

WINTER – 15 EXAMINATION

Subject Code: **17526 (Automobile Engineering)** **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.
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Q1.A (a)

Functions of transmission system of an automobile like, (1M per point)

- i. To transmit power from the engine to the rear wheels of the VEHICLE,
- ii. To make reduced speed available, to rear wheels of the VEHICLE,
- iii. To alter the ratio of wheel speed and engine speed in order to suit the field conditions and
- iv. To transmit power through right angle drive, because the crankshaft and rear axle are normally at right angles to each other.

Q1.A (b)

Advantages of Rear Wheel Drive like, (any four @ 1m per advantage) -

- i) Better handling in dry conditions - accelerating force is applied to the rear wheels, on which the down force increases, due to load transfer in acceleration, making the rear tires better able to take simultaneous acceleration and curving than the front tires.
- ii) More predictable steering in low traction conditions (ie: ice or gravel) because the steering wheels maintain traction and the ability to affect the motion of the vehicle even if the drive wheels are slipping.

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iii) Less costly and easier maintenance - Rear wheel drive is mechanically simpler and typically does not involve packing as many parts into as small a space as does front wheel drive, thus requiring less disassembly or specialized tools in order to replace parts.

iv) No torque steer.

v) Even weight distribution - The division of weight between the front and rear wheels has a significant impact on a car's handling, and it is much easier to get a 50/50 weight distribution in a rear wheel drive car than in a front wheel drive car, as more of the engine can lie between the front and rear wheels (in the case of a **mid engine** layout, the entire engine), and the transmission is moved much farther back.

vi) Steering radius - As no complicated drive shaft joints are required at the front wheels, it is possible to turn them further than would be possible using front wheel drive, resulting in a smaller steering radius.

vii) Towing - Rear wheel drive puts the wheels which are pulling the load closer to the point where a trailer articulates, helping steering, especially for large loads.

vii) **Weight transfer** during acceleration. (During heavy acceleration, the front end rises, and more weight is placed on the rear, or driving wheels).

Q 1 A (C) Requirements of steering system

a) The front wheels should roll without lateral skid while negotiating a curve.

b) There should be proper proportion between the angles turned by the front wheels.

c) The tyres must have good elasticity so that on turns these may follow an arc of greater radius than stiff tyres.

e) The wheels must automatically come to the straight ahead position after negotiating the bend. When going straight, the wheels must maintain the neutral position.

f) The angular oscillation of the wheels must be minimum.

g) The system must be irreversible to a certain degree so that minimum front wheels shocks are transmitted to driver's hand.

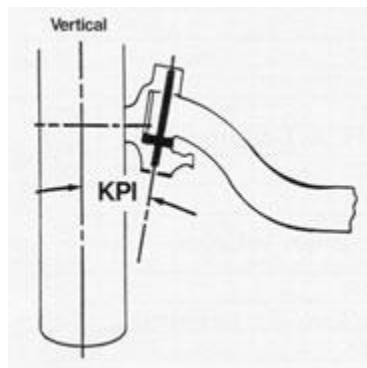
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Q1.A (d) (@ 2m per explanation)

i) **king pin inclination:**

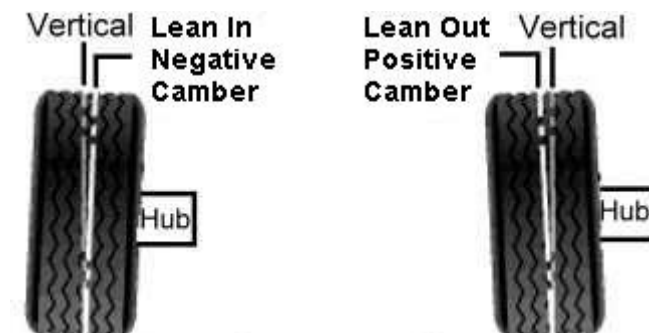
The angle between the vertical line and center of the king pin or steering axle, when viewed from the front of the wheel is known as steering axle inclination or **king pin inclination** (0-5 degrees for trucks and 10-15 degrees on passenger cars).



Effect:

- KPI helps the straight head recovery thus directional stability.
- ii) Camber angle- Camber is the angle of the wheels, relative to the road, looking at the car from the front (or rear).

ii) CAMBER generally will be around - 0.5 to - 5.5 degrees. (negative)



When cornering the body of the car will start rolling, inducing positive camber. Negative camber will compensate this effect.

Result: more grip and stability while cornering.

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Also; negative camber creates a force on the wheels called "camber-thrust". Going straight Left and Right will be in balance and the car goes straight.

Result; better straight stability with more negative camber.

When cornering the inner wheel will be lifted from a little to sometimes completely. Than the camber-thrust will cause the car to make a sharper turn, pushing the car inwards.

Result; Better cornering.

That's why car-designers try to keep about 0.5 degree negative camber while cornering with the suspension being compressed. That means that the negative-camber at ride height will become more negative when suspension compresses, at the same time the body roll will eat up negative camber.

Hopefully leaving a bit of negative for Cornering-grip and better steering and even heating of the tires as well as even tire-wear.

Q1.B (a)

Aerodynamic shape improves performance of vehicle: (six point like given below 6 m)

Automotive aerodynamics is the study of the aerodynamics of road vehicles. Its main goals are reducing drag and wind noise, minimizing noise emission, and preventing undesired lift forces and other causes of aerodynamic instability at high speeds. Air is also considered a fluid in this case. For some classes of racing vehicles, it may also be important to produce down force to improve traction and thus cornering abilities.

