WINTER – 19 EXAMINATION

Subject Name: Automobile Engineering **Model Answer** Subject Code: 17526

Important Instructions to examiners:

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

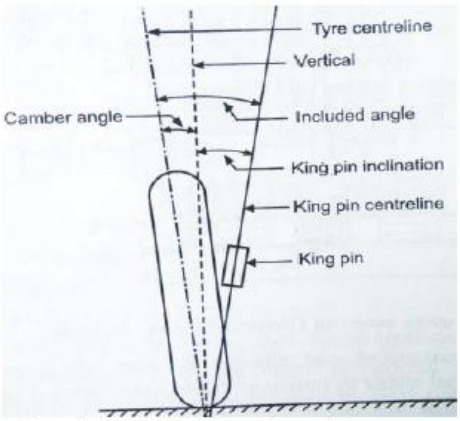
Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any THREE of the following.**	12
	a)	State the necessity of transmission system in automobile.	04
		Answer: (1 mark for each) **Necessity of transmission system:** 1. To disconnect the engine from the driving wheels when starting the engine 2. To connect 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 transmit the power from engine to rear axle at varied angle and speed. 6. To drive the driven wheel on either side of the vehicle at different speeds while the vehicle is negotiating a turn.	
	b)	**Classify automobiles on the basis of any four criteria with example of each.**	04
		Answer: *(Any four purpose – 1 mark each)* **1. According to Purpose (Use)** a) Passenger Cars b) Goods Carriage c) Special Purpose d) Earth Moving e) Motor Cycle (Bikes) f) Mopeds **2. According to Fuel Used:**	***(Any four purpose – 1 mark each)***

		a) Petrol Vehicles b) Diesel Vehicles c) LPG/CNG Vehicles d) Electric Cars e) Hybrid Cars f) Solar Cars g) Fuel Cell **3. According to Load Carrying Capacity:** a) Heavy Motor Vehicle b) Medium Motor Vehicle c) Light Motor Vehicle **4. According to Drive Used:** a) Left and Right Hand Drive b) Two Wheel and Four Wheel Drive **5. According to Engine Location and Mounting:** a) Front Engine Front Wheel Drive b) Rear Engine Rear Wheel Drive c) Front Engine Rear Wheel Drive d) Bus Chassis e) Full Forward Chassis f) Semi Forward Chassis **6. According to Body Styles:** **A. Passenger Cars:** a) Sedan/Saloon b) Hardtop c) Lift back (Hatchback) d) Station Wagon e) Coupe f) Limousine g) Convertible h) Estate Car **B. Heavy Vehicles/Trucks:** a) Truck Punjab Body b) Truck Half Body c) Truck Platform Type d) Truck with Trailer e) Dumper f) Tanker **7. According to Wheel and Axle:** a) Two and Three Wheeler b) Four Wheeler and Six Wheeler c) Single and Multi Axle.	
	c)	**Define the following terms with the help of simple sketch:** (i) **Camber** (ii) **King pin inclination**	**04**

Answer **02**

(i) Camber:

It is the tilt of car wheels from the vertical when viewed from the front of vehicle. Camber is **positive**, if the tilt is outward at the top. Camber is **negative**, if the tilt is inward at the top.



(ii) King pin inclination: **02**

It is the angle between vertical line and centre line of king pin or steering axis when viewed from the front of the vehicle.

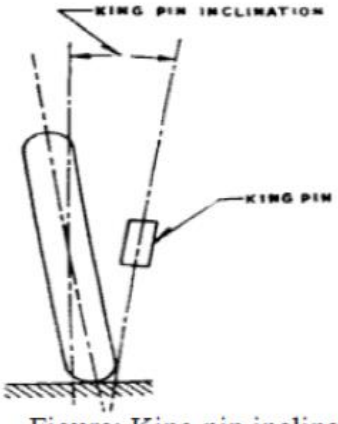
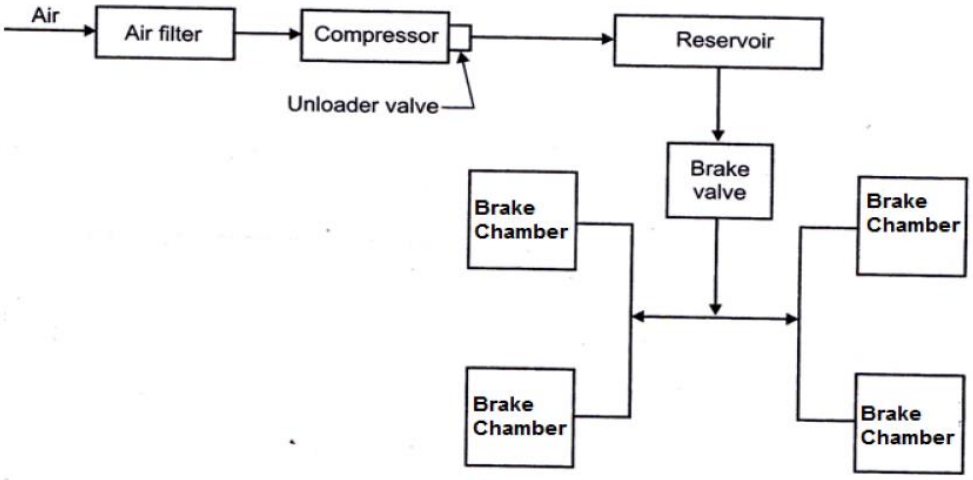


Figure: King pin inclination.

	d)	**Draw neat labelled layout of air brake system.**	**04**

		 Figure: Layout of Air Brake System	04
1	**(B)**	**Attempt any ONE of the following.**	**06**
	a)	**Enlist various types of vehicle layout and explain with neat sketch front engine rear wheel drive layout.**	06
		Types of Vehicle Layouts: **According to Engine Location:** **[1] Two Wheel Drive Vehicle:** 1.1.1 Front Engine Front Wheel Drive (FFWD) 1.1.2 Front Engine Rear Wheel Drive (FRWD) 1.1.3 Rear Engine Rear Wheel Drive (RRWD) **[2] Four (All) Wheel Drive Vehicle:** 2.1.1 Manual Operated Four Wheel Drive 2.1.2 Electronic Operated Four Wheel Drive **According to Engine Mounting:** 1. Full Forward Chassis 2. Semi Forward Chassis 3. Bus Chassis **Front Engine Rear Wheel Drive Layout:**	**02**

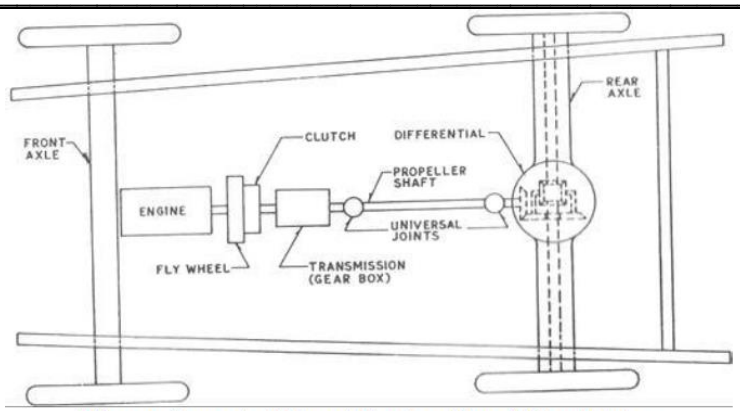


Figure: layout of Front Engine Rear Wheel drive

02

The layout of car is shown in the figure. It shows the position of the main parts of an automobile. It consists of engine located at the front of vehicle, followed by a clutch, gear box, propeller shaft, universal joint, differential, rear axle etc. The drive from the gear box is conveyed through a short shaft to the front universal joint of the propeller shaft. From the propeller shaft it is conveyed to the rear wheel through a sliding slip joint and universal joint. The bevel gear of the short shaft is driven by rear universal joint. This bevel gear meshes with a larger bevel gear which drives the two rear axle shafts through a differential gear.

