



Winter – 15 EXAMINATION

Subject Code: 17617

Model Answer

Page No: 1/25

Important Instructions to examiners:

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

		Marks
1. a) Attempt any <u>THREE</u> of the following-		12
i) State the purposes of following electrical components. 1)Relays 2) Solenoids		4
<b>Answer :</b> (Description - 2 marks each)		
1) <b>Relay:</b> A Relay is an electric switch that allows a small amount of current to control a high-current circuit. It controls one electrical circuit by opening & closing contacts in other circuits		2
2) <b>Solenoid:</b> Purpose of a solenoid is to control a larger current carrying circuit with use of small current carrying circuit that uses a movable core. The core is mechanically linked to the contacts through some form of mechanical linkage. Solenoids are electromagnetic switches with a movable core that converts current flow into mechanical movement.		2
ii) Explain any four battery ratings.		4
<b>Answer:</b> (Any four - 1 mark each)		
<b>Types of Battery ratings:</b>		
1. <b>Ampere-hours (A-h)</b> is the product of the time that a battery can deliver a certain amount of current (in hours) times that current (in amperes), for a particular discharge period. This is one indication of the total amount of charge a battery is able to store and deliver at its rated voltage. This rating is rarely stated for automotive batteries, except in Europe where it is required by law.		4
2. <b>Cranking amperes (CA)</b> also sometimes referred to as marine cranking amperes (MCA), is the amount of current a battery can provide at 32 °F (0 °C). The rating is defined as the number of amperes a lead-acid battery at that temperature can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12 volt battery).		
3. <b>Cold cranking amperes (CCA)</b> is the amount of current a battery can provide at 0 °F (-18 °C). The rating is defined as the current a lead-acid battery at that temperature can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery). It is a more demanding test than those at higher temperatures.		

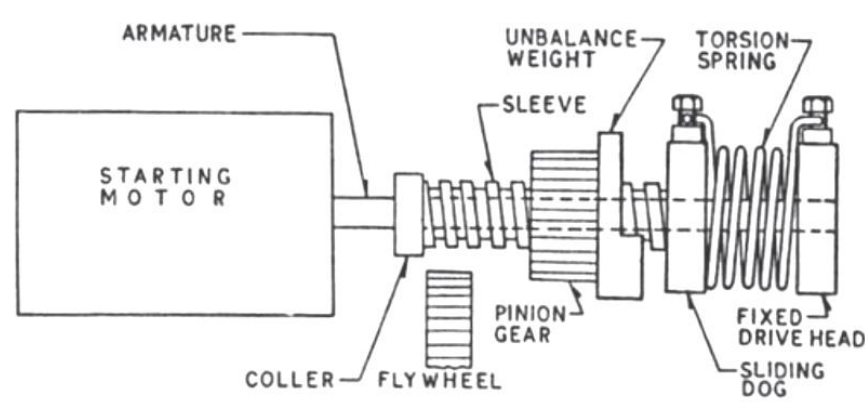


Winter – 15 EXAMINATION

Subject Code: 17617

Model Answer

Page No: 2/25

<p><b>4. Hot cranking amperes (HCA)</b> is the amount of current a battery can provide at 80 °F (26.7 °C). The rating is defined as the current a lead-acid battery at that temperature can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery).</p> <p><b>5. Reserve capacity minutes (RCM)</b> also referred to as reserve capacity (RC), is a battery's ability to sustain a minimum stated electrical load; it is defined as the time (in minutes) that a lead-acid battery at 80 °F (27 °C) will continuously deliver 25 amperes before its voltage drops below 10.5 volts.</p>	
<p>iii) Draw a schematic arrangement of Bendix drive and label it.</p>	4
<p><b>Answer: Bendix Drive</b> (Diagram - 3 marks, Labels - 1 mark):</p> 	4
<p>iv) State any four needs of ignition system.</p>	4
<p><b>Answer: The needs of ignition system</b> are as follows:(any four- 1mark each)</p> <ol style="list-style-type: none"> <li>1. It should provide sufficiently strong spark between the electrodes of the plugs at correct timing.</li> <li>2. It should function efficiently over the entire range of engine speed.</li> <li>3. It should be light,, effective and reliable in service.</li> <li>4. It should be compact and easy to maintain.</li> <li>5. Sufficiently large voltage across the spark plug electrodes to affect the spark discharge even in lean mixtures.</li> <li>6. Supply energy required to ignite the combustible mixture across air gap.</li> <li>7. It should be capable to advance or retard ignition timing as per engine load and speed.</li> <li>8. Effective to trigger the primary circuit at appropriate time with respect to crankshaft position.</li> </ol>	4
<p>b) Attempt any <u>ONE</u> of the following:</p>	6
<p>i) Draw a neat labelled sketch of electromagnetic engine oil pressure gauge and describe its construction and working.</p>	6
<p><b>Answer: (Diagram - 3 marks, construction and working- 3 marks)</b></p> <p><b>Construction and working of electromagnetic engine oil pressure gauge:</b></p> <p>Oil pressure gauge shown in the diagram is electrically operated. It displays the actual oil pressure of the engine. The indicator light only warns the driver of low oil pressure. Oil pressure sending unit is screwed into the oil gallery. As oil passes through an oil pressure sender, it moves a diaphragm, which is connected to a variable resistor. This resistor changes the amount of current passing through the circuit. The gauge then reacts to the current and moves a needle over a scale to indicate the oil</p>	3

pressure. As oil pressure changes, the resistance in the oil pressure gauge circuit and the reading on the gauge change accordingly.

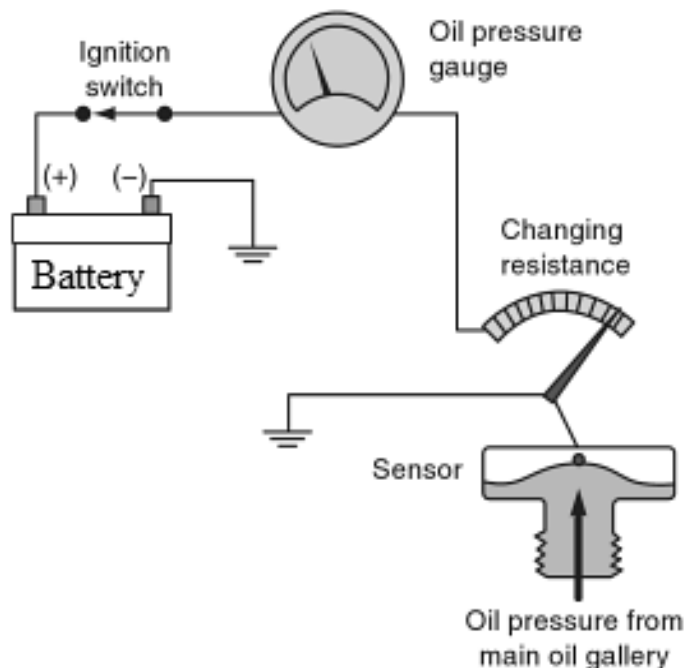


Figure: Electromagnetically operated engine oil pressure gauge

3

ii) Describe construction and working of lead acid battery with neat sketch.

6

**Answer:** (construction – 2marks, working- 2 marks, Diagram - 2 marks)

**Construction of lead acid battery:** Batteries are made of five basic components:

1. A resilient plastic container.
2. Positive and negative internal plates made of lead.
3. Plate separators made of porous synthetic material.
4. Electrolyte, a dilute solution of sulfuric acid and water, better known as battery acid.
5. Lead terminals, the connection point between the battery and whatever it powers.