- An aerodynamic automobile will integrate the wheel arcs and lights into the overall shape to reduce drag. It will be streamlined. It does not have sharp edges crossing the wind stream above the windshield and will feature a sort of tail called fastback or Kammback or liftback.
- It will have a flat and smooth floor to support the Venturi effect and produce desirable downwards aerodynamic forces. The air that rams into the engine bay, is used for cooling, combustion, and for passengers, then reaccelerated by a nozzle and then ejected under the floor.
- Door handles, the antenna, and roof rails can have a streamlined shape. The side mirror can only have a round fairing as a nose. Air flow through the wheel-bays is said to increase drag (German source) though race cars need it for brake cooling and many cars emit the air from the radiator into the wheel bay.
- An aerodynamic shape of car body is the external shape of car body which will offer least resistance to air motion.

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- Frontal area of car & body of car is designed in such a way that front portion is made inclined & body is given smooth curves. This offers a least resistance to air & called as an aerodynamic shape.
- Since there is least air motion resistance due to the aerodynamic shape. Engine load is decreased and there is better fuel efficiency & average.

Q1.B (b)

(Sketch 2 explanation 4m)

A **transfer case** is a part of the drive train of four-wheel-drive, all-wheel-drive, and other multiple powered axle vehicles. The transfer case transfers power from the transmission to the front and rear axles by means of drive shafts. It also synchronizes the difference between the rotation of the front and rear wheels, and may contain one or more sets of low range gears for off-road use.

Functions

- The transfer case receives power from the transmission and sends it to both the front and rear axles. This can be done with gears, hydraulics, or chain drive. Some vehicles, such as all-wheel-drive sports cars, have transfer cases that are not selectable. Such a transfer case is permanently "locked" into all-wheel-drive mode.
- Transfer cases that are designed to allow for normal road use synchronize the difference between the rotation of the front and rear wheels, in much the same way the differential acts on a given axle. This is necessary because the front and rear tires never turn at the same speed.
- Transfer cases designed for off-road use can mechanically lock the front and rear axles when needed (e.g. when one of the axles is on a slippery surfaces or stuck in mud, whereas the other has better traction). This is the equivalent to the differential lock.
- The transfer case may contain one or more sets of low range gears for off-road use. Low range gears are engaged with a shifter or electronic switch.

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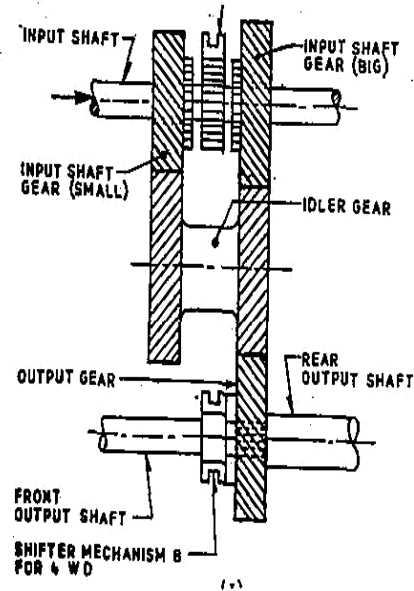


Figure - 04
mark

Transfer case:-

- The transfer case is an auxiliary transmission mounted in back of the main transmission. This is used in four wheel drive vehicles.
- The transfer box enables the driver to drive in two wheel drives on highway or shift to four wheel drives for cross-country operation, to drive in high gear or low gear as required.
- The input shaft is connected to the gear box and carries on it a neuter having axial teeth. Two input shaft gears are free to rotate on the shaft. Each of these gears have bosses on the side which have axial teeth of the same pitch as the central member on the input shaft.
- Depending upon the movement of the transfer box gear level the central member and thereby the input shaft may be connected either to the small gear or to the big gear.
- There are two output shafts, one going to the front axle and the second going to the rear axle. The front output shaft is smaller in diameter & is supported inside the rear output shaft, which is directly connected to the output gear.

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- The front output shaft has fitted on it a shifter mechanism and also has splines over a small length of it, which when engage with the corresponding internal splines on the rear output shaft, connect the two shafts rotationally with each other.
- When the shifter mechanism A is at the center so that no gear is connected to the input shaft the drive is in neutral. When the shifter mechanism A connects the input shaft with the big input gear, but the shifter mechanism B disconnects the front output shaft from the rear output shaft. In this position, two wheel drive with the high gear is obtained, In the same way four wheel drive in low gear is obtained. Application: - 4 wheel drives jeeps & cars & Trucks.

Q 2 (a)

Auto bodies: (Stating 8 types 4m)



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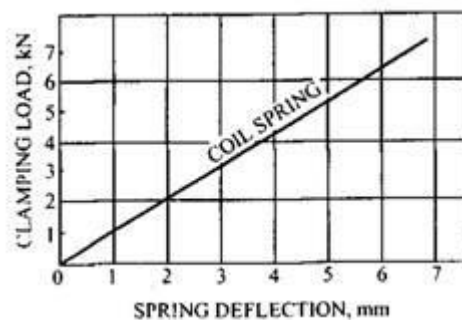
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Q 2 (b)

Difference between coiled and diaphragm clutch. (Proper explanation any 4 points 4 m)

i) Clamping Characteristics.

