Important Instructions to examiners:

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

Q.1 a) (i) 01 Mark for each components and its function, Should consider individual components also e.g. Clutch, Gear box etc.

The main components of automobiles are:

1. The basic structure: It consist of the frame, the suspension system, axles, wheels and tyres.

Function: To support the weight of body and passenger, to cushion the shocks due to road irregularities.

2. The engine:

Function: It provides the motive power for all various functions which the vehicle or any part of it, may be
required to perform.

3. The Transmission system: It consist of a clutch, a gearbox, a propeller shaft and differential.

Function: To engaged or disengaged the power from engine to transmission system, to transmit the torque and to distribute the final torque equally between the driving wheels.

4. The auxiliaries : It consist of electrical systems.

Function: To provide spark for ignition of charge, to start the engine by providing initial motive force,
to provide electrical energy for lighting system.

5. The controls: It consist of steering system and brakes

Function: to control direction of moving vehicle, to steer the vehicle according to drivers will.

6. The body:

Function: To provide space for passenger and luggage.

Q.1 a) (ii) Any four points, one mark for each point

Necessity of transmission system:

1. To disconnect the engine from the driving wheels when starting the engine.
2. To connect the driving wheels smoothly & without shock to the engine, when the engine is running.
3. To reduce the speed of the engine at the driving wheels in the ratio of about 4:1 in the passenger cars & in greater ratio in heavy vehicles up to 10:1.
4. To vary vehicles speed and torque according to driving conditions.
5. To turn the drive through 90^0.
6. To drive the driven wheel on either side of the vehicle at different speeds while the vehicle is turning a circle.

Q.1 a) (iii) Definition: 1 Mark, Sketch: 1 Mark.

1) Negative caster
   - The king pin or the steering axis is tilted forward or backward from the vertical as shown in fig. is known as caster (viewing from side of the vehicle).
   - The forward tilt is known as negative caster.

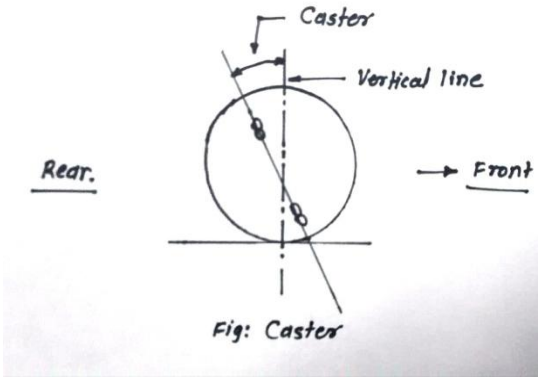
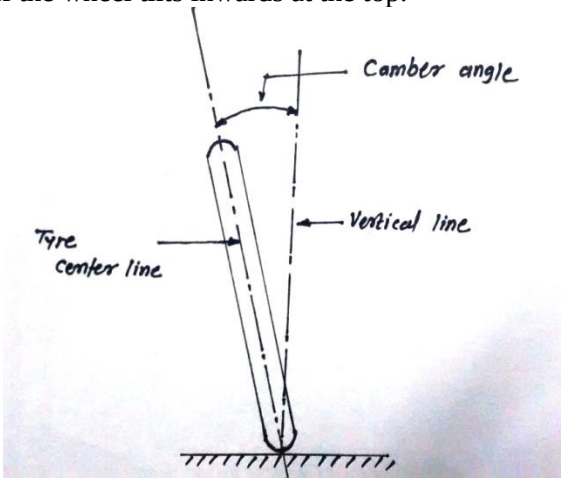


Fig: Caster

2) Negative Camber:
   - The angle between the vertical line & the tyre center line is termed as camber (viewing from front of the vehicle)
   - The camber is negative if the wheel tilts inwards at the top.



Q.1 a) (iv)

Broadly, brakes are classified as **(Two main points - 1 mark)**

1. Drum brakes
   - I) Internal expanding shoe brakes
   - II) External expanding shoe brakes.
2. Disc brakes

The operating system for such brakes can be of any of the following type:
(Any 3 systems - 3 marks)

- I) Mechanical braking system.
- II) Hydraulic braking system.
- III) Pneumatic braking system.
- IV) Vacuum braking system.
- V) Electrical braking system.
- VI) Combined vacuum and electrical braking system.

Q.1 b) (i)

Types of vehicle layout (**2Marks)**

I) Front engine Rear wheel drive vehicle.
II) Front engine Front wheel drive vehicle.
III) Rear engine Rear wheel drive vehicle.
IV) Four wheel drive vehicle.

Front Engine Front Wheel Drive Vehicle: **(Sketch - 2 Marks, Explanation – 2 Marks)**

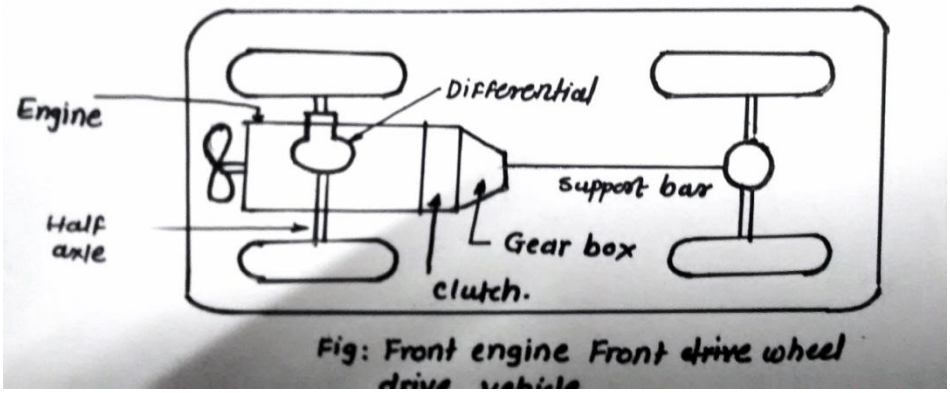


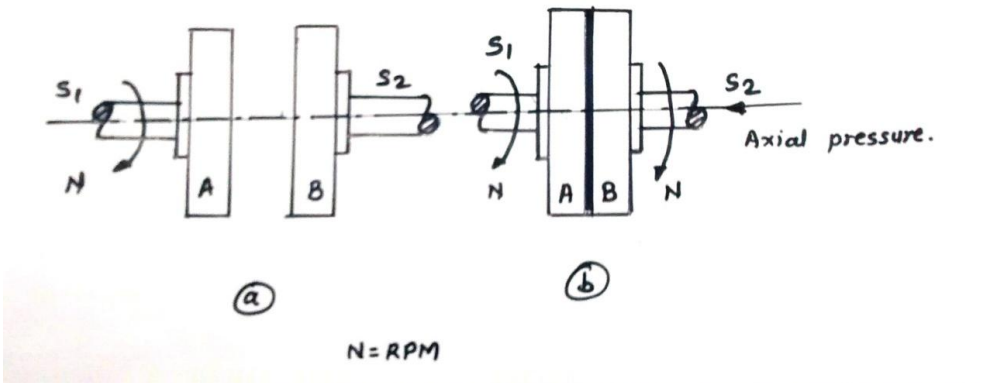
Fig: Front engine Front drive wheel drive vehicle

- In this arrangement the engine is fitted in the front of vehicle and drive is given to the front wheel.
- The propeller shaft length is reduced or neglects the propeller shaft.
- The drive is transferred from engine, situated at front end, to the gear box to the differential with the help of gear drive. The differential unit is placed in the front axle.
- This arrangement provides good grip with road surface due to engine weight at the front.
- Absence of propeller shaft can decrease the chassis height.

