**WINTER – 19 EXAMINATION**

**Subject Name: Vehicle systems Maintenance Model Answer** Subject Code: 17618

**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 judgement 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.

| Q. No. | Sub Q. N. | Answer | Marking Scheme |
|---|---|---|---|
| 1 | (a) | **Attempt any THREE of the following:** | 12 |
| | i | **State general precautions and procedure while using**<br>**(1) F. I. P. Tester Machine (Calibration)**<br>**(2) Measuring Tools** | 04 |
| | Ans | **General Safety Precautions and Procedures while Using**<br>**(1) FIP Calibration Machine:**<br>1. Do not allow unauthorized personal to operate service or maintain on this machine.<br>2. Never attempt to operate the machine or its tools from any position other than seated in the operator's seat.<br>3. Always check work area for dangerous features like slopes, overhangs, demolitions, fire, drop-off, ditches.<br>4. Never leave the machine unattended while running condition.<br>5. Wear insulated rubber gloves, shoes with insulated soles, protective garments and safety face shield while working.<br>6. Do not wear sandals or open toe shoes.<br>7. Keep long hair out of machine by wearing a cap.<br>8. Do not wear rings or bracelet or watches while working around running machine.<br>9. Observe and strictly follow the safety precautions displayed and instructed on Equipment<br>**(2) Measuring Tools:**<br>1. Grip the tool firmly. Avoid excessive force on the tool while gripping the measuring tool.<br>2. Clean and dry the surface of the object which needs to be measured.<br>3. Do not use measuring tools for dirty, mismatched or worn parts.<br>4. Be careful when using sharp or pointed tools.<br>5. Check for wear of Contact Point.<br>6. Check measuring tool for zero error.<br>7. To avoid parallax error observer should position his eyes directly above the scale when taking reading.<br>8. Always pull, do not push, torque wrench to apply torque.<br>9. Never use a "cheater bar" on a torque wrench to apply excess leverage. | **Any four - 1/2 mark each**<br><br>**Any four - 1/2 mark each** |

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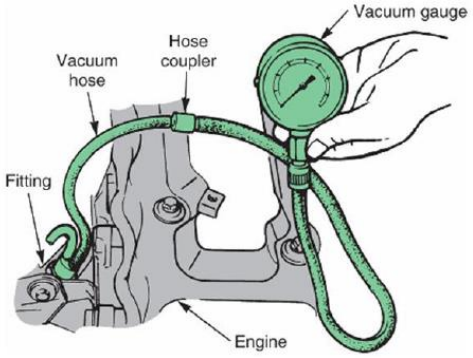
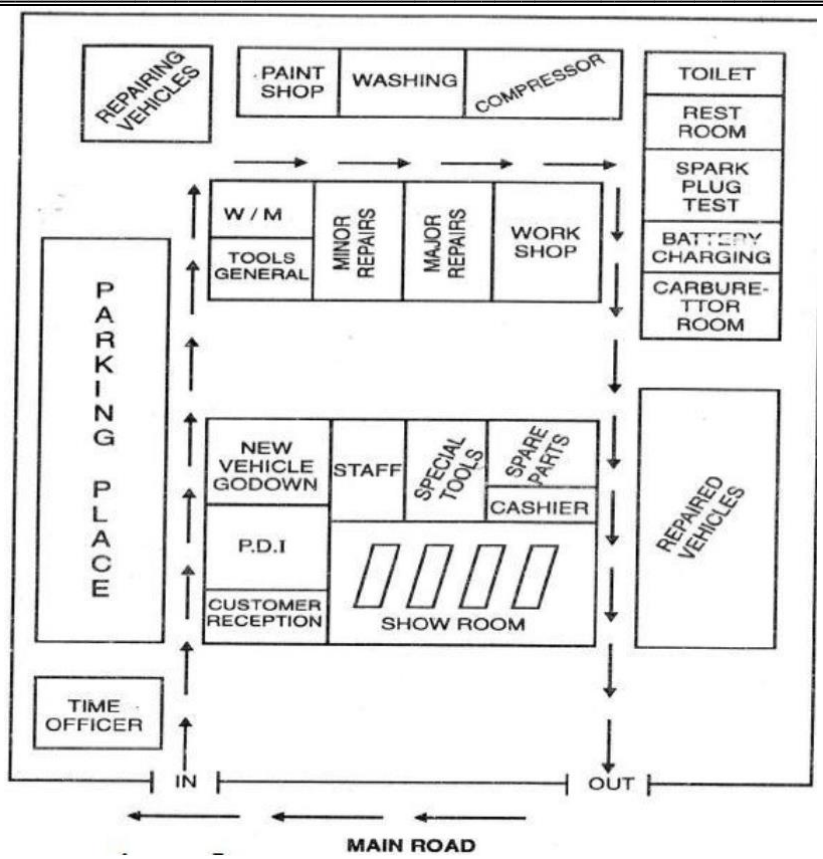
| | | 10. Do not use torque wrench with sockets or fasteners showing wear or cracks.<br>11. Remove any dust or dirt after use of tool.<br>12. Keep the measuring tool in provided case in cool and dry location. | |
| | ii | **State the functions of following tools and equipment**<br>**(1) Wheel Aligner (2)Torque Wrench (3)Arbor Press (4)Tyre Changer** | **04** |
| | **Ans** | (1) **Wheel Aligner:** To check the alignment of wheels.<br>(2) **Torque Wrench:** To Loose or tight the nut and bolt as per required torque**.**<br>(3) **Arbor Press:** To Straighten the bend up shaft/ parts.<br>(4) **Tyre Changer:** To replace the old faulty tyre with new one. | **01 Mark Each** |
| | **iii** | **State the types of maintenance and write their applications.** | **04** |
| | **Ans** | **Types of maintenance:**<br>Preventive Maintenance, Scheduled Maintenance and Breakdown Maintenance.<br>**Applications of Maintenance:**<br>1. The increasing performance of a vehicle.<br>2. 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.<br>3. 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.<br>4. Maintenance gives us trouble free performance.<br>5. It increases the life of vehicle.<br>6. It avoid breakdown of vehicle. | **01 Mark**<br>**Any Three = 01 Mark Each.** |
| | **iv** | **Write procedure for engine vacuum test.** | **04** |
| | **Ans** | **Procedure to be carried out the Vacuum Test of Cylinder:**<br>Measuring the amount of manifold vacuum during cranking is a quick and easy test to determine if the piston ring and valves are properly sealing (For accurate results the engine should be warm and the throttle closed).<br>1. Run the engine so that the water temperature is between $75^0$C to $80^0$C.<br>2. Disable the ignition.<br>3. Connect the vacuum gauge to a manifold vacuum source.<br>4. Crank the engine while observing the vacuum gauge.<br>5. Observe the gauge to note the reading. Reading should not be less than 40 cm of Hg. A low vacuum reading if recorded means that leaky cylinder head gasket.<br>  <br><br>*(Credit should be given any equivalent figure)* | **02 Marks for Procedure & 02 Marks for Figure.** |
| **1** | **(b)** | **Attempt any ONE of the following:** | **06** |
| | **i** | **Draw the layout of modern workshop and list the tools and equipment required.** | **06** |
| | **Ans** | **Layout of Modern Workshop:** | **Layout = 03 Marks** |