2

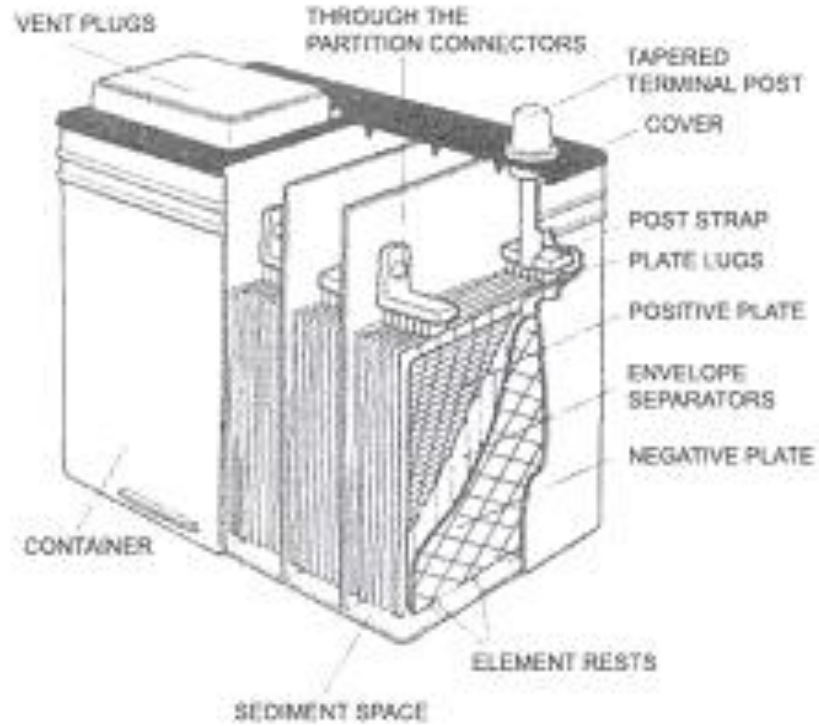
A battery consists of number of cells, generally six for 12V battery. Each cell consists of positive and negative plates separated by a separator and connected in series with positive and negative terminals of battery respectively. The plates are immersed in a solution of sulfuric acid, which acts as electrolyte. Each plate consists of a grid upon which is attached the active material, lead dioxide on the negative plates, pure lead on the positive plates.



Winter – 15 EXAMINATION  
Model Answer

Subject Code: 17617

Page No: 4/25



OR

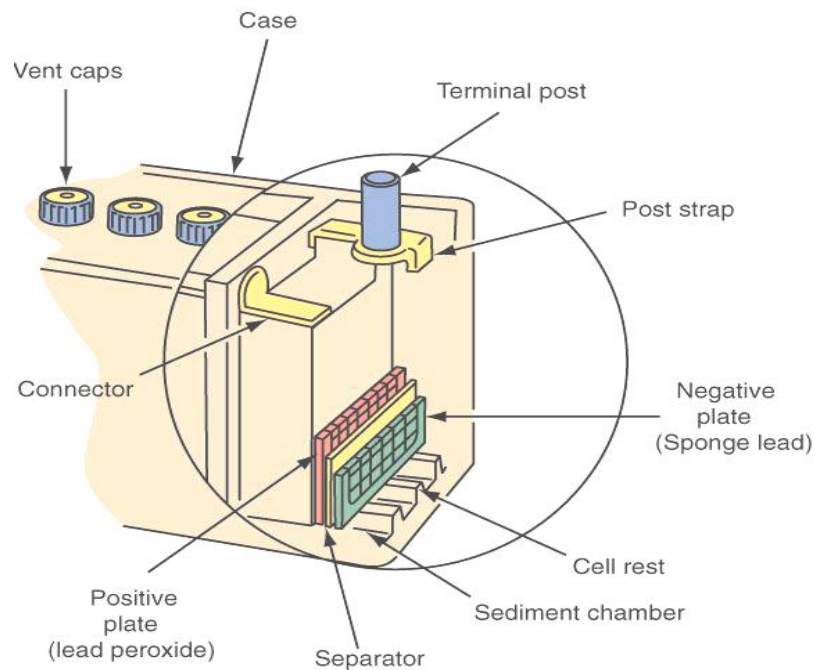


Figure: Lead Acid Battery

**Winter – 15 EXAMINATION**

Subject Code: **17617**

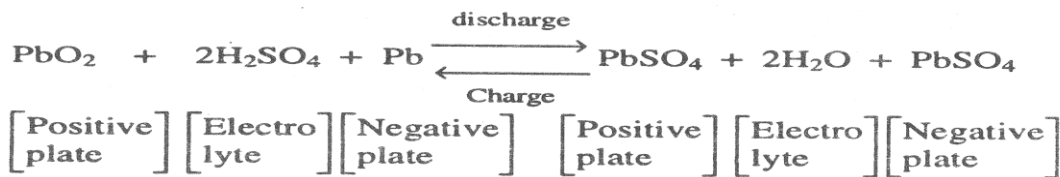
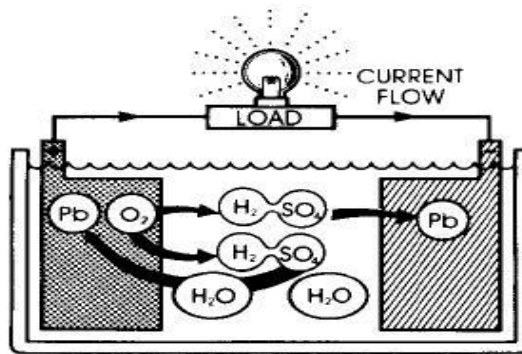
**Model Answer**

Page No: 5/25

**Working :-**

During discharging, the sulphuric acid molecules split up into H<sub>2</sub> and SO<sub>4</sub>. One SO<sub>4</sub> unites with the Pb of the positive plate, while the other unites with the Pb of the negative plate, forming PbSO<sub>4</sub> in each plate. This action sets free two atoms of oxygen from the positive plate and they get united with the hydrogen left behind in the electrolyte. The union of hydrogen and oxygen forms H<sub>2</sub>O which is simply water.

This means that during discharge, lead sulphate (PbSO<sub>4</sub>) is formed on both plates, while sulphuric acid is replaced by water. The water content in the electrolyte increases & thus the specific gravity of electrolyte decreases. The active material on positive & negative plates tends to become equal & so the terminal voltage reduces.



2. Attempt any FOUR of the following:

a) Explain the working of any one electrical buzzer with neat sketch.

**Answer :** (Diagram - 2 marks, working- 2 marks)

**Electrical Buzzer:**

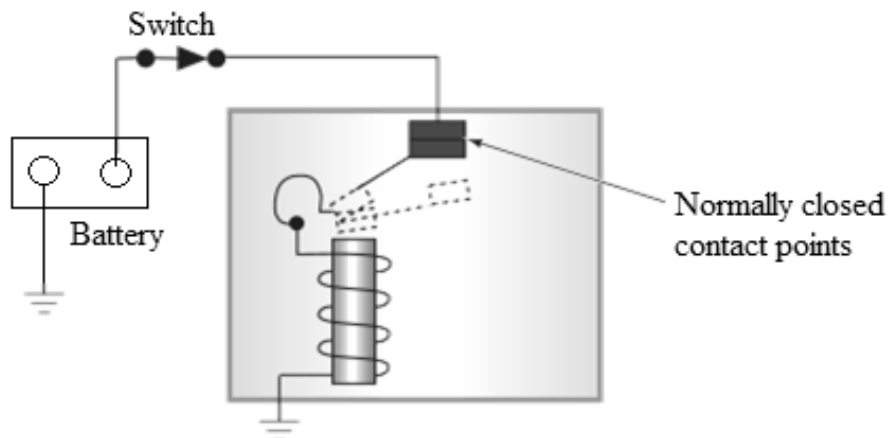


Fig: A buzzer opens and closes contact points rapidly, creating a noise



Winter – 15 EXAMINATION

Subject Code: 17617

Model Answer

Page No: 6/25

**Working: A buzzer, or sound generator,** is sometimes used to warn the driver of possible safety hazards by emitting an audio signal (such as when the seat belt is not buckled). A buzzer is similar in construction to a relay except for the internal wiring. The coil is supplied current through the normally closed contact points. When voltage is applied to the buzzer, current flows through the contact points to the coil. When the coil is energized, the contact arm is attracted to the magnetic field. As soon as the contact arm is pulled down, the current flow to the coil is opened, and the magnetic field is dissipated. The contact arm then closes again, and the circuit to the coil is closed. This opening and closing action occurs very rapidly. It is this movement that generates the vibrating signal and the buzzing sound.

2

b) Describe open circuit defect with suitable sketch.

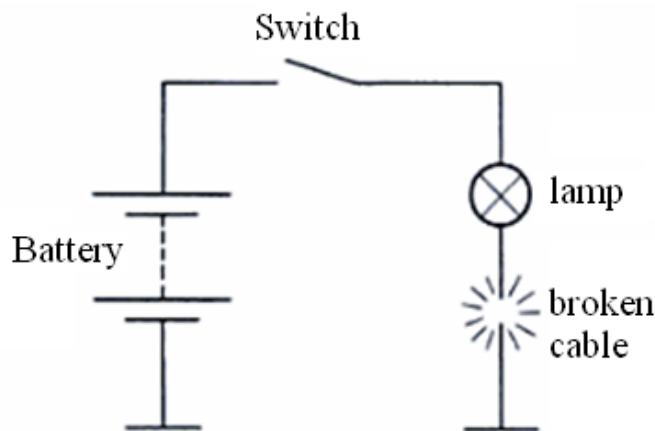
4

**Answer :** (Diagram - 2 marks, Description- 2 marks)

**Open circuit defect:** An open circuit defect exists when a circuit has a break in the wire or the circuit is interrupted either intentionally or unintentionally. Without a completed path, current cannot flow and the load or component cannot work. A switch ‘opens’ the circuit by breaking the supply wire and a similar effect is produced when either a poor terminal connection or a broken cable stops the current flow. (An open circuit can be caused by a poor terminal, a disconnected wire, a broken wire, or a switch in the off position.)

