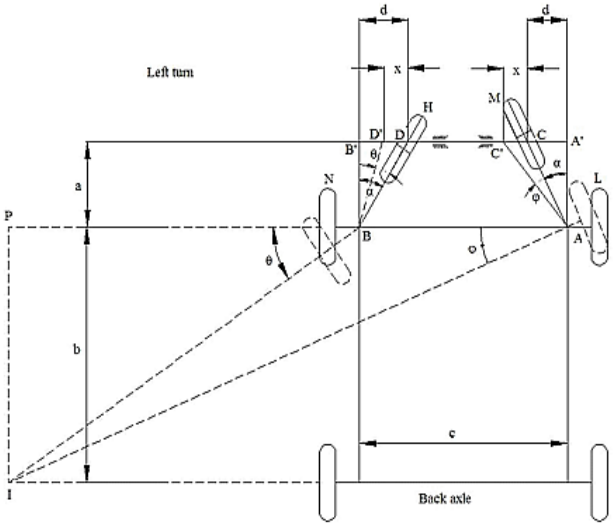
SUMMER – 19 EXAMINATION

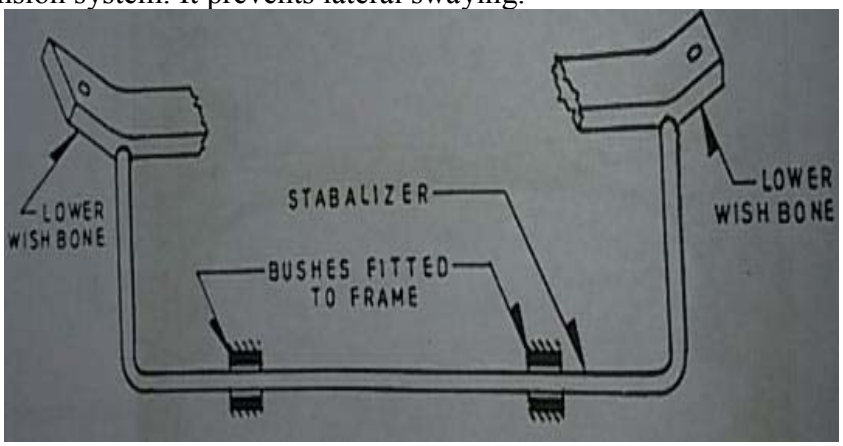
Subject Name: Automobile system and body engineering Subject Code: 22442

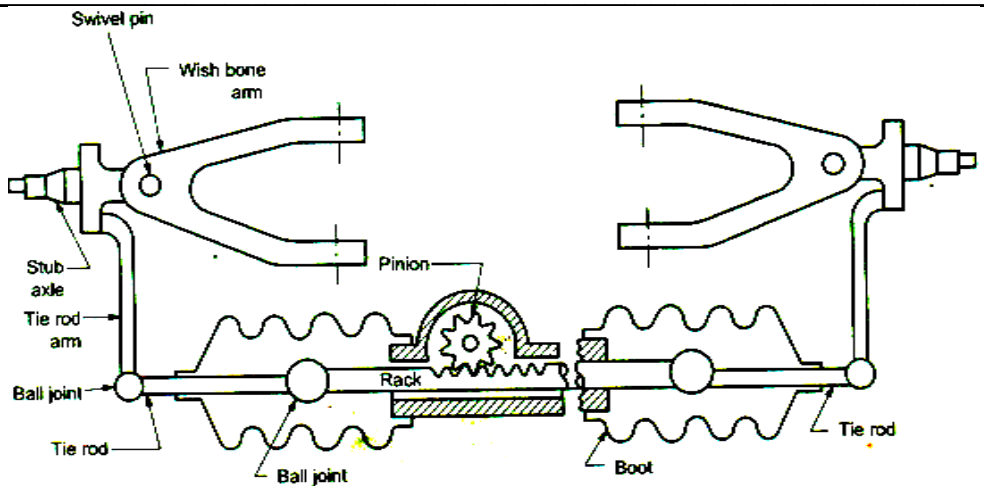
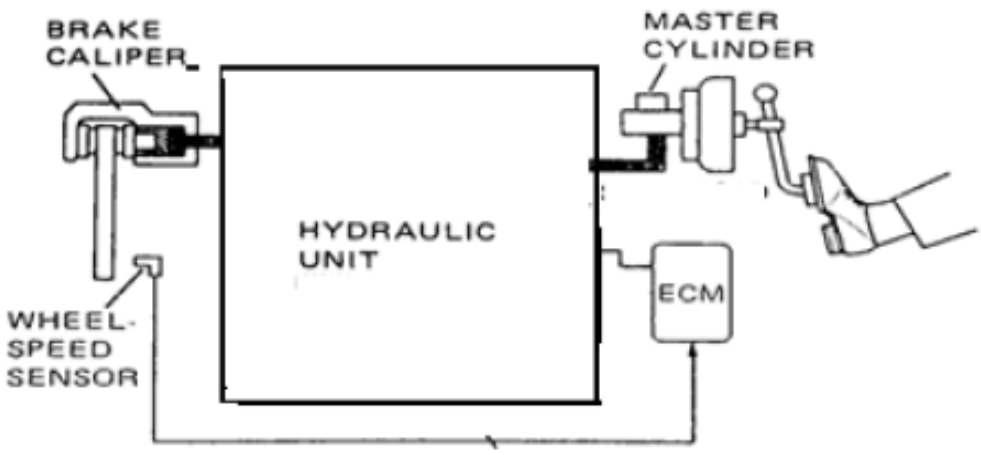
Important Instructions to examiners:

