



WINTER- 18 EXAMINATION  
Model Answer

Subject Name: Two Wheeler Technology

Subject Code: 17521

**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)	Explain working of constant mesh gear box with neat sketch.	04
	Ans	<p><b>Working:</b> Top or 4th speed gear is obtained when the left dog clutch is slides to left to mesh with clutch gear by using the gear shift lever. In this case, main shaft rotates at the same speed as that of clutch gear or engine crankshaft speed which is the maximum speed. Third gear is obtained when dog clutch (left side) meshes with third gear on main shaft. In this way by sliding the second dog clutch, second and first gears are obtained.</p>	02
			02

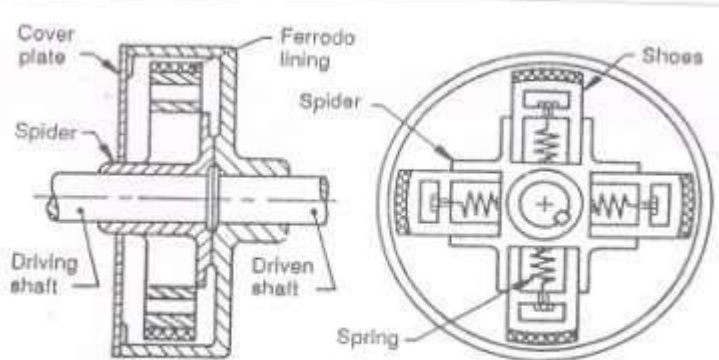


	<b>(ii) State specific objectives of frames and bodies. (Any two)</b>	<b>04</b>																											
<b>Ans</b>	<p><b>specific objectives of frames: (Any two)</b></p> <ol style="list-style-type: none"> <li>To carry load of the passengers or goods carried in the body.</li> <li>To support the load of the body, engine, gear box etc.,</li> <li>To withstand the forces caused due to the sudden braking or acceleration</li> <li>To withstand the stresses caused due to the bad road condition.</li> <li>To withstand centrifugal force while cornering</li> </ol> <p><b>Specific objectives of bodies: (Any two)</b></p> <p>The body for scooter / Scooterette is designed to fulfil the following objectives:</p> <ol style="list-style-type: none"> <li>It covers internal components like wiring harness, engine, battery, air filter and electrical/ electronic components are protected from dirt, dust and from thieves. Locking arrangement is provided in some designs.</li> <li>It gives a good look with graphics and panel colours matching the colour of vehicle fuel tank.</li> <li>Aerodynamic shape to the vehicle and reduce air drag. The entire body of the motorcycle is covered to provide the lowest attainable drag coefficient ratio. It reduces fuel consumption.</li> <li>In event of a crash, parts of the body slide against the road surface and the engine and chassis are protected. It also saves injury to the rider and pillion rider from getting injured.</li> <li>Scooter/ Scooterette body panels also protect the rider/ pillion rider from the engine heat and hot exhaust muffler. Some designs include a spare wheel within a side panel.</li> <li>The rider's clothes do not get stuck at protruding components/ system assemblies or torn on account of rider's body movement.</li> <li>Body panels protect the rider and pillion rider from the splashed water, dust, dirt and debris on the road.</li> </ol>	<b>02</b>          <b>02</b>																											
	<b>(iii) Compare two stroke engine and four stroke engine</b>	<b>04</b>																											
<b>Ans</b>	<table border="1"> <thead> <tr> <th data-bbox="237 1356 321 1392">Sr.</th> <th data-bbox="321 1356 821 1392">Four Stroke Engine</th> <th data-bbox="821 1356 1390 1392">Two Stroke Engine</th> </tr> </thead> <tbody> <tr> <td data-bbox="237 1392 321 1455">1</td> <td data-bbox="321 1392 821 1455">One working stroke for every two revolutions of the crankshaft.</td> <td data-bbox="821 1392 1390 1455">One working stroke for each revolutions of the crankshaft.</td> </tr> <tr> <td data-bbox="237 1455 321 1612">2</td> <td data-bbox="321 1455 821 1612">Turning moment on the crankshaft is not even due to one working stroke for every two revolutions of the crankshaft. Hence heavy flywheel is required and engine runs unbalanced</td> <td data-bbox="821 1455 1390 1612">Turning moment on the crankshaft is more even due to working stroke for each revolution of the crankshaft, hence lighter flywheel is required and engine runs balanced.</td> </tr> <tr> <td data-bbox="237 1612 321 1644">3</td> <td data-bbox="321 1612 821 1644">Engine is heavy.</td> <td data-bbox="821 1612 1390 1644">Engine is light.</td> </tr> <tr> <td data-bbox="237 1644 321 1738">4</td> <td data-bbox="321 1644 821 1738">Thermodynamic cycle is completed in 4 strokes of piston or in two revolutions of crankshaft</td> <td data-bbox="821 1644 1390 1738">Thermodynamic cycle is completed in 2 strokes of piston or in one revolutions of crankshaft</td> </tr> <tr> <td data-bbox="237 1738 321 1770">5</td> <td data-bbox="321 1738 821 1770">Volumetric efficiency is more.</td> <td data-bbox="821 1738 1390 1770">Volumetric efficiency is less.</td> </tr> <tr> <td data-bbox="237 1770 321 1801">6</td> <td data-bbox="321 1770 821 1801">Thermal efficiency is more.</td> <td data-bbox="821 1770 1390 1801">Thermal efficiency is less.</td> </tr> <tr> <td data-bbox="237 1801 321 1833">7</td> <td data-bbox="321 1801 821 1833">Engine design is complicated.</td> <td data-bbox="821 1801 1390 1833">Engine design is simple.</td> </tr> <tr> <td data-bbox="237 1833 321 1917">8</td> <td data-bbox="321 1833 821 1917">Less mechanical efficiency due to more friction on many parts.</td> <td data-bbox="821 1833 1390 1917">More mechanical efficiency due to less friction on few parts.</td> </tr> </tbody> </table>	Sr.	Four Stroke Engine	Two Stroke Engine	1	One working stroke for every two revolutions of the crankshaft.	One working stroke for each revolutions of the crankshaft.	2	Turning moment on the crankshaft is not even due to one working stroke for every two revolutions of the crankshaft. Hence heavy flywheel is required and engine runs unbalanced	Turning moment on the crankshaft is more even due to working stroke for each revolution of the crankshaft, hence lighter flywheel is required and engine runs balanced.	3	Engine is heavy.	Engine is light.	4	Thermodynamic cycle is completed in 4 strokes of piston or in two revolutions of crankshaft	Thermodynamic cycle is completed in 2 strokes of piston or in one revolutions of crankshaft	5	Volumetric efficiency is more.	Volumetric efficiency is less.	6	Thermal efficiency is more.	Thermal efficiency is less.	7	Engine design is complicated.	Engine design is simple.	8	Less mechanical efficiency due to more friction on many parts.	More mechanical efficiency due to less friction on few parts.	<b>Any 04 points</b>
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<b>(iv)</b>	<b>Write down advantages of electronic fuel injection system. (any four)</b>	<b>04</b>
<b>Ans</b>	<p><b>Advantage of electronic fuel injection system (Any four-1 marks for each)</b></p> <ol style="list-style-type: none"> <li>1. Improved power output.</li> <li>2. Better fuel efficiency over a wide range of engine speed.</li> <li>3. Quick warm-up of engine.</li> <li>4. Reduced engine emission that meets strict emission norms.</li> <li>5. Better throttle response of the engine.</li> <li>6. Better pick- up (acceleration).</li> <li>7. Compact design of fuel supply system.</li> <li>8. Modular design</li> </ol>	<b>04</b>
<b>b)</b>	<b>Attempt any ONE of the following:</b>	<b>06</b>
<b>(i)</b>	<b>Explain the working of damper and double acting type of shock absorber</b>	<b>06</b>
<b>Ans</b>	<p><b>Double acting type of shock absorber:</b></p> <p>The telescopic shock absorber is shown in fig its upper eye is connected to the axle and the lower eye to the chassis frame. A two way valve A is attached to a rod another two way valve B is attached to the lower end of cylinder the fluid is in the space above and below the valve A and also in the annular space between the cylinder and tube which is connected to the space below the valve B the heat has a gland. Any fluid scraped off by the rod is brought down into the annular space through the inclined passage. When the vehicle comes across a bump the lower eye moves up. Therefore, the fluid passes from the lower side of the valve A to its upper side but since the volume of the space above valve A is less than the volume of the rod the fluid exerts pressure on the valve B. This pressure of the fluid through the valve opening provides the damping force. Similarly, when the lower eye moves down the fluid passes from the upper side of the valve A to the lower side and also from the lower side of the valve B to its upper side.</p>	<b>03</b>
		<b>03</b>
	<b>Figure: Double acting shock absorber</b>	