2

When a circuit is off, it is open. When the circuit is on, it is closed. Although voltage will be present up to the open point, there is no current flow. Without current flow, there are no voltage drops across the various loads.



2

**Fig: Open Circuit**

c) List the components of starting system and write their function.

4

**Answer:** (List any four components - 2 marks, Function- 2 marks)

The components of starting system and their functions are as follows:(any Four)

- 1) **Battery:** A starter battery supplies the current to starter motor, needed for engine cranking.
- 2) **Ignition switch:** It controls the current supplied to the solenoid and to the starter motor for cranking. In starter mode, the switch provides current to solenoid and the starter motor gets supply.
- 3) **Neutral safety switch:** The switch provides continuity in starter circuit if the transmission is in neutral or clutch is disengaged.
- 4) **Solenoid:** Solenoid controls a larger cranking current with use of small current carrying circuit that uses a movable core. The core is mechanically linked to the electrical contacts through some form of mechanical linkage.

4

Winter – 15 EXAMINATION

Subject Code: 17617

Model Answer

Page No: 7/25

- 5) **Starter motor:** Upon receiving current, motor initially provides adequately high torque needed for engine cranking.  
6) **Starter drive:** It ensures the starter motor engagement while cranking, and immediate disengagement upon engine starting.

d) Draw the wiring diagram of power window circuit and describe its working.

4

**Answer:** (Diagram - 2 marks, working- 2 marks ,credit given to equivalent diagram)

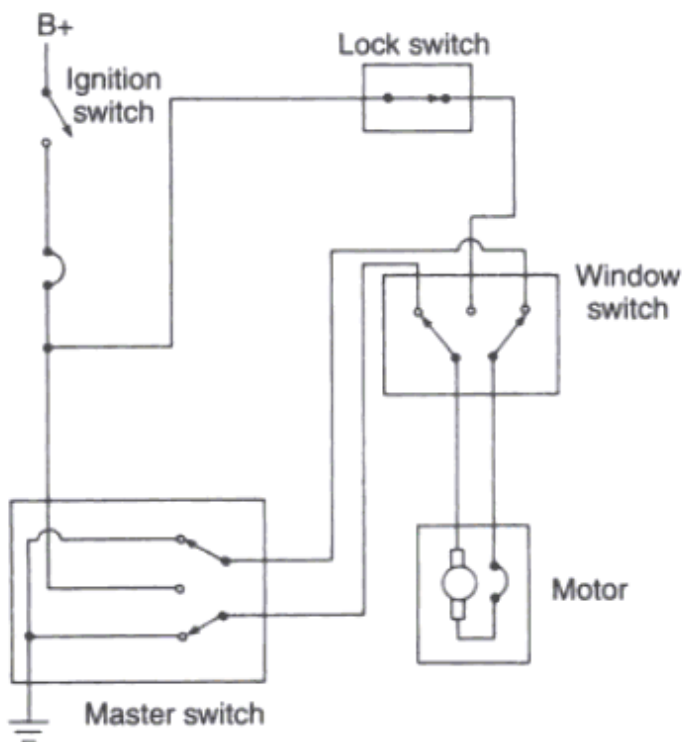


Figure A simplified power window circuit.

2

**Working of Power window circuit:**

Major components of a typical Power windows system are – master control switch, individual window control switches, lock switch and the window drive motors as shown in figure.

A permanent magnet motor operates each power window. Each motor raises or lowers the glass when voltage is applied to it. The direction that the motor moves the glass is determined by the supply voltage. The motors are permanent magnet reversible DC motors.

2

The master control switch provides overall system control. A lock switch is safety device to prevent children from opening the windows without the driver's knowledge.

Circuit breakers are generally used on power windows to open the circuit if an overload occurs. Without a circuit breaker to open, the motor may be damaged trying to move the window against the ice. As ice is removed, the breaker will cool, close and allow future window operation.

**Winter – 15 EXAMINATION**

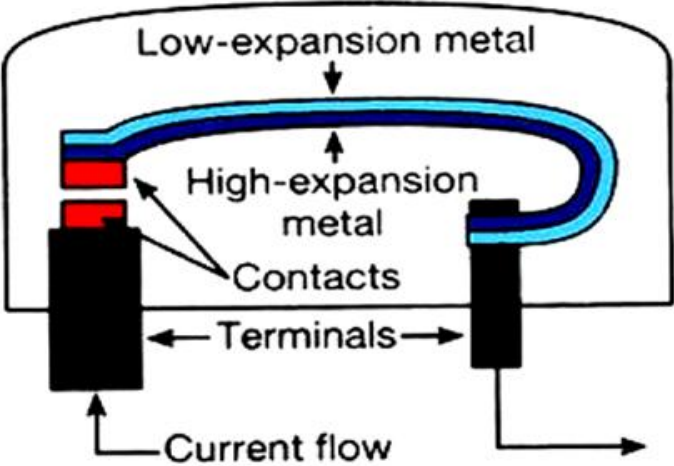
Subject Code: **17617**

**Model Answer**

Page No: 8/25





3. Attempt any <u>FOUR</u> of the following:	16
a) Describe the operation of keyless entry system.	4
<p><b>Answer: (Explanation 4 Marks, credit given to equivalent figure)</b></p> <p>The keyless entry system allows the driver to unlock the doors or trunk lid from outside the vehicle without using a key. The main components of the keyless entry system include:</p> <ol style="list-style-type: none"> <li>1) A control module</li> <li>2) A coded button keypad located on the driver's door</li> <li>3) Door lock motors</li> </ol> <p>The keypad consists of five normally open, single-poles, and single-throw switches. Each switch represents two numbers 1-2, 3-4, 5-6, 7-8, 9-0. The keypad is wired into the circuit to provide input to the control module. The control module is programmed to lock the doors with door lock motors when the 7-8, and 9-0 switches are closed at the same time.</p> <p>The driver's door can be unlocked by entering a five-digit code through the keypad. Remote controlled keyless entry systems are also available. They use a hand held transmitter attached as a key chain. It can be operated within a range of 25 to 50 feet and from any direction. The operating is done by a button press, then driver door is unlocked, theft security is disarmed. During exit, lock button locks all doors.</p>	4
b) Describe the testing procedure of throttle position sensor.	4
<p><b>Answer: Procedure-4 Marks</b></p> <p>Following procedure is followed to diagnose a throttle position sensor</p> <ol style="list-style-type: none"> <li>1. The ignition switch in the RUN position, connect a voltmeter from the sensor signal wire to ground.</li> <li>2. Slowly open the throttle and observe the voltmeter.</li> <li>3. The voltmeter reading should increase smoothly and gradually.</li> <li>4. Typical TPS voltage readings are 0.5V to 1V with the throttle in the idle positions, and 3.5V to 4.5V at wide open throttle.</li> <li>5. Always refer to the vehicle manufacturer's specifications.</li> <li>6. If the TPS does not have the specified voltage or if the voltage signal is erratic, replace the sensor</li> </ol>	4
c) Explain working of automatic resetting type circuit breaker with neat sketch.	4
<p><b>Answer: (Sketch – 2 marks &amp; working -2 Marks)</b></p> <div style="text-align: center;">  </div> <p><b>Figure:</b> Automatic resetting type circuit breaker</p>	2



Winter – 15 EXAMINATION

Subject Code: 17617

Model Answer

Page No: 10/25

**Operation of a thermal circuit breaker:**

A circuit breaker uses a bimetallic strip that reacts to excessive current as shown in the figure. A bimetallic strip consists of two different types of metals with different coefficient of thermal expansion. There is nothing to replace. Circuit breakers range from 5 to 50 amperes. One strip will react more quickly to heat than the other causing the strip to bend in proportion to the amount of current flow.

2

When an overload or circuit defect occurs that causes an excessive amount of current draw, the current flowing through the bimetallic strip causes it to heat. As the strip heats, it bends and opens the contacts. Once the contacts are opened current can no longer flow. With no current flowing, the strip cools and closes again. If the high current cause is still in the circuit, the breaker will open again.

d) State the function of following components used in ignition system.

i) Ignition coil ii) Distributor iii) Spark plug iv) Condenser

4

**Answer: Functions:** (1 mark for each component)

(i) **Ignition Coil:** An ignition coil (also called a spark coil) is an induction coil in an automobile's ignition system which transforms the battery's low voltage (6 to 12 volts) to the thousands of volts needed to create an electric spark in the spark plugs to ignite the fuel.

