

17526

- 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.

Page 1 of 21

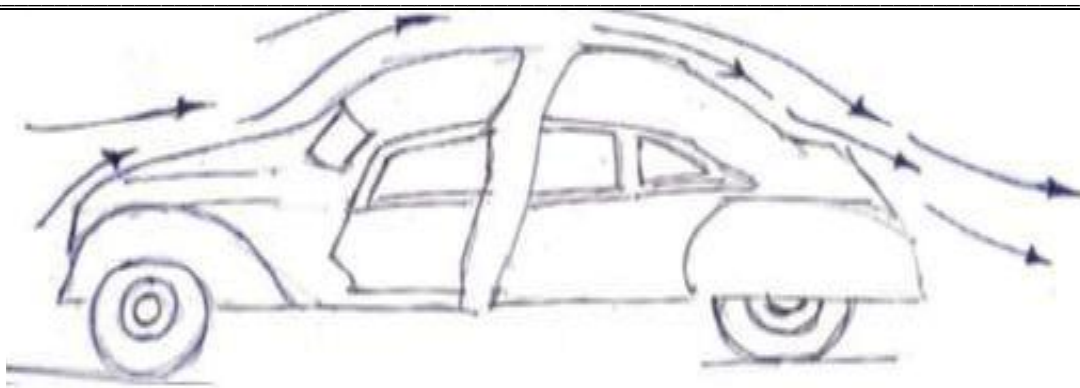
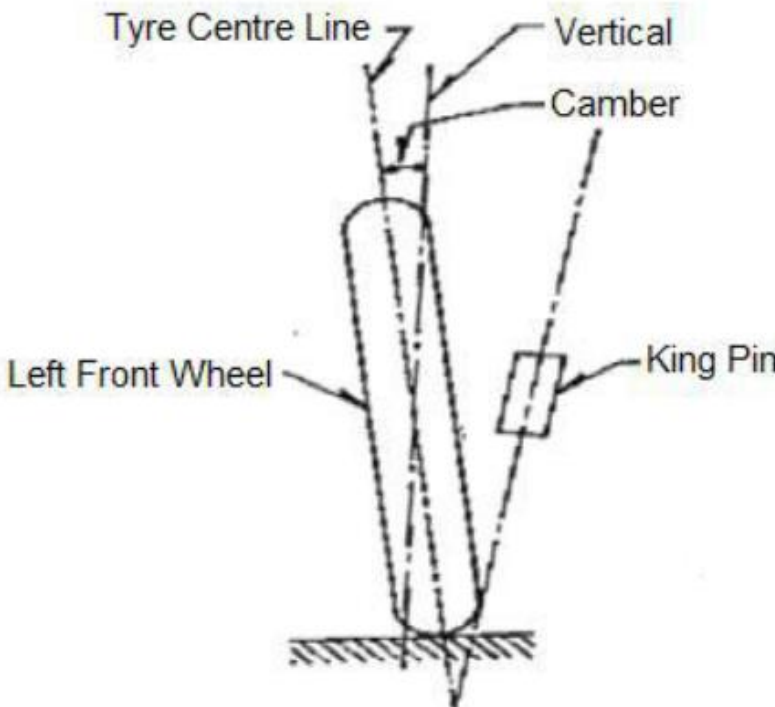
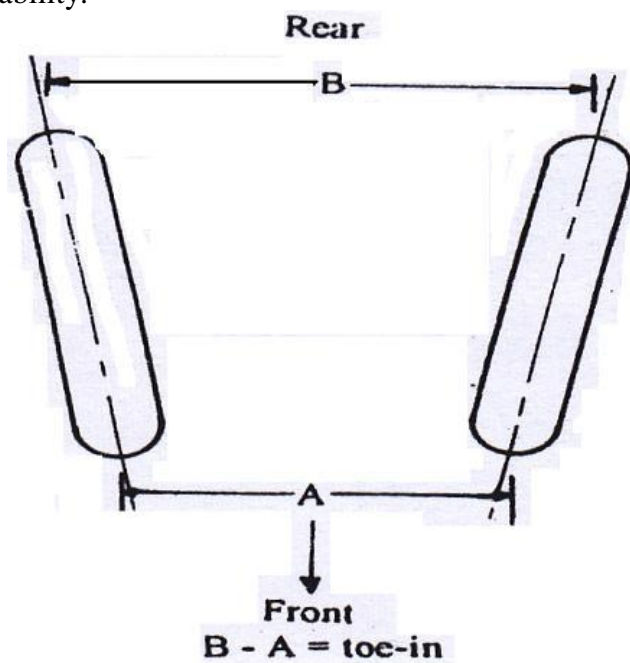
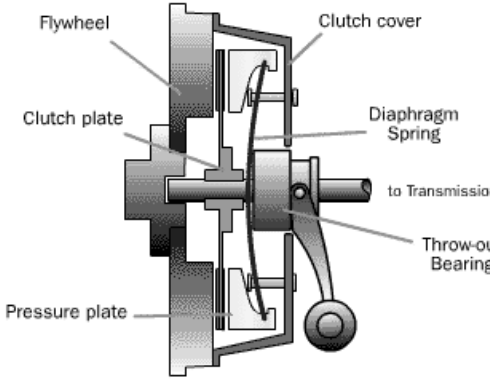