NOTE THAT FOR FRONT ENGINE,FRONT WHEEL DRIVE VEHICLE THERE IS GENERALLY NO PROPELLER SHAFT IN MODERN VEHICLES.BUT THERE IS A TRANS AXLE WITH TWO HALF SHAFTS /AXLES ON EACH SIDE CONNECTING WHEELS WITH BALL JOUNTS.

Q.1 b) (ii) 1)

Principle: **(2 Marks)**



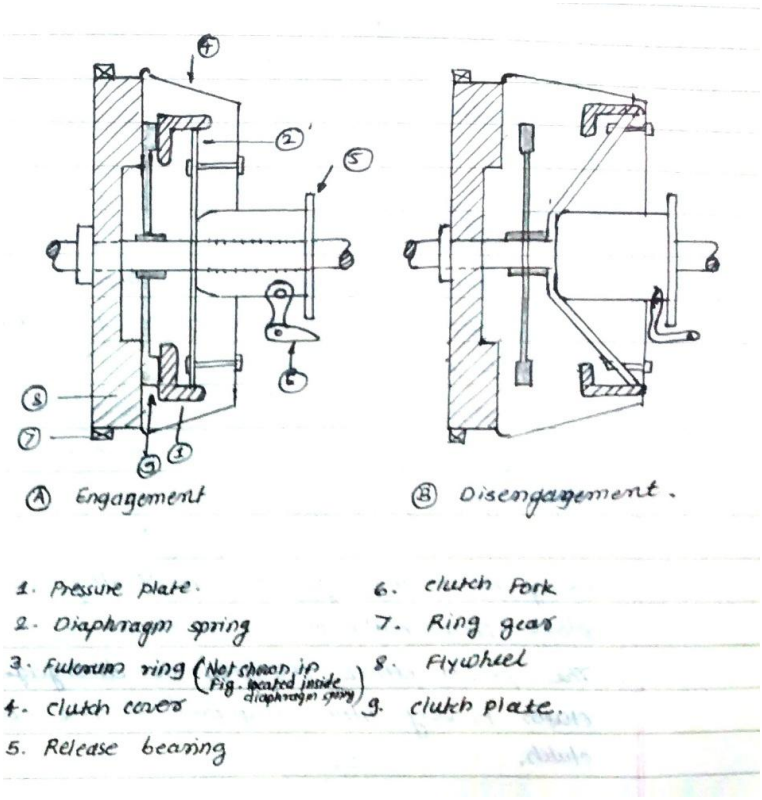
- Let a disc covered with some frictional material revolve at a high speed.

- Another disc having the same friction material is brought in contact with the first.
- The second one shaft to rotate but at a slow speed.
- When axial force is applied to both discs, it is seen that second disc starts rotating at a speed equal to first one.

- Similarly, the clutch assembly has three principle compounds: The flywheel, the driven or clutch plate & pressure plate.
- The flywheel is represented by the first disc & the pressure plate by the second disc.

Q.1 b) (ii) 2).Sketch: 2Marks, Explanation: 2 Marks.

Working of diaphragm type plate clutch**:**



- The constructional details of diaphragm clutch as shown in figure. Coil spring is replaced by diaphragm plate.
- The figure shows the clutch in engaged position.
- The conical diaphragm has been flattened in order to exert thrust on the pressure plate & friction facing.
- When the clutch pedal is depressed, the release bearing exerts pressure at the center of the diaphragm spring.
- The outer edge of the diaphragm spring moves away from the flywheel, disengaging the pressure plate from clutch plate. Hence disengaged the power from engine to the transmission system.
- The pedal effort required to disengage the clutch is very little compared to the conventional clutch.

Q.2 a) Any four points- 4 Marks

Advantages of LPG & CNG operated engines:

1. The fuel cost is less.
2. Less pollution and more efficiency.
3. It is safer for vehicle. The LPG/CNG fuel tank is made of thick wall so they can withstand dynamic explosion, crash test, and direct gunfire.
4. Increased life of lubricating oils, as LPG/CNG does not contaminate and dilute the crankcase oil. No need of oil change frequently which reduce vehicle maintenance.
5. Due to its antilock property, CNG can be used safely in engine with compression ratio as high as 12:1 compare to gasoline engine. Because CNG has a higher octane number than petrol, CNG engines operate at higher compression ratio without knocking.
6. CNG/LPG fuel systems are sealed, preventing fuel losses from spills or evaporation.

Q.2 b) Functions of propeller shaft: 2 points- 2 Marks

I) It transmits rotary motion & power to the differential.
II) Transmit motion at varying angles.
III) Accommodates change in length.
IV) Bears & Cushion the shocks coming on to the transmission system when the vehicles start from rest.

Necessity of Sliding joint: (1 Mark)

- To accommodates change in length due to road irregularities.

Necessity of Universal Joint: (1Mark)

- Universal joint is used to transmit motion at varying angles

Q.2 c) Sketch-2marks, Explanation-2marks.

Working of differential:

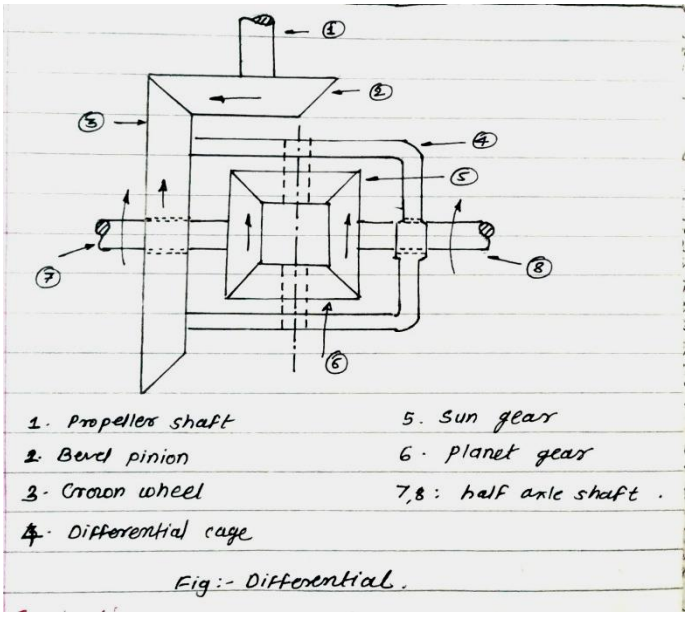


Fig:- Differential.

Straight ahead position:

- The drive from the drive pinion on propeller shaft is transmitted to the crown wheel.
- It rotates in the clockwise direction along with the differential cage.
- The two planet gears attached gears attached to this cage orbit about X-X axis, but do not spin.
- The planet gears turn the sun gears as they are in mesh with them.

