



WINTER- 18 EXAMINATION

**Model Answer**

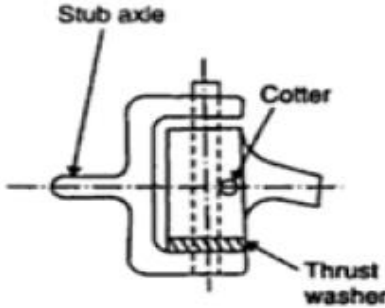
Subject Name: Automobile Systems and Body Engg.

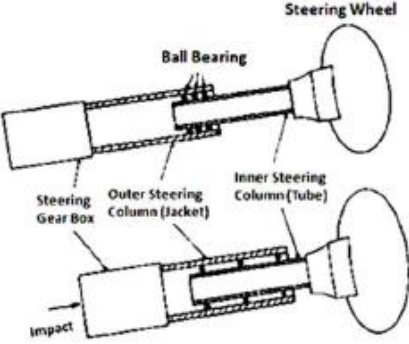
Subject Code: **17409**

**Important Instructions to examiners:**

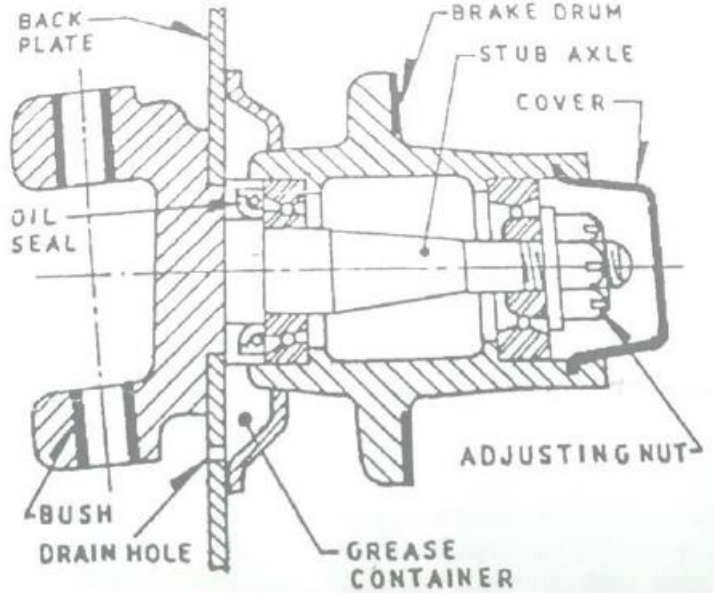
- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling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

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	a)	<b>Attempt any SIX of the following</b>	12
	(i)	<b>Define king pin inclination</b>	02
	Ans	It is the angle between vertical line and centre line of king pin or steering axis when viewed from the front of the vehicle. It is normally about 70 to 80	02
	(ii)	<b>State the types of stub axle arrangement</b>	02
	Ans	<b>Types of stub axles:</b> 1) Elliot 2) Reversed Elliot 3) Lamoine 4) Reversed Lamoine	02
	(iii)	<b>List any two friction materials used for brake shoe.</b>	02
	Ans	<b>Material used for brake shoes:</b> Sheet Steel, Cast Aluminum Alloy	02
	(iv)	<b>State the purpose of compressor and evaporator used in car A. C.</b>	02
	Ans	<b>Purpose of compressor:</b> The purpose of the compressor is to circulate the refrigerant in the system under pressure; this concentrates the heat it contains. At the compressor, the low pressure gas is changed to high pressure gas.  <b>Purpose of evaporator:</b> The evaporator unit where the cooling effect is obtained is usually located inside the passenger compartment below the dash board. A high capacity blower circulates the air in the car interior across the evaporator coils, and this drops the temperature of the air inside the passenger compartment. It also helps in dehumidification, as warmer air travels through the evaporator coil; the moisture containing the air condenses on its surface.	01  01

	<b>(v)</b>	<b>Write the purpose of following: (1) Service brake (2) Parking brake</b>	<b>02</b>																																	
	<b>Ans</b>	<p><b>(1) Service brake:</b> Braking is the mechanism in the vehicle which is used to slowing down and stopping the vehicle to rest in the shortest possible distance.</p> <p><b>(2) Parking brake:</b></p> <p>i) This is an auxiliary brake (a non-service brake) used to work when the vehicle is either moving on a long downhill gradient, or in busy traffic where it has to slowdown continuously over a large distance. This type of brake effects fuel economy of vehicle.</p> <p>ii) It is the secondary braking system used to hold the car in stationary position when parked on a slope. By using emergency brake, vehicle can be brought to a complete stop if there's a failure of the brake system.</p>	<b>01</b>  <b>01</b>																																	
	<b>(vi)</b>	<b>Compare drum brake and disk brake (any four point)</b>	<b>02</b>																																	
	<b>Ans</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;">Sr. No.</th> <th style="width: 45%;">Disc Brake</th> <th style="width: 50%;">Drum brake</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">01</td> <td>Friction surfaces are directly exposed to the cooling air.</td> <td>Friction occurs on the internal surfaces, therefore heat dissipated only by conduction through the drum.</td> </tr> <tr> <td style="text-align: center;">02</td> <td>Flat friction pads are used.</td> <td>Curved friction linings are used.</td> </tr> <tr> <td style="text-align: center;">03</td> <td>There is uniform wear of friction pads.</td> <td>Non uniform wear of friction linings.</td> </tr> <tr> <td style="text-align: center;">04</td> <td>There is no loss of efficiency due to expansion.</td> <td>There is loss of efficiency due to expansion.</td> </tr> <tr> <td style="text-align: center;">05</td> <td>Weight is less so saving upto 20 % is possible.</td> <td>Comparatively higher weight.</td> </tr> <tr> <td style="text-align: center;">06</td> <td>Disc brakes have comparatively better anti-fade characteristics.</td> <td>Comparatively poor anti-fade characteristics.</td> </tr> <tr> <td style="text-align: center;">07</td> <td>Simple in design.</td> <td>Complicated design.</td> </tr> <tr> <td style="text-align: center;">08</td> <td>Comparatively easy to remove and replace friction pads.</td> <td>Removal and replacement of brake linings is difficult and consumes more time.</td> </tr> <tr> <td style="text-align: center;">09</td> <td>Less frictional area</td> <td>More frictional area</td> </tr> <tr> <td style="text-align: center;">10</td> <td>Pressure intensity is more</td> <td>Pressure intensity is less</td> </tr> </tbody> </table>	Sr. No.	Disc Brake	Drum brake	01	Friction surfaces are directly exposed to the cooling air.	Friction occurs on the internal surfaces, therefore heat dissipated only by conduction through the drum.	02	Flat friction pads are used.	Curved friction linings are used.	03	There is uniform wear of friction pads.	Non uniform wear of friction linings.	04	There is no loss of efficiency due to expansion.	There is loss of efficiency due to expansion.	05	Weight is less so saving upto 20 % is possible.	Comparatively higher weight.	06	Disc brakes have comparatively better anti-fade characteristics.	Comparatively poor anti-fade characteristics.	07	Simple in design.	Complicated design.	08	Comparatively easy to remove and replace friction pads.	Removal and replacement of brake linings is difficult and consumes more time.	09	Less frictional area	More frictional area	10	Pressure intensity is more	Pressure intensity is less	<b>02</b>
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	<b>(vii)</b>	<b>Draw a neat labelled sketch of reverse eliot type of stub axle</b>	<b>02</b>																																	
	<b>Ans</b>	 <p style="text-align: center;">(ii) Reversed Elliot</p>	<b>02</b>																																	