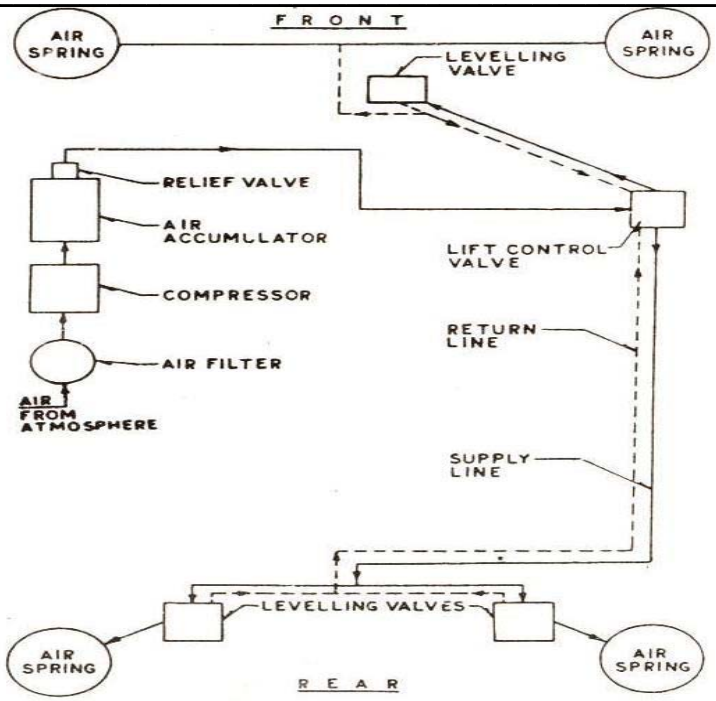
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling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

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any FIVE of the Following**	**10**
	(a)	**List different types of " Stub Axles"**	**02**
	Ans	***(1/2 Mark Each)*** **Types of stub axles:** (1) Elliot (2) Reversed Elliot (3) Lamoine (4) Reversed Lamoine	*1/2 Mark Each*
	(b)	**Define (i) Under Steering (ii) Over Steering**	**02**
	Ans	***(01 Mark Each)*** **(i) Under Steering:** 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 under steering. **(ii) Over Steering:** 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 over steering.	*01 Mark Each*
	(c)	**State the necessity of brake**	**02**
	Ans	***(Any two 01 Mark Each)*** **Necessity of Brakes:** 1) To stop or slow down the vehicle in the shortest possible distances in emergencies. 2) It is used to control the vehicle while descending along the hill. 3) To park the vehicle and held it in stationary position without the presence of driver.	*Any Two 01 Mark Each*
	(d)	**List the desirable properties of "Braking Fluid"**	**02**
	Ans	***(Any four Properties ½ Mark each)*** **Properties of brake fluid:** [1] It should have high Boiling Point [2] It should possess good viscosity	*Any four Properties ½ Mark each*

