



Subject Name: Automotive Electrical & Electronics Systems

Subject Code:

22651

Model Answer

Important Instructions to examiners:

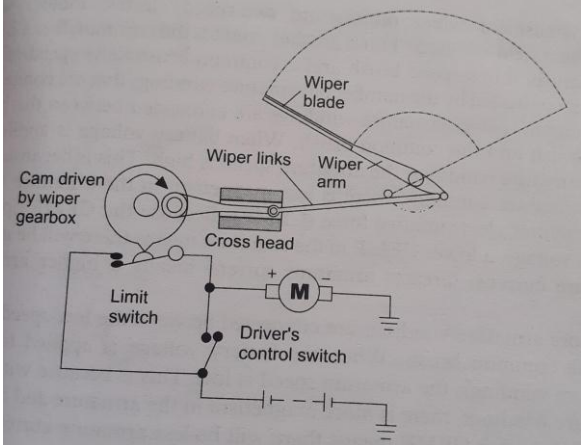
- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling 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.
- 8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		Attempt any FIVE of the following	10
	a	List four types of circuit defects	02
		Answer:- (<i>1/2 mark for each type</i>) i) Open circuit ii) Short circuit iii) Short to ground iv) Voltage drop (Undesired Resistance in connection)	<i>1/2 mark for each type</i>
	b	Interpret the function of a buzzer in automotive electrical system	02
		Answer:- (<i>2 marks for interpretation</i>) Function of buzzer in an automobile is to warn the driver about possible safety hazard by an audio signal. Seat belt, Speed limit and similar safety provisions are made to avoid possibility of hazard to passengers. If these are not followed, the driver is warned through an audio signal. Driver is supposed to take relevant corrective action. Buzzer buzzes till	02



		corrective action is taken.	
c		State four parameter of battery specification	02
		Answer: (Any four parameters, ½ mark each) 1. Voltage 2. Capacity 3. Dimension 4. Battery rating/s 5. Dimension 6. Cycle life 7. Fast Charge Time 8. Energy Density 9. Polarity 10. Acid volume 11. Operating Temperature	½ mark each
d		Defines and list types of battery ratings	02
		Answer: (½ mark for each rating, any four) <ul style="list-style-type: none">● Ampere-Hour Rating- Describes how much current the battery is able to supply for 10 or 20 hours● Watt-Hour Rating- A Watt-hour is the <i>voltage</i> (V) that the battery provides multiplied by how much <i>current</i> (Amps) the battery can provide for some amount of time (generally in hours).● Reserve capacity - The reserve capacity rating measures the amount of time (in minutes) a fully charged battery can - discharge at 25 amperes, while maintaining a voltage of at least 1.75 volts per cell.● Cold Cranking Amperes- It is the number of amperes that a battery delivers for 30 seconds at 0°F without the cell voltage falling below 1.2 volts● Twenty Minutes Rating: it is the amount of current a battery can deliver - for 20 minutes, without dropping the cell voltage below 1.75 volts and temperature of 26°C is maintained at the start of the test.	½ mark for each rating, any four
e		List types of methods of triggering primary circuit	02
		Answer: (2 marks for correct types) <ul style="list-style-type: none">● Magnetic Pick up	2 marks for correct



	<ul style="list-style-type: none">• Hall effect generator• Optical Pulse generator	types
f	Explain reasons for providing time delay in automatic headlight system	02
	<p>Answer: (2 marks for correct explanation)</p> <p>Time delay in automatic headlight system enables a vehicle to illuminate the way on a street /car parking garage, where there may be no lighting. It keeps the headlights turned ON for a pre-set measure of time after the ignition is turned OFF.</p>	2
g	Discuss functions of mass air flow sensor	02
	<p>Answer: Mass air flow sensor is used to calculate the amount of air volume delivered to the engine. If the mass air flow sensor (MAF) doesn't work properly, it will cause ECU to miscalculate the fuel to be injected, causing additional damage to the engine.</p>	2 marks
2	Attempt any three of the following	12
a	Draw a neat labeled wiring diagram of windshield wiper in automobile	04
	<p>Answer:- (Correct Sketch – 3 marks, Correct Labels – 1 mark)</p>  <p>Fig. windshield wiper</p>	Correct Sketch – 3 marks Correct Labels – 1 mark
b	Describe working of following switches in the vehicle i) Ganged switch ii) Mercury Switch	04
	<p>Answer: (2 mark each)</p> <p>Ganged switch:</p> <p>Ganged switches allow one movement to move multiple contacts at the same time. A headlight switch turns on parking lights and head lights even though these two circuits are separated and do not come in contact. The movement is usually indicated by a dotted line connecting the contacts of the switch.</p>	

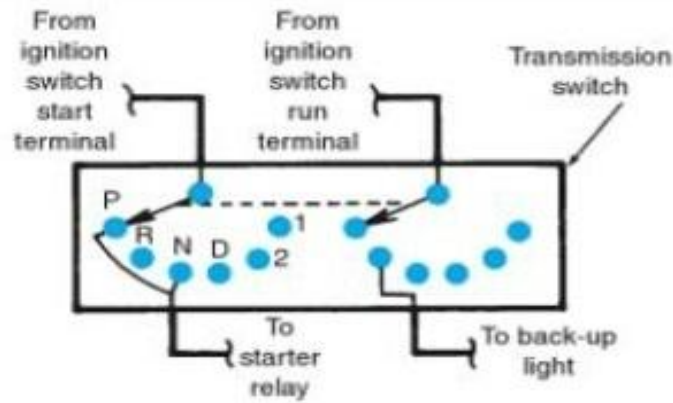


Figure The dotted line between switch wipers indicates that both wipers move together.

