MODEL ANSWER
SUMMER– 17 EXAMINATION

Subject Title: Automobile Systems and Body Engineering   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. N o.	Sub Q. N.	Answer	Marking Scheme
Q.	Sub Q.	1. a) Attempt any <u>SIX</u> of the following-	**12**
i)	i)	Define Castor	02
		Answer: (Definition - 02 mark) **Caster:** It is the angle between the king pin center line & the vertical, in the plane of the wheel, when viewed from the side is called the caster angle. Directional stability i.e. straight line tracking is improved by caster. However, positive caster increases the effort required to turn the vehicle and high negative caster causes abnormal wobble. It is generally taken as 3^0 for good directional stability.	02
	ii)	State the function of the steering gear box	02
		Answer: *(any two-02)* 1) The main purpose is to convert a rotary motion (The steering wheel) to a linear motion which then is transferred to the wheels via the steering box gears and linkage. 2) Most cars these day also have power assistance which means less effort is required to steer when at low speeds or static, and less gearing by using hydraulics	01 mark each
	iii)	State the function of brake in vehicle	02
		Answer: (Functions of brakes: (Any 02)) 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.	01 mark each

MODEL ANSWER
SUMMER– 17 EXAMINATION
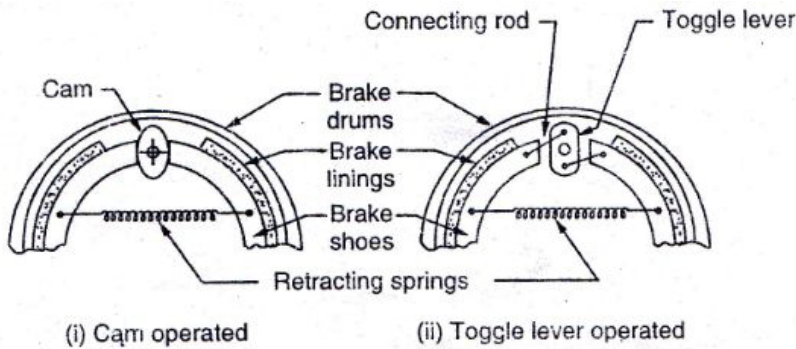Subject Title: Automobile Systems and Body Engineering   Subject Code: **17409**

Q.N o.	Sub Q. N.	Answer	Marking Scheme
	iv)	State necessity of Air conditioning system	02
		Answer: (Necessity of car air - conditioning system: (Mark 02)) 1) Due to varying conditions of heating, ventilating, cooling and dehumidification in the atmosphere at various places, the air conditioning of automobiles is very essential. 2) To maintain human comfort & improve internal atmosphere in an enclosed space, proper control of freshness, temperature, humidity & cleanliness of the air is required.	02
	v)	Define tractive effort	02
		Answer Tractive effort: (Definition - 02 mark) 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.	02
	vi)	List out any four components in air brake system	02
		Answer: The components of air braking system are: (Any 04- ½ mark each) i) Air filter ii) Compressor iii) Reservoir iv) Brake valve v) Unloader valve vi) Brake Chamber	½ mark each
	vii)	Define toe-in and toe-out	
		Answer: (Definition of toe-in = 01 and toe-out = 01) **1) Toe-in:** It is the amount by which the front wheels are set closer together at the front than at the rear when the vehicle is stationary. The amount of toe-in is usually 3 to 5mm. **2) Toe-out:** The front wheels may be set closer at the rear than at the front in which case the difference of the distances between the front wheels at the front and at the rear is called as toe-out.	01 mark each
	vii)	**List out any four components in air suspension system**	
		Answer: The components of air suspension system are: (Any 04- ½ mark each) i) Air filter ii) Air Accumulator iii) Relief valve iv) Air spring v) Lift control valve vi) Return valve vii) Supply line	½ mark each
	b)	Attempt any <u>TWO</u> of the following:	08
	a)	Explain working of emergency brake system	04

