



Important Instructions to examiners:

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

	Marks
1. A) Attempt any THREE of the following:	12
a) State general safety precautions and procedures while using i) Electrical equipments ii) Measuring tools	4
Answer: General safety precautions and procedures while using- i) Electrical equipments: (Any four - 1/2 mark each) 1. Make sure electric tools and equipments are properly grounded. 2. Do not use any piece of equipment that is damaged, has broken plugs, has poor insulation, or cords are coming apart. 3. Floors must be dry where electric power tools are used. 4. Don't work with wet hands. 5. Make sure the switch is off before plugging in any electric tool. 6. Wear rubber boots, insulated rubber gloves, shoes with insulated soles, protective garments, and safety goggle. Do not wear any metal-based jewelry. Do not wear loose clothing. 7. Use Non-conducting handles for tools and equipment. 8. When working in cold room, move electrical equipment away from the floor and mount on a wall or panel. 9. Observe and follow the safety precautions displayed on electrical equipment.	2
ii) Measuring tools: (Any four - 1/2 mark each) 1. Grip the tool firmly. Avoid excessive force on the tool while gripping the measuring tool. 2. Clean and dry the surface of the object which needs to be measured. 3. Do not use measuring tools for dirty, mismatched or worn parts. 4. Be careful when using sharp or pointed tools. 5. Check for wear of Contact Point. 6. Check measuring tool for zero error. 7. To avoid parallax error observer should position his eyes directly above the scale when taking reading.	2



8. Always pull, do not push, torque wrench to apply torque. 9. Never use a "cheater bar" on a torque wrench to apply excess leverage. 10. Do not use torque wrench with sockets or fasteners showing wear or cracks. 11. Remove any dust or dirt after use of tool. 12. Keep the measuring tool in provided case in cool and dry location.	
b) State functions of i) Feeler gauge ii) Head- light-Aligner iii) Engine Analyzer iv) Honning Machine	4
Answer: Function of equipments: (1 mark each) i) Feeler gauge: To check and measure the gap or clearance between the two components. ii) Head- light-Aligner: It is a device used to check the aiming of head lights. With head light aligner Low beam, High beam is checked as per manufacturer's recommendations. iii) Engine Analyzer: To check engine rpm, dwell angle, contact breaker point gap, cylinder leakage, oil temperature, exhaust emission, vacuum checking, engine performance, battery charging, engine timing, spark leakage etc. iv) Honing Machine: To remove some out of roundness, taper, tool marks and axial distortion.	4
c) What is meant by maintenance? State types of maintenance.	4
Answer: Maintenance: Vehicle maintenance means efforts directed towards the increasing performance of a vehicle. It is performed on a regular basis at a set time interval or after the vehicle has traveled certain kilometers or in breakdown situations and also if the vehicle is kept idle for some specific period. The service intervals are specified by the vehicle manufacturer in a service schedule. It includes oil change, repairing of parts, replacement of parts, adjustments of linkages, lubrication, tightening of loose nut and bolts, cleaning and washing of the vehicle etc. Maintenance is necessary for trouble free performance, to increase the life of vehicle, to avoid breakdown of vehicle. Types of maintenance: Preventive maintenance, scheduled maintenance and Breakdown maintenance.	3 1
d) Write procedure of engine compression test.	4
Answer: Procedure of Engine compression test: The compression test checks the sealing qualities of the rings, valves and combustion chambers. 1. Operate the engine until it reaches normal operating temperature. 2. Disable the ignition system by disconnecting the positive primary wire from the ignition coil and insulate the wire. 3. Disable the fuel injection system by shutting off the fuel pump. 4. Loosen the spark plugs and blow any dirt from the plug recesses with an air blow gun. Remove all plugs. 5. Place a screw driver in the throttle linkage to hold the throttle open. This permits the maximum amount of air to be drawn into the engine. 6. Install or thread the compression tester into one spark plug hole.	4

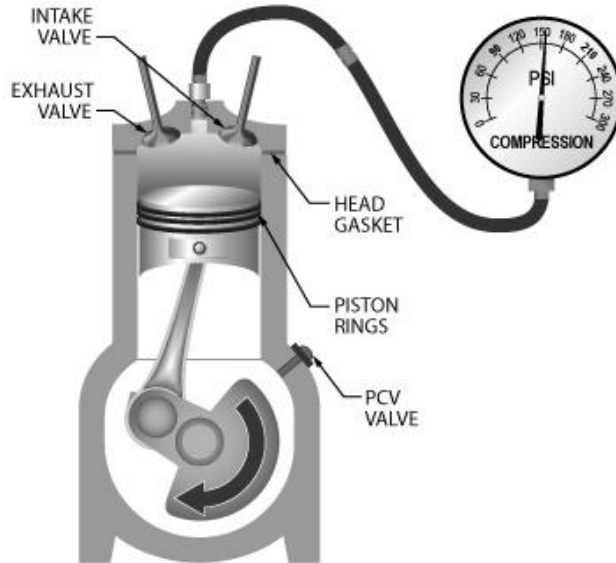
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7. Crank each cylinder through at least four compression strokes. Observe gauge pointer reading.
8. Release the pressure from the compression tester, and follow the same procedure to obtain the compression reading on each cylinder. Record the reading obtained on each cylinder.
9. Compare the readings to the manufacturer's specifications.

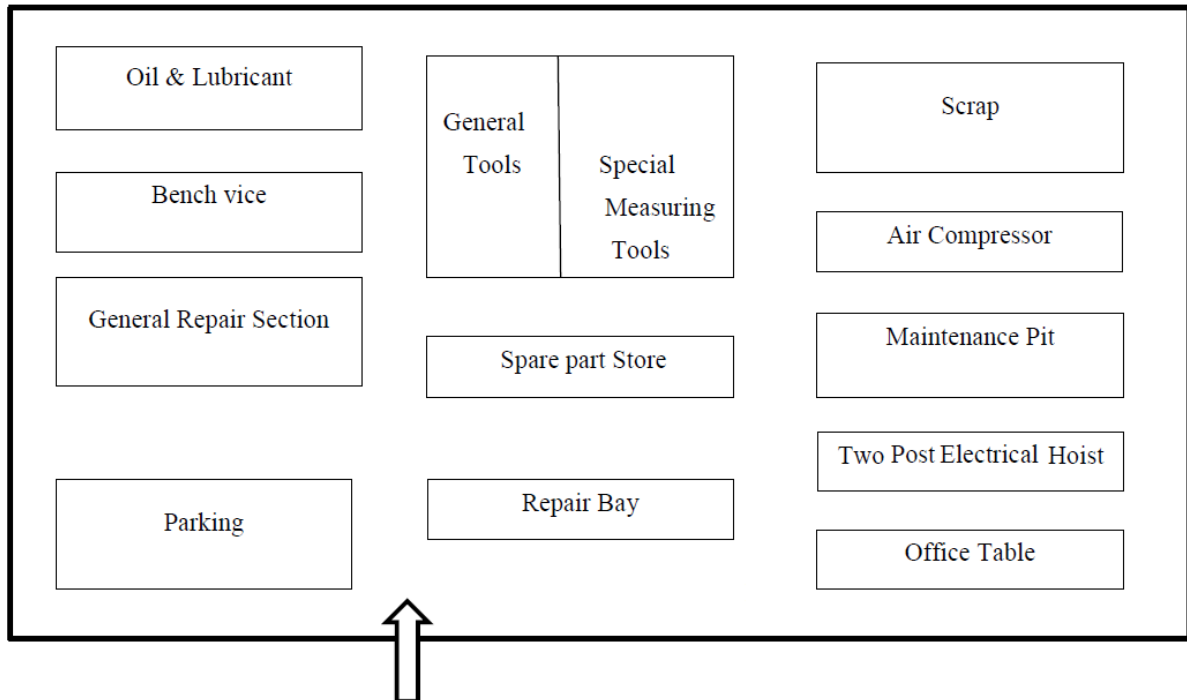


(Suitable Credit may be given to diagram if drawn)

B) Attempt any **ONE** of the following:

a) Draw a layout of road-side garage attending repairs and list tools and equipments required.