Fig.Ganged switch

Mercury Switch:

Mercury is very good Conductor of Electricity. In mercury switch, Capsule is partially filled with mercury. One end of the capsule is two electrical contact points. The switch is attached to the hood or Luggage compartment lid. Normally mercury is in end opposite to contacts. When the lid is open the mercury flows to contact end and provides close circuit between the electrical contacts.

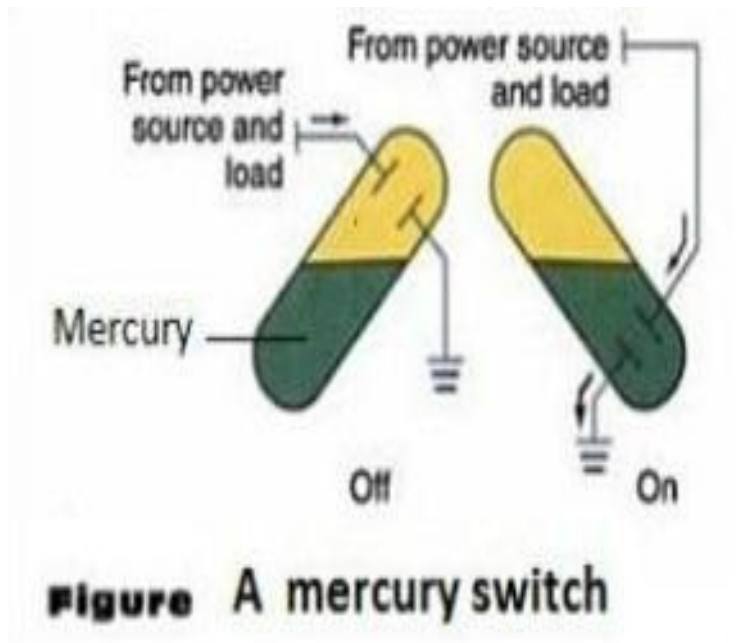
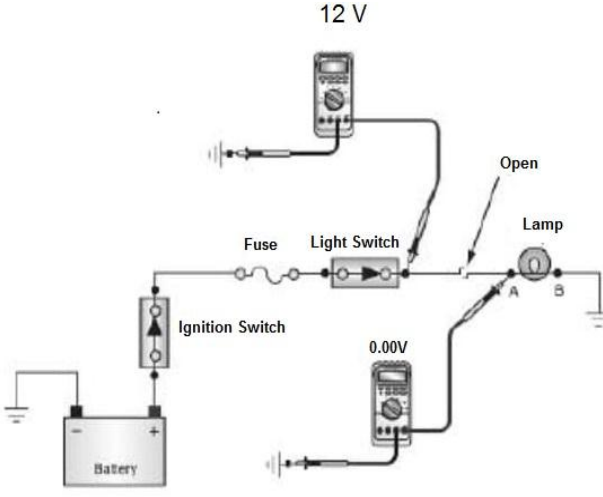


Figure A mercury switch

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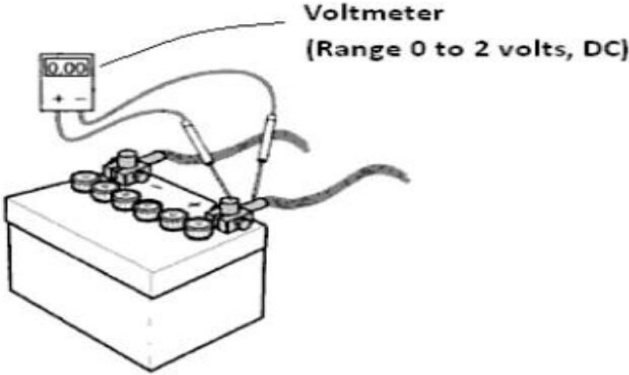
2



C	Illustrate with simple circuit diagram the testing of open circuit defect using voltmeter	02
	<p>Answer:(2 marks for explanation, 2 marks for circuit diagram)</p> <p>The easiest method of testing a circuit is to start at the most accessible place and work from there if the load components is easy accessible, test for voltage at the input to the load</p> <p>Remember, to get reliable test results, the load component must remain in the circuit.do not do any open circuit testing unless directed to in the service information. Use the following procedure for locating the open:</p> <ol style="list-style-type: none">1. With the switch in on position measure the voltage at point A, if the voltage is 10.5V or higher check the ground side (point B) .if the voltage at point B is less than 10.5V there is excessive resistance or an open in the ground circuit. If the voltage at point A is less than 10.5V continue testing.2. work towards the battery the test on connection for voltage. If the voltage is present at a connection then the open ids between that connection and the previously tested location. Used afused jumper wire to bypass tthat section to confirm the location of the open3. If the battery voltage is present at point B the open is in the ground circuit. The used fused jumper wire to connect the ground circuit then retest the components <p>Circuit diagram the testing of open circuit defect using voltmeter</p>  <p>Fig- Open Circuit Test</p>	2

(Note: Circuit dia. Can vary and should be considered if caters to the procedure of test.)