(viii)	<b>State the necessity of stabilizer bar</b>	<b>02</b>
Ans	Stabilizer is necessarily used in all independent front suspension. It reduces tendency of the vehicle to roll on either side when taking a turn. When both the wheels deflect up or down by the same amount, the stabilizer bar simply turns in the bearings. When only one wheel deflects, then only one end of the stabilizer moves, thus it acts as a spring between two sides of the independent front suspension.	<b>02</b>
b)	<b>Attempt any TWO of the following</b>	<b>08</b>
(i)	<b>Describe the working of collapsible steering with neat labeled sketch</b>	<b>04</b>
Ans	<div style="text-align: center;">  </div> <p><b>Figure: Arrangement of a ball type collapsible steering column in normal mode and in collapsed condition.</b></p> <p><b>Working:</b> The design of these columns is such that they collapse due to impact forces caused during head-on collision of the vehicle. The collapsing columns ensure greater safety to the driver by minimizing or avoiding a direct severe impact to him. This type of column consists of inner tube and outer tube. Ball bearing is provided between the two overlapping tubes. The inner tube is attached on the steering wheel while the outer jacket is fitted over the brackets (not shown in figure) on the body or on the frame. In case of a collision, the inner tube collapses by sliding inside the outer jacket and thus saves the driver from severe impact.</p>	<b>02</b>
(ii)	<b>Explain the following terms: (1) Traction (2) Tractive efforts</b>	<b>04</b>
Ans	<p><b>(1) Traction:</b> The ability of the drive wheels to transmit tractive effort without slipping is known as 'traction'.</p> <p><b>(2) Tractive efforts:</b> Tractive effort is the force available at the points of contact between the rear wheel tyres and the road. Therefore, the useful tractive effort is always less than the traction.</p>	<b>02</b>
(iii)	<b>State the various types of denting tools used for vehicle body repair</b>	<b>04</b>
Ans	<p><b>(Any 04, 01 mark each)</b></p> <p><b>1) Hammer:</b> These are special purpose hammer used for roughing out heavy dent.</p> <p><b>2) Dolly blocks:</b> These are small set of anvils which are to be held in hand underneath while dent is being hammered.</p> <p><b>3) Spoons:</b> Used for same purpose as that of dolly blocks but they are made small for dents which are difficult to access.</p>	

		<p><b>4) Files:</b> These are used to smoothen the rough surface or for removal of excess unwanted material from surface.</p> <p><b>5) Pick Tools:</b> Picking bars, Hook bar, Pull rods etc. are used to pick the bumped surface.</p> <p><b>6) Acetylene torch, Soldering torch, Brazing torch:</b> These are used in joining processes.</p>	
<b>2</b>		<b>Attempt any FOUR of the following</b>	<b>16</b>
	<b>a)</b>	<b>Explain the working of electrical power assisted steering system with neat labeled sketch</b>	<b>04</b>
<b>Ans</b>		<p><b>Electrical power steering:</b> The system consists of following components:</p> <ol style="list-style-type: none"> <li>1. Steering column that connects the steering pinion with steering wheel inside the Vehicle.</li> <li>2. Steering pinion that converts the rotating steering movement into linear movement of the rack.</li> <li>3. Rack connected to the wheels via tie rods and links.</li> <li>4. Sensors to record the information required to calculate the necessary supporting steering torque.</li> <li>5. Servo unit consisting of an ECU and servo motor (electric motor) that generates the supporting steering torque. When the driver moves the steering wheel a sensor registers the steering torque exerted and sends this information as an electric signal to ECU. This calculates the supporting torque and activates the servo motor on the basis of the calculated result. Generally the steering torque generated by these motors is 3-6 Nm. The direction of rotation of motors depends on the direction of motion of steering wheel. The control electronics takes into account the different signals and parameters e.g. Driving speed, steering angle, steering torque and steering speed with the help of other sensors in the vehicle and due to networking of steering ECU with other ECUs in the vehicle framework. This steering system can be used to implement assistance function to enhance comfort and safety.</li> </ol> <div style="text-align: center;"> <p>The diagram illustrates the Electronic Power Steering (EPS) system. At the top, a steering wheel is connected to a steering column. A <b>Steering Angle Sensor</b> and a <b>Torque Sensor</b> are mounted on the steering column. The <b>Torque Sensor</b> sends a signal to the <b>ECU</b>. A <b>Vehicle Speed Sensor</b> also sends a signal to the <b>ECU</b>. The <b>ECU</b> processes these signals and sends a control signal to the <b>Motor</b>. The <b>Motor</b> is connected to a <b>Reduction Gear</b>, which is part of the steering rack and pinion assembly. This assembly is connected to the front wheels via tie rods and links.</p> </div> <p style="text-align: center;"><b>Figure: Electronic Power Steering</b></p> <p style="text-align: center;"><b>Figure: Electronic Power Steering</b></p>	<b>02</b>