Figure: Streamlined car body

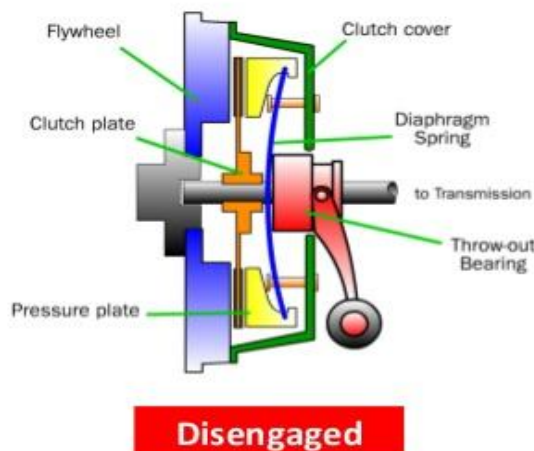
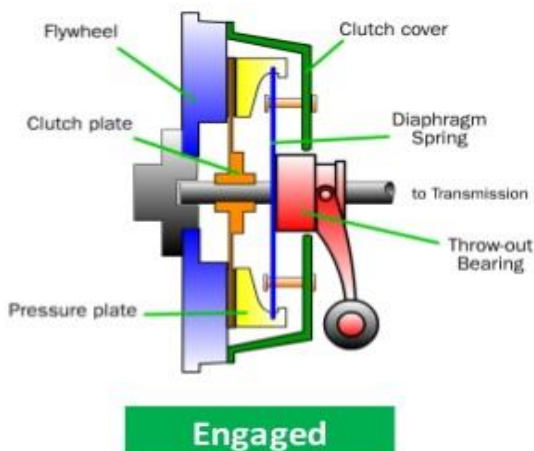
	(b)	Justify use of universal and sliding joints in propeller shaft.	04
Ans		<p>Universal joint: A universal joint is used where two shafts are connected at an angle to transmit the torque. Universal joint is used to transmit motion at varying angles.</p> <p>Justification: In front engine rear wheel drive vehicles, the transmission rigidly fixed to the frame or body is normally at higher level than wheels. The rear axle is suspended to the frame through springs. The driveshaft hence requires some flexibility at the bend near the transmission and at the axle. So the universal joints are used at front and rear end of propeller shaft which transmit the power to the wheels even if the heights of transmission and rear axle are different. Also whenever the axle moves up and down due to road irregularities, the angle of drive changes continuously and universal joint allows transmission of power and rotary motion at a varied angle.</p> <p>Sliding joints: Depending upon the type of the drive, one slip joint may be there in shaft. This serves to adjust the length of the propeller shaft when demanded by the rear axle movement. Slip joint is formed by the internal splines on the sleeve attached to the left universal joint and external splines on the propeller shaft.</p> <p>Justification: When the rear wheel comes across a bump, the spring compresses or expands as the differential with the rear axle housing and the wheel moves up and down. This not only changes the angle but also varies the length of propeller shaft. So the slip joint permits the effective length of propeller shaft depending upon the road conditions. If there is no slip joint, the propeller shaft will buckle or brake</p>	<p>02</p> <p>02</p>
	(c)	List requirements of steering system.	04
Ans		<p>Requirements of steering system:</p> <ol style="list-style-type: none"> It must keep the wheel at all times in to rolling motion without rubbing on the road. This system should associate to control the speed. It must light and stable. It should also absorb the road shocks. It must easily be operated with less maintenance. It should have self-centering action to some extent. 	Any 04 points
	(d)	Define following terms with suitable sketches:	04

		<div>(i) Camber (ii) Toe-in</div>	
Ans	<p>Camber: It is the tilt of car wheels from the vertical when viewed from the front of vehicle.</p> <div></div> <p>Toe-in: It is the amount in minimum at the front part of the wheel points inwards approximately 3 to 5 mm. It prevents side slipping excessive tyre wear, proper rolling of front wheels and steering stability.</p> <div></div>	<div>01</div> <div>01</div> <div>01</div> <div>01</div>	
B)	Attempt any ONE of the following:		06

(a)	Write advantages of front engine front wheel drive vehicles.	06
Ans	<p>Advantages of front engine front wheel drive: (any six – 1mark each)</p> <p>1) Interior space: Since the powertrain is a single unit contained in the engine compartment of the vehicle, there is no need to devote interior space for a driveshaft tunnel or rear differential, increasing the volume available for passengers and cargo.</p> <p>2) Weight: Fewer components usually means lower weight.</p> <p>3) Fuel efficiency: Improved fuel efficiency due to less weight.</p> <p>4) Cost: Fewer material components and less installation complexity overall.</p> <p>5) Improved drive train efficiency: the direct connection between engine and transaxle reduce the mass and mechanical inertia of the drive train compared to a rear-wheel-drive vehicle with a similar engine and transmission.</p> <p>6) Assembly efficiency: the power train can often be assembled and installed as a unit, which allows more efficient production.</p> <p>7) Placing the mass of the drive train over the driven wheels moves the centre of gravity farther forward than a comparable rear-wheel-drive layout, improving traction and directional stability on wet, snowy, or icy surfaces.</p> <p>8) Predictable handling characteristics: front-wheel-drive cars, with a front weight bias, tend to under steer at the limit, which (according to SAAB engineer Gunnar Larsson) is easier since it makes instinct correct in avoiding terminal over steer, and less prone to result in fishtailing or a spin.</p> <p>9) The wheelbase can be extended without building a longer driveshaft (as with rear-wheel-driven cars).</p>	Any 06-1mark each)
(b)	Draw neat sketches for diaphragm spring type clutch in engage and disengage position. Name of components.	06
Ans	 <p style="text-align: center;">Figure: Diaphragm Clutch (Disengaged)</p>	03 marks each position.

Parts of a Clutch

(3) Pressure Plate Assembly



2 Attempt any FOUR of the following:

16

(a) State advantages and disadvantages of Gas(LPG, CNG) operated automobiles.

04

Ans

Advantages of LPG & CNG operated engines: (any 2-1 Mark for each)

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

02

Disadvantages of LPG & CNG operated engines:(Any two)

1. Space Required for LPG/CNG Cylinder is more.
2. LPG/CNG tank is bulky.
3. More current rated battery is required.
4. Eats entire boots space of vehicle.
5. Easily not available in rural areas.

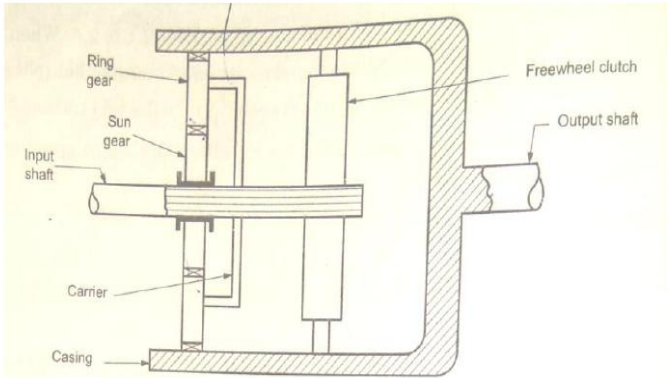
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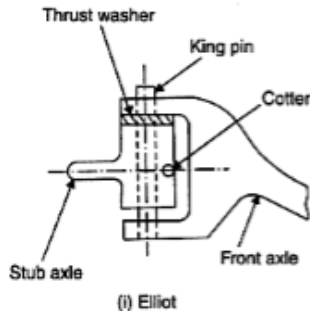
(b) Draw neat sketch of overdrive and explain its working.