	(ii)	<b>State the purpose of following: 1) Crash bar 2) Saree guard 3) Mudguard</b>	<b>06</b>																		
	Ans	<p><b>i) Crash bar:</b> Crash bars aim to protect motorcycle engines and body panels as well as it is used to protect the rider. It is also used as a mount point for accessories like highway pegs, lights and, on police motorcycles, sirens, cameras and radar guns.</p> <p><b>ii) Saree guards-</b> The Saree guards are very practical accessories that can prevent a lot of unwanted accidents. The Saree guard is an important though local piece of initiative to help loose &amp; flowing clothes from getting tangled in the rear wheel. There have been numerous events where female pillion riders have ended up with injuries because the Saree or Dupatta they were wearing got pulled into the rear wheel resulting in them getting either thrown off the bike or in extreme events, facing the risk of getting choked So for safety purposes the Saree guard is most essential. The Saree guards will not only protect the rider, but also the cargo from being pulled into the rear wheel.</p> <p><b>iii) Mud guard-</b> It is used in combination with the vehicle fender to protect the vehicle, passengers, other vehicles, and pedestrians from mud and other flying debris thrown into the air by the rotating tire. Mud guard can be aerodynamically engineered, utilizing shaping, louvers or vents to improve airflow and lower drag.</p>	<b>02 marks each</b>																		
2		<b>Attempt any FOUR of the following:</b>	<b>16</b>																		
	a)	<b>What is gear ratio? Explain gear ratio in motor cycle?</b>	<b>04</b>																		
	Ans	<p><b>Gear ratio:</b> Gear ratio is ratio of number of teeth on the driven gear to number of teeth on the driving gear. In a motorcycle there are more than one gear at work so there also are more gear ratio. All these are working together and form the overall ratio. Most gearing consists of: 1. Primary drive, this is the gear ratio between engine RPM and the clutch shaft RPM, also called 'Primary reduction ratio' 2. Gearbox ratio, this is the ratio between the clutch shaft RPM and the countershaft RPM. Because there are more gears in a gearbox, different ratio are possible 3. Final drive ratio, this is the ratio between countershaft RPM and rear sprocket RPM. In the low gear the driven gear almost has more teeth and in the higher gear, the driven gear has less number of teeth compare to the driving gear.</p> <p><b>Gear ratio for motorcycle (YamahaYZF-R15):</b></p> <table border="1"> <tr> <td>Primary reduction ratio</td> <td>73/24(3.042)</td> </tr> <tr> <td>Secondary reduction ratio</td> <td>42/14(3.000)</td> </tr> <tr> <td colspan="2"><b>Gear Ratio</b></td> </tr> <tr> <td>1 st</td> <td>34/12(2.833:1)</td> </tr> <tr> <td>2 nd</td> <td>30/16(1.875:1)</td> </tr> <tr> <td>3 rd</td> <td>30/22(1.1364:1)</td> </tr> <tr> <td>4 th</td> <td>24/21(1.143:1)</td> </tr> <tr> <td>5 th</td> <td>22/23(0.957:1)</td> </tr> <tr> <td>6 th</td> <td>21/25(0.840:1)</td> </tr> </table> <p>(Note: Equivalent credit should be given to gear ratios of any other motorcycle)</p>	Primary reduction ratio	73/24(3.042)	Secondary reduction ratio	42/14(3.000)	<b>Gear Ratio</b>		1 st	34/12(2.833:1)	2 nd	30/16(1.875:1)	3 rd	30/22(1.1364:1)	4 th	24/21(1.143:1)	5 th	22/23(0.957:1)	6 th	21/25(0.840:1)	<b>02</b>
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b)	<b>Draw a neat sketch of centrifugal clutch and explain working in brief</b>	<b>04</b>
<b>Ans</b>	<p>The centrifugal clutches are usually incorporated into the motor pulleys. It consists of a number of shoes on the inside of a rim of the pulley, as shown in fig. The outer surface of the shoes are covered with a friction material. These shoes, which can move radially in guides, are held against the boss (or spider) on the driving shaft by means of springs. The springs exert a radially inward force which is assumed constant. The mass of the shoe, when revolving, causes it to exert a radially outward force (i.e. centrifugal force). The magnitude of this centrifugal force depends upon the speed at which the shoe is revolving. A little consideration will show that when the centrifugal force is less than the spring force, the shoe remain in the same position as when the driving shaft was stationary, but when the centrifugal force is equal to the spring force, the shoe is just floating. When the centrifugal force exceeds the spring force, the shoe moves outward and cones into contact with the driven member and presses against it. The force with which the shoe presses against the driven member is the difference of the centrifugal force and the spring force. The increase of speed causes the shoe to press harder and enables more torque to be transmitted.</p>  <p style="text-align: center;">Fig. Centrifugal clutch.</p>	<p><b>02</b></p> <p><b>02</b></p>
c)	<b>Explain the function of carburetor under various operating condition like: (i) Idling (ii) Starting (iii) Acceleration (iv) Normal running</b>	<b>04</b>
<b>Ans</b>	<p><b>Functions of carburetor under four engine operating conditions:</b></p> <p><b>i) Idling:</b> A separate idling and low speed passage is provided with low speed port and idle port. For idling rich mixture is required in small quantity the throttle valve is almost closed. The whole of engine suction is now applied at the idle port through which air and fuel are drawn, giving rich mixture.</p> <p><b>ii) Starting:</b> Choke is used for starting. it is mounted eccentrically which facilities it's automatic opening after the engine has started as the choke valve is closed, whole of engine suction is applied at the main nozzle, which then deliver fuel. As the air flow is quite small, the mixture supplied is very rich.</p> <p><b>iii) Acceleration:</b> When acceleration is desired the accelerator twist grip is twisted, which actuate the main jet giving an extra supply of fuel for acceleration it must be clear that the purpose of accelerating circuit is not to provide a continuous fuel supply for acceleration, but only to provide extra supply of fuel to avoid flat spot.</p> <p><b>iv) Normal running:</b> The throttle is held partly opened so that engine suction is now applied at the main jet, which now supplies the fuel. The air enters directly through the venturi; the quantity of mixture is controlled by throttle valve.</p>	<b>01 mark each</b>