02

b) Explain with neat sketch construction and working of overdrive. **06**

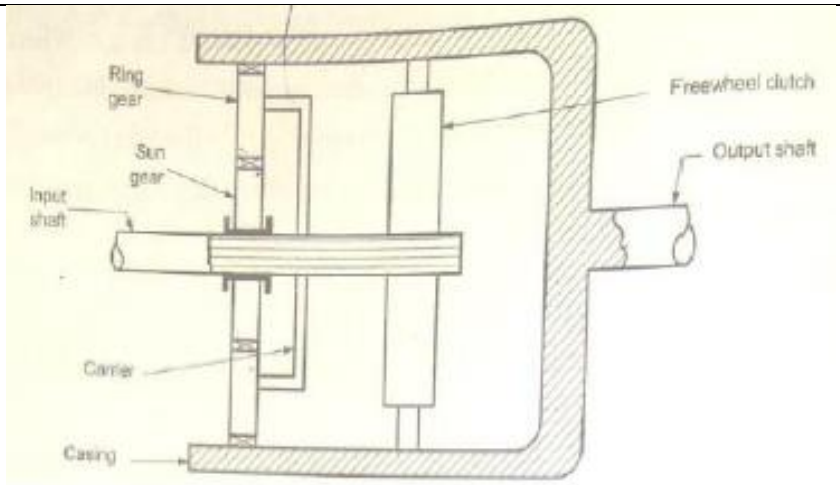


Figure: Overdrive

02

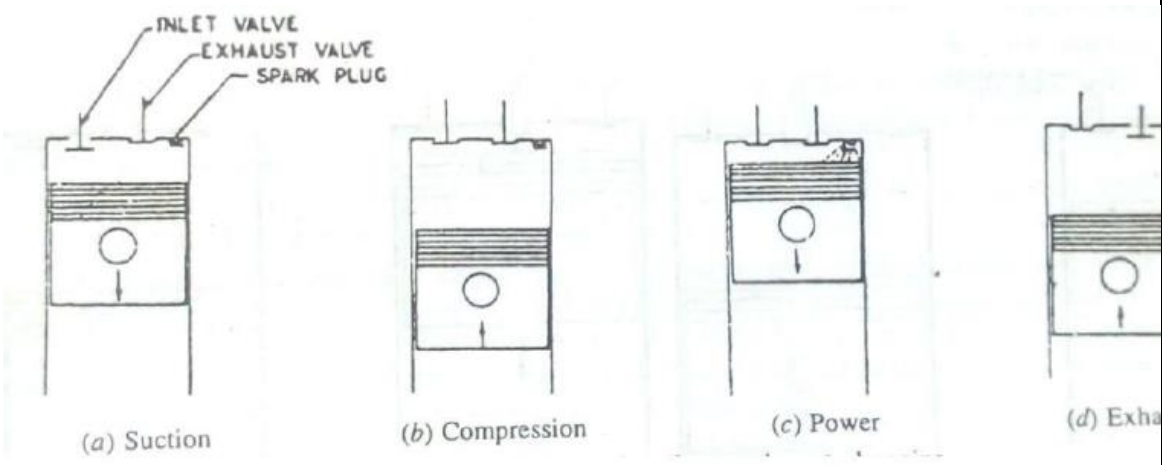
Construction:

It consists of an Epicyclic gear train in which sun gear is free to rotate on the engine shaft (input shaft) which is splined while the carrier can be slide. A free clutch is also fitted on input shaft. The ring gear is mesh with the casing of the output shaft.

02

Working:

1. When the sun gear is locked with the casing i.e. it became stationary, the speed of the output shaft increase hence says as overdrive is engaged.
2. When the sun gear is locked with the carrier or ring gear, solid drive through the gear train is obtained.

		3. Thus depending upon the locking of sun gear with casing or carrier the overdrive or direct drive is obtained. 4. There is another possible control of mechanism there is a direct drive through the free wheel clutch when engine develops the power 5. When accelerator pedal is brought to zero position and engine is idling, the output shaft will tends to override the input shaft.	**02**
2.		**Attempt any FOUR of the following.**	**16**
	a)	Explain with sketch working of four stroke petrol engine power plant.	**04**
		Working of FOUR stroke Petrol engine : The cycle of events that takes place in 4 stroke petrol engine is shown in figure. Fig. (a) shows the suction of air-fuel mixture in the cylinder during the downward movement of the piston. The piston moving away from cylinder head creates a pressure reduction or below atmospheric pressure. This depression is responsible for sucking the air-fuel mixture in the cylinder in naturally aspirated engine. In fig. (b) is shown the compression stroke in which both the inlet and exhaust valves are closed at the end of which the typical cylinder pressure will be from 8 bar to 13 bar with engine running under load. Towards the end of the compression stroke, combustion of the charge is ignited by the spark plug occurs. This generate the heat and rises pressure. The burning gases expands as shown in fig (c) pushing the piston downward. This is called the power or expansion stroke. At the end of power stroke the inlet valve remains closed but exhaust valve opens, the piston moves towards the cylinder head expelling most of the burnt gases to atmosphere (fig. d). Thus whole cycle is completed in four strokes i.e. two revolution of crankshaft.  	**02** **02**
	b)	Explain with neat sketch working of constant mesh gear box.	**04**
		Working of constant mesh gear box: A simplified diagram of constant mesh gear box has been shown in Figure. In this gear box, all gears on the main transmission shaft are constantly connected to corresponding gears on countershaft or lay shaft. In addition, two dog clutches are provided on the main shaft. One dog clutch is between the third gear and clutch gear and another is between the first (Low) gear and second gear. Top or 4th speed gear is obtained when the left dog clutch is shifted to left to mesh with clutch gear by using the gear shift lever. In this case, main shaft rotates at the same speed as that of clutch gear or engine crankshaft speed which is the maximum speed. Third gear is obtained when dog cutch (left side) meshes	**02**

with third gear on main shaft. In this way by sliding the second dog clutch, second and first gears are obtained.