04

Ans

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

	<p>ring gear is mesh with the casing of the output shaft.</p> <ul style="list-style-type: none"> - 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. - When the sun gear is locked with the carrier or ring gear, solid drive through the gear train is obtained. - Thus depending upon the locking of sun gear with casing or carrier the overdrive or direct drive is obtained. - There is another possible control of mechanism there is a direct drive through the free wheel clutch when engine develops the power. - When accelerator pedal is brought to zero position and engine is idling, the output shaft will tends to override the input shaft. <p style="text-align: center;">Answer: Working of Overdrive:</p>  <p style="text-align: center;">Figure - Overdrive</p>	02
		02
(c)	State the components of pneumatic braking system with its function.	04
Ans	<p>The five main components of an “elementary” air brake system and their functions are:</p> <ol style="list-style-type: none"> 1. Compressor: to build up and maintain air pressure. The function of the air compressor is to build up and maintain air pressure required to operate air brakes and air-powered accessories. 2. Reservoirs: to store the compressed air. Reservoirs are pressure-rated tanks, which hold a supply of compressed air until required for braking or operating auxiliary air systems. They must store a sufficient volume of air to allow several brake applications if the engine stops or the compressor fails. 3. Foot valve: to draw compressed air from reservoirs when it is needed for braking. This foot-operated valve (Fig. 10) applies air to operate the brakes. The amount of air delivered to the brakes is regulated by the driver according to the distance the treadle or brake pedal is depressed. Releasing it exhausts air in the service brakes through its exhaust port. 4. Brake chambers: to transfer the force of compressed air to mechanical linkages. Service-brake chambers (Fig. 11) convert compressed air pressure energy into mechanical force and movement, which apply the vehicle’s brakes. 6. Brake shoes and drums or brake rotors and pads: to create the friction needed to stop the vehicle 	01 mark each
(d)	Explain the concept of double declutching related to constant mesh gear box.	04
Ans	<p>In constant mesh gearbox the driver has to disengage the clutch twice while shifting to the required gear, hence it is called as double declutching. Double de-clutching ensures smooth engagement and disengagement with reduced wear of dogteeth, less noise and vibrations. In constant mesh gear box, for smooth engagement of dog clutches it is necessary that the speed of</p>	

		main shaft and sliding dog clutch must be equal. To obtain lower gear, the speeds of the clutch shaft, lay shaft and main shaft must be increased. This is done by double declutching. The clutch is disengaged and the gear is brought to neutral. Then the clutch is engaged and accelerator pedal pressed to increase the speed of the main shaft gears. After this the clutch is again disengaged and the gear moved to the required lower gear and the clutch is again engaged. For changing to higher gear, however reverse effect is desired i.e., the driver has to wait the gear in neutral till the main shaft speed is decreased sufficiently for smooth engagement of the gear.	04
	(e)	Explain with neat sketch Elliot stub axle.	04
		<p>There are four types of stub axles as below:</p>  <p style="text-align: center;">(i) Elliot</p> <p>i) Elliot Stub Axle: In this type of stub axle, king pin is placed in stub axle housing and its ends therefore turn in forked end of axle beam.</p>	02
03		Attempt any TWO of the following	16
	(a)	Explain with sketch construction and working of epicyclic gear box.	08
		<p>Construction of epicyclic Gear box: In epicyclic gear box, epicyclic gear train is a very general term. Basically, it involves 3 gears: a sun gear, a planet gear and a ring gear, the underlying concept being many gear ratios can be obtained from a small volume as compared to other types of gear trains which take up more space. Unlike simple gear trains, an epicyclic gear train requires defining more than one input to obtain a specific output, hence making the analysis a little difficult and non-intuitive.</p> <p>Working of epicyclic gear box: The working principle of the epicyclic gearbox is based on the fact the fixing any of the gears i.e. sun gear, planetary gears and annular gear is done to obtain the required torque or speed output. As fixing any of the above causes the variation in gear ratios from high torque to high speed. So let's see how these ratios are obtained</p> <p>First gear ratio: This provide high torque ratios to the vehicle which helps the vehicle to move from its initial state and is obtained by fixing the annular gear which in turn causes the planet carrier to rotate with the power supplied to the sun gear.</p> <p>Second gear ratio: This provides high speed ratios to the vehicle which helps the vehicle to attain higher speed during a drive, these ratios are obtained by fixing the sun gear which in turn makes the planet carrier the driven member and annular the driving member in order to achieve high speed ratios.</p> <p>Reverse gear ratio: This gear reverses the direction of the output shaft which in turn reverses the direction of the vehicle, this gear is achieved by fixing the planet gear carrier which in turn makes the annular gear</p>	02 02 04

the driven member and the sun gear the driver member.

Note- More speed or torque ratios can be achieved by increasing the number planet and sun gear in epicyclic gear box.

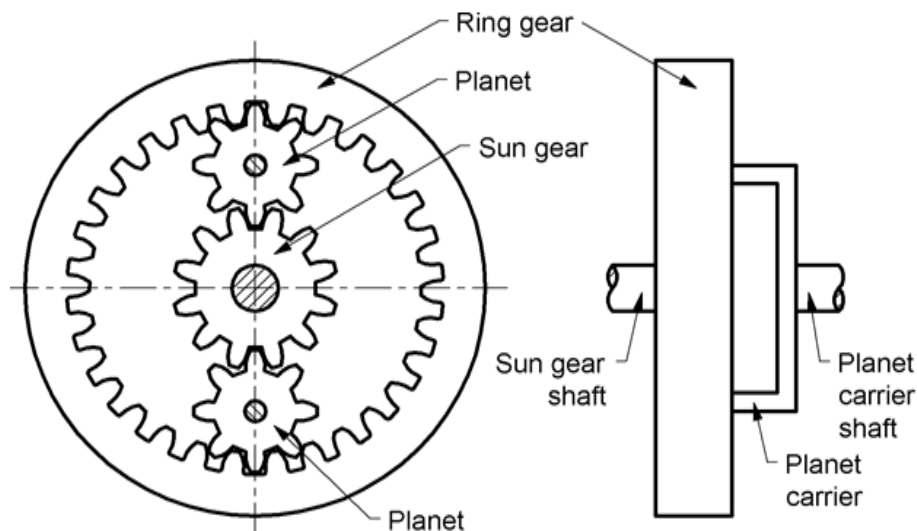


Figure: Epicyclic gear box

(b) Explain working of re-circulating ball type steering system with sketch.

08

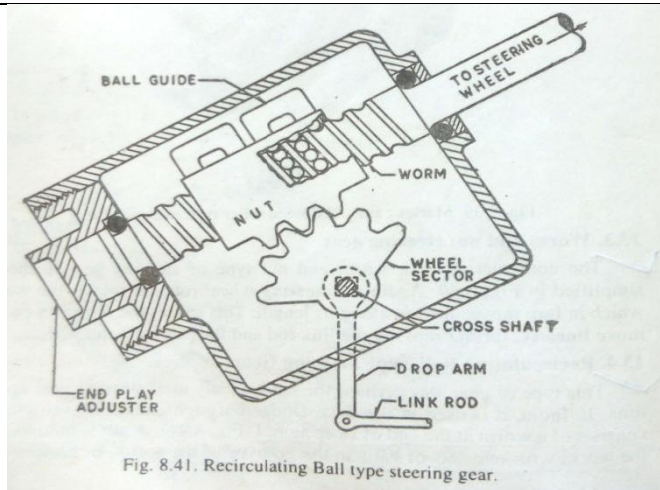


Fig. 8.41. Recirculating Ball type steering gear.