(ii) **Distributor:**

- To interrupt the flow of current through the primary winding so that a high voltage is produced in the secondary winding.
- To distribute the high voltage surge to different plugs at the right moment.
- To provide advance/retard an ignition timing
- To provide drive to oil pump and mechanical fuel feed pump.

4

(iii) **Spark Plug:**

- Purpose of spark plug is to provide an arc to ignite the air fuel mixture within the combustion chamber of a SI engine.
- Spark at the plug electrodes must be regular and synchronously timed with respect to the cylinder piston position at all speeds and loads of an engine.
- The spark should be sufficiently strong so as to start proper ignition of even lean charge.
- Being the hottest component in the SI engine, it dissipates the heat effectively to the cylinder head. This avoids abnormal combustion.
- The duration of spark should be sufficient enough so as to sustain the flame and avoid flame quenching in turbulent mixtures.

(iv) **Condenser:** The condenser is used to prevent the arc action in case of ignition system with distributor contact points. Also improve the life of contact breaker points.

e) State the function of: i) Camshaft position sensor ii) Detonation sensor

4

**Answer:**

(i) **Function of the Camshaft Sensor:** (2 marks)

1. The camshaft sensor informs the PCM of the camshaft position relative to the crankshaft. By monitoring the camshaft position, the PCM remains informed as to the timing of the opening and closing of the intake valves. By monitoring the camshaft sensor and comparing it with the crankshaft sensor, the PCM knows when each cylinder is approaching top dead center and where the valves are positioned.

2



Winter – 15 EXAMINATION

Subject Code: 17617

Model Answer

Page No: 11/25

<p>2. Ignition and fuel injector timing relies on this information. This is especially helpful with sequential fuel injection. Sequential fuel injection fires individual injectors at a specific point in the cylinder's compression stroke. The cam sensor (in conjunction with the crank sensor) also allows the PCM to determine which cylinder is on its compression stroke</p> <p><b>(ii) Function of Detonation Sensor:</b></p> <ol style="list-style-type: none"> <li>1. A large spark-advance is needed to obtain maximum power and economy from an engine. But when the spark is over-advanced, combustion knock will occur. To overcome this problem a detonation sensor is used. The detonation sensor detects the engine detonation and sends the voltage signal to the Engine control unit. The ECU uses the detonation sensor signal to control timing.</li> <li>2. The detonation sensor signal is an input to the ECM which then retards the computed ignition timing signal already advanced by the igniter circuit. i.e. the ignition timing is retarded to make the engine work without detonation.</li> </ol>	2
<p>4. a) Attempt any <u>THREE</u> of the following:</p>	12
<p>i) Describe the operation of common anti theft system.</p>	4
<p><b>Answer: Working of common anti-theft system:</b> Anti-theft systems are warning systems designed to scare off car thieves by sounding alarms and/or disabling the ignition system. The common components include:</p> <ul style="list-style-type: none"> <li>• An electronic control module</li> <li>• Door switches at all doors</li> <li>• Trunk key cylinder switch</li> <li>• Hood switch</li> <li>• Starter relay</li> <li>• Horn relay</li> <li>• Alarm</li> </ul> <p>For the system to operate, it must first be armed. This is done when the ignition switch is turned off and all the doors are locked electrically by either the door switches or the remote keyless system. When the system is armed, a security light will illuminate for approximately 30 seconds and is ready to function. If any one of the doors is open, the system will not arm until it is closed.</p> <p>The alarms are triggered by any of the following events:</p> <ul style="list-style-type: none"> <li>• Opening any door without using the key in one of the front doors.</li> <li>• Removing the trunk lock cylinder.</li> <li>• Turning the ignition switch to the ON position.</li> <li>• Opening the hood.</li> </ul> <p>Once the alarm is triggered, the module flashes the park and tail lamps, sounds the horn, and signals the PCM to prevent injector operation.</p>	4
<p>ii) Explain concept of automatic headlight dimming.</p>	4
<p><b>Answer: Concept of automatic headlight dimming:</b> Headlight dimming is essential for safe night driving. When a vehicle approaches another vehicle, the drivers are unable to see the road ahead. Further, while overtaking a vehicle required the dimming of headlights. This requires changing the focus of light from high beam to low beam.</p>	

**Winter – 15 EXAMINATION**

Subject Code: **17617**

**Model Answer**

Page No: 12/25

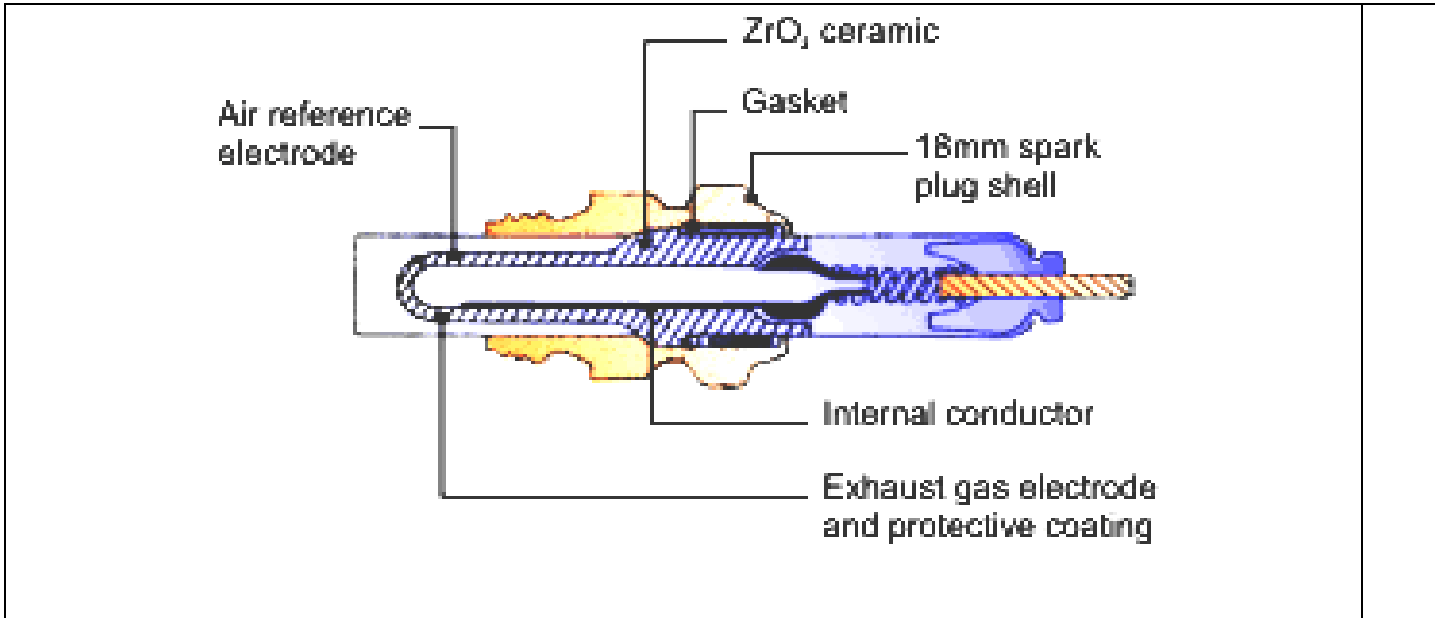


Winter – 15 EXAMINATION

Subject Code: 17617

Model Answer

Page No: 13/25



iv) Enlist any two purposes of OBDII. Define the terms: i) Drive cycle 2) Trip 3) Warm up cycle

4

**Answer:** (Purpose -1 Mark, Definitions- 01 Mark each)

**OBD II stands** for on-board diagnostics, second generation. To enable the computer systems to monitor the ability of systems and components to maintain low emission.

1. The standardized data link connector, that allows for these tools to communicate with the PCM. identifying faults in the computer-controlled systems and to notify the driver by means of a malfunction indicator light if the emission related fault causes an increase in emission up to 1.5 times the allowable standard.
2. In addition a diagnostic trouble code (DTC) was stored in the computer's memory. For easier diagnosis of a problem by a technician by using added information stored in the PCM.
3. It brings standardization in components and systems used by various automobile manufacturers. e.g. Data link connectors, data circuits, diagnostic tests and diagnostic trouble codes.

1

**1) Drive Cycle:**

A drive cycle may be defined as an engine startup and vehicle operation that allows the PCM to enter closed loop and allows all the monitors to complete their function.