b)	<b>Draw neat labeled sketch of front wheel assembly</b>	<b>04</b>
Ans	 <p style="text-align: center;"><b>Figure: Front wheel assembly.</b></p>	<b>04</b>
c)	<b>What do you mean by understeering and oversteering? Explain</b>	<b>04</b>
Ans	<p>During turns, centrifugal force acts on the wheels. Two cases can arise:</p> <p><b>i) Oversteering:</b> When the slip angles of the front wheels are less than those of the rear wheels, radius of the turn is decreased. This means that the vehicle will turn more sharply than it should for a given rotation of the steering wheel. This condition is called oversteering.</p> <p><b>ii) Understeering:</b> When the slip angles of the front wheels are greater than those for the rear wheels, radius of the turn is increased. This means that the vehicle will turn less sharply than it should for a given rotation of the steering wheel. This condition is called understeering.</p>	<b>02</b>  <b>02</b>

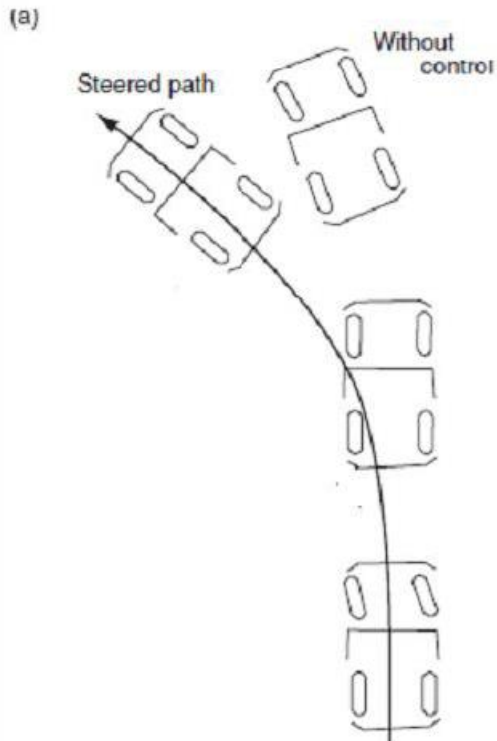
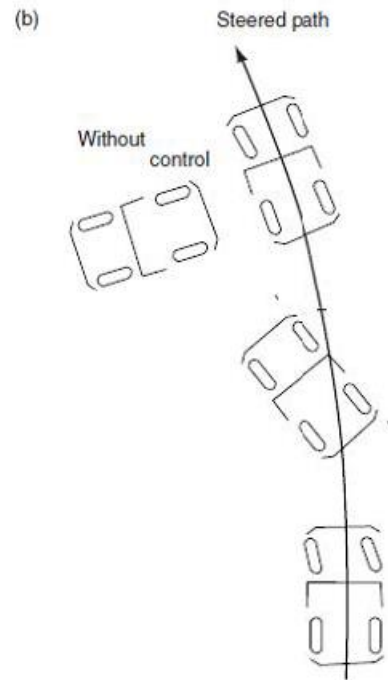


Figure: understeering



Stability control; (a) understeer, (b)

Figure: oversteering

d) Describe the working of vacuum assisted braking system

04

Ans

**Working:** When brake pedal is free, upper valve in the control unit is closed and lower is opened. Thus both side of piston is exposed to engine vacuum. However when brake pedal is pressed to apply brake, the lower valve is closed and upper is opened. This causes atmospheric air to apply pressure on left side of piston causing servo piston moves to right causing movement of master cylinder piston thereby applying brake. When pedal is released both side of servo piston is once again exposed to vacuum.

02

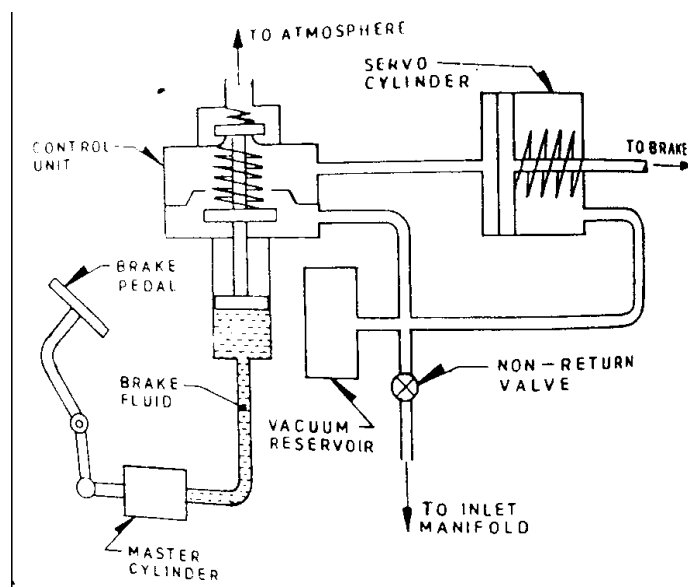
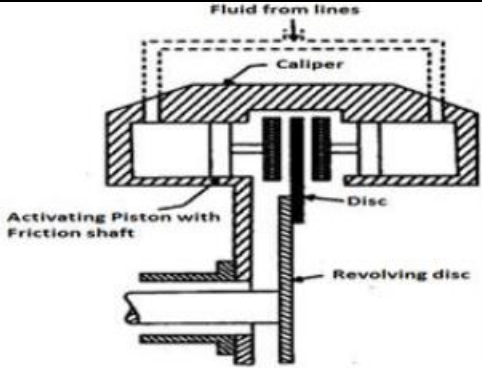
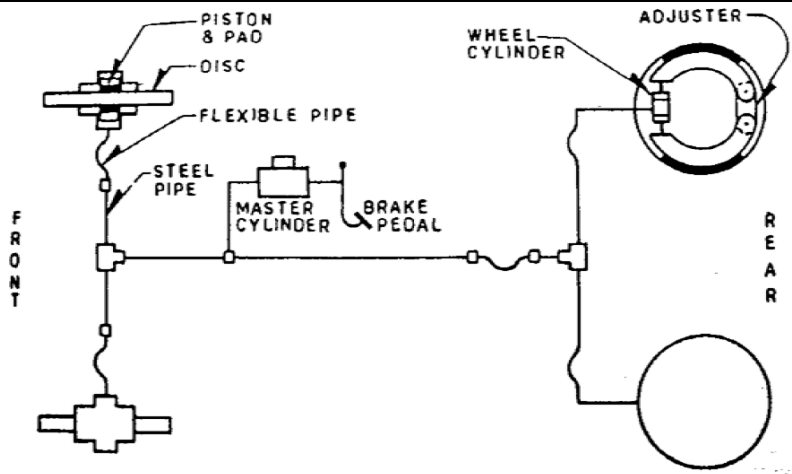