d)	<b>Draw a neat sketch of catalytic convertor and explain working in brief</b>	<b>04</b>
Ans	<p><b>Three Way Catalytic Converter: Working:</b> The catalytic converters conversion rate is largely a function of operating temperature; no meaningful treatment of pollutants takes place until the converter has reached an operating temperature of approximately 400...8000C provide ideal conditions for maximum efficiency and extended service life. <b>Catalyst Reduction</b> First, nitrogen oxide gives up its oxygen. This only occurs when a sufficient amount of carbon monoxide is available for the oxygen to bond with. This chemical reaction results in reduction of nitrogen oxide to pure nitrogen and oxidation of carbon monoxide to form carbon dioxide.</p> <p><b>Catalyst Oxidation.</b> Second, hydrocarbon and carbon monoxide continue to burn. This occurs only if there is a sufficient amount of oxygen available for the hydrogen and carbon to bond with. This chemical reaction results in oxidation of hydrogen and carbon to form water vapour (H<sub>2</sub>O) and carbon dioxide (CO<sub>2</sub>).</p> <div data-bbox="240 703 1177 955" data-label="Diagram"> </div> <p style="text-align: center;"><b>Fig: Catalytic convertor</b></p> <p style="text-align: center;"><b>OR</b></p> <p><b>Two Way Catalytic Converter: Working:</b> A two way catalytic converter has two simultaneous task: 1) Oxidation of carbon monoxide to carbon dioxide: <math>2CO + O_2 \rightarrow 2CO_2</math> 2) Oxidation of unburnt hydrocarbons (unburnt &amp; partially burnt fuel) to carbon dioxide &amp; water: <math>2C_xH_y + (2x + y/2)O_2 \rightarrow 2x CO_2 + yH_2O</math> This type of catalytic converter is widely used on diesel engines to reduce hydrocarbon &amp; carbon monoxide.</p> <div data-bbox="219 1333 1177 1564" data-label="Diagram"> </div> <p style="text-align: center;"><b>Fig: Catalytic convertor</b></p>	<p style="text-align: center;"><b>02</b></p> <p style="text-align: center;"><b>02</b></p> <p style="text-align: center;"><b>02</b></p>

e)	<p><b>Explain wet sump pressurised lubrication in four stroke engine with neat labelled sketch</b></p>	04
	<div data-bbox="581 220 1055 819" data-label="Diagram"> </div> <p>The system in which lubricating oil is stored in the oil sump is called wet sump system, like pressure lubricating system. In this system, the engine parts are lubricated under pressure feed. The lubricating oils is stored in a separate tank or the sump from where an oil pump takes the oil through a strainer and delivers it through a filter to the main oil gallery at a pressure to 2-4 kg/cm<sup>2</sup>. The oil from the main gallery goes to main bearings from where some of it after lubricating the main bearing falls back to the sump, some is splashed to lubricate the cylinder walls and the remaining goes through a hole to the crankpin. From the crank pin it goes the piston pin through a hole in the connecting rod web where it lubricates the piston rings. For lubricating camshafts and timing gears the oils is led thought a separate oil line from the oil gallery. The valve tappets are lubricated by connecting the main oil gallery to the tappet surfaces through drilled holes. An oil pressure gauge at the instruments panel indicates the oil pressure in the system. Oil filters and strainers in the systems clear off the oil from dust metal particles and other harmful particles.</p>	02
03	<p><b>Attempt any four of the following</b></p>	16
a)	<p><b>Explain vacuum operated system</b></p>	04
	<p>(Any suitable answer shall be consider for full credit)</p> <p>This system is based upon the simple fact that the engine suction can be based for sucking fuel from the main tank to the auxiliary fuel tank from where it flows by gravity to the carburetor float chamber.</p> <p>In this system the fuel tank is placed below the level of the carburetor. The fuel from the tank is sucked by a separate unit (auto-vac) with the assistance of the inlet manifold vacuum. Then the fuel is fed to the carburetor by gravity.</p> <p style="text-align: center;"><b>OR</b></p> <p>Vacuum operated fuel supply system is having the vacuum operated fuel valve and the levers with three positions: On, reserve and prime. The on and reserve position allows the fuel to flow only when engine is running and engine vacuum is present. When running, engine vacuum pulls on a diaphragm inside the fuel valve, allowing fuel to flow freely to carburetor. When lever is in prime position, the fuel flows at all the time. The prime position is usually</p>	02

used only when the carburetor has been drained off all fuel, after long storage or following disassembly. The vacuum fuel valve has two hoses, as shown in figure, one hose for fuel delivery and another smaller hose for engine vacuum that is attached in front of one of the carburetor.

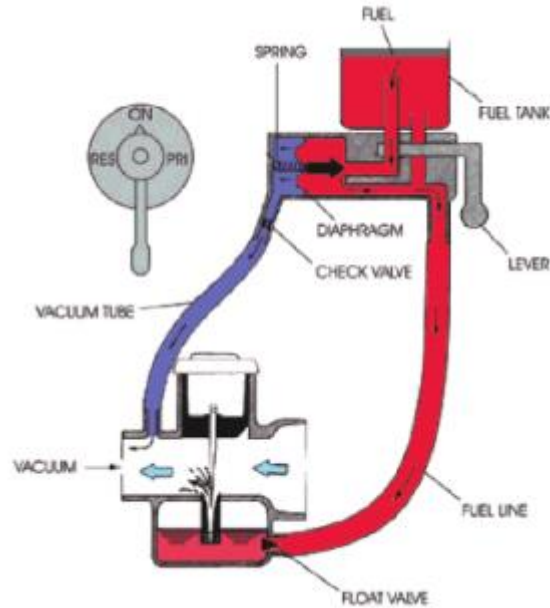


Fig. Vacuum operated fuel supply system

02

b) Draw a block diagram of Exhaust Gas Recirculation (EGR)

04

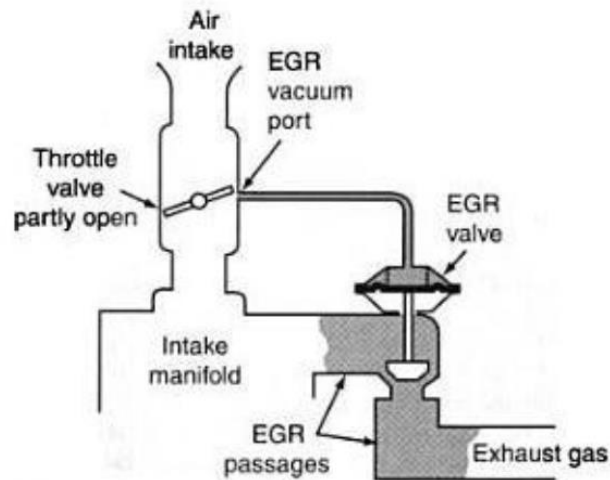
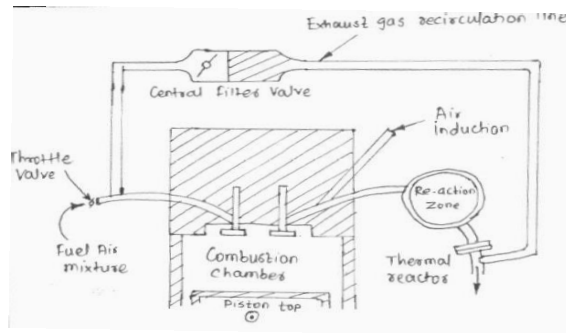


Figure: The EGR valve controls the amount of exhaust flowing back into intake manifold

OR

04





c) List the types of air filter and explain anyone.

Answer:

(Types- 1 marks, Explanation of any one with sketch – 3 marks)

Two types of Air filter

1. Foam Type air filter
2. Dry Type air filter

**1. Foam Type air filter:**

**Construction:** It consists of filtering element which is made from a polyster or polyurethane low density sponge which has been impregnated with lubricating oil. The foam filter usually fits over a metal or plastic apparatus to help hold its shape. One side of air filter is open to atmosphere and other is connected to the induction side of the engine.