		Answer: *(Diagram – 2 marks, working- 2 marks)*
		     Mechanical braking system- Mechanical brakes are obsolete now as a service brake and these are still used on rear wheel in cars as a parking or emergency brake. When effort from the pedal is transmitted to the wheel brakes by means of cables, rods or shafts then this system is known as mechanical brakes.
		     When the brake pedal is depressed, the cam or toggle is turned and operates the brake shoes. It means that the brake shoes are expanding against the spring force and com to contact with brake drum, so brake is applied When brake pedal is released, due to spring tension the brakes shoes are comes to it original position. So drum is free from the brake shoes, thus brakes is released Usually this type of brakes used for the two wheelers.
			02

MODEL ANSWER
SUMMER– 17 EXAMINATION

<u>**Subject Title:**</u> **Automobile Systems and Body Engineering**   Subject Code: | 17409 |

		(i) Cam operated (ii) Toggle lever operated Mechanical brakes are used for parking and emergency brakes-Mechanical brakes are operated by hand and foot both. The hand operated is suitable for use as parking and emergency brakes are suitable for all the four wheels. In an alternative arrangement, there can be a foot pedal only instead of hand lever for application of effort by the driver. The construction of mechanical brake is simple and low cost.	02
	b)	Explain effect of streamline shape on vehicle performance.	04
		Answer: Concept of streamlining: (Mark 04) 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.	04
	c)	Explain protective and anticorrosive treatment for car body.	04
		Answer: **A) 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, and shop dust are removed from metal surface. • **Descaling:** The process of removing scales on the ferrous surface. • **Derusting:** 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. **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.	04

MODEL ANSWER
SUMMER– 17 EXAMINATION

Subject Title: Automobile Systems and Body Engineering   Subject Code: | 17409

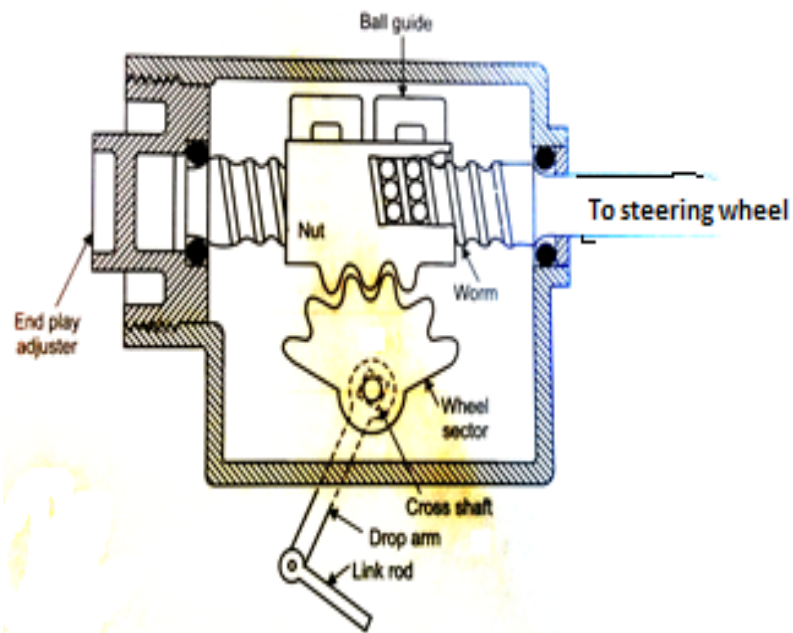|			
		5) Sealing: After passivation and drying, the sealant is to be applied within 2 hours during monsoon and 6 hours during winter and summer months.	
2.		Attempt any <u>FOUR</u> of the following:	16
	a)	Draw neat and label sketch of recirculating ball type steering gear box.	04
			04

Fig.   **Recirculating Ball Type Steering Gear**
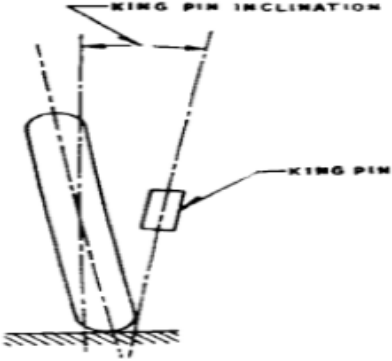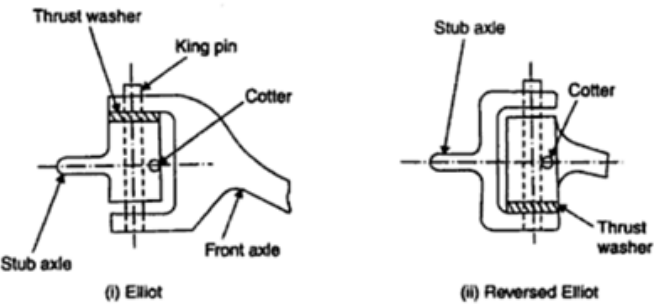
MODEL ANSWER
SUMMER– 17 EXAMINATION