**OR**

An OBD- II drive cycle is a method of driving that begins with an engine starts. The engine is then run until the system goes into closed loop. The drive cycle continues to include whatever specific operating conditions are necessary either to initiate and complete a specific monitoring sequence or to verify a symptom or verify a repair.

1

**2) Trip:**

A trip is defined as an engine operating drive cycle that contains all of the necessary conditions for a particular test to be performed.

**OR**

A trip for a particular diagnostic test is defined as a key on and key off cycle in which all the enabling criteria for a given diagnostic test have been met.

1

**Winter – 15 EXAMINATION**

Subject Code: **17617**

**Model Answer**

Page No: 14/25

Winter – 15 EXAMINATION

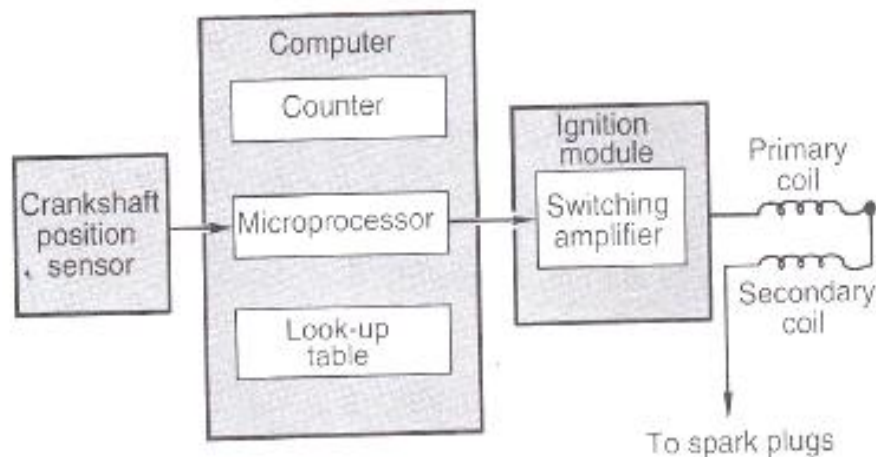
Subject Code: 17617

Model Answer

Page No: 15/25

microprocessor or computer in fact some of this system have even removed the primary switching function from the distributor by using crank shaft position sensor. In this case the function of distributor is to distribute secondary voltage to the sparks plugs..

- Spark timing on this system is controlled by the computer that continuously varies ignition timing to obtain optimum air /fuel combustion. The computer monitors the engine operating parameters with sensors. Based on this input computer signal and ignitions modules to collapse the primary circuits allowing the secondary circuits to fire the spark plug (figure)
- Timing control is selected by the computers program during engine starting computer control is bypassed and mechanical setting of distributor controls spark timing. Ones the engine started and running spark timing is control by the computer.
- This scheme of strategy allows the engine to start regardless of weather the electronic control system is functioning properly or not.
- The goal of the computerized spark timing is to produce maximum engine power top fuel efficiency and minimum emissions level during all types of operating conditions. The computer does this by continuously adjusting ignition timing.
- The computer determines the best spark timing based on certain engine operating conditions such as crank shaft position, engine speed, throttle position engine coolant temperature and initial an operating manifold or barometric pressure.
- Once the computer receives input from these and other sensors, it compress existing operating conditions to information permanently store or programmed into its memory. The computer matches the existing conditions to set of condition store in its memory determine proper timing setting and sends the signal to the ignition module to fire the plugs
- The computer continuously monitors existing conditions adjusting timing to match what its memory tells. It is ideal setting for those conditions. It can do this very quickly making thousands of decisions in a signal second.
- The control computer typically has the following types of information permanently program into it





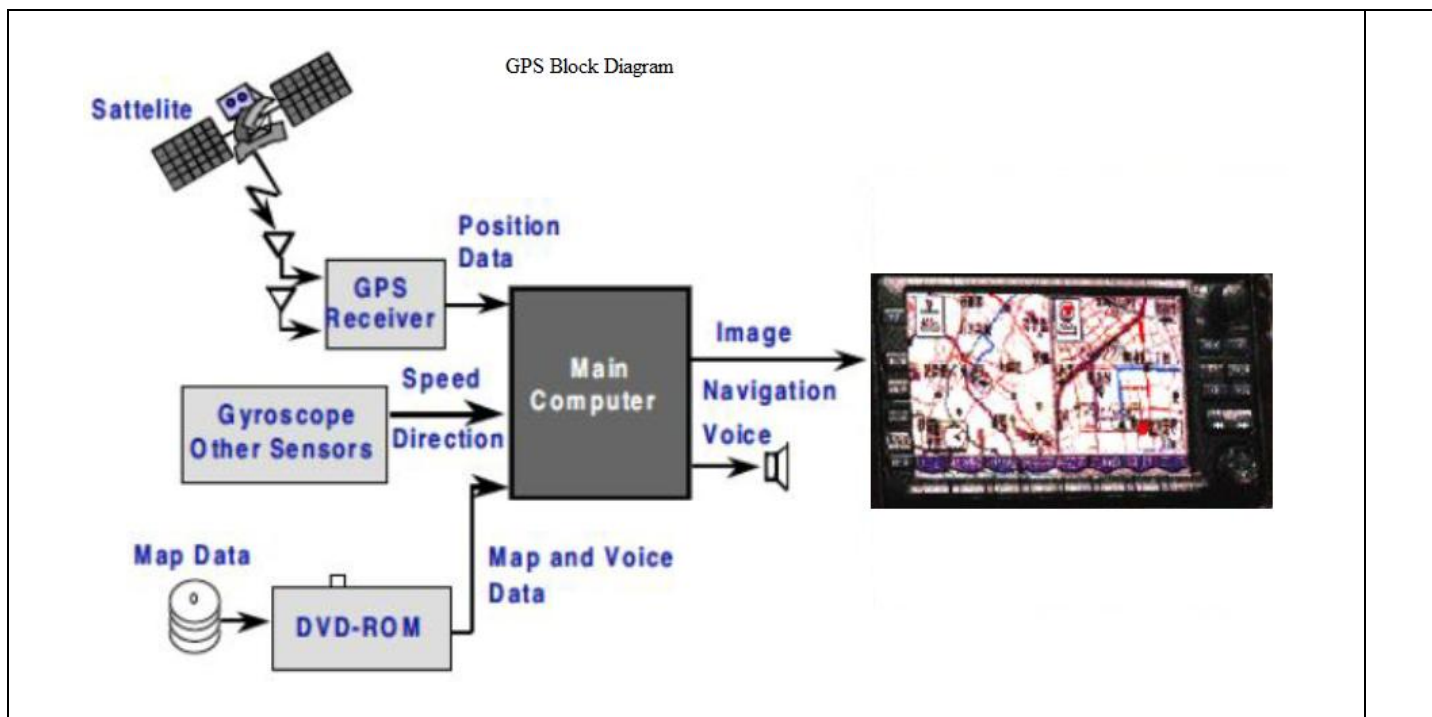


**Winter – 15 EXAMINATION**

Subject Code: **17617**

**Model Answer**

Page No: 17/25



b) Describe the fiber optics concept used in advance lighting accessories.

4

**Answer: Fiber optics Concept used in advance lighting accessories:**

The invention of fiber optics has provided a means of illuminating several objects with a single light source.

- Plastic fiber optic strands made from a special plastic (**polymethylmethacrylate plastic**) are used to transmit light from the source to the object to be illuminated.
- This plastic helps to keep the light rays parallel even in the presence of extreme bends in the plastic.
- The strands of plastic are sheathed by a polymer that insulates the light rays as they travel within the strands.
- The light rays travel through the strands by means of internal reflections.

4

**Some of the application of fiber optics include:**

- Fender-mounted turn signal lights
- Lighting ash trays
- Illuminating instrument panels
- Dash lighting over switches

c) Explain how specific gravity test performed with help of hydrometer..

4

**Answer: (Sketch 2 marks and Explanation 2 marks)**

- 1) Remove all battery vent caps.
- 2) Check the electrolyte level. It must be high enough to withdraw the correct amount of solution into hydrometer.
- 3) Squeeze the bulb and place the pick-up tube into the electrolyte of a cell.
- 4) Slowly release the rubber bulb. Draw in enough solution until the float is freely suspended in the barrel. Hold the hydrometer in vertical position.
- 5) The float rises and specific gravity is read where the float scale intersects the top of the solution.
- 6) The reading must also be compensated for temperature.