Working of Re-circulating type steering gear box:

It consists of worm at the end of steering rod. A nut is mounted on the worm with two sets of balls in the grooves of the worm, in between the nut and worm. The balls reduce the friction during the movement of nut on the worm. the nut has large number of teeth on the outside, which mesh with the teeth on a worm wheel sector, on which is further mounted the drop arm, which steers the road wheels through the link rod and steering arm.

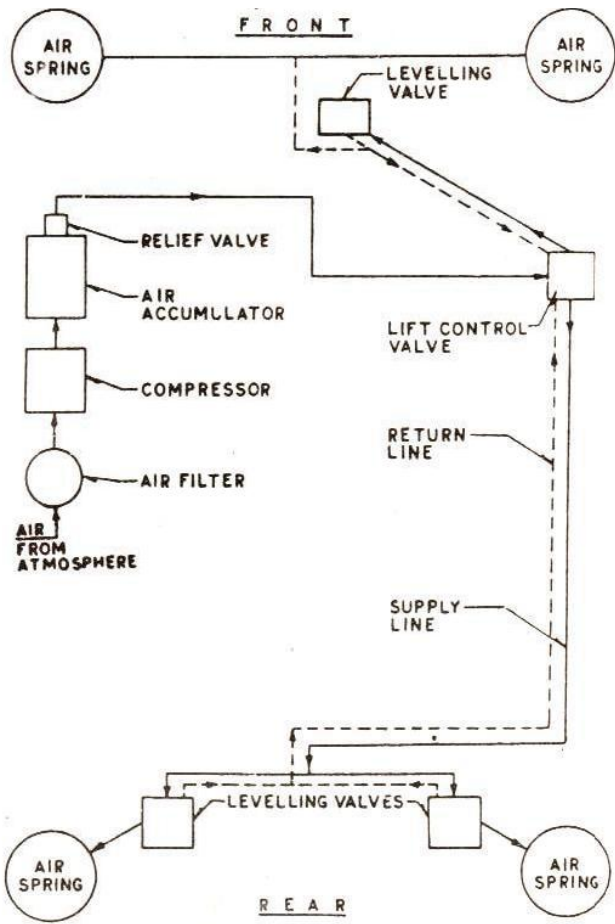
When the steering wheel is turned, the balls in the worm roll in the grooves and cause the nut to travel along the length of the worm. The balls, which are in Two sets are re-circulated through the guides as shown in the fig. the movement of the nut causes the wheel sector to turn at an angle and actual the link rod through the drop arm, resulting in the desired steering of the wheels

04

04



	c)	Differentiate between: (i) disk brake and drum brake (ii) hydraulic brake and pneumatic brake		08																																	
		Answer: i) disk brake and drum brake: (Any 4, 1 mark each)		111111 1 mark each																																	
		<table><tr><th>Sr. no</th><th>Drum brake</th><th>Disk brake</th></tr><tr><td>1</td><td>Consists of drum and internal expanding curved shoes.</td><td>Consists of disc and float shoes.</td></tr><tr><td>2</td><td>Brake pads on shoes are curved in shape.</td><td>Brake pads on shoes are of flat shape.</td></tr><tr><td>3</td><td>Pad wear adjusting is not automatic.</td><td>Pad wear adjustment is automatic.</td></tr><tr><td>4</td><td>Non-uniform pressure on curved drum surface.</td><td>Uniform pressure on disc surface.</td></tr><tr><td>5</td><td>Less stability.</td><td>Better stability.</td></tr><tr><td>6</td><td>Less cooling of brakes due to closed design.</td><td>Better cooling of brakes.</td></tr><tr><td>7</td><td>More braking effort required.</td><td>Less braking effort required.</td></tr><tr><td>8</td><td>Non-uniform wear on brake pad.</td><td>Uniform wear on brake pad.</td></tr><tr><td>9</td><td>More weight than disc brake.</td><td>Less weight than drum brake.</td></tr><tr><td>10</td><td>Takes time to replace friction pad.</td><td>Easy to replace friction pad.</td></tr></table>	Sr. no		Drum brake	Disk brake	1	Consists of drum and internal expanding curved shoes.	Consists of disc and float shoes.	2	Brake pads on shoes are curved in shape.	Brake pads on shoes are of flat shape.	3	Pad wear adjusting is not automatic.	Pad wear adjustment is automatic.	4	Non-uniform pressure on curved drum surface.	Uniform pressure on disc surface.	5	Less stability.	Better stability.	6	Less cooling of brakes due to closed design.	Better cooling of brakes.	7	More braking effort required.	Less braking effort required.	8	Non-uniform wear on brake pad.	Uniform wear on brake pad.	9	More weight than disc brake.	Less weight than drum brake.	10	Takes time to replace friction pad.	Easy to replace friction pad.	
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04	A)	Attempt any THREE of the following		12																																	
	(a)	Explain necessity of suspension system in automobile.		04																																	

Ans	Necessity of Suspension system: <ol style="list-style-type: none"> 1. It prevents the vehicle body and frame from road shocks. 2. It gives stability of the vehicle. 3. It safeguards the passengers and goods from road shocks. 4. It gives the good road holding while driving, cornering and braking. 5. It gives cushioning effect. 6. It provides comfort. 	Any four - 1 marks each
(b)	Explain air suspension with sketch	04
Ans	<p>Working: An air compressor takes the atmospheric air through a filter and compresses it to a pressure of about 240 MPa, at which pressure the air in the accumulator tank is maintained, which is also provided with a safety relief valve. This high pressure air goes through the lift control valve and the leveling valves, to the air springs as shown. Each air spring is filled with compressed air which supports the weight of the vehicle. The air gets further compressed and absorbs the shock when the wheel encounters a bump on the road.</p>  <p>The diagram illustrates the layout of an air suspension system. It shows the flow of air from the atmosphere through an air filter, a compressor, and an air accumulator (equipped with a relief valve) to the front and rear leveling valves. The front leveling valve is connected to two air springs. The rear leveling valves are connected to two air springs. A lift control valve is also shown, which can direct air to either the leveling valves or the air springs. A supply line and a return line are also indicated.</p> <p style="text-align: center;">Figure: Layout of Air suspension system</p>	<p style="text-align: center;">02</p> <p style="text-align: center;">02</p>
(c)	Explain with sketch Bendix drive	04
Ans	Bendix drive used in starting system:	02