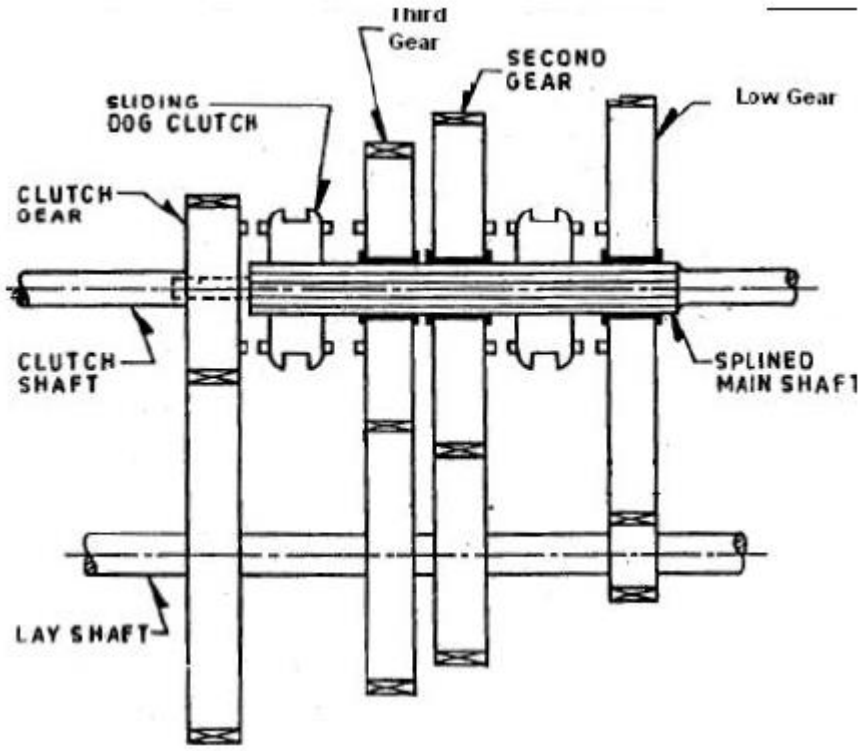


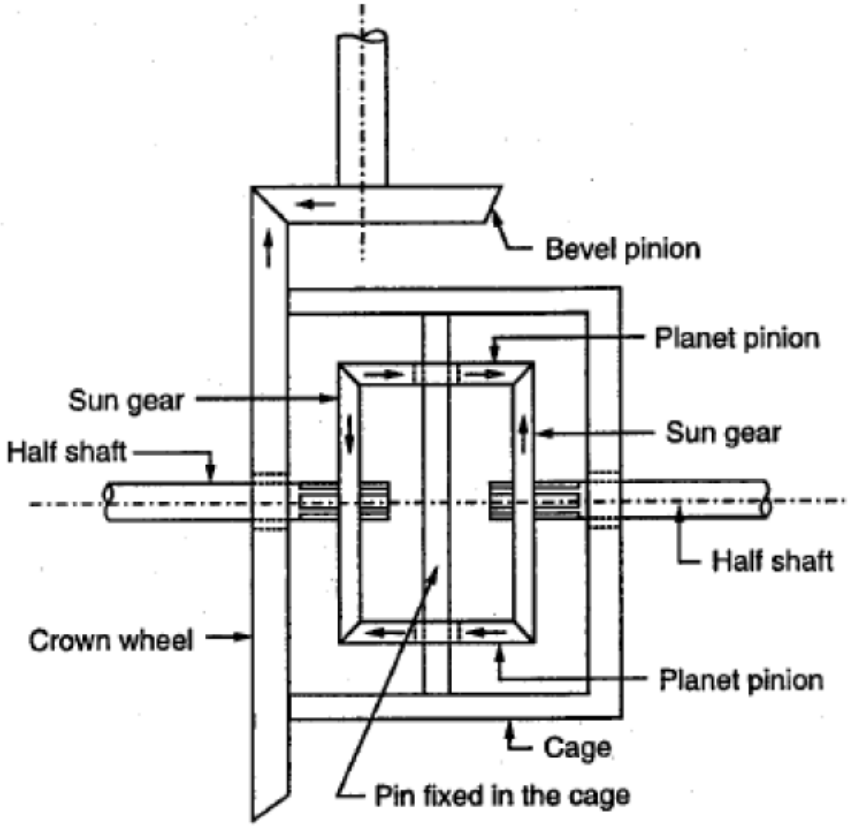
Figure: Constant Mesh gear box

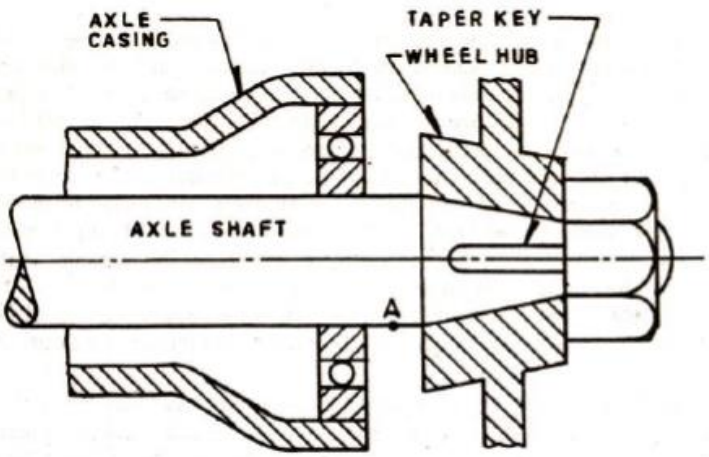
02

c) Differentiate between disc brake and drum brake. **04**

Sr. No.	Disc Brake	Drum brake
01	Friction surfaces are directly exposed to the cooling air.	Friction occurs on the internal surfaces, therefore heat dissipated only by conduction through the drum.
02	Flat friction pads are used.	Curved friction linings are used.
03	There is uniform wear of friction pads.	Non uniform wear of friction linings.
04	There is no loss of efficiency due to expansion.	There is loss of efficiency due to expansion.
05	Weight is less so saving upto 20 % is possible.	Comparatively higher weight.
06	Disc brakes have comparatively better anti-fade characteristics.	Comparatively poor anti-fade characteristics.
07	Simple in design.	Complicated design.
08	Comparatively easy to remove and replace friction pads.	Removal and replacement of brake linings is difficult and consumes more time.
09	Less frictional area	More frictional area

04 (any 8 points)

		10	Pressure intensity is more	Pressure intensity is less
	d)	Explain with neat sketch working of differential.		**04**
		Working of Differential:  Figure: Differential		**02**
		1. When vehicle moves in a straight line: The power comes from propeller shaft to the bevel pinion which drives the crown wheel. Then it is carried to the differential cage in which a set of planet pinions and sun gears are located. From the sun gear it is transmitted to the road wheels through axle half shafts. In this case, the crown wheel, differential cage, planet pinions and sun gears all turn as a single unit and there is no any relative motion between the sun gear and planet pinion. The planet pinions do not rotate about their own axis. The road wheels, half shafts and sun wheels offer the same resistance to being turned and the differential gearing does not therefore operate. Both the road wheels turn at the same speed **2. When Vehicle takes a turn:** The inner wheel experiences a resistance and tends to rotate in opposite direction. Due to this the planet pinions starts rotating about their own axis and around the sun gear and transmit more rotary motion to the outer side sun gear. So that outer sun gear rotates		**02**

		faster than the inner sun gear. Therefore the outer road wheel runs faster than the inner road wheel and covers a more distance to negotiate a turn safely.	
	e)	**State the different types of rear axle. Explain construction details of any one of them**.	**04**
		:**(types- 1 marks, Explanation & sketch- 3marks)** **Types of Rear Axle:** 1) Semi floating Rear Axle 2) Quarter Floating rear axle 3) Fully floating rear axle **1)** Semi floating rear axle:  **Construction deatails:** The figure shows a schematic diagram of the semi floating rear axle. A single ball bearing is inside the axle casing. The axle of the wheel is at the centre of the axle casing and the wheels are fitted at the end of the axle. This is done by means of key, bolt and nut. The whole weight of the vehicle is first transmitted to the suspension spring. From there it is transmitted to the axle casing from there to the axle and wheel. Finally it is transmitted to the ground. The axle can be removed by first placing a support below the axle casing. **OR** 2. Quarter floating rear axle:	**(1 mark for types, explanation & sketch 3 marks)**