**List of Major Equipment:**

1. Battery Charger.
2. Arbor Press
3. Nitrogen Filling Station.
4. Car Lifts
5. Engine Analyzer
6. Electric Drill.
7. Vehicle Washer.
8. Electric Soldering Iron.
9. Grease Gun
10. Fuel Injector Tester
11. Computerized Wheel Aligner.
12. Computerized Wheel Balancer
13. Air Conditioner Charging Unit
14. Head Light Aligner,
15. Engine Analyser,

**List of Important General Tools:**

[1] Hand Tools (Service Tools)
[2] Measuring Tools
[3] Shop Power Tools
[4] Shop Cutting Tools
[5] Hydraulic Jack, Axle Stands, Creepe

**List of Specialized Tools:**

[1] Vehicle Washer
[2] Portable Electric Drill
[3] Headlight Beam Aligner
[4] Brake Tester
[5] Electronic Soldering Iron
[6] Spark Plug Cleaner & Tester
[7] Valve Grinder
[8] Piston ring compressor
[9] Piston ring expander,
[10] Valve spring compressor
[11] Bearing Puller

**List of Any Six Equipment & Any Six Tools = 1/2 Mark Each.**

| | ii | **Describe breakdown maintenance, by giving two wheeler example.** | **06** |
|---|---|---|---|
| | **Ans** | **Breakdown Maintenance:** It is the attention provided when a vehicle is stopped due to faults created during running.<br>**Example of Causes Breakdown of Two Wheeler:**<br>(i) Due to unpredictable failures of components.<br>(ii) Due to gradual wear and tear of parts.<br>(iii) Incorrectly inflated tyres.<br>(iv) Improper Engine oil level and condition.<br>(v) Rash and Careless driving habits. | **Definition = 01 Mark**<br>**&** |

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| | | (vi) Overloading, over running and over speeding of the vehicle.<br>(vii) Clogged filters.<br>(viii) Improper braking system.<br>(ix) Failure to replace worn out parts<br>(x) Lack of lubrication<br>(xi) Negligence towards minor faults<br>(xii) Negligence towards the unusual vibrations of the vehicle.<br>(xiii) Overheating of the engine | **Example = 05 Marks** |
| **2** | | **Attempt any FOUR of the following:** | **16** |
| | **a** | **Describe work order file.** | **04** |
| | **Ans** | **Work order :**<br>It contains details of vehicle owner as well as vehicle, job to be done on vehicle, list of spare parts and cost, and labour cost incurred. | **Definition = 01 MarK** |

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|---|---|---|---|
| Name<br>Address<br><br>Pin<br>Phone | Work Order No.<br>Speedometer Reading | Date<br>Veh. No.<br>Ch. No.<br>Engine No. | Reason for check<br>Scheduled ☐<br>Non-sheduled ☐<br>Abuse ☐ |
| Work order<br>Written by<br>Approved by<br>Vehicle down time | Fuel reading<br>Check accessories<br>Spare wheel<br>Tool Kit | | Remark ☐<br>Accident ☐<br>If warranty ☐<br>Involve |
| | | | Damage to vehicle |

| Spare part list cost | | | Labour cost | | | |
|---|---|---|---|---|---|---|
| No. | Parts Description | Price | Work done | Hour | Mech. Sign | Labour charge |
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |
| | Total Cost | | Total Labour Cost | | | |