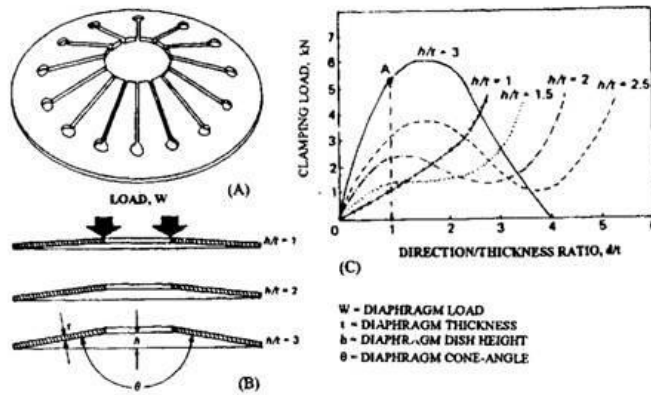


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- Figure illustrates the linear relationship between load and deflection of a multi-coil clutch. As the springs are compressed (deflected) in a multi-coil clutch and compressive clamping load increases proportionally. This provides a linear relationship between load and deflection.

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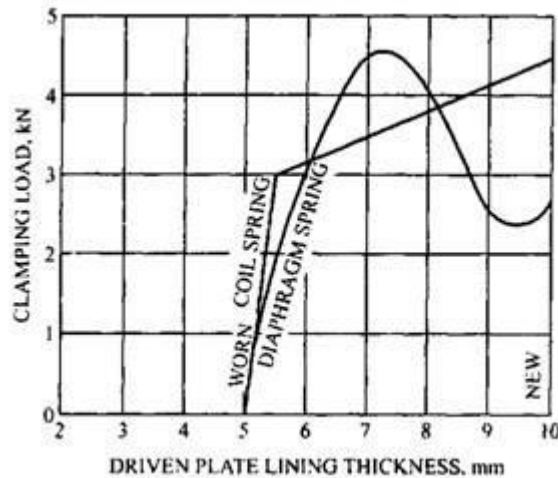
- On the other hand, a non-linear relationship is exhibited between load and deflection of a diaphragm-spring clutch. The shape of the load-deflection curve mainly depends on the ratio h/t , the dish height (h) in the free state to the thickness (t) of the diaphragm spring for a given spring size.
- Thus the load-deflection characteristic of the spring can be varied to suit the application.

Relationship between Driven-plate Wear and Clamping Thrust.

Coil springs provide maximum compressive clamping load when the driven-plate is new with maximum lining thickness. As lining wears, the coil springs extend and accommodate the distance between the pressure-plate and the cover-pressing. This causes the spring to progressively loose its compressive thrust.

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In contrast, when the driven-plate is new the diaphragm spring is practically flattened, due to which it cannot exert its maximum clamping load on to the pressure-plate. As the lining wears the dishing of the diaphragm increases, so that the load acting on the pressure-plate increases effectively. However, this increased diaphragm thrust is counteracted by the gap caused between the pressure-plate and the cover-pressing, which gradually enlarges to such an extent that the compressive force of the spring becomes over-relaxed; so that the pressure-plate loading decreases with further driven-plate wear.

Merits of the Diaphragm Spring over Multi-coil Spring.

- (a) The diaphragm spring is compact permitting the use of a shallow clutch bell-housing to enclose the clutch unit.
- (b) Due to fewer moving parts squeaks, rattles, and wear are eliminated in diaphragm spring.
- (c) This system does not require initial adjustment of the pressure-plate unit unlike the multi-coil spring clutch units, where a small clearance is necessary between the release-lever plate and the thrust bearing.
- (d) In this design accurate balance of the clutch assembly is maintained under all operating conditions.
- (e) The diaphragm acts as both clamping spring and release-finger.
- (f) As the driven-plate wears, the spring axial load self-compensates in this clutch.

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- (g) Clamping load in diaphragm-spring is independent of the engine speed whereas coil springs tend to bend along their length and lose their thrust at high speeds.
- (h) In this clutch disengagement pressures reduce with increase in pedal movement.

Q2 (c)

(Sketch 2m Working 2M)

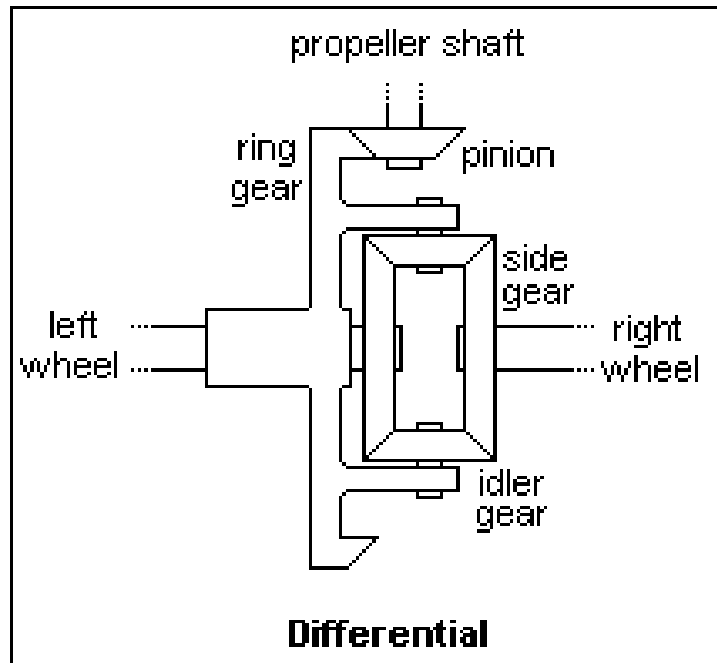


Relevant explanation should be written.

