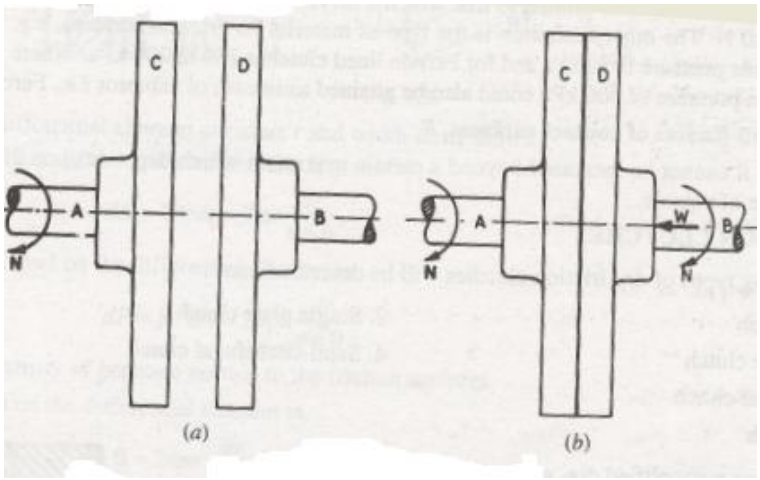
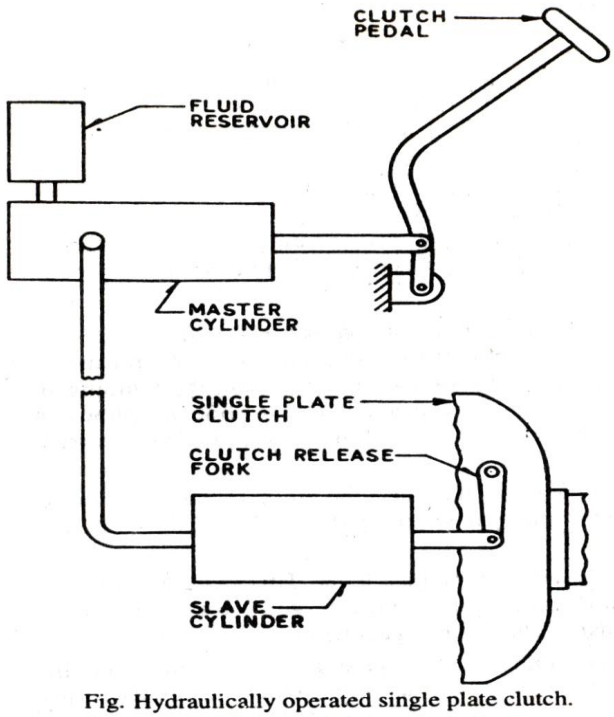
Important Instructions to examiners:
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language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

	Marks
1. a) Attempt any SIX of the following.	**12**
i) What is meant by 'Vehicle Layout'? Give one example.	02
Answer : Vehicle Layout- Vehicle layout is a systematic arrangement of different units which consists of engine, followed by clutch, gearbox, propeller shaft, universal joints, differential and axles that are fitted on the frame. The layout of a vehicle shows the location or position of the main parts used in vehicle performing different required functions. **Example-(any one example)** 1) Front engine front wheel drive 2) Front engine rear wheel drive 3) Four wheel drive 4) Rear engine rear wheel drive	01 01
ii) Define-An Automobile. State its major parts.	02
Answer: **Automobile-**An automobile or motor vehicle is a self propelled vehicle running on the ground and used for the transportation of goods and passengers. Major parts- 1. **Chassis –** includes frame, steering system, suspension system, braking system, wheels and tyres, engine, clutch, gear box, propeller shaft and final drive unit. 2. **Body**- Body contains doors, windows, lights, fans, seats, air conditioner and other accessories.	01 01
iii) What is working principle of automotive clutches?	02
Answer: Working principle of automotive clutches- Clutch operates on the friction principle i.e. **"When two friction surfaces are brought in contact with each other and pressed they are united due to friction between them".**	02

When we apply a force on the stationary disc (D), friction is produced between the two discs, and due to this friction both of the discs start to rotate. The axial force is applied till we get same speed of both the discs.  Fig. Working principle of automotive clutches	
iv) List the types of gear boxes.	02
Answer: Types of gear boxes- 1. **Manually operated gearboxes**: There are three types of manually operated gearboxes 1. Sliding mesh gearbox 2. Constant mesh gearbox 3. Synchromesh gearbox 2. **Semi-automatic gearbox**: e.g. Overdrive 3. **Chrysler semi-automatic** 4. **Automatic gearboxes**: e.g. Hydromatic drive, Torque converter etc.	02
v) What is transfer case?	02
Answer: Transfer case- Transfer case also called as a transfer box or an auxiliary gear box is used in four wheel drive vehicle. It is mounted on the chassis cross member behind the main gear box and receives power from the same. It enables the driver to drive the vehicle in two wheel drive on highways or shift to four wheel drive for rough, muddy roads i.e. for cross country applications. It also enables to drive the vehicle in high gear or low gear whenever required.	02
vi) State the components of differential unit.	02
Answer: Components of differential unit- 1) Bevel pinion 2) Crown wheel or Ring gear 3) Sun gears	02

4) Planet pinions 5) Differential cage 6) Half shafts	
Vii) Write functions of following. 1) Universal joint. 2) Slip joint.	02
Answer: **Function of Universal Joint-** Universal joint allows transmission of power and rotary motion at an angle which varies as a vehicle encounters a bump. **Function of Slip Joint-** It is provided at the gearbox end, this joint allows variation in length of the propeller shaft.	01 01
viii) State the materials used for chassis frame.	02
Answer: Materials used for chassis frame- 1) Mild steel 2) Carbon steel 3) Nickel alloy steel 4) Aluminium alloy.	02
b) Attempt any TWO of the following.	08
i) Draw four sections of chassis frame and write their significance.	04
Answer: Four sections of chassis frame are-  Channel Box Tubular I-section **Figure: Frame sections** **Significance:** • The channel section is used for making the long members and it provides a good resistance to bending but is poor in torsion. • The box sections are comparatively resistant to bending and torsion. • Tubular sections provide good resistance to torsion but poor resistance to bending. • The I section provide good resistance to both bending and torsion.	02 02

ii) State the loads acting on chassis frame.	04
Answer- Various loads acting on the frame are given below-(Any four) **a) Static loads**: The loads due to the chassis parts like engine, transmission, steering system, body, fuel tank etc. and passengers are acting on the frame which causes vertical bending of side members. **b) Inertia loads**: Inertia loads of short duration are acting on the vehicle while application of braking torque and engine torque. This results into bending of side members in the vertical plane**.** **c) Impact loads**: When a vehicle or wheel collides with any other object on the road or road obstacle, it is subjected to externally applied impact load. Impact load may distort the frame to parallelogram shape. **d) Short Duration load**: While crossing a broken patch of a road, a vehicle is acted upon by heavy and suddenly applied loads of short duration. **e) Momentary duration (combined) loads:** While negotiating curves, applying brakes and striking a pot hole, a vehicle is acted upon by combined loads of momentary duration. **f) Overloads**: Overloading a vehicle beyond its designed capacity.	4
iii) Sketch and describe hydraulically operated clutch mechanism.	
Answer: Hydraulic Clutch Operating Mechanism- A hydraulically operated clutch mechanism is shown in the figure. The mechanism consists of master and slave cylinders. The cylinders are connected by hydraulic lines. When the clutch pedal is pressed the fluid under pressure from the master cylinder reaches the slave cylinder which is mounted on the clutch itself. The fluid under pressure actuates the slave cylinder push rod which further operates the clutch release fork to disengage the clutch. In India, this type of clutch has been used in Standard 20, Swaraj Mazda and Eicher Mitsubishi's vehicles.  Fig. Hydraulically operated single plate clutch.	02 Labeled Sketch 02

2) Attempt any FOUR of the following.	16
a) Differentiate between Torque converter and Fluid coupling.	04

Answer: Difference between Torque converter and Fluid coupling: (Any four points) — 04 (01 mark for each point)

Sr. No	Torque converter	Fluid coupling
01	Main components are pump, stator and turbine.	Main components are impeller and runner.
02	It is a torque multiplication unit.	It is simply a means to connect driving and driven members.
03	The turbine blades are inclined having pitch.	Blades are merely fins.
04	It acts as an automatic clutch and serves the purpose of automatic gear box to increase torque.	It serves the purpose of an automatic clutch.
05	It is not as efficient as fluid coupling at highway speeds but is slightly more efficient under load.	It is efficient at highway speeds.
06	It is usually used in conjunction with automatic clutch (mostly fluid flywheel) to eliminate the slight loss of efficiency at highway speeds.	It is not assisted by friction clutch.
07	It never locks up and flow of oil never stops but continues.	Impeller and runner are locked up and movement of oil stops during engagement when centrifugal force is approximately the same on both members.

b) Differentiate between dry and wet clutch.	04

Answer: Comparison between dry clutch and wet clutch: (Any four points)

Sr.No	Dry clutch	Wet clutch
1	When the clutch is operated dry i.e. without oil, it is called as a dry clutch.	When the clutch is operated in an oil bath, it is called as wet clutch. In this, clutch plates are always wetted by oil circulation.
2	Torque transmission capacity is higher.	Torque transmission capacity is lower (35-50% of dry clutch), since the clutch plates are wetted by oil.
3	Due to metal and air contact heat dissipation is fair.	Due to metal and oil contact heat dissipation is much better.
4	Single plate dry clutch is used in light motor vehicles for e.g. Jeep, Car, Bus, Truck etc.	Multi-plate clutch is used in motor cycles, racing cars, heavy duty vehicles.
5	Coefficient of friction is high, since the friction materials are operating dry.	Since the friction materials are operating in oil, coefficient of friction is low.
6	Clutch plate is non-perforated type.	Clutch plate has perforations.
7	Tolerance to engagement time is comparatively smaller.	Tolerance to engagement time is longer.
8	Life is less.	Life is longer as compare to dry clutch.
9	Cost is less.	Cost is high.