- The half axle shafts attached to the road wheels revolve along with the sun gears.
- Both the sun gears revolve at the same speed.

Negotiating a bend:

- As the car negotiate a bend, the inner wheel slightly locked & hence revolves at slower speed than outer wheel.
- The partial locking of the inner wheel allows spinning motion of the planet gear about Y-Y axis.
- The inner sun gear revolves more slowly than the crown wheel. The outer sun gear revolves faster than other as it gets two motions one due to the orbiting movements of the planet gear about X-X axis and the other due to its spinning motion about Y-Y axis.
- The sun gear accelerates one axle shaft and retard the other by same amount.

Q.2 d) (01 mark for each point, 04marks) alternative suitable points should be considered.

Torque tube drive	Hotchkiss drive
1. Propeller shaft enclosed in tube called torque tube	1. Propeller shaft is opened to atmosphere does not enclosed in the tube.
2. The braking torque and driving thrust are taken by torque tube and the spring takes the side thrust and support the body weight.	2. In this drive the spring besides taking weight of the body, also take the torque reaction, driving thrust and side thrust.
3. Only one universal joint is situated exactly at the center of spherical cup & no universal joint is needed at the rear end of propeller shaft.	3. The propeller shaft is provided with two universal joints.
4. No sliding joint is provided because pinion shaft moves about the same center.	4. Sliding joint is provided to accommodate change in length of the shaft.
5. Both end of spring is connected to shackle.	5. The front end of the spring is rigidly on the frame while the rear end is supported in a shackle.
6. Comparatively used in light load vehicle.	6. Comparatively used in heavy load vehicle.

Q.2 e) (01 mark for each point, 04marks) alternative suitable points should be considered.

Disk brake	Drum brake
1. In disc brakes friction surface are directly exposed to the cooling air.	1. In drum brake, the friction occurs on the internal surface from which heat can be dissipated only by conduction.
2. Friction pads are flat.	2. Friction linings are curved.
3. There is no loss of efficiency due to expansion.	3. There is loss of efficiency due to expansion.
4. Less weigh than drum brake.	4. More weight than disc brake.

5. Better anti-fade characteristics than drum brake.	5. Less anti-fade characteristics than drum brake.
6. Simple in design than drum brake.	6. Complicated in design than drum brake.

Q.3. Attempt any two.

(a**) Synchromesh gear box :-**

-All gears on main shaft are in constant mesh with corresponding gears on the layshaft. The gears on layshaft are fixed to it while those on main shaft are free to rotate on the same.

- A is the engine shaft , gears B,C,D,E are free on the main shaft & are always in mesh with corresponding gears on the layshaft.

- Members F_1 & F_2 are free to slide on splines on the main shaft.

- For direct gear, member G_1 & hence member F_1 is slide towards left till cones M_1 & M_2 rub & friction makes their speed equal. Then drive the main shaft is direct from B via F_1 and the splines.

-For second gear the member F_1 and G_1 are slide to the right so that finally the internal teeth on G_1 are engaged with L_1 . Then the drive to main shaft will be from B via U_1 ,U_2 ,C , F_1 and splines .

-For reverse, G_2 and F_2 are slide toward right. The drive will be from B via U_1,U_4, U_5, E , F_2 and splines to the main shaft .

(Explaination & working –5 marks, Diagram – 3 marks)

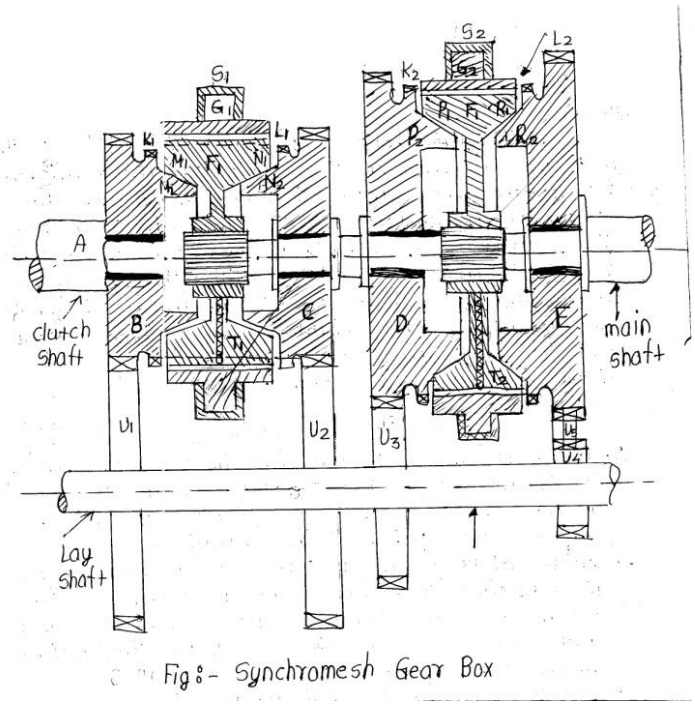


Fig :- Synchromesh Gear Box

(b) **Pneumatic braking system:-**

- Compressor takes air from the atmosphere to the filter and the compressed air is sent to the reservoir through the unloader valve , which gets lifted at a predetermined reservoir pressure (900KPa) & relieves the compressor of load. From the reservoir the air goes to various accessories &

also to the brake chambers located at each wheel. The control of brake valve is with driver who can control the intensity of braking according to the requirements. When pressure drops to 700 KPa, the governor again cuts in the compressor to raise system pressure. When air system pressure falls to 400 KPa, a warning in the form of a buzzer, is sounded.

Advantages –

(1) More powerfull than mechanical or hydraulic brakes, are exclusively used in heavy vehicles.
(2) Simplifies the chassis design.
(3) Its location & working is easy & simple.
(4) Available compressed air also used for tyre inflation, windscreen wipers, horns & many other accessories.
(Description – 3 marks, advantages – 3 marks , sketch – 2marks)

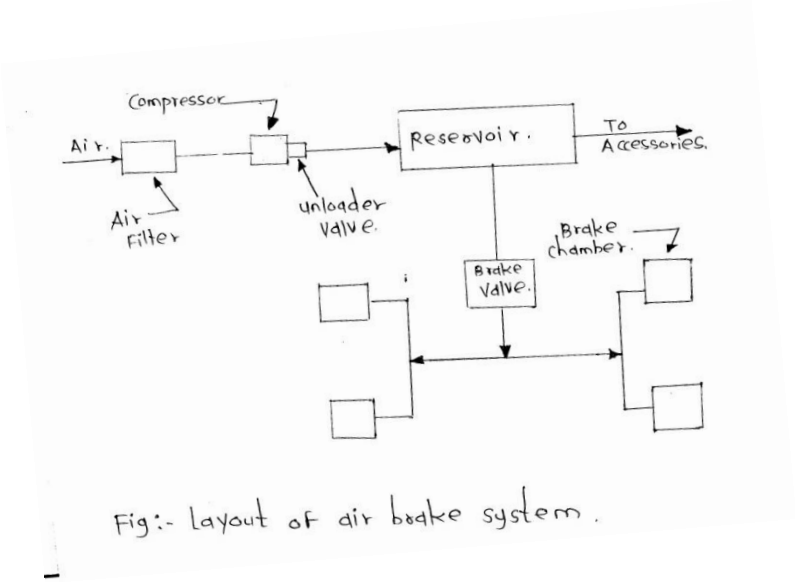


Fig:- Layout of air brake system.