**Example = 05 Marks**

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| | **b** | **Describe General Servicing Procedure.** | **04** |
| | **Ans** | **General Servicing Procedure:**<br>[1] Park the vehicle on the servicing ramp.<br>[2] Place the stopper at the front and rear of the wheel.<br>[3] Drain the Engine oil from engine oil sump and fill up new recommended oil.<br>[4] Check oil level in gear box and differential. If level found less top up to correct level by Specified oil.<br>[5] Clean air filter by blow of compressed air. If clogged replace with new one.<br>[6] Check the water level, coolant level and Belt tension of the alternator.<br>[7] Check battery electrolyte level. If necessary top up to correct level.<br>[8] Perform engine tune up, if required.<br>[9] Do the brake and clutch adjustments as required.<br>[10] Check tyre condition and do tyre rotation if required<br>[11] Perform Wheel alignment and wheel balancing if necessary.<br>[12] Wash the vehicle thoroughly and by using grease gun lubricate the points | **Any Four Points = 01 Mark Each.** |

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| | | where grease lubricant required. | |
| | c | **State four generally observed troubles related to engine lubrication system.** | **04** |
| | **Ans** | **The four problems that most often occur in the lubrication system are as follows:**<br>1. High oil consumption (oil must be added frequently)<br>2. Low oil pressure (gauge reads low, indicator light glows, or there are abnormal engine noises)<br>3. High oil pressure (gauge reads high, oil filter swells)<br>4. Indicator or gauge problems (inaccurate operation or readings) | **Any Four Points = 01 Mark Each.** |
| | d | **Describe how to check engine smoke and coolant level.** | **04** |
| | **Ans** | **How To Check Engine Smoke:**<br>The smoke meter shall have probes of sufficient length (minimum 2 meter) to facilitate easy attachment to the tailpipe of vehicles. According to the test procedure for free acceleration tests, the ratio of cross sectional area of the probe to that of exhaust pipe shall not be less than 0.05. Considering the exhaust pipe diameter of 4 inch, the equipment shall be supplied with at least one probe of internal diameter not less than 2.25 cm.<br>**How To Check Coolant Level:**<br>**Step 1: Raise the bonnet and secure in raised position**<br>**Step 2: Locate the coolant tank:** The cap of the coolant tank will often have a warning on it to not open unless the engine is cold. The coolant system is pressurized, if you remove the cap while the engine is hot, coolant could spurt out as the pressure is released and scald you. If the location of the coolant tank is not clear to you, make sure you refer to your vehicle handbook, where you should find a diagram of its location.<br>**Step 3: Check the level:** On the side of the coolant tank, or sometimes on the inside, you will see a minimum and maximum guide. If your coolant level is between these levels, there is nothing you need to do. If your coolant level is close to the minimum or below the minimum level you will need to top up.<br>**Step 4: Top up your coolant:** If you need to top up your coolant, make sure your coolant is mixed and ready. You can buy coolant ready mixed, or as a concentrate. If you need to mix your coolant from antifreeze concentrate, then refer to the manufacturers guide printed on the bottle, You can mix your antifreeze with water in a jug ready to pour into the coolant tank. Make sure you dispose of any extra coolant mixed safely.<br>**Step 5: Unscrew the Coolant Tank Cap:** Ensure the engine is cool. Put your rag over the cap to unscrew, this will ensure that if any coolant does squirt out of the pressurised system it does not end up on you!<br>**Step 6: Top up Coolant:** You can then refer to the minimum and maximum guides on the coolant tank and top up as required, use a funnel if you wish to prevent spillages. You can then replace the cap and lower the bonnet. If you have spilt any coolant make sure you rinse it off the body work of the car and wash your hands thoroughly. | **02 Marks**<br><br>**02 Marks** |
| | e | **Describe tuning of engine.** | **04** |
| | **Ans** | **Engine tune-up:** Engine tuning is the adjustment, modification of the internal combustion engine or modification to its control unit to obtain optimum performance, to increase an engine's power output, economy, or durability**.**<br>**OR**<br>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 | **Correct Answer = 04 Marks** |

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| | | manufacturer's recommendations to ensure an automobile runs as expected.<br>If regular maintenance and inspection isn't performed on engine, vehicle may not be operating as reliably or efficiently as it should. A well-tuned engine operates at maximum performance levels. During a tune-up, engine parts that affect performance are checked, cleaned adjusted and replaced.<br>**e.g.** Spark plugs create an electrical spark that ignites the gasoline/air mixture in engine. They create, and must be able to withstand, a tremendous amount of voltage and heat. If engine's spark plugs aren't working properly, the engine can stall and may not even start. Spark plug wires are also very important. They have to be able to transfer and withstand the voltage created by the spark plug. If they are old, they can burn out and cause a misfire. | |
| | **f** | **Write the procedure for checking and servicing of piston and piston ring.** | **04** |
| | **Ans** | **Procedure for Checking and Servicing of Piston:**<br>1) Clean the piston to remove dirt, carbon depositions etc.<br>2) Check piston diameter with micrometer.<br>3) Measure the clearance between cylinder bore and piston. If the clearance is not within specifications replace the piston.<br>4) Check the piston ring groove clearance with the help of feeler gauge.<br>5) Inspect the condition of piston skirt for wear.<br>6) Check the oil holes in the oil ring grove.<br>7) In case piston is scored, cracked, burned spots, scuffed sides and broken ring lands the piston should be replaced.<br>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.<br>**Piston Rings:**<br>1) Check piston Ring end gap.<br>2) Insert the piston ring into the cylinder.<br>3) Using the piston push the piston ring a little beyond the bottom of the ring travel.<br>4) Using a feeler gauge measure the end gap.<br>Standard piston ring end gap.<br>No.1 -Ring:- 0.30 to 0.51 mm<br>No.2- Ring:- 0.30 to 0.57 mm Oil ring :- 0.35 to 0.60 mm If the end gap is within specification<br>5) Check the fit of each compression ring in its piston groove.<br>6) If fit is tight, the groove probably need cleaning.<br>7) If the ring is too loose, check the piston ring side clearance.<br>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.<br>9) Visual Inspection of ring for cut and damage.<br>10) If piston rings are excessively worn-out, damaged, replace set of piston rings with new one. | **Checking & Servicing Of Piston = 02 Marks**<br><br>**Checking & Servicing Of Piston Ring = 02 Marks** |
| **3** | | **Attempt any FOUR of the following:** | **16** |
| | **a** | **Give the procedure for Injector tune – up.** | **04** |
| | **Ans** | **Procedure For Injector Tune – Up:**<br>1. Remove injectors, install a compression gauge, carry out a compression test and interpret the test results<br>2. Carry out a machine stall test or engine load test to determine engine condition by measuring air inlet restriction, boost pressure, exhaust back pressure and crankcase pressure<br>3. Evaluate exhaust smoke and determine corrective action<br>4. Adjust engine valve clearances | **Correct Answer = 04 Marks** |