Figure: Vacuum assisted brake system.

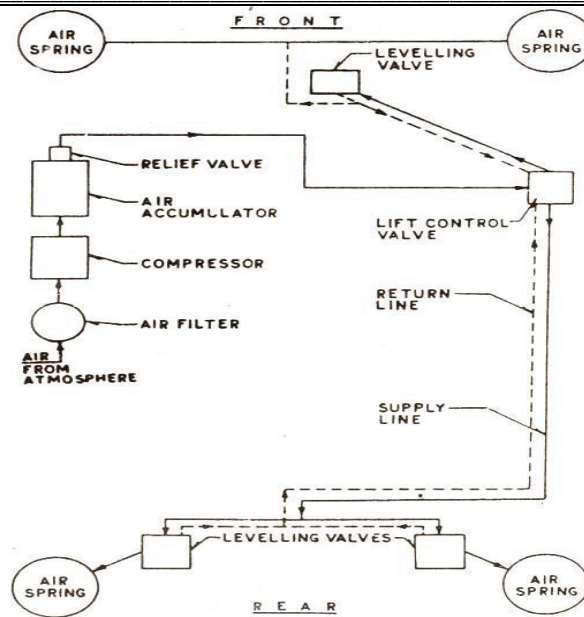
02

e)	<b>Describe anti corrosive treatment for a vehicle.</b>	<b>04</b>
Ans	<p><b>1) Surface preparation:</b></p> <ul style="list-style-type: none"> <li>• <b>Degreasing:</b> It is a process by which organic deposits such as oil, grease, metallic soaps and inorganic matters like soil, dirt, and shop dust are removed from metal surface.</li> <li>• <b>Descaling:</b> The process of removing scales on the ferrous surface.</li> <li>• <b>Derusting:</b> If the metal is exposed to atmosphere or water, the oxides of iron are formed on the metal surface; these oxides are called as rust. This process of removing the rusting on the surface.</li> </ul> <p><b>2) Rinsing:</b> To remove all acids and acid salts, the work is passed through 2 or 3 successive rinse baths.</p> <p><b>3) Phosphate coating:</b> Phosphate coating is secondary metallic phosphate of iron, zinc or manganese deposited on steel surfaces. They provide a good anchorage to the paint film and prevent rust creep underneath the paint film.</p> <p><b>4) Passivation:</b> After Phosphate coating and rinsing, surfaces are given a final passivation rinse with solution of chromic acid to improve their corrosion resistance.</p> <p><b>5) Sealing:</b> After passivation and drying, the sealant is to be applied within 2 hours during monsoon and 6 hours during winter and summer months.</p>	<b>04</b>
f)	<b>Draw neat labeled sketch of disk brake system.</b>	<b>04</b>
Ans	 <p style="text-align: center;"><b>Disk braking system</b></p>	<b>04</b>
3	<b>Attempt any FOUR of the following:</b>	<b>16</b>
a)	<b>Describe the working of hydraulic braking system with neat sketch</b>	<b>04</b>
Ans	 <p style="text-align: center;"><b>Figure: Hydraulic braking system.</b></p>	<b>02</b>



	<p><b>Working:</b> When the brakes are not in operation, the system is filled with brake fluid under light pressure. When driver presses the brake pedal for applying the brake, the piston in the master cylinder moves forward and compresses the fluid in cylinder. It increases the pressure of the fluid in master cylinder and in entire hydraulic system. This pressure is instantly transferred to all four wheel cylinders (in case of disc brake this pressure is transferred to calipers). Thus the piston in wheel cylinders moves outward which moves brake shoes against brake drum to apply brakes. When driver releases the brake pedal, the master cylinder piston returns to its original position due to return spring and the pressure is dropped. It releases brake shoes from brake drum to their: original position and brakes are released.</p>	02
b)	<p><b>Explain the following characteristics of friction material (i) co-efficient of friction (ii) brake fade</b></p>	04
Ans	<p><b>(i) Co-efficient of friction:</b> The coefficient of friction should be sufficiently high to limit brake pedal effort. It should not be so high that it causes grab, or in the extreme cases lock or sprag. In such a situation rotation of the drum becomes impossible. The friction material must be compatible with the degree of self-energization. The average coefficient of friction of modern friction materials is between 0.3 and 0.5.</p> <p><b>(ii) Brake fade:</b> Brake fade is indication of the partial or total loss of braking power used in a vehicle brake system. It occurs when the brake pad and the brake rotor no longer generate sufficient mutual friction to stop the vehicle at its preferred rate of deceleration. Number of severe stops, holding the brakes on a long down hilling results into brake fading.</p>	02 02
c)	<p><b>Describe the working of air suspension system with neat sketch. State its application.</b></p>	04
Ans	<p><b>Working of air suspension system:</b> 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>	02