04

(01 mark for each point)

c) Describe construction and working of fluid coupling. 04

Answer: Fluid Coupling-

Construction:

Fluid coupling or hydraulic coupling is used as clutches in cars employing automatic transmissions. It consists of two members, the driving and driven as shown in fig. The driving member is attached to the engine flywheel and the driven member to the transmission shaft. The two members do not have any direct contact with each other. The driven member is free to slide on splines on the transmission shaft. The two rotors are always filled with oil. 1

Working:

When the crankshaft rotates, the driving member or impeller also rotates. The driving member is filled with oil and the centrifugal force causes the oil to be forced outward radially. As a result of this, the driven member or turbine is forced to rotate .Thus the engine power is transmitted from crankshaft to the transmission shaft. 1

As the engine speed increases, the thrown out oil from the driving member strikes the driven member with greater force and tends the driven member to rotate at the same speed, becoming one unit by means of oil film which combines both the members. As the engine speed falls down, the oil film between the driving and driven members is broken away and the members are disengaged.

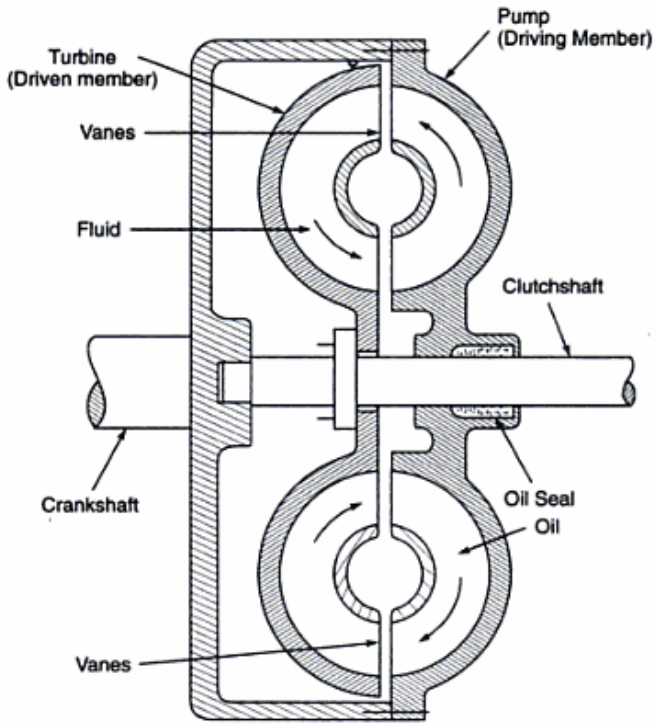


Fig. Fluid Coupling

Labeled Sketch- 2 marks

d) Draw a neat labelled diagram of Diaphragm type single plate clutch in disengaged position. — 04

Answer- Diagram of Diaphragm type single plate clutch in disengaged position-

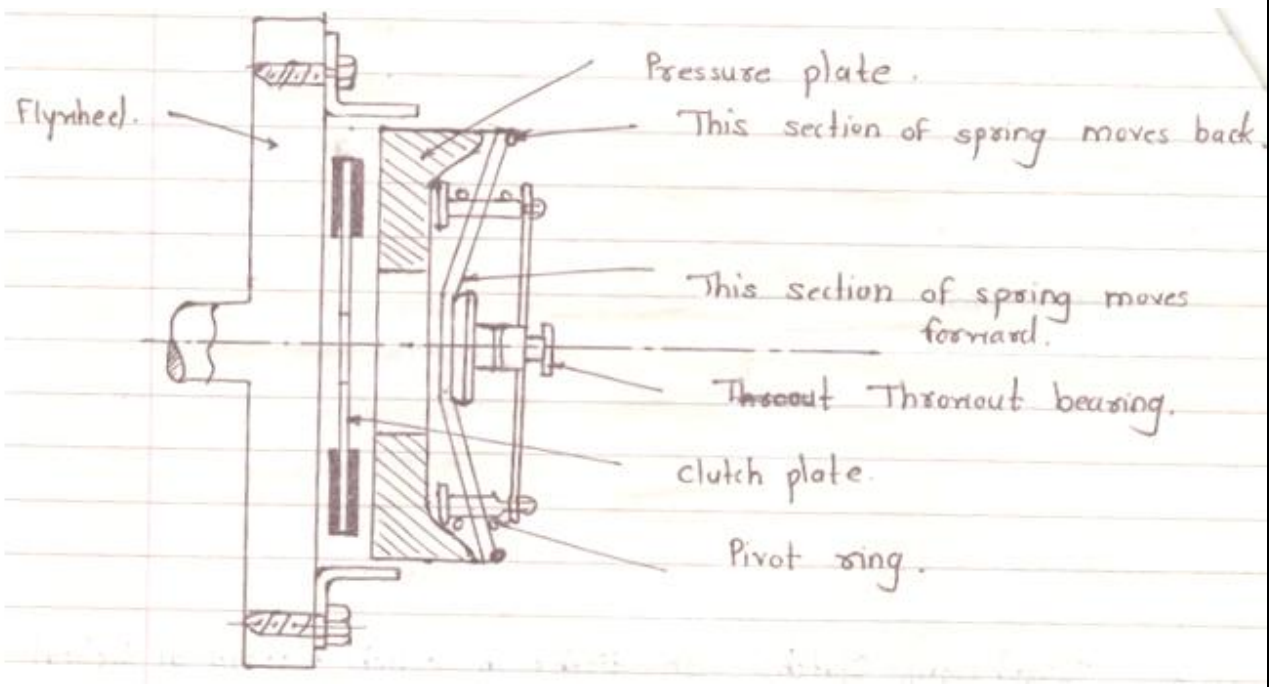
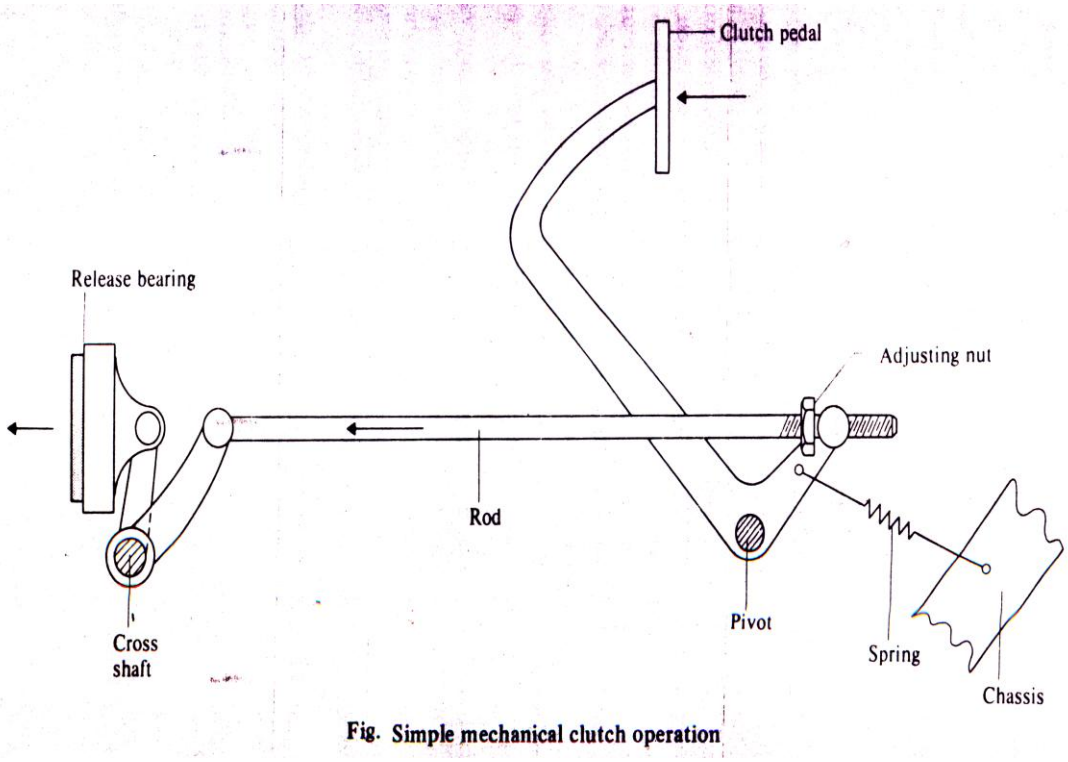