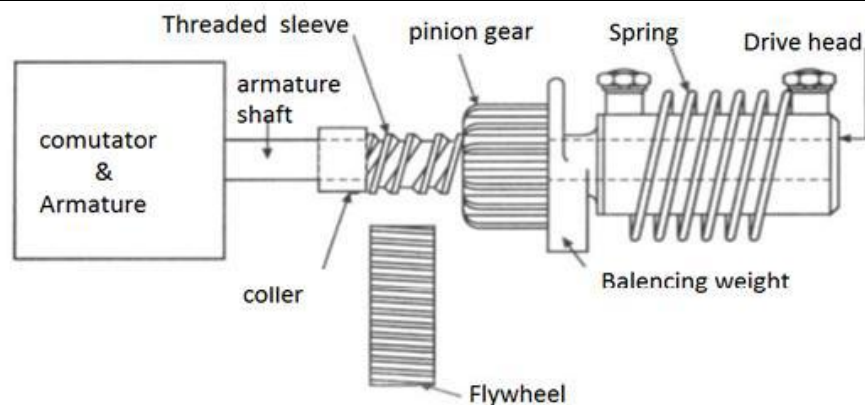


Figure: Bendix Drive

(Note: Equivalent credit shall be given to any other suitable sketch if drawn)

Bendix drive is an inertia based drive in which the pinion on the starter motor armature engages and disengages with the flywheel depending on the inertia of motor and flywheel. When the ignition switch is turned „ON“, the starter motor armature starts spinning. This causes the sleeve to rotate while the pinion is stationary due to the unbalanced weight. The pinion hence moves axially towards the collar until it engages with the flywheel ring gear. Since the pinion cannot move further axially, it starts to rotate along with the sleeve thereby also rotating the flywheel. When the flywheel starts rotating at above 100 rpm the engine gets started. After the engine has started the pinion gear is turned by the engine much faster than rotated by starting motor. This causes the pinion gear to turn back on the threaded sleeve, making it disengaged with the flywheel

02

(d) Explain different wire colour codes used in automobile wiring system

04

Answer: Color code with function 1mark (any Four)

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

**Any 4,
1-mark
each**

B) Attempt any ONE of the following

06

(a) State important precautions to be used while using air conditioning system in car (any eight)

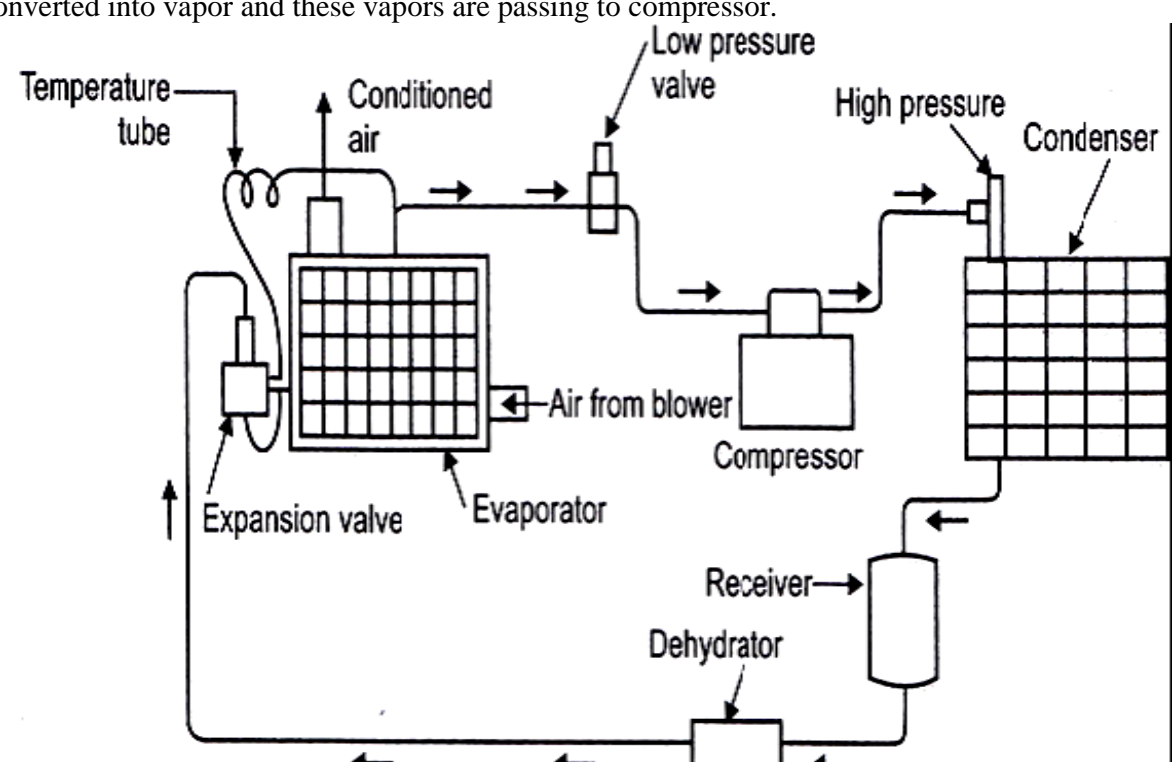
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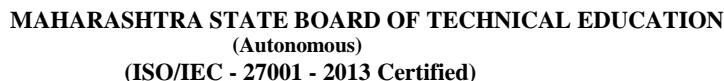
Answer: (Any 8, 6 marks)

Important precautions to be taken while using air conditioning system of vehicle:

- i. Operate the air conditioner periodically or at least once a week to keep the internal parts lubricated as well as prevent the hoses from hardening.
- ii. Do not switch ON the A.C. at high speeds which may result in the ceasing of compressor.
- iii. Do not stick anything into the air outlet or the air inlet. As it dangerous and it can cause

06

	<p>injury or damage.</p> <p>iv. Avoid exposing a body directly to a continuous cool air flow for long periods- It is not good for health.</p> <p>v. Avoid placing any obstacles near the inlet or outlet- if inlet or outlet is blocked it may causes damage to the unit.</p> <p>vi. Do not run or stop the unit frequently. If run or stop the unit more than 4-5 times an hour, it may cause damage to the unit.</p> <p>vii. The air filter should be cleared at least once every two weeks</p> <p>viii. When the unit is cleaned, set the selector switch at off position</p> <p>ix. Never operate A.C. with heater on.</p> <p>x. Do not charge the refrigerant in the A.C. system before flushing.</p>	
	(b) Explain working of car air conditioning system with layout diagram	06
	<p>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.</p>  <p style="text-align: center;">Figure: Layout of car air-conditioning system</p>	03
05	Attempt any four of the following	16
	a) State advantages of electric ignition system	04
Ans	<p>Advantages of electric ignition system : (Any 4, 1 mark each)</p> <p>1. High voltage at secondary circuit throughout engine speed range.</p>	