d	Describe the procedure of battery terminal test with help of schematic diagram	04
	<p>Answer:- (2 marks for test procedure, 2 marks for circuit diagram)</p> <p>Procedure</p> <ul style="list-style-type: none">• Checks for poor electrical connection between the terminals and the battery cables.• A voltmeter is used to measure voltage drop across terminals and cables.• To perform a battery terminal test, connect the negative voltmeter lead to the battery cable end. Touch the positive lead to the battery terminal.• Keep the ignition or injection system disabled so that the engine will not start• Crank the engine while watching the voltmeter reading.• If the voltmeter reading is 0.5 volts or above, there is high resistance at the battery cable connection.• This indicates that the battery connections need to be cleaned.• A good, clean battery will have less than a 0.5 volt drop <p style="text-align: center;">Figure: Battery Terminal Test</p>  <p style="text-align: center;">Voltmeter (Range 0 to 2 volts, DC)</p>	2 marks for test procedure 2 marks for circuit diagram (Note: Circuit dia. Can vary and should be considered if caters to the procedure of test.)
e	Illustrate with sketch current output test of an alternator. Predict the possible test results and their inference.	04
	<p>Answer: (2 marks for test procedure & inference, 2 marks for circuit diagram)</p> <ul style="list-style-type: none">• Start the engine and let it idle at about 1200 rpm while all other electrical equipment's are off• Connect an amperage meter (or multi meter) across the battery terminals (or positive terminal of alternator and negative terminal of battery)• Turn on all electrical equipment in the vehicle• Check amp reading on the meter	2 marks for test procedure & inference

- The reading should be near the maximum rated output of alternator (Find this value in manufacturers catalogue)
- If the reading is too low (approx. about 10%), alternator is not functioning properly
- If ammeter read $\pm 10\%$ of rated output current, then alternator is working well.
- If the reading is far below the rated value, then alternator is faulty and not producing the required current. Replacement is the general recommendation.

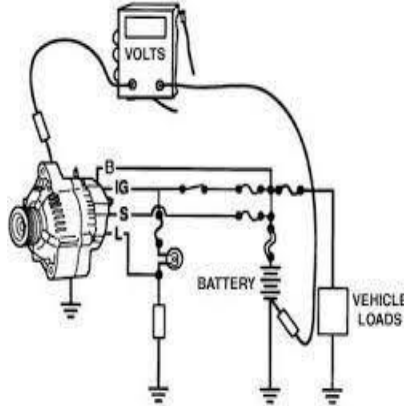


Fig. Current output test of an alternator

2 marks for circuit diagram and

(Note: Circuit dia. Can vary and should be considered if caters to the procedure of test.)

Q3

Attempt any Three of the following

12

a

List any four components of starting system and state their functions.

04

Answer:

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.
5. **Starter motor:** Upon receiving current, motor initially provides adequately high torque needed for engine cranking.

1 mark for each component



6. **Starter drive:** It ensures the starter motor engagement while cranking, and immediate disengagement upon engine starting

b **Explain working of bendix drive with sketch**

04

Answer: (Diagram – 2 marks, Working – 2 mark)

Bendix 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 with the result that the pinion backed out of mesh with the flywheel.

Working –
2 mark

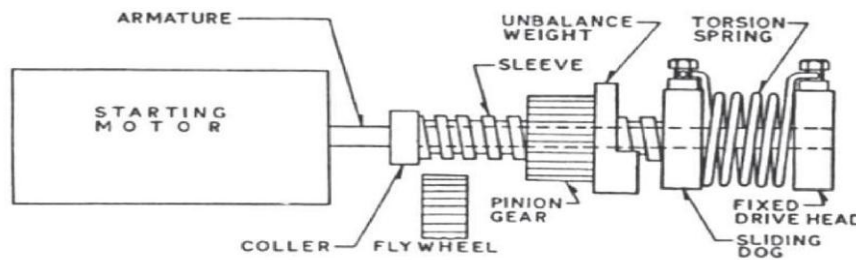


Fig. Bendix Drive

Diagram –
2 marks,

c **Explain working of computer controlled ignition system.**

04

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

Working :-

- i. An ECU
 - ii. Crankshaft speed and crankshaft position sensor.
 - iii. Ignition coils
1. The system is generally used for four cylinder or six cylinder engines. The basic principle is that of the “Lost Spark”.
 2. The distribution of the spark is achieved by using two double ended coils, which are fired alternately by using ECU.

Working -
2marks

3. 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.

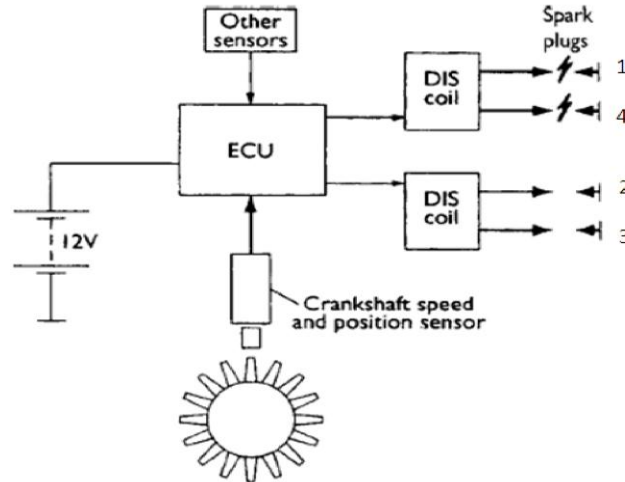


Fig. Computer controlled ignition system

4. 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.
5. 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.
6. 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.
7. The spark delivered to the cylinder on the compression stroke will ignite the mixture.
8. The spark produced in the other cylinder will have no effect, as this cylinder will be completing its exhaust stroke.