Fig. Diaphragm type single plate clutch in disengaged position

Figure- 03 Marks, Label- 01 Marks.

e) Describe the lubrication of gear box.	04
Answer: Lubrication of gear box- Proper lubrication of gear box is extremely important.The **transmission gears** operate in a bath of lubricanting oil to prevents metal-to-metal contact. Lubrication of gear box is done by putting oil of specification given by the manufacturer (the gear oil is thicker than the engine oil), in the gear box to ensure that at least one gear dips in the oil.With the clutch engaged the gears will rotate and splash the oil. The **bearings** located in transmission case are lubricated with grease periodically as and when it is required. Different design of the gear boxes have different requirements. Some car makers recommend engine oil for gear boxes, with overdrive.Synchromesh gear box and some overdrive units require fluid gear oil of SAE 80 and 90 viscosity.The lubricant level in the gear box should be inspected every 1000 miles and filled if necessary. If the lubricant should be contaminated, the gear box should be drained, flushed and refilled with fresh lubricant.	04
f) Explain clutch operating mechanism with single sketch in friction clutch.	04
Answer: Any one type of clutch operating mechanism (Sketch – 02 marks, suitable explanation-02 marks) **01) Mechanical Clutch Linkage:** The mechanical clutch linkage is shown in the fig. when the clutch pedal is pressed it pivots on the pivot point and it moves the rod further. This rod turns cross shaft, which moves the fork lever and actuates the release bearing. This movement is further conveyed to the clutch levers to disengage the clutch. Generally mechanical leverage from 10:1 to 12:1 is employed that would require a paddle force of about 100-120 N when using travel of 75mm.  Fig. Simple mechanical clutch operation	

02) Cable operated clutch Linkage-

Cable linkage is a popular and effective method of transferring movement from the pedal to the clutch. The cable assembly uses an inner multi-strand steel-wire core and an outer cable sheath of a spiral wound flexible sleeve normally with nylon end-pieces. A screw adjustment is incorporated at either the pedal or the bell-housing end to alter the length of the outer cable sleeve, for increasing or decreasing the free-play of the inner cable. From the cable the leverage is relayed through a pressed steel release-fork lever to the thrust bearing. A spherical headed bolt pivots the lever end. The outer end of the lever extends outside the bell-housing and is connected to the inner cable. When the clutch is disengaged, the inner cable is subjected to tension and the outer sleeve into compression. The fork-lever then tilts about its pivot forcing the release bearing against the release-fingers to disengage the drive.

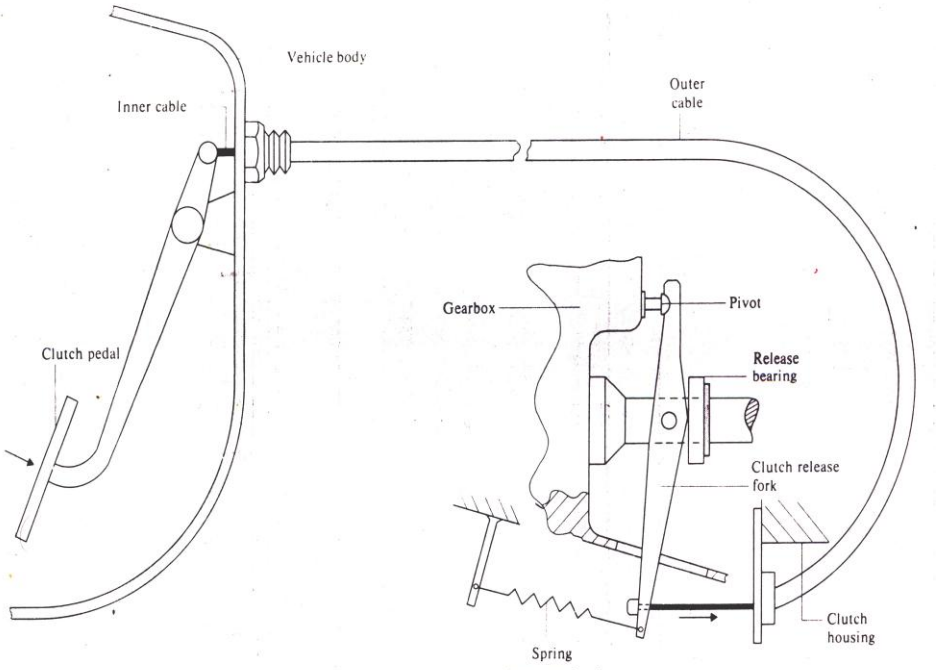


Fig. Cable-operated clutch release mechanism

03) Hydraulic Clutch Operating Mechanism:

A hydraulically operated clutch mechanism is shown in the figure. The mechanism consists of master and slave cylinders. The cylinders are connected by hydraulic lines. When the clutch pedal is pressed the fluid under pressure from the master cylinder reaches the slave cylinder which is mounted on the clutch itself. The fluid under pressure actuates the slave cylinder push rod which further operates the clutch release fork to disengage the clutch. In India, this type of clutch has been used in Standard 20, Swaraj Mazda and Eicher Mitsubishi's vehicles.

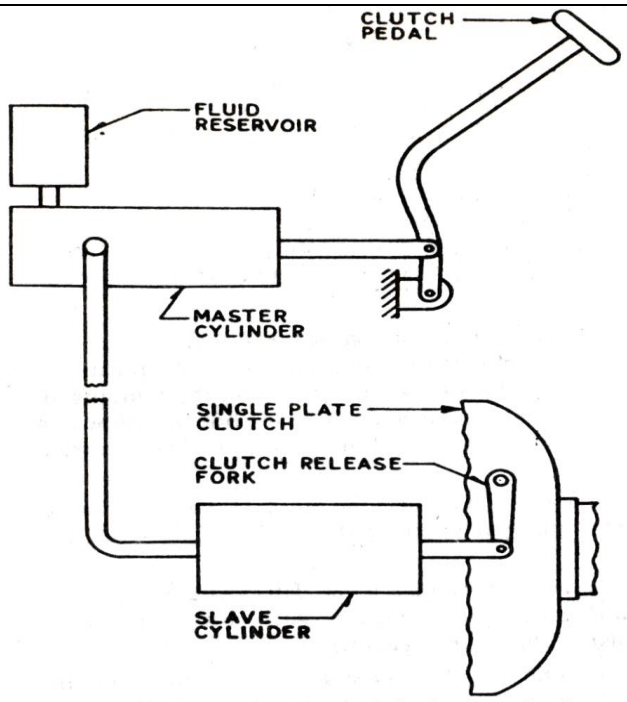


Fig. Hydraulically operated single plate clutch.

3. Attempt any TWO of the following	16
a) Draw a schematic diagram of constant mesh gear box in neutral position and label it. Describe its construction and working.	08
Construction:- In this type of gear box, all the gears are in constant mesh with the corresponding gears on the lay shaft. The gears on the main shaft which is splined are free. The dog clutches are provided which are free to slide on the main shaft. The gears on the lay shaft are fixed.	02
Working:- When the left dog clutch is slide to left by means of the selector mechanism, its teeth are engaged with those on the clutch gear & we get the direct gear. The same dog clutch when slide to right makes contact with the second gear & second gear is obtained. Similarly movement of the right dog clutch to the left results in low gear & towards right in reverse gear.	02