Answer: **A layout of road-side garage:** (Layout - 4 marks, Any four equipments and tools - 2 marks)





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Required Tools and equipments: (Any four)

- | | | |
|---|---|---|
| a) Screw driver: standard, flat, insulated driver. | b) Pliers: combination, long nose, round nose, side cutting, adjustable, slip joint pliers. | 2 |
| c) Wrenches: open end, box end, ring, tubular, socket wrench. | d) Files: General purpose | |
| e) Hacksaw | f) Chisel | |
| g) Hammer | h) Ridge reamer. | |
| i) Torque wrench. | j) Hydraulic Jack. | |
| k) Electric soldering gun. | l) Portable electric drill. | |
| m) Air compressors. | n) Bench Vice | |
| o) Battery Charger | p) Piston ring compressor | |
| q) Piston ring expander | r) Valve spring compressor | |
| s) Bearing Puller | | |

b) Prepare a general maintenance schedule on kilometers travelled basis for light motor vehicle.

6

Answer: General maintenance schedule on kilometers travelled basis for light motor vehicle:

1) At 500 km

1. Check engine oil level and fill, if necessary.
2. Check electrolyte level in battery and fill, if necessary.
3. Drain oil from engine sump and replenish.
4. Clean gauge filters in petrol.
5. Check engine mounting nuts.
6. Check cylinder head nuts.
7. Tight inlet manifold and exhaust manifold nuts.

6

2) First 1000 Km

1. Drain oil in sump to clear it of any impurities in accumulator, refill it with the appropriate grade of lubricant.
2. Drain gearbox by unscrewing the drain plug, now fill it with correct amount of the recommended lubricant.
3. Drain oil from the rear axle; refill it with the recommended lubricant up to the prescribed level.
4. Lubricate the water pump bearing with recommended grease.

3) Every 1000 km

1. Repeat items described under every 500 km with addition of the following.
2. Provide grease to the sliding joint and two needle type universal joints
3. Grease each of the swivel pin with grease gun.
4. Grease gun should be applied to the nipple on the ends of steering rods.
5. Test the tyre pressure.
6. Fill radiator to full level.

4) Every 2000 Km

1. Repeat the items under 1000 km with addition of the following.
2. Replenish gear box oil. Oil level should not be too high, otherwise it will get into the clutch housing and cause clutch slipping.



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<ol style="list-style-type: none"> 3. Top up the rear axle. 4. Change oil in the sump to remove any impurities that have accumulated. 5. Check the fluid level of the master cylinder by turning back the front floor carpet on driver's side and removing the exposed rubber plug. The fluid should be within 13 mm of the bottom of the filter neck. 6. Apply grease to the nipples on the hand brake cable. 7. Check specific gravity of the battery fluid by taking hydrometer readings. 																																	
<p>2. Attempt any FOUR of the following:</p>	16																																
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<table border="1"> <thead> <tr> <th>Sr</th> <th>Factors</th> <th>Repair</th> <th>Replace</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Cost of component and repair/replace</td> <td>Cost of repair is less as compared to new part to be replaced.</td> <td>Cost of repair is more as compared to the new part.</td> </tr> <tr> <td>2</td> <td>Performance</td> <td>Repair gives substandard performance</td> <td>Original new parts give standard performance.</td> </tr> <tr> <td>3</td> <td>Availability of spares</td> <td>Repair is essential, if new parts are not available.</td> <td>If new parts are readily available with reasonable cost than repair, replacement is preferred.</td> </tr> <tr> <td>4</td> <td>Safety aspects</td> <td>If safety aspect is not of prime importance, repair is done</td> <td>If safety aspect is of greater concern, parts are replaced.</td> </tr> <tr> <td>5</td> <td>Manpower required</td> <td>Skilled workers are required for repair.</td> <td>Semiskilled or untrained workers may replace the parts.</td> </tr> <tr> <td>6</td> <td>Life of component</td> <td>Life of repair component is less and gives less assurance.</td> <td>Life of new component is more and gives assurance.</td> </tr> <tr> <td>7</td> <td>Feasibility of repair /replace</td> <td>If the component is within the service limit, it can be repaired.</td> <td>Parts that are beyond the service limit must be replaced</td> </tr> </tbody> </table>	Sr	Factors	Repair	Replace	1	Cost of component and repair/replace	Cost of repair is less as compared to new part to be replaced.	Cost of repair is more as compared to the new part.	2	Performance	Repair gives substandard performance	Original new parts give standard performance.	3	Availability of spares	Repair is essential, if new parts are not available.	If new parts are readily available with reasonable cost than repair, replacement is preferred.	4	Safety aspects	If safety aspect is not of prime importance, repair is done	If safety aspect is of greater concern, parts are replaced.	5	Manpower required	Skilled workers are required for repair.	Semiskilled or untrained workers may replace the parts.	6	Life of component	Life of repair component is less and gives less assurance.	Life of new component is more and gives assurance.	7	Feasibility of repair /replace	If the component is within the service limit, it can be repaired.	Parts that are beyond the service limit must be replaced	4
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<p>b) What is 'Activity File'? State its importance.</p>	4																																
<p>Answer: Activity file:</p> <p>The activity file can be maintained on monthly or weekly basis. It helps supervisor to keep track of activity going on in the shop. This document make the tracking out vehicle maintenance history, the guide lines of current maintenance and repair based on last repairs and the projection of further repair with reference to the vehicle. Activity file provides valuable data for analysis, productivity and quality of work.</p>	2																																
<p>Importance of Activity file:</p> <ol style="list-style-type: none"> a) For Analysis of unnecessary jobs. b) For Identification of warranty claims. c) For Investigation of accident to determine insurance. d) For Identification of cases, what type of repair, equipments used? 	2																																