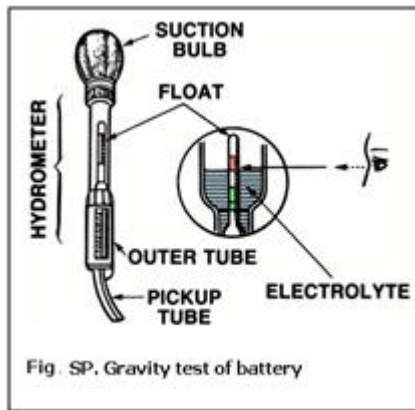
2

Winter – 15 EXAMINATION

Subject Code: 17617

Model Answer

Page No: 18/25



Following table shows specific gravity readings in various stages of charge at a temperature of 80°F (26.7°C).

Specific Gravity	Percentage of Charge
1.265	100%
1.225	75%
1.190	50%
1.155	25%
1.120 or lower	Fully discharged

2

d) Explain Ohm-meter test for electronic fuel injector.

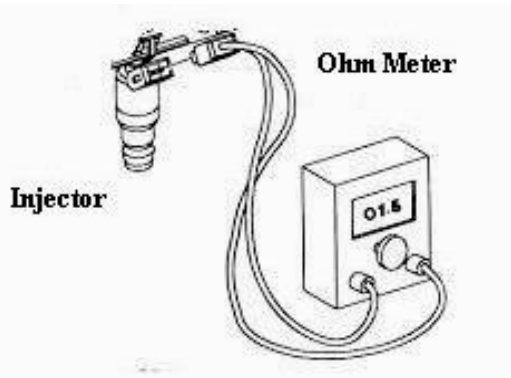
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**Answer:**

**Following are the steps of Ohm meter test for electronic fuel injector:**

- An ohmmeter is connected across the injector terminals to check the injector windings after the injector wires are disconnected.
- If the ohmmeter reading is infinite, the injector winding is open.
- An ohmmeter reading below the specified value indicates that the injector winding is shorted.
- A satisfied injector winding should have resistance between 0.3 to 0.4 ohms.
- Replace the injector if the results do not have the resistance as specified by manufacturer.

2



2

e) Explain current output test for alternator.

4

**Answer: CURRENT OUTPUT TEST:** Current output test will determine the maximum output of the AC generator /Alternator.

**The following test is carried out on a Auto Electric Test Bench or equivalent:**

- The alternator taken for the test is of 14V 16/35 A.
- Place the alternator on a secure vice on the test bench.
- Connect the test pulley on the alternator.
- Connect the belt of the motor to the test pulley.
- Start the motor, the alternator will run at 6000 rpm.
- Turn `ON` the load switch one by one 5A, 20A, 30A, 40A.
- The alternator will show the maximum current output i.e. >/ 33 Amps at 13.5 V.

4



Winter – 15 EXAMINATION

Subject Code: 17617

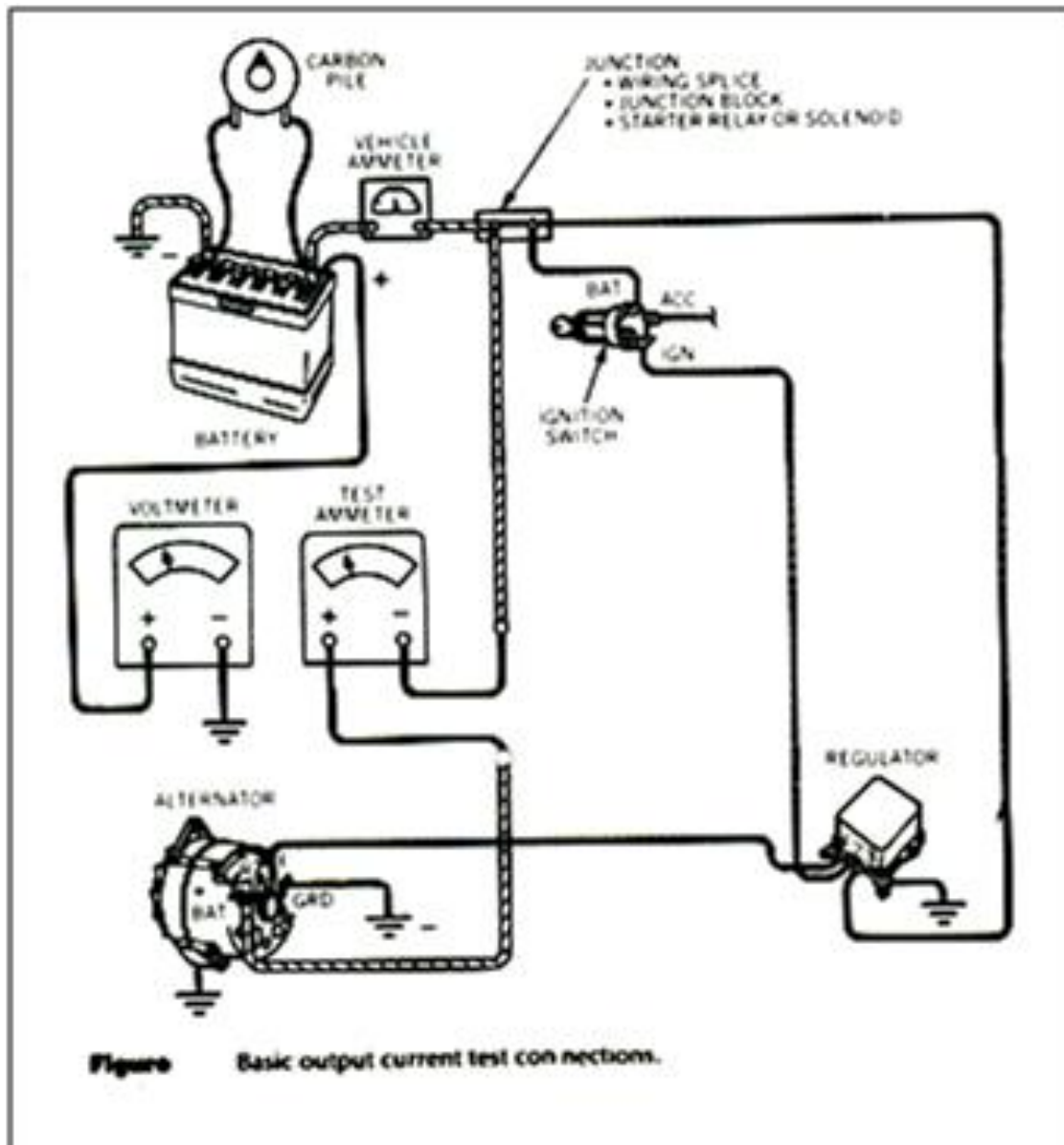
Model Answer

Page No: 19/25

OR

Connect a carbon pile across the battery to load the alternator output circuit. Connect a voltmeter between the battery + terminal and ground, Connect an ammeter + lead to the alternator BAT terminal and the - lead to the battery + terminal or to a junction for the alternator output as shown in fig. Turn on the ignition and read the rate of discharge on the ammeter. This is field current and ignition current draw. Then, start and run the engine at specified test speed and adjust the carbon pile for a steady 15 volts of system voltage or for the highest possible current. Read the ammeter and add this reading to the previous one.

**Result:** Compare the total current to alternator maximum output specifications. Most manufacturers allow  $\pm 10$ -percent or  $\pm 10$ -ampere tolerance on the rated maximum current.