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| | | 5. Check and adjust injection pump timing on in-line pumps and rotary pumps using either spill, pin, mark or dial gauge methods; time and calibrate unit injectors<br>6. Adjust governor settings - maximum speed/idle speed<br>7. Test and adjust injectors<br>8. Be able to isolate injectors on a running engine to determine cylinder misfire. | |
| | **b** | **Explain CRDI injector servicing.** | **04** |
| | **Ans** | **Servicing of CRDI injector:** Engine Common Rail Injectors sometimes need to be cleaned, repaired or replaced.<br>**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.<br>**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.<br>**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<br>**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 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. | **Correct Answer = 04 Marks** |
| | **c** | **'External Oil Leakage' what will be probable cause? Write suitable remedies for them.** | **04** |
| | **Ans** | **External Oil Leakage:**<br>**S. N.** \| **Causes** \| **Remedies**<br>**1** \| Leaking gaskets or seals \| Replace it.<br>**2** \| Oil pan damage \| Repair the damage or replace the oil pan<br>**3** \| Oil drain plug becomes worn out or is loosened from running over debris in the road, \| Replace the worn out drain plug, Align it and tight it properly.<br>**4** \| Oil filler cap is loose, broken or missing, \| Tight it, Replace it. | **Any Four = 01 Mark Each** |

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| | | 5 | Oil filter wear out or become loose or misaligned over time. | The filter should be changed every time you change the oil and should be checked for proper fitting |

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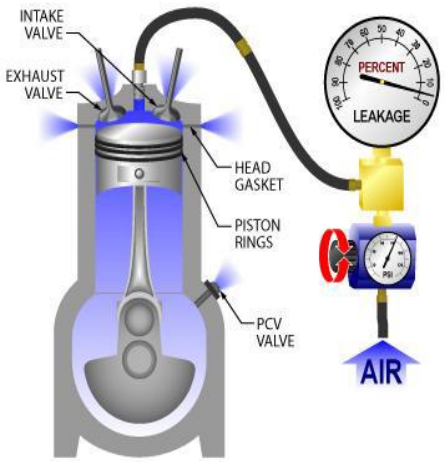
| | d | **Describe the procedure for service of fuel feed system.** | **04** |
| | Ans | **Procedure for service of Fuel Feed System:**<br>**Fuel Pump:** Remove the top of the pump first. It is held on by a central bolt or screw, Do not clamp a pump in a vice to dismantle it — the pressure could break the alloy casting. Hold the halves together while removing the body screws. Separate the halves carefully to avoid tearing the diaphragm. Mark or scratch both halves so that you can refit them in the same position — but do not scratch a line straight across the diaphragm edge. Hold the halves together while you remove all the body screws. Spring pressure inside will push them apart. Release your grip slowly; the diaphragm may stick and need gently freeing. Do not pry with a sharp metal object, which might scratch the mating surfaces and cause a leak.<br>**Fuel Filter**<br>Many fuel pipe problems are caused by the filters becoming blocked. There are different types of filter of which one of the most common is the plastic in-line type. Check along the fuel pipes until you see the filter, which is usually barrel shaped. It is often transparent and you can see if it is blocked.<br>**Fuel Tank:** Leakage may occur which can be repaired or Replace the old fuel tank with new tank<br>**Fuel Lines (Pipes) between the tanks and the engine.**<br>Pipes can suffer from two main faults: leaking or blockage. Probably the first indication you will get of a leak is the smell of petrol wafting into the car - don't delay in finding the problem, as the petrol vapour can be ignited easily. Blocked pipes are usually very obvious - the car comes to a halt or suffers from fuel starvation. Thankfully this is now rare because fuel filters are fitted to remove dirt. | **Every Correct Point = 01 Mark** |
| | e | **Describe the procedure to carry out the leakage test of cylinder** | **04** |
| | Ans | **Cylinder Leakage Test:**<br>1) Engine should be at normal operating temperature.<br>2) The cylinder being tested must be at top dead center of the compression stroke<br>3) Calibrate the cylinder leakage unit as per manufacturer instructions.<br>4) Inject air into the cylinder, one at a time, rotating the engine as necessity by firing order to test each cylinder at TDC on the compression stroke.<br>5) Evaluate the results.<br>Less than 10% leakage- Good<br>Less than 20% leakage- Acceptable<br>Less than 30% leakage- Poor<br>More than 30% leakage- Definite problem<br>6) Check the source of air leakage<br>a) if air is heard escaping from the oil filter cap, the piston rings are worn or broken<br>b) If air is observed bubbling, out of the radiator there is possible blown head gasket or cracked cylinder head.<br>  <br> | **Figure 01 Mark And Procedure = 03 Marks** |