Equivalent diagram- 2 Marks)

d Justify the precautions in handling of ignition system using Hall effect sensor. 04

Answer:

In electronic ignition system using Hall effect sensor, ignition voltage up to 30 KV may be encountered.

Under adverse conditions, such as moisture in the engine compartment, voltage spike can penetrate the insulation. If technician's bare hand comes in contact with it will cause severe electric shock.

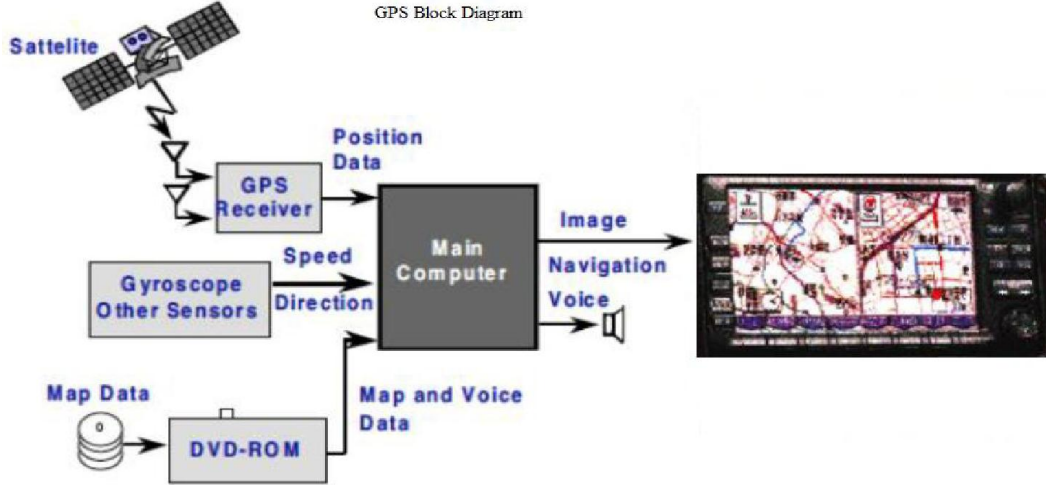
In order to avoid injury and damage to the electronic ignition system, it is necessary

4

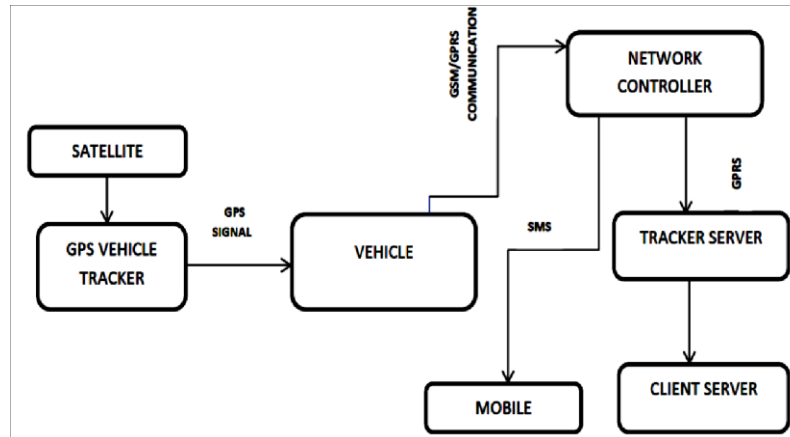


	<p>when working on engines equipped with an electronic ignition system, following precautions should be taken.</p> <ol style="list-style-type: none">1. When the engine is running, or getting cranked by the starter motor, do not touch the high voltage line.2. Disconnect /connect the wiring of the ignition system only when the ignition is switched off.3. A Hall switch gets triggered (and causes high voltage in the secondary circuit) when the distributor shutter is pulled out of the gap between the permanent magnet and Hall IC. So, the ignition switch should be turned off during assembly/dismantling of system components.	
04	Attempt any three of the following	12
	a) List the navigation system in automobile .Explain any one	04
	<p>Answer: The Navigation system in Automobile</p> <p>GPS – Global Positioning System.</p> <p>GPRS – General Pocket Radio Services.</p> <p>Global Positioning System (GPS)</p> <p>Technology fulfills goals of accurate location, navigation, and asset tracking. It makes automotive commute safer and easier.</p> <p>Working:</p> <ol style="list-style-type: none">1. A GPS receiver must be locked on to the signal of 4 or more satellites to calculate a 3-D position of user (latitude, longitude and altitude) and track movement.2. The GPS satellites transmit signals to a GPS receiver. These receivers passively receive satellite signals; they do not transmit and require an unobstructed view of the sky, so they can only be used effectively outdoors.3. GPS operations depend on a very accurate time reference, which is provided by atomic clocks on board the satellites.4. Each GPS satellite transmits data that indicates its location and the current time.5. All GPS satellites synchronize operations so that these repeating signals are transmitted at the same instant.6. The signals, moving at the speed of light, arrive at a GPS receiver at slightly different times because some satellites are further away than others.7. The distance to the GPS satellites can be determined by estimating the amount of time it takes for their signals to reach the receiver.	<p>1 for list</p> <p>3 mark for Explanation</p>

8. When the receiver estimates the distance to at least four GPS satellites, it can calculate its position in three dimensions.