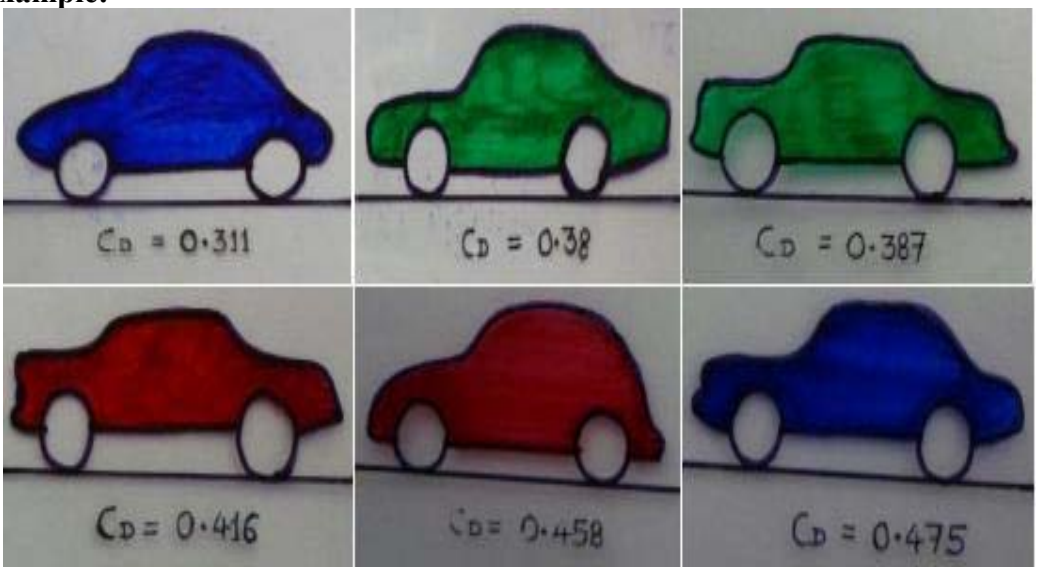
		[3] It should provide good lubrication properties [4] It should not affected by rubber [5] It should provide good corrosion resistance [6] It should have sufficient storage stability	
	(e)	**Classify " Suspension System"**	**02**
	Ans	***(Correct Answer 02 Marks)*** **Suspension System:** (1) Dependent Suspension System. (2)Independent Suspension System.	*Correct Answer 02 Marks*
	(f)	**State the function of Shock Absorber**	**02**
	Ans	***(Correct Answer 02 Marks)*** **Function of Shock Absorber:** The shock absorber is a part of suspension system used as springing device to compromise between flexibility and stiffness. It absorbs the energy of shock converted into the vertical movement of the axle by providing damping and dissipating the same in to heat.	*Correct Answer 02 Marks*
	(g)	**Name the different materials are used for vehicle body construction**	**02**
	Ans	***(Any Four ½ Mark Each)*** **Materials used for body construction:** 1) Steel 2) Alloy steel 3) Aluminum 4) Plastic: (i)Thermoplastic (ii) Thermosetting plastic (iii) Glass reinforced plastic 5) Fiber glass 6) Wood 7) Glass 8) Rubber	*Any Four ½ Mark Each*
2		**Attempt any THREE of the Following**	**12**
	(a)	**Explain the working of Ackerman steering gear mechanism with neat sketch.**	**04**
	Ans.	***(Sketch 02 Marks and Explanation 02 Marks)***  **Figure: Ackerman Steering Gear Mechanism** **Working:** The whole mechanism of Ackerman Steering gear is on the back of the front wheels. The Ackerman steering gear consists of turning pairs	*Sketch 02 Marks and Explanation 02 Marks*