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| | | c) if the air is heard coming from carburetor or air inlet on fuel injection equipped engines there is defective intake valve.<br>d) If air is heard coming from the tail pipe, there is defective exhaust valve. | |
| **4** | **(a)** | **Attempt any THREE of the following:** | **12** |
| | **i** | **Write the diagnosis of the fault – "Engine Emits Excessive Black Smoke".** | **04** |
| | **Ans** | **Engine Emits Excessive Black Smoke:**<br>**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.<br>**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.<br>**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.<br>**4. Bad Turbocharger:** If turbocharger not working properly or bad. The sufficient air is not supplied in the cylinder for combustion of fuel.<br>**5. Bad EGR Valve:** Bad EGR valve causing the valves to clog. There is no circulation of engine exhaust during suction.<br>**6. Excessive Load:** Excessive load on the vehicle than recommended results in black smoke.<br>**7. Improper Ignition Timing:** Check and set proper ignition timing. | **Any Four Points = 01 Mark Each** |
| | **ii** | **Describe how to check and adjust fan belt tension.** | **04** |
| | **Ans** | **Checking the belt tension:**<br>1. Note the line the belt makes.<br>2. Push the belt inwards with your finger.<br>3. It should only deflect 1/2" to 3/4" (9 - 10mm).<br>**To adjust fan belt tension:**<br>1. Remove the pulley nut.<br>2. Observe that there are some notches in the front half of the pulley.<br>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.<br>4. By removal of bolt, see a metal bell-looking thing, and under that are some shims.<br>5. Remove the rear pulley half.<br>6. Then add or subtract shims as required to bring your belt tension into specification. | **Checking procedure =02 Marks & Adjustment Procedure = 02 Marks** |
| | **iii** | **Describe how to carry FIP phasing and calibration.** | **04** |
| | **Ans** | **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 900 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 900. The adjustment of fuel pumps at correct timing intervals is known as the "phasing of the pump".<br>**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. | **02 Marks**<br><br>**02 Marks** |
| | **iv** | **Describe clutch slipping troubleshooting causes and remedies.** | **04** |
| | **Ans** | **Clutch Slipping:**<br>**Causes** \| **Remedies**<br>[1] Incorrect Linkages adjustment which \| [1] Adjustment of Linkages | **Each Correct Point =** |

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| | | causes insufficient 'free pedal play' | |
| | | [2] Oil or Grease on friction faces due to leakage | [2] Clean the components and replace the clutch facing. |
| | | [3] Weak or Broken Clutch Spring | [3] Replace the springs. |
| | | [4] Worn out Facings | [4] Replace |

**01 Mark Each**

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| **4** | **(b)** | **Attempt any ONE of the following:** | **06** |
| | **i** | **Describe any two causes and its remedies for the starting system failure.** | **06** |
| | **Ans** | **Starting System Failure Causes And Its Remedies:** | **Any Six Point = 01 Mark Each** |

| | CAUSE: | REMEDY: |
|---|---|---|
| 1 | **Poor Wiring Connection:** | Connect wires properly |
| 2 | **Poor Earth Connection:** | Connect wires properly |
| 3 | **Defective Solenoid** | Replace it. |
| 4 | **Defective Starter Motor** | Replace it. |
| 5 | **Defective Ignition Switch** | Replace it. |
| 6 | **Worn Teeth on the Pinion Gear** | Replace it. |
| 7 | **Worn Teeth on the Flywheel** | Replace it. |
| 8 | **The Stater Motor Turns Slowly** | Discharged Battery |
| 9 | **Trigger Wiring** | Replace it. |
| 10 | **Generally Worn Starter Motor** | Replace it. |
| 11 | **Corroded Battery Cables** | Replace it. |

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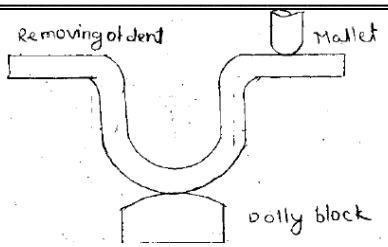
| | **ii** | **List four complaints of Body. Describe the procedure to rectify any one Body complaints** | **06** |
| | | **Complaints of Body:**<br>Body repairs due to collision.<br>Body repair due to dents on it.<br>Scratches on body.<br>Discoloring of body.<br>**Procedure for Removal Of Dent:**<br>**Preparation of Work:**<br>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.<br>**Ironing Of Dent:**<br>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.<br>**Welding:**<br>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.<br>**Finishing Job:**<br>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. | **01 & 05 Marks For Complete Procedure** |