(c) **Power steering:-**

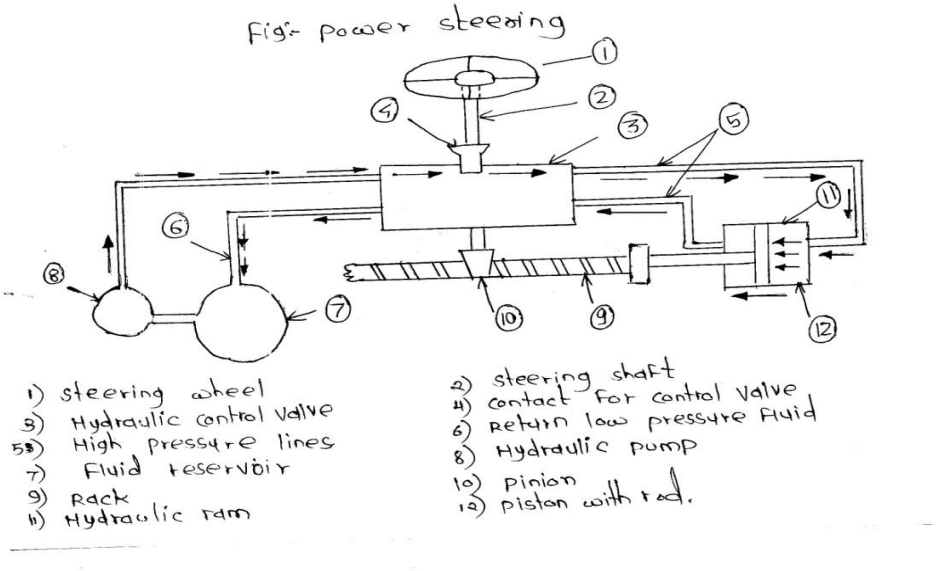
-Power steering mechanism employs electrical devices, compressed air & hydraulic pressure.

- Two types of power steering (1) integral (2) linkage.

- Hydraulic power steering consist of fluid reservoir, hydraulic pump, hydraulic ram with a fixed length piston rod, hydraulic control valve, steering shaft, steering box & steering wheel.

- Engine driven hydraulic pump feeds the fluid under pressure from fluid reservoir to the hydraulic feed lines. A hydraulic control valve situated below the steering senses the input pressure at the steering wheel & converts it into pressure changes into the hydraulic ram.

- As soon as the driver turns the steering wheel , the steering arm moves the control valve such that one of the ports closes whilst the other open. High pressure fluid from the pump flows to one side of the hydraulic ram piston moves it towards one side. The movement of the piston causes the steering linkage to move in the required direction.(Working -5 marks, diagram -3 marks)



Q.4 (a) Attempt any three.

(i) **Need of suspension system.** (any four points -4 marks)

- for cushion the shocks due to road irregularities.

-Maintain the tyre –road grip under all conditions i.e. during straight driving, braking and cornering.

-strong enough to bear the vehicle & passenger load.

- resist the driving & braking torques, side sway and roll over

(ii) **Telescopic shock absorber:-** (working – 2marks, sketch – 2 marks)

-comprises two thin tubes, inner forms the cylinder the outer, the reservoir.

- consist of chassis eye , which is fixed to chassis & axle eye, which is fixed to axle., moving up & down with road irregularities. Chassis eye is connected to the piston.

- The piston is provided with valves as,(outer rings of holes , which passes fluid from bottom part of piston to top parts of piston, inner ring of holes, which passes fluid from top of piston to bottom of piston.)

-Inner cylinder on its lower portion is fitted with foot valve.(provided with inner & outer rings of holes.)

-When axle eye is moved in upward direction , fluid must displaces from bottom part of piston to top part of piston through the outer rings of holes.

- When axle eye is moved in downward direction , fluid must displaces from top part of piston to bottom part of piston .

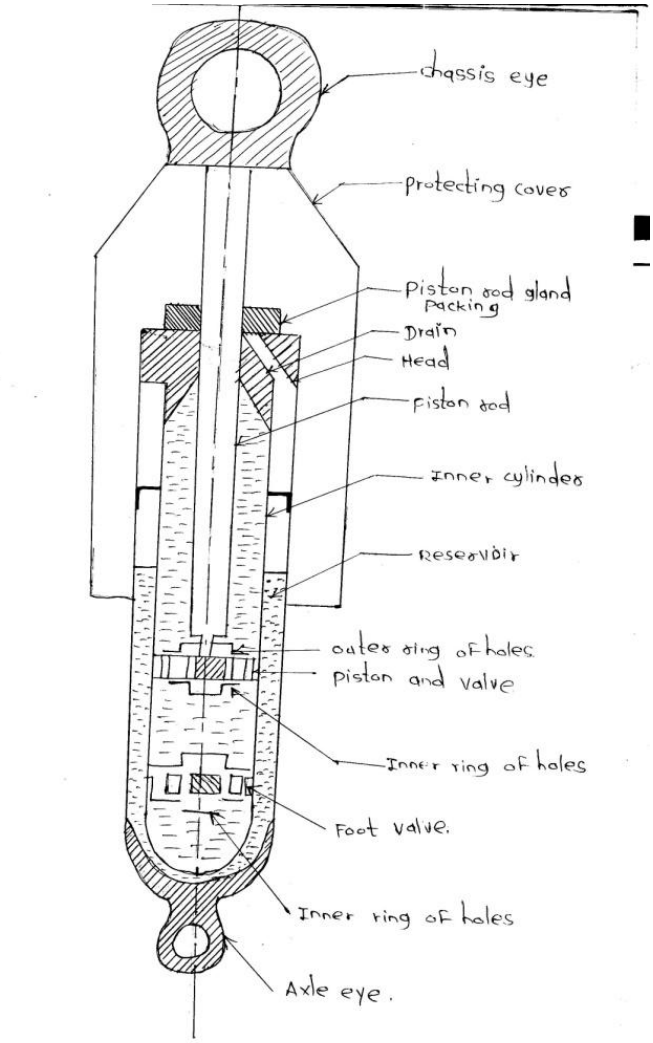


Fig :- Shock absorber.

(iii)**Bendix drive:-** (Explaination -2, diagram -2 marks)

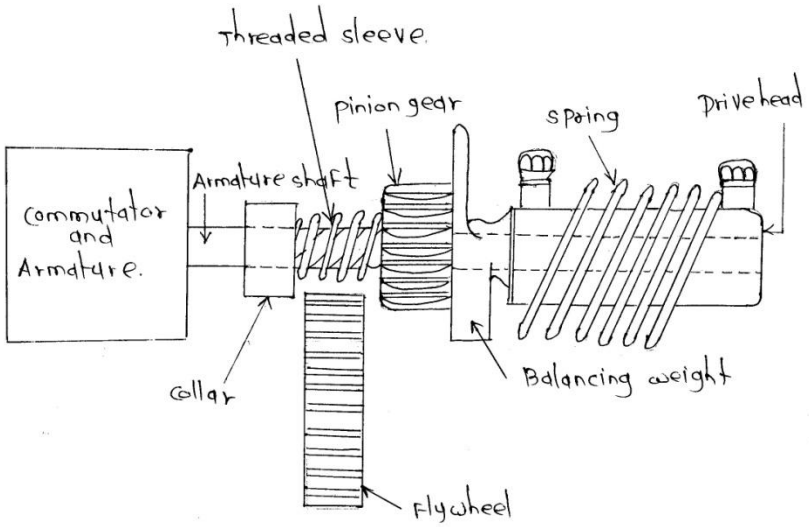


Fig :- Bendix drive.