**Figure: Schematic diagram showing the layout of an air suspension system.**

**Application:** Air suspension system is used in Modern Buses, Volvo, passenger cars and trucks for comfort ride.

01

01

d) **State human comfort conditions used in car AC system**

04

Ans

**Human comfort condition: (one mark each)**

- 1) **Temperature:** Temperature is the most important factor which affects human comfort to a great extent. Most of the human being feels comfortable at a temperature 21°C to 25°C. Generally human being feels comfortable at relatively higher temperature in winter season and feels comfortable at relatively lower temperature in summer season. The comfort temperature of individual person depends on his body structure, eating habits, the area in which he is to make familiar to live.
- 2) **Humidity:** The control of humidity is not only necessary for human comfort but it is also important from point of view of efficiency of driver. For human comfort, relative humidity is kept within a range of 35% to 60%.
- 3) **Purity of air:** A person does not feel comfortable when breathing in contaminated air even if temperature and humidity is within comfortable range. Therefore, proper filtration, cleaning and purification of air is necessary to keep it free from dust, dirt and other impurities. The proper percentage of oxygen in air is necessary to be maintained for human comfort. Therefore, proper filtration system is provided in HVAC system in automobiles.
- 4) **Air motion and circulation:** Even if temperature, humidity and purity of air is satisfactory, certain amount of air motion is necessary for human comfort. We do not feel comfortable in dead or still air. It is therefore, necessary that there should be equi-distribution of air throughout the space to be air conditioned.

e) **State advantages and disadvantages of central locking of vehicle (two each)**

04

Ans

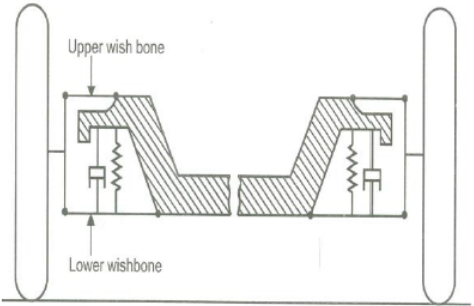
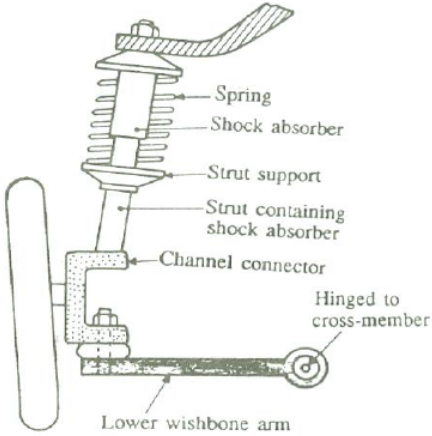
**Answer:-central locking system: (Any 02- 02 mark each)**

- 1) All the doors and luggage compartments can be locked or unlocked simply by operating one key.
- 2) It Indicates open door with flash
- 3) Locking/ unlocking can be done by remote

4) In case of failure of electronic system, the manual locking is still possible.  
**Disadvantages of central locking system:** (Any 02-02 mark each)  
 1) It is not convenient in case of accident because occupant may not open the door in Emergency since all doors are centrally locked.  
 2) It's initial and maintenance cost is high.

**f) Compare McPherson strut with wishbone type suspension along with their sketches. 04**

**Ans** **Comparison between Wishbone and Macpherson strut type suspension:** (Diagrams-02 marks, Any 02 points- 01 mark each)

Wishbone type suspension	Macpherson strut type suspension
<p>1.</p> 	<p>1.</p> 
2. In this, upper & lower wishbones are used.	2. In this type only lower wishbones are used
3. It has less space for engine compartment.	3. It has more space for engine compartment
4. It is complicated in construction	4. It is simpler in construction
5. Applications: Honda Accord, Mercedes Benz etc.	5. Applications: Maruti 800, Volkswagen Jatta, Passat cars etc.
6. Ideal camber control.	6. Variation in camber when cornering due to body roll.
7. Costly due to more components involved	7. Cheap as compare to wishbone type.

**04** **Attempt any TWO of the following 16**

**a) Describe the working of rack and pinion steering gear box with neat sketch. State its application. 08**

**Ans** **Rack and Pinion type of steering gear box:** The rotary motion of the steering wheel is transmitted to the pinion of the steering gear through the universal joints. The pinion is in mesh with rack. The circular motion of the pinion is transferred to the rack and rack moves linearly and this linear movement of rack is transmitted to the stub axle and wheel gets steered. The rack has ball joints at each end to allow for rise and fall of the wheels. **04**

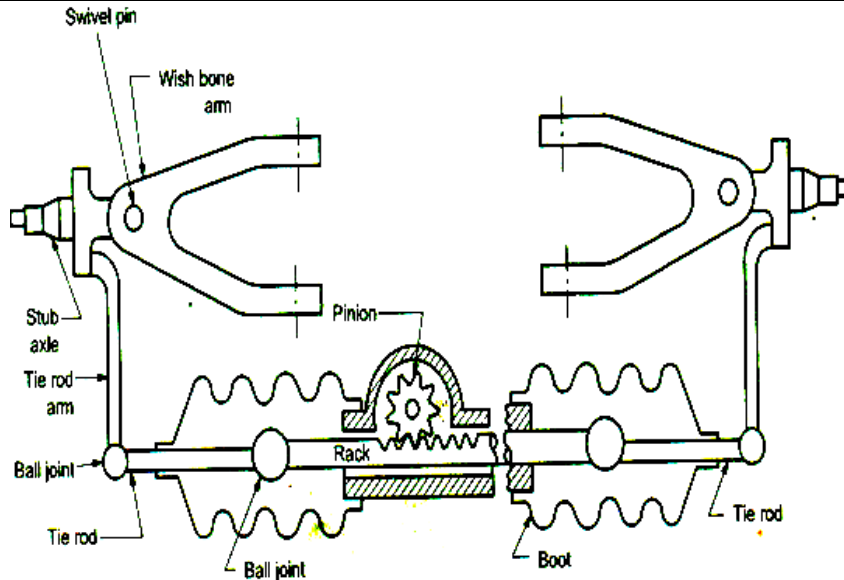


Figure: Rack and Pinion type of steering gear box.

