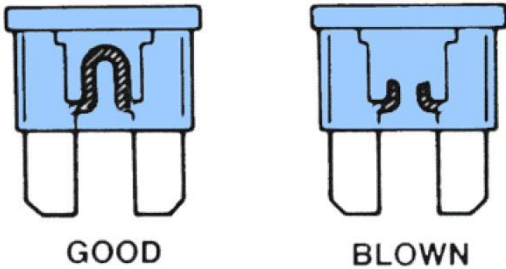


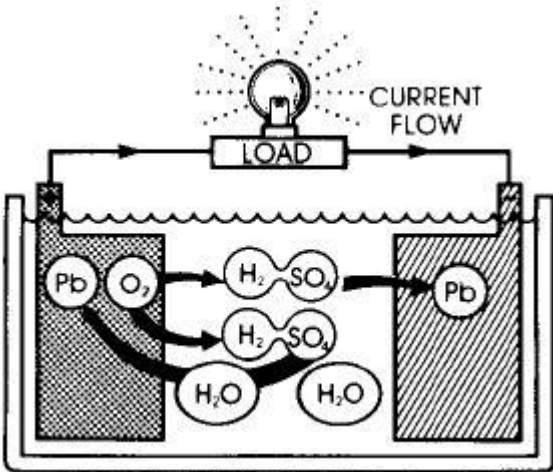


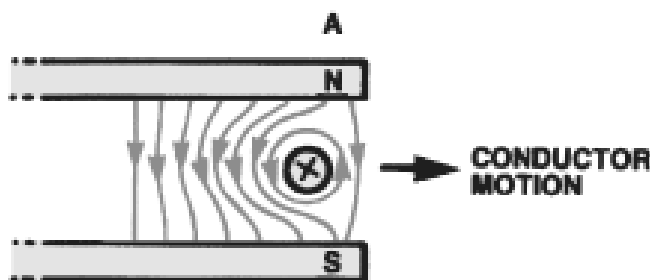
Important Instructions to examiners:

- 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.

Model Answer	Marks
Que.1. a) Attempt any <u>THREE</u> of the following.	12
a) How does an electrical fuse work?	04
<p>Answer : (Note: Working – 4 Marks, credit should be given for suitable sketch)</p> <p>A fuse is the most common circuit protection device. A fuse is placed in an electrical circuit so that, when current flow exceeds the rating of the fuse, it blows or blows out i.e. it is designed to turn off the circuit that it protects.</p> <p>The size of the metal fuse element determines the rating. Excessive current causes excessive heat and that causes the circuit protector to open as shown in the figure below. Once a fuse blows, it must be replaced with a new one.</p> <div style="text-align: center;"><p>GOOD BLOWN</p></div> <p>The element in the fuse melts, opening the circuit and preventing the other components of the circuit from being damaged by the over current. A fuse also separates a number of circuits like starting circuit, ignition circuit, charging circuit etc. thus failure of a fuse doesn't affect the other circuit.</p>	04



b) What happens in a lead acid cell during discharging?	04
<p>Answer: (Note: Description – 2 Marks, Chemical Reaction – 2 Marks & credit should be given for suitable sketch)</p> <p>During discharging, the sulphuric acid molecules split up into H_2 and SO_4. One SO_4 unites with the Pb of the positive plate, while the other unites with the Pb of the negative plate, forming $PbSO_4$ in each plate.</p>  $\begin{array}{ccccccc} & & \xrightarrow{\text{discharge}} & & & & \\ PbO_2 & + & 2H_2SO_4 & + & Pb & \rightleftharpoons & PbSO_4 + 2H_2O + PbSO_4 \\ & & \xleftarrow{\text{Charge}} & & & & \\ \left[\begin{array}{c} \text{Positive} \\ \text{plate} \end{array} \right] & \left[\begin{array}{c} \text{Electro} \\ \text{lyte} \end{array} \right] & \left[\begin{array}{c} \text{Negative} \\ \text{plate} \end{array} \right] & & \left[\begin{array}{c} \text{Positive} \\ \text{plate} \end{array} \right] & \left[\begin{array}{c} \text{Electro} \\ \text{lyte} \end{array} \right] & \left[\begin{array}{c} \text{Negative} \\ \text{plate} \end{array} \right] \end{array}$ <p>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_2O which is simply water.</p> <p>This means that during discharge, lead sulphate ($PbSO_4$) 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.</p>	04
c) What is the principle of operation of a starter motor?	04
<p>Answer:(Note: Description – 3 Marks, suitable sketch- 1 Mark)</p> <p>When current flows through a conductor, a magnetic field builds up around that conductor. If the conductor is in a magnetic field, the magnetic field exerts a force on the conductor as shown in the figure. The cross in the centre of the conductor indicates the current is flowing away from the observer. This causes the magnetic field due to current flow to encircle the conductor in counter clockwise direction.</p>	04



The circular magnetic field to the left of the conductor is in the same direction as the straight line magnetic field from the magnet. To the right of the conductor, the circular magnetic field is in the opposite direction. This weakens the magnetic field to the right of the conductor. Therefore the resulting magnetic field distorts around the conductor as shown.

Magnetic lines of force try to shorten themselves. This causes the bent lines of the force in the magnetic field pattern to try to straighten out, as they do, they try to push the conductor to the right.

d) Define the following terms related with an alternator

04

i) Initial Excitation

ii) Self Excitation

Answer:

i) **Initial Excitation:**

Initial Excitation is the process in which battery current is directly used with the help of rotor relay of voltage regulator to excite the rotor. Initial excitation means to provide magnetic field to the rotor. The vehicle battery supplies the required current to the rotor.

02

ii) **Self Excitation:**

Self Excitation is the process where some of the power outputs from the rotor is used to power the field coil. During running the alternator stator provides all the excitation current. hence the name 'Self Excitation'.

02

b) Attempt any ONE of the following:

06

a) How does a power door lock system operates?

06

Answer: (Note: Description - 6 Marks & credit should be given for suitable sketch)

Operation of Power Door Lock system:

Power door locks use either a solenoid or a permanent magnet reversible motor. Motors used in power door locks are operated through a relay by conventional switches. The reversible permanent magnet motor is controlled by a single pole double throw, double coil relay that is externally grounded.