**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 shrunked 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.

**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.

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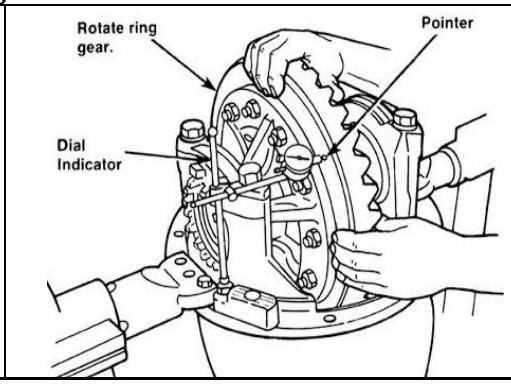
| **5** | | **Attempt any FOUR of the following:** | **16** |
| | **a** | **What is mean by backlash in ring gear? State the procedure for checking differential ring gear run out.** | **04** |
| | **Ans** | **Backlash:**<br>Backlash, a clearance between mating gear teeth, is built into speed reducers to let the gears mesh without binding and to provide space for a film of lubricating oil between the teeth.<br>**Procedure for Checking Differential Ring Gear Run Out:**<br>1. Mount the dial indicator on the carrier assembly as shown in figure.<br>2. With the plunger of the dial indicator on the ring gear, note the highest and lowest reading.<br>3. The difference between two readings is the runout of ring gear.<br>  | **02 Mark**<br>**02 Mark** |
| | **b** | **Describe checking of synchromesh unit.** | **04** |
| | **Ans** | **Checking of Synchromesh Unit:**<br>1. Check that all splines on synchromesh hub are free from excessive wear.<br>2. Check that the engagement of dog teeth on the sliding sleeve and gear are free from chipping and burring.<br>3. Check that the synchroniser cones are not excessively worn or showing the effects of overheating.<br>4. Renew the springs and locking balls, if worn out.<br>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.<br>6. Check blocker pin chamfer for excessive wear, Renew as necessary. | **Any Four Points = 01 Mark Each** |
| | **c** | **Describe any two gearbox's Troubleshooting – Cause and Remedies.** | **04** |
| | **Ans** | **1. Grinding Noise in Neutral:**<br>**Cause:** Gear box properly not aligned with the engine causing the shaft from the flywheel to the gearbox to bind. \| **Remedy:** Align gear box with engine<br>**2. Noise in Gears:** | **Any Four Points = 01 Mark** |

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| | | **Cause:** Lack of Lubrication \| **Remedy:** Use proper lubrication<br>**3. A hum or bowl in neutral:**<br>**Causes:** a) Lack of lubrication. b) Worn shaft. c) Too much backlash in gear train. d) Too much end play in gears or counter shaft. e) Worn bearing. \| **Remedies:** Use proper lubrication. Replace shaft. Remove backlash or change gear. Minimise play. Replace bearing<br>**4. Hard shifting, sticking in gear:**<br>1. Distorted splines of the main shaft. — Replace shaft.<br>2. Too strong shifter lock spring. — Replace spring.<br>3. Improper clutch adjustment. — Make proper adjustment.<br>4. Shifting mechanism out of alignment. — Align properly.<br>5. Battered gear teeth. — Replace gear.<br>6. Selector fork & rod are bent. — Remove bend or replace.<br>7. Insufficient lubrication — Provide adequate lubrication<br>**5.Oil leakage:**<br>**Causes:** a) Too high oil level in case. b) Damaged or Improperly installed gasket or oil seal. c) Loose cover bolts. d) Cracked case, e) Loose drain or filler cap. \| **Remedies:** Maintain proper level of oil. Replace damaged oil seal and gasket. Tight the cover bolts. Repair it. Tight the drain plug and filler cap | **Each** |
| | **d** | **What will the causes for "Hard Gear Shifting?' Suggest suitable remedies.** | **04** |
| | **Ans** | **1. Hard Gear Shifting:**<br>1. Distorted splines of the main shaft. — Replace shaft.<br>2. Too strong shifter lock spring. — Replace spring.<br>3. Improper clutch adjustment. — Make proper adjustment.<br>4. Shifting mechanism out of alignment. — Align properly.<br>5. Battered gear teeth. — Replace gear.<br>6. Selector fork & rod are bent. — Remove bend or replace.<br>7. Insufficient lubrication — Provide adequate lubrication | **Any Four 01 Mark Each** |
| | **e** | **Explain how you will check –**<br>**(i) Backlash in differential gears.**<br>**(ii) Tooth contact between ring gear and pinion.** | **04** |
| | **Ans** | **(i) Checking of Backlash in Differential Gears.**<br>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. 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.<br>**(ii) Tooth contact between Ring Gear and Pinion:**<br>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 | **02 Marks +** |