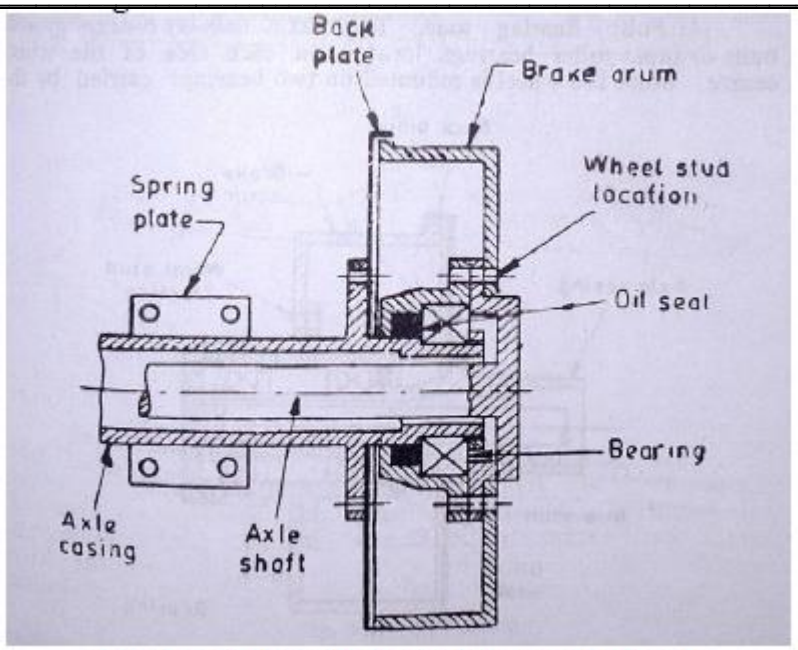


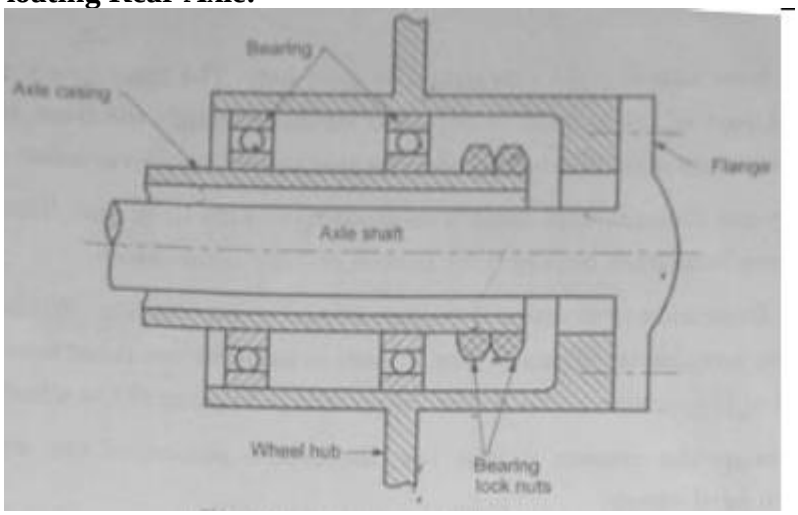
Figure Three quarter floating rear axle

Construction details:

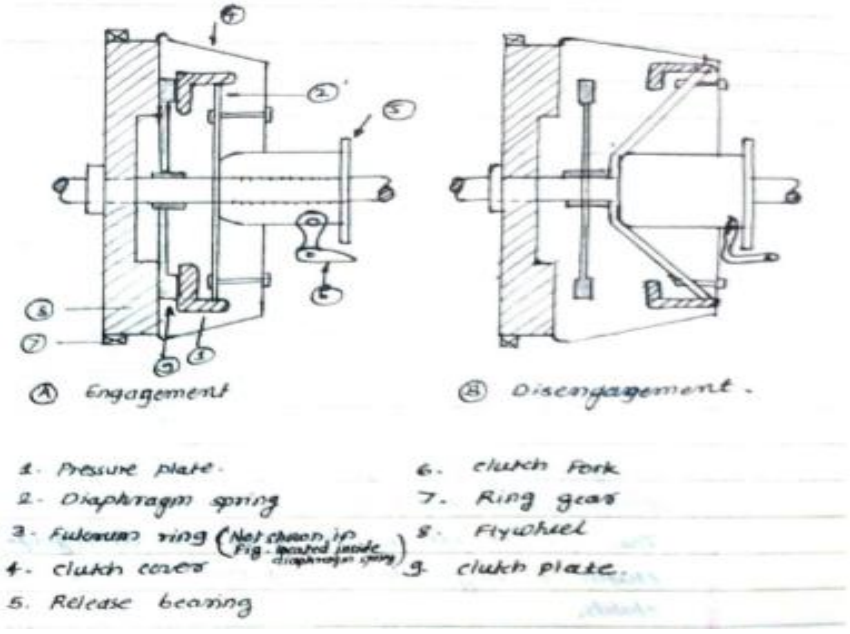
This axle is generally used on large vehicles and high performance cars. In this axle, a bearing is provided inside the axle housing to carry the final drive unit. To support the weight of the vehicle, an outer bearing is also placed between the wheel hub and the axle housing. The weight of the vehicle is transferred to the axle casing while the side trust and the driving torques are supported on the axle shaft.One bearing of the brake drum is fitted on the axle while the other on the axle tube. The hub bearing housing flange carries the wheel studs. It is either integral with the half shaft or carried on a keyed taper pass through the half shaft flange. During cornering, the half shafts are only subjected to a bending load. As shown in the figure , this axle is quite complicated but more reliable ascompared to semi-floating axle. The wheel will still be attached to car on case of half shaft failure. But the side loads may cause it to rock on the bearing.

OR

2) Full Floating Rear Axle:



Construction details:

		In this type of axle two taper roller bearings are used. Bearings are placed between the axle housing and the wheel hub. Since the load of the vehicle is supported completely by the axle housing. The axle only transmits driving torque. The inner end is supported inside gear of differential and outer end have a flange to which wheel hub is bolted. The axle may be removed or replace from the housing without disturbing the wheel by removing the nut. This type of axle is more expensive and heavier than other axle. This type is used in trucks or commercial vehicles.	
3.		**Attempt any TWO of the following.**	**16**
	a)	**State the functions of clutch. Explain with neat sketch working of single plate clutch(diaphragm type) .**	**08**
		Function of clutch- 1. To permit engagement or disengagement of gears when the vehicle is stationary (the engine is running) and when the vehicle is in motion without damaging the gear wheels. 2. To transmit the engine power to the road wheels smoothly without shock to the transmission system while setting the vehicle in motion. 3. To allow the engine to take up load gradually without shock or jerk	**02**
		Working : 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.	**02**
		 (A) Engagement (B) Disengagement. 1. Pressure plate. 6. clutch fork 2. Diaphragm spring 7. Ring gear 3. Fulcrum ring (Not shown in Fig. mounted inside diaphragm spring) 8. Flywheel 4. clutch cover 9. clutch plate. 5. Release bearing	**03**
	b)	**Explain with neat sketch hydraulic breaking system. Also state any two advantages and disadvantages of hydraulic brake system.**	06
	Ans.	**Working:** When the brakes are not in operation, the system is filled with brake fluid under light pressure. When driver presses the brake pedal for applying the brake, the	02

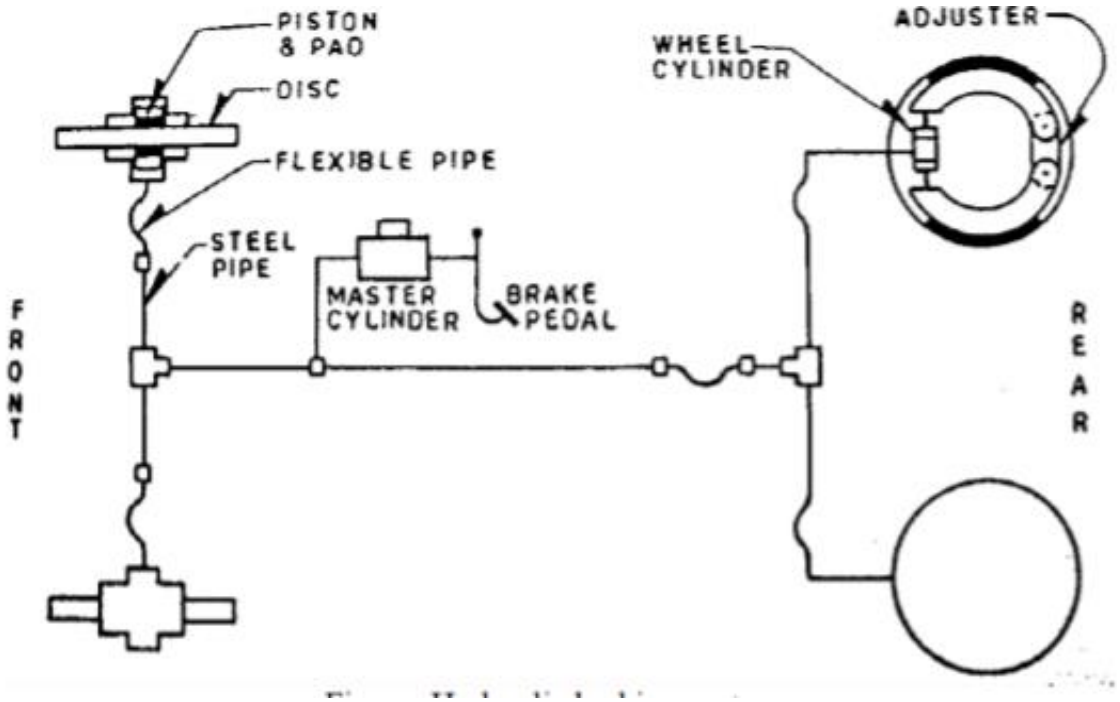
piston in the master cylinder moves forward and compresses the fluid in cylinder. It increases the pressure of the fluid in master cylinder and in entire hydraulic system. This pressure is instantly transferred to all four wheel cylinders (in case of disc brake this pressure is transferred to calipers). Thus the piston in wheel cylinders moves outward which moves brake shoes against brake drum to apply brakes. When driver releases the brake pedal, the master cylinder piston returns to its original position due to return spring and the pressure is dropped. It releases brake shoes from brake drum to their: original position and brakes