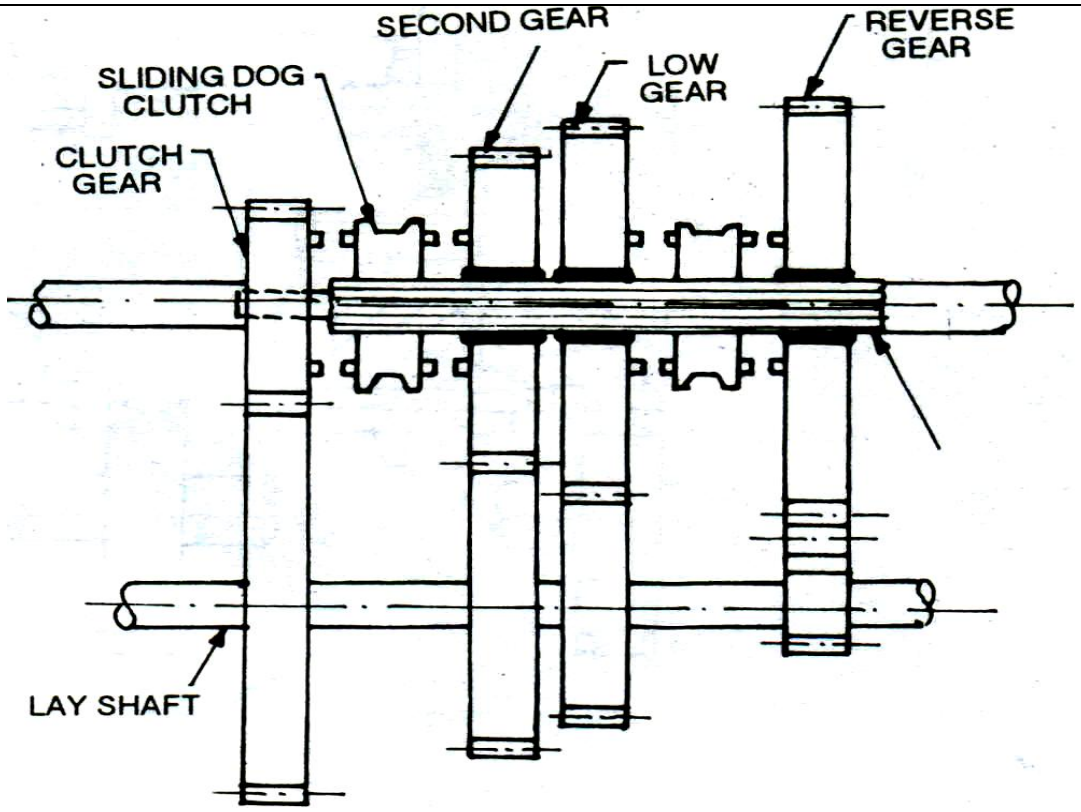
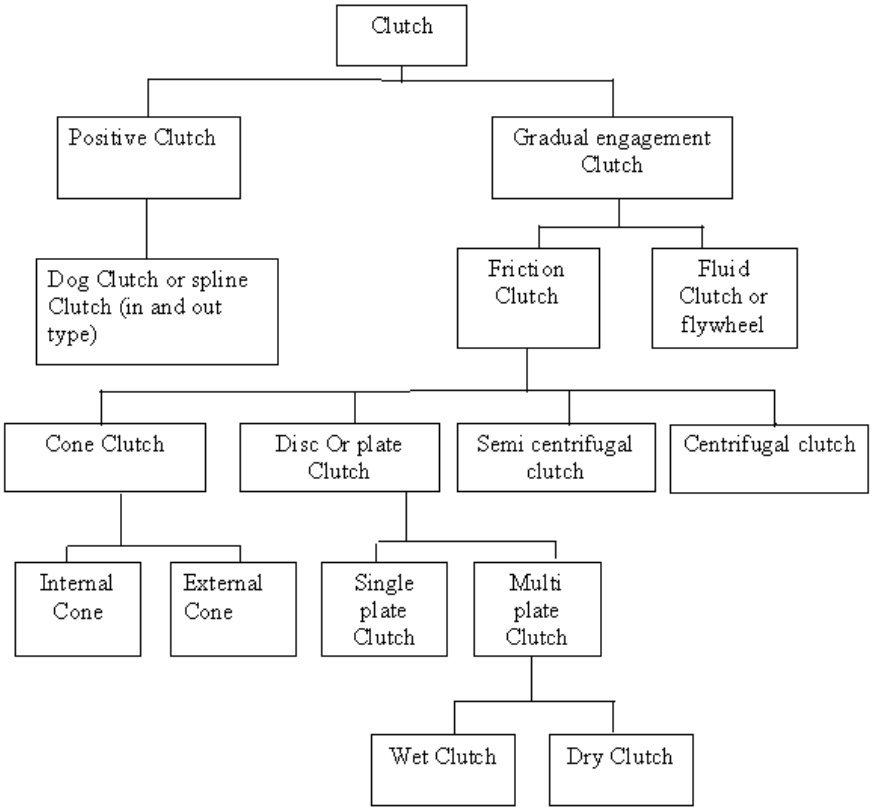


Fig. Constant mesh gear box in neutral position

Labeled Sketch- 04 Marks

b) Write in detail classification of clutches. Describe working of centrifugal clutch with schematic diagram. 08

Answer-Classification of clutches-(2 Marks)



Classification Of Clutches

06 Marks

Centrifugal clutch-

(Sketch –03 marks, suitable explanation – 03 marks)

Working of Centrifugal Clutch**:**

Centrifugal clutch works on the principle of centrifugal force. When the engine is started, the speed of the driving shaft is less, so the centrifugal force is also less. Therefore, shoes (flyweights) do not move outwards and torque is not transmitted to the rear wheel. As the speed of engine increases, the centrifugal force also increases. At certain engine speed, the shoes fly off outwards due to increased centrifugal force and they come in contact with the driven member. Now both the driving and driven members rotate together and the clutch is said to be engaged. Thus the engine torque is transmitted to the rear wheel.

When the engine speed decreases, the centrifugal force also decreases. Now the shoes return back to their original position due to spring force which results in a disengagement of the clutch and torque is not transmitted to rear wheel.

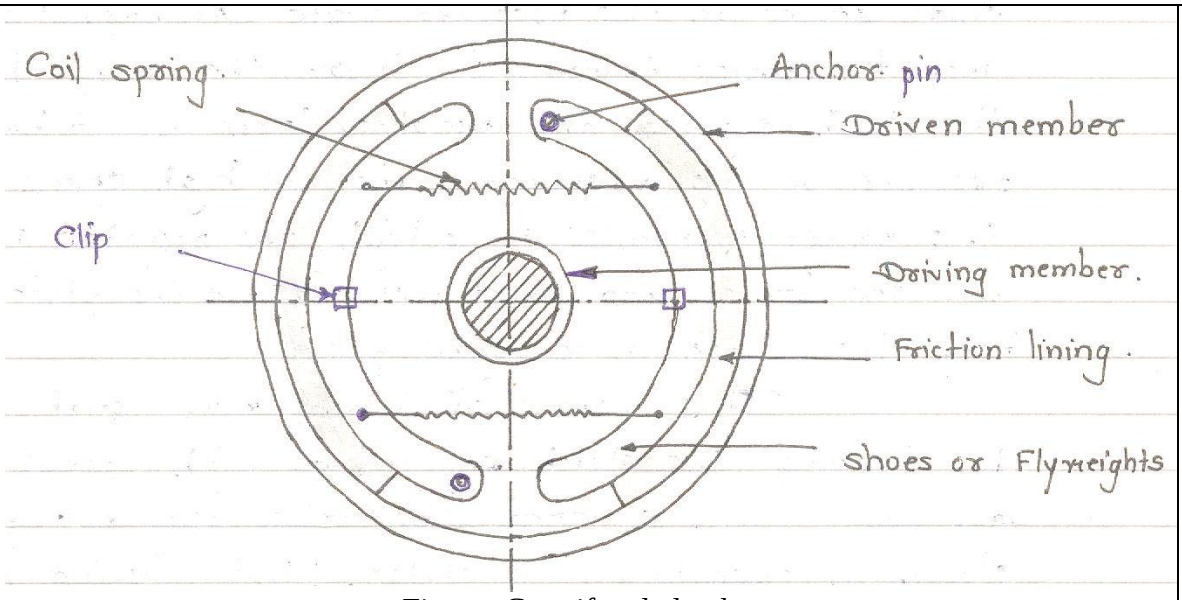


Figure- Centrifugal clutch

OR

Working of centrifugal clutch:-

Fig. Shows schematic arrangement of centrifugal clutch. As the speed increases the weight A flies, therefore operating the bell crank lever B which presses the plate C. This force is transmitted to the plate D by means of springs E. The plate D containing friction lining is thus pressed against the flywheel F therefore engaging the clutch. Spring G serves to keep the clutch disengaged at low speed. The stop H limits the amount of centrifugal force.

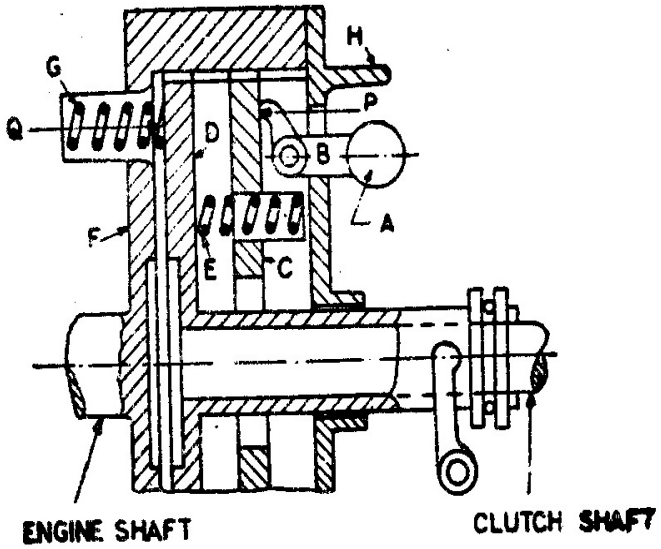
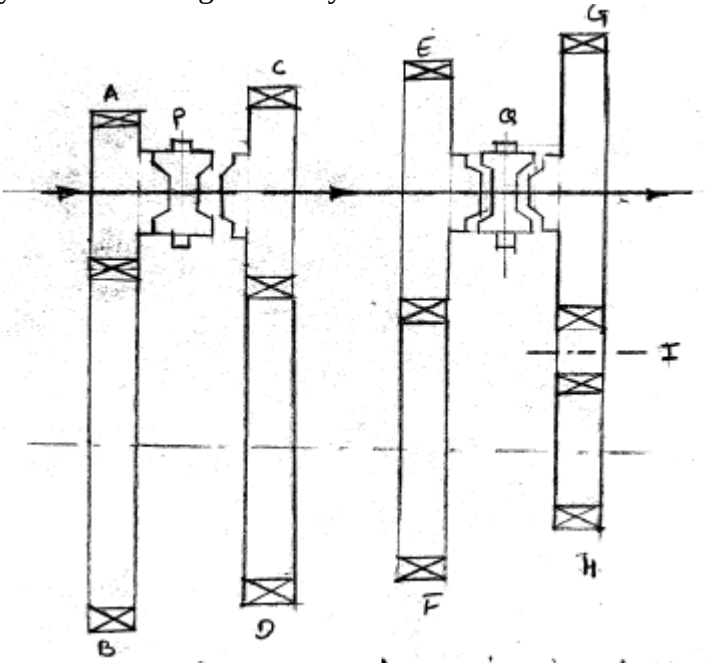