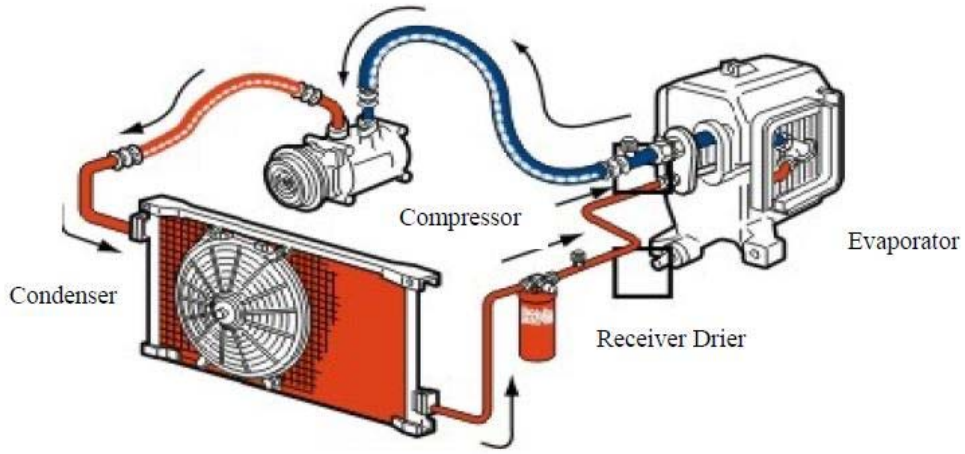
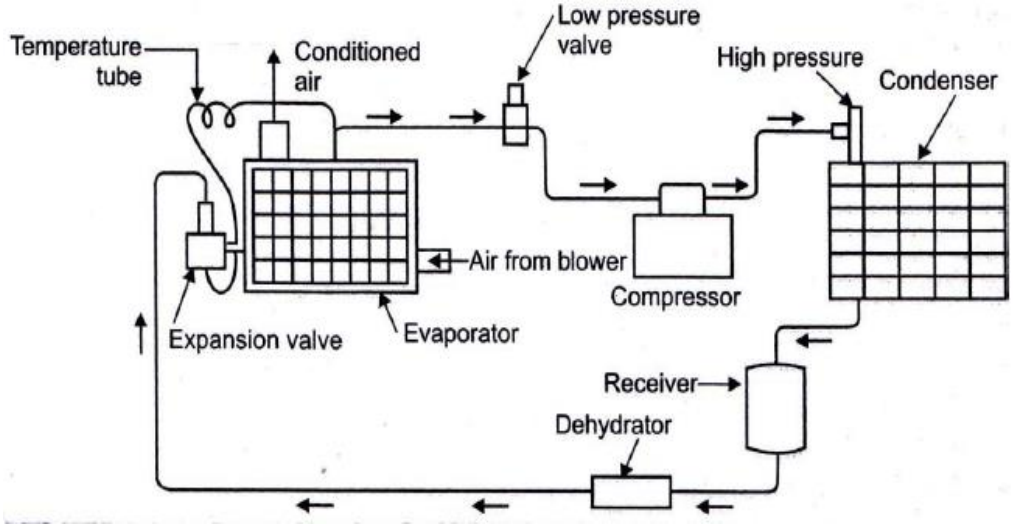
		$\sin \alpha = y/r$ The slotted links AM and BH are attached to the front wheel axle, which turn on pivots A and B respectively. The rod CD is constrained to move in the direction of its length, by the sliding members at P and Q. These constraints are connected to the slotted link AM and BH by a sliding and a turning pair at each end. The steering is affected by moving CD to the right or left of its nominal position.	
	(b)	**List any four applications of Air Braking System.**	**04**
	Ans	***(Any four 01 Mark each)*** **Applications of Air Braking System:** (1) Trucks. (2) Buses. (3) Trailers (4) Semi Trailers (5) Railway Train.	*Any four 01 Mark each*
	(c)	**Describe working of Stabilizer bar with neat sketch**	**04**
	Ans	***(Sketch 02 Marks and Working 02 Marks)*** **Stabilizer (Anti Roll) Bar:** **Working:** When the wheel strikes a bump, it starts vibrating up & down, thus exerting torque on the bar, which acts as a spring. When one road wheel is deflected more than other, there is a tendency for vehicle to roll. To obviate this tendency, a stabilizer is used in car suspension system. It prevents lateral swaying.  **Figure : Stabilizer (Anti Roll) Bar**	*Sketch 02 Marks and Working 02 Marks*
	(d)	**Define (i) Draw Bar Pull (ii) Tractive Effort**	**04**
	Ans	***(Each Definition 02 Marks)*** **(i) Draw Bar Pull:** If the extra load attached to the vehicle is pulled by fully utilizing the excess power, then, maximum drawbar pull = Tractive effort – Road resistance. **(ii) Tractive effort:** 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.	*Each Definition 02 Marks*
3		**Attempt any TWO of the Following**	**12**
	(a)	**Draw a sketch of rack and pinion steering gear mechanism. Explain its working.**	**06**
	Ans.	***(Neat Labeled Sketch 04 Marks and Its Working 02 Marks)***	*Neat*