A side of air filter which is open to atmosphere sucks the atmospheric air through duct. The air passes through the tiny holes of air filter. The oil which is present over the foam air filter reduces the size of air passages & it provides a sticky retaining medium for the un trapped dust. This type of air cleaner should be cleaned periodically, about every 8000 km.

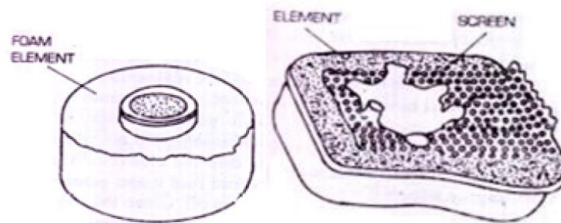


Fig: Foam Type air filter

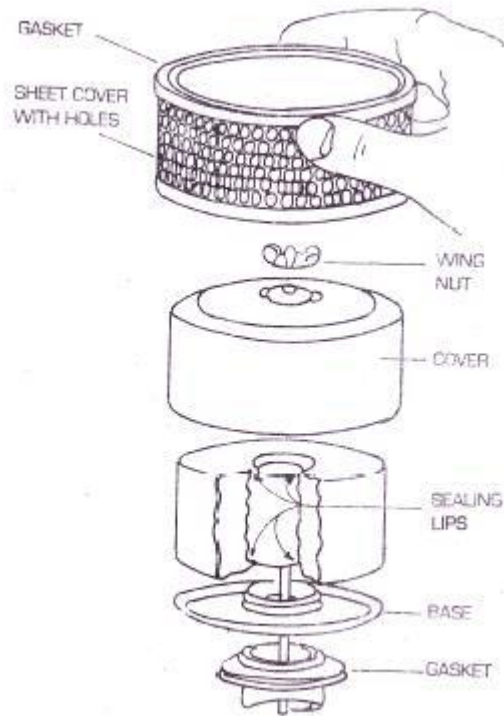
Fig: Foam Type air filter

**2. Dry Type air filter:**

**Construction:**

It consists of cleaning elements only and not the oil bath the cleaning element is a specially pleated paper element, over which is put fire mesh screen to provide strength. This cleaning element is enclosed in a silencing chamber. Figure shows parts of a dry type cleaner.

The dust particles and dirt is filtered from the air by the filter and thereby it protects the engine and increases its life. In this process the filter elements becomes dirty. It should be cleaned periodically. It is a light duty air cleaner. The paper is corrugated to increase the surface area and hence the breathing capabilities of the filter.

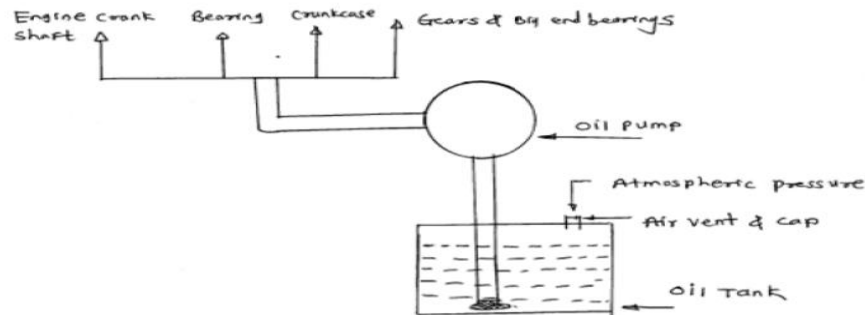


**Fig : Dry Type air filter**

**d) Explain petrol lubrication with separate oil pump for two stroke engines.**

**04**

**Ans**



**Figure: Schematic diagram of petrol lubrication with separate oil pump**

**02**

This is used generally for small two stroke engine e.g. in scooter and motor cycle engines. It is simplest of all types of engine lubrication system. Certain amount of lubricating oil is mixed with petrol itself, the usual ratio being 3 to 5 percent of oil. If it is less there is danger of oil starvation or insufficient lubrication causing damage to engine. If it is more, there will be excessive carbon deposits in cylinder head and engine will give dark smoke. When petrol mixture enters crankcase due to high temperature there, petrol components vaporized leaving a thin film of lubrication oil on the crankcase, cylinder walls and bearings. Petroil lubrication system is insufficient for racing bikes and high cc bikes so that there is a provision of extra arrangement of lubricating oil (a separate oil pump) to lubricate the crankshaft, crankcase, crankshaft bearing and other moving parts.

More recent two-stroke engines might pump lubrication from a separate tank of two-stroke oil. The supply of this oil is controlled by the throttle position and engine speed. The technology is referred to as auto-lube. This is still a total-loss system with the oil being burnt the same as in the pre-mix system; however, given that the oil is not properly mixed with the fuel when burned in the combustion chamber, it translates into a slightly more efficient

lubrication. This lubrication method also pays dividends in terms of user friendliness by eliminating the user's need to mix the gasoline at every refill, makes the motor much less susceptible to atmospheric conditions (Ambient temperature, elevation) and ensures proper engine lubrication, with less oil at light loads (such as idle) and more oil at high loads (such as full throttle). In some vehicles, had some oil pump designs have no oil injected at idle to reduce smoke levels, as the loading on the engine parts was light enough to not require additional lubrication beyond the low levels that the fuel provides. Ultimately oil injection is still the same as premixed gasoline in that the oil is burnt in the combustion chamber and the gas is still mixed with the oil, although not as thoroughly as in pre-mix. In addition, this method requires extra mechanical parts to pump the oil from the separate tank, to the carburetor or throttle body

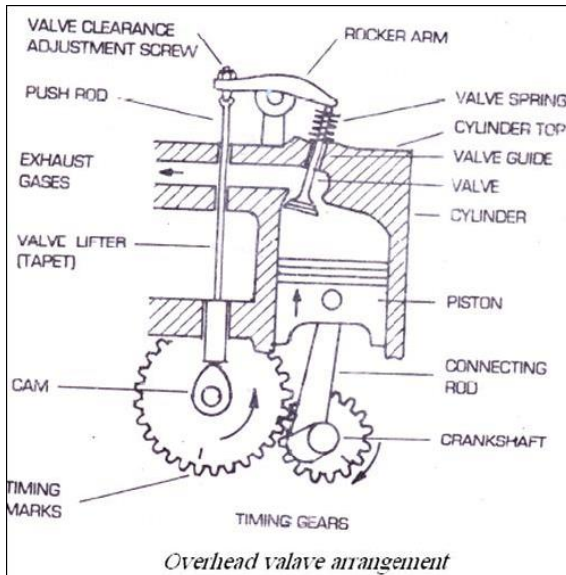
**02**

**e) Explain overhead valve arrangement with neat labelled Sketch**

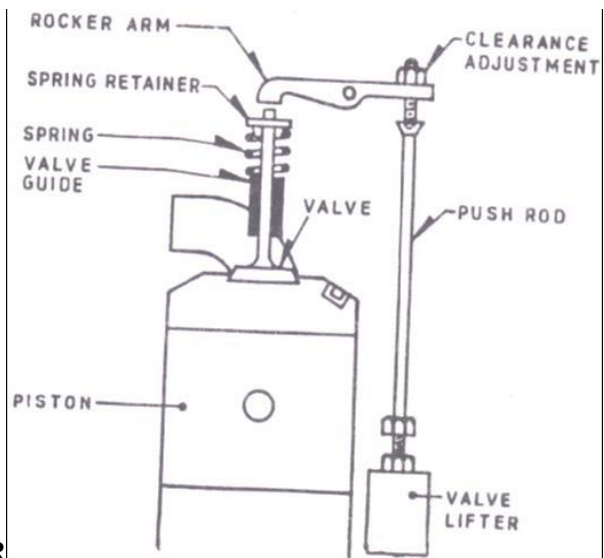
**04**

**Ans Description- 2 marks, sketch -2 marks.**

Overhead valve arrangement used in 4 –S engine (OHV 4 -S engine): An overhead valve engine (OHV engine) is an engine in which the valves are placed over the cylinder head. The camshaft drive-chain sprocket has twice as many teeth as the crankshaft sprocket, so that the camshaft rotates at half engine speed. The overhead valve system (OHV) system, operated by pushrods, has the camshaft adjacent and parallel to the crankshaft in the cylinder block. In overhead-valve (OHV) system, as the pushrod rises on the cam it pivots the rocker arm, which pushes the valve down (open) against the pressure of its spring. As the cam lobe rotates further, the valve spring acts to close the valve. As the crankshaft rotates, each valve is opened by means of a tappet, pushrod and rocker arm. The valve is closed by spring pressure. This overhead-valve (OHV) system is less efficient than an overhead camshaft because the number of moving parts limits the speed at which the engine can run safely. Overhead valve arrangement makes the engine slightly shorter than overhead camshaft.