Figure-Centrifugal Clutch

A-Weight, B- Bell crank lever, C &D – Plates, E-Springs, F-Flywheel, G-Spring, H-Stop

c) What is meant by tyre inflation? Describe the effect of inflation pressure on tyre life. What is importance of tyre rotation?	08
Answer: Tyre inflation:(02 Marks) The inflation pressures are recommended by the vehicle manufacturer depending upon tyre size, speed and load. Although tires are made up of more or less airtight materials, they still allow minute quantities of air to gradually leak away over time. Therefore, the tire inflation pressure must be checked regularly and adjusted as necessary whenever it differs from the specified pressure. **Effects of Under-inflation:** (02 Marks) 1) Uneven tread wear, more wear at tyre sides. 2) Lack of directional stability. 3) Increased rolling resistance leading to increased fuel consumption. 4) Excessive flexing of sidewall causes build up. 5) Vehicle will roll on curves. **Effects of Over-inflation:** (02 Marks) 1)Reduced tread contact area with road surface. 2)Reduced tyre grip. 3)Increased vibration resulting in uncomfortable ride. 4)Increased stresses may causes tread separation and crack in the side wall. 5) The centre of tyre will be worn rapidly. **Importance of tyre rotation:** (02 Marks) • Reducing tyre wears and increases tyre life and hence the tyre cost is controlled. • It provides the vehicle stability in running condition.	
Q 4 Attempt any FOUR of the foilowing:	16
Q 4 a) what is multi-plate clutch? Give its three applications with specific reasons.	04
Answer: Multi-plate clutch- Multi-plate clutch consists of a number of clutch plates, instead of only one clutch plate as in the case of single plate clutch. As the number of clutch plates is increased, the friction surface also increases. The increased number of friction surfaces obviously increases the capacity of the clutch to transmit torque. **Application-** 1.It is used where more torque transmission & limited space is available such as in racing cars. 2.It is used where overall space required to accommodate the clutch is constrained such as in Scooters & motorbikes. 3. It is used in heavy vehicles for high torque transmission, where single plate clutch of same size is not sufficient to transmit such high torques.	01 03

Q 4 b) Draw a power flow diagram for a synchromesh gear box, when third gear is engaged and describe it.	04
Answer: Synchromesh gear box when third gear is engaged- To engage the third gear, Synchronizer sleeve P is moved towards left. It is made to engage with gear A through synchronizing ring & third gear is obtained. **Power flow for third gear-** Gear 'A' ⟹ Synchromesh ring ⟹ Synchronizer sleeve ⟹ main shaft  A-Clutch gear; B,D,F,H- Counter or lay shaft gear; C,E,G- Main shaft gear P, Q-Synchronizer sleeve. Fig. Power flow for a synchromesh gear box (third gear or top gear engaged)	01 01 02
Q 4 c) With sketch describe how synchronization of speed is obtained by synchromesh device?	04
Answer: Synchromesh Gear Unit- The main purpose of this unit is to synchronize the speed of the two gears before they are engaged. We know that in running vehicle, when we press the clutch & put the gear in neutral position, till the gear are revoling. All the gear do not revolve at the same speeds & when we have to engage two gears running at different speeds by shift lever there will be some sound due to clashes of gears and very hard to engage and disengage the gears. To avoid said problems the synchromesh devices are used. Synchromesh devices are not fitted to all the gears. They are fitted only on the higher gears. During synchronization the synchronizer sleeve is moved towards selected gear pushing the block ring to the right, the ring contacts the shoulder of the driven gear and begins to synchronize the speed of the two parts. In this way the drive from lay shaft gears to main shaft gear and then to the main shaft through synchronizer device.	02

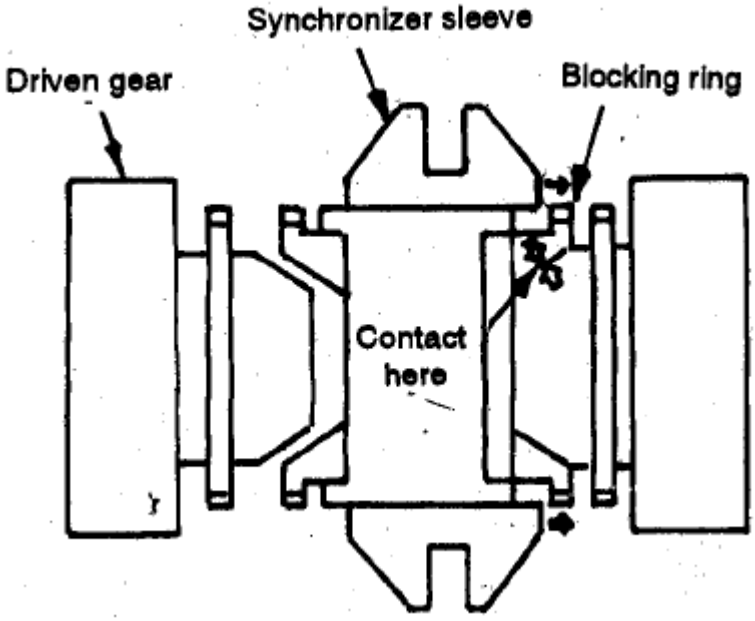
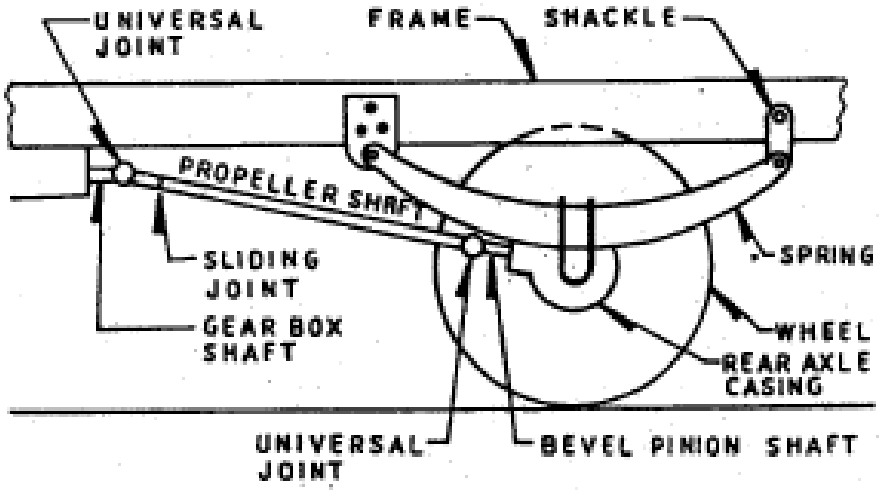


Fig. Synchromesh device — 02

Q 4 d) Describe working of 'Hotchkiss drive, with sketch. — 04

Answer: Hotchkiss drive-



Hotchkiss drive — 02

Working of Hotchkiss Drive-

This is the simplest & most widely used. The springs be sides taking weight of the body also take the torque reaction, driving thrust & side thrust. The propeller shaft is provided with two universal joints & also sliding joint. The spring is fixed rigidly in the middle to the rear axle. The front end of the spring is fixed is fixed to the frame by the front half of the springs. Due to torque reaction, the spring deflects as shown in fig. & is taken up by the springs. Similarly to take up the — 02

braking torque, the springs would deflect in the opposite direction. When the rear axle moves up & down due to the road condition, it has to move in a circle with the front spring support at the frame as centre. But for the propeller shaft motion, the centre is at the front of the universal joint. This means that during this movement of the rear axle, the length of propeller shaft has to vary. This is provided for by means of a sliding joint in propeller shaft.