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c) State four generally observed troubles related to engine cooling system.	4																		
Answer: Troubles related to engine cooling system: (Any 4 - 1 mark each) 1) Engine Overheating 2) Loss of liquid coolant due to leakage. 3) Overcooling 4) Incorrect temperature gauge reading. 5) Noises 6) Frozen coolant 7) Loose or slippage, broken V-belt.	4																		
d) Describe how to check engine oil level and oil condition.	4																		
Answer: To check engine oil level: Oil level is checked by dip stick. 1. Park the vehicle on a flat even surface to get an accurate reading. 2. Be sure the engine is cold or has been off for at least ten minutes before oil check. 3. Identify the location of the oil dipstick on vehicle. 4. Pop the hood. Usually, there will be a latch somewhere at the foot of the driver side door. Get some paper towels or an old rag. 5. Slowly pull the dipstick out and wipe the oil off. 6. Reinsert the dipstick in the dipstick bore. 7. Slowly pull the dipstick out. 8. There is a mark on the dip stick to indicate proper level of oil. If dip stick is not wet up to the mark, more oil has to be added up to correct level. To check engine oil condition: Examine the colour and quality of the oil. 1. The colour and the consistency of engine oil are indicative of its age, and possibly of other engine efficiency issues. 2. Wipe the oil off the end of the dipstick and examine it on the rag. Engine oil that's in good condition should look slightly yellow-greenish on the rag, and shouldn't be super-dark. 3. If colour of oil is milky appearance, this could mean coolant is leaking into the engine. 4. Oil will change in colour from golden or amber colored to brown and black as more and more particulate gets in the oil from the engine. 5. Look closely for any metal particles, too, as this could mean there is internal engine damage. 6. If colour of oil is too black, then there is need of oil change.	2																		
e) Write four most probable causes and suitable remedies for the trouble 'Engine does not start'.	4																		
Answer: Causes and suitable remedies for the trouble 'Engine does not start': (Any four)	4																		
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9. Lack of Fuel	9. Top up fuel	
10. Lack of Spark due to distributor cap and/or rotor is bad, Defective ignition coil	10. Replace	
11. Defective injectors.	11. Replace	
f) Write procedure for checking and servicing of piston and piston rings.		4
Answer: Procedure for checking and servicing of- Piston: 1) Clean the piston to remove dirt, carbon depositions etc. 2) Check piston diameter with micrometer. 3) Measure the clearance between cylinder bore and piston. If the clearance is not within specifications replace the piston. 4) Check the piston ring groove clearance with the help of feeler gauge. 5) Inspect the condition of piston skirt for wear. 6) Check the oil holes in the oil ring groove. 7) In case piston is scored, cracked, burned spots, scuffed sides and broken ring lands the piston should be replaced. 8) If the piston is serviceable, the old rings must be removed and carbon must be cleaned from the ring grooves prior to the installation of new rings. Piston rings: 1) Check piston Ring end gap. 2) Insert the piston ring into the cylinder. 3) Using the piston push the piston ring a little beyond the bottom of the ring travel. 4) Using a feeler gauge measure the end gap. Standard piston ring end gap. No.1 -Ring:- 0.30 to 0.51 mm No.2- Ring:- 0.30 to 0.57 mm Oil ring :- 0.35 to 0.60 mm If the end gap is within specification 5) Check the fit of each compression ring in its piston groove. 6) If fit is tight, the groove probably need cleaning. 7) If the ring is too loose, check the piston ring side clearance. 8) To check the ring side clearance: Place the ring in the groove, measure the clearance between the ring and groove, with a thickness gauge. The side clearance should be maintained as per manufacturer's recommendation. 9) Visual Inspection of ring for cut and damage. 10) If piston rings are excessively worn-out, damaged, replace set of piston rings with new one.		2 2
3. Attempt any FOUR of the following:		16
a) Give procedure for carburetor tune-up.		4
Answer: Procedure for carburetor tune-up: 1. Start the engine and run it for at least five minutes to warm up. 2. Allow the engine to idle. The idle is set with a "Volume Control" screw and a "Bypass" screw of the left side of the carburetor. 3. Note the rpm. Adjust the screw on the top of throttle lever so that it just touches the fast idle cam. Then turn it in 1/4 turn.		4



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4. Turn off the engine momentarily.
5. Slowly turn in the Volume Control screw until it bottoms lightly. Then back it out 2 & 1/2 to 3 turns. This is the starting point for this screw.
6. Restart the engine and adjust the Bypass Screw until you obtain the desired idle speed as indicated on the dwell-tachometer. Turning the bypass screw out increases the rpm; turning it in decreases the rpm.
7. Turn the Volume Control screw one way or the other to obtain the highest idle speed, and then turn the screw clockwise (in) until the engine speed drops by about 25 rpm.
8. Reset the idle to desired rpm using the Bypass Screw.

b) Explain phasing and calibration of FIP.

4

Answer:

Phasing FIP: The camshaft of the pump rotates at half the speed of the crankshaft. Therefore, the supply of oil from each plunger should be at 90° differences for a four cylinder engine. This means that the timing of fuel delivery and cut off between one cylinder and the other should be 90°. The adjustment of fuel pumps at correct timing intervals is known as the 'phasing of the pump'.

2

Calibration of FIP:

FIP is calibrated for efficient delivery, so that quantity of diesel fuel supplied by all the plungers in a given pump is more or less same at any rpm. Calibration of FIP is done on FIP test bench. If these measured quantities differ much, then the quantity of fuel is adjusted by loosening the clamping screw of the toothed quadrant and rotating the plunger by turning the control sleeve of pump.

2

c) 'Excessive oil consumption' is observed during a vehicle, what will be probable causes? Write suitable remedies for them.

4

Answer: Causes and remedies for 'Excessive oil consumption': (Any four - 1 mark each)

Sr.	Causes	Remedies
1	Loose main or connecting rod bearings.	Check and adjust or replace.
2	Tapered or out of round cylinders.	Repair.
3	Worn out piston rings, piston or scored liner.	Replace with new one.
4	Worn oil seals (front and rear main bearings).	Replace with new one.
5	Clogged oil return pipe.	Clean and refit.
6	Worn out rear camshaft oil seals.	Replace with new one.
7	Clogged air breather.	Clean it.
8	Leaky fuel pump vacuum booster.	Check and repair or replace
9	Excessive clearance in intake valve guide.	Check and repair.
10	Improperly installed oil pan.	Install properly

4

d) Describe the procedure for pressure testing in cooling system.

4

Answer: The procedure for pressure testing in cooling system.

1. Allow the engine to cool down completely.
2. A cooling system pressure tester can be installed in place of the radiator cap.
3. Use caution, and never remove the radiator cap from an engine that has been run even for a short time.
4. After relieved any excess pressure, can fully remove the radiator cap.
5. After installing the gauge, pressurize the cooling system by operating the plunger on the pump.

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6. Look around for leaks if the gauge shows any pressure loss.
7. Common trouble spots include heads, hoses, water pump and rear heater core. If you smell something sweet when you turn the heater fans on, it may be a coolant leak at one of the heater cores, or simply the O-ring at the rear heater valve leaking.
8. Because there is often more than one leak in the system, it is necessary to continue pressure testing until the system holds pressure.
9. Start the engine cold with no pressure indicated on the gauge.
10. The pressure in the cooling system builds to approx 7 lbs at normal running temperatures looking around for leaks. But if the pressure builds quickly to around 15 lbs the pressure is coming from one of the cylinders through the inner head gasket.
11. This can also show up as a coolant pressure loss in the first test.
12. In extreme cases the cylinder can fill with coolant, and will not turn over.
13. This is known as hydraulic lock, and if you suspect this pull the spark plugs and tries to turn the engine again.
14. Pulling the plugs from the engine allows water to escape from the spark plug holes.
If gauge stays consistent, then don't have a leak. If a vehicle that was having an overheating problem then try running it with the pressure tester connected. This would simulate a working cap. If vehicle does not overheat then pressure cap that is causing the coolant to boil before it should because the system is not pressurized.

e) Describe the servicing of CRDI injector.