**OR**



**f) Explain the ergonomics effect of-**  
**(i) Seat arrangement for rider and pillion rider.**  
**(ii) handle bar arrangement**

**04**

**Ans Answer: (i) Seating arrangement for rider and pillion rider:** The design of the motorcycle is limited by the physical constraints of making the machine work. Comfort and ease of use,

**02**



		<p>and ultimately your safety, will be determined by the type of bike you choose and this should depend on how you plan to use it. The seat and footrests are the right height for you. The fit of the bike to the user can be critical in long term comfort. Riders, of course, are different shapes and sizes so a bike that works well for one person may not work for someone else. It is more convince to both rider &amp; pillion rider to seat for long trip or tour. The taper portion of raised seat supports the seating arrangement for rider. The taper portion of seat supports the back bone of rider. For pillion riders the design of seat at rear end is important. At the time of braking due to inertia effect the pillion rider should moves on front side pushing the rider at downward direction not in forward direction. It improves the comfort driving as well as seating. Now a day Instead of using separate seat for rider &amp; pillion rider, combined seat is used for better comfort. It provides large space as compared to earlier (old) designed seat. The front side of seat should have narrow section which gives comfort zone to rider while driving. Seat should have good cushioning (use of helical tension spring &amp; leather) to protect both rider &amp; pillion rider from shocks &amp; vibrations on road.</p> <p><b>(ii) Handle Bar arrangement:</b> It gives rider a proper leverage to make the front wheel as his wish or as he required. The position of handle bar should be ergonomically correct. It is related to rider's driving comfort. The handle bar is fitted with controlled sleeves and handgrip on both sides. The handle bar it is made in different shapes and design keeping in mind the rider comfort and different views. The handle bar position is concerns with the shape of seat and foot rest. The location of foot rest &amp; shape of seat as well the handle bar position differs as per manufacturers. It also depends upon the type of bike. Different type of bike has a body position, feet position and hands position The Handle bar position gives proper gesture to the rider. Improper selection of bike may create the back pain or other problems to the rider while long drive. The handle bar should be lighter and transmit less vibration.</p>	<b>02</b>
<b>04</b>	<b>a)</b>	<b>Attempt any THREE of the following</b>	<b>12</b>
	<b>(i)</b>	<b>Write a advantages of Multiple valves in four stroke</b>	<b>04</b>
<b>Ans</b>		<p><b>(Any four - 1 marks each.)</b></p> <ol style="list-style-type: none"><li>1. Multiple valves in four stroke increases valve area and improves the flow of intake and exhaust gases.</li><li>2. Multiple valves in four stroke increases volumetric efficiency and power output.</li><li>3. Multiple-valve geometry allows the spark plug to be ideally located within the combustion chamber for optimal flame propagation.</li><li>4. Multiple valves in four stroke engines tend to have smaller valves that have lower reciprocating mass, which can reduce wear on each cam lobe, and allow more power from higher RPM without the danger of valve bounce.</li><li>5. Some engines are designed to open each intake valve at a slightly different time, which increases turbulence, improving the mixing of air and fuel at low engine speeds</li><li>6. More valves also provide additional cooling to the cylinder head.</li><li>7. Multiple valves in four stroke engines reduces chances of detonation.</li></ol>	<b>Any four - 1 marks each</b>
	<b>(ii)</b>	<b>Explain the function of muffler and write down their types.</b>	<b>04</b>
<b>Ans</b>		<p><b>Function of Muffler:</b></p> <ol style="list-style-type: none"><li>1) Getting the hot and noxious gas from the engine away from the vehicle</li><li>2) Reduce exhaust emission</li></ol>	<b>02</b>

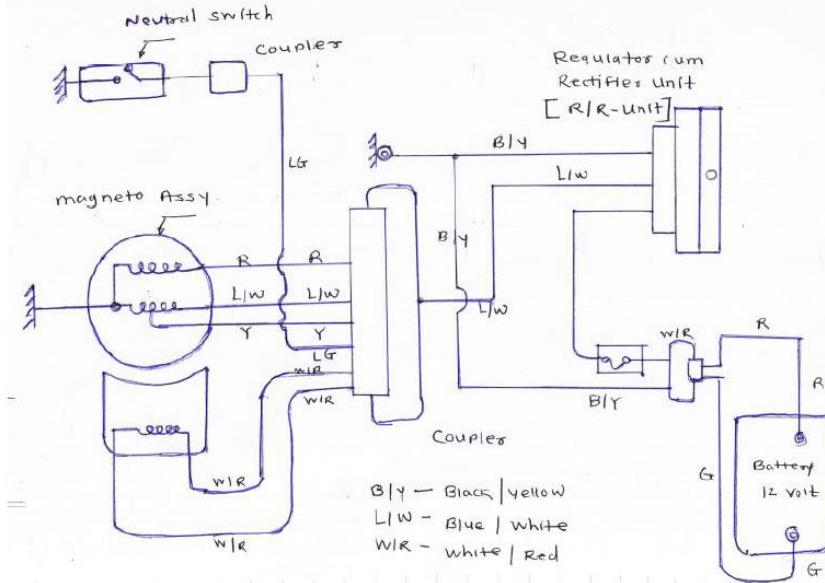
3) Attenuating the noise output from the engine  
**Types of muffler:**  
 1. Baffle type  
 2. Wave cancellation type  
 3. Resonance type  
 4. Absorber type  
 5. combined resonance and absorber type

**02**

**(iii) Draw a schematic circuit of charging system**

**04**

**Ans**



**Figure: Circuit diagram of two wheeler charging system showing AC and DC circuits**

**04**

**(iv) Explain the working of CDI system**

**04**

**Working of Condenser / capacitor discharge ignition(CDI) system:**

It mainly consists of 6-12 V battery, ignition switch, DC to DC converter, charging resistance, tank capacitor, Silicon Controlled Rectifier (SCR), SCR-triggering device; step up transformer, spark plugs. A 6-12 volt battery is connected to DC to DC converter i.e. power circuit through the ignition switch, which is designed to give or increase the voltage to 250-350 volts. This high voltage is used to charge the tank capacitor (or condenser) to this voltage through the charging resistance. The charging resistance is also so designed that it controls the required current in the SCR.

Depending upon the engine firing order, whenever the SCR triggering device, sends a pulse, then the current flowing through the primary winding is stopped. And the magnetic field begins to collapse. This collapsing magnetic field will induce or step up high voltage current in the secondary, which while jumping the spark plug gap produces the spark, and the charge of air fuel mixture is ignited.