Subject Title: Automobile Systems and Body Engineering Subject Code: **17409**

Q. N o.	Sub Q. N.	Answer	Marking Scheme
	b)	Define and describe the effect of king pin inclination of wheel performance.	04
		Answer : (Definition 01, Figure 02, Effect of king pin 01) It is the angle between vertical line and centre line of king pin or steering axis when viewed from the front of the vehicle. King pin inclination helps the straight ahead recovery of steering wheel, thus providing directional stability. It also reduces tyre wear. It is normally about 7^0 to 8^0 Figure: King pin inclination.	04
	c)	List with different axle types of stub and explain any two with diagram.	04

		Answer (Types 01, Explanation with figure 1.5 mark each any Two)
		Types of stub axles:
		    1) Elliot
		    2) Reversed Elliot
		    3) Lamoine
		    4) Reversed Lamoine
		
		1) 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.
		2) Reversed Elliot Stub Axle:
		• This type of Stub Axle is used commonly.
		• In this, a kingpin is placed in an axle beam and its ends turn in the forks of steering knuckle.
			04

MODEL ANSWER
SUMMER– 17 EXAMINATION

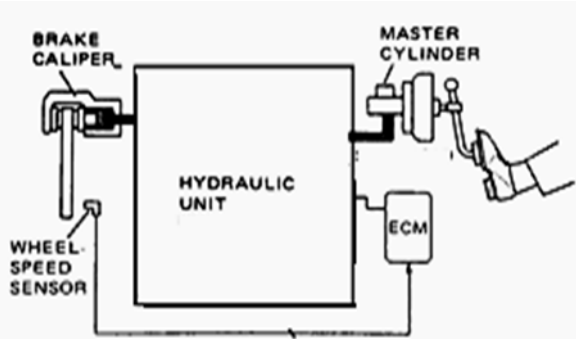**Subject Title: Automobile Systems and Body Engineering**   Subject Code: **17409**

Q. N o.	Sub Q. N.	Answer	Marking Scheme
		• This enables easy repair or replacement of bearing surface	
	d)	Give four main differences between drum brake and disc brake.	04
		Answer: _(01-Each)_	01 Each

Sr.	Drum brake	Disc Brake
01	Friction occurs on the internal surfaces, therefore heat dissipated only by conduction through the drum	Friction surfaces are directly exposed to the cooling air.
02	Curved friction linings are used.	Flat friction pads are used.
03	Non uniform wear of friction linings.	There is uniform wear of friction pads.
04	There is loss of efficiency due to expansion.	There is no loss of efficiency due to expansion.
05	Comparatively higher weight.	Weight is less so saving up to 20 % is possible
06	Comparatively poor anti-fade characteristics.	Disc brakes have comparatively better antifade characteristics.
07	Complicated design.	Simple in design
08	Removal and replacement of brake linings is difficult and consumes more time.	Comparatively easy to remove and replace friction pads.
09	More frictional area	Less frictional area
10	Pressure intensity is less	Pressure intensity is more

Q. N o.	Sub Q. N.	Answer	Marking Scheme
	e)	Describe aluminum and plastics as body materials.	04
		Answer: Materials used for body construction: Aluminum & Plastics (02 marks each) **1. Aluminum:** Aluminum is used as a body material because of its better formability, lightness and anti-rusting qualities, though its main disadvantage is lesser stiffness and rigidity. e. g. Pillars, frame work and paneling are all made out of aluminum sections and sheets. **2. Plastic:** Plastic is also popular material in body work. Thermoplastics are often used for components like boot coves, grills etc., whereas thermosetting plastics are used for the body shells. The latest type of plastic used for body work is reinforced carbon fiber which is stronger that steel.	02 Mark each