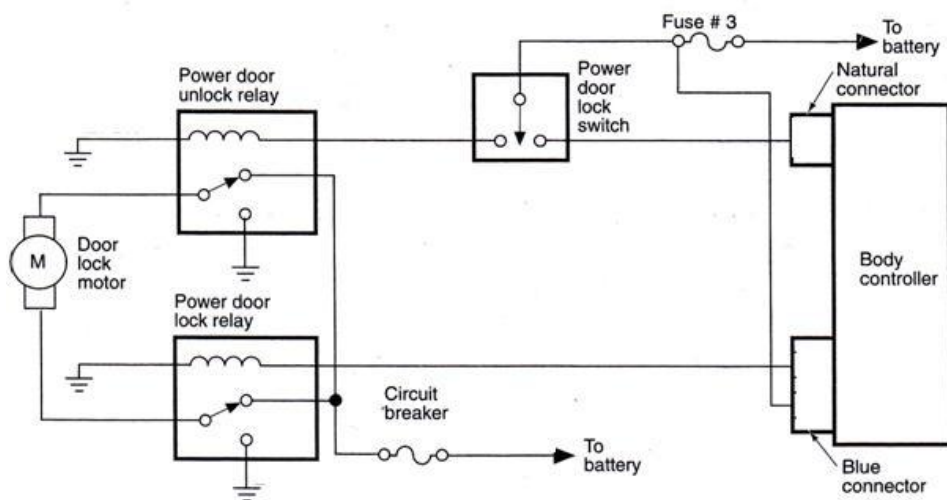
In order for the door lock controller to lock the doors, the following conditions must be met:

06

i. Ignition switch is in the RUN Position.



- ii. Seat Switch is closed by the driver.
- iii. All doors are closed (switches are open)
- iv. Gear selection is not in PARK.
- v. Courtesy light switch is OFF.



A clockwise rotation of the motor output shaft extends the shaft to unlock the door. When the polarity is reversed, the output shaft rotates counterclockwise, retracting the shaft to lock the door.

b) Explain the construction and working of hydrometer

06

Answer:

Hydrometer:

Construction:

A hydrometer is made up of a glass tube containing a weighted float with markings on its stem in figures, so that the specific gravity readings can be taken directly.

At one end of the glass tube is fitted with a rubber bulb and on the other end a flexible suction tube.

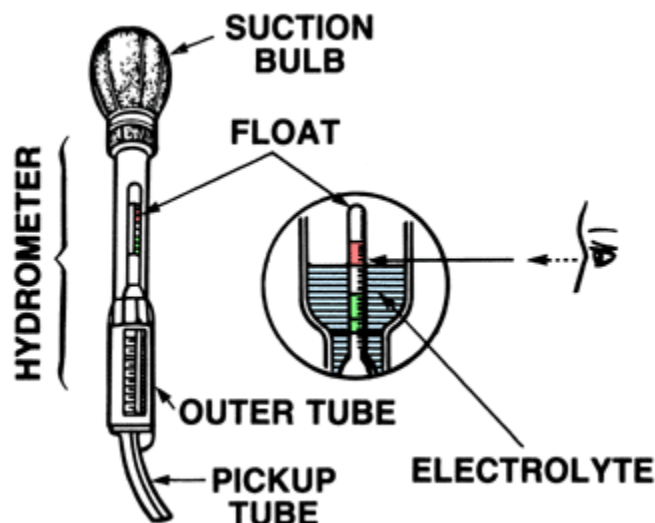
Working:

Insert the suction tube of the hydrometer into the battery cell. Squeeze the bulb and the electrolyte is drawn inside the tube, the float rises or sinks, depending upon the gravity of the electrolyte.

The specific gravity reading can be taken from the markings on the float stem.

02

02



02

2. Attempt any FOUR of the following

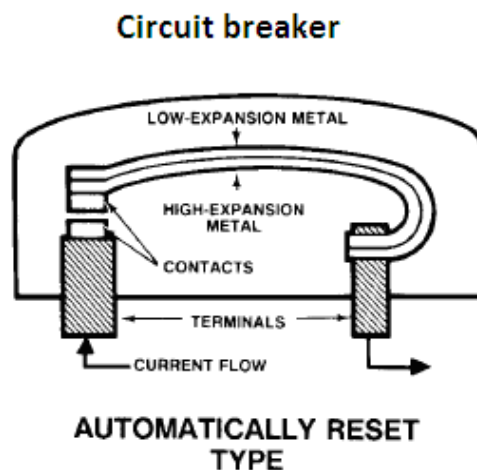
16

a) Explain the operation of a thermal circuit breaker

04

Answer:

Operation of a thermal circuit breaker: A circuit breaker uses a bimetallic strip that reacts to excessive current as shown in the figure.



01

A bimetallic strip consists of two different types of metals. One strip will react more quickly to heat than the other causing the strip to bend in proportion to the amount of current flow.

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.

03

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.



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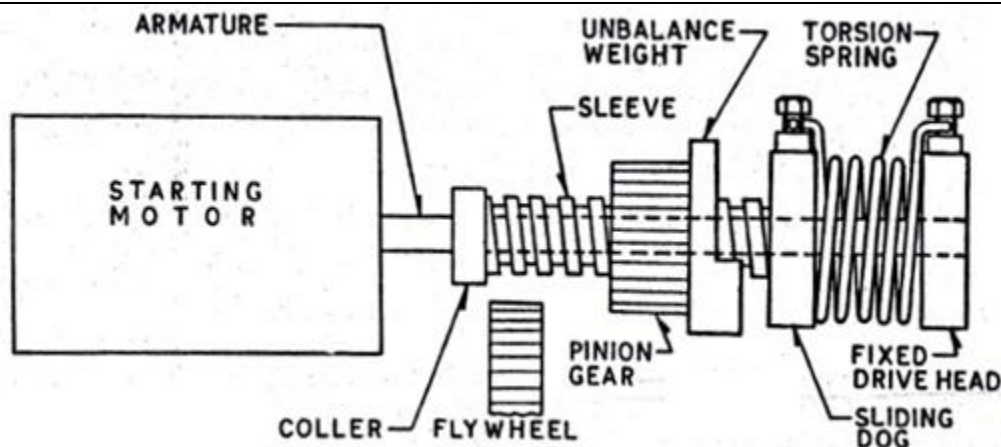
Summer – 14 EXAMINATION