Advantages:

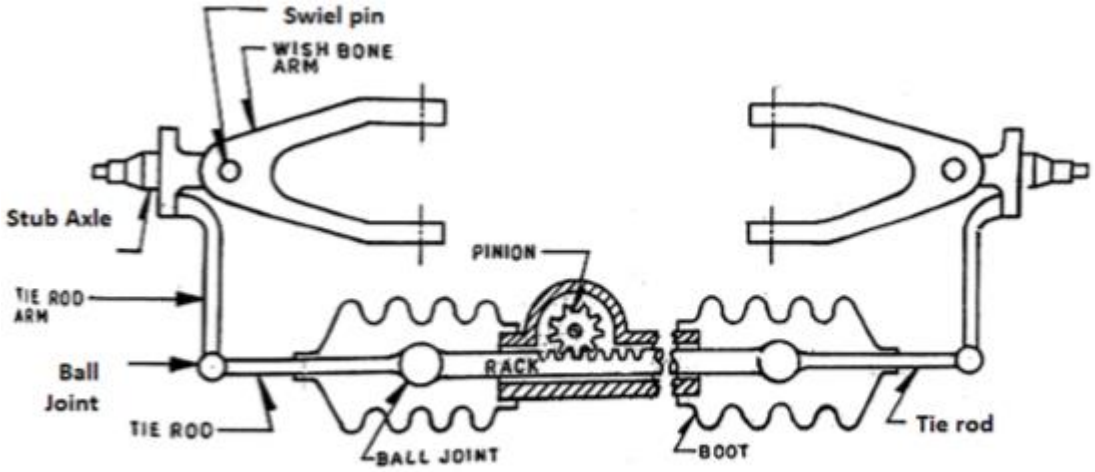
1. Brake fluid act as lubricant. 01
2. Reduces frictional losses.
3. Lighter in weight.

Disadvantages:

1. They can leak which makes them messy
2. Fluid inside them are often caustic to paint and some seals 01



02

	c)	**Explain with neat sketch construction and working of rack and pinion steering gear box.**	**08**
	Ans.	**Working:** The rack-and-pinion steering box has a pinion, connected to the steering column. This pinion runs in mesh with a rack that is connected to the steering tie rods. Both the pinion and the rack teeth are helical gears. Helical gearing gives smoother and quieter operation for the driver. Turning the steering wheel rotates the pinion, and moves the rack from side to side. Ball joints at the end of the rack locate the tie-rods and allow movement in the steering and suspension. Mechanical advantage is gained by the reduction ratio. The value of this ratio depends on the size of the pinion. A small pinion gives light steering, but it requires many turns of the steering wheel to travel from lock, to lock. A large pinion means the number of turns of the steering column is reduced, but the steering is heavier to turn.  **Figure: Rack and pinion steering gear box**	**04** **04**
4	**A**	**Attempt any THREE of the following.**	**12**
	a)	**Define wheel alignment and wheel balancing.**	04
		Wheel alignment: It refers to the adjustment of a vehicle's suspension the system that connects a vehicle to its wheels. It is not an adjustment of tires or wheels themselves. The key proper alignment is adjusting the angles of the tires which affects how they make contact with the road. **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.	**02** **02**
	b)	**Explain Mac-Pherson type suspension system with neat sketch.**	**04**
		Mc-pherson strut type independent suspension: In this type, only lower wishbones are used as shown in fig. A strut containing shock absorber and the spring carries also the stub axle on which the wheel is mounted. The wishbone is hinged to the cross member and positions the wheel as well as resists accelerating, braking and side forces. This system is simple, lighter and keeping the unsprung weight lower. Further the camber also does not change when the wheels move up and down. This type of suspension provides the maximum area in the engine compartment and is, therefore, commonly used on front wheel drive cars.	**02**

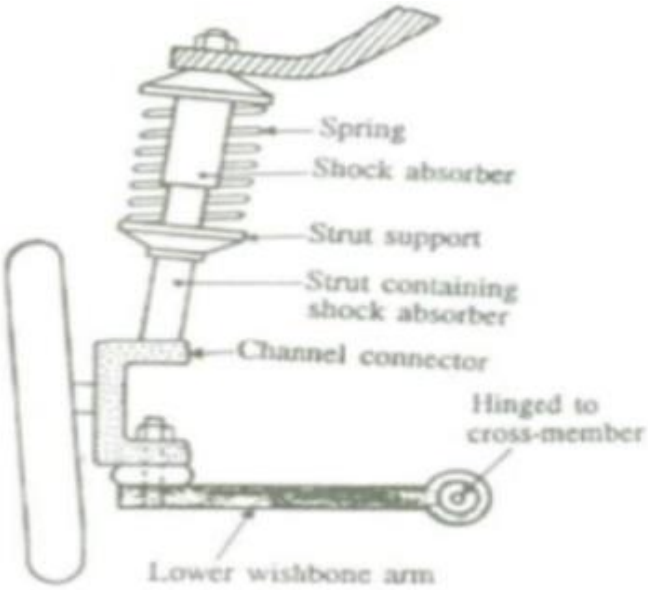


Figure: Mc-pherson strut type independent suspension
(Note: Equivalent credit shall be given to any other suitable sketch if drawn)

02

c) Explain wire harness and state any four color codes used in wiring system. **04**

Wire harness: In order to quickly identify and also to simplify the wiring system, the cables are colored. For quick identification, insulations of various wires in a circuit are assigned different colors. The seven color code system is the general one and involves brown, yellow, red, white, green, blue and black colors. [2] In motor vehicle wiring system there are number of wires for different systems such as head lamp, fog, side indicator, horn etc. As the wires are more for each circuit, we have limited space for making of suitable arrangement of wiring.
Thus following seven color code system mentioned below, used in an automobile:

02

Color codes

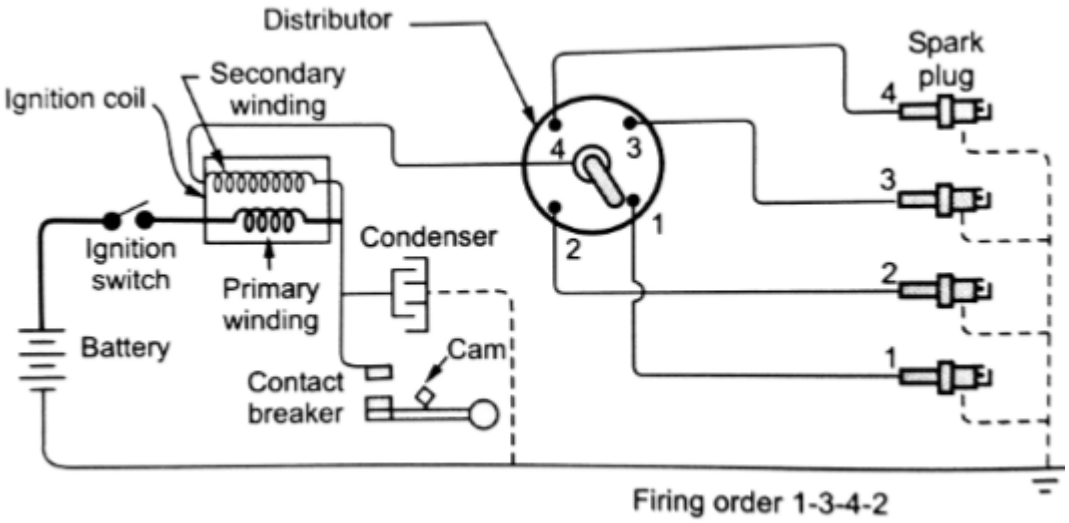
Sr. No	Colour	Colour code	Function
01	Brown	BR	Battery circuit
02	yellow	Y	Generator circuit
03	White	W	Ignition circuit
04	Green	G	Auxiliary circuit
05	Blue	BL	Head lamp circuit
06	Red	R	side lamp and tail lamp