MODEL ANSWER
SUMMER– 17 EXAMINATION

Subject Title: Automobile Systems and Body Engineering   Subject Code: 17409

Q.N o.	Sub Q. N.	Answer	Marking Scheme
	f)	List four properties of brake fluid.	04
		Answer: Properties of brake fluid: (Any 04, 01 mark each) **1) Boiling point:** Boiling point of fluid must be high because due to continue operation of brakes, generates the heat inside the drum, which increases the temperature of fluid in the wheel cylinder and lastly generates the vapour, which decreases the effectiveness of brakes. Therefore the boiling point should be high i.e. 2500^0 C to 3000^0 C. **2) Viscosity:** Viscosity of brake fluid should be such that the fluid should not lose its fluidity in any atmospheric condition. i.e., too cold or too hot temperature. Therefore, it is necessary that the viscosity of brake fluid should change adequately with the change in temperature to maintain its fluidity. **3) Lubrication properties:** The brake fluid should provide proper lubrication to the pistons in the master cylinder, wheel cylinder. Otherwise these components wear out quickly. **4) Effect on rubber**: A number of rubber seals are used in the hydraulic braking system, therefore the brake fluid should not have any effect on these seals. Otherwise it leads to leakage of fluid, loss of pressure in lines. **5) Corrosive action:** The brake fluid should not corrode the metal components with which it comes into contact. **6) Storage stability:** Brake fluid should have sufficient stability at least 3 years. During this period the fluid should not be spoiled.	01 mark each
3.		Attempt any <u>FOUR</u> of the following:	16
	a)	Explain the working of antilock braking system	04
		Answer: *(Explanation 2 Marks, cfigure-02)* **Figure: Antilock braking system** **Working**: Fig. 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.	02 02

MODEL ANSWER
SUMMER– 17 EXAMINATION
Subject Title: Automobile Systems and Body Engineering   Subject Code: | 17409

		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. Conversely, if the ECU detects a wheel rotating faster than the others, brake hydraulic pressure to the wheel is increased so the braking force is reapplied, slowing down the wheel. This process is repeated continuously and can be detected by the driver via brake pedal pulsation. Some anti-lock systems can apply or release braking pressure 15 times per second.	
	b)	Describe any two characteristics of brake lining material	04
		Answer: *Any two explain in details -02 Marks each*	
		Characteristics of friction linings material for brakes	
		i) **Friction Level.**	
		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.	02 for Each
		ii) **Resistance to Heat Fade.**	
		This property allows a lining or pad material to retain its coefficient of friction with an increase in rubbing temperature of the drum and shoes or disc and pads. A decrease in the coefficient of friction requires greater brake pedal effort and results in poor braking response..	
		iii) **Recovery from Fade.**	
		This is the ability of a friction material to return to its original friction level after cooling once brake lining or pad temperature fade has occurred. A good quality material restores its frictional characteristics on cooling, even after repeatedly subjected to severe heating. In case of an inferior material, the poor recovery is principally due to chemical breakdown in the ingredients. The friction level may be permanently altered causing hardening, cracking, flaking, and charring or even burning of the linings or pads.	
		iv) **Resistance to Wear.**	
		The life of a friction material, for both lining and pad, depends to a great extent upon the rubbing speed and pressure because they are responsible for material wear. The wear is also greatly influenced by the working temperature. At the upper limits of the lining or pad temperature range, the material structure is weakened, resulting in a higher wear rate	

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MODEL ANSWER
SUMMER– 17 EXAMINATION