		 **Figure: Rack and Pinion Steering Gear Mechanism.** **Working:** The rotary motion of the steering wheel is transmitted to the pinion of the steering gear through universal joints. The pinion is mesh with a rack. The circular motion of the pinion is transferred into the linear rack movement, which further relayed through the ball joints and the rods to the stub axles for the wheels to be steered.	*Labeled Sketch 04 Marks and Its Working 02 Marks*
	(b)	**Explain with sketch the constructional features of "Anti Lock Braking" System.**	**06**
	Ans	***(Neat Labeled Sketch 03 Marks and its constructional details 03 Marks)*** **Anti lock brake system:**  **Figure: Antilock Braking System.** Figure shows block diagram of the ABS system. Typically ABS includes a central electronic control unit (ECU), four wheel speed sensors, and at least two hydraulic valves (hydraulic unit or actuator) and pump. The brake lines from master cylinder connect to hydraulic unit or actuator. Lines from the actuator connect to the wheel brakes. The actuator is controlled by ECU. Wheel speed sensors at each wheel continuously send rotational wheel speed information to the ECU. If it detects a wheel rotating slower than the others, it means there is tendency of wheel lock, it actuates the valves to reduce hydraulic pressure to the brake at the affected wheel, thus reducing the braking force on that wheel; the wheel then turns faster.	*Neat Labeled Sketch 03 Marks and its constructional details 03 Marks*
	(c)	**Describe with neat sketch the working of "Air Suspension"**	**06**
	Ans	***(Sketch 03 Marks and its working 03 Marks)***	*Sketch 03 Marks and*

		 **Figure: Schematic diagram showing the layout of an air suspension system** **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.	*its working 03 Marks*
4		**Attempt any TWO of the Following**	**12**
	(a)	**List the three safety devices used in modern cars with their functions.**	**06**
	Ans.	***(List of Any Three 03 Marks and their functions 03 Mark each)*** **Safety Devices used in Automobile:** **1) Exhaust Brake:** The function of exhaust brake is to slow down continuously over a large distance **2) Central Locking:** The function of central locking is to lock or unlock the doors and luggage compartments simply by operating one key and locking/ unlocking can be done by remote **3) Collapsible Steering:** The function of collapsing steering is to ensure greater safety to the driver by minimizing or avoiding a direct severe impact to him. **4) Air Bag:** The function of air bag is to minimize the injury to the passenger or driver when vehicle comes across the accident, **5) Seat Belt:** The function of seat belt is to minimize the injury to the passenger or driver when vehicle stopped suddenly or comes across the accident	*List of Any Three 03 Marks and their functions 03 Mark each*
	(b)	**Explain in detail the procedure "Protective Treatment" on vehicle body with example.**	**06**

	Ans	***(Detailed Procedure 04 Marks and Example 02 Marks)*** **Procedure for Protective, Anticorrosive Treatment:** **(1) Surface Preparation:** • **Degreasing:** It is a process by which organic deposits such as oil, grease, metallic soaps and inorganic matters like soil, dirt, shop dust are removed from metal surface. • **Descaling:** The process of removing scales on the ferrous surface. • **De-rusting:** If the metal is exposed to atmosphere or water, the oxides of iron are formed on the surface of metal, these oxides are called as rust. This process of removing the rusting on the surface. **(2) Rinsing**: To remove all acids and acid salts, the work is passed through 2 or 3 successive rinse baths. **(3) Phosphate Coating:** 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. **(4) Passivation:** After Phosphate coating and rinsing, surfaces are given a final passivation rinse with solution of chromic acid to improve their corrosion resistance. **(5) Sealing:** After passivation and drying, the sealant is to be applied within 2 hours during monsoon and 6 hours during winter and summer months. **Example: old/new/accidental vehicle, silencer, vehicle body, doors, etc (suitable examples should get full marks)** **Painting Procedure:** 1) Thoroughly wash the vehicle. 2) Carryout protective and anticorrosive treatment. 3) Spray a thin coat of primer. Allow to dry for 15 min. 4) Apply three full coats of surfacer allowing 10 – 15 minutes between the coats. 5) Allow it to dry for 1 hour. Then wet flat with P 600 grade paper. 6) Apply stopper (putty) wherever necessary allowing 15 to 20 minutes between the layers. 7) Allow to dry for 1 to 1½ hours. Wet flat stopper with 320 wet paper. 8) Spray surfacer to stopped up areas and flat with P 600 grade paper. 9) Blow off vehicle with air gun and tack off. 10) Spray finishing material, apply one coat and allow it to dry for 15 to 30 minutes. Then apply second coat. 11) Allow overnight drying. Wet flat with P 800 grade paper and dry with air gun. 12) Spay double header coat.	*Detailed Procedure 04 Marks and Example 02 Marks*
	(c)	**Explain body accessories and write their functions.**	**06**
	Ans	***(Any Six Body Accessories and their Functions 01 Mark Each)*** **(1) Body Cover:** To keep the car covered in open parking. **(2) Puncture Repair Kit:** To repair the punctured vehicle in case of emergency **(3) Tyre Inflator:** To fill the air in the flat tyre. **(4) Air Pressure Gauge:** To check tyre air pressure regularly. **(5) Comprehensive Tool Kit:** To attend the minor repairs. **(6) Cleaning Cloth:** To wipe out dirt dust etc. from car body. **(7) Spoilers:** To spoil unfavorable air movement across the body. **(8) Sports Mirrors:** Better Appearance **(9) Head And Tail Light Cover:** Better Look	*Any Six Body Accessories and their Functions 01 Mark Each*