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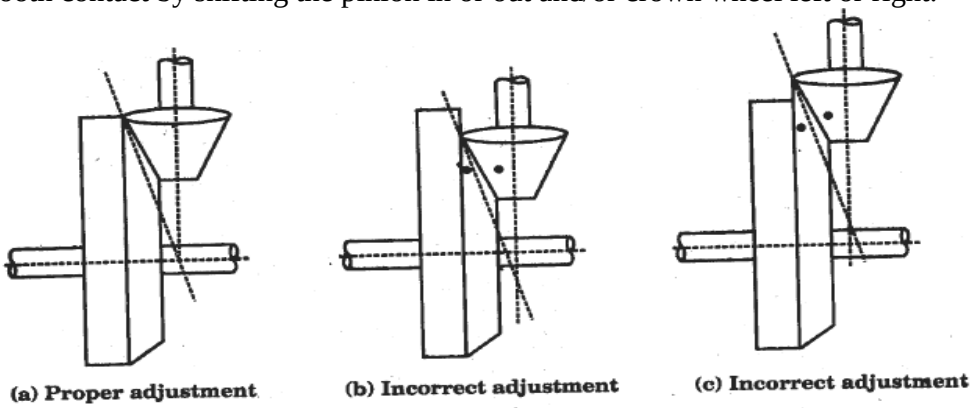
| | | the tooth contact by shifting the pinion in or out and/or crown wheel left or right.<br>  <br><br>**Fig. Adjustment of Bevel Pinion and Crown Wheel** | **02 Marks** |
| | **f** | **Write procedure for patch work.** | **04** |
| | **Ans** | **1. Prepare and clean before Filing:**<br>Start by removing the paint inside and around the dent with 24-grit paper. Switch to 80-grit sandpaper and hand-sand the entire dent..<br>**2. Mix the Filler:**<br>Scoop filler onto the mixing board and apply the hardener according to the directions. Then mix it using a spread-and-fold motion.<br>**3. Apply the Filler:**<br>Scoop up some filler and press it hard into the rough metal. Spread the filler to form a "tight" coat. That will burp air out of the scratches and wet the bare metal.<br>**4. Sand to Shape and Glaze:**<br>Sand the filler to match the contours of the car body using 80- and 180-grit sandpaper. Then feather the edges of the filler right up to the painted edge.<br>Next, apply finishing glaze to the entire patch and then sand with 180- grit and then 320-grit sandpaper. Spray the patch with primer, and follow up by painting it. | **Each Step 01 Mark** |
| **6** | | **Attempt any FOUR of the following:** | **16** |
| | **a** | **Describe the inspection of Master Cylinder and wheel cylinder.** | **04** |
| | **Ans** | **Inspection of Master Cylinder:**<br>1. Check the piston wear.<br>2. Inspect rubber valve seat, rubber boot, stop washer, primary cup and secondary cup for cracks.<br>3. Inspect body of master cylinder for wear condition.<br>4. Inspect spring tension.<br>5. Inspect filler plug wear.<br>6. Inspect push rod wear.<br>7. Inspect circlip for damage.<br>**Inspection of Wheel Cylinder :**<br>The method of checking will depend on the type of rear drum brake.<br>1. Use a screw driver or other suitable tool to physically push each wheel cylinder piston in while noting the amount of resistance<br>2. See the wheel cylinder leakage visually. (Some wetness is acceptable) | **02 Marks**<br>**+**<br>**02 Marks** |

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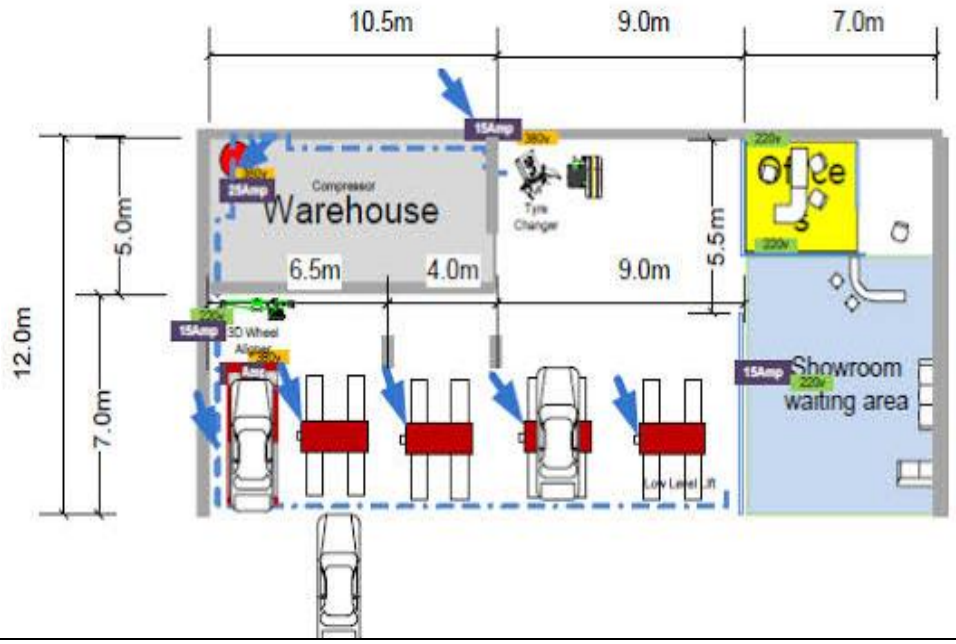
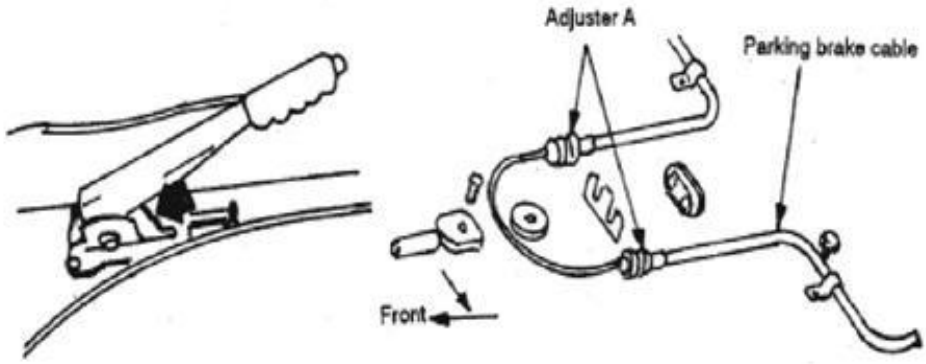
| | **b** | **Draw layout of workshop of specialized work wheel balancing and alignment.** | **04** |
| | **Ans** | **Lay out of Wheel balancing and alignment Workshop:**<br>  | **Sketch 04 Marks** |
| | **c** | **Write procedure of parking brake adjustment.** | **04** |
| | **Ans** | 1. Pull the parking brake lever by one hand and see that the rear wheels are completely broken and note the notches travelled by hand lever.<br>2. In case the lever moves more than 3 notches, rear brake shoe requires adjustment.<br>3. In case after adjusting brake shoe and drum clearance of the parking brake lever still moves by 3 notches and wheels are not braked then adjust the parking brake cable through adjusting nut A as shown in figure.<br>  <br>**Figure: Parking Brake Adjustment** | **02 Marks For Explanation**<br>**02 Marks For Figure** |
| | **d** | **What will be the causes if vehicle pulls to one side.** | **04** |
| | **Ans** | **Causes if vehicle pulls to one side. (Any four causes-1 mark each)**<br>1. One of the front tyres under-inflated or worn out.<br>2. Loose U or I bolt of font axle spring.<br>3. Bent steering arm.<br>4. Misaligned front axle with rear axle.<br>5. Bent stub axle.<br>6. Brake linings of different types.<br>7. Uneven spring, sagging, broken loose attachment of leaf spring.<br>8. Tight wheel bearing.<br>9. Misalignment of caster, camber, toe in, steering axle inclination | **Any Four Points = 01 Mark Each** |

