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PRACTICE PAPER - ANSWER BANK

Assessors Note:
This answer bank should be used as the primary resource when marking students work. However, responses to some questions may be subjective and tutors are advised to exercise their professional judgement when making assessment decisions.

You must complete the assessment instructions on Page 2 before starting this assessment!

ELEMENT ONE

Demonstrate knowledge of carrying out a pre-tuning visual inspection and service.

1. Complete the table below by providing the relevant checks that should be carried out when visually inspecting a vehicle before starting a tune up.

	Checks
Oil and engine components	Check the engine oil level. Top up as required. Check that engine components are secure and look for evidence of fuel leaks.
Coolant and cooling system components	Check the level and the colour of the coolant. If level is low top up, if discoloured, flush and refill with new coolant. Check for damage to coolant systems hoses or for any leaks. Check radiator fins for rust.
Fuel system	Check the engine bay and exhaust systems for evidence of any fuel leaks.
Drive belts	Check the belts for evidence of the following Excessive wear Pieces missing from the ribs Severe glazing Major cracks
Wires and connectors	Check that are wires and connections are secure, free from oil, grease and water and are not damaged.

2. Complete the table by providing relevant safety precautions that must be observed when carrying out engine tuning.

	Precautions
Your Personal safety	Wear safety glasses for eye protection, where appropriate. Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide. Do not smoke while working on the vehicle. To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler. To avoid injury, always remove rings, watches, loose hanging jewellery, and loose clothing before beginning to work on a vehicle. Tie long hair behind the head. Keep hands and other objects clear of the radiator fan blades. Electric cooling fans can start to operate at any time by an increase in temperature. Avoid contact with battery acid. Do not smoke or have any flame, or sparks near a battery while it is being charged or used. Hydrogen gas emitted may explode. Set the hand brake when working on the vehicle. If you are working on an automatic transmission set it in park unless otherwise required by the procedure. If you are working on a manual transmission in reverse (engine off) or neutral (engine on). Place wheel chocks to the front and rear surfaces of the tyres to provide further restraint from inadvertent vehicle movement.

Safety of other staff and customers	Set the hand brake when working on the vehicle. If you are working on an automatic transmission set it in park unless otherwise required by the procedure. If you are working on a manual transmission in reverse (engine off) or neutral (engine on). Place wheel chocks to the front and rear surfaces of the tyres to provide further restraint from inadvertent vehicle movement. Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide. Check for colleagues, tools, equipment and vehicles when driving the vehicle in the workshop.

Safety of the vehicle you are working on	Set the hand brake when working on the vehicle. If you are working on an automatic transmission set it in park unless otherwise required by the procedure. If you are working on a manual transmission in reverse (engine off) or neutral (engine on). Place wheel chocks to the front and rear surfaces of the tyres to provide further restraint from inadvertent vehicle movement. Drive slowly and with care at all times.
Safety of the tools and equipment that you are using	Do not exceed the lifting capacity of vehicle hoists. Make sure to use the appropriate tools and equipment. Ensure that tools and equipment are returned to their designated areas after use. Clean tools and equipment after use. Check the condition of tools and equipment prior to use, particular attention should be given to electrical tools.

3. Outline the procedure involved in a carrying out a compression test.

Clean around the spark plug seats to ensure that no dirt enters the cylinder when the spark plug is removed. Remove the spark plugs. Care must be taken when removing spark plugs from hot engines.

Disconnect the low-tension coil lead from the coil.

Set the throttle butterfly and the choke butterfly in the wide-open position.

Screw the compression gauge firmly in the number one spark plug cylinder.

Crank the engine until a maximum reading is obtained. Note the number of strokes required.

Record the compression reading shown on the gauge.

Repeat the steps (5-7) on the remaining cylinders, using the same number of strokes as required on the number one spark plug cylinder to reach a maximum reading.

4. Outline the procedure involved when carrying out a cylinder leakage test.

Run the engine to normal operating temperature.

Clean around the spark plug seats to ensure that no dirt enters the cylinder when the spark plug is removed. Remove the spark plugs.

Select the cylinder to be tested and turn the crankshaft so that the piston is at top dead centre on the end of the compression stroke, both valves are closed.

Screw in the cylinder leak gauge adapter into the cylinder spark plug hole.

Apply compressed air to the cylinder by attaching the compressed air hose to the cylinder leakage tester.

Remove the radiator cap, oil filler cap and the air cleaner.

Investigate for air leakage and record your findings.

Disconnect the test equipment from the number one spark plug hole.

Repeat the procedure for each of the cylinders.

5. Provide a likely cause of air bubbles in the coolant.

A leaking head gasket, damaged cylinder head or block.

6. Provide a likely cause of air in the oil filler.

Cylinder ring leakage.