		(10) Window Visors: To keep the window open in all type of seasons. **(11) Sun Roof:** To provide natural air conditioning to the car. **(12) Windshield Wiper Blades:** To clean the windshield of a car.	
5		**Attempt any TWO of the Following**	**12**
	(a)	**Explain the term "Streamlining". State its effect on vehicle with suitable example.**	**06**
	Ans.	***(Definition 02 Marks and suitable example 04 Marks)*** **Streamlining:** 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 **Effect of Streamlining:** 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. **Coefficient of Drag(C_D):** For a body moving through air of density (ϱ) and at uniform velocity (V), the mathematical expressions for drag are; $$F_D = C_D \times A \times \varrho \times V^2/2$$ **&** $$C_d = 2 \times F_D / A \times \varrho \times V^2$$ Where, A = Projected Frontal Area (mm2) V = Uniform Velocity (km/hr) ϱ = Air Density (N/mm3) F_D = Drag (N) C_D = Coefficient of Drag **Example:**  **Figure : Aerodynamic Coefficient of Drag for Passenger Cars**	*Definition 02 Marks and suitable example 04 Marks*
	(b)	**Draw the lay out of "Car Air Conditioning"**	**06**
	Ans	***(Neat Labeled Sketch 06 Marks)***	*Neat Labeled*

		 **Figure: Layout of Car Air Conditioning System** **OR**  **Figure: Layout of Car Air Conditioning System**	*Sketch 06 Marks*
	(c)	**State the functions of "Refrigerants". Name the popular refrigerants used in modern cars.**	**06**
	Ans	***(Functions 02 Marks and name of any four refrigerants 01 mark each)*** **Functions of Refrigerants:** (1) The main function of the refrigerant is to absorb the heat from the indoor air, it transitions from a low pressure gas to high pressure liquid and transfer it to the atmosphere. **Refrigerant used in car air conditioning:** 1) Dichloro difluro-methane or Freon -12 (R-12) 2) Tetra fluro- ethane or R-134a or HFC-134a 3) R-134a 4) R-22 5) R-410A 6) R-32	*Functions 02 Marks and name of any four refrigerants 01 mark each*
6		**Attempt any THREE of the Following**	**12**
	(a)	**Name the steering gear box used in following:**	**04**

		(i) Maruti 'Alto' **(ii) Tata 'Sumo'** **(iii) Ashok Leyland Truck** **(iv) Road Roller**	
	Ans	***(01 Mark Each)*** (i) Maruti 'Alto'==========Rack and Pinion Type Gear Box. (ii) Tata 'Sumo'==========Recirculating Ball Type Gear Box. (iii) Ashok Leyland Truck === Worm and Nut Type Gear Box (iv) Road Roller========== Worm and Roller Type Steering Gear Box	*01 Mark Each*
	(b)	**Differentiate between 'Mechanical Braking System' and 'Hydraulic Braking System'.**	**04**
	Ans	***(Any four Points 01 Mark each)***	*Any four Points 01 Mark each*

S. N.	Mechanical Braking System	Hydraulic Braking System
1	Less Braking efficiency.	More Braking Efficiency.
2	Poor Anti fade characteristics	Better Anti fade characteristics
3	Complicated due to more parts.	Simple in construction
4	It do no self compensate	Self compensating system
5	Construction is less flexible	Construction is more flexible
6	Low mechanical advantage	High mechanical advantage
7	External Lubrication is required	System is self lubricating
8	No leakage problem	Leakage may takes place
9	No hydraulic oil use	Hydraulic oil is used
10	More effort required for braking operation	Less effort required for braking operation
11	Cheaper	Expensive
12	Ex: Motor Cycles	Ex: Cars and Jeeps.