OR



b Describe working of keyless entry system.

04

Ans *Answer: (Working 4 Marks, credit should be given to equivalent figure)*

Working of keyless entry system

1. The main components of the keyless entry system include: 1) A control module
2) A coded
2. button keypad located on the driver's door 3) Door lock motors
3. 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.
4. 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.
5. The driver's door can be unlocked by entering a five-digit code through the

02

keypad.

6. Remote controlled keyless entry systems are also available. They use a hand held transmitter attached as a key chain.
7. 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.



Fig: Keyless Entry System Keypad

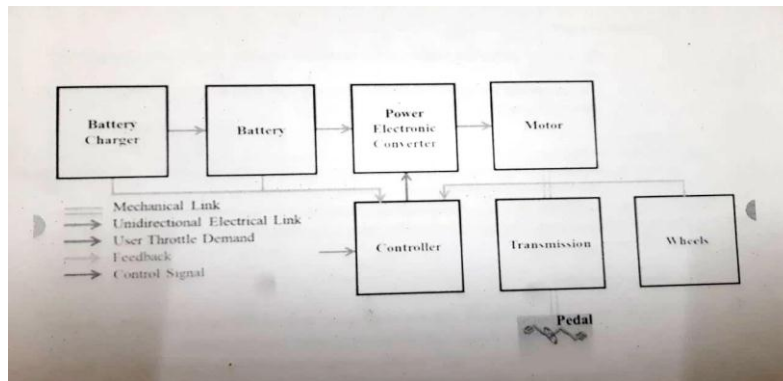


Fig: Remote Keyless Entry System Transponder

02

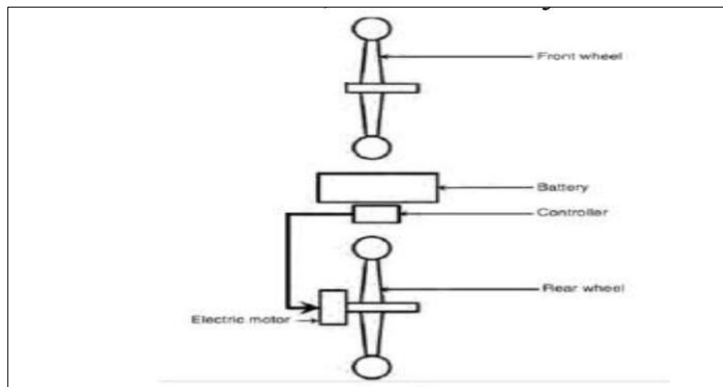
c Describe working of an Electric two wheeler with layout.

Answer: (Working: 02 marks, Sketch=02marks)



02

OR





Working of Electric two wheeler

1. An electric two wheeler consist of a battery that provides energy, an electric motor that drive the wheels, and a controller that regulates the energy flow to the motor.
2. Electric two wheeler is simple, high reliable, have lifetimes measured in millions of kilometers, need no periodic maintenance, and cost significantly less per km to operate. They are highly flexible as well, using electrical energy readily available anywhere as input fuel.
3. The direct drive-train layout is used most widely to drive small electric scooters.
4. In case of indirect drive. Mostly used on electric motorcycles,transmission,a chain or belt drive, or maybe a shaft drive unit are conventionally used on high capacity electric vehicles

02

d Explain with sketch throttle position sensor

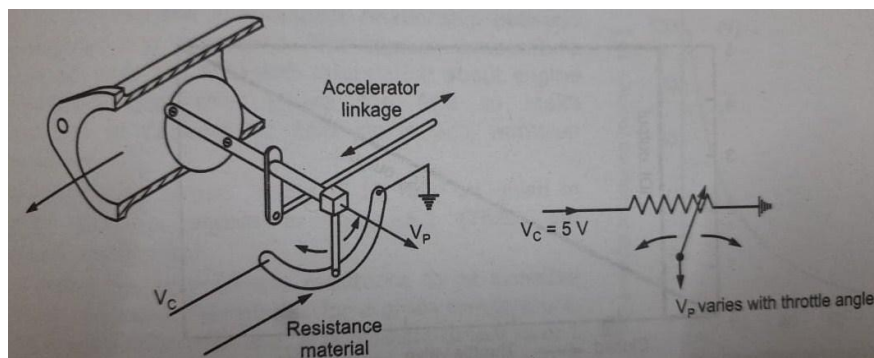
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Answer: (*Explanation-2, sketch=02*)

Throttle position sensor :

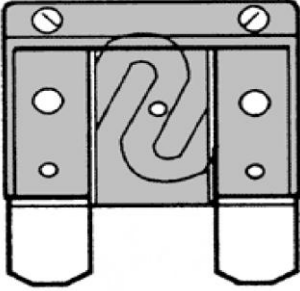
1. This sensor is usually mounted on the throttle body.
2. It senses the position of the throttle valve or butterfly valve and transmits the information to the Engine control unit.
3. This sensor monitors how far down the accelerator pedal is pushed and gives the output current determining the position of the pedal.
4. The position of the pedal controls the airflow of the engine.
5. If the valve is wide opened, a large amount of air is supplied to the engine and vice-versa.
6. The output given by this sensor, along with other sensors is transmitted to the engine control unit, which decides the amount of fuel to be injected into the engine accordingly.