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Q2 (d)



Function & Necessity of overdrive:- **Function:-** Overdrive is a device to step up the gear ratio in the car. It is fitted in between transmission and the propeller shaft. It enables a high cruising speed to be attained with a comparatively low engine speed. These results in less wear of the engine parts & decreases Vibration and noise, as the friction losses at low speeds are less, there is a saving of fuel also with the overdrive.

Necessity: - In the conventional transmission the higher gear position produces a 1:1 ratio between the clutch gear and the transmission output shaft. At intermediate and high car speeds, it is sometimes desirable to have the transmission output shaft turn faster than clutch gear and engine crankshaft, therefore some transmission are designed with gears that provide an overdrive ratio.

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Q2 (e) Sketch 2 m explanation 2m)

Full floating type of rear axle

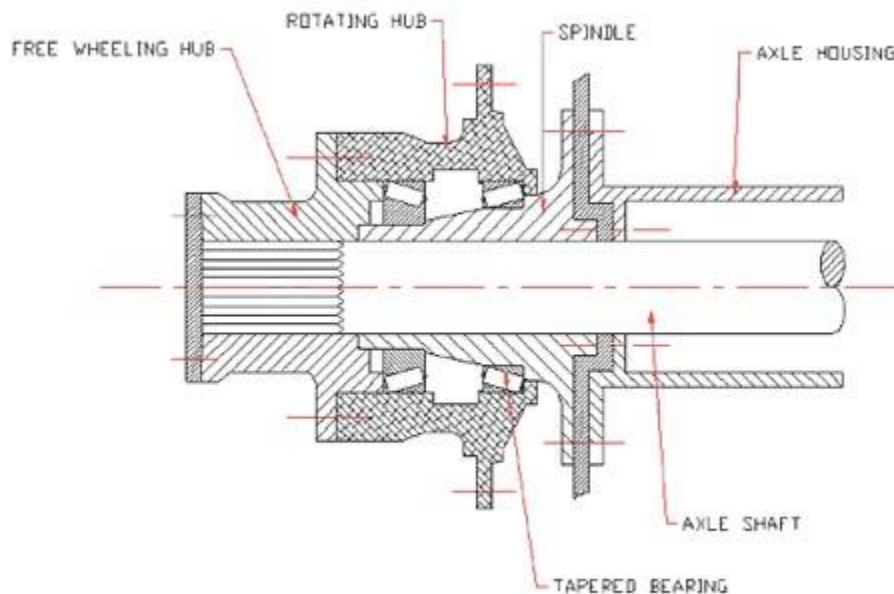


Figure 1: Cross Section of a Full Floater

The rear drive axle connects the differential side gears to the drive wheels. The axle may or may not support the weight of the vehicle. Rear axles are normally induction hardened for increased strength.

The full-floating axle is used in many heavy-duty trucks. The drive wheel is carried on the outer end of the axle housing by a pair of tapered roller bearings.

The bearings are located outside the axle housing. In this way, the axle housings take the full weight of the vehicle and absorb all stresses or end thrust caused by turning, skidding, and pulling. Only the axle shaft transmits torque from the differential.

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Q 3 Attempt any two of the following (fig=2marks,construction -2marks)

Synchromesh gear box:-

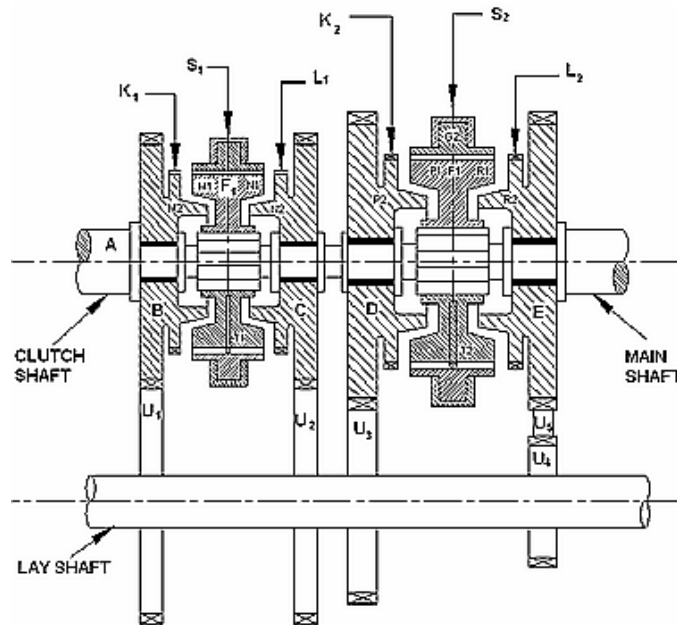


Fig shows the construction and working of a synchromesh gear box. In most of the cars, however, the synchromesh devices are not fitted to all the gears. They are only on the high speed gears but on the low speed and reverse gears, ordinary dog clutches are only provided. This is done to reduce the cost.

In other words, the gear wheels which are to be positively connected are first brought into frictional contact and when the friction has equalized their speeds, the positive connections are made. Synchromesh devices can be applied to the sliding mesh gear box but they are universally used with constant mesh gear boxes used in different motor vehicles. The main features of this gear box are:

- The output gears are free to rotate on bushes on the output shaft. They are internally located by splined thrust bearings. Single or double helical gears remain in constant mesh with the lay shaft gears.
- The output gears are locked to their shaft by the dog clutch
- Change of the synchronizing hub takes place when its speed equalizes or synchronizes by their cones.