4

Answer: Servicing of CRDI injector:

Engine Common Rail Injectors sometimes need to be cleaned, repaired or replaced.

1. Common Rail Injector Removing: Under the hood, a plastic dust heat shield rests on the four bolts. Unscrew them and remove the cover. Open the box and fuse under the hood and pull out the fuel pump relay. This is to ensure that diesel fuel is not flooded the engine. Disconnect the electrical connector's nozzles. Pull out the locking brackets that are fixed reverse connection hose. Use a screwdriver to disconnect the injector return hose and remove it.

4

2. Dismantling and inspection of CRDI injector: Hold the injector's body with wrench. Twist off solenoid and check inside spring and ring. Check upper part of back-valve's mechanism. Twist off fuel pick-up fitting. Remove three-lobe metal detail - one is supported from the bottom with the spring and other detail is located on the small braking clamp. Twist off screw having external thread and internal hexagon. Take out the contents of the valve. Measure the diameter of this ball with the caliper. Check the bottom of the back valve and orifice output hole in the center. Hold and twist the mouth piece with the help of box-wrench. Take out the nozzle carefully and do not lose the small details, needle out of nozzle and other small details. Press out the multiplier and the package of control chamber.

3. Cleaning and repairing CRDI injector: Clean all injector components with carburetor cleaner, duster and solvent. Nozzle was blown with the help of cleaner's balloon. Rub the needle with the duster moistened with the carburetor cleaner and ideally the needle must be shined without any yellow colours. Clean ball by rolling it between two pieces of paper moistened in carburetor cleaner. Clean ball housing and input orifice by blow out from the cleaner balloon. All other details have to be cleaned in order to remove deposits. After cleaning assemble all the parts of injector.

4. Assembly of CRDI injector: Put pivot and control chamber. It is necessary to put it's inside package but peculiarity is that the hole on the valve side must be opposite of input hole on the inside package of injector. Otherwise the fuel will not to fill in chamber of back-valve and not to pour out



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when the valve opening. Under these conditions the injector will not start running. Put together the details of atomizer, insert needle, put up small details, twist mouse pieces but not tighten its. Put up valve accurately. It is necessary to bolt on fuel supply fitting and to tighten it. Assembly the mechanism with tri-lobe device, put on spring on it, mounts and fix with the available half-ring. Insert plate and the ring into solenoid and twist it, not forgotten to lay plate-laying. Connect the electrical connector's nozzles.	
4. A) Attempt any THREE of the following:	12
a) Write diagnosis of fault –“Engine emits excessive black smoke”.	4
Answer: Fault –“Engine emits excessive black smoke”: (Any 4 fault- 1mark each) 1. Over-fueling: Over-fueling is the primary cause of black smoke. Over-fueling can be caused by diesel fuel injector wear that enlarges the nozzle hole or erodes the injector needle and allows excess fuel to flow into the combustion chamber. 2. Dirty air-filters: Dirty air-filters that do not allow sufficient air into the combustion chamber for complete combustion of the fuel charge contribute to black smoke. 3. Excessive oil consumption: Excessive oil consumption due to worn valves and valve stem seals, worn or stuck/sluggish rings from deposits, and worn cylinder liners contribute to black smoke. 4. Bad turbocharger: If turbocharger not working properly or bad. The sufficient air is not supplied in the cylinder for combustion of fuel. 5. Bad EGR valve: Bad EGR valve causing the valves to clog. There is no circulation of engine exhaust during suction. 6. Excessive load: Excessive load on the vehicle than recommended results in black smoke. 7. Improper ignition timing: Check and set proper ignition timing.	4
b) Describe how to check and adjust cooling fan belt tension.	4
Answer: Checking the belt tension: 1. Note the line the belt makes. 2. Push the belt inwards with your finger. 3. It should only deflect 1/2" to 3/4" (9 - 10mm). To adjust cooling fan belt tension. 1. Remove the pulley nut. 2. Observe that there are some notches in the front half of the pulley. 3. Take screwdriver and stick that in one of the notches so it can hold the pulley stationary while using wrench to loosen the pulley bolt. 4. By removal of bolt, see a metal bell-looking thing, and under that are some shims. 5. Remove the rear pulley half. 6. Then add or subtract shims as required to bring your belt tension into specification.	2 2
c) Describe how injector pressure is tested.	4
Answer: Diesel engine injector pressure testing procedure: 1. Fix the injector to be tested to injector pipe of tester as shown in fig. 2. Work the hand pump. Note the opening pressure of spray on gauge provided. If the pressure is less, it is increased by loosening the check nut and tightening the adjusting screw. 3. If it is more than the specified, the adjusting screw is loosened. 4. After adjusting pressure, lock the lock nut and replace the cap. 5. In some make of nozzles shims are added or removed instead of adjusting screw.	2

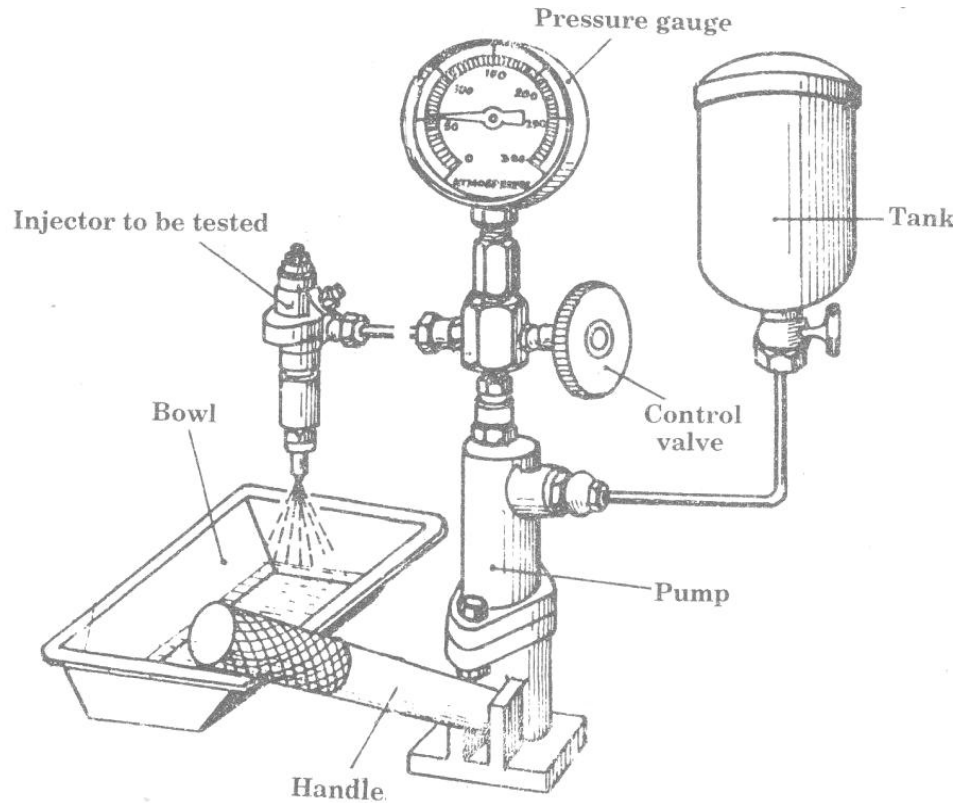


Fig: Injector Tester

2

d) Describe the procedure for clutch free play adjustment.