Subject Code: 12252

Model Answer

Page No: 6/22

b) How do maintenance free batteries differ from conventional lead acid battery?	04														
Answer: (Note: Any four – 1 Mark each)															
<table><thead><tr><th>Conventional Lead acid Battery</th><th>Maintenance Free Battery</th></tr></thead><tbody><tr><td>• Plate grid material is lead antimony alloy</td><td>• Plate grid material is lead alloyed with calcium/cadmium/strontium.</td></tr><tr><td>• It is prone to gassing and also prone to self discharge</td><td>• Lead calcium alloy reduces gassing and also reduces self discharge.</td></tr><tr><td>• It requires frequent filling of distilled water.</td><td>• It doesn't require filling of distilled water.</td></tr><tr><td>• Battery has vent plugs for release of gases.</td><td>• Battery is sealed & gasses are collected and condensed and drain back into the cells.</td></tr><tr><td>• In built hydrometer is not provided.</td><td>• It has in built hydrometer.</td></tr><tr><td>• It tolerates deep cycling.</td><td>• It doesn't tolerate deep cycling.</td></tr></tbody></table>	Conventional Lead acid Battery	Maintenance Free Battery	• Plate grid material is lead antimony alloy	• Plate grid material is lead alloyed with calcium/cadmium/strontium.	• It is prone to gassing and also prone to self discharge	• Lead calcium alloy reduces gassing and also reduces self discharge.	• It requires frequent filling of distilled water.	• It doesn't require filling of distilled water.	• Battery has vent plugs for release of gases.	• Battery is sealed & gasses are collected and condensed and drain back into the cells.	• In built hydrometer is not provided.	• It has in built hydrometer.	• It tolerates deep cycling.	• It doesn't tolerate deep cycling.	04
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• It tolerates deep cycling.	• It doesn't tolerate deep cycling.														
c) What are the types of starter drive system used in a vehicle? Describe working of one type.	04														
Answer: (Note: Listing any two – 1 Marks, Working– 3 Marks, credit should be given to sketch) The various drives are as follows:- 1) Bendix drive 2) Folo-thru drive 3) Barrel type drive 4) Gear reduction drive 5) Overrunning clutch 6) Dyer drive 7) Friction clutch drive Working: Bendix Drive 1. When the motor starts, the armature shaft rotates causing the sleeve to rotate and because the pinion cannot rotate due to unbalance weight, it moves axially towards the motor till it is engaged with flywheel. 2. Further movement of the pinion is prevented by the collar attached on the sleeve and because of this pinion has to start rotating. 3. As it is also mesh with engine flywheel, the flywheel is rotated and the engine starts. 4. When the engine starts, it is flywheel that rotates the pinion and because of its bigger size, the flywheel rotates the pinion much faster than the armature (which by now, has slowed down due to releasing of the self- starter switch) with the result that the pinion backed out of mesh with the flywheel															



d) Describe working of Electronic voltage regulator

04

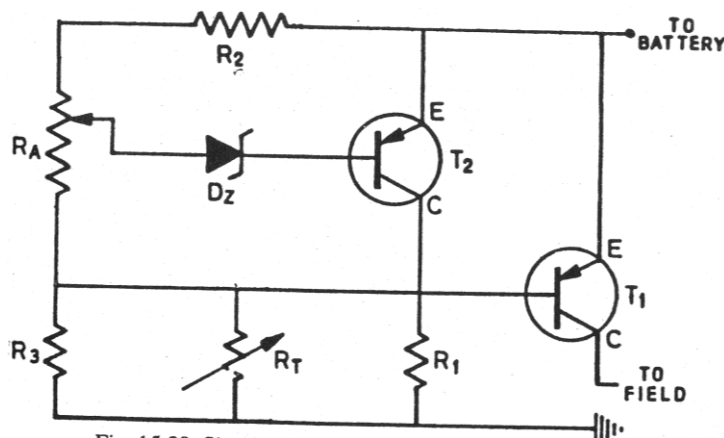
Answer:(Note: Working– 3 Marks, suitable circuit diagram – 1mark)

Working of electronic voltage regulator-

The voltage regulator uses the pair of transistors to regulate the field current. Using the resistors R_1 , R_2 & R_3 , R_A & R_T the required voltage drops are achieved as per the need of the circuit.

With transistor T_1 in switched ON condition, full current goes to alternator field. Battery voltage is applied to transistor T_2 but reversed biased zener diode D_z would not allow the base current to flow so long as voltage applied to it is below the zener point with the result that T_2 remains OFF. A small current would then flow through R_2 , R_A & R_3 to ground.

04



When the zener diode receives a higher voltage, reverse current flow starts. The zener point is adjusted by resistor R_A . As transistor T_2 comes ON, T_1 get OFF and rotor field current flow stops.

With the stopped field current, alternator voltage drops. It causes transistor T_2 to switch OFF and T_1 to switch ON. This cycle is repeated at high frequency (7000 cycles per second approximately) to regulate the output voltage of alternator.

The regulator comes in to action with charged battery having adequate voltage. It doesn't work at low battery voltage i.e. the field current continues to flow fully.



e) Why is Electronic Ignition preferred to conventional ignition system?	04
<p>Answer: (Note: Any four points – 1 Mark each)</p> <p>Electronic ignition system is preferred to conventional ignition system for the following reasons:</p> <ul style="list-style-type: none">a) Proper spark timing is achieved throughout the speed rangeb) No contact breaker points to erode or wear. This eliminates maintenance in respect of C.B. point replacement, dwell adjustment and setting of spark timing. Furthermore, the timing remains correct for a very long period.c) High energy output from the ignition coil is obtained.d) It gives noiseless operation at high speed; the switching speed is very high up to 10^9 / second.e) Spark plug electrode remains clean off carbon deposits & ash deposits.f) Ignition advance can be electronically obtained unlike conventional mechanical advance mechanism.g) Reduction in emission.h) Increased output power.	04
f) How can fiber optic materials be useful in Advanced lighting system?	04
<p>Answer:</p> <ul style="list-style-type: none">• The invention of fiber optics material 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. <div data-bbox="253 1314 1292 1801"></div>	04



3. Attempt any FOUR of the following:

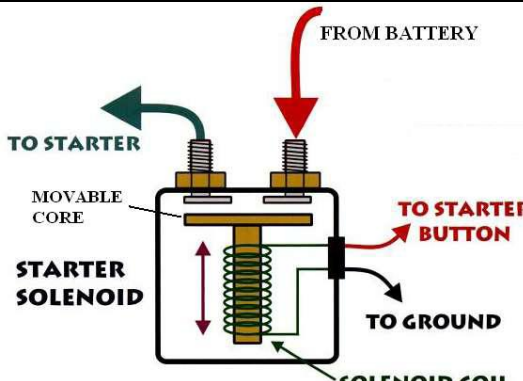
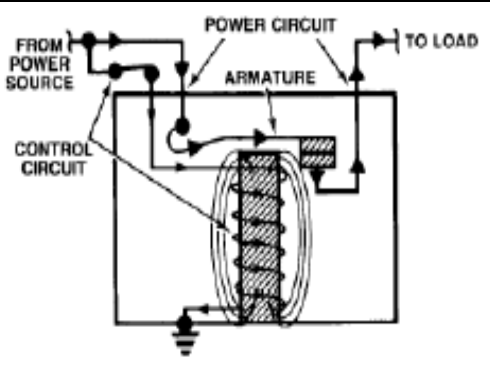
16

a) What is the difference between solenoid and relay as applied to automobile practice?

04

Answer: Difference between a solenoid and relay as applied to automobile practice is as follows.

(Note: Any 2 points, 2 mark each.)

Sr. No.	Solenoid	Relay
1	Core is movable, Armature is stationary	Core is stationary, Armature is movable.
2	Applications: Starter motor solenoid, EGR solenoid, Canister Purge solenoid.	Applications: horn relay, headlight relay, Radiator fan relay.
3		

04

b) Describe “Trickle charging” procedure. When trickle charging is done?