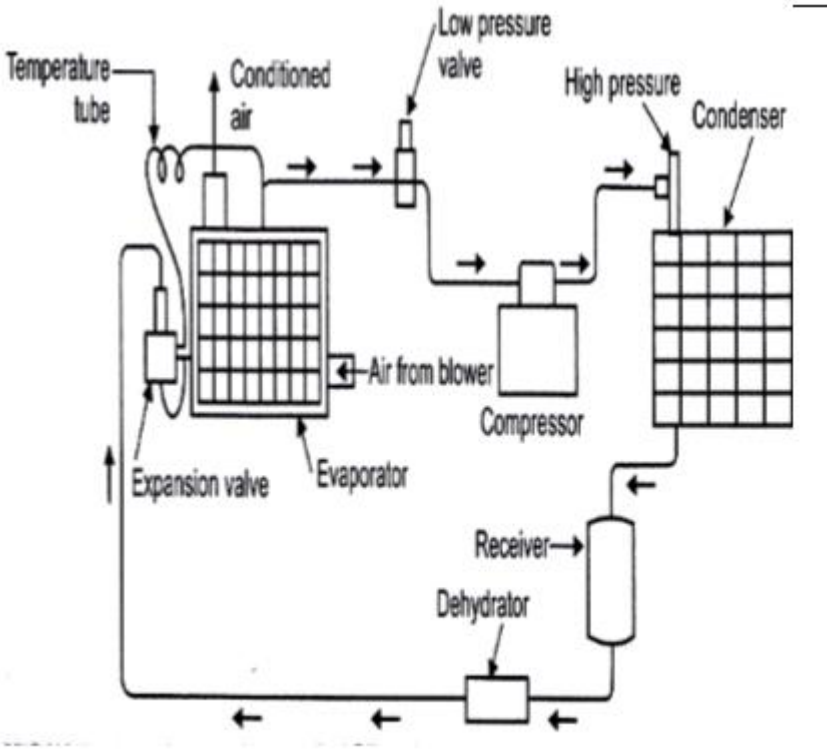
02 (1/2 mark each)

d) Explain working of battery ignition system with neat sketch. **04**

Battery ignition system for four cylinder engine **02**

When the ignition switch is in the ON Position, current flows from the battery to the

		primary winding of ignition coil. The current in the primary circuit goes on increasing exponentially during the period that the contact breaker points are connected. The laminated core of the ignition coil stores the electromagnetic energy generated on account of this current built up in the primary circuit. When the contact breaker points open, the electromagnetic field built up in the primary circuit collapses and the energy is projected in the secondary circuit. As the break period of contact breaker is very short, the EMF voltage induced in secondary circuit is very high and is proportional to the rate of change of flux in winding. This sudden high voltage generated is directed to specific spark plug as per the firing order with the help of distributor. The condenser stores energy during this break period of contact breaker and releases it during the make period, thereby avoiding acting at contact breaker point. The voltage multiplication is dependent on the number of turns of primary and secondary winding of ignition coil.  **Figure: Battery ignition system for four cylinder engine.**	**02**
4.	**B**	**Attempt any ONE of the following.**	**06**
	a)	**Sketch the layout of an air conditioning system for a car and explain its working.**	**06**
		Working: Air Conditioning System in a Car works on Vapor compression cycle. It consists of compressor, condenser, evaporator, receiver, expansion valve, thermostat, blower fan and heating core. In compressor during suction stroke low pressure vapor in dry state is sucked from evaporator. It is then compressed to high pressure and temperature. These vapors are then passed into condenser where heat is removed by cooling medium which converts vapor into liquid. The liquid is stored into receiver. The liquid from receiver is then passed to evaporator through expansion valve. Expansion valve reduces pressure. The low pressure liquid refrigerant enters evaporator, where it absorbs the heat from the warm air which is passed over the evaporator. The worm air gets cooled thereby cooling the passenger compartment. Due to heat absorption, liquid refrigerant gets converted into vapor and these vapors are passing to compressor.	**03**

		 **Figure: Layout of car air-conditioning system**	**03**
	b)	**State and explain air conditioning parameters for human comfort.**	**06**
		Answer: (Any three parameters each for 02 marks) **1) Temperature:** Temperature is the most important factor which affects human comfort to a great extent. Most of the human being feels comfortable at a temperature 210C to 250C. Generally human being feels comfortable at relatively higher temperature in winter season and feels comfortable at relatively lower temperature in summer season. The comfort temperature of individual person depends on his body structure, eating habits, the area in which he is to make familiar to live. **2) Humidity:** The control of humidity is not only necessary for human comfort but it is also important from point of view of efficiency of driver. For human comfort, relative humidity is kept within a range of 35% to 60%. **3) Purity of air:** A person does not feel comfortable when breathing in contaminated air even if temperature and humidity is within comfortable range. Therefore, proper filtration, cleaning and purification of air is necessary to keep it free from dust, dirt and other impurities. The proper percentage of oxygen in air is necessary to be maintained for human comfort. Therefore, proper filtration system is provided in HVAC system in automobiles. **4) Air motion and circulation:** Even if temperature, humidity and purity of air is satisfactory, certain amount of air motion is necessary for human comfort. We do not feel comfortable in dead or still air. It is therefore, necessary that there should be equi-	**(Any three parameters each for 02 marks)**

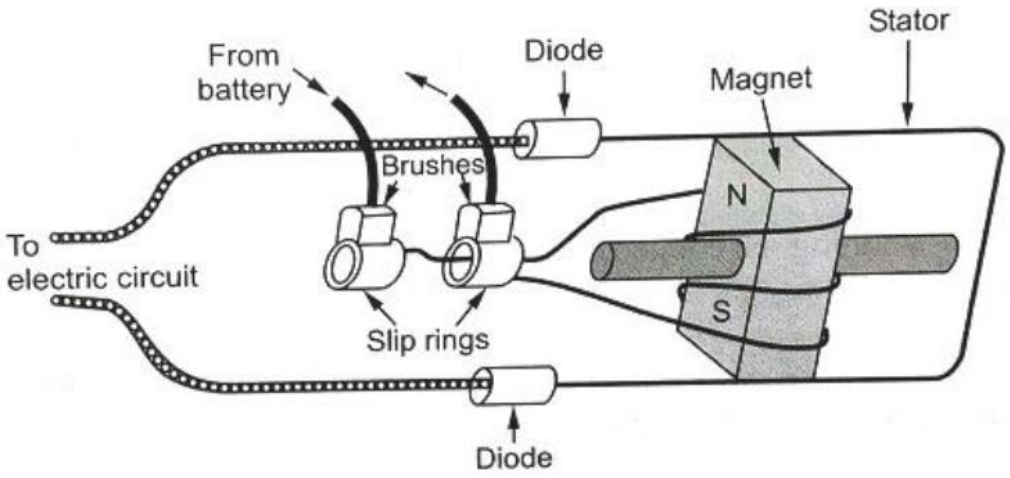
		distribution of air throughout the space to be air conditioned.	
5.		**Attempt any FOUR of the following**	**16**
	a)	**Describe with neat sketch working of alternator**	**04**
	ans	**Construction and working of alternator:**  Figure: Alternator *(Note: Equivalent credit shall be given to any other suitable sketch if drawn)* **Construction**: It consists of fan, rectifier, diode, spacer, stator, drive and housing, slip rings, rotors, drive and bearing, regulator, pulley etc. The operation of alternator is improved by placing the stator and rotor assembly inside the iron frame of housing which provide a conducting path for the magnetic line of force. Voltage increase by increasing stator winding in to number of coil. Alternators consist of rotor assembly, stator assembly and rectifier mounted in housing. Housing near of two piece of die cast aluminium which is light and weight. Stator is clamp in housing. **Working:** It consists of an electromagnetic rotor which is energized form the current of the battery through brush and slip ring assembly. Rotor is rotated by belt and pulley arrangement get power form engine stator winding is wound around the rotor. The rectifier circuit consisting of diodes is connected to the stator winding. Diodes are electronic device that allows current to flow only in one direction. When the electromagnetic rotor is turned its magnetic lines of force cut the stationary stator loop. This induces a current in the stator winding. Through the electromagnetic rotor reverses its polarity the alternating current produces in the stator winding is converted to direct current by the diodes.	**02** **02**
	b)	**Explain with neat sketch spoke wheel.**	**04**
		(Credit should be given to appropriate answer) Wheel consists of hub (with bearings and axle), rim and spokes that keep it all together. Wheel stands on its spokes.A spoke is one of some number of rods radiating from the center of a wheel (the hub where the axle connects), connecting the hub with the round traction surface.	**02**