4

Answer: Procedure for clutch free play adjustment:

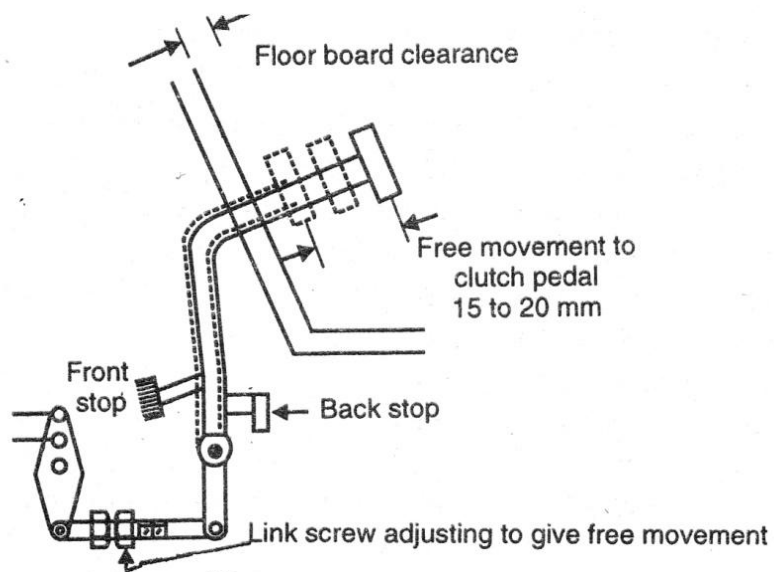


Figure. Clutch adjustment

2



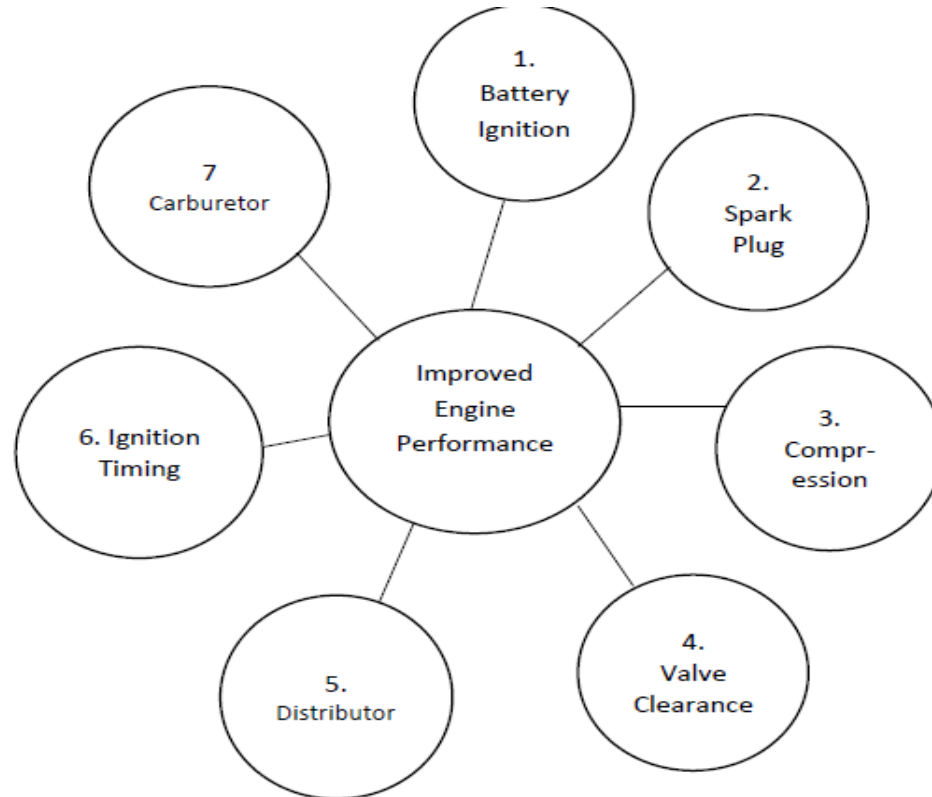
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<p>This adjustment can be done by changing the length of link rod located in the clutch linkage. The adjustment should be set, so that the specified amount of free play remains in the pedal after the clutch has been engaged. This measurement will vary slightly from model to model but the usual free play specified is 15 to 20 mm. After the correct adjustment is made, both nuts are tightened to effectively lock the adjustment. This adjustment should be done after the correct floor board clearance or clutch pedal has been established. If no free play is kept, it may result in noise and also slipping of clutch and damage of release bearing.</p>	2
<p>B) Attempt any ONE of the following:</p>	6
<p>a) Describe procedure of engine tune-up.</p>	6
<p>Answer: Procedure of engine tune-up:</p> <p>A tune-up usually refers to the routine servicing of the engine to meet the manufacturer's specifications. Tune-ups are needed periodically as according to the manufacturer's recommendations to ensure an automobile runs as expected.</p> <p>Tune-up procedure for petrol engine.</p> <ol style="list-style-type: none">1. If the engine is cold, operate it for about 20 minute at 1500rpm or operate until it reaches the operative temperature. If there any operational problems during this warm up time these problems may be noted.2. Connect oscilloscope and exhaust gas analyser and perform diagnosis. Check for any abnormal condition and if possible the cylinder in which it appears.3. Remove all spark plugs open the throttle & choke valve fully Disconnect the distributor lead from the primary oil terminal thus preventing excessive secondary voltage.4. If the compression ratio is not up to specifications, perform engine services that will eliminate the trouble. If the compression is all right, reinstall the spark plugs.5. Clean, inspect, check gap and test the spark plugs. Replace worn or defective spark plugs.6. Inspect and clean the battery, battery terminal cable and hold down brackets. Test the battery, add electrolyte if necessary. If the battery has been over charged or under charged the alternator & regulator should be checked.7. Check distributor contact points and clean them. Read just the point opening.8. Check drives belts. Tighten or replace them as required.9. Inspect the distributor rotor, cap and primary and high voltage.10. Check the condition of the manifold heat control valve making sure that it is free to operate.11. Check the intake manifold bolts for tightness to proper specifications.12. Check fuel lines for tight connections and kinks beads or leaks.13. Check the cooling system for leaks, wear or collapsed hoses correct coolant level and antifreeze protection.14. Check and adjust the accelerator linkage if necessary15. Check crankcase ventilation system16. Check intake manifold and air injection system17. Remove carburettor, air cleaner and check choke valve to make sure choke is working normally.18. Clean or replace air filter element if necessary19. Check and adjust idle speed and mixture to specification.	6



(Note: Suitable credit shall be given to above sequential diagram drawn)

b) Describe procedure for frame repair.