	(c)	**Draw the constructional arrangement of 'Leaf Spring' showing all the Parts.**	**04**
	Ans	***(Sketch 03 Marks and proper labeling 01 Mark)***	*Sketch 03 Marks and proper labeling 01 Mark*

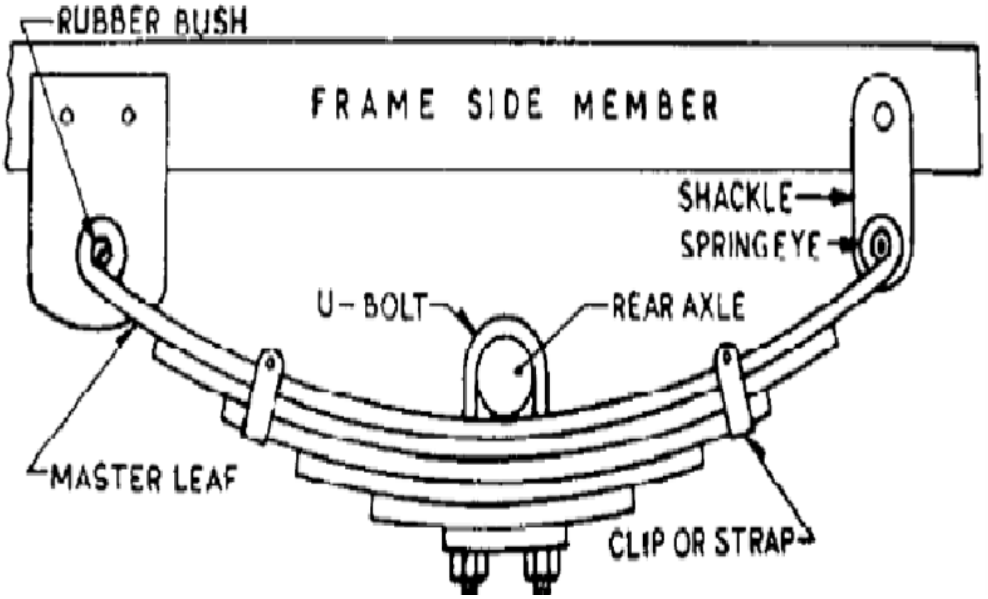


Figure: Constructional Arrangement of Leaf Spring

	(d)	**List out safety devices used in modern car and write down their function.**	**04**
	Ans	***(Name of any four 02 Marks and function of each ½ Mark)*** **Safety Devices used in Automobile:** **1) Exhaust Brake:** The function of exhaust brake is to slow down continuously over a large distance **2) Central Locking:** The function of central locking is to lock or unlock the doors and luggage compartments simply by operating one key and locking/ unlocking can be done by remote **3) Collapsible Steering:** The function of collapsing steering is to ensure greater safety to the driver by minimizing or avoiding a direct severe impact to him. **4) Air Bag:** The function of air bag is to minimize the injury to the passenger or driver when vehicle comes across the accident, **5) Seat Belt:** The function of seat belt is to minimize the injury to the passenger or driver when vehicle stopped suddenly or comes across the accident.	*Name of any four 02 Marks and function of each ½ Mark*
	(e)	**List the friction material used in 'Brakes'. State its important characteristics.**	**04**
	Ans	***(List of Any Four Materials 02 Marks and any four Characteristics ½ Mark each)*** [1] Cast Iron on Cast Iron [2] Bronze on Cast Iron [3] Steel on Cast Iron [4] Asbestos on Metal [5] Fiber on Metal [6] Cork on Metal [7] Leather on Metal **Important Characteristics:** [1] High Coefficient of Friction [2] Low Wear Rate [3] High Heat Resistance [4] High Heat Dissipation Capacity [5] Adequate Mechanical Strength [6] Not affected by moisture & oil	*List of Any Four Materials 02 Marks and any four Characteristics ½ Mark each*