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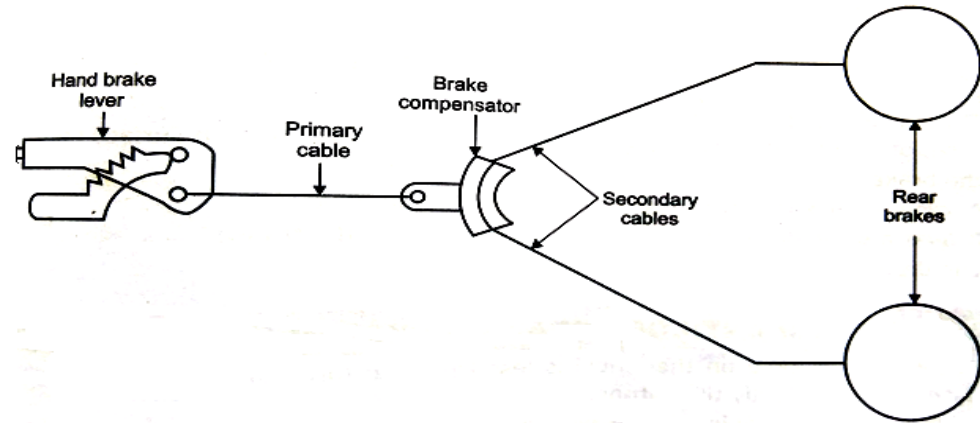
		v) **Resistance to Water Contamination.** Principally all friction materials to some extent are affected by water contamination. Therefore, a safe margin of friction level should be available for operation with wet conditions. Good quality friction materials should recover quickly and progressively to their original friction level during the drying out process. A poor quality material may either recover very slowly or may have over-recovery characteristic. **vi)** **Resistance to Moisture Sensitivity.** Atmospheric dampness, humidity or dew may increase the friction level for the first few applications. They may develop the brakes noise and cause brake-grab for a short time. Moisture-sensitive friction materials should not be used with brakes having high self-energizing characteristics.	
	c)	Identify various part in semi-elliptical leaf spring and draw neat and label sketch	04
		Answer: (Sketch – 2 marks & Identification -2 Marks)	02
		Parts are i) Rubber bush ii) Frame side member iii) U bolt iv) Shackle v) Spring Eye	02
	d)	Explain role of dehydrator and evaporator in air conditioning system	04
		Answer: (02 marks each) **Role of dehydrator :** The refrigerant is stored under pressure in receiver-drier. The refrigerant is passed through dehydrator that removes any traces of moisture present in the system to avoid freezing of moisture at low temperature and thus clogging the lines.	02
		Role of evaporator: 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.	02

MODEL ANSWER
SUMMER– 17 EXAMINATION

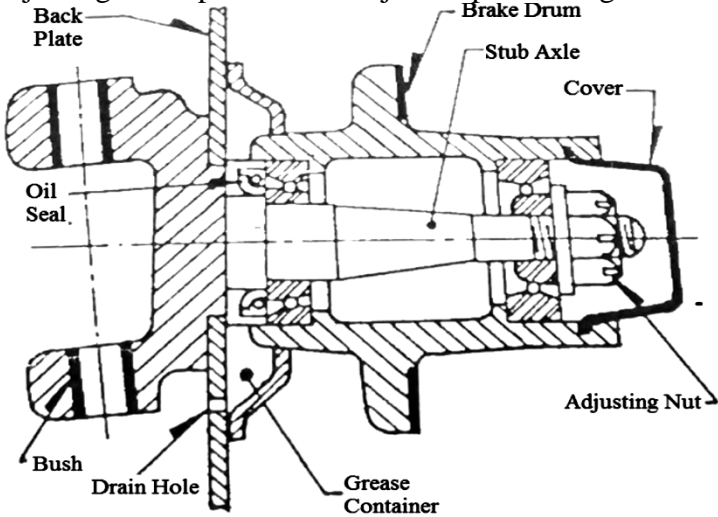**Subject Title: Automobile Systems and Body Engineering**   Subject Code: **17409**

Q. N o.	Sub Q. N.	Answer	Marking Scheme
	e)	Explain construction of parking brake system	04
		Answer :(Figure 02 & Construction 02) **Construction:** 1) Fig. shows handbrake arrangement. it consists of pawl and ratchet provided in lever along with release knob. 2) When we engage brake pawl & ratchet arrangement lock lever in particular position. The other end of lever is connected to primary cable & secondary cable through the brake compensator. 3) This cable further connected to actuating mechanism on brake shoes. 4) Brake lever is provided beside the driver or on dashboard.	02
		Fig. Parking Brake	02
	f)	State any two advantages and disadvantages of air bag	
		Answer : (Any two Advantages : 02 Marks & Disadvantages :02 Marks) **Advantages of Airbags:** 1. Reduce cases of death 2. Prevent chest injuries 3. Reduce insurance rates 4. Prevent brain injuries	02
		Disadvantages of Airbags: i. Airbags are very effective but it also has some injury risks. ii. Resetting your deployed air bags is not possible and you can re-position your airbag once it is deployed.	02

