures balanced braking and reduced wear.

10. Explain the functions of each of the following:
(a) An injector pump – Pressurizes and delivers precise fuel amounts to diesel engine injectors.
(b) Fuel pump – Transfers fuel from tank to engine or carburettor/injector system.
(c) Water pump – Circulates coolant through engine and radiator to regulate temperature.

11. Calculate the torque transmitted by single plate clutch having a mean radius of 100 mm, total spring thrust of 1500 N and coefficient of friction of 0.3.

Torque (T) = $\mu \times F \times r$
Where $\mu = 0.3$, $F = 1500$ N, $r = 0.1$ m
$T = 0.3 \times 1500 \times 0.1 = 45$ Nm

12 (a) Describe the main function of piston rings.

Piston rings form a seal between the piston and the cylinder wall, preventing combustion gases from leaking into the crankcase. They also regulate oil consumption by scraping excess oil off the cylinder walls and conducting heat from the piston to the cylinder wall for dissipation.

(b) Differentiate between working gap and free gap of piston rings.

Working gap is the clearance between the ends of a piston ring when installed inside the engine cylinder. It ensures proper expansion under operating temperature.
Free gap is the gap between the ends of a piston ring when it is not compressed or installed. It is larger than the working gap and represents the ring's natural state.

13 (a) What is the purpose of fitting a thermostat in the vehicle cooling system?

The thermostat controls the engine's operating temperature by regulating coolant flow. It remains closed when the engine is cold to allow rapid warm-up and opens gradually to allow coolant circulation and prevent overheating once the engine reaches optimal temperature.

(b) Describe how to test a thermostat.

To test a thermostat, remove it from the engine and place it in hot water with a thermometer. As the temperature rises, observe the thermostat's valve opening. It should start to open at the specified temperature (usually around 80-90°C) and fully open shortly after. If it fails to open or closes too late, it is faulty.

14. What is the importance of changing engine lubricating oil at regular intervals?

Regular oil changes remove contaminants such as dirt, metal particles, and combustion residues, which can cause wear and engine damage. Fresh oil provides better lubrication, reduces friction, and maintains engine performance. It also prevents sludge formation and protects against corrosion.

15 (a) Explain briefly, why brakes are designed so that two thirds of the braking effort is on the front wheels?

During braking, vehicle weight shifts forward due to inertia, increasing load on the front wheels. Designing two-thirds of the braking force on the front wheels ensures effective stopping power, stability, and reduces the risk of rear-wheel lock-up or skidding.

(b) Explain briefly the function of a propeller shaft.

The propeller shaft transmits rotational torque from the gearbox or transfer case to the differential at the rear axle in rear-wheel or four-wheel drive vehicles. It accommodates movement between components through universal joints and maintains power delivery across variable distances and angles.

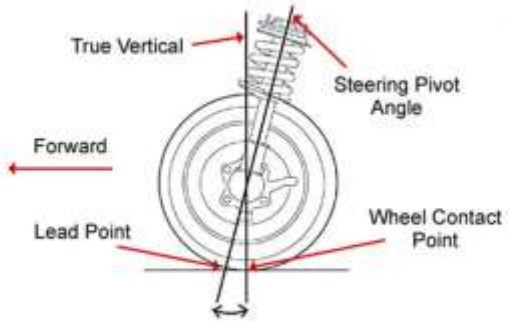
16. (a) Explain the following spring and damper conditions:

(i) Rebound refers to the extension movement of the suspension after it has been compressed. The damper controls the rate of this return motion to prevent bouncing and maintain contact between the tire and road surface.

(ii) Bump is the compression of the suspension when a vehicle wheel strikes an obstacle or road irregularity. The spring absorbs the impact, while the damper dissipates the energy to stabilize the vehicle and improve ride comfort.

(b) (i) With a simple sketch describe what a caster angle is?

A caster angle is the angle between the steering axis and vertical axis, viewed from the side of the vehicle. Positive caster has the upper ball joint behind the lower one, while negative caster has it in front.



(ii) Explain the purpose of a caster angle.

Caster angle improves directional stability and self-centering of the steering. Positive caster enhances straight-line tracking and helps the wheels return to the center position after turning, making the steering more stable and responsive.