Page 13 of 21

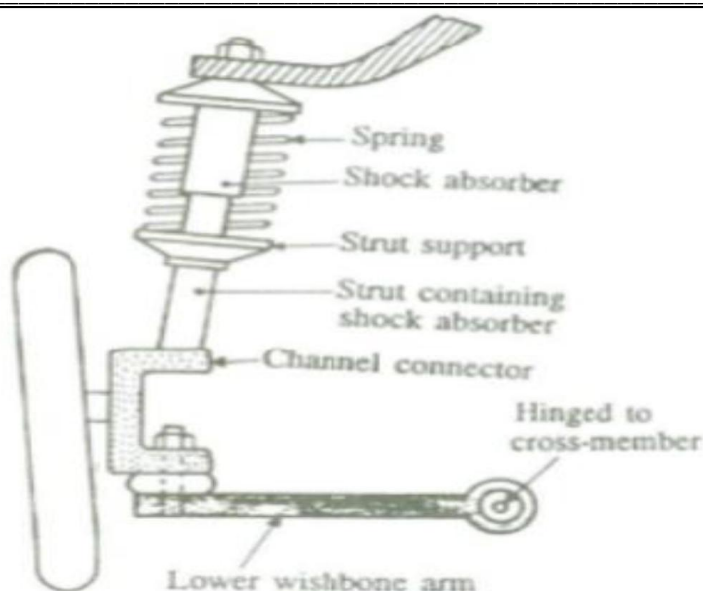


Figure: Mc-pherson strut type independent suspension
(Note: Equivalent credit shall be given to any other suitable sketch if drawn)

d) State and explain various types of automobile bodies

04

Ans Answer: (1 mark for 1 type)

Types of automobile bodies:

i) Closed Cars:

a) Sedan: Type of car design consists of engine compartment, passenger compartment and a separate boot. A sedan possesses fixed roof with fixed B pillar which seats four or more. Most commonly it is a four-door; two-door models are rare.

b) Hatchback: An automobile design, consisting of a passenger cabin with an integrated cargo space, accessed from behind the vehicle by a tailgate. Opening rear tail gate. The interior design includes fold down rear seats, which can be used as a cargo area. The rear seat can be folded partially (for instance 1/2, 1/3 or 2/3) or completely to expand the cargo space.

c) Coupe: Coupe was an enclosed two-seater mainly used in towns and was driven by a coachman. If the carriage had an emergency (tip-up) seat or a seat for a child, then it was a so-called three-quarter coupé. Coupés generally, but not necessarily, have two doors, although automobile makers have offered four-door coupés and three- and five-door hatchback coupés, as well. The SAE distinguishes a coupé from a sedan (saloon) primarily by interior volume.

d) Limousine: is a luxury vehicle driven by a chauffeur with a partition between the driver's compartment and the passenger compartment. A car with a partition and a lengthened wheelbase is called a "stretch limousine".

ii) Open cars

a) Sports: is a small, usually two-seater automobile designed for spirited performance and nimble handling. The term "sports car" was used in London.

b) Convertible: is a passenger car that can be driven with or without a roof in place. The methods of retracting and storing the roof vary between models. A convertible allows an open-air driving experience, with the ability to provide a roof when required.

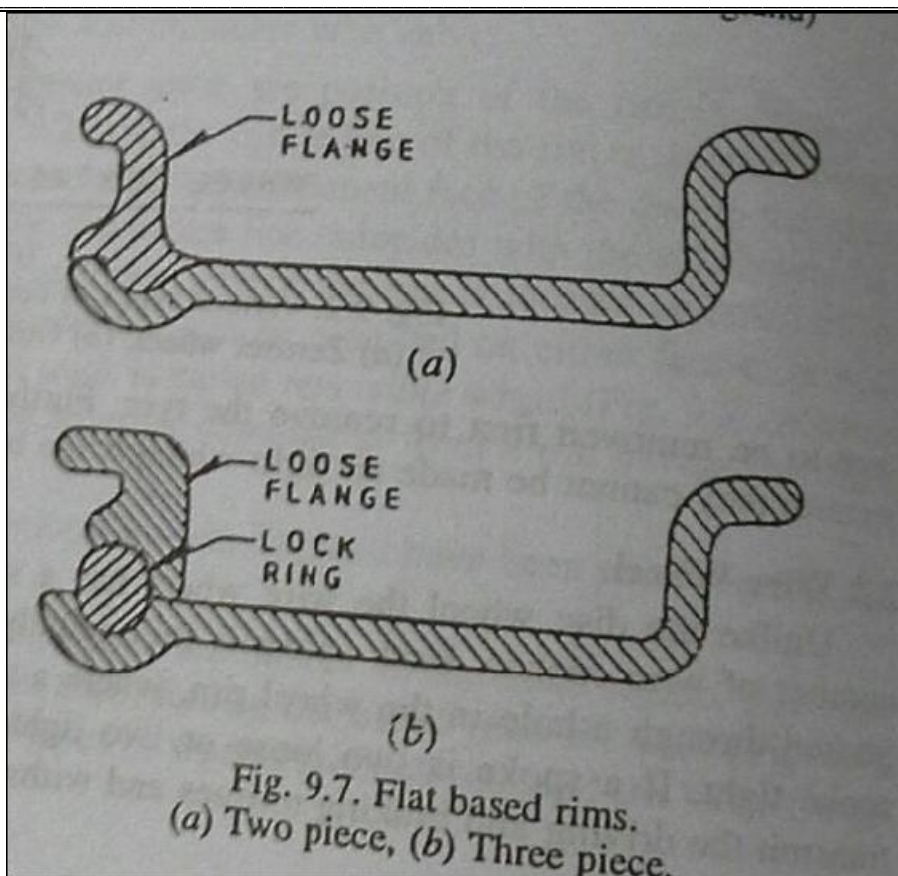
iii) Special Style: is a car body style which has a two-box design, a large cargo area and a rear tailgate that is hinged at roof level. The body style is similar to hatchbacks, however station wagons are longer and are more likely to have the roofline extended to the rear of the car^[1] (resulting in a vertical surface at the rear) to maximise the cargo space.