MODEL ANSWER
SUMMER– 17 EXAMINATION

__Subject__ **Title: Automobile Systems and Body Engineering**   Subject Code: **17409**

Q. N o.	Sub Q. N.	Answer	Marking Scheme
4.	a)	Attempt any __TWO__ of the following:	16
	a)	Explain construction and working front wheel assembly with neat sketch.	08
		Answer (Construction and working : 04 and figure 04) **: Construction and working of Front wheel assembly:** The figure shows the front wheel mounted on stub axle. Two taper roller bearings are mounted on the stub axle on which wheel hub is fitted. The brake back plate is bolted to the stub axle. The brake shoe assembly along with the wheel cylinder is mounted on this back plate. Oil seals are also provided to prevent the leakage of lubricant from the bearings. The adjusting nut is provided to adjust or positioning the front wheel. 	08
	b)	**Explain construction of the disc type brake system with diagram and write its advantages and disadvantages**	08
		Answer: (Construction-2 sketch-02 & Advantages -02 Disadvantages-02) These brakes consist of a metal disc instead of a drum and a pair of pads, instead of the curved shoes. The disc is attached to the wheel hub by bolts. The caliper is connected to the axle casing or stub axle. When the brakes are applied, the caliper cannot move. Such disc brake is called fixed caliper disc brake. The caliper is cast in two parts, each part containing a piston. There is a friction pad in between each piston and the disc. The passages are drilled in the caliper for the fluid to enter or leave the housing. These passages are also connected to another one for bleeding. There is a rubber sealing ring between each cylinder and the piston.	

MODEL ANSWER
SUMMER– 17 EXAMINATION

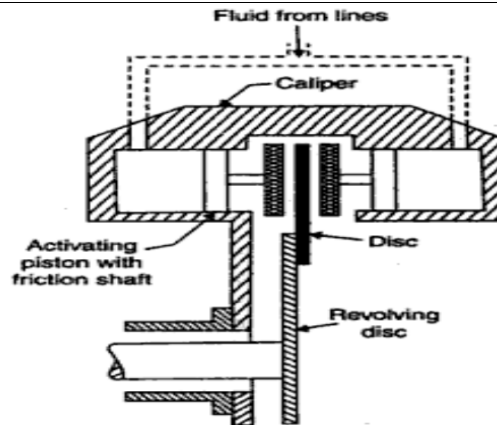__Subject Title: Automobile Systems and Body Engineering__   Subject Code: | 17409

Fig . Disc Brake

Advantage of disc type brake system.
1) Lighter than drum brake
2) Better cooling (since braking surface is directly exposed to air
3) Offer better resistance to fade
4) Uniform pressure distribution
5) Brake pads can be easily replaced
6) These brakes are self-adjusting

Dis-Advantage of disc type brake system.
1) Costlier than drum brake
2) For stopping the vehicle higher pedal pressure is required
3) There is no servo action in theses brakes
4) It is difficult to install an adequate parking adjustment
5) Slight leakage of air makes it ineffective
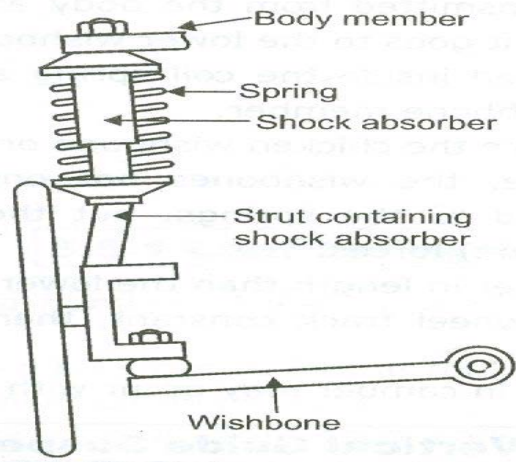
| | **C)** | Explain working McPherson strut type suspension with diagram | 08 |

Answer: (Figure-04 & Explaination-04)
In this type, only lower wishbones are used as shown in fig. A strut containing shock absorber and the spring carries also the stub axle on which the wheel is mounted. The wishbone is hinged to the cross member and positions the wheel as well as resists accelerating, braking and side forces. This system is simple, lighter and keeping the unsprung weight lower. Further the camber also does not change when the wheels move up and down. This type of suspension provides the maximum area in the engine compartment and is, therefore, commonly used on front wheel drive cars.