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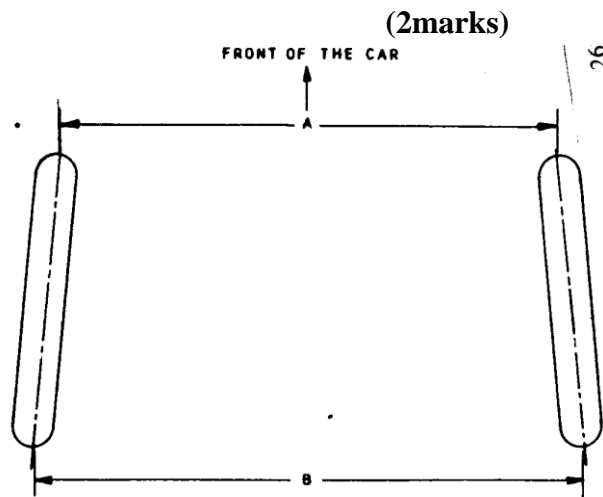
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In case this gear is not used, it is left to the skill of the driver to bring one or more gears for meshing. By the skillful use of this clutch and accelerator pedal, he can bring the gears approximately the same speed. Even for the unskilled driver it is not difficult to affect quite satisfactory the change of gears. He can do it simply by using the clutch pedal gear lever with the help of successful commercial gear synchronizers.

a) **Requirement of steering geometry :-** (Relevant points to be considered =2marks)

- 1) The steering mechanism should be very accurate and easy to handle.
- 2) The effort required to steer should be minimal and must not be tiresome to the driver.
- 3) The steering mechanism should also provide directional stability.
- 4) Vehicle should have a tendency to return to its straight ahead position after turning.

TOE IN TOE OUT:-



Toe in

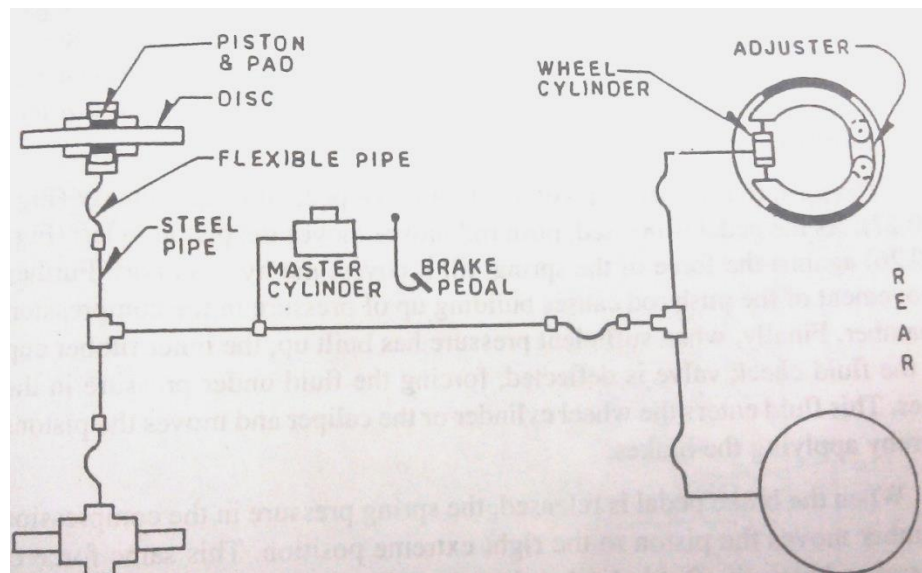
Explanation:- toe-in is the amount by which the wheels are set closer together at the front than the rear when the vehicle is stationary. Tendency of wheel to toe out hence toe in is provided to front wheel. It does not exceed 3 mm.

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b) Hydraulic brake system:-

Sketch:-2marks working=2marks



Working :-it consist of master cylinder and wheel cylinder .

Flexible pipes, brake pedal, etc. Pressurised oil from master cylinder flows to wheel cylinder after pressing brake pedal.

Hence brake pressure apply on brake pad.

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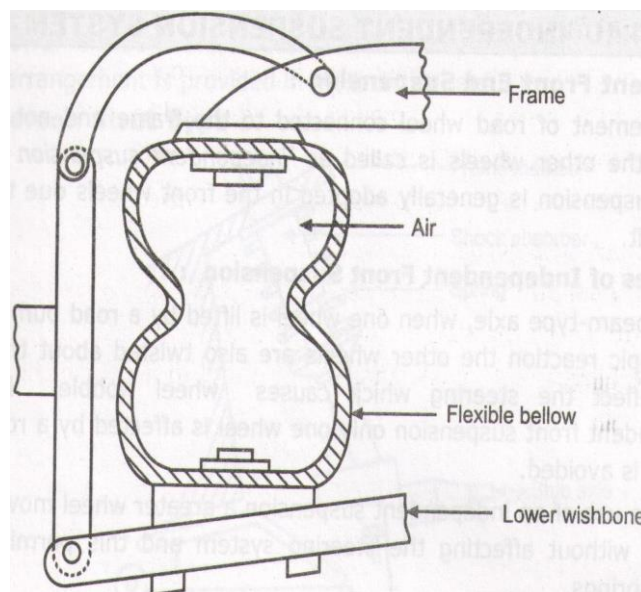
Q4 A) Attempt any three of the following

a) **Requirements of suspension system :- (relevant explanation 4marks)**

The frame as well as body of vehicle is attached to the rear axle and front axle by springs. These springs damp the road shocks transmitted to the body structure by the wheels. The force due to road shock causes the spring to deflect, elongate or compress depending upon the type of spring and the direction of force. On releasing, the spring rebounds due to its elasticity and thus starts vibrating which dissipates the energy due to shock. The vibrations die down gradually due to internal friction of the spring material and the friction of the suspension joints.