- It is a starting device.
- Bendix drives are the inertia drives in which the starter motor pinion is made to engage or disengage with the toothed rings on the periphery of the engine flywheel.
- Drive head is keyed to the end of armature shaft. When current is passed to the starting motor (commutator and armature assembly), the armature shaft starts revolving at full speed.
- When pinion travels to the end of thread , it strikes the collar at left & forced to turn with the thread sleeve. This causes the flywheel & crankshaft to turn & crank the engine.

(iv) In automobiles all wires are grouped together, cotton braided & clipped to the chassis or body, called wiring harness.

(wire harness -2, colour codes any four -2 marks)

Wire colour codes

Code	Colour
B	Black
BR	Brown
G	Green
L	Blue
O	Orange
R	Red
Y	Yellow
W	White

Q.4 b) i) 1) 01 Mark for each point, any 4 points, 04 marks.

Important precaution while using A.C. system.

- Operate the air conditioner periodically or at least once a week to keep the internal parts lubricated as well as prevent the hoses from hardening.
- Do not switch ON the A.C. at high speeds which may result in the ceasing of compressor.
- Do not stick anything into the air outlet or the air inlet. As it dangerous and it can cause injury or damage.
- Avoid exposing a body directly to a continuous cool air flow for long periods- It is not good for health.
- Avoid placing any obstacles near the inlet or outlet- if inlet or outlet is blocked it may causes damage to the unit.
- Do not run or stop the unit frequently. If run or stop the unit more than 4-5 times an hour, it may cause damage to the unit.
- The air filter should be cleared at least once every two weeks.
- When the unit is cleaned, set the selector switch at off position.
- Never operate A.C. with heater on.
- Do not charge the refrigerant in the A.C. system before flushing.

Q.4 b) i) 2) 02 Mark for explanation or two points of advantages of R134a refrigerant over R-12.

- Refrigerant R134a is a hydro fluorocarbon (HFC) that has zero potential to cause the depletion of the ozone layer and very little greenhouse effect.
- R134a is the nonflammable and non-explosive, has toxicity within limits and good chemical stability.
- It has somewhat high affinity for the moisture.
- The overall physical and thermodynamic properties of refrigerant R134a closely resemble with that of refrigerant R12.
- Due to all the above factors, R134a is considered to be an excellent replacement for R12 refrigerant.

Q.4 b) ii) 02 Marks for labeled layout, 04 marks for explanation.

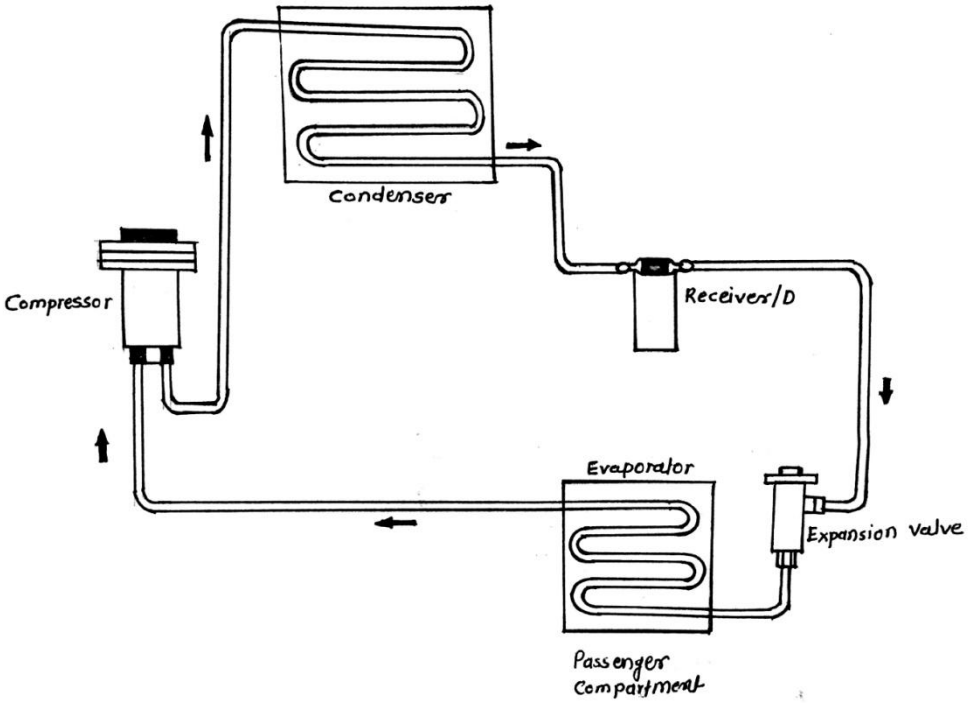


Fig:- Layout of car air conditioning system.

Working of car air conditioning system.

- The layout of car air conditioning system is shown in figure.
- The main components of the system are compressor, condenser, receiver/dryer, expansion valve and evaporator.
- In this system the heat is absorbed and transferred in the following steps.
  i. Refrigerant leaves the compressor as high pressure vapour.
  ii. By removing heat via condenser, the vapour becomes high pressure, high temperature liquid.
  iii. Moisture and contaminants are removed by the receiver dryer, where the clean refrigerant is stored until it is needed.

iv. The expansion valve controls the flow of refrigerant into the evaporator.

v. Heat is absorbed from the air inside the passenger compartment by the low pressure, warm refrigerant, causing the liquid to vaporize and greatly decreased passenger compartment temperature.

vi. The refrigerant returns to the compressor as a low pressure, low temperature vapours and a cycle completed.

Q5) Attempt any FOUR of the following, (16 marks)

a) Explain the Importance of Aerodynamic shape of Car body.

(3 marks explanation, 1m figure.)

The body of vehicle is designed to protect the passenger as well as various components of the vehicle from the air.
An aerodynamic shape of car body is the external shape of car body which will offer least resistance to air motion. Whenever car is moving there is an air resistance to motion of car. This air resistance depends on (i) Size of car (ii) frontal shape and area (iii) speed and (iv) wind velocity. This air resistance is given by
Ra= Ca.A.V2
Where Ra= Air Resistance, Ca=coefficient of air resistance V= Velocity of vehicle (speed)
Now as perpendicular frontal projected area of vehicle increases then vehicle air resistance increases & vice- versa.
Figure 1. Indicates frontal area of vehicle which is vertical, flat & offers more air resistance also flat portion at the rear produces drag which pulls the vehicle back reducing the motion of the vehicle.