**Application:** Maruti 800, small trucks, SUV's

04

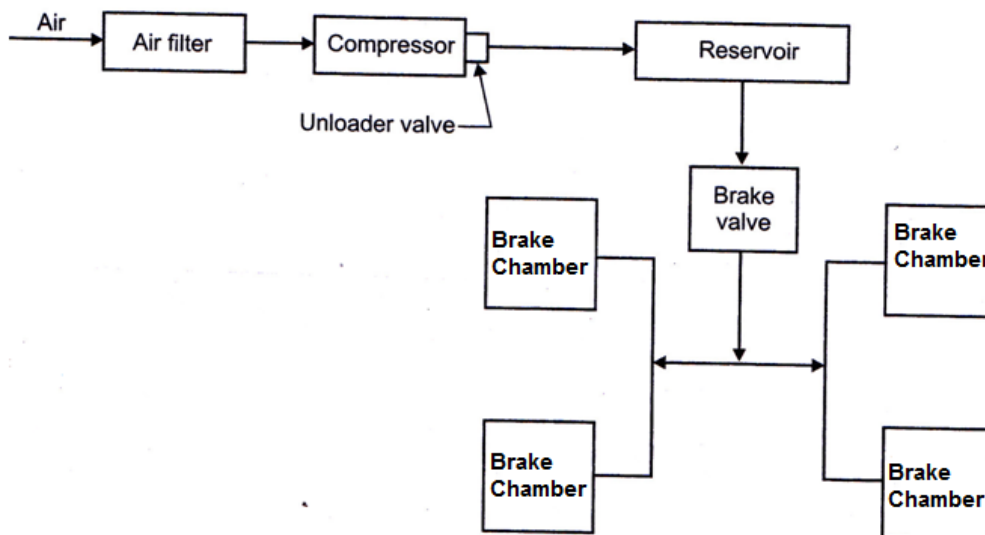
b) Describe the air braking system with neat labelled sketch. State its two advantages.

08

**Ans** Working:

As shown in the figure, in the air brakes the compressed air (around 700 kPa) is used to actuate the brake mechanism. When the brake pedal is depressed, compressed air from the reservoir is transmitted through pipes equally in all directions to the brake chambers through brake valve which further applies the brake.

When driver releases the brake pedal, the master cylinder piston returns to its original position due to return spring and the pressure is dropped. It releases brake shoes from brake drum to their: original position and brakes are released.



03

**Advantages of air braking system: (Any 02- 01mark each)**

1. The compressed air can be used for tyre inflation, windscreen wipers, horns etc.
2. Required less effort to operate the brake as compared to hydraulic system.
3. The air brake parts can be located anywhere making the chassis design simpler.
4. These are more powerful than hydraulic or mechanical brakes and therefore used for heavy vehicles

02

c)	<b>Describe construction and working of gas filled shock absorber with neat labeled sketch</b>	<b>08</b>
Ans	<div data-bbox="386 268 1209 1018" data-label="Diagram"> </div> <p style="text-align: center;"><b>Fig.: Gas filled shock absorber</b></p> <p><b>Construction:</b></p> <ol style="list-style-type: none"> <li>1) The piston rod is attached to two way valve while another similar two way valve is attached at the lower end of the cylinder.</li> <li>2) There is a mixture of oil and gas in the space below the valve assembly, below valve and also in the annular space between cylinder and tube, which is connected to the space below valve assembly.</li> <li>3) The bottom eye is connected to the axle while the top eye is connected to the chassis frame.</li> <li>4) The mixture of oil and gas is used for damping.</li> </ol> <p><b>Working:</b> Fig. shows the sectional view of the gas-filled shock absorber. In this type of shock absorbers, instead of only oil, the mixture of oil and gas is used for the damping effect. During compression, the working direction is controlled by the valves on the piston rod side of the damping piston. The additional volume of the piston rod compresses the gas cushion. During expansion, the oil between the piston and guide must be compressed via the spring washer package on the gas chamber side. Due to the ascending piston rod, the gas cushion expands</p>	<p style="text-align: center;"><b>02</b></p> <p style="text-align: center;"><b>03</b></p> <p style="text-align: center;"><b>03</b></p>
<b>05</b>	<b>Attempt any FOUR of the following</b>	<b>16</b>
a)	<b>State four advantages of power steering.</b>	<b>04</b>
Ans	<p><b>Advantages of power steering:</b> (Any 04- 1 mark each)</p> <ol style="list-style-type: none"> <li>1) Power steering reduces the effort needed to turn the steering wheel</li> <li>2) Higher degree of steering response is achieved</li> <li>3) Hydraulic system also absorbs road shocks, thereby archiving comfort driving.</li> <li>4) It reduces driver's fatigue.</li> </ol>	<b>04</b>

5) Higher control over the vehicle is possible which leads to greater safety of vehicle.

b) Describe the painting procedure for used vehicle.

04

Ans **Painting procedure for used car:**

1. Remove dent using denting tools and dent removing procedure.
2. Preparing the Surface: Begin by sanding the car's surface with a dual action sander and 120 grit sandpaper to remove old paint and primer.
3. Carryout any necessary masking so that paint remover may not fall on the finished surface.
4. Wipe the surface down with a proprietary sprit.
5. **Primer coat:** Spray a coat of primer on the entire car and allow it to dry for 30 minutes. Use a long block sander and 120 grit sandpaper to slowly sand the entire car, keeping the sanding block flat and level. Repeat the primer and block sanding steps until the body is smooth.
6. **Painting:** Wipe the car with wax and grease remover. Spray the car with automotive spray paint, starting at the roof and work your way to the hood, trunk and then the sides of the car. Spray a total of four thin coats of paint on the car, allowing 30 minutes of dry time between each coat.
7. **Polishing:** Inspect the painted finish for runs and other imperfections. Use 800 grit sandpaper and water to sand the entire car. Once the car is sanded and looks dull, use a mildly abrasive liquid rubbing compound and a dual action orbital polisher to polish the car. Use circular and back and forth motions until the entire car has been polished.

04

c) Draw a neat labeled sketch of semi-elliptical leaf spring.