Q 4 e) Differentiate between Torque tube drive and Hotchkiss drive. — 04

Answer: (Note- Any 4 difference required each carry 01 mark) — 04

Torque Tube Drive	Hotchkiss Drive
1) Propeller shaft is housed in a tube called torque tube.	1) Open type propeller shaft is used.
2) Only one universal joint is used at the front end of the propeller shaft.	2) Two universal joints is used one at front & second at rear end of the propeller shaft.
3) No slip joint is used.	3) Slip joint is used to accommodate change in length.
4) Weight of the body & side thrust are taken by leaf spring. Torque reaction, driving thrust, braking torque are taken by the torque tube.	4) Torque reaction, driving thrust, side thrust, weight of the body & braking torque all are taken by leaf spring.
5) Both end of the leaf spring are shackled.	5) Leaf spring is shackled at the rear and bracketed at front end.
6) Axis of propeller shaft and bevel pinion shaft coincide always.	6) The centre axis of propeller shaft and bevel pinion shaft is not coinciding when axle moves up and down.
7) It is used in light vehicles like cars.	7) It is used in heavy vehicles like bus, truck.

Q 4 f) State necessity of final drive and differential. Also write its location in different types of Vehicle layouts. — 04

Answer: Necessity of differential-

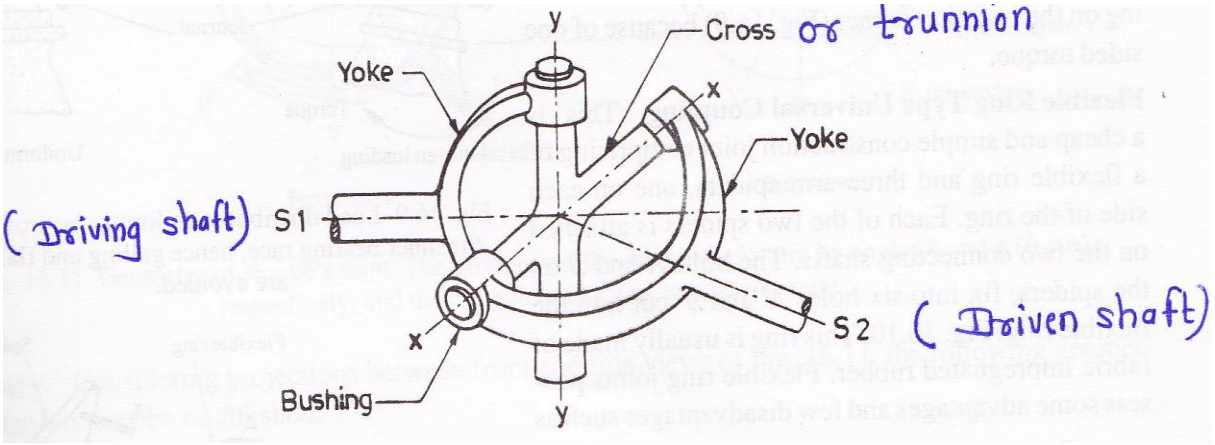
If a vehicle travels in a straight line, the two rear wheels turn exactly at the same speed, and there is no relative movement between them. But when the vehicle takes a turn the outer wheel travels a longer radius than the inner wheel. If the two rear wheels are rigidly fixed to the rear axle. The inner wheel will slip which will cause rapid tyre wear, steering difficulty and poor road holding. Therefore there must be some device to provide the relative movement to the rear wheels when vehicle is taking turn. — 02

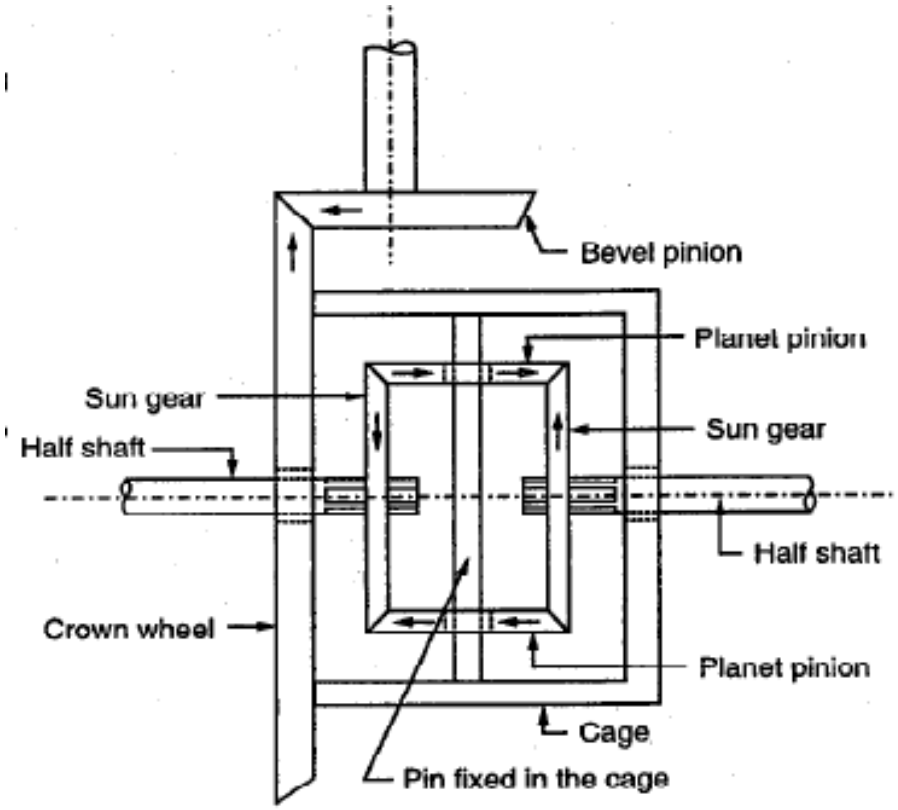
Necessity of Final drive- — 01

1. It allows power transmission at right angle.
2. It also provides means of gear reduction.

.Location in different type of vehicle layouts- — 01

1. In Front engine front wheel drive layout - differential is located at the front next to gear box.
2. In Rear engine rear wheel drive layout - differential is located at the rear next to gear box.
3. Four wheel drive layout - differential is located at the front as well as rear.
4. Front engine rear wheel drive layout - it is located at the rear in between two half shafts.

Q 5 Attempt any FOUR of the following	16
Q. 5 a) Sketch cross and yoke type universal joint and describe its working.	04
Answer: Cross & Yoke type U.J. –  Fig. Cross & yoke type universal joint	02
Working of Cross & yoke type universal joint- Driving shaft S1 of first yoke is connected to the transmission main shaft and driven shaft S2 is connected to the propeller shaft. When the transmission shaft rotates the drive is transmitted from shaft S1 to shaft S2 through yokes and cross since two yokes are connected with each other by means of central cross. When the road wheel gets bumped the axle is lifted upwards, the central cross with needle bearings swings in yoke and allows angular drive transmission.	02
Q. 5 b) What is constant velocity (C V) joint? State its two types. In which vehicle C. V. joints are used? Why?	04
Answer: (Note- Definition 1 mark, Types 1 mark, Application 1 mark, Reason 1 mark)	
Constant velocity (C V) joint- When the angle of drive is more than 30 degree, irregularity of rotation angle at more torque and speed fluctuation causes steering problem in case of universal joint so the type of joint used to overcome this problem is known as CV joint.	01
Types of C V joint- 1. Rzeppa joint, 2. Tripod joint.	01
Application & Reason- In Front wheel drive vehicles the drive shaft rise and falls due to road shocks and also turn from side to side while steering the vehicle. It means the shafts must be able to slide in and out as large operating angles are involved, the shaft being in smaller length. Hence CV joints are used at inner and outer ends of drive shaft.	02

Q. 5 c) Describe principle of working of differential with sketch.	04
Answer:  Fig. Principle of Working of Differential **Principle of Working :** If a vehicle travels in a straight line, the two rear wheels turn exactly at the same speed, and there is no relative movement between them. But when the vehicle takes a turn the outer wheel travels a longer radius than the inner wheel i.e. there is relative movement between the two rear wheels. Also inner wheel makes larger angle with stub axle than outer wheel. If the two rear wheels are rigidly fixed to the rear axle.	02 02
Q 5 d) Explain necessity and types of loads acting on rear axle.	04
Answer: **Necessity of rear axle-**(Any 02 points each carry 01 mark) 1) It carries the rear road wheels. 2) It transmits power to the rear wheels. 3) It compensates for the difference in speeds (by means of differential gear) of outer and inner wheels while traversing a curve. 4) The rear axle sustains a major fraction of vehicles gross weight and transfers it to the ground through rear wheels.	02