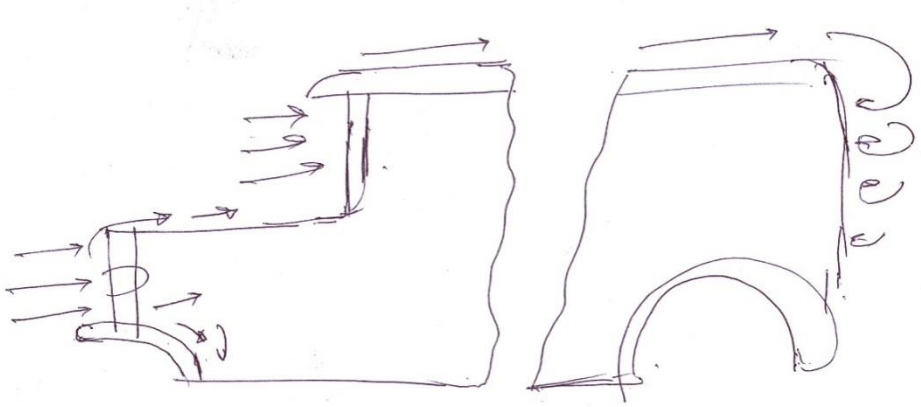


Figure.No.1

So frontal area of car & body of car is designed in such a way that front portion is made inclined & body is given smooth curves (using curves instead of flat surfaces). This offers a least resistance to air & called as an aerodynamic shape.
Figure 2.indicates the use of curved surfaces in modern vehicles instead of flat surfaces .This offers less air resistance.
Aerodynamic body shape of car Improves,

- There is least air motion resistance due to the aerodynamic shape.
- Engine load is decreased and there is better fuel efficiency & average.
- Air eddies are not formed.

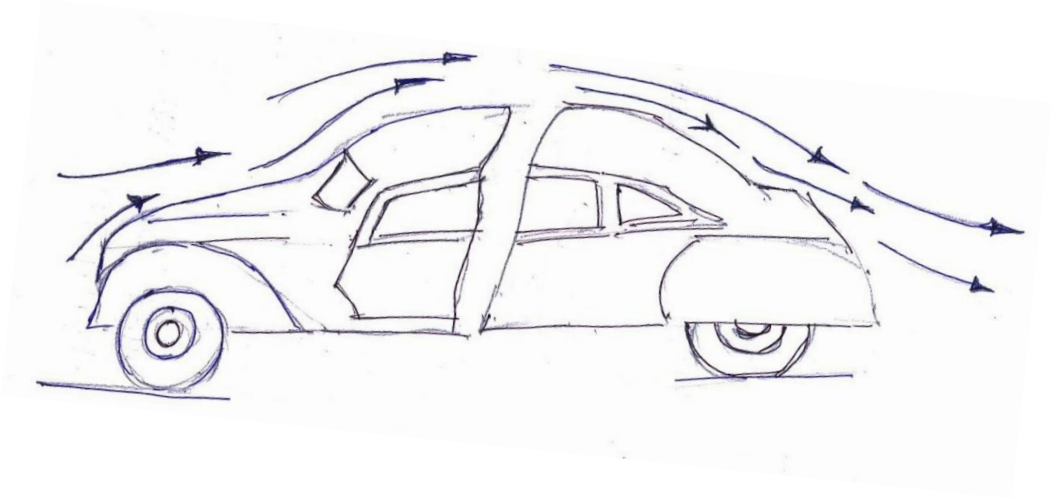


Figure No.2

b) State the various types of Automobile Bodies. (Any Eight types carry four marks)

i) Closed Cars
   a) Saloon
   b) Hatchback
   c) Coupe
   d) Limousine

ii) Open cars
   a) Sports
   b) Convertible

iii) Special Style
   a) Estate Cars
   b) Station Wagon

Transport Vehicles

a) Van
b) Truck
c) Articulated Vehicle
d) Bus
e) Coach

Other types of bodies are

1. Tractor with articulated trailer
2. Half body Truck
3. Dump truck
4. Tanker
5. Delivery truck

c) Compare Tubed Tyre with Tubeless Tyre. (Any four points carry four marks)

Tubed Tyre	Tube-less Tyre
Inside the tyre there is a separate tube	Inside the tyre Separate tube is not provided instead the tyre from inside is lined with air retaining liner.
Tube contain air under pressure	Whereas the air is present in between rim and the air retaining liner.
Air leakage is more as compare to tubeless tyre.	Slower leakage of air.
Poor Heat Decipation	Better Heat Decipation
Tubed tyre can be used on wire spoked wheels	It is not possible to useTubeless Tyre on wire spoked wheels.
More Unsprung weight	Less Unsprung weight
In tube tyre the deflation is fast damaging the tyre & tube.	If Punctured the tubeless tyre let the air out Slowly.

d) Explain Wheel Balancing. Describe its procedure.

(Explanation 2 marks, Procedure 2 marks)

Wheel balancing: It is a process that ensures wheel spins truely as they are fitted on a vehicle. In case wheel are not spinning properly then there are problems like uneven tyre wear, a vehicle pulling on one side, excessive bouncing of a vehicle, wheel shimmy etc which we face. To avoid them this is done.

Wheel balancing means balancing wheel around axis around which it rotates. We have two types of balancing .Static balancing and dynamic balancing. Wheel Balancing machines are used to carry out this act.

Procedure of Wheel Balancing:

Fill tyre with recommended tyre pressure, check for tyre / wheel damage don't use damaged rim for balancing

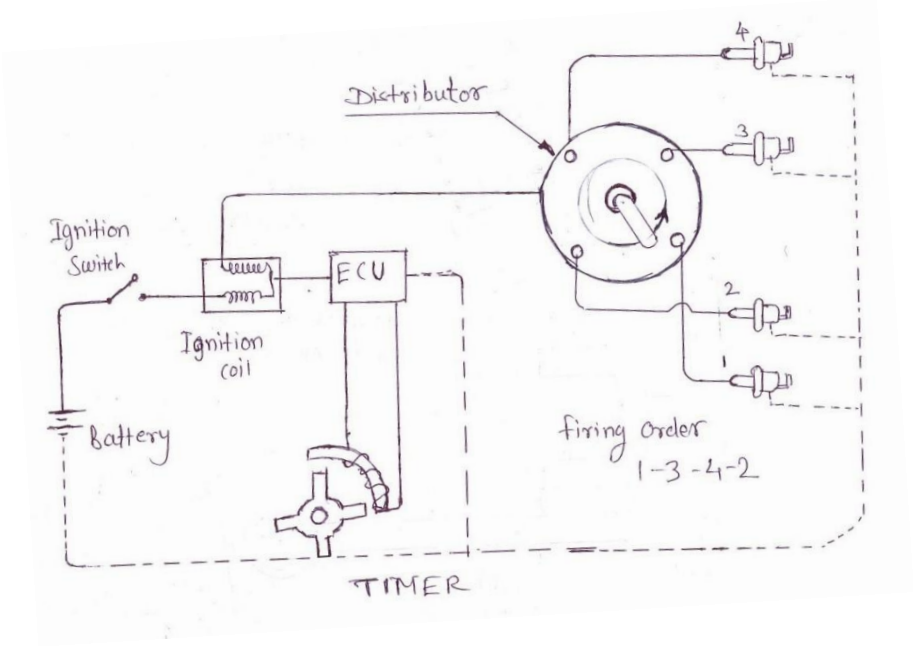
1. Mount wheel on balancing Machine and lock it. Remove old balance weights.
2. Set balance for size of tyre and start the machine.
3. Read values of imbalance on right and left side of wheel on display.
4. Put respective weights on both sides on marks.
5. Start balancer again and check that reading is zero on both sides then the wheel is balanced.
6. If reading on both sides is not zero then repeat the procedure.
7.

e) Describe Electronics Ignition System with neat Sketch.