6

Answer: Procedure for frame repair.

A) Cracks:

Cracks can be detected by inspecting the chassis carefully. If it is not visible, wash the chassis first, then coat the surface with a solution of chalk and water. When it becomes dry, tap the area with a hammer then the crack will be visible.

In case, the crack is observed, it should be immediately repaired. In case the repair facilities do not exist, then drill 5 to 6 mm diameter hole at the end of cracks as shown in figure. This drilling of hole will stop further expansion of crack. The holes work like the first aid for the crack. Fig.

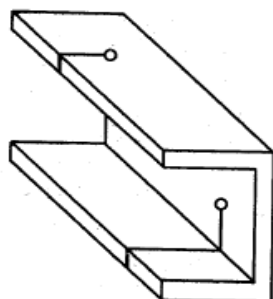


Fig. Drilling hole at the end of crack

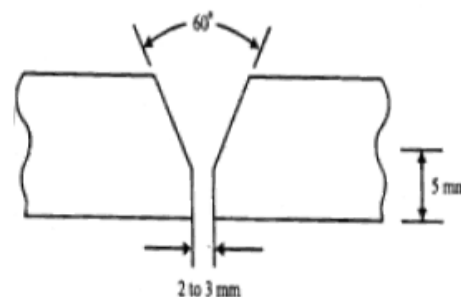


Fig. Making „V“ groove for welding

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To repair cracks following procedure is adopted:

1. For welding the chassis make a groove of 2 to 3 mm in the crack at bottom portion and chamfer the upper end of the groove to make a V shape. Weld a groove with at least 3 layers. After welding, it is cooled down, then grid the surface to make it smooth.
2. Considering second case. If crack is more than $\frac{1}{2}$ of chassis cross-section, it will be necessary to reinforce the area, by placing a steel plate and chassis thickness. While welding the plate, never weld it fully on all sides.

B) Loose Rivets:

Check for loose rivets especially in the vehicle which are being overloaded or run on bad road. The loose rivets can easily be detected by presence of the rust or bur around the rivets by visual inspection and then tapping it with a hammer. If found loose, it should be removed and a new rivet should be placed immediately.

For replacement of rivets following procedure is adopted:

1. Cut the rivet head with drill or welding torch; do not use a chisel as it will damage the rivet hole. In case the hole is already damaged, drill a bigger hole and use bigger diameter rivet.
2. The diameter of new rivets should be 1 mm less than the hole diameter.
3. Clean the hole thoroughly, there should be no bur.
4. Heat the rivet, when hot, fix it in the hole and rivet its head.
5. Never fix up a cold rivet, as it will not make a good joint.
6. Do not weld rivet with chassis. If it is loose, remove and fix a new one.

C) Procedure for checking skewness (Misalignment and repair):

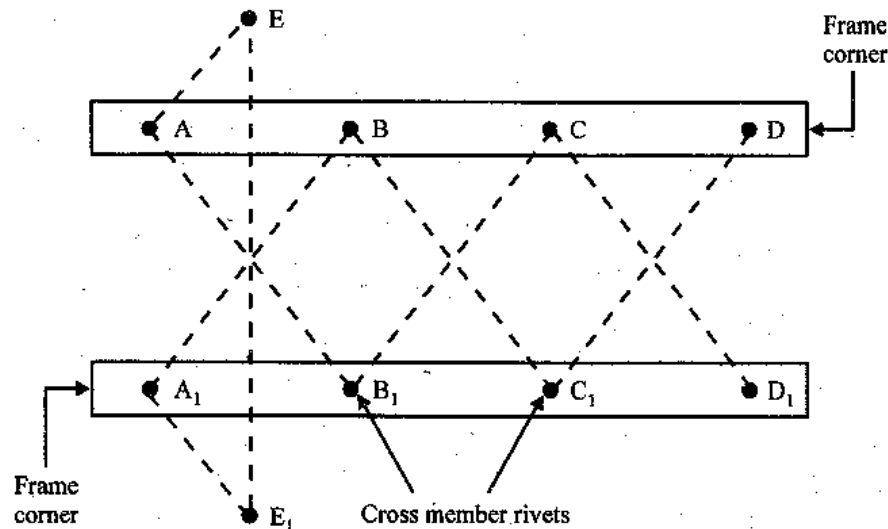


Fig: Checking alignment of frame.

1. Place the vehicle on plane leveled ground.
2. Mark the markings on the floor from all the points from which measurements should be taken by dropping the plumb bob directly underneath the point.
3. Move the vehicle away from the layout on floor.
4. Check frame width at front and rear end. If width is corresponds to specification, draw a center line up to full length of the vehicle half way between marks indicating front and rear width. If frame width is not correct draw center line through intersections of any two pairs of equal diagonals.



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<p>5. With the center line properly laid out, measure the distance from it to points opposite over the entire length of chassis. If frame is in proper alignment measurement should not be vary.</p> <p>6. To locate the points at which the frame is sprung measure the diagonals marked in pairs A-B, B-C, and C-D. If the diagonals in each pair are within 3.17mm, that part of the frame between the points of measurements is considered as in satisfactory alignment. These diagonals should intersect at center line.</p> <p>Repair of Skewness of frame: Skewed frame can be repaired with two jacks, dolly block, special type of bending tools and localized heating of the particular chassis bend. After repairing of frame check alignment of chassis accurately.</p>	
<p>5. Attempt any FOUR of the following:</p>	16
<p>a) What is meant by bearing preload? State the procedure to keep bearing preload in final drive.</p>	4
<p>Answer: Bearing preload A slight over-tightening of taper bearing used on differential pinion shaft is known as preloading of bearing. Bearing preload is important because of degree of internal clearance within a bearing can influence a variety of factor including noise, Vibration; heat built up and fatigue life. When preload is applied correctly –</p> <ol style="list-style-type: none">1. It controls rapid and axial play.2. Reduces non-repetitive run out.3. Reduces the difference in contact angle between inner and outer rings at very high speed.4. It controls balls skidding under very high acceleration.	1
<p>Procedure to keep bearing preload in final drive:</p> <ol style="list-style-type: none">1. The pinion is held in position in the housing with the help of two bearings are mostly taper rollers bearing.2. Disconnect the rear end of the propeller shaft by loosening the flange bolts.3. Remove the lock nut and thrust washer.4. To remove free play in the bearing usually two methods are employed. By adding or removing shims under the cap of differential pinion housing or by check nut on pinion shaft.5. In heavy vehicles, over two taper roller bearings one pilot bearing is also used at the front end of the pinion.	3
<p>b) Describe checking of synchromesh unit.</p>	4
<p>Answer: Checking of synchromesh unit:</p> <ol style="list-style-type: none">1. Check that all splines on synchromesh hub are free from excessive wear.2. Check that the engagement of dog teeth on the sliding sleeve and gear are free from chipping and burring.3. Check that the synchroniser cones are not excessively worn or showing the effects of overheating.4. Renew the springs and locking balls, if worn out.5. Check synchroniser contact surfaces on the gears and cups for excessive wear; if burnt out contact surfaces are evident, gears or cups should be renewed.6. Check blocker pin chamfer for excessive wear, Renew as necessary.	4



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c) Write causes and remedies for symptom- “ clutch slip”

4

Answer: Causes and remedies for “ clutch slip”: (Any four-1 mark each)

Sr.	Causes	Remedies
1	Oil or grease on the driven plate facings	Fit new plate and eliminate oil leak
2	Worn-out facing of clutch plate	Replace clutch plate.
3	Binding of clutch pedal mechanism/ Incorrect pedal adjustment.	Make Free and lubricate joints./ Adjust the pedal.
4	Weak pressure springs.	Replace with new springs.
5	Incorrect setting of release levers.	Reset the lever properly.
6	Improper clutch free play.	Adjust properly.
7	Worn-out facing of pressure plate or flywheel.	Replace it

4

d) What will be the causes for “Hard gear shifting”? Suggest suitable remedies.