04

Answer: Trickle Charging procedure:

Trickle charging, or **float charging**, means charging a battery at a similar rate as its self-discharging rate (of about 5 % of the normal charging current), thus maintaining a full capacity battery. It is a very slow process tried on sulphated battery to recover it. Care must be taken, however, that if a battery regulator is not employed, overcharging and possible damage or leakage may occur.

02

Trickle charging is done for the following conditions:

02

1. Vehicle at garage and being used infrequently.
2. Vehicles on display at showrooms or expositions.
3. Sulphated battery

c) How does an “Over running clutch” work?

04

Answer: Overrunning clutch working:

(Note: Working -4 Marks; Credit may be given to the diagram, if drawn)

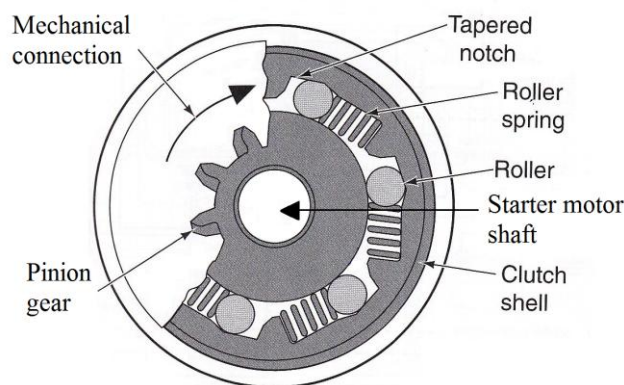
The Overrunning clutch is a roller-type clutch that transmits torque in one direction only and freewheels in the other direction. This allows the starter motor to transmit torque to the ring gear, but prevents the ring gear from transferring torque to the starter motor.

In a typical overrunning clutch, the clutch, the clutch housing is internally splined to the starter armature shaft. The drive pinion turns freely on the armature shaft within the clutch housing. When



torque is transmitted through the armature to the clutch housing, the spring-loaded rollers are forced into the small ends of their tapered slots. They are then wedged tightly against the pinion barrel. The pinion barrel and clutch housing are now locked together; torque is transferred through the starter motor to the ring gear and engine.

When the engine starts and is running under its own power, the ring gear attempts to drive the pinion gear faster than the starter motor. This unloads the clutch rollers and releases the pinion gear to rotate freely around the armature shaft. Thus it protects the starter motor from getting driven by the started engine.



Overrunning Clutch

04

d) Describe the construction of an alternator.

04

Answer: Alternator construction: (Note: Components-1 mark and construction description- 3 marks)

An alternator assembly consists of rotor, brushes, stator, rectifier bridge, housing and cooling fan.

01

The **rotor** is rotated by the drive belt. It is constructed of many turns of copper wire around an iron core. There are metal plates bent over the windings at both ends of the rotor winding. The metal plates are called poles or fingers.

The wires from the rotor coil are attached to two **slip rings** that are insulated from the rotor shaft. The brushes and slip rings provide a means of maintaining electrical continuity between stationary and rotating components.

03

The **stator** is the stationary coil which contains three main sets of windings wrapped in slots around a laminated circular iron frame. Each of the three windings has the same number of coils as the rotor has pairs of north and south poles.

The rotor is fitted inside the stator. A small air gap is maintained between the rotor and the stator.

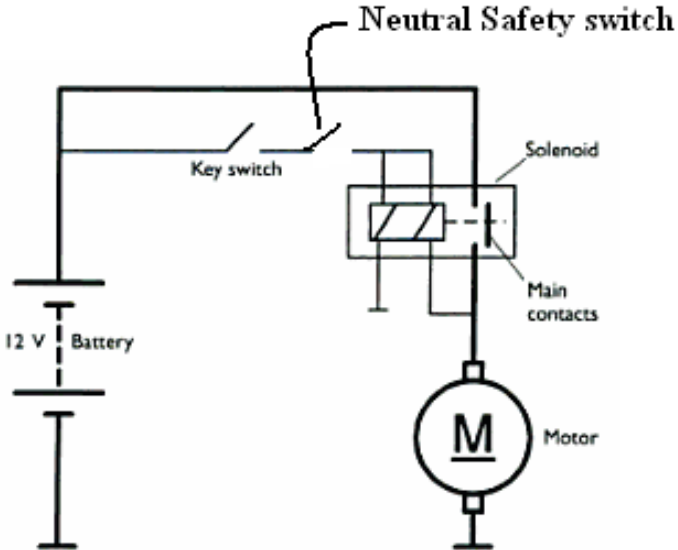
The delta connection connects the lead of one end of the winding to the lead at the other end of the next winding.

The **housing** is a two-piece construction, made from cast- aluminium. The two end frames provide support to the rotor and the stator. In addition, the end frames contain diodes, **regulator**, **heat sinks**, **terminals**, and other components of the alternator.

The **cooling fan** draws air in the housing through the openings at the rear of the housing. The air leaves through openings behind the cooling fan.

e) State three merits and one demerit of CDI system	04
Answer: Merits of CDI system <i>(Note: Any 3 merits- 1 mark each; demerit-1 mark)</i> <ol style="list-style-type: none"> 1. High voltage at secondary circuit throughout engine speed range. 2. Fast buildup of output voltage. 3. A large spark plug gap may be utilized to get a larger spark. 4. Spark plug fouling is greatly reduced. 5. Maintenance is easier. 6. Precise control of ignition timing is obtained. 	03
Demerit of CDI system <ol style="list-style-type: none"> 1. Short Spark duration. 	01
4 a) Attempt any <u>THREE</u> of the following:	12
a) List four salient features of scan tester.	04
Answer: Salient features of Scan Tester: <i>(Note: Any 4 points- 1 mark each)</i> <ol style="list-style-type: none"> 1. Display window displays data and messages to the technician. 2. Memory cartridge is plugged into the scan tester. 3. Power cord is connected from the scan tester to the battery terminals or auxiliary power point in the vehicle. eg. Mobile charger socket or Cigarette lighter socket. 4. Adapter cord that plugs into the scan tester and connects to the data link connector on the vehicle 5. Serial interface for connecting optional devices, such as a printer, terminal, or personal computer. 6. Keypad that allows the technician to enter data and reply to the tester messages. 	04
b) Describe battery load test procedure.	04
Answer: Battery Load Test Procedure The following steps are included in the procedure for Battery load test. <ol style="list-style-type: none"> 1. Test the open circuit voltage. The battery must be at least half charged. If the open circuit voltage is less than 12.4 V, charge the battery. 2. Disconnect the battery cables, ground cable first. 3. Prepare the tester. Check the meter's mechanical zero. Adjust, if necessary. Connect the tester load leads to the battery terminals. Connect RED to Positive, BLACK to negative. Test voltmeter should indicate battery open-circuit voltage. 4. Load the battery by pressing the load button. Maintain the load for no more than 15 seconds and note the voltmeter reading. 5. Immediately release the press button for load test. 6. If the voltmeter reading was 10.0 volts or more, the battery is good. If the reading is 9.6 volts, the battery is serviceable, but requires further testing. Charge and re-test. If the reading was below 9.6 volts, the battery is either discharged or defective. Note: the test results will vary with temperature. Low temperatures will reduce the reading. The battery should be at operating temperature.	04