(2 marks explanation, 2 marks diagram)

Electronics Ignition system is similar to conventional point type Ignition System with a small difference. Electronics Ignition system is provided with Electronic control unit which opens and close the primary circuit instead of contact breaker point as in Contact breaker point ignition system.

Electronics Ignition system is having two circuits Primary and Secondary circuit. Battery, primary winding, ECU and the timer forms primary circuit. Where as secondary winding, distributor and spark plug forms secondary circuit. A timer is employed in the distributor instead of contact breaker. This timer may be Pulse generator or Hall- effect switch which Triggers the Ignition module also called as electronic control unit. This control unit primarily contains transistor circuit whose current is triggered off and on by timer which results in the stopping and starting of the primary circuit. The secondary circuit worked in the similar manner as in conventional contact breaker type. i.e when the magnetic field collapses it induces current in the secondary winding having more number of turns.This results in development of very high voltage necessary to generate the spark at the spark plug.



Q 6) Attempt any TWO of the following. **(16 marks)**

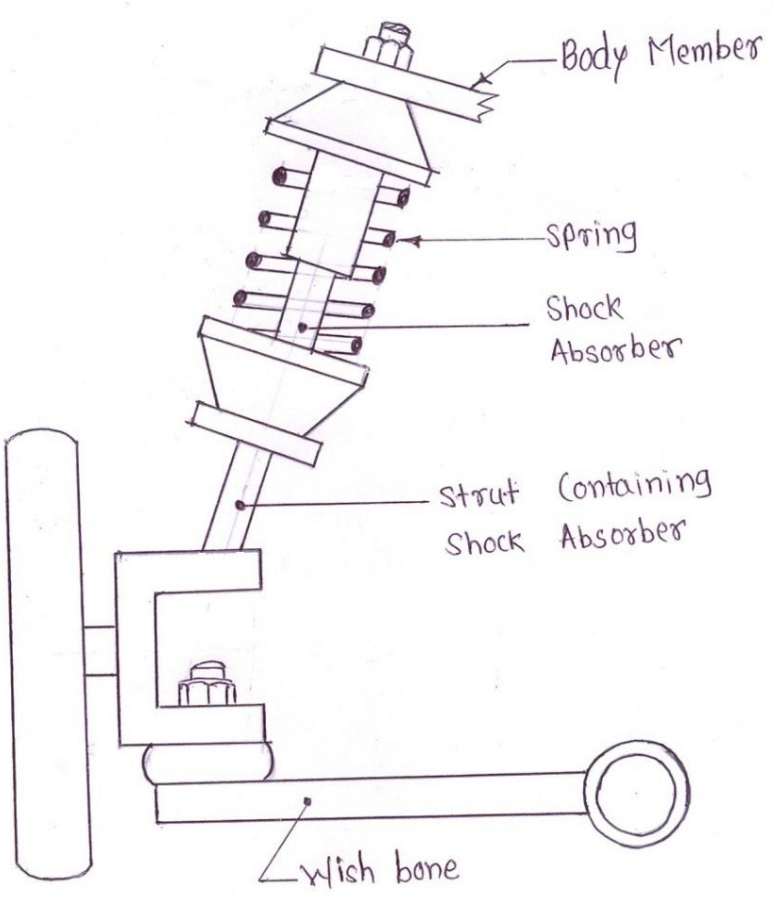
a) Explain with neat sketch Mac-pherson type of Suspension system. Give the name of vehicles in which this type of suspension system is used. Give any two advantages of it.

(Description 2 marks)

In this type of Suspension system only lower wishbone is used. A Strut containing shock absorber and the spring carries also the stub axle on which wheel is mounted. The Wishbone is hinged to the cross member

The wishbone positions the wheel as well as resists accelerating, braking and side forces.

This type of suspension system is firstly used in Maruti 800. This type of Suspension with anti-roll bar as employed in Volkswagen jetta and passat car. (Actual example can also be considered other than this). **(1 example 1 mark)**



(Diagram 3 marks)

Figure No.4

(Mac-Pherson Strut suspension)

Advantages (any two points 2marks)

1) This System is Lighter keeping unsprung weight lighter.

2) This type of Suspension gives maximum space in the Engine Compartment.

3) Simple in construction.

4) The Camber is almost constant when the wheel moves up and down.

b) State the function of Battery. List the main Components of Lead acid battery. Explain its construction with neat sketch.

Function of Battery, **(2 point 2 marks)**

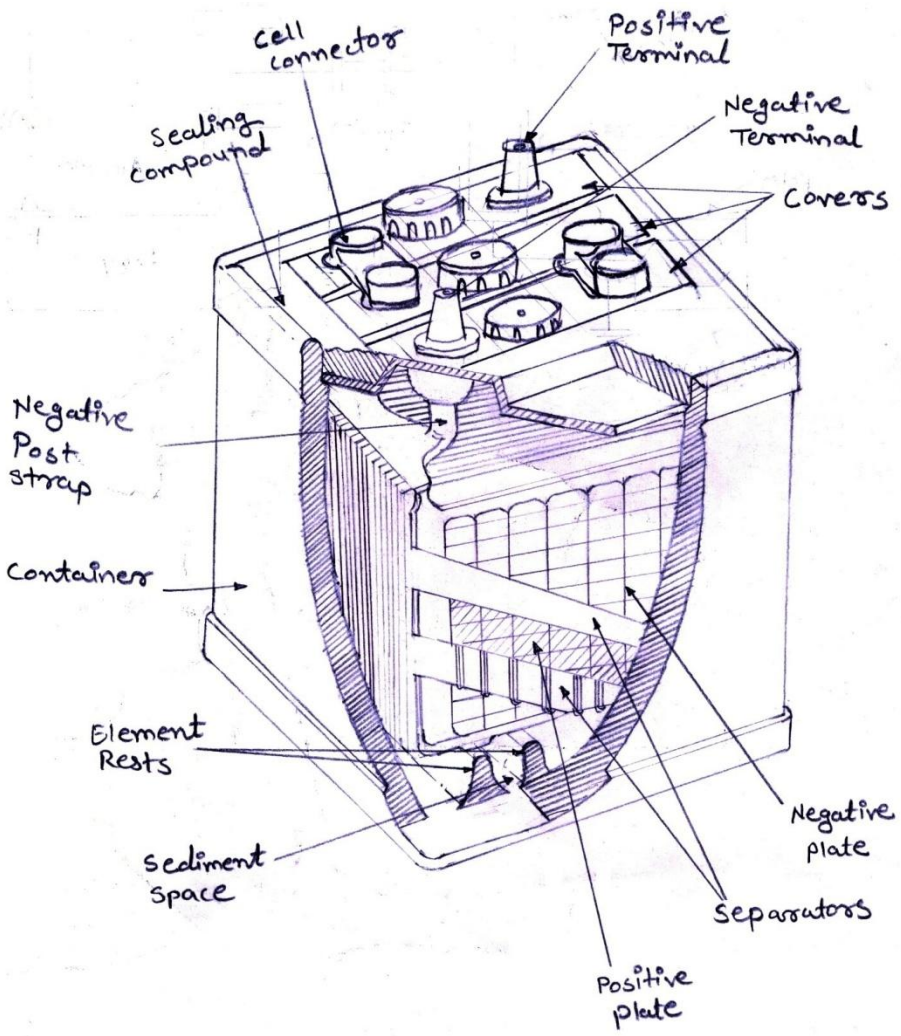
1. Battery supplies the current for cranking motor and ignition system when the engine is being cranked for starting.
2. When the vehicle is stationary battery supplies electricity for operating the various electrical devices.
3. It is the secondary source of electrical energy when vehicle is not operating and generator speed is insufficient to meet the full load requirement.