**02**

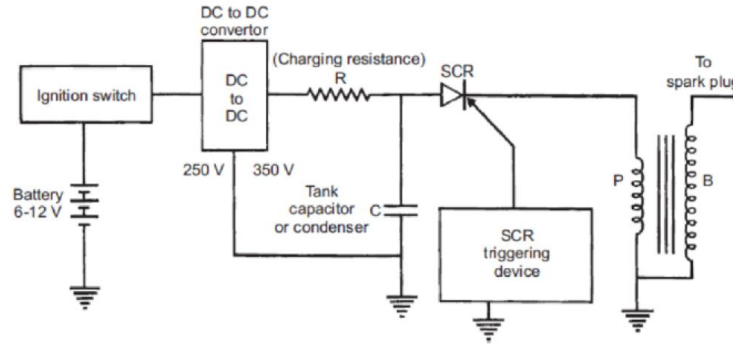


Fig: Capacitance Discharge Ignition System

OR

**Working:**

CDI system uses charge of capacitor for generating spark- using pulse transformer.

Thyristor/ silicon controlled rectifier is used as switch- for primary circuit current through capacitor.

It also uses a pulse generator to trigger SCR through Gate circuit.

Pulse transformer has low inductance, so the change in flux across primary and secondary windings is very rapid.

This provides high voltage spark (about 30,000V) during the entire speed range of the engine.

The electronic circuitry uses conversion of AC to DC charging device, signal conditioning and amplifying unit and control circuit.

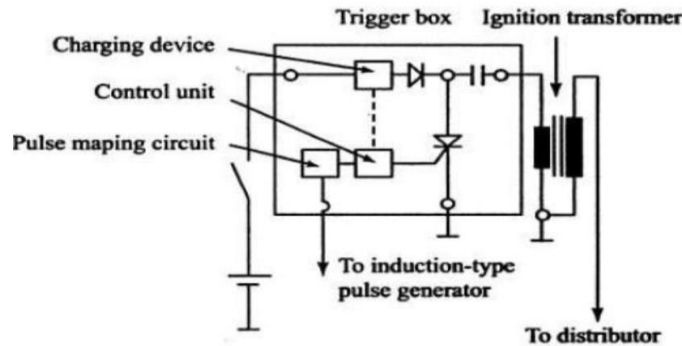


Fig. Schematic of Capacitive Discharge Ignition (CDI) System

02

02

02

b) Attempt any ONE of the following

06

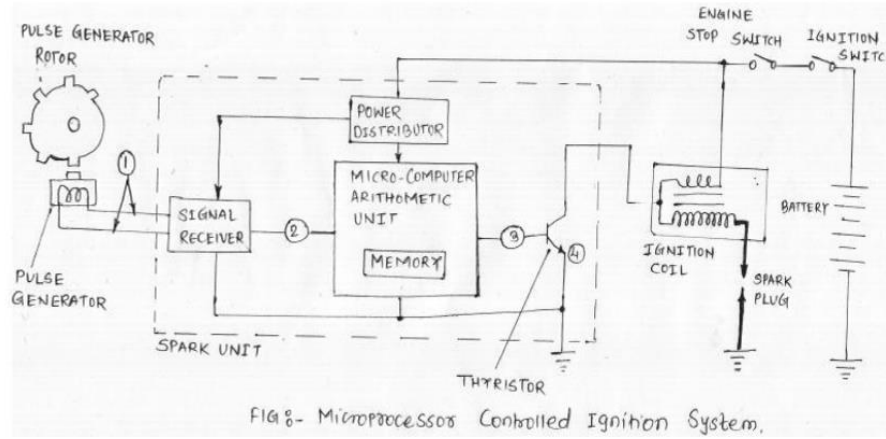
(i) Draw a block diagram and explain the working of microprocessor controlled ignition system

06

**Working of microprocessor controlled ignition system:** This system digitally controls the ignition timing by a microcomputer inside the spark unit and calculates the ideal ignition timing at all the engine speed. The control unit consists of a distributor, a signal receiver which processes the pulse generator and a microcomputer which has a memory and an arithmetic unit. The circuit below is the ignition system of a 90 0 V – type 2 cylinder engine. 1 As the engine starts, a pulse signal from the pulse generator is sent to the spark unit. 2. The signal receiver converts the pulse signal to a digital signal and it is fed to the microcomputer. 3. As the microcomputer receives the digital signal, it processes signals containing information on the crankshaft angle and engine speed; the microcomputer then reads the information on ignition timing, which is based on the engine speed from its memory and determines the ignition

03

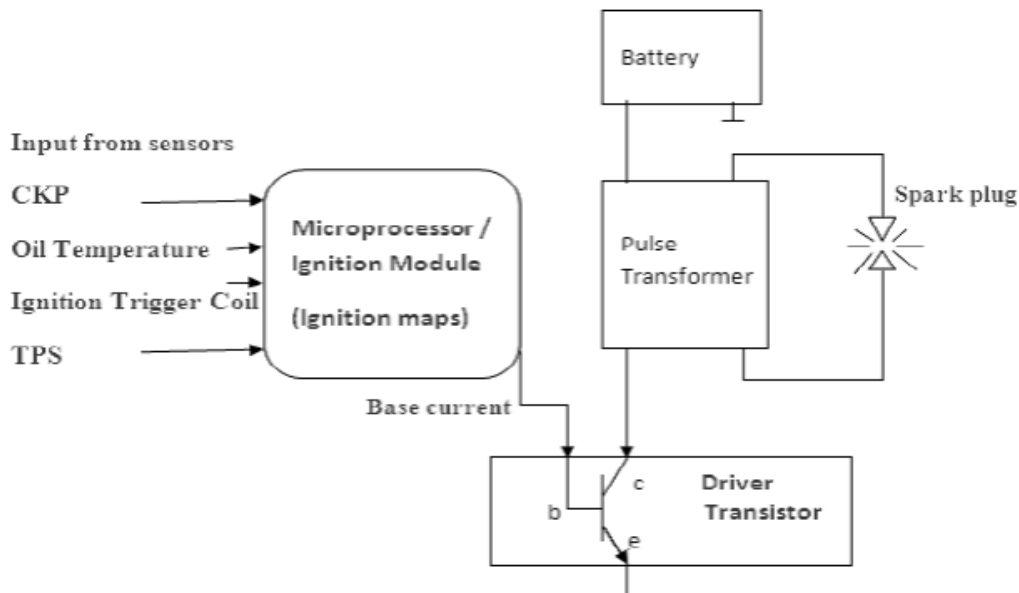
timing. Then the microcomputer sends current to the base. 4. As the current from the microcomputer flows to the base of transistor, the transistor is turned ON, and ignites the spark plug.



OR

The microprocessor controlled ignition system uses input from sensors like crankshaft position sensor, oil temperature sensor, ignition trigger coil and throttle position sensor. The ignition module/ microprocessor uses ignition maps to trigger the driver transistor for optimum spark timing. It uses a pulse transformer (a type of ignition coil) having low inductance. As the trigger coil generates a signal/ pulse – it is sent to the microprocessor. Microprocessor switches on the driver transistor by supplying base current. Now the collector emitter circuit of the driver transistor carries the primary circuit current to ground. Primary current flow causes magnetism to be induced in secondary winding as well (primary and secondary windings are wound around the same iron core of ignition coil). A high voltage is induced in the secondary winding of pulse transformer. This voltage is sufficient to ignite the leanest charge in combustion chamber. The ignition maps stored in the ignition module / microprocessor enables the spark to be timed accurately.