		 Figure: Spoke wheel As shown in the picture above: when a rider sits, the load will be transferred over the fork to the wheel axle. Wheel axle will start loading the rim, through spokes with which they are connected. When the axle starts pushing down, and the rim is on the ground, rider only way the axle can go down is if it somehow manages to completely unload the spokes in the lower part of the wheel. Spokes are easily bent, and the only way they provide some sort of leverage is when they resist pulling force – the one that tries to elongate them. So it is important to have the wheel trued and spokes tightened to appropriate torque.	**02**
	c)	**Differentiate between radial ply and cross ply tyres.**	**04**
		Answer: (any four, 1 mark for each)	

Sr.No	Radial ply tyre	Cross ply tyre
1	Plies are running radially straight from bead to bead	Plies are running diagonally opposite from bead to bead
2	Stiffness of tyre is less	Stiffness of tyre is more
3	It gives ultimate comfort for speed more than 55 Km/hr.	Because of more stiffness tyre is less comfortable.
4	Steering is harder	Steering is easy
5	Tyre has firm grip with road	Tyre has lesser grip with road.
6	Radial ply tyre has more breaking grip	Cross ply tyre has less breaking grip
7	Parking of vehicle is difficult	Parking of vehicle is easy
8	It is costlier	It is cheaper than radial
9	Tread life is more	Tread life is less

d) Explain the importance of an aerodynamic shape of car body. **04**

(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.
(v) 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.

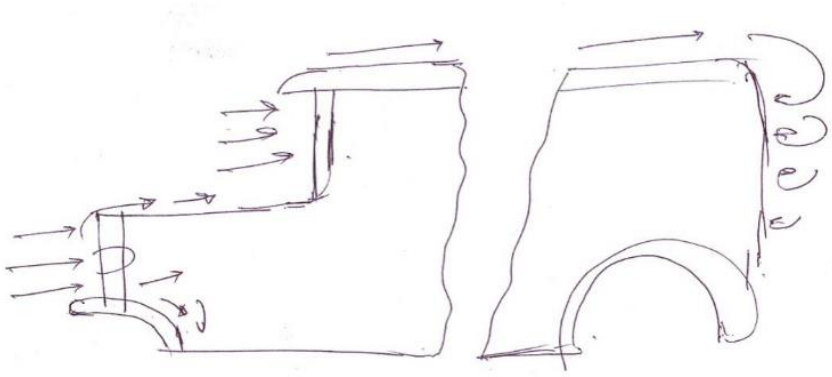


Figure 1

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.