7. Outline the procedure involved in a carrying out an engine vacuum test.

Warm-up the engine to normal operating temperature.

Allow the engine idle speed to settle down to normal, and is steady.

Connect the vacuum gauge hose to a constant vacuum source on the inlet manifold.

Record the reading shown on the vacuum gauge. Also monitor the various needle movements. Compare readings with manufacturer's specifications.

ELEMENT TWO
Demonstrate knowledge of servicing an ignition system.

1. Outline the procedure involved when removing a spark plug.

Remove spark plug wires from the spark plugs.

Loosen each plug about one turn to break free any accumulation of carbon, dirt, or gravel which may be lodged around the shell.

Blow out spark plug ports with compressed air to remove dirt or gravel which may have collected around the base of the spark plug.

Remove spark plugs using a spark plug wrench and place them in a suitable holder in the order they were removed from the engine.

2. Identify each spark plug condition and describe how it can be identified.

Condition A: Gap bridged

A gap-bridged spark plug can be identified by deposit build up closing the gap between electrodes.

Condition B: Normal

Normal conditions are usually indicated by a rusty-brown to greyish-tan, powdery deposits and minor electrode erosion, indicating correct ignition and combustion conditions.

White, powdery deposits identify normal conditions where highly leaded petrol has been used.

Condition C: Worn

Severely eroded or worn electrodes can identify a worn spark plug.

Condition D: Overheated

Burned or overheated spark plugs are usually identified by a white, burned, or blistered insulator nose and badly eroded electrodes.

Condition E: Ash fouled

This condition is indicated by a build-up of combustion deposits

Condition D: Detonation

This form of abnormal combustion has fractured the insulator core nose of the plug.

3. Describe the checks that should be carried on spark plugs before they are installed and explain why each check is necessary.

Check and clean spark plug threads. These threads are the means of carrying the heat away from the plug. Any deposits will retard the heat flow from the plug to the cylinder head, causing spark plug overheating and pre-ignition.

Check the spark plug centre electrode is clean, filed and gapped before installing the spark plug. By removing the oxide coating on the surface and providing sharp edges on the electrodes, the voltage required to jump the gap is reduced, and spark plug performance is improved. A visual inspection will indicate when the plug has been properly cleaned. The insulator appearance should be white and the metal case clean.

4. List the main tools and equipment that are commonly used when checking ignition timing.

Tachometer
Timing light

5. Complete the table by describing each ignition timing situation.

Ideal timing	Occurs when the piston is at a position corresponding to a few crankshaft degrees before top dead centre. If the plug fires at this point the mixture will have burned and will impart maximum force to the piston when it is in the best position, usually a few degrees after top dead centre.
Timing retarded	The spark occurs after the optimum firing point, possibly even after the piston has reached top dead centre. The piston will then have travelled part of its working stroke before any force is applied to it. The exhaust valve will open before combustion is completed, resulting in serious loss of power and a hot, noisy exhaust system.
Timing Advanced	The spark occurs too long before the piston reaches top dead centre. The air/fuel mixture is ignited under reduced pressure and the energy produced by the reaction is reduced. The downward force is imparted to the piston while it is still travelling upwards and considerable energy is dissipated before the piston starts to travel downwards. In addition, of course, the downward force of the piston slows, rather than speeds up, the movement of the crankshaft. This condition results in excessive strain on the bearings.

6. Outline the procedure involved when checking the high tension and low tension circuit resistance of an ignition coil.

Disconnect all leads and wiring from ignition coil. Connect the test probes of the Ohmmeter to the ignition coil. First to the terminals of the secondary winding. Then to the terminals of the primary winding.
Compare readings for high tension and low tension circuits with manufacturer's specifications. Replace ignition coil as necessary.

7. Outline the procedure involved when checking ignition timing.

Clean the dirt from the timing marks and, if necessary, chalk the timing pin or timing marks to improve vision.

Connect a tachometer gauge to the primary circuit of the ignition system.

Start the engine until normal operating temperature is reached.

Observe the engine speed reading on the tachometer and compare with manufacturer's specifications.

Disconnect the distributor vacuum line.

Connect the timing light high-tension lead to the number one spark plug, ensuring the directional arrow is pointing in the direction of the current flow.

Connect the other two leads of the timing light to the respective battery positive and negative terminals.

Direct the timing light at the timing mark location.

The timing light should flash just as the correct mark lines up with the pointer or pin. The operator's eye should be in line with the centre of the damper and timing pointer.

ELEMENT THREE
Demonstrate knowledge of servicing the air and fuel filters.