**Microprocessor controlled ignition system:**





	<b>(ii) Write down advantages (Any three) 1) Mono-shock suspension system 2) Gas filled shock absorber for rear and suspension.</b>	<b>06</b>
	<p><b>1) Advantages of Mono-shock suspension system (Any three points -1 Mark each)</b>  1. Mono-shock suspension system improves handling of the motor cycle while going over potholes or bad roads as all the force is focused at one point.  2. Due to position of mono-shock suspension is places ahead of the rear axle at the center of the motorcycle, the movement of the swing arm is not directly transferred to the suspension, this allows a more stability  3. motorcycle performance is more constant than using double shock.  4. More stylish suspension system.</p> <p><b>2) Advantages of gas filled shock absorber used at rear end- (Any three points -1 Mark each)</b>  1. The full diameter of the tube can be used as a working chamber and thereby a larger volume of oil becomes available for damping.  2. The larger volume of oil made available in any one stroke because of the adjustments between gas and oil volumes provides a better facility for the damping force.  3. The tolerance to heat in gas filled shock absorber is greater.  4. Gas filled shock absorber give longer life to tyres and other related components in the suspension such as springs, brushes etc.  5. A gas filled shock absorber is designed to reduce foaming of the oil.</p>	<b>03</b>       <b>03</b>
<b>05</b>	<b>Attempt any four of the following</b>	<b>16</b>
	<b>a) Write down criteria for selection of wheels and tyres for scooters.</b>	<b>04</b>
<b>Ans</b>	<p><b>Answer: Criteria for selection of wheels and tyres: (Any four points)</b>  1. <b>Performance and efficiency:</b> A tyre should give good performance in rain, cold/ hot weather, on different road surfaces. It should provide very good fuel economy by offering lower rolling resistance.  2. <b>Cost:</b> A tyre should have low cost.  3. <b>Road Grip:</b> It should have a very good grip of road surface on hot/ cold/ wet/ dry/ gravel road surface while travelling straight or cornering.  4. <b>Comfort:</b> It should provide a comfortable ride to the rider and pillion rider  5. <b>High speed stability:</b> A tyre should provide better high speed stability.  6. <b>Handling characteristics:</b> A tyre should provide better cornering behavior.  7. <b>Durability:</b> It should have long life.  8. <b>Cushion:</b> It should provide adequate cushion against road shocks.  9. <b>Temperature:</b> it should have a characteristic by which the tyre for specific application, will quickly reach optimal operating temperature to provide proper road grip and performance.  10. <b>Tread Depth:</b> It should provide adequate tread depth as per application.</p>	<b>04</b>
	<b>b) Explain working of hydraulic brakes with neat sketch.</b>	<b>04</b>
<b>Ans</b>	<p><b>Working:</b>  In a disc brake, the fluid from the master cylinder is forced into a caliper where it presses against a piston. The piston in turn crushes two brake pads against the disc that is being attached to wheel, making it to stop or slow down. Main advantage of disc brakes is their resistance to wear as the discs remain cool even after repeated brake applications.</p>	<b>02</b>



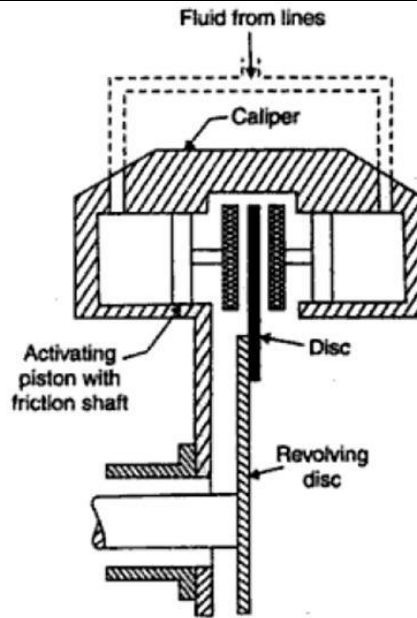


Figure: hydraulic disc brake

(Note: Equivalent credit shall be given to any other suitable sketch and relevant description)

02

c) What is important role of battery in two wheelers.

04

**Ans** Battery is the one of the most important components of the electrical system and may be described as the heart of entire electrical system of a two wheeler. The battery performs following important role:

1. To supply the heavy current required by the starter motor for starting engine.
2. To supply the current to lamps and other accessories when the engine is not running.
3. To act a stabilizer the voltage in the electrical system

04

**OR**

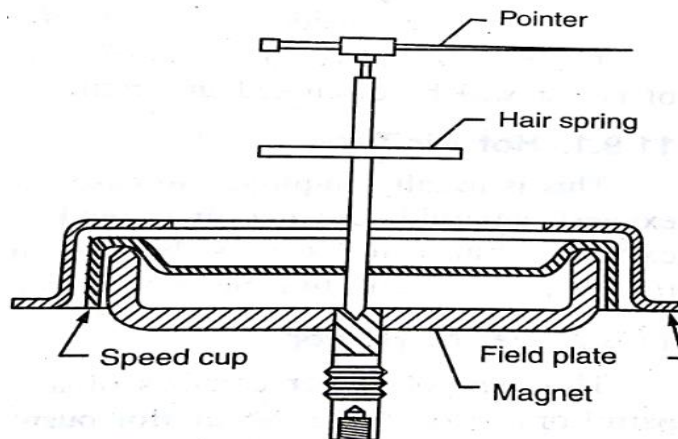
A starter battery supplies the current to starter motor, needed for engine cranking. An automotive battery is a type of rechargeable battery that supplies electric energy to an automobile. Battery powers the starter motor, the lights, and the ignition system of a vehicle's engine, mainly in combustion vehicles.

(Note: Equivalent credit shall be given to any other relevant description)

d) Draw a neat sketch of speedometer and explain the working in brief.