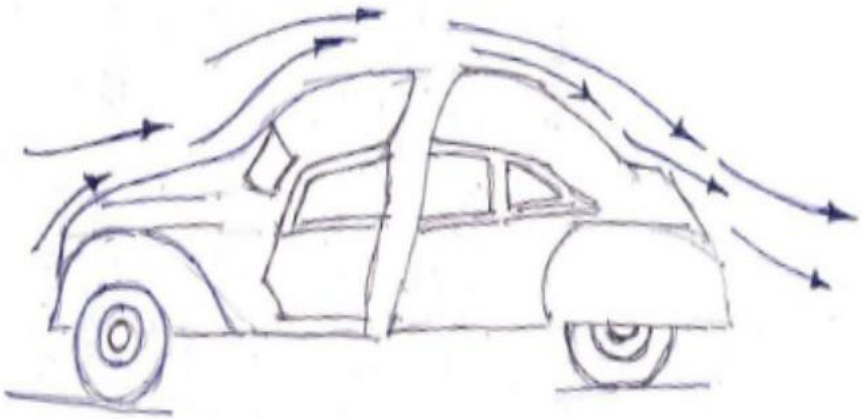
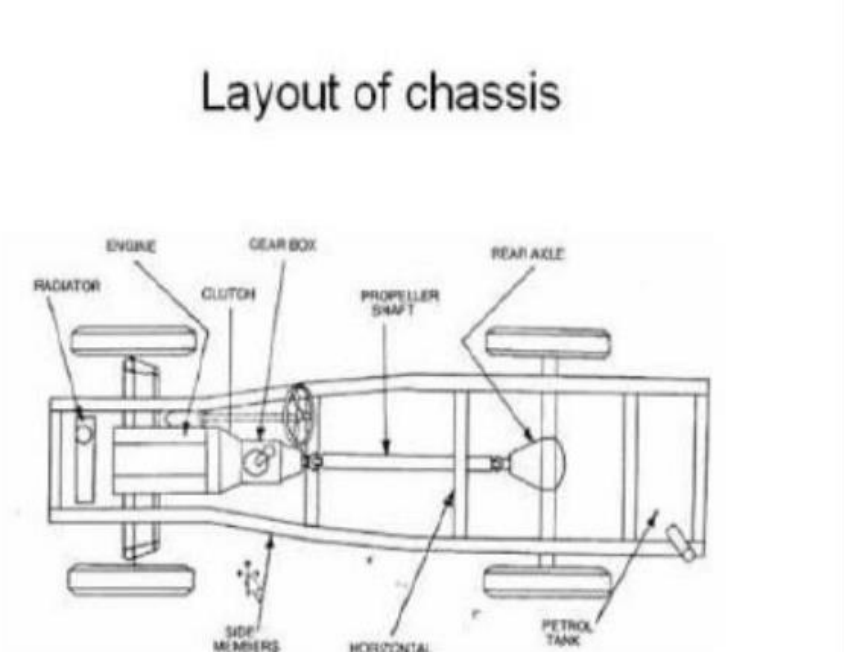
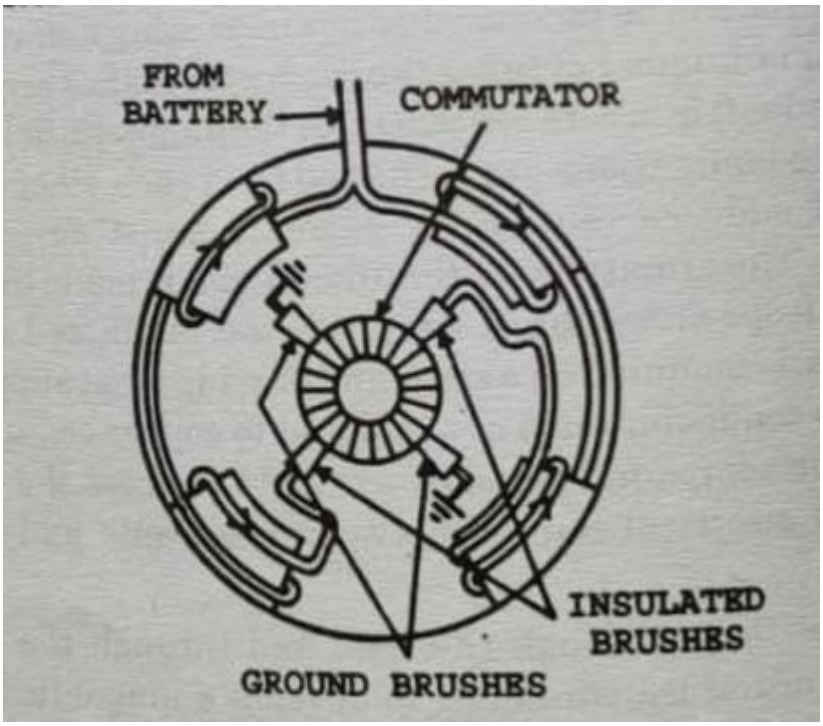
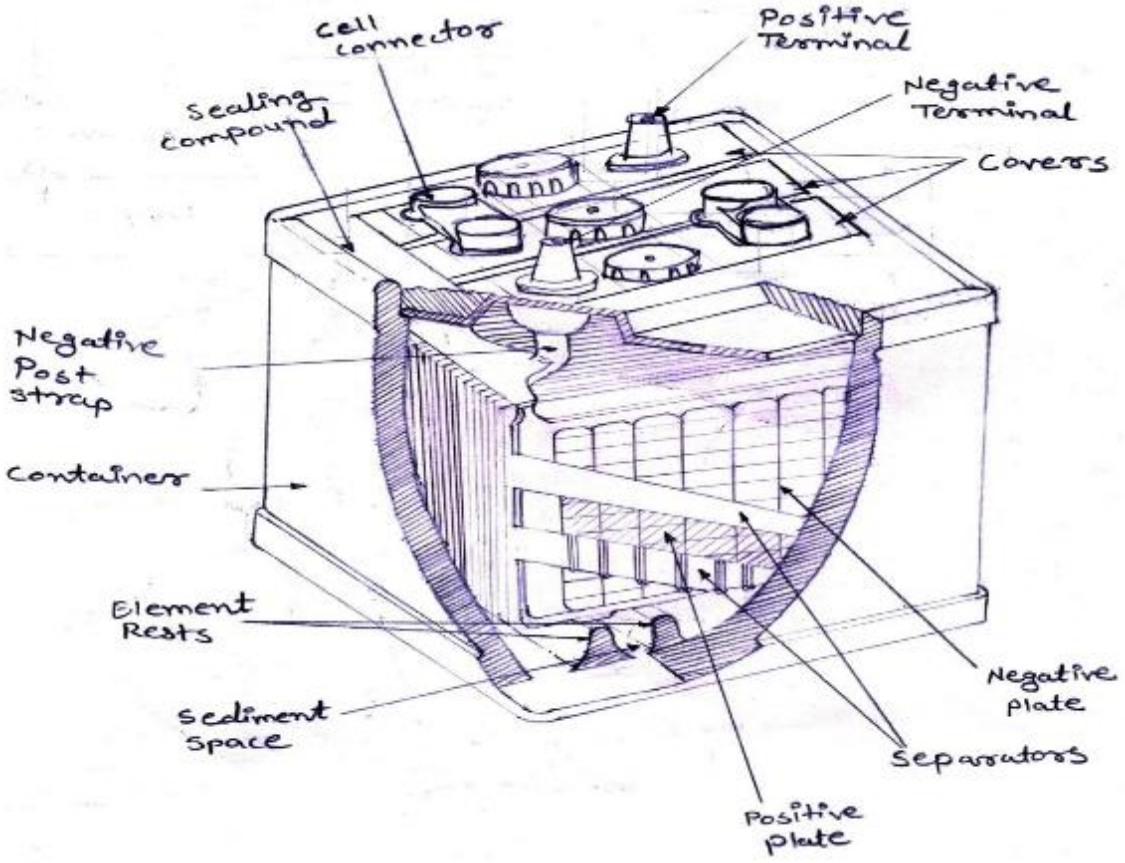


Figure No.2

	e)	**Draw the general layout of an automobile chasis and label the component**	**04**
			**04**
6.		**Attempt any TWO of the following.**	**16**
	a)	**Explain with neat sketch construction and working of starting motor.**	**08**
		(Credit should be given to appropriate answer) **Construction:** A starter motor consist of two major parts: i) A stationary field ii) Rotating armature. The field is made up of number of conductor turns around the soft iron core and armature is made from a number of a number of conductor loops or windings wrapped on a laminated soft iron core which is mounted on a shaft and bearing that support it within the field. The conductor ends are soldered to copper commutator bars. Carbon-copper compound brushes are held against the commutator bars to make electric contact between the frame and the rotating armature. **Working:** Current flows through the field and through the commutator bars into the armature winding, to develop the magnetic field around the conductors in each. Before the armature winding can reach its neutral point, the next set of commutator bars moves into contact with the brushes. This produce the same electromagnetic force on the next armature conductor. The rotating force of armature is transferred through the starter drive mechanism to crank the engine. The maximum torque or turning force developed by the starter result from the strength of its magnetic field which is due to the design of the starter, winding size, and conductor size. In general, for more current drawn by the starter more torque will produce by the attracting and repelling of magnetic field.	**04** **02**

		Sketch:  Fig: Starting motor	**02**
	b)	**Sketch a cut section showing construction of battery. Label the components and state their function.**	**08**
		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.	**02**
		The main Components of Battery are **(four major comp. 1marks)** 1. Container 2. Plates 3. Separators 4. Electrolyte 5. Cell Covers	**01**
		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)**  	**02** **03**
	c)	**Explain with neat sketch construction and working of telescopic shock absorber.**	**08**
		Below figure shows a simple Telescopic Shock absorber. There is a fluid in space above valve assembly (A), below (A) & also in annular space between cylinder (C) & tube (D), which is connected to the space below valve assembly (B). (H) is gland in head (J) &	**04**

any fluid scrapped off by rod (G) is brought down into annular space through inclined passage shown in head. Eye (E) is connected to axle, while eye (F) is attached to chassis frame. Fluid generally used in shock absorbers is a mixture of 60 per cent Transformer oil & 40 per cent Turbine oil.

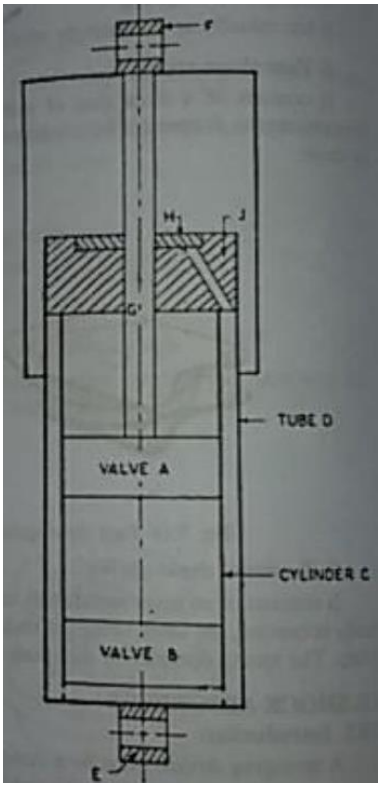


Figure: Telescopic Shock Absorber

When car has come across a bump,

[1] Eye (E) would move up & thereby the fluid will pass from lower side of valve assembly (A) to its upper side.

[2] Due to pressure of fluid through rod (G) fluid will be go to underside of valve (B).

[3] This passing of fluid through valve openings provides damping.

[4] Similarly for downward motion of eye (E), fluid will pass upper side of valve assembly (A) to lower side & also from lower side of valve assembly (B) to its upper side.

04