MODEL ANSWER
SUMMER– 17 EXAMINATION

Subject Title: Automobile Systems and Body Engineering | Subject Code: | 17409

Fig- McPherson strut type suspension

5		**Attempt any <u>FOUR</u> of the following**	16
	a	**State four advantages of Electrical power assisted steering system**	04
		Answer: Advantages of electrical power steering: (Any 04- 1 mark each)	
		1) Power steering reduces the effort needed to turn the steering wheel.	
		2) Higher degree of steering response is achieved.	
		3) It reduces driver's fatigue.	
		4) Higher control over the vehicle is possible which leads to greater safety of vehicle.	
		5) Failure chances are less.	
	b	**State any two advantages & disadvantages of central locking system Advantages of Answer:-central locking system:** *(Any 02)*	04
		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)*	
		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	

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MODEL ANSWER
SUMMER– 17 EXAMINATION
Subject Title: Automobile Systems and Body Engineering   Subject Code: **17409**

Q. N o.	Sub Q. N.	Answer	Marking Scheme
		c) Explain construction of telescopic type shock absorber with diagram **Answer:** **Figure: Telescopic shock absorber** **Construction:** The telescopic shock absorber is shown in fig its upper eye is connected to the axle and the lower eye to the chassis frame. A two way valve A is attached to a rod another two way valve B is attached to the lower end of cylinder the fluid is in the space above and below the valve A and also in the annular space between the cylinder and tube which is connected to the space below the valve B the heat has a gland. Any fluid scraped off by the rod is brought down into the annular space through the inclined passage.	4 2 2
	d)	**State any four desirable properties of refrigerant.** **Answer: Properties of refrigerant: (Any 04- 1 mark each)** 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. 7) It should give high C.O.P. in the working temperature range. This is necessary to	04

MODEL ANSWER
SUMMER– 17 EXAMINATION

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		Reduce running cost of the system. 8) It must be readily available and it must be cheap also.	
	e)	**Draw a neat and label sketch of air suspension system** **(Diagram 2 Marks & labeling 2 marks)** **Figure: Schematic diagram showing the layout of an air suspension system.**	04
	f)	**Draw a neat and label sketch of HVAC Layout** **Answer: (Diagram: 02 Marks & Correct Labeling : 02 Marks)** **Figure. Car Air-Conditioning System**	04

MODEL ANSWER
SUMMER– 17 EXAMINATION

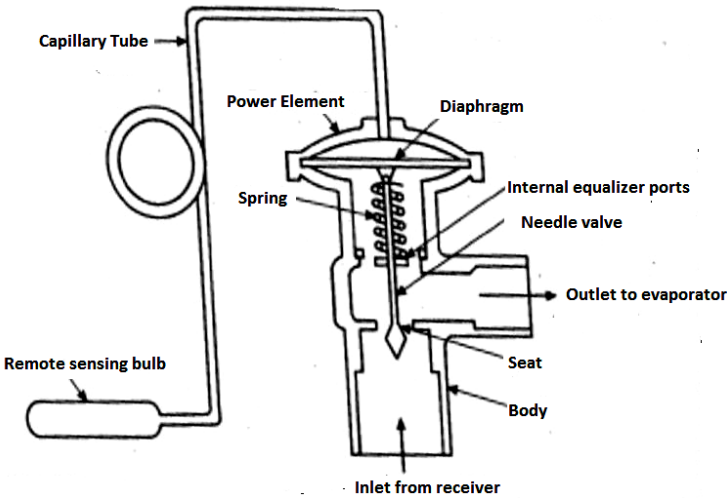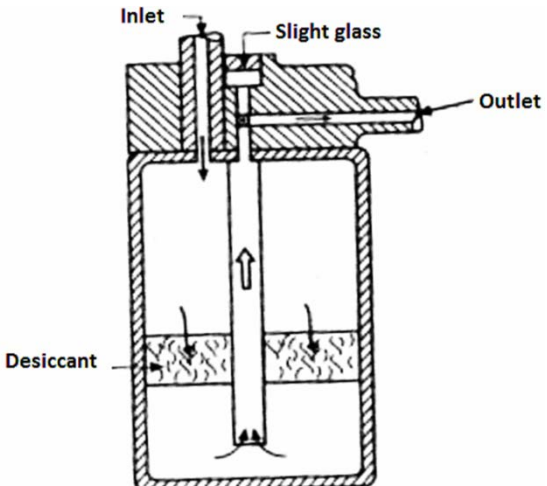**Subject Title: Automobile Systems and Body Engineering**   Subject Code: | 17409