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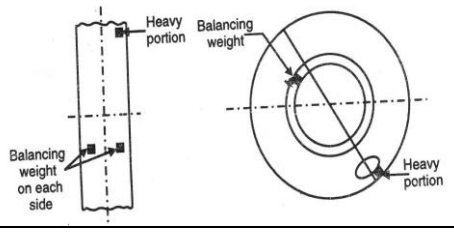
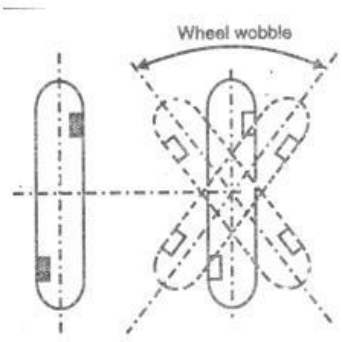
| | e | **Write procedure of wheel balancing.** | **04** |
| | **Ans** | **1. Procedure of Static Balancing:**<br>1. It can be done when vehicle is stationary and wheel jacked up.<br>2. Set it in motion by hand and allow stopping by itself.<br>3. Put the chalk mark at lowest portion of tyre.<br>4. Repeat above procedure 3 to 4 times.<br>5. If the same portion of chalk mark always remains lowest position, this portion of tyre is heaviest. To balance, attach lead weight to opposite side of heaviest portion of tyre to the rim<br>  <br>**2. Procedure for Dynamic Balance:**<br>1. Mount the wheel on balancing machine.<br>2. Rote the wheel at different speeds.<br>3. Wheel balancer shows how much weight is to be attached and on location.<br>4. Then clip the required weight on both sides of rim opposite to heavy spot.<br>5. Recheck the wheel for balancing.<br>  | **02 Marks**<br>**+**<br>**02 Marks** |
| | **f** | **Describe procedure of tyre retreading.** | **04** |
| | **Ans** | **Tyre Retreading Procedure:**<br>**1. Inspection**: Tyre will be inspected carefully to show up puncture, cracks, wears and any other damage on the tyre in retreading unit. Mechanic or technicians check the whole tyre and come to point if it is to be retreaded or not.<br>**2. Buffing:** Tyre casing are buffed by inflated and using same size of rim as in original use. On lathe machine to assure proper radiation profile, less rubber is removed and under thread, rubber compound remain safe for giving extra protection to plies. This result in perfectly round and balanced tyre.<br>**3. Cementing:** After buffing tyre is sprayed with rubber compound.<br>**4. Tread Preparation:** After cementing tyre is prepared for tread design. For that purpose solution of cushion gum is applied on a tyre. When this is cured, the rubber material becomes strongest part of the tyre.<br>**5. Tread Bonding:** The rubber, newly coated with cushion gum is applied to the tyres on a special tyre builder. The tyre is kept in an inflated condition on the same size rim as originally in use during this operation.<br>**6. Enveloping:** This is method to bond the tyre properly, that means, in this stage uniform pressure is applied at all points on the thread and it gives perfect bonding of the thread.<br>**7. Curing:** The tyre is then placed in the hot retreading machine-segmented mould retreading machine. During this processing, the tyre threads are to be printed by the flower patterns of machine mould. After vulcanization, the new retreaded tyre is taking shape. It is new tyre and have own brand.<br>**8. Final inspection:** The retreaded tyre is subjected to a final inspection. This inspection insures that only tyres which meet the industry quality standards are allowed to leave the retread plant. | **Each Step = ½ Mark** |