c) Draw a labeled diagram of automotive starting circuit	04
<p>Answer: (Note: Equivalent circuit diagram - 3 marks and Labels- 1 mark.)</p>  <p style="text-align: center;">Figure: Basic Starter Circuit</p>	04
d) Describe the purpose of the alternator stator and rotor.	04
<p>Answer: Purpose of Alternator Stator and Rotor is as follows.</p> <p>The field winding of the Rotor receives current (2 to 5 amperes) through Slip rings and brushes. A small air gap allows the rotor's magnetic field to energize all the windings of the stator at the same time and to maximize the magnetic force. The rotor creates magnetic field of the alternator that is rotated by the drive belt.</p> <p>The stator is stationery coil in which electrical voltage is produced. As the rotor revolves in the stator, a voltage is produced in each loop of the stator at different phase angles. Alternator output is taken out from the stator.</p>	02 02
b) Attempt any <u>ONE</u> of the following:	06
a) i) Enlist the various types of speedometers. ii) Explain with neat sketch working of one speedometer type	06
<p>Answer: (Note: List - 2 Marks, Working - 2 marks and equivalent sketch - 2 marks)</p> <p>Types of Speedometer are</p> <ol style="list-style-type: none">1. Mechanical Speedometer2. Electrical / Electronic Speedometers <p>1 Mechanical Speedometer: the speedometer is driven from the transmission output shaft by a set of gears. The driven gear fastens to a flexible shaft or speedometer cable. It runs from the transmission output shaft to the back of the speedometer head.</p>	02

Inside the speedometer, the cable turns a shaft with a small magnet on it. The rotating magnetic field produces a varying pull on the metal ring surrounding the magnet. A pointer is attached to the metal ring. As the magnetic field spins, it causes the ring to overcome a light spring and swing with the magnetic field. This moves the pointer which then indicates car speed. The faster the vehicle speed, the faster the magnet spins, and the farther the pointer moves.

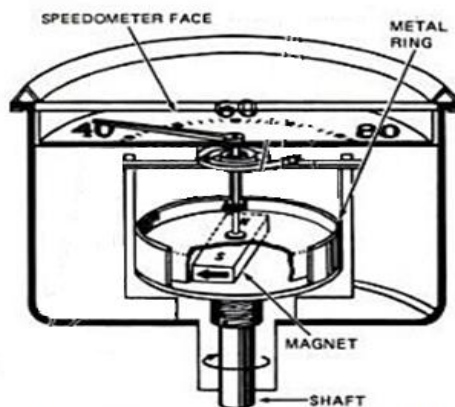


Fig: A speedometer Assembly

OR

2. Electrical / Electronic Speedometer:

The electronic Speedometer receives voltage signal from the vehicle speed sensor (VSS). This sensor can be a PM generator, Hall effect sensor or Optical sensor.

Such speedometer operates using conventional speedometer cable. The cable rotates a slotted wheel between a light-emitting diode (LED) and a phototransistor. As the slots in the wheel break the light, the transistor conducts an electronic pulse signal to the speedometer. An integrated circuit rectifies the analog input signal from the optical sensor and counts the pulses per second. The value is calculated into kilometers per hour and displayed in the digital readout. The display is updated every 1/2 second.

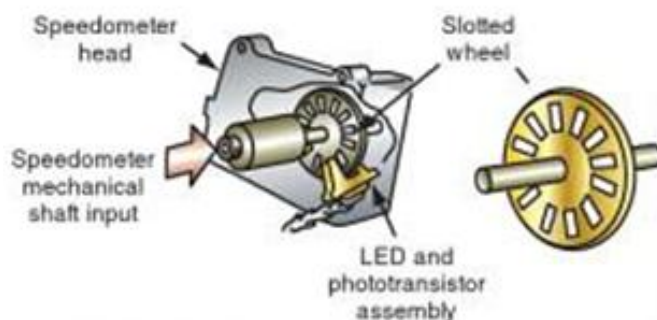


FIGURE Optical speed sensor.

OR



Transistorized Pulse Generator type Speedometer:

The circuit shown in the figure has a single cable joining the transducer to the speedometer. Pulses are passed through this cable to an IC chip within the speedometer. This chip counts and converts the pulses to an analogue signal. Needle operation of the speedometer is produced by an action similar to that given by a normal voltmeter.

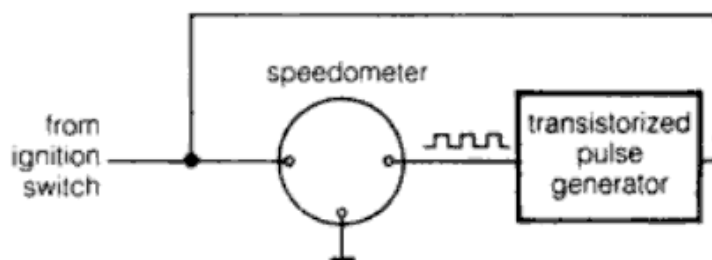


Fig. Transistorized pulse generator-type speedometer

b) How are the following defects caused in lead acid batteries:

- Sulphation
- Self discharge
- Internal short circuit

Answer: (Note: 2 marks each defect)

The defects caused in lead acid batteries in the following way.

- Sulphation:** If a battery is allowed to stand in a discharged condition for a longer period, the lead sulphate will become hard, which shall resist reconversion. During this process the negative plates become greyish white, whereas the positive plates tend to become milky white. In addition, the plates tend to expand and break the grid.
- Self-discharge:** Batteries tend to self-discharge over a period of time. Even if a battery is not utilized, it is found to discharge at a slower rate. The self-discharge tends to occur more quickly at higher temperatures.
- Internal short circuit:** Internal short circuit occurs due to bridging over of the material across the negative and positive plates which has been shed from them. The short circuits may also result because of the failure of a separator. Orange-coloured spots are developed on the plates or the separators. These are due to the heat produced from short-circuits.

5. Attempt Any Four of the following:

a. Describe the operation of charge indicator light circuit.