In this way the springs are the protecting units supported directly by the frame of the vehicle. Therefore all the parts, which perform the function of protection, are collectively called as *suspension system*. These springs are generally leaf springs, coil springs, torsion bar or any other types of springs. These springs provides the best suspension system to the vehicle to protect passengers and load from jerks.

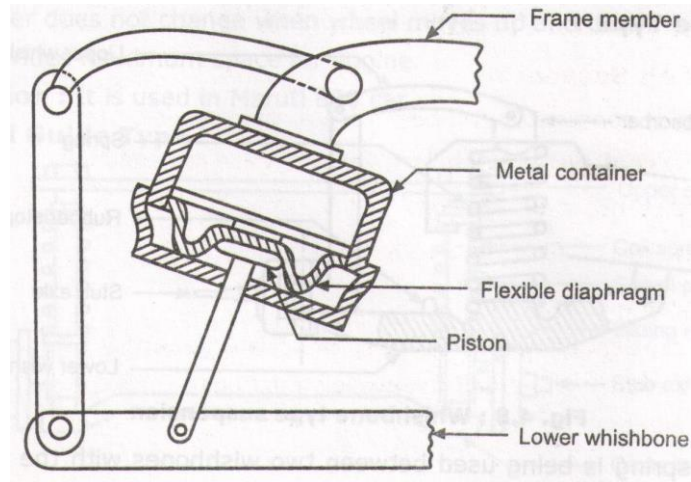
b) **Construction of air suspension with neat sketch :-**



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Bellow (Air bags) type



Piston type

Construction :-

- Compressed air supplied to air bags
- Air bags mounted beneath the chassis
- Controls through valve control system
- Type:-1) Air bag type 2) piston type

(relevant fig =2marks,explanation=2marks)

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c) The various colour codes used for different cables in automobile :-

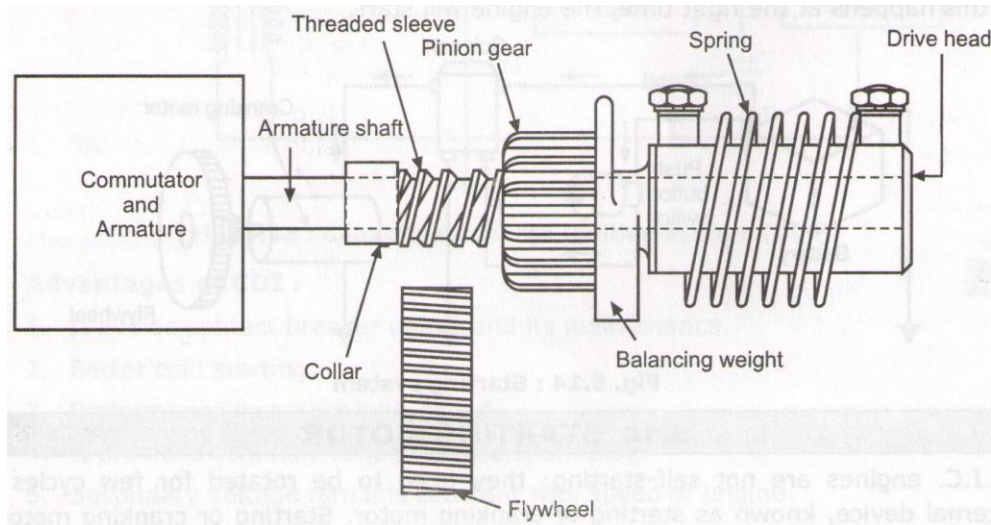
S.N.	Colour	Circuit	Example with tracer
1.	Brown	Battery and generator circuit.	Starter switch to control box - brown with blue tracer.
2.	Yellow	Overdrive circuit.	Overdrive switch or column to overdrive relay - yellow with green tracer.
3.	White	Ignition circuit and all other requirements when ignition circuit is switched or without fuse protection.	Starter switch to solenoid switch - white with red tracer.
4.	Green and light green	Auxiliary circuits fed through ignition switch as well as protected by ignition auxiliary fuse.	Stop lamp switch to stop lamp - green with purple tracer.
5.	Purple	Circuits protected by fuse and normally not controlled by the ignition switch.	Horn push to horn - purple with black tracer.
6.	Blue	Head lamp circuit.	Lighting switch to head lamp - blue with white tracer.
7.	Red	Side and tail lamp circuit including fog lamp, panel lights etc.	Penal lamp switch to panel lamp - red with white tracer.
8.	Black	Earth (ground) circuits.	

(Each point 1marks)

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d) Function of bendix drive in starter system:- (fig=2marks,function =2marks)



Function:-

- Bendix drive fastened to armature of starter motor armature shaft.
- Armature shaft start revolving at full speed.
- This turning effect is transmitted the head and spring to the threaded sleeve.
- Pinion gear engages flywheel
- Flywheel cranks engine, this shock relived by the spring connection and threaded sleeve.
- This starts the system.