02



02



5	a	Explain with neat sketch construction and working of i) Maxi Fuse ii) Relays	6 Marks
		<p>Answer: (<i>Construction & working of maxi fuse and relay - 3 marks each</i>) Maxi Fuse: (<i>Sketch – 1 mark & description – 2 marks</i>)</p>  <p style="text-align: center;">Maxifuse</p> <p style="text-align: center;">Figure: Typical Maxi Fuse</p> <ul style="list-style-type: none">● A fuse is the most common circuit protection device in the electrical systems of vehicle.● A fuse is placed in an automotive electrical circuit so that, when current flow exceeds the rating of the fuse, it blows or blows out i.e. it are designed to turn off the circuit that it protects.● The size of the metal fuse element determines the rating. Excessive current cause's excessive heat and that causes the circuit protector to open. Once a fuse blows, it must be replaced with a new one.● 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.● Maxi-Fuse is a fast-acting blade fuse, standard for vehicle circuit protection. These are also designed to provide predictable time delay and low heat dissipation.● These fuses are color-coded for easy identification of fuse ratings.● Maxi fuses are a large version of blade fuses and are used to replace fusible links in many vehicles.● Maxi fuses are rated up to 80 amperes or more.	<p style="text-align: right;">Sketch – 1 mark & 2 marks for description of constructio n & working of maxi-fuse</p> <p style="text-align: right;">Sketch – 1 mark & 2 marks for description of constructio n & working of relay</p>

Relay: (Sketch – 1 mark & description – 2 marks)

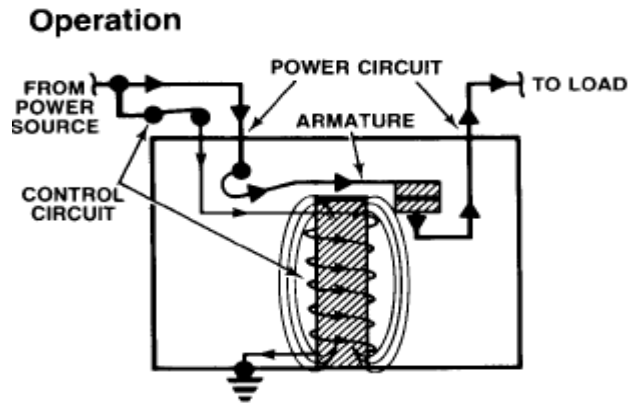


Figure: Schematic of Typical Relay

- A Relay is an electric switch that allows a small amount of current to control a high-current circuit.
- When the control circuit switch is open, no current flows to the coil of the relay, so the windings are de-energized.
- When the switch is closed, the current flows through the control coil, which is wrapped around an iron core. The iron core intensifies the magnetic field, the coil is energized, turning the soft iron core into an electromagnet.
- The magnetic field attracts the upper contact arm and pulls the armature down, closing the contacts and allowing power from the power source to go to the load.
- This closes the power circuit contacts, connecting power to the load circuit.
- When the control switch is opened, current stops flowing in the coil and the electromagnet disappears.
- This releases the armature, which breaks the power circuit contacts.
- The purpose of relay is to control a load circuit with the use of small current carrying control circuit.
- It saves the size of wiring connected to the switches and reduces weight.

5 b Explain with neat sketch construction of Lead Acid Battery

6 Marks

Answer: (Construction – 4 marks, Equivalent Fig/ Diagram - 2 marks)

Construction of lead acid battery:

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.

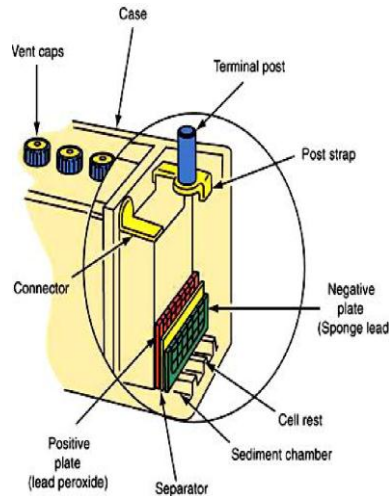


Figure: Typical construction of Lead Acid Battery

The lead acid batteries are made of five basic components:

1. **Positive and negative internal plates:** The positive and negative plates are made up of lead material. The grid has horizontal and vertical grid bars that intersect at right angles. An active material made from ground lead alloys (usually Antimony) oxide, acid, and material expanders is pressed into the grid in paste form. About 5% to 6% antimony is added to increase the strength of the grid.
2. **Plate separators:** Plate separators are made of micro porous synthetic material. Many batteries have envelope type separators that retain active materials near the plate.
3. **Electrolyte:** Electrolyte is a dilute solution of sulfuric acid and water, better known as battery acid. Electrolyte solution consists of 64% water and 36% sulphuric acid, by weight. Electrolyte is both conductive and reactive.
4. **A resilient plastic container:** The battery case is made of polypropylene, hard rubber and plastic base materials. Battery case must be capable of withstanding temperature extremes, vibration and acid absorption. Provision in container for cell elements sit on raised supports in the bottom of the case.
5. **Lead terminals:** The connection point between the battery and whatever it powers.