04

**Ans**



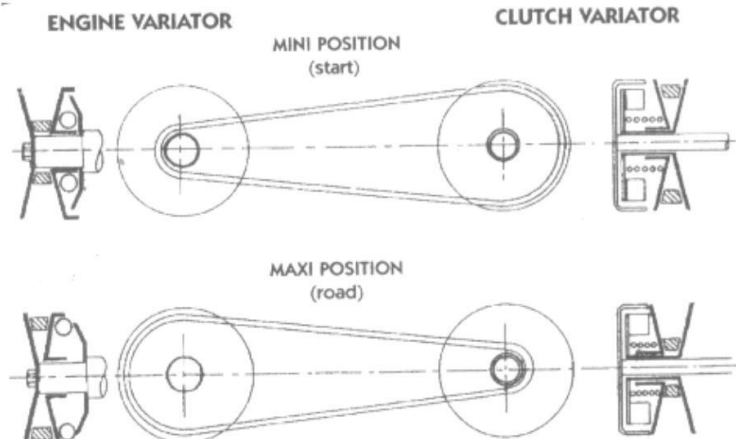
02

Fig. Working principle of speedometer



	<p><b>Working of Speedometer:</b> The speedometer is as shown in fig. the rotating magnet produces a magnetic field that exerts a torque on the speed cup which does not have any mechanical connection with the magnet. THE spindle is fitted with a hair spring also. Due to magnetic field the spindle turns and the magnitude of the turn depends upon the magnitude of the magnetic field produced which itself is proportional to the vehicle speed. Thus, the pointer attached to the spindle indicates the vehicle speed. The hair spring also serves to bring the pointer to zero and keep it there when the vehicle is brought to rest.</p>	<b>02</b>
<b>e)</b>	<b>Explain the purpose of using LED light in tail lamp.</b>	<b>04</b>
<b>Ans</b>	<p><b>LED light in tail lamp:</b> LED stands for light emitting diode. The LED tail lamps are used to illuminate the rear end of vehicle and it is signal for other vehicles that a vehicle is running on the road. Tail lamps are also using to indicate the other vehicles that a vehicle is park outside the road at night. LED looks cool and give your bike a unique custom look. Number plate lamps are used to illuminate rear registration plate so that follower can read the vehicle registration number.</p>	<b>04</b>
<b>f)</b>	<p><b>State the importance of –</b> <b>(i) Driving Habit</b> <b>(ii) Helmet</b></p>	<b>04</b>
<b>Ans</b>	<p><b>i) Importance of Driving habits:</b> A countless number of accidents occur each day on roads. Not a day goes by that we don't hear about some sort of highway pile-up, or of a pedestrian being struck by a distracted driver. There must be a way to prevent the risk of automobile accidents. Being a good driver means more than just obeying speed limits, and traffic lights – it means completely respecting all elements of the road safety code. Whether you're driving through densely populated city streets, where cyclists and pedestrians are ever-present; or navigating winding country roads, where each unpredictable turn can bring disaster, one must always be ready to react swiftly in the event of an unexpected situation. These, and other, obstacles require drivers to display a considerable amount of patience and attentiveness. Unfortunately, most drivers do not adhere to, or are unaware of, all road rules of conduct, and find themselves as the responsible parties in a very high number of accidents.</p> <p><b>2. Importance of Helmet:</b> The primary goal of motorcycle helmet is motorcycle safety to protect the riders head during impact, thus preventing or reducing head injury and saving the riders life. Some helmets provide additional convenience such as ventilation, face shield and ear protection. The helmet is used to protect the head injury at front, rear and head restraint. The helmet protects against cervical spine injury. It provides protection against noise, wind and improves visibility.</p>	<b>02</b> <b>02</b>

<b>06</b>	<b>Attempt any FOUR of the following</b>	<b>16</b>
	<b>a) Draw a neat sketch of expanding shoe types brakes.</b>	<b>04</b>
<b>Ans</b>	<p style="text-align: center;">Figure: Internal expanding shoe type of mechanical brake</p>	<p><b>(Sketch – 02 marks , Labeling -02 Marks)</b></p> <p style="text-align: center;"><b>4</b></p>
	<b>b) Explain the term belt-drive with variator mechanism.</b>	<b>04</b>
<b>Ans</b>	<p>Belt drive with Variator mechanism consists three basic components- A high power metal or rubber belt, A variable input driving pulley which is connected to the crankshaft of the engine, output driven pulley which transfers energy to the drive shaft. Each pulley is made of two 20 degree cones facing each other. A belt rides in the groove between the two cones. This assembly has rollers which move in and out depending on the load condition and engine rpm giving the differential pulley diameter thus providing the optimum wheel rpm and traction force V belts are preferred if the belt is made of rubber. When the two cones of the pulley are far apart (When the diameter increases) the belt rides lower in the groove and the radius of the belt loop going around the pulley gets smaller. When the cones are close together (when the diameter decreases), the belt rides higher in the groove and the radius of the belt loop going around the pulley gets larger. CVTs may use hydraulic pressure, centrifugal force or spring tension to create the force necessary to adjust the pulley halves.</p> <div style="text-align: center;"> </div> <p style="text-align: center;">Figure: Pulley based vario drive arrangement</p>	<p style="text-align: center;"><b>02</b></p> <p style="text-align: center;"><b>02</b></p>
<b>OR</b>		

		 <p>The diagram illustrates the operation of engine and clutch variators. It is divided into two horizontal sections: 'MINI POSITION (start)' and 'MAXI POSITION (road)'. Each section shows a side view of the engine variator on the left and the clutch variator on the right, connected by a belt. In the 'MINI POSITION', the belt is taut and the variators are in their innermost positions. In the 'MAXI POSITION', the belt is slack and the variators have moved to their outermost positions, increasing the gear ratio.</p>	
	<p><b>c)</b></p>	<p><b>State the importance of-</b></p> <p><b>(i) Jacket</b></p> <p><b>(ii) Day night goggle</b></p>	<b>04</b>
	<p><b>Ans</b></p>	<p><b>(i) Jacket-</b> While driving a motorcycle, use proper jacket to cover the body. Jacket closes the body completely. Due to wind our cloths are continuously blows, making tedious sound which was very enormous i.e. undesirable. Jackets never stick to the body. These are made from impregnated/laminated cloths; these are light weight, high resistance to sunlight, wear and tear resistance in case of accidents. Water droplets are not sticking. Jacket adds the effective driving values. These are available in dark glowing colors with radium spectrum so that at night driving it shows your presence on the road.</p> <p><b>ii) Importance of Day-night goggle:</b> Eye protection is of utmost importance - an insect or a kicked-up pebble in the eye at speed has enough momentum to cause significant damage. Such an event could easily cause the rider to lose control and crash. Besides this danger, squinting into the wind is unpleasant at best and watering eyes are quite distracting. Goggles or Day night goggles are forms of protective eyewear that usually enclose or protect the area surrounding the eye in order to prevent particulates, water or chemicals from striking the eyes. It prevents insects, dust, and so on from hitting the eyes.</p>	<b>02</b>  <b>02</b>
	<p><b>d)</b></p>	<p><b>Explain the aerodynamic aspect of</b></p> <p><b>(i) Head lamp shape</b></p> <p><b>(ii) Shape of fuel tank</b></p>	<b>04</b>
	<p><b>Ans</b></p>	<p><b>Aerodynamic aspects for (2 marks each)</b></p> <p><b>(i) Head lamp shape</b> The headlamp is available in different shapes; it is depending on the type of manufacturer or type of vehicle. For example -</p> <ol style="list-style-type: none"> <li>1. In motorcycle it is separately placed at the center of handle bar.</li> <li>2. In case of scooters the head lamp is inbuilt in the handle bar arrangement.</li> </ol> <p>The head lamp is open to atmosphere. The front upcoming air strikes directly on it. So that the head lamp body must be robust and it should be suitably installed. If any sharp edge is on the outer body of the head lamp creates air resistance which affects the efficiency of vehicle. So that the shape must be streamline with no sharp edges. The rounded portion of outer body minimized the air resistance. In this way the head lamp must be streamlined aerodynamically shaped and easy to install. The angle of various beams must be suitably adjusted so that the visibility is cleared.</p>	



- ii) Shape of fuel tank:** The shape of fuel tank in motorcycle provides the following.
1. It holds adequate fuel as per class of motorcycle.
  2. Generally the fuel tank shape is a tear drop design. It offers least aerodynamic drag.
  3. Its shape allows the rider's knees to be included within the contour of front end of vehicle. i.e. the rear end of fuel tank is narrower. This also reduces air drag.
  4. Appropriately positioned handlebar with adequate handlebar width allows rider to lean forward and reduce air drag. If the driver lies on the fuel tank, then he experiences less of parachute effect. i.e. the vehicle is not slowed down due to aerodynamic drag.
  5. Its shape accommodates the frame tube and allows fuel to be stored at a lower height to slightly reduce the height of the center of gravity of motorcycle. Space is ensured for handlebar turning through the required angle.

**e) Differentiate between drum brake and disc brake (any four points)**

**04**

**Ans** Answer: **Comparison of drum brake with disc brake:** *(Any four points)*

Sr. No.	Drum brake	Disc brake
1.	Friction occurs on the internal surfaces therefore heat dissipated only by conduction through the drum	Friction surfaces are directly exposed to the cooling air.
2.	Curved friction pads are used	Flat friction pads are used
3.	Non uniform wear of friction linings.	There uniform wear of friction pads
4.	There is loss of efficiency due to expansion	There is no loss of efficiency due to expansion
5.	Comparatively higher weight	Weight is less so saving up to 20 % is possible
6.	Comparatively higher anti-fade characteristics	Disk brakes have comparatively better anti fade characteristics.
7.	Complicated design	Simple in design
8.	Removal and replacement of brake linings is difficult and consumes more time.	Comparatively easy to remove and replace friction pads
9.	More friction area	Less friction area
10.	Pressure intensity is less	Pressure intensity is more