Winter – 15 EXAMINATION

Subject Code: 17617

Model Answer

Page No: 20/25

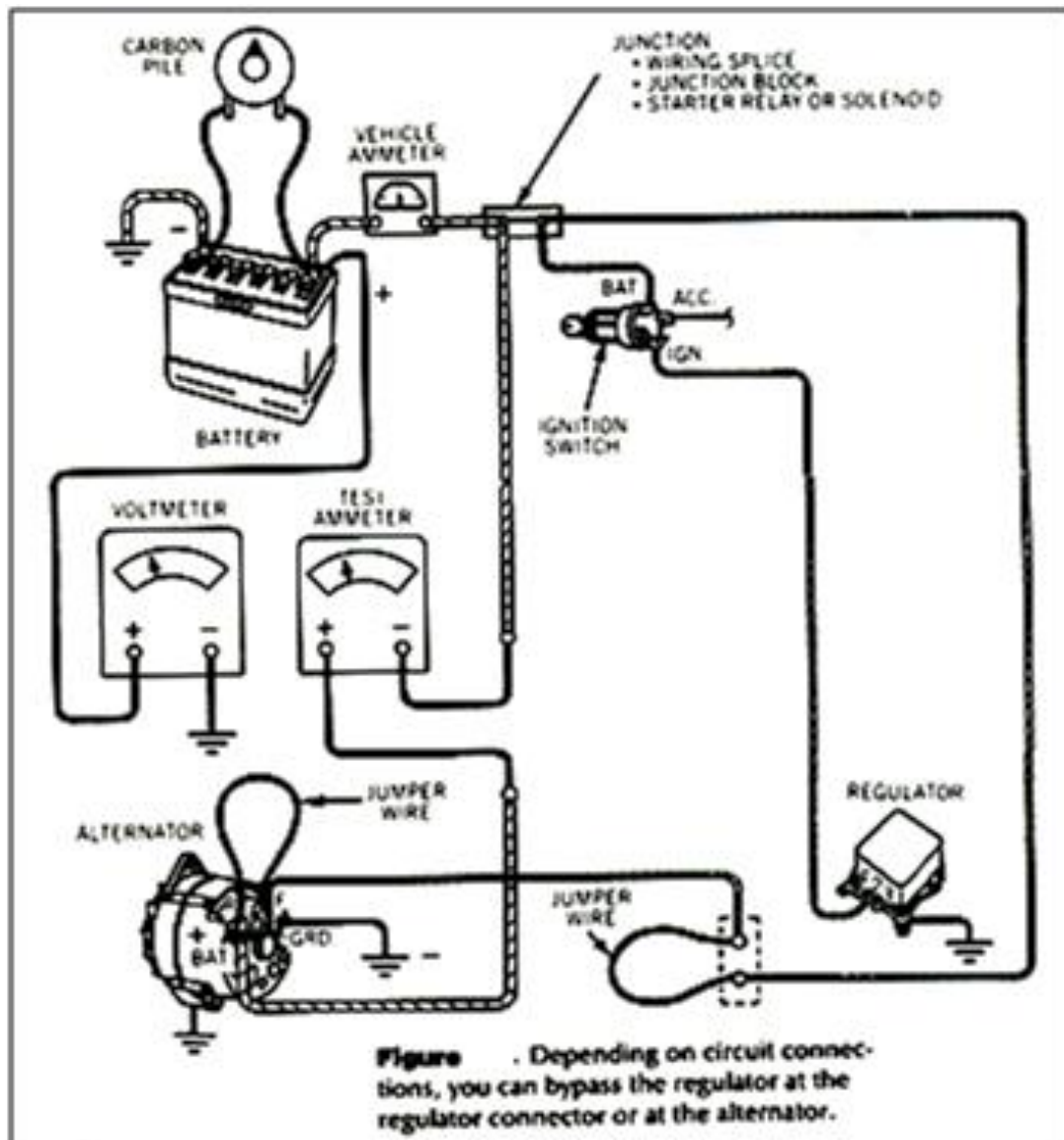
OR

Bypass the voltage regulator to apply full current to the alternator field. Some carmakers recommend this method instead of the previous test. If any system fails the first current output test above, you don't know if the cause is in the alternator or the regulator. Bypassing the regulator lets you check unregulated current output and isolate the problem to the alternator or the regulator.

Use the same test equipment connections as used for the first current output test.

If the regulator is mounted remotely from the alternator, you must bypass it with a jumper wire. If the regulator is a solid-state unit, mounted on or inside the alternator, manufacturers provide different ways to bypass it. With the regulator bypassed and full current to the field, run the engine at the specified speed and adjust the carbon pile for maximum current at a specified voltage (about 15 volts).

**Result:** Compare the ammeter reading to specifications. If current is out of limits, the alternator is bad. If current is within limits, the regulator may be bad.





f) Describe the procedure for testing alternator rotor and stator with neat sketch.

4

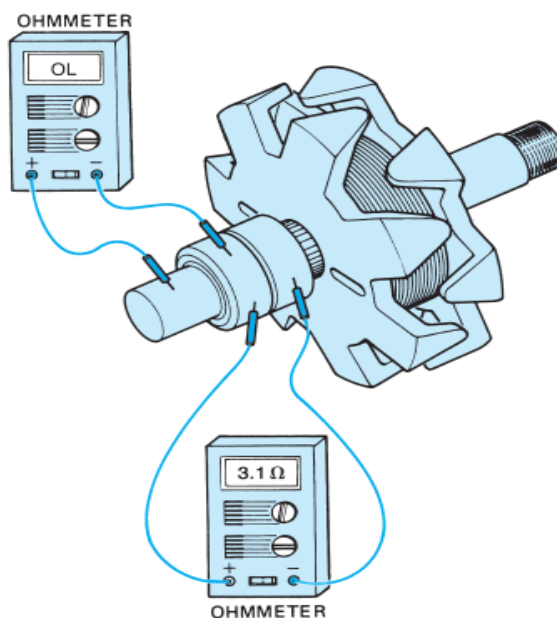
**Answer: Procedure applied to conduct tests on rotor & stator:**

**For Rotor Testing: (2 marks)**

1. Remove the rotor from end frame
2. Extract the retainer plate screws
3. Remove the retainer plate
4. Remove the end frame bearing
5. Remove the three attaching screws & separate the stator from end frame.
6. Attach one lead of a 110 volts test lamp or an ohmmeter to either slip ring & outer lead to the rotor- shaft or poles.
7. Note down reading of ohmmeter
8. Attach lamp or ohmmeter connections to each slip ring
9. Note down reading of ohmmeter or observe the lamp light
10. Connect 12 V battery and an ohmmeter in series with the slip rings of rotor
11. Record reading of ammeter
12. Connect an ohmmeter in series with slip ring of rotor
13. Record reading of ohmmeter

2

CHECKING FOR GROUNDS  
(SHOULD READ INFINITY IF ROTOR IS NOT GROUNDED)



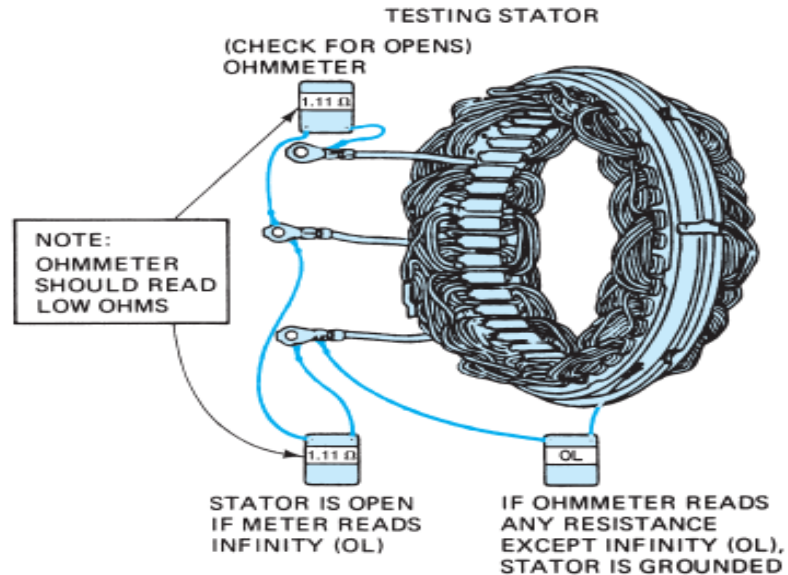
**Figure:** Testing a rotor using an ohmmeter. (credit given to equivalent sketch)

**For Stator Testing: (2 marks)**

1. Connect the test lamp or ohmmeter to the stator frame & one of the stator leads.
2. Record reading of ohmmeter / lamp illumination
3. Connect the test lamp or ohmmeter between each pair of stator leads
4. Record reading of the ohmmeter / lamp illumination

2

If the ohmmeter reads infinity between any two of the three stator windings, the stator is open and, therefore, defective. The ohmmeter should read infinity between any stator lead and the steel laminations. If the reading is less than infinity, the stator is grounded. Stator windings can be tested if shorted because the normal resistance is very low.



**Figure:** Testing a Stator using an ohmmeter. (credit given to equivalent sketch)

6 Attempt any FOUR of the following :

16

a) Describe trickle charging process used in battery.

4

**Answer:** (1 mark each point, equivalent information should be given credit)

**Procedure Of Trickle Charging of Battery:**

4

- i) When batteries are left in storage for longer periods they are subjected to self-discharge.
- ii) During `TRICKLE CHARGING` a continuous charging at very low charging rate of about 5 percent of the normal charging current is employed for keeping the battery in proper condition.
- iii) Trickle charging is employed on batteries used for display purpose and on vehicle doing very little running.
- iv) However continuous trickle charging should not be used and it is recommended that only during day time the battery should be connected to trickle charge while during the night it Should be disconnected.

b) Describe the procedure of insulated circuit resistance test for a starting system.