Description of construction – 4 marks,

Equivalent Fig/ Diagram - 2 marks



		<p>Some batteries are top-terminal batteries – they have the two main terminals or posts in the cover. The positive terminal post is larger than the negative terminal post. Other batteries are side-terminal batteries. They have the terminals on the side of the battery.</p>										
5	C	<p>Give probable cause & remedies for following troubles i) corroded battery bracket ii) reading of voltage on individual cell differ</p>	6 Marks									
		<p>Answer: (Causes & remedies for troubles/defect – 3 marks for each defect)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Defect</th> <th style="width: 30%;">Cause</th> <th style="width: 45%;">Remedy</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;">Corroded battery bracket</td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> ● Over filling of battery electrolyte ● Over charging of battery than the specified limit of the battery. ● More Moisture content around battery bracket </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> ● Avoid overfilling of battery electrolyte ● Regularly clean battery brackets ● Apply anti rust or anti corrosive coat or paint it. ● To avoid overcharging of battery, adjust voltage regulator of an alternator </td> </tr> <tr> <td style="vertical-align: top;">Reading of voltage on individual cell differ</td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> ● The battery plates may be defective because of loss of active material due to sulphation ● Short circuiting of battery cells ● Open circuit cells </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> ● Defective battery should be replaced by one of the same rating. ● Visually inspect the condition of battery plates. ● If the battery is in poor state, it may be replaced. </td> </tr> </tbody> </table>	Defect	Cause	Remedy	Corroded battery bracket	<ul style="list-style-type: none"> ● Over filling of battery electrolyte ● Over charging of battery than the specified limit of the battery. ● More Moisture content around battery bracket 	<ul style="list-style-type: none"> ● Avoid overfilling of battery electrolyte ● Regularly clean battery brackets ● Apply anti rust or anti corrosive coat or paint it. ● To avoid overcharging of battery, adjust voltage regulator of an alternator 	Reading of voltage on individual cell differ	<ul style="list-style-type: none"> ● The battery plates may be defective because of loss of active material due to sulphation ● Short circuiting of battery cells ● Open circuit cells 	<ul style="list-style-type: none"> ● Defective battery should be replaced by one of the same rating. ● Visually inspect the condition of battery plates. ● If the battery is in poor state, it may be replaced. 	<p>The marks should be awarded to the logical causes & remedies other than mentioned here in the answer.</p>
Defect	Cause	Remedy										
Corroded battery bracket	<ul style="list-style-type: none"> ● Over filling of battery electrolyte ● Over charging of battery than the specified limit of the battery. ● More Moisture content around battery bracket 	<ul style="list-style-type: none"> ● Avoid overfilling of battery electrolyte ● Regularly clean battery brackets ● Apply anti rust or anti corrosive coat or paint it. ● To avoid overcharging of battery, adjust voltage regulator of an alternator 										
Reading of voltage on individual cell differ	<ul style="list-style-type: none"> ● The battery plates may be defective because of loss of active material due to sulphation ● Short circuiting of battery cells ● Open circuit cells 	<ul style="list-style-type: none"> ● Defective battery should be replaced by one of the same rating. ● Visually inspect the condition of battery plates. ● If the battery is in poor state, it may be replaced. 										
6	a	<p>“Computer controlled Ignition system is better as compared to conventional ignition system.” Justify your answer.</p>	6 Marks									
		<p>Answer: (Any six justification points – 1 marks each)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;">Sl. No.</th> <th style="width: 15%;">Parameters</th> <th style="width: 35%;">Computer Controlled Ignition System</th> <th style="width: 45%;">Conventional Ignition System</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="vertical-align: top;">Construction:</td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> ● The computer controlled ignition system generally does not reduce the performance of the engine because it does not use mechanical devices. It works electrically without power from crankshaft. ● Breaker point, has been </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> ● The conventional ignition system uses a distributor device to drive the breaker point, and to distribute the secondary coil voltage to each spark plug. This distributor device is connected to </td> </tr> </tbody> </table>	Sl. No.	Parameters	Computer Controlled Ignition System	Conventional Ignition System	1	Construction:	<ul style="list-style-type: none"> ● The computer controlled ignition system generally does not reduce the performance of the engine because it does not use mechanical devices. It works electrically without power from crankshaft. ● Breaker point, has been 	<ul style="list-style-type: none"> ● The conventional ignition system uses a distributor device to drive the breaker point, and to distribute the secondary coil voltage to each spark plug. This distributor device is connected to 	<p>Any other suitable justification or points may be awarded with 1 mark for each</p>	
Sl. No.	Parameters	Computer Controlled Ignition System	Conventional Ignition System									
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		replaced using a transistor while the distributor is replaced with an ignition coil module.	the crankshaft engine, so it can be said that conventional ignition systems somewhat reduces the engine's performance.	justification.
2	Servicing and Maintenance:	<p>The Computer controlled ignition system does not require adjustment as in conventional ignition.</p> <p>There is no moving part in computer controlled ignition. So it only relies on the quality of electronic component materials. Therefore less wear and tear of parts.</p>	<p>The conventional ignition systems use breaker points to trigger induction on the coil. In some time, the opening angle of the breaker point will shift because this is one of the moving parts and there is definitely a wear usage. So it needs an adjustment called dwell angle adjustment.</p> <p>Due to maintenance problems, carbon deposits on spark plug reduce the fuel efficiency.</p>	
3	Operation:/Combustion quality:	<ul style="list-style-type: none"> ● The higher the engine RPM, the faster the sparking interval. The faster the sparking interval, the faster the induction interval on the coil. ● In computer controlled ignition, it has at least two ignition coil and has transistor according to the number of spark plugs. So that the induction interval for each ignition coil is not too fast even at high RPMs. it keeps the fire produced stable. ● Noiseless operation at higher speed ● optimum ignition timing can be achieved as per ignition map stored in Ignition module. Detonation can be avoided using detonation sensor 	<ul style="list-style-type: none"> ● The conventional ignition only has one ignition coil and one breaker point that will work at intervals according to the induction interval on the coil. So, when the RPM is high, the induction of the ignition coil is less than the maximum so that the voltage produced is also relatively lower. ● It creates some noise at higher speed. ● Ignition timing can be varied as per engine speed and engine load. But is not efficient. Detonation can not be avoided. 	