4

Answer: Causes for Hard gear shifting: (Any four causes-1 mark each)

Sr.	Causes	Remedies
1	Distorted splines of the main shaft	Replace shaft.
2	Too strong shifter locks spring.	Replace spring
3	Improper clutch adjustment.	Make proper adjustment
4	Shifting mechanism out of alignment	Align properly.
5	Battered gear teeth.	Replace gear.
6	Silent synchromesh shifter binding	Adjust it.
7	Gear shifting lever out of adjustment.	Adjust it.

4

e) Explain how will you check (i) Backlash in differential gears, (ii) Tooth contact between ring gear and pinion.

4

Answer: Checking of -

(i) Backlash in differential gears.

To check backlash, fix up the dial gauge on differential housing and its pointer resting on tooth of sun gear. Set the gauge at zero. Now move the wheel on both sides without moving the planet pinion and read the gauge, the play should be 0.15 to 0.18.

2

Similarly, for checking the backlash in Crown wheel and bevel pinion, rest the pointer of dial gauge on the tooth of crown wheel and hold the bevel pinion. Now with screw driver move the crown wheel and note the reading on dial gauge.

(ii) Tooth contact between ring gear and pinion.

Apply red lead paste on 3 teeth of ring gear as shown in figure. Now rotate the ring gear in the direction of its rotation 4 to 5 times. When these marked teeth pass over the teeth of pinion, it leaves a contact mark as shown in figure (b) & (c). In case correct contact mark is not coming, i.e. it is coming at top or bottom, right or left or in one corner adjust the tooth contact by shifting the pinion in or out and/or crown wheel left or right.

2

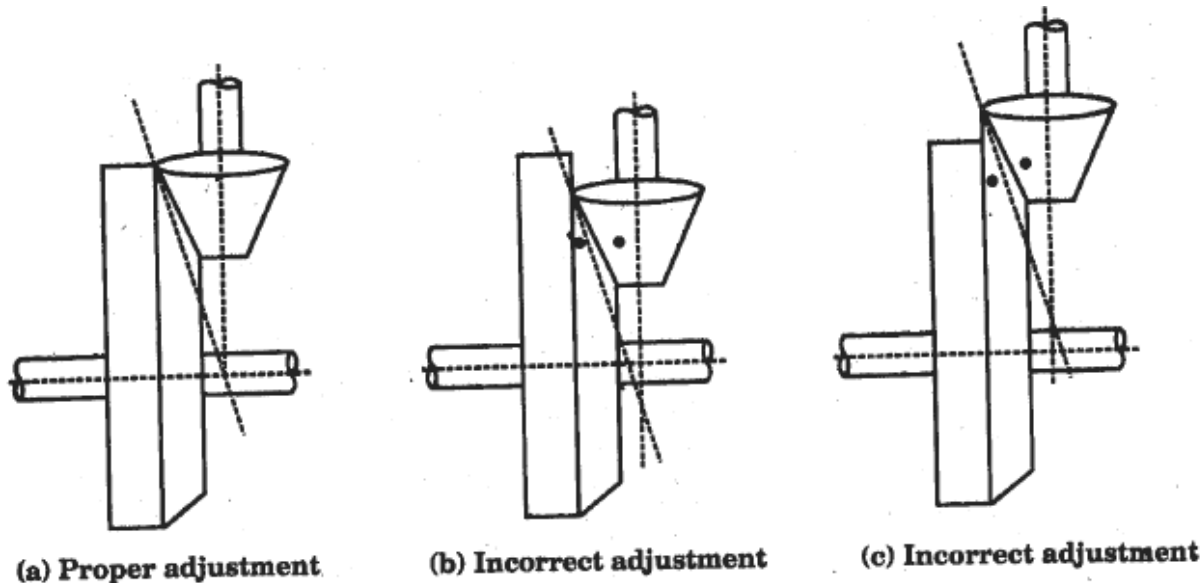


Fig. Adjustment of bevel pinion and crown wheel

f) Write procedure for removal of dent.

4

Answer: **Procedure for removal of dent:**

Examine the dent very carefully and to find out how dent is formed in correct sequence.

4

1) Preparation of work: Before starting actual repair it is necessary to clean the dented area thoroughly. Removing paint, road dust & other particles both from top and bottom end of denting area.

2) Ironing of dent: As shown in figure, identify particular dented area of sheet metal and carry the repair work with dolly block, spoons and hammers to bring it at its original shape.

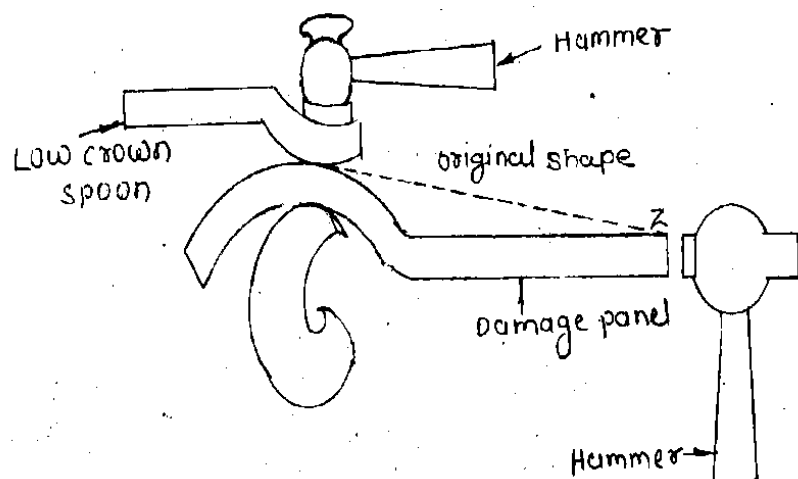


Fig. Ironing of dent

3) Welding: Sometime when impact is sever, the sheet metal torn apart, while filing the sheet metal gets weakened and cracks occurred. Under this circumstance, it is necessary to weld the cracks for permanent joint.



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4) Finishing Job: Final job is to smooth out bumped surface to its original shape or appearance. Slight irregularity or roughness in the surface can be felt by moving the hand over the dented area. Special flexible files are used to remove high spots. Especially adjustable vixen files are used for this purpose.