B) Attempt any one of the following (consider relevant points one mark each)

a)Six important precautions for using A/C system in automobile:-

- 1) There should not be any leakages of refrigerant.
- 2) Compartment must be isolated with environments.
- 3) Cleaning of flouing must be ensured.
- 4) properly working of belt for power transmission must be ensured.
- 5)Refrigerant must be free from air bubbles.
- 6)Recycling of air must be through compartment only.
- 7)There should be Odourless air conditioning system.

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B) Human comfort parameters:- (min four points=4marks)

Following are the parameters to be considered for air conditioning:-

- 1) Temperature control.
- 2) Humidity control.
- 3) Air ventilation
- 4) Odorless a/c system.
- 5) Economy of working .

Q 5) Attempt any four of the following,

(16 marks)

a) Any Four advantages of the following (one mark each)

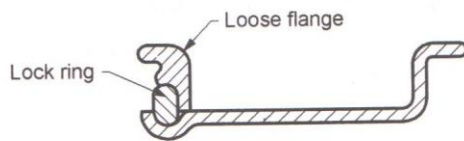
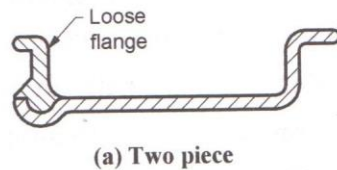
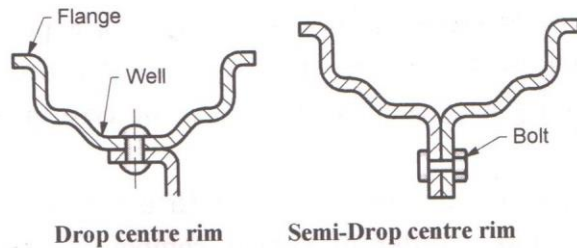
- i. It is insensitive to electrical shunt resulting from spark plug fouling.
- ii. CDI is the higher voltage coil output and hotter spark and accurate.
- iii. This is better at high RPM.
- iv. Less possibility of arcing at spark plug.
- v. Longer life due to stable timing.
- vi. Spark plug life is more due to less electrode wear.
- vii. No change in ignition timing due to absence of C.B., Cam, etc which expose to wear and tear.

b) Types of rims

- a) There are two types
- b) Drop centre rim
- c) Flat base rim
- d) Draw sketch any one of the following

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e)

c) Explain with neat sketch Mac-pherson type of Suspension system.

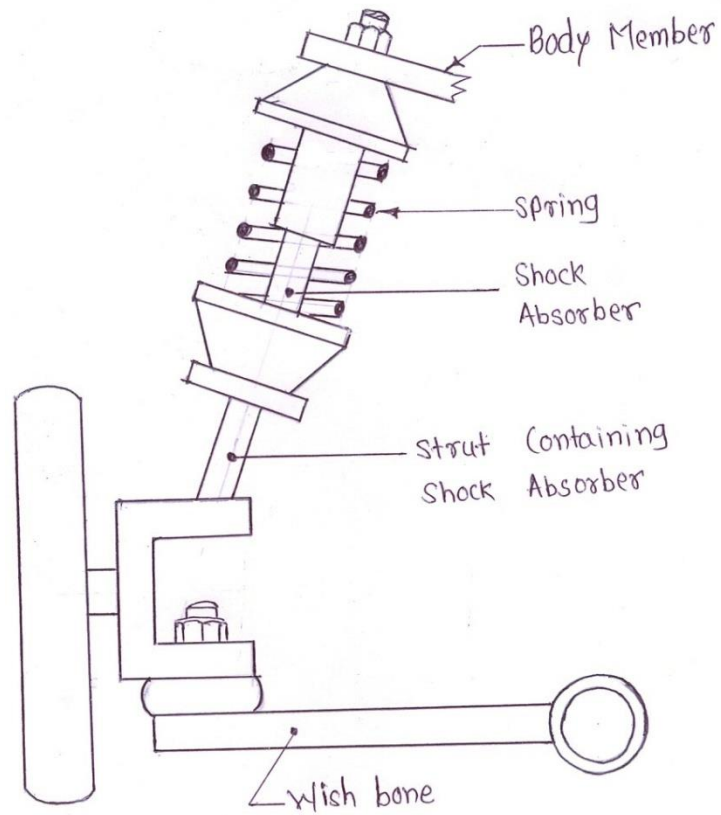
(Description 2 marks)

- c) 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.

(Sketch 2marks)

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(Mac-Pherson Strut suspension)

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d)Difference between framed and frameless vehicle.(Any four differences one mark each)

Sr.NO.	Framed	Frameless vehicle
1	All mechanical units are attached to perform function of only support(frame)	Performed combine function body and frame.
2	Longitudinal member and cross member form the frame.	Floor is strengthened but cross member and heavy side members are eliminated which are welded together
3	Heavy in weight used for truck and buses	Light in weight used for small cars
4	More fuel consumption	Less fuel consumption
5	Manufacturing cost is more	Manufacturing cost is less
6	Repair is less	Repair is more
7	Frame and body are not integral structure	Frame and body are integral structure For extra strength and durability.