02

02



		<p>a) Estate Cars b) Station Wagon:</p> <p>iv) Transport Vehicles: vehicle used for transportation or movement of public/ passenger or goods through road. Passenger transport may be public, where operators provide scheduled services, or private.</p> <p>a) Van : small passenger vehicle. b) Truck: large goods transport vehicle. c) Articulated Vehicle: very large goods transport vehicle. d) Bus : large public / passenger transport vehicle e) Coach : large public / passenger transport vehicle</p> <p>Other types of bodies are</p> <ol style="list-style-type: none">1. Tractor with articulated trailer2. Half body Truck3. Dump truck4. Tanker5. Delivery truck	
	e)	List various types of rims used in automobiles	04
	Ans	<p>(Any suitable answer shall be given due credit.)</p> <p>It is well type of structure in which the tyre is contained. Different types of rims used are well base, flat base three piece rim, semi-drop centre and flat base divided type.</p> <p>For car tyre, well base or drop centre is the common tyre. The tyre is pressed into recess of the drop centre or well for leveling the opposite side over the rim flange. A slight taper of 5 degree is provided for riding up the bead due to air pressure in the tyre.</p> <p>Flat based three piece rim: It has flat base and is in three pieces. The three pieces are fixed flange, loose flange and lock ring. In case of heavy vehicles tyres it difficult to break beads while putting a tyre on rim this kind of rims are used. They can be used only with tubed tyres Use : commercial vehicle</p> <p>Semi- drop centre rim is two piece rims. It is a compromise between the well base and the flat base rim. It is suitable for light vehicles. Its removal is simplified by spilt, detachable flange while the tyre is locked to the rim by slight taper. When the tyre is being removed, the slight well may be used.</p>	04



		<p>Fig. 9.7. Flat based rims. (a) Two piece, (b) Three piece.</p>	
06	Attempt any FOUR of the following	16	
a)	How batteries are rated? Explain testing of lead acid battery. Elaborate procedure of testing.	08	
Ans	<p>(Any one – 2 mark,)</p> <p>Batteries are rated according to any of the following five types of Battery ratings:</p> <ol style="list-style-type: none"> 1. Ampere-hours (A-h) is the product of the time that a battery can deliver a certain amount of current (in hours) times that current (in amperes), for a particular discharge period. This is one indication of the total amount of charge a battery is able to store and deliver at its rated voltage. This rating is rarely stated for automotive batteries, except in Europe where it is required by law 2. Cranking amperes (CA) also sometimes referred to as marine cranking amperes (MCA), is the amount of current a battery can provide at 32°F (0°C). The rating is defined as the number of amperes a lead-acid battery at that temperature can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12 volt battery). 3. Cold cranking amperes (CCA) is the amount of current a battery can provide at 0°F (–18°C). The battery rating is defined as the current a lead-acid battery at that temperature can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery). It is a more demanding test than those at higher temperatures. 4. Hot cranking amperes (HCA) is the amount of current a battery can provide at 80°F (26.7°C). The rating is defined as the current a lead-acid battery at that temperature can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery). 5. Reserve capacity minutes(RCM) ,also referred to as reserve capacity(RC), is a battery's ability to sustain a minimum stated electrical load; it is defined as the time (in minutes) that a lead-acid 	02	

battery at 80°F (27°C) will continuously deliver 25 amperes before its voltage drops below 10.5 volts.

Battery testing: (any one method)

There are various testing method of battery as follows:

- 1) State of charge test:
- 2) Specific Gravity test.:
- 3) Open volt test.
- 4) High Discharge Test.
- 5) Cadmium Test.
- 6) Load test.

03

8.14 BATTERY STATE-OF-CHARGE TEST

The battery state-of-charge measurement (testing) is a check on the condition of battery's electrolyte and plates. The following are the important tests that are conducted to check the battery state-of-charge.

1. Specific gravity test; 2. Open circuit voltage test; 3. High discharge test; and 4. Cadmium test. These tests are discussed, in detail, in the following articles.

8.15 SPECIFIC GRAVITY TEST

The specific gravity of the battery's electrolyte decreases in direct proportion to the discharging of the battery. Thus, it is possible to determine the degree of battery charge by measuring the specific gravity of the electrolyte.

The specific gravity is measured by using an instrument called as hydrometer as shown in Fig. 8.11. A *hydrometer* consists of a glass tube with a nozzle at one end and a soft rubber suction bulb at the other end. Inside the tube, there is glass float on which a scale is marked for measuring the specific gravity of the electrolyte.

When taking a reading from the hydrometer, ensure that the glass tube is oriented vertically and that the float does not come in direct contact with this tube. Insert the nozzle into the electrolyte in the cell, squeeze the bulb and then release the bulb. The electrolyte will move up into the glass body as a result of surface tension. The reading should be taken at highest point of the electrolyte on the scale as shown in Fig. 8.12.

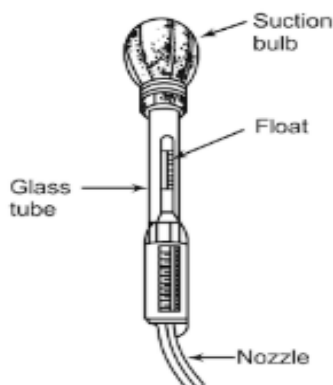


Fig. 8.11. Hydrometer.

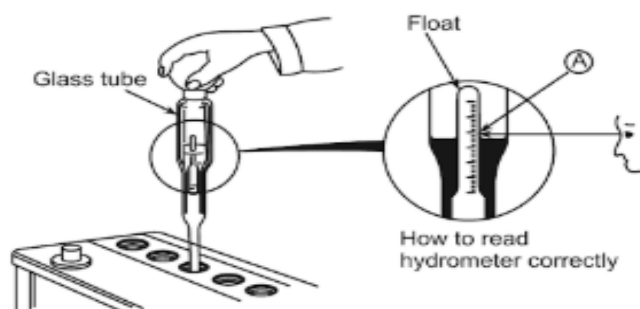


Fig. 8.12. Reading from the hydrometer.

We have already discussed that the specific gravity of the electrolyte changes with the change in temperature (*i.e.* the specific gravity increases as the temperature decreases and vice-versa). Therefore, the measurement should be taken at standard temperature or the correction should be calculated and then applied to specific gravity reading to get the correct reading accordingly as discussed in Art. 8.4. The following table shows the battery state-of-charge at 80° F (26.7° C).

8.17 HIGH DISCHARGE TEST

The high discharge test is also conducted on a battery to know its state-of-charge. In actual operating conditions, the open circuit voltage is not the correct representative of the battery ability to perform when loaded (when electrical equipments are turned on). For this test to be conducted accurately, the battery must pass the open circuit voltage test. If it does not pass, recharge the battery and test it again.

The starter motor, at the time of starting, draws a very heavy current due to which the cell voltage falls. In order to satisfy this condition, high discharge test is made with the help of a cell voltage tester. It consists of a voltmeter connected to two legs with a high resistance placed across them, as shown in Fig. 8.13. When the two legs are pressed on cell terminals, a heavy current (150 to 200 amperes) flows through the cell voltage tester. The test is made for 5 to 10 seconds, at the end of which the voltage should not fall below 1.5 volts, and also the difference of cell voltage of various cells should not exceed 0.2 volts, otherwise the battery is considered to be damaged.