Q. N o.	Sub Q. N.	Answer	Marking Scheme
6)		**Attempt any <u>TWO</u> of the following**	16
	a)	**Describe painting & repainting procedure of vehicle body in details.**	08
		Answer: Procedure of painting: 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 surface 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 surface to stop 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. **Repainting procedure for old vehicle.** 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 along 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 04

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**MODEL ANSWER**
SUMMER– 17 EXAMINATION
<u>**Subject Title: Automobile Systems and Body Engineering**</u>   Subject Code: 17409

Q. N o.	Sub Q. N.	Answer	Marking Scheme
	b)	**How the temperature & humidity is controlled in car air conditioning?**	08
		Answer: Control of temperature : The expansion valve is placed at the evaporator inlet tube. It is used to control refrigerant flow into the evaporator. The expansion valve contains a variable orifice that is controlled by a sensing bulb placed inside the evaporator cooling fins. The sensing bulb is a sealed tube containing a small amount of refrigerant. The changes in temperature of the evaporator cause the refrigerant inside the sensing bulb to expand or contract. The action of the internal pressure of the sensing bulb controls the amount of refrigerant that flows through the expansion valve by varying the size of the orifice.	02
		Figure -Control of temperature	02
		Control of humidity:	02

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		Liquid refrigerant enters through the inlet. Any dirt is filtered by the filter pads and moisture is absorbed from the refrigerant by the desiccant. Any refrigerant vapor that does not liquefy in the condenser, is trapped and held until it condenses. Finally, clean and dry liquid refrigerant leaves the receiver dehydrator and goes to expansion valve. Evaporator also helps in dehumidification, as warmer air travels through the aluminum fins of cooler evaporator coil, the moisture content in the air condenses on its surface.	02
	c)	**Describe various resistance faced by vehicle & state effect of each resistance on vehicle performance**	08
		Answer:	
		1) **Air resistance :-**Resistance to the motion of vehicle when it moves on road due air is called as air resistance	
		Air resistance is directly proportional to square of speed of vehicle. $R_a=K_a A V^2$ **Where** R_a =Air resistance (N) K_a =Coefficient of air resistance A=Frontal projected area in m^2 V= Vehicle speed in Km/Hr K_a= 0.02688 for passenger car K_a=0.023 Streamline car K_a=0.0314 average car K_a=0.045 for trucks & buses	2
		Effect: - as air resistance increase with square of speed of vehicle we need pay attention on frontal shape of high speed vehicle it should be stream line.	1
		2) **Gradient Resistance:-**Resistance to the motion of vehicle due to different gradient condition of road is called as Gradient resistance. **Note:-**it remains constant; component of vehicle gradient is parallel to plane of road & is responsible for gradient resistance. $R_g=WG=M_g G$ R_g=Gradient resistance(N) M=Mass of vehicle in Kg W=Weight of vehicle in (N) G=Gradient expressed as the unit rise divided by distance travelled.	2
		Effect:- as gradient resistance in constant maximum gradiebilty in India 30^0 for road however vehicle tested for 45^0 in fully rated condition.	1
		3) **Rolling Resistance:-**Resistance to motion of vehicle due deformation of tyre & road & energy dissipated through the impact this resistance is termed as rolling resistance.	1
		Rolling resistance $R_r=K_r Mg$	

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		R_r=Rolling resistance N M=Mass of vehicle in Kg K_r=Constant of road resistance **Effect**:-Rolling resistance caused by road surface & its different types of constant for speed of 22 to 55Km/Hr for asphalt road it is 70 N/1000Kg & for sand road it is 1500N/1000Kg	1