4

**Answer: Procedure of insulated circuit resistance test for a starting system:**

- The schematic diagram shows the Insulated side Voltage drop in the Starting system. The test is performed while the circuit is actually operating. Current must be flowing through the circuit to measure the voltage drop.
- When performing a voltage drop test on the positive side of a circuit, connect the positive lead of voltmeter to the source of highest voltage- the battery's positive terminal.
- Connect the voltmeter negative lead to the point across which voltage is to be noted, i.e. the Starter motor solenoid terminal.
- Select lower voltmeter range to get accurate reading. While performing the test, ignition system is disabled.
- Ground side voltage drop test is also equally important.

4

**Winter – 15 EXAMINATION**

Subject Code: **17617**

**Model Answer**

Page No: 23/25

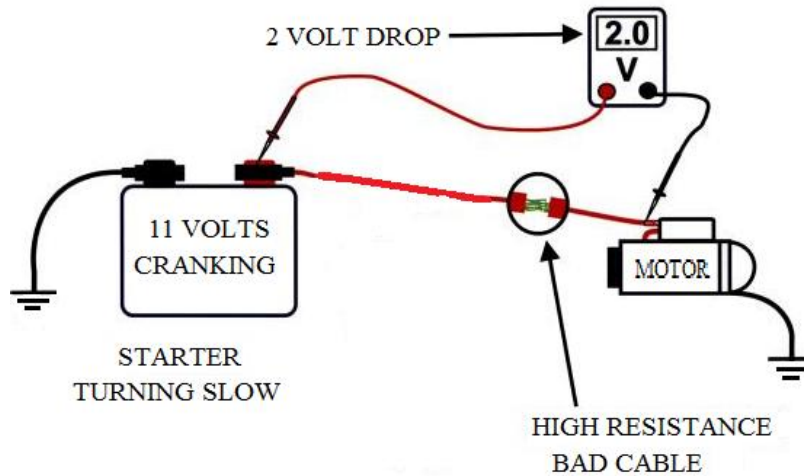


Figure: Insulated circuit resistance test for a starting system

Winter – 15 EXAMINATION

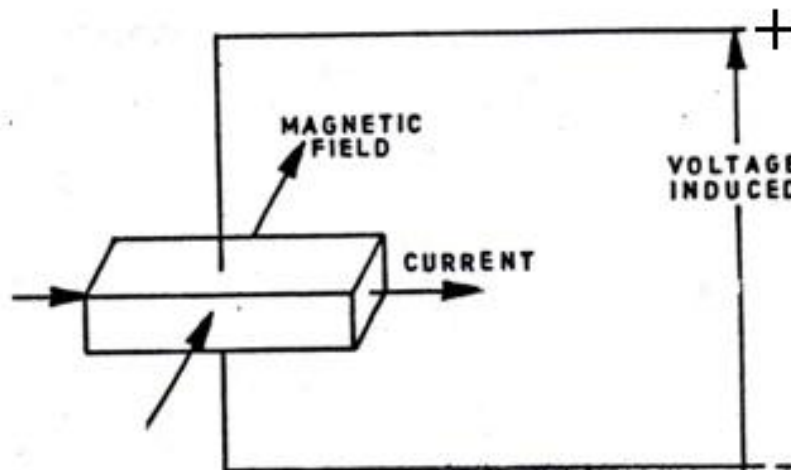
Subject Code: 17617

Model Answer

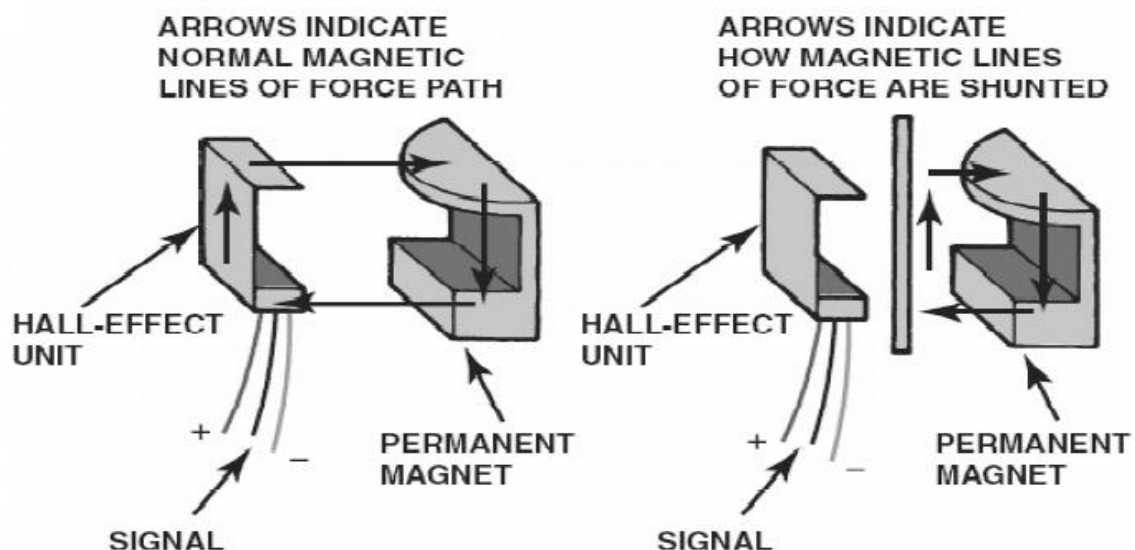
Page No: 24/25

- The Hall Effect switch consists of a Hall unit (Silicon), a permanent magnet, and a rotating shutter wheel.
- Whenever the opening of the rotating shutter wheel comes in between the Hall unit and the permanent magnet, it allows the magnetic field to strike the sensor and a small voltage is produced and is sent to the electronic control unit.
- As the distributor rotates, a blocking shutter diverts the magnetic field and the current stops flowing from the sensor.
- The electronic control units can be designed to either turn on or turn off the ignition coil primary current when the shutter blades are blocking.

**Principle of Hall Effect:**



OR





e) Describe operation of distributorless ignition system with block diagram.

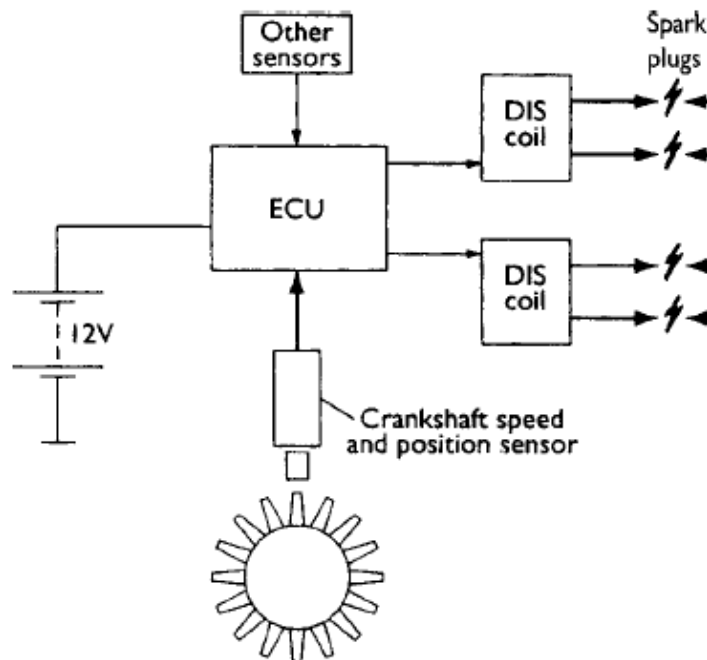
4

**Answer: The Distributor less ignition system consists of three main components:**

- i. An ECU
- ii. Crankshaft speed and crankshaft position sensor.
- iii. Ignition coils

- The system is generally used for four cylinder or six cylinder engines. The basic principle is that of the 'Lost Spark'.
- The distribution of the spark is achieved by using two double ended coils, which are fired alternately by using ECU.
- The timing is determined by using information from a crank shaft speed and crankshaft position sensors as well as some other sensors such as engine load, coolant temperature and detonation sensor etc.
- The coil pack (2 ignition coils for four cylinder engine) gets triggered twice in each cycle of operation by using ECU, so that flow of current through one of the two primary windings is stopped.
- When the flow of current is stopped, the magnetic field in the primary winding collapses suddenly and a high voltage is produced in the secondary winding.
- When one of the coils is fired, a spark is delivered to two companion cylinders, either 1 and 4 or 2 and 3 for four cylinder engine, at the end of compression and exhaust respectively.
- The spark delivered to the cylinder on the compression stroke will ignite the mixture.
- The spark produced in the other cylinder will have no effect, as this cylinder will be completing its exhaust stroke.

2



2

Figure: Block diagram of distributorless ignition system