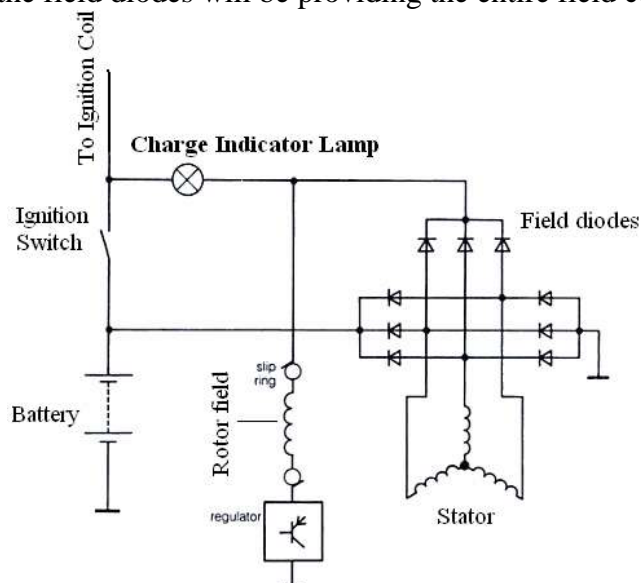
Answer: (Operation - 4 Marks & give credit to sketch if drawn)

Operation of Charge Indicator Light Circuit:

- When the engine is to be started, the ignition is switched on.
- This connects the Charge Indicator Lamp to the battery and makes a circuit through rotor field and regulator to earth.
- At this stage the charge indicator lamp is illuminated and the field is excited to the extent controlled by the wattage of the lamp; a typical lamp size is 12V, 2W.



- As alternator speed is raised, the potential difference on the output side of the field diodes is increased.
- This gradually reduces the voltage applied to the lamp so the light slowly fades and goes out when the output voltage of the alternator equals the battery voltage; i.e. when the alternator “cuts – in” and starts to charge.
- When this happens the field diodes will be providing the entire field current.



a. How is the Hall Effect used in Triggering Electronic Ignition System?

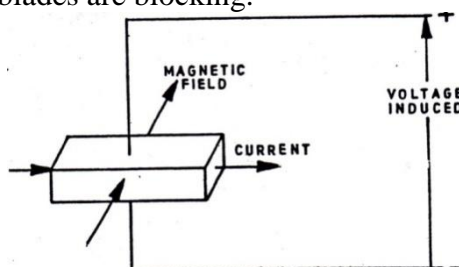
04

Answer:

Hall Effect:

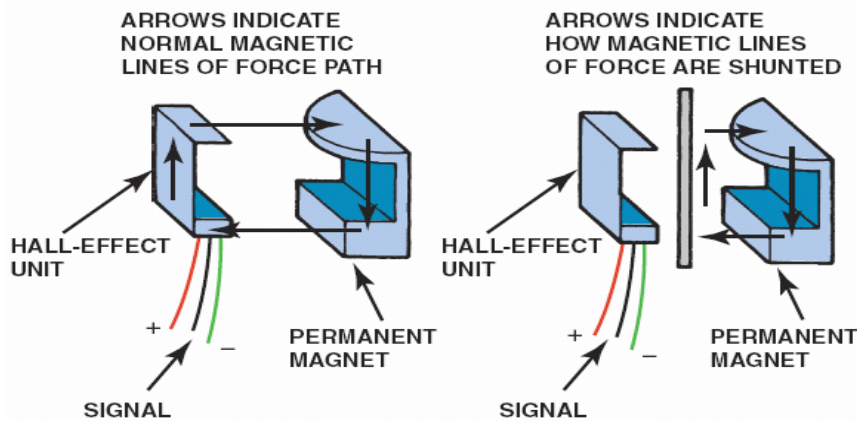
When a thin rectangular gold conductor carrying a current is crossed at right angles by a magnetic field, a difference of potential is produced at the edges of the gold conductor. Modern Hall effect units use semiconductor material e.g. silicon.

- 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.



04

OR



As the central shaft of the distributor rotates, the chopper plate attached under the rotor arm alternately covers and uncovers the Hall chip. The number of vanes corresponds with the number of cylinders. In constant dwell systems the dwell is determined by the width of the vanes. The vanes cause the Hall chip to be alternately in and out of a magnetic field. The result of this is that the device will produce almost a square wave output, which can then easily be used to switch further electronic circuits.

The three terminals on the distributor are marked ‘_ 0 _’; the terminals _ and _ are for a voltage supply and terminal ‘0’ is the output signal. Typically the output from a Hall effect sensor will switch between 0 V and about 8V. The supply voltage is taken from the ignition ECU and on some systems is stabilized at about 10 V to prevent changes to the output of the sensor when the engine is being cranked.

b. Describe distributorless ignition system working with a schematic diagram.

04

Answer: (Explanation 2 marks, Equivalent diagram- 2 Marks)

Working of distributorless ignition system:

- In the distributorless ignition system, the spark plugs are fired directly from the coils. The spark timing is controlled by an Ignition Control Unit (ICU) and the Engine Control Unit (ECU).
- The distributorless ignition system may have one coil per cylinder, or one coil for each pair of cylinders. Some systems use one ignition coil per two cylinders.
- This type of system is often known as the waste spark distribution method.
- In this system, each cylinder is paired with the cylinder opposite it in the firing order (usually 1-4, 2-3 on 4-cylinder engines or 1-4, 2-5, 3-6 on V6 engines).
- The ends of each coil secondary leads are attached to spark plugs for the paired opposites.
- These two plugs are on companion cylinders, cylinders that are at Top Dead Center (TDC) at the same time. But, they are paired opposites, because they are always at opposing ends of the 4 stroke engine cycle.
- When one is at TDC of the compression stroke, the other is at TDC of the exhaust stroke. The one that is on compression is said to be the event cylinder and one on the exhaust stroke, the waste cylinder.
- When the coil discharges, both plugs fire at the same time to complete the series circuit.
- Since the polarity of the primary and the secondary windings are fixed, one plug always fires in

02



a forward direction and the other in reverse.

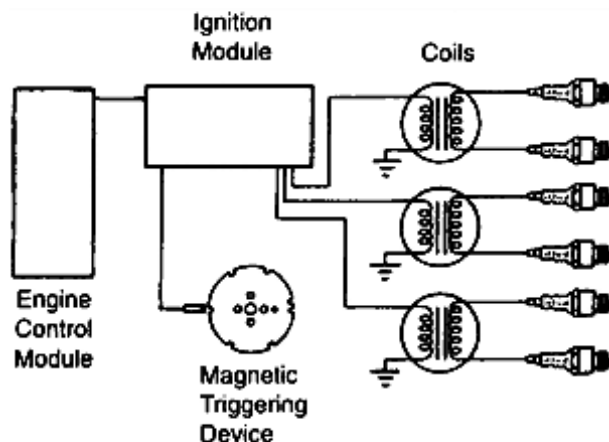


Figure: Typical distributorless ignition schematic.

02

c. Describe a typical keyless entry system.

04

Answer:

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:

- 1) A control module
- 2) A coded button keypad located on the driver's door
- 3) Door lock motors

The keypad consists of five normally open, single-pole, 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.