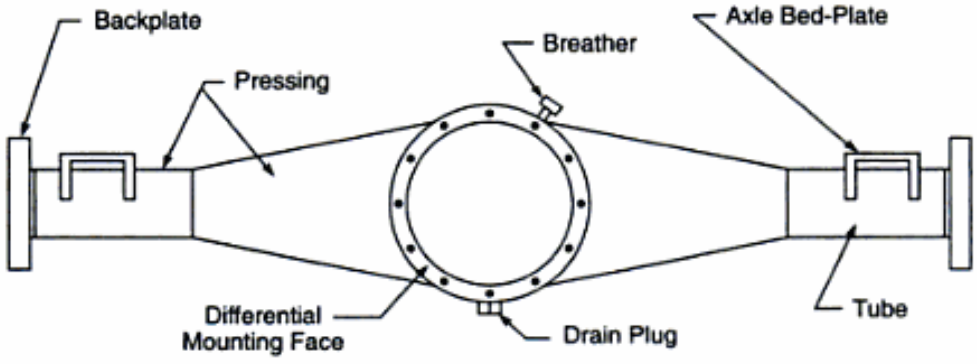
The various loads acting on the rear axle are-(Any 02 points each carry 01 mark) 1) **Driving thrust-**Driving torque produced in the engine causes the thrust to be produced in the road wheels, which has to be transmitted from the axle casing to the chassis frame and the body of the vehicle. 2) **Torque Reaction-**If the rear axle is held rigidly when the road wheels are prevented from rotation, (due to driving needs or road conditions) the bevel pinion of the final drive tends to rotate around the crown wheel. It produces a tendency in the whole vehicle to rotate about the rear axle, or to lift off the front of the vehicle. This effect is known as torque –reaction. 3) **Braking torque or thrust-**The axle casing experiences the brake torque when the brakes are applied to the vehicle. 4) **Side thrust**-When the vehicle is taking the turn, the rear axle subjected to the side thrust or pulls due to any side load on the wheel. 5) **Weight of the body**-The rear axle may be considered a beam supported at ends loaded. This weight causes bending and shears force in the axle shaft.	02
Q 5 e) Sketch and describe any two types of rear axle casings.	04
Answer: (Note- Each type carry 02 marks in that Figure 01 mark & explanation 01 mark) **Types of rear axle casings-** **1) Banjo type (or one piece) casing-** It is named so, because its shape like the musical instrument banjo. It is also called separate carrier type casing because the complete differential unit is carried in a separate carrier which is bolted to the axle casing. The two half shafts are put-in or taken-out from the sides during assembly or repairs. In majority cars the propeller shaft lies along the centre line of the car, and the rear axle gearing is enclosed in banjo at the centre of the axle casing. However, in certain cases the banjo may be offset to one side or the other.  Figure-Banjo type (or one piece) casing **2) Split (or two piece) casing-** The casing is made in two-pieces which are bolted together to form a casing. This type is obsolete now because in case of a fault, the whole rear axle unit has to be taken out before its dismantling. This type is obsolete now.	02

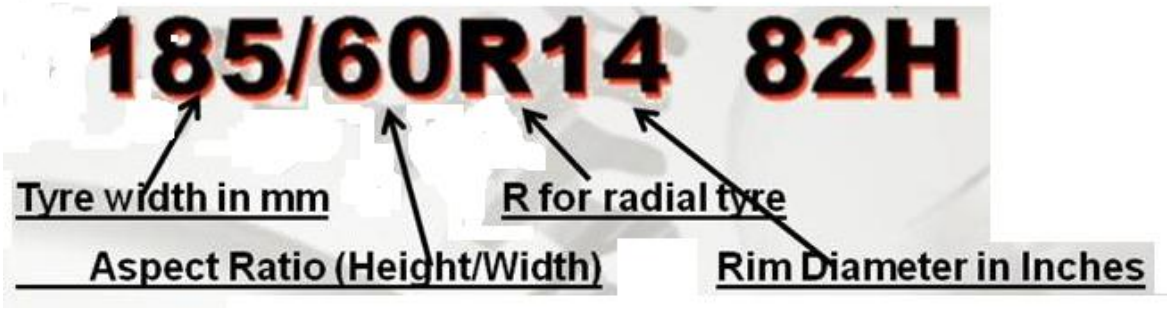
Figure-Split (or two piece) casing

02

Q 5 f) Give one example of tyre nomenclature and write meaning of each term.

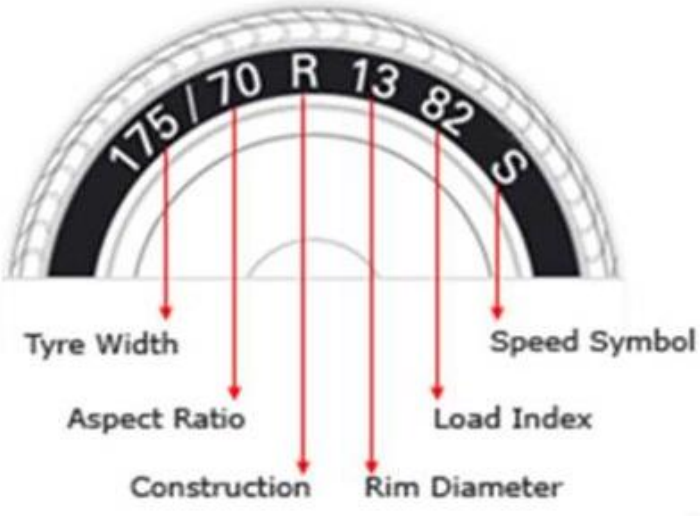
04

Answer:



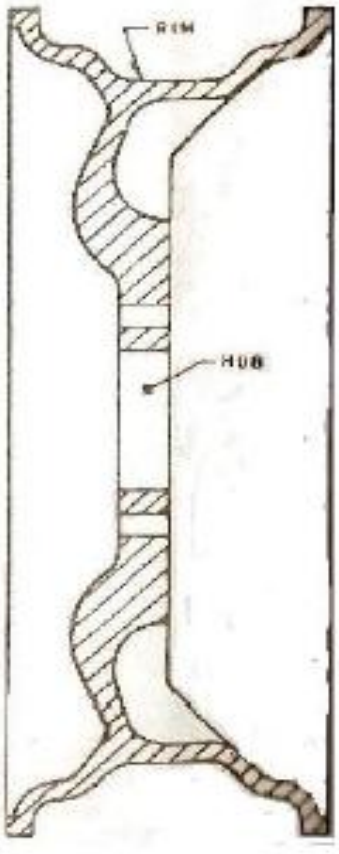
OR

02



The tyre is specified by the following method
1. Width (Measured at the widest point when tyre is inflated to the correct pressure)
2. A code number giving speed rating.
   I) In case of radial tyres, the speed rating code becomes SR, HR or VR
   - SR speeds up to 170 km/hr
   - HR speeds up to 210 km/hr
   - VR speeds more than 210 km/hr

02

II) For cross-ply tyres, the speed rating are coded as S or H 3. Diameter (same as rim diameter) 4. PR represent the number of piles in the tyre	
Q 6. Attempt any FOUR of the following	16
Q. 6 a) Write functions of wheel. Describe with sketch construction of alloy wheel.	04
Answer: Function of wheel- 1. To sustain vehicle & passenger load. 2. It provide cushioning effect & cope's with steering control. **Alloy Wheel:-**  Fig. Construction of alloy wheel **Construction of alloy wheel-** Light weight wheels are made from aluminum or magnesium alloys. Alloy wheels are manufactured by casting & forging processes. It consists of central hub & outer rim. The hole is provided in the body to accommodate rubber sealed valve. Sometimes wheels are made in composite form means that the wheel body with cast aluminum alloys & rim with steel.	01 1 ½ 1 ½

Q 6 b) Compare Tubed tyre with Tubeless tyre. — 04

Answer: Comparison of tube tyre and tubeless tyre- (*Any four points***)** — 04

Tube tyre	Tubeless tyre
1. Weight is more as it has tube and flap inside the tyre.	1. Weight is less due to absence of the tube.
2. Fuel consumption is more as its un-sprung weight is more.	2. Fuel consumption is less as its un-sprung weight is less.
3. In tubed tyre tube is made of rubber and other components which are bad conductors of heat. The heat dissipation does not take place due to which life of tyre is less.	3. The life of tyre is more due to better cooling.
4. Steering and road holding is fair.	4. Steering and road holding is good.
5. Air retaining liner is not provided on tyre.	5. Air retaining liner is provided
6. Low air sealing quality.	6. Better air sealing quality.
7. In case of puncture, both tyre and tube need to be removed.	7. Tyre need not to be removed. Plug is inserted in case of puncture.
8 Suitable for spoked wheel rims.	8. Suitable for alloy cast rims.