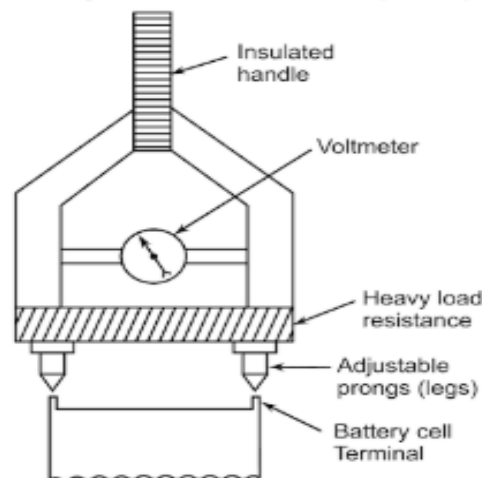


Fig. 8.13. High rate discharge tester.

This test should not be carried on half charged batteries and for more than 15 seconds, otherwise the battery would get permanently damaged. This test is a very severe test and should preferably be performed on a fully charged or at least 70% charged batteries.

8.18 CADMIUM TEST

This test is done to check the condition of positive and negative plates of the battery. In this test, a cadmium rod is enclosed in a perforated ebonite tube. The rod is immersed in the electrolyte, and is connected to the negative terminal of a high resistance voltmeter. The voltmeter positive terminal is connected alternately to the positive and negative terminals of the battery cell. When connected with positive terminal, the voltage reading should not be less than 2.5. A lower reading would indicate that the positive plates are defective. When connected with negative terminal of battery, the voltage reading should not be more than 0.2 volt. A higher reading will indicate that the negative plates are defective.

The following steps are included in the procedure for Battery load test.

1. Test the open circuit voltage. The battery must be at least half charged. If the open circuit voltage is less than 12.4 V, charge the battery.
2. Disconnect the battery cables, ground cable first.
3. Prepare the tester. Check the meter's mechanical zero. Adjust, if necessary. Connect the tester load leads to the battery terminals. Connect RED to Positive, BLACK to negative. Test voltmeter should indicate battery open-circuit voltage.
4. Load the battery by pressing the load button. Maintain the load for no more than 15 seconds and note the voltmeter reading.
5. Immediately release the press button for load test.
6. If the voltmeter reading was 10.0 volts or more, the battery is good. If the reading is 9.6 volts, the battery is serviceable, but requires further testing. Charge and re-test. If the reading was below 9.6 volts, the battery is either discharged or defective.

Note: the test results will vary with temperature. Low temperatures will reduce the reading. The battery should be at operating temperature.

Note:- Relevant may be considered for due credit.



	b)	State wheel balancing and wheel alignment. Describe its procedure.	08
Ans	<p>(wheel balancing -1 mark, procedure - 03 marks, wheel alignment - 1 marks ; procedure of wheel alignment – 3 mark)</p> <p>Wheel balancing: It is a process that ensures wheel spins truly 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 bo`uncing of a vehicle, wheel shimmy etc which we face. To avoid them this is done. Wheel balancing means balancing wheel around axis around which it rotates. We have two types of balancing .Static balancing and dynamic balancing. Wheel Balancing machines are used to carry out this act.</p> <p>Procedure of Wheel Balancing: Fill tyre with recommended tyre pressure, check for tyre / wheel damage don't use damaged rim for balancing</p> <ol style="list-style-type: none"> 1. Mount wheel on balancing Machine and lock it. Remove old balance weights. 2. Set balance for size of tyre and start the machine. 3. Read values of imbalance on right and left side of wheel on display. 4. Put respective weights on both sides on marks. 5. Start balancer again and check that reading is zero on both sides then the wheel is balanced. 6. If reading on both sides is not zero then repeat the procedure <p>Wheel alignment: It is is part of standard automobile maintenance that consists of adjusting the angles of wheels to the car manufacturer specifications. The purpose of these adjustments is to reduce tire wear, and to ensure that vehicle travel is straight and true (without "pulling" to one side).</p> <p>Procedure of wheel alignment: (3 marks)</p> <p>STEP-1: Lock the steering wheel in the straight ahead position and apply the brake pedal depressor if measuring Castor/Camber (optional gauge required).</p> <p>STEP-2: Fit the measuring heads to the rear wheels and the centre line scales to the front wheels. Switch on the lasers.</p> <p>STEP-3: The number that the laser line hits the scales should read the same on both scales. If they are different the rear Toe will need adjusting in order to correct any thrust angle deviation.</p> <p>STEP-4: Read the Toe scales to calculate the rear Toe, remembering that as the heads are reversed the reading will read the opposite way. Therefore 'Toe-in' will now become 'Toe-out' etc. Adjust the rear axle to the correct settings and finish with the two centre line scales reading the same. Rear adjustment is now finished.</p> <p>STEP 5: Fit the measuring heads to the front wheels and fit the centre line scales to the rear wheels. Now calculate and adjust using the same procedure as the rear of the vehicle. Please remember the heads are now the correct way around so the reading will read correctly.</p> <p>STEP 6: All Toe and thrust angle readings can be seen when you are standing under the vehicle.</p> <p>STEP 7: Optional Camber/Castor adjustment.</p>		<p>01</p> <p>03</p> <p>01</p> <p>03</p>

(Note: Any suitable answer shall be considered for due credit)

- c) (i) sketch and explain working of fuel level gauge**
(ii) state advantages and disadvantages of tubeless tyres

08

Ans

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.

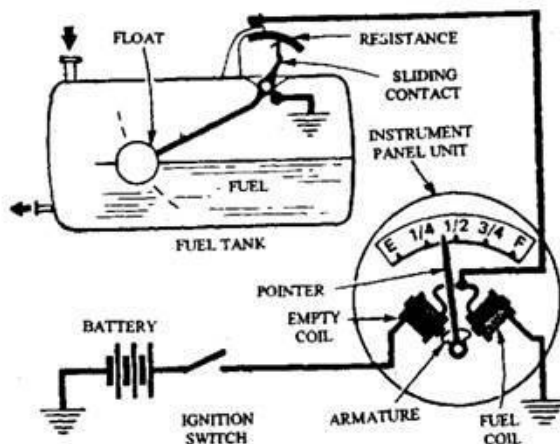


Fig. fuel level gauge

ii) Advantages and disadvantages of Tubeless Tyres:

advantages: (any two- 1mark each)

- 1) Weight is less due to absence of the tube.
- 2) Fuel efficiency is more as its unsprung weight is less.
- 3) Better cooling
- 4) Steering and road holding is good
- 5) Slower leakage of air, If Punctured the tubeless tyre let the air out Slowly.
- 6) The punctured can be repaired without removal of tyre from wheel.

02

Disadvantages: (any two- 1mark each)

- 1) It is not possible to use Tubeless Tyre on wire spoked wheels.
- 2) It costlier.
- 3) The life of tubeless tyre is less than tubed tyre.
- 4) Mounting and disassembling of tubeless tyre is difficult than tubed tyre