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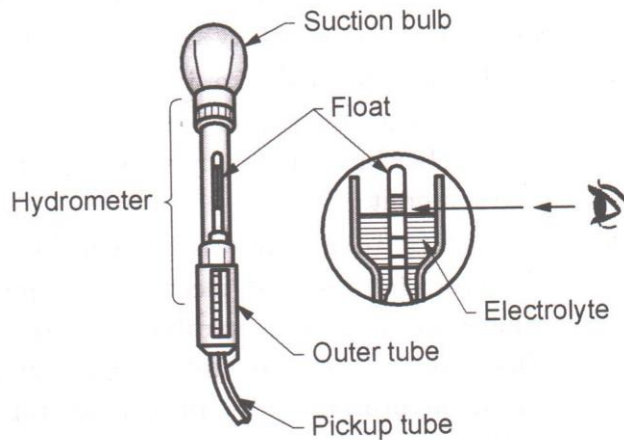
Q.No.6 Attempt any two

a) Different tests of battery

- i) Specific gravity test
- ii) Open circuit voltage test
- iii) light load test
- iv) High discharge test
- v) Cadmium test

Specific gravity test

This can be done by the use of Hydrometer contained in a syringe hydrometer consists of a barrel type glass tube and rubber bulb at the top with a graduated scale marked on it. Squeezing the rubber bulb sucks electrolyte into the reservoir. The height of float in a glass sinks in the test. The readings are noted from the scale by sighting along the level of the electrolyte.



Specific gravity test of battery

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b)i)Fuel Level gauge

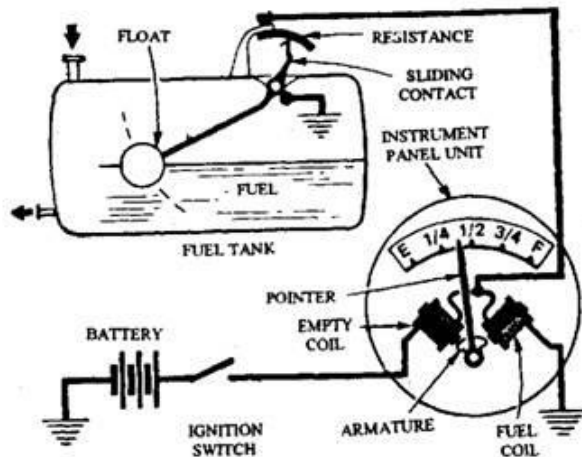
A fuel gauge (or gas gauge) is an instrument used to indicate the level of fuel contained in a tank. Commonly used in most motor vehicles, these may also be used for any tank including underground storage tanks.

As used in vehicles, the gauge consists of two parts:

- The sensing unit
- The indicator

The sensing unit usually uses a float connected to a potentiometer, typically printed ink design in a modern automobile. As the tank empties, the float drops and slides a moving contact along the resistor, increasing its resistance. In addition, when the resistance is at a certain point, it will also turn on a "low fuel" light on some vehicles. Most new cars have an arrow on the fuel gauge. It indicates which side the gas tank is on.

Meanwhile, the indicator unit (usually mounted on the dashboard) is measuring and displaying the amount of electric current flowing through the sending unit. When the tank level is high and maximum current is flowing, the needle points to "F" indicating a full tank. When the tank is empty and the least current is flowing, the needle points to "E" indicating an empty tank.



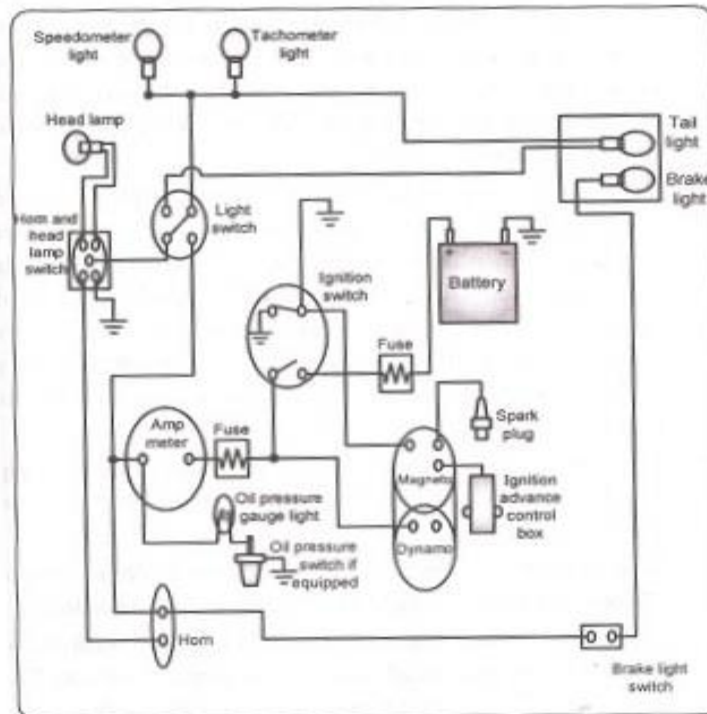
WINTER – 15 EXAMINATION

Subject Code: **17526 (Automobile Engineering)** **Model Answer**

ii)

Lighting system of two wheeler

Wiring (Vehicle Lighting System) Circuits for Two Wheeler :



WINTER – 15 EXAMINATION

Subject Code: **17526 (Automobile Engineering)** **Model Answer**

iii) Causes of tyre wear and remedies:-

- i. Atmospheric Condition
- ii. The road surface condition
- iii. The Route
- iv. Type of work
- v. Style of driving
- vi. inflation pressures and load
- vii. Correct alignment of wheel
- viii. proper maintenance

Remedies

Wheel alignment, Wheel balancing, Do not overload the vehicle, Maintain tyre pressure, bleeding the excess air which is increased due to heat, Maintain caster and camber angle