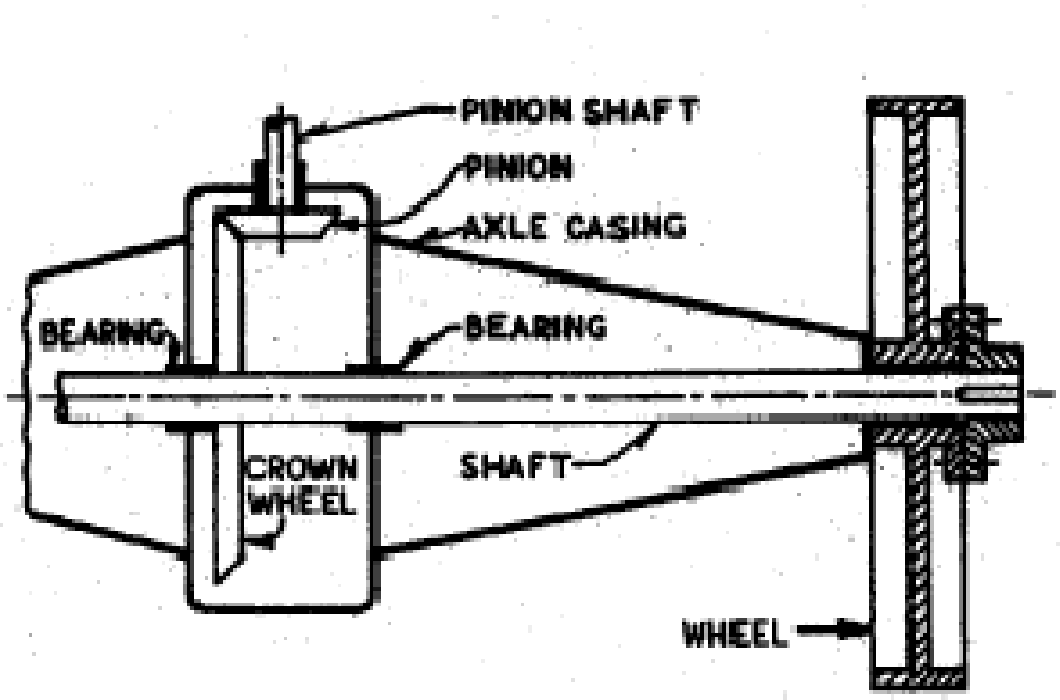
Q 6 c) State types of tyres based on construction and compare them with each other. — 04

Answer: Types of tyres based on construction- — 01

1. Cross ply type
2. Radial ply type
3. Belted bias type (This is the modification of cross ply type).

Comparison- (*Any four points***)** — 03

Sr. No.	Cross ply tyre	Radial ply tyre
1	Piles are running diagonally opposite from bead to bead.	Plies are running radially straight from bead to bead
2.	Stiffness of tyre is more, so less comfortable.	Stiffness of tyre is less, so it gives ultimate comfort at high speed.
3	Steering is easy.	Steering is harder.
4	Tyre has lesser grip with road.	Tyre has firm grip with road.
5	Cross ply tyre has less tread life.	Radial ply tyre has more tread life.
6	Less braking grip.	More braking grip.
7	Cheaper than radial ply tyre.	Costlier than cross ply tyre.

Q 6 d) Sketch the arrangement of live rear axle and describe how torque transmission takes place?	04
Answer: Live rear axle- Live axels are those axels through which the engine driving torque is transmitted to wheels. Fig. shows simlified view of the live rear axle of a front engine ,rear driven automobile.The drive from propeller shaft comes to the pinion shaft which is supported in bearings in the axle casings.The crown wheel is in mesh with the pinion and is mounted on shaft on the ends of which are fixed the caps which serves to restrict the wheels in axial direction.The wheels are mounted on bearing on the ends of the axle shaft. The power from differential is equally divided to both wheels.  Fig.Live rear axle	02 02
Q 6 e) What is meant by 'Double reduction axle'? State its two applications.	04
Answer: Double Reduction Axle- In this type of axle the drive speed is reduced in two separate steps.The bevel pinion is driven by the propeller shaft and then drive is passed to the the small crown wheel which is fixed to a layshaft,on which is also fixed a spur pinion.The spur pinion meshes with a large spur wheel which is attached to the differential casing just at the cwown wheel of a single reduction axle.Thus the final drive is transmitted to the axle shaft.	1 ½

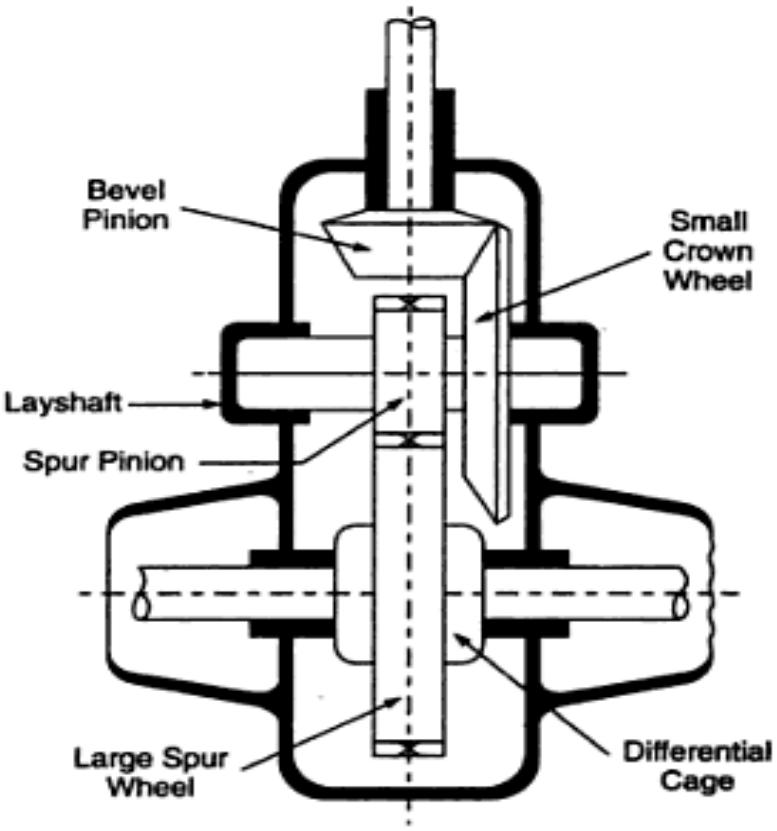


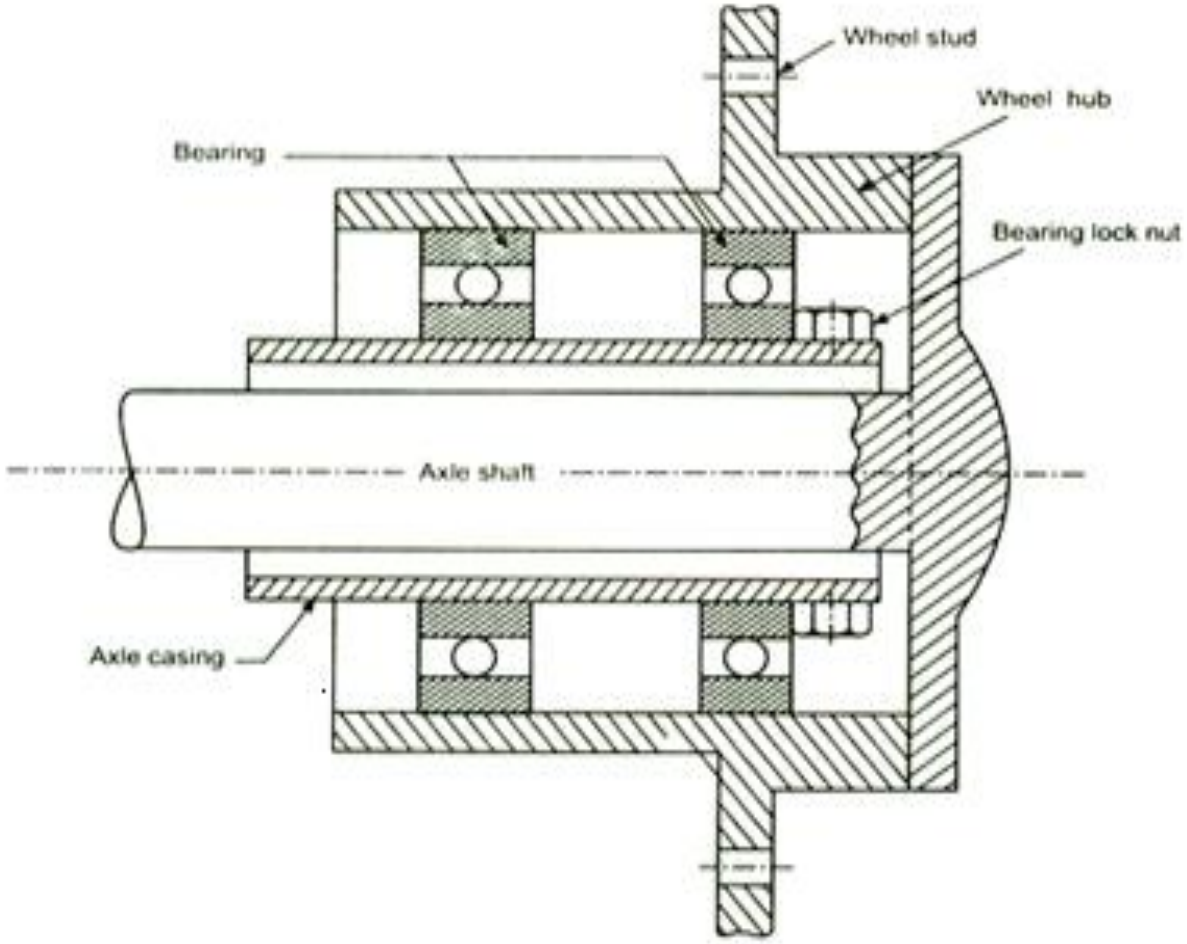
Fig.-Double reduction axle

1 ½

Applications-

For vehicles carrying heavy loads and requiring high torque like lorries, buses etc.

01

Q 6 f) Draw a neat sketch of full floating type rear axle and label the parts.	04
Answer: Full floating type rear axle-(Neat labeled fig. 04 marks)  Fig.: Full floating rear axle	04