1. Complete the table below:

When is it necessary to replace an air filter?	List the tools should be used?	Outline the procedure involved in replacing an air filter
Damaged air filter Excessive dirt in air filter Oil in air filter Exceeds manufacturer's recommended service life	Ring spanners, socket set, screw driver, compressed air, air gun, pipe spanner.	Remove the air filter element from the air filter container. Tap the filter against a hard surface to clean. Do not tap enough to deform the element. Do not immerse the element in a cleaning solvent or blow it out with compressed air. When the element is cleaned, clean the air cleaner body and cover in cleaning solvent, then wipe dry.
When is it necessary to replace a fuel filter?	List the tools should be used?	Outline the procedure involved in replacing a fuel filter
Damaged fuel filter Excessive dirt in fuel filter Exceeds manufacturer's recommended service life	Ring spanners, socket set, screw driver, compressed air, air gun, pipe spanner, drip tray to collect spilt fuel.	Disconnect the fuel hoses. Remove the fuel filter with the bracket. Install a new filter and reconnect the fuel hoses in the direction of the fuel flow. When installing the filter ensure that the fuel hoses are pushed on as far as possible. Secure the hoses with clamps. Run the engine and inspect for fuel leaks. Repair as necessary.

ELEMENT FOUR
Demonstrate knowledge of checking and adjusting valve clearances.

1. Outline the procedure involved when checking the valve clearances for number 1 cylinder.

Operate the engine until normal operating temperature is achieved.

Remove the rocker cover and any other components as necessary.

Consult manufacturer's specifications for recommended valve clearances and select the appropriate feeler gauge/s.

Rotate the crankshaft until the number 1 piston is at top dead centre and is at the end of the compression stroke (both inlet and exhaust valves are closed).

Check the inlet valve clearance with the feeler gauge to determine the need for adjustment.

Adjustment is required if clearance is outside manufacturer's specification.

If adjustment is required, loosen the adjusting locking nut, to allow movement of the adjuster.

Insert the feeler gauge between the adjuster and the valve and rotate the adjuster until a firm drag on the feeler gauge is felt.

Secure the valve adjusting locking nut.

Recheck the feeler blade drag.

Repeat steps 5-9 to check and adjust if necessary the exhaust valve clearance.

2. What tools are used when measuring valve clearances?

Feeler Gauge, ring spanner, screwdriver, ratchet and socket

3. Which <u>ONE</u> of the following statements is true? Please tick the appropriate box.

✓	If the valve clearance is set too close the valve will open too early and close too late, resulting in rough engine idle and possible burning and warping of the valve.

4. What final checks should be carried out following the reassembly of the engine after valve clearances have been adjusted?

Run the engine to operating temperature and check for oil leaks and abnormal valve noise.

ELEMENT FIVE
Demonstrate knowledge of checking and adjusting engine idle speed and exhaust emissions.

1 Complete the table below:

When is it necessary to check engine idle speed	List the tools should be used?	Outline the procedure involved in checking and adjusting engine idle speed.
	Tachometer multimeter	Make sure the engine is at operating temperature, the ignition timing and idle mixture are set to manufacturer's specifications and a taco meter is connected. If the manufacturer's idle speed is not showing on the tachometer, adjust the idle speed by turning the idle speed adjustment screw until the manufacturer's idle speed is obtained.
When is it necessary to check exhaust emissions?	List the tools should be used?	Outline the procedure involved in measuring exhaust emissions
		Plug in and warm-up the exhaust analyser. After warm-up, calibrate the meter zero reading. Warm-up the engine to normal operating temperature. If fitted, disconnect the air outlet line from the air injection pump. Disconnect any other system supplying air to the exhaust. Insert the sampling probe into the exhaust pipe. Run the engine at idle with the air cleaner installed. Note the HC and CO readings. Increase engine speed to the speed specified by the manufacturer. Note the HC and CO readings. Return the engine to idle and note the HC and CO readings again. Compare readings to those given on the tune-up decal if fitted (normally located under the bonnet or inside the engine compartment), or manufacturer's specifications. All readings should be within allowable tolerances. If not, the idle mixture may need to be adjusted.

2. List two harmful gases that can be measured using an exhaust gas analyser.

1 HC - Hydrocarbons
2 CO – Carbon monoxide

3. After carrying out an engine tune up a high HC emission reading was displayed during an exhaust emissions test, what is a possible cause and where may the problem be?

Incorrect ignition timing – distributor, computer or timing adjustment problem.

Ignition system faults that cause misfire – fouled spark plug, incorrect plug type, cracked distributor cap, defective spark plug wires or breaker points.

Excessively rich or lean air-fuel mixture – carburettor or fuel injection problem.

Engine oil fuming due to blow-by, worn rings, burnt valve, valve clearance, defective valve springs, blown head gasket or low engine compression.

Leaking vacuum hoses, gaskets, faulty positive crankcase ventilation or evaporative control system.