04

Ans Sketch 02 marks and labeling 02 marks.

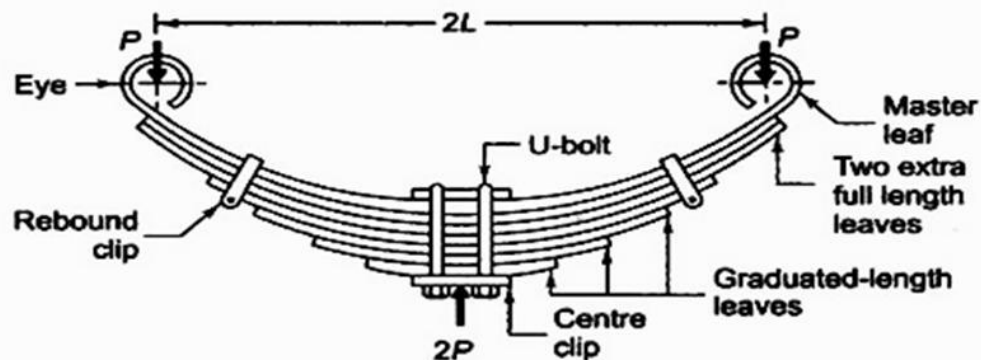


Fig. semi-elliptical leaf spring.

04

d) List four properties of refrigerant.

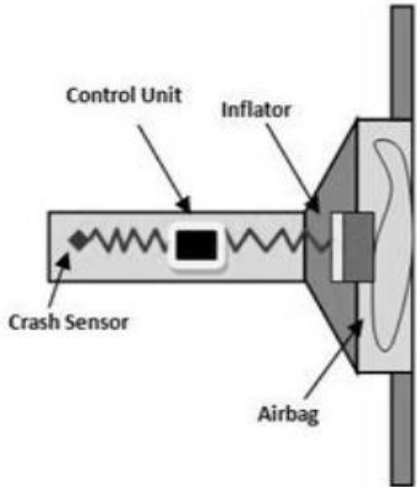
04

Ans **Properties of ideal refrigerant:** (Any 04)

1. The refrigerant should have low freezing point.
2. It must have high critical pressure and temperature to avoid large power requirement.
3. It must have low specific heat and high latent heat.
4. It should have low specific volume to reduce the size of the compressor.
5. It must have high thermal conductivity to reduce the areas of heat transfer in evaporator and condenser.
6. It should be non-inflammable, non-explosive, non-toxic and non-corrosive.

04

	<p>7. It should give high C.O.P. in the working temperature range. This is necessary to reduce running cost of the system.</p> <p>8. It must be readily available and it must be cheap also.</p>	
e)	<b>Describe the working of wishbone type independent suspension system with neat sketch.</b>	<b>04</b>
Ans	<p><b>( Working 02 marks and Sketch 02 marks)</b></p> <p><b>Working of Wishbone Type Independent Suspension System:</b></p> <p>It consists of two wishbone arm pivoted to the frame. The upper wishbone arm is shorter in length than lower arm. This help to keep the wheel track constant, so avoid the tyre scrub and thus reduces the tyre wear. A small change in the camber does occur with such arrangement. The coil spring is located in between the lower wishbone and underside of the cross member. The weight of vehicle is transmitted from the body and the cross member to the coil spring through which it goes to the lower wishbone member. A shock absorber is placed inside the coil spring and is attached to the cross member and to lower wishbone member.</p> <p>When the vehicle come across a bump and wheel tends to move up, the lower and upper arm (control arm) moves up and the coil spring is compressed so shock absorber (damper) damps the vibrations set up in the coil spring due to road irregularities.</p> <div style="text-align: center;"> <p>The diagram illustrates a wishbone type independent suspension system. It shows two wheels on either side of a central frame. Each wheel is connected to the frame by two wishbone arms: an upper wishbone arm and a lower wishbone arm. The upper wishbone arm is shorter than the lower wishbone arm. A coil spring is positioned between the lower wishbone arm and the underside of the cross member. A shock absorber (damper) is placed inside the coil spring, with one end attached to the cross member and the other end attached to the lower wishbone member. The diagram is labeled 'Upper wish bone' and 'Lower wishbone'.</p> </div> <p style="text-align: center;">Fig. Wishbone type independent suspension</p>	<b>04</b>
f)	<b>Explain necessity of temperature control system.</b>	<b>04</b>
Ans	<p>Due to varying conditions of heating, ventilating, cooling and dehumidification in the atmosphere at various places, the air conditioning of automobiles is very essential. To maintain human comfort &amp; improve internal atmosphere in an enclosed space, proper control of freshness, temperature, humidity &amp; cleanliness of the air is required. The temperature control devices maintain the proper temperature inside as per our comfort requirements. When the desired temperature is reached these devices switch off the compressor of the air-conditioning system and when temperature goes away to certain extent from the desired levels the compressor is restarted. The setting of the temperature is done by the user manually or automatically using the remote control devise of the air-conditioning system.</p> <p><i>((Note: Credit shall be given to any other suitable answer))</i></p>	<b>04</b>