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.

04

d. Explain operation of Automatic On/OFF headlight with time delay.

04

Answer:

The automatic on/off with time delay feature has two functions:-

- To turn on the headlights automatically when the ambient light decreases to a predetermined level.
- To allow the headlights to remain on for a certain amount of time after the vehicle has been turned off.

This system is used in combination with the automatic dimming system. The common components of the automatic on/off with time delay include:-

- i. Photocell and amplifier.



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<p>ii. Power relay. iii. Timer control.</p> <p>In this system the photocell is located inside the vehicles dash to sense the outside light. As the ambient light level decreases, the internal resistance of the photocell increases. When the resistance value reaches a predetermined value, the photocell and amplifier trigger the sensor amplifier module. The sensor-amplifier module energizes the relay, turning on the headlights and exterior parking lights. Some systems provide a time delay feature that allows driver to set a timer circuit to control how long the headlights remain on after they leave the vehicle.</p> <p>The timer control is a potentiometer that is the part of the head light switch. The timer control unit controls the automatic operation of the system and the length of time the headlights stay on after the ignition switch is turned off.</p> <p>The timer control signals the sensor-amplifier module to energize the relay for the requested amount of time.</p>	04
<p>e. State the purpose of OBD-II. Define the terms Drive Cycle and Trip.</p>	04
<p>Answer:</p> <p>The purpose of OBD-II: (any 2 points of following- 1 mark each)</p> <ul style="list-style-type: none"> • 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. • The standardized data link connector, developed by OBD II and the SAE, allows for these tools to communicate with the PCM. • Onboard Diagnostic system capable of 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. • 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. <p>i. DRIVE CYCLE:</p> <p>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.</p> <p style="text-align: center;">OR</p> <p>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.</p> <p>ii. TRIP:</p> <p>A trip is defined as an engine operating drive cycle that contains all of the necessary conditions for a particular test to be performed.</p> <p style="text-align: center;">OR</p> <p>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. For example, for the EGR test to be performed, the engine has to be at normal operating temperature and decelerating for a minimum amount of time.</p>	<p>02</p> <p>01</p> <p>01</p>



06. Attempt Any Four of the following:

16

a. Differentiate between battery and Magneto Ignition System.

04

Answer:

Any 4 of the following (1 Mark Each)

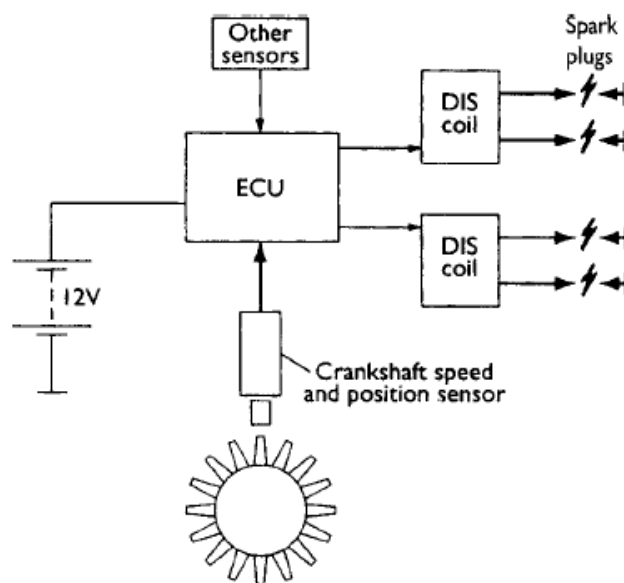
Battery Ignition System	Magneto Ignition System
• Battery is necessary. Difficult to start the engine when battery is discharged.	• No battery is needed and therefore there is no problem of battery discharge.
• Maintenance is more due to battery	• Maintenance is less since there is no battery
• Current for the primary circuit is obtained from the battery	• The required electric current is generated by the magneto.
• A good spark is available at the spark plug even at low speed.	• During starting, quality of spark is poor due to low speed.
• Efficiency of the system decreases with the reduction in spark intensity as engine speed rises.	• Efficiency of the system improves as the engine speed rises due to high intensity spark.
• Occupies more space.	• Occupies less space.
• Commonly employed in cars and light commercial vehicles.	• Mainly used in racing cars and two wheelers.

04

b. Draw labeled diagram of computer controlled coil ignition system.