The main Components of Battery are **(four major comp. 1marks)**

1. Container
2. Plates
3. Separators
4. Electrolyte
5. Cell Covers

Construction of Battery **(2 marks)**

1. **Container:** - The container is made of acid resistance hard rubber or plastic. It is divided in to compartments. Each compartment form a cell of 2V. At the bottom of Container bridges are provided form space for sediment collection. This avoids the danger of short circuit.
2. **Plates**: - There are two types of battery plates positive & negative. Each plate is made of frame or Grid of an alloy of lead and antimony. The function of grid is to hold active material and carry the current. Active material in the positive plate grid is red lead (Pb3O4) and in the negative plate it is litharge (PbO).The negative plate group contain one plate more than the positive plate group.
3. **Separators**:-To avoid the direct contact & thus short circuiting of positive & -ve plates thin sheet of some Non-conducting material inserted between them called separator.
4. **Cell Cover**:- They are moulded from hard rubber . Each cell cover contains holes for positive and negative plate, a vent & filler opening. Vents are provided to escape the gases.
5. **Electrolyte:**- After assembling completely the battery is filled with electrolyte. It is a solution of Sulphuric acid contains approximately one part of Sulphuric acid & two part of water by volume. specific gravity of Electrolyte is the measure of discharge of the battery. In the charge condition Sp.gr.is 1.290 where as in the discharge condition it is reduced to about 1.110. **(Diagram 3m)**



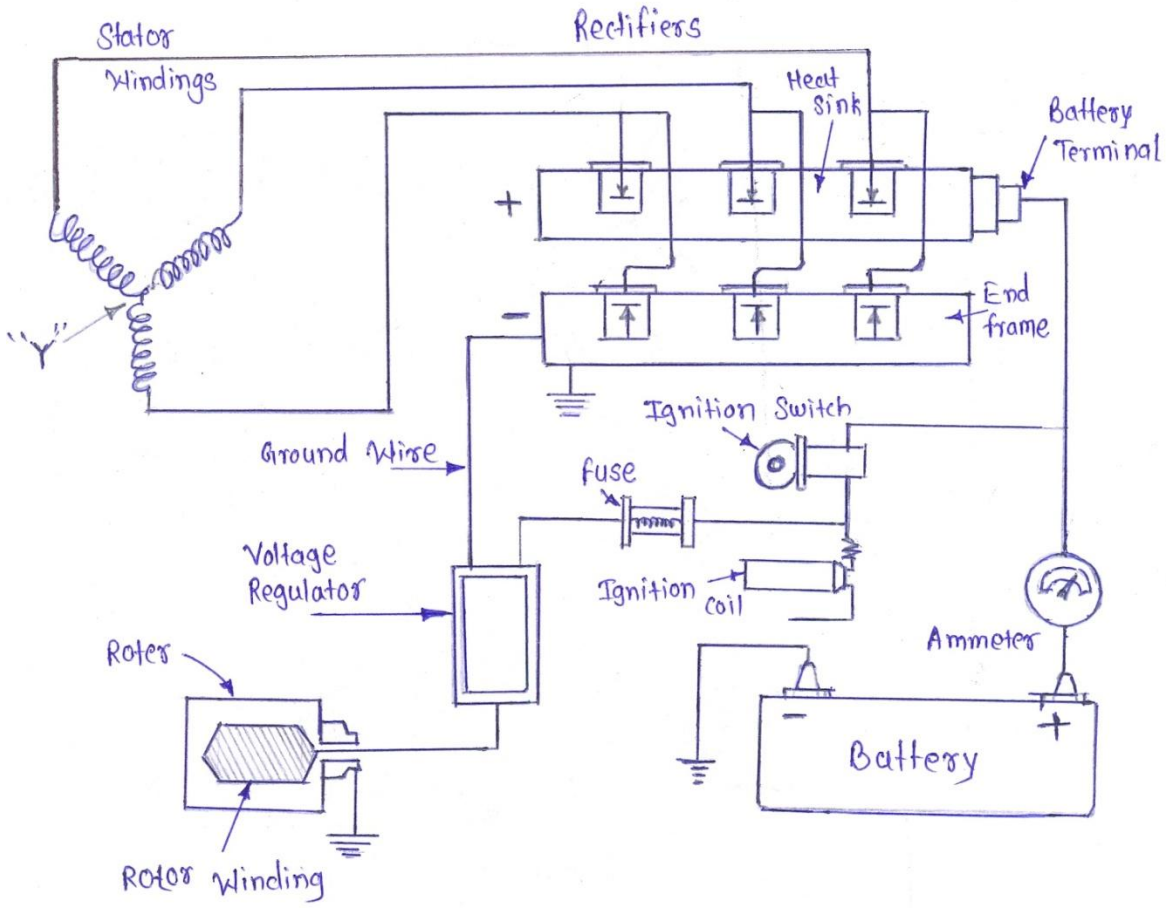
C) State the need of charging System. Explain the construction and operation of charging system Used in Automobile.

Need of charging system: - The battery is storage of direct current. The battery has to supply the current to the starter at the time of starting as well as to the various accessories of automobile. Due to prolonged use the charge of battery is decreased. Therefore to keep the battery always in charged condition there is a need of charging system. **(1mark)**

Construction: The charging system consists of an alternator provided with rectifier to convert AC to DC and a voltage regulator to limit the generator voltage to a correct value .The alternator consist of stator , Rotor which is driven by fan belt. **(2marks)**

Operation: - When the Ignition switch is turned on, the rotor receives the current from the battery through the voltage regulator. This current energizes the rotor field magnet, which induce a current in the stator windings as the rotor is turned by the pulley. The induced alternating current is changed to direct current by the rectifier.

When rotor speed increases, the DC voltage of the alternator increases as the battery gains in charge. To limit the generator voltage a voltage regulator is used. **(2marks)**



(sketch 3maks)