		4	Power Output:	<ul style="list-style-type: none"> It does not use mechanical distributors to distribute secondary voltage, but use a single coil/ coil pack where each coil /coil pack will be connected directly to each spark plug. It makes the connection shorter and no voltage is wasted, so the secondary voltage is completely used to ignite air fuel mixture. It is very effective and saves electricity because no voltage is wasted. More power output 	<ul style="list-style-type: none"> It does use mechanical distributors to distribute secondary voltage which results in longer path and there are chances of waste of secondary voltage. It is not effective and do not saves electricity because of waste of voltage at the various places in the ignition system such as breaker plate, breaker points etc. Low power output 	
		5	Fuel Efficiency:	The above factors results in higher efficiency.	The above factors reduces the efficiency.	
		6	Service life of components	The service life of spark plug and other components of system is more.	The service life of spark plug and other components of system is less	
6	b	List & explain any one electronic fuel injector testing types.				6 Marks
		<p>Answer: <i>(List of electronic fuel inject test- 2 marks & explanation of any one test of electronic fuel injector- 4 marks)</i></p> <p>Following is the list tests of Electronic Fuel Injector: <i>(2 marks)</i></p> <ol style="list-style-type: none"> Sound test Spray test Voltage drop test Fuel Flow test Ohmmeter test. <ul style="list-style-type: none"> Sound test for testing electronic fuel injector: <p>The use of electronic fuel injectors is a sophisticated way to provide the right fuel and air mix to an engine for a vehicle. The small cylindrical fuel injectors play a specific role in a larger fuel intake system, along with other elements like the fuel pump and the fuel tank. Over time, fuel injectors may need to be maintained or checked for proper</p>				<p>Marks should be awarded to any other electronic fuel injector testing other than specified in this model answer</p>



functioning.

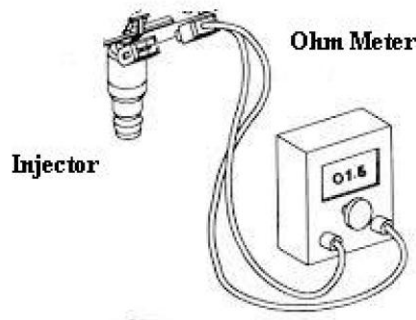
The following is the test Procedure for sound test for electronic fuel injector:

- The electronic fuel injection system relies on electronic signals that control how these items operate
- Along with checking a fuel injector electronically, you can listen for certain kinds of sounds that will tell you when a fuel injector might not be working correctly
- A clunking sound or similar warning sound may show that the fuel injector is not functioning the way it should be
- If the injector electrical leads are difficult to access, an injector power balance test is hard to perform. As an alternative, start the engine and use a technician stethoscope to listen for correct injector operation
- A good injector makes a rhythmic clicking sound as the solenoid is energized and de-energized several times each second
- If clunk- clunk instead of steady click-click is heard, chances are the problem injector has been found
- Cleaning or replacement is in order
- If an injector does not produce any clicking noise, the injector, connecting wires or PCM may be defective
- When the injector clicking noise is erratic, the injector plunger may be sticking
- If there is no injector clicking noise, proceed with the injector resistance test and light to locate the cause of problem
- If a stethoscope is not handy, use a thin steel rod, wooden dowel, or fingers to feel for a steady on/off pulsing of the injector solenoid.

OR

● **Ohmmeter test:**

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



- An ohmmeter/multimeter is connected across the injector terminals to check the injector windings after the injector wires are disconnected.
- If the ohmmeter/multimeter 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.

6 C State the purpose of OBD II. Define the terms.
i) Drive cycle
ii) trip
iii) warm up cycle

6 Marks

Answer: (Purpose of OBD-II-3 marks- 1 marks each point & Defining terms – 1 mark each)

Purpose of OBD-II (Any three- 3 marks):

- To enable the computer systems to monitor the ability of systems and components to maintain low emission
- 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
- 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
- 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 and generic codes
- It provides almost complete engine control and also monitors parts of the chassis, body and accessory devices, as well as the diagnostic control network of a vehicle.

03

i) Drive cycle

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.

OR

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.

ii) 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.

iii) Warm up cycle

A warm-up cycle consists of engine start -up and vehicle operation such that the coolant temperature has risen greater than 40°C from the start-up temperature and reached at least 71°C. If this condition is not met, during the ignition cycle, the diagnostic tests may not run.