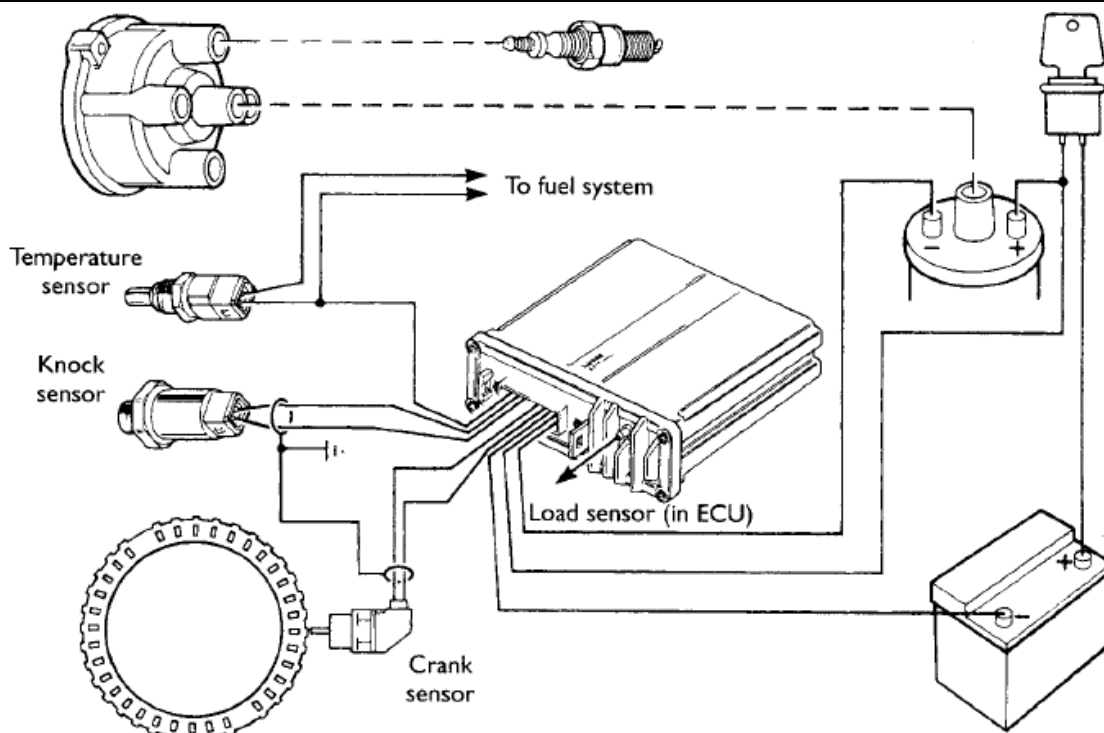
04

Answer: *Equivalent Sketch – 3 Marks & Labeling – 1 Mark*

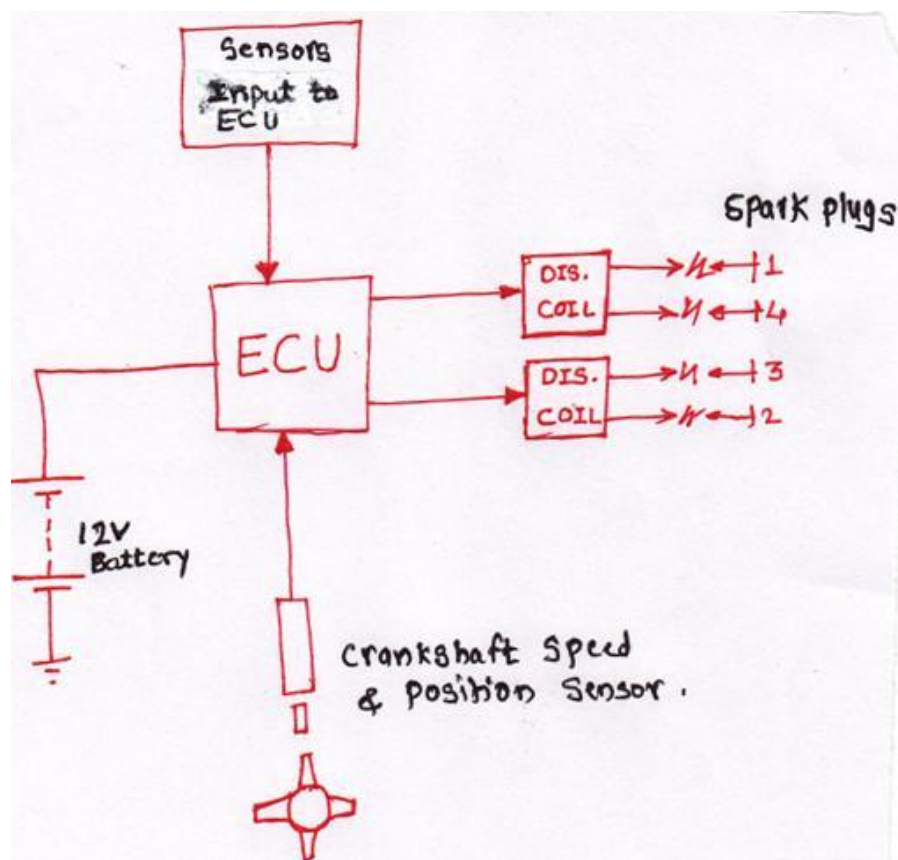


04

OR



OR





c. Enlist the common anti theft system used in modern automobiles. Explain any one in brief.	04
<p>Answer: (Listing – 2 Marks & simple explanation of any one type of antitheft system used in vehicles-2 Marks)</p> <p>Following are the common anti theft systems used in modern automobiles:</p> <p>Three basic types of antitheft devices are available: locking devices, disabling devices, and alarm systems.</p> <ul style="list-style-type: none">i. locks and keysii. Passkey Systemsiii. Keyless Entry Systemsiv. Alarm Systems <p>Anti-theft system: (any one)</p> <p>An anti-theft system is any device or method used to prevent or deter the unauthorized appropriation of items considered valuable. Anti-theft systems have been around since individuals began stealing other people's property and have evolved accordingly to thwart increasingly complex methods of theft. From the invention of the first lock and key to the introduction of RFID tags and biometric identification, anti-theft systems have evolved to match the introduction of new inventions to society and the resulting theft of them by others.</p> <p>a) locks and keys:</p> <p>Locks are designed to deny entry to the engine, passenger, and trunk compartments of the car as well as to prevent a thief from driving the car away. Most locks deny entry by moving a mechanical block between the vehicle's body and the door. Latches and keys simply move those blocks.</p> <p>b) Passkey Systems</p> <p>The passkey is a specially designed key, or transponder, that is selected and programmed just for the vehicle for which it was intended. Although another key may fit into the ignition switch or door lock, the system does not allow the engine to start without the correct electrical signal from the key.</p> <p>c) Keyless Entry Systems</p> <p>A keyless entry system allows the driver to unlock the doors or trunk lid from outside of the vehicle without using a key. It has two main components: an electronic control module and a coded-button keypad on the driver's door or a key fob</p> <p>d) Alarm Systems:</p> <p>The two methods for activating alarm systems are passive and active. Passive systems switch on automatically when the ignition key is removed or the doors are locked. They are often more effective than active systems. Active systems are activated manually with a key fob transmitter, keypad, key, or toggle switch.</p>	02

<p>d. Give probable causes and remedies for the following troubles:</p> <p>i) Gauge reads low constantly.</p> <p>ii) Inaccurate gauge reading.</p>	<p>04</p>
<p>Answer: (Equivalent points should be given credit)</p> <p>i) Gauge reads low constantly:</p> <p>Causes:</p> <p>A gauge that constantly reads low when the ignition switch is in the RUN position indicates an open in the gauge circuit.</p> <p>Remedies:</p> <p>To locate the open circuit, following steps are carried out:</p> <p>i) Disconnect the wire harness from the sending unit.</p> <p>ii) Connect a jumper wire between the wire circuit from the gauge and ground.</p> <p>iii) Turn the ignition switch to the RUN position. The gauge should indicate maximum.</p> <p>If the gauge reads high, check the sending unit ground connection. If the ground is good, the sending unit is faulty and must be replaced.</p> <p>ii) Inaccurate gauge reading:</p> <p>Causes:</p> <p>It is usually caused by faulty sending units. Other reasons for inaccurate gauge reading include poor connections, resistive shorts and poor grounds. Also there may be damage around the sending unit. e.g. a damaged fuel tank can result in accurate gauge readings.</p> <p>Remedies:</p> <p>To test the operation of the gauge, need the manufacturer's specifications concerning resistance values as they relate to gauge readings. Gauge testers are available to test the units as different resistance values are changed.</p>	<p>01</p> <p>01</p> <p>01</p> <p>01</p>
<p>e. How Ohmmeter test of an Electronic fuel injector is done?</p>	<p>04</p>
<p>Answer: Description- 4 Marks OR schematic diagram – 2 marks and Description – 2 marks.</p> <p>Following are the steps of Ohm meter test for electronic fuel injector:</p> <ul style="list-style-type: none"> • An ohmmeter is connected across the injector terminals to check the injector windings after the injector wires are disconnected. <div data-bbox="589 1499 997 1812" data-label="Diagram"> </div> <ul style="list-style-type: none"> • 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. 	<p>04</p>