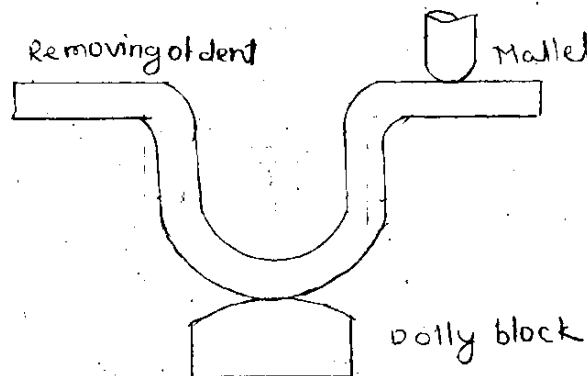


Fig. Finishing job

5) Metal shrinkage: Panel and other sheet metal components, which are hammered to bring its original shape, usually stretched during repair, weaken the structure. This stretched area can be shrunk by localized heating with torch flame and hammered with the help of dolly block, to smoothen out. If structure is very weak, then weld it as permanent joint and refinish it.

6) Final step: A thick paste is applied with a knife edge. After 3/4 hour it becomes dry. After it gets hard, then it is smoothened with file.

6 Attempt any **FOUR** of the following: 16

a) Describe inspection of brake disc and brake pads. 4

Answer:

Inspection of brake disc:

1. Before the inspection of brake pads must be removed.
2. Check disc surface for scratches in wearing parts. When there are deep scratches all over disc surface, replace it. 2
3. When only one side is scratched, polish and correct that side.
4. Measure the thickness of disc, it shall be within manufacturers limit
5. To measure the deflection of disc, take measurement at two points on its periphery and center with dial gauge while rotating it.

Inspection of brake pads:

1. Inspect the brake pads; remove the caliper from the disc by disconnecting its mounting bolts.
2. Check brake pad lining for wear. When wear exceeds limits, replace with new one. 2
3. Measure the thickness of brake pad; it shall be within manufacturers limit.
4. Inspect caliper for brake fluid leak, correct leaky point if any.

b) Write procedure of manual brake bleeding. 4

Answer: Procedure of manual brake bleeding

Two service technicians are needed for the manual bleeding. One technician opens a bleeder and the other technician depress the pedal, to force out air and brake fluid from bleeder screw. To bleed the system following procedure is adopted.

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- Attach a bleeder hose to bleeder screw at the wheel cylinder and insert the other end of hose into the clean plastic container which is partially filled with clean brake fluid.
- Loosen the bleeder screw at least one full turn.
- Have an assistant to depress and hold the brake pedal and then tighten the bleeder screw.
- Have your assistant to release the brake pedal.
- Repeat steps b,c & d until the fluid flow in container is free of air bubbles .Periodically check the brake fluid level in the master cylinder and brake fluid of correct grading to keep the reservoir filled.
- Repeat this procedure at each wheel.

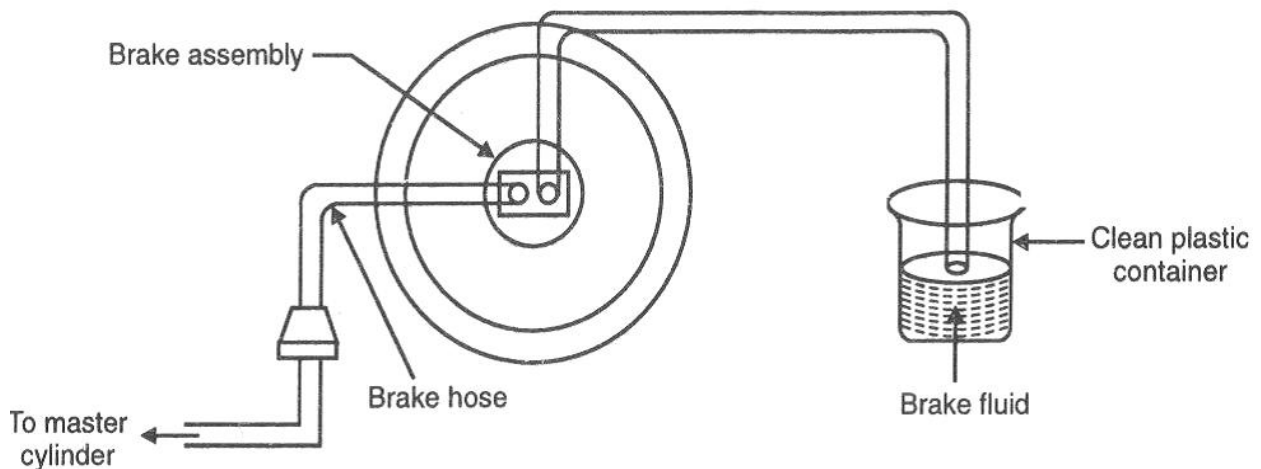


Figure. Manual brake bleeding

- What is meant by ‘spongy brake pedal’? Write causes and remedies for it.

Answer: Spongy brake pedal:

Air is compressible and its presence in the brake system greatly reduces the hydraulic pressure that can be developed within the system. If air is entrapped in hydraulic system brake pedal may not be firm to transmit the effort to apply the brakes, this condition is known as Spongy brake pedal.

Causes and remedies for spongy brake pedal: (Any three)

Sr.	Causes	Remedies
1	Air entrapped in hydraulic system.	Bleed the system
2	Incorrect brake shoe adjustment.	Adjust it properly.
3	Distorted Shoes or back plate.	Replace the shoes and backplate.
4	Bell mouthed, worn out, weak or cracked brake drums.	Replace drums.
5	Master cylinder filler cap vent clogged.	Clean vent hole or replace cap, bleed system.
6	Weak, cracked hose	Replace with new one
7	Weak master cylinder mounting	Check and strengthen master cylinder mounting.
8	Bent master cylinder push rod and clevis	Replace push rod and clevis



d) What will be the causes if vehicle pulls to one side?	4
Answer: Causes if vehicle pulls to one side. (Any four causes-1 mark each) 1. One of the front tyres under-inflated or worn out. 2. Loose U or I bolt of front axle spring. 3. Bent steering arm. 4. Misaligned front axle with rear axle. 5. Bent stub axle. 6. Brake linings of different types. 7. Uneven spring, sagging, broken loose attachment of leaf spring. 8. Tight wheel bearing. 9. Misalignment of caster, camber, toe in, steering axle inclination	4
e) Give procedure of wheel alignment using wheel alignment gauges.	4
Answer: Procedure of wheel alignment using wheel alignment gauges: 1) For checking and making adjustments for wheel alignments, always use manufacturer's manual. Because, there are cars of number of makes and models. So the specification varies in wide range. 2) All alignments check and adjustments should be made with the car on leveled ground, at curb weight, spare tyre in place, normal supply of water, fuel and oil, but with no passengers or load. 3) Check castor, camber and king pin inclination by using combination gauge. 4) Check toe in with toe in gauge provided. 5) If these measurements are not within limit then adjust it as per the manufacturer's manual 6) Castor and camber are adjusted by adding or removing shims provided, at the upper control arm and inside the frame. For positive castor remove shims from the front and/or add shims from both the front and rear. For positive camber remove an equal number of shims from both the front and rear. 7) For toe in adjustment: loosen the clamps on the tie rod ends and shorten one tie rod and lengthen the other. Adjust equal amount until the steering wheel position is correct.	4