<b>06</b>	<b>Attempt any TWO of the following</b>	<b>16</b>
	<b>a) State types of safety devices used in modern vehicle. Explain working of bag. State its application.</b>	<b>08</b>
<b>Ans</b>	<p><b>Safety devices used in automobile: (any four :2Marks)</b></p> <ol style="list-style-type: none"> <li>1) Exhaust brake</li> <li>2) Central locking</li> <li>3) Collapsible steering</li> <li>4) Air bag</li> <li>5) Seat belt</li> </ol> <p><b>Working of air bag:</b> (Note: Credit shall be given to any other suitable diagram, Sketch 01 mark and Working 03 marks )</p> <p>As vehicle comes across the impact, the sensor detects it and triggers the inflator. Once the electrical circuit has been turned on by the sensor, a pellet of sodium azide (<math>\text{NaN}_3</math>) is ignited. A rapid reaction occurs, generating nitrogen gas (<math>\text{N}_2</math>). This gas fills a nylon or polyamide bag at a velocity of 150 to 250 miles per hour. This process, from the initial impact of the crash to full inflation of the airbags, takes only about 40 milliseconds. Thus minimizing the injury to the passenger or driver. When <math>\text{N}_2</math> generation stops, gas molecules escape the bag through vents. The pressure inside the bag decreases and the bag deflates slightly to create a soft cushion. By 2 seconds after the initial impact, the pressure inside the bag has reached atmospheric pressure.</p> <div style="text-align: center;">  <p>The diagram illustrates the components of an air bag system. On the left, a 'Crash Sensor' is connected to a 'Control Unit'. The 'Control Unit' is connected to an 'Inflator', which is in turn connected to an 'Airbag' mounted on the dashboard. The inflator is shown as a cylindrical component with a valve leading to the airbag.</p> </div> <p style="text-align: center;">Figure: Air bag.</p> <p><b>Applications of airbags: (any four : 2Marks)</b></p> <p>Airbags are used in following cars</p> <ol style="list-style-type: none"> <li>1. Maruti Suzuki Swift</li> <li>2. Maruti Suzuki Baleno</li> <li>3. Maruti Suzuki Dzire</li> <li>4. Honda city</li> <li>5. Honda Amaze</li> <li>6. Hyundai Elite i20 etc</li> </ol>	<p><b>02</b></p> <p><b>03</b></p> <p><b>01</b></p> <p><b>02</b></p>

b)	<b>Describe the working of vapour compression cycle with its layout.</b>	<b>08</b>
Ans	<p><b>Vapour Compression Cycle: ( Working 04 marks , Layout 04 marks)</b></p> <p>In Vapor compression cycle working medium is liquid refrigerant, ( i.e. R12 or R 134a) which is pressurized by using compressor. It consists of compressor, condenser, evaporator, receiver and expansion valve.</p> <p>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 body to be cooled. Due to heat absorption, liquid refrigerant gets converted into vapor and these vapors are passing to compressor.</p> <div data-bbox="516 674 1062 1121" data-label="Diagram"> </div> <p style="text-align: center;"><b>Fig. Layout of vapour compression system</b></p>	<p><b>04</b></p> <p><b>04</b></p>
c)	<b>What is meant by “Streamlined body”? Describe the effect of streamlined body on vehicle performance.</b>	<b>08</b>
Ans	<p><b>Streamlined Body:</b></p> <p>When the vehicle moves along the road, it faces various forces applied by the air, known as aerodynamic forces. The major effects of these aerodynamic forces on vehicle performance are: Aerodynamic Drag (Induced drag, Profile drag, Friction drag) and Aerodynamic Lift. To reduce the air resistance during running, the body of motor vehicle is so shaped that is streamlined. An arbitrary shape body of vehicle experiences a large air resistance. This leads to loss of power required for propulsion. This implies a need of aerodynamic considerations for designing a body. So the profiling or shaping of the vehicle body to reduce air resistance as vehicle moves forward is called streamlining.</p> <p><b>Effect of streamlining:</b></p> <p>When the vehicle moves along the road, it faces various forces applied by the air, known as aerodynamic forces. The major effects of these aerodynamic forces on vehicle performance are:</p> <ol style="list-style-type: none"> <li>1. Aerodynamic Drag <ol style="list-style-type: none"> <li>a. Induced drag</li> <li>b. Profile drag</li> <li>c. Friction drag</li> </ol> </li> </ol>	<p><b>02</b></p> <p><b>02</b></p>



## 2. Aerodynamic Lift

**Aerodynamic Drag:** It is the resistance offered by air while moving the vehicle on road; it is called as aerodynamic drag. In fig.  $F_x$  is the aerodynamic drag.

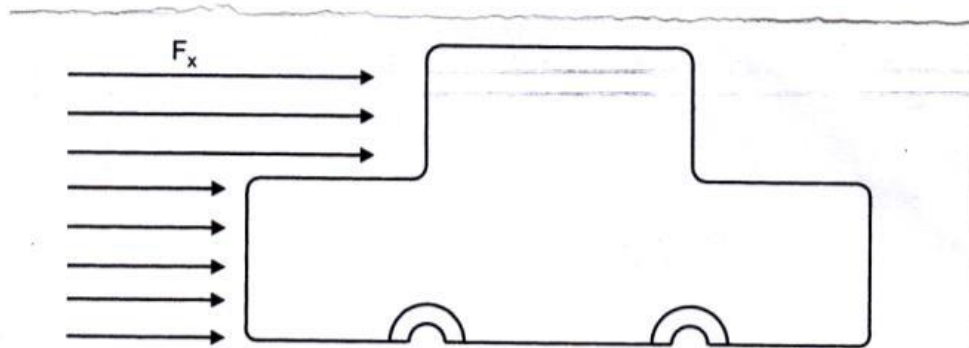


Figure: Aerodynamic Drag

**Aerodynamic Lift:** The vertical component of the resultant of air force is called as aerodynamic lift. Due to the lift force, one moment is created about centre of gravity is called pitching moment.

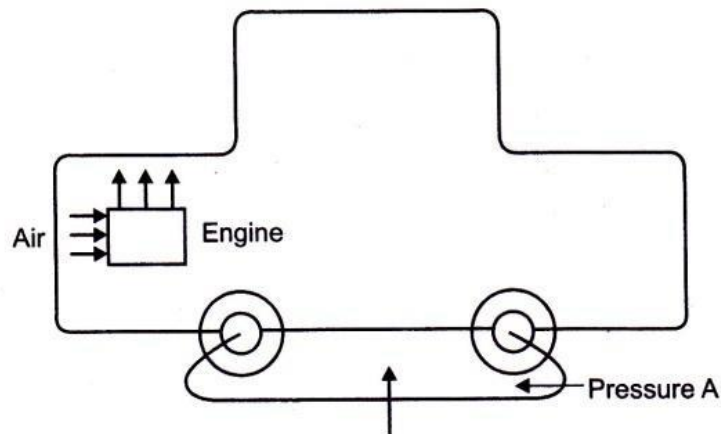


Figure: Aerodynamic Lift

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