

WINTER – 19 EXAMINATION

Model Answer

Subject Name: Automobile Body Engg and Safety (ABE) (Elective-1) Subject Code: 22561

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.

Que No.	Sub Q. No.	Answer	Marking Scheme
Q. 1		Attempt any FIVE of the following	10
	a)	State type of resistance faced by moving vehicle on road.	02
	Ans	1. Stationary loads namely the loads of permanent attachment like all the parts of the chassis, body etc. 2. Short duration loads while turning, braking etc. 3. Momentary loads while quick acceleration, sudden braking etc. 4. Loads applied while crossing roads of irregular and uneven surfaces 5. Loads caused by sudden accidents, head on collisions etc. 6. Loads caused by irregular and overloading of vehicle.	Any 2 Types- 1 mark each



	b)	List types of glasses and give its application in automobile bodies.	02
	Ans	Laminated Glass It is usually used for the front and rear windshield of the car. Tempered Glass It is used in the rear and door windows.	Any 2 Types- 1 mark each
	c)	List four basic hand tools used in automobile workshop and write their use.	02
	Ans	D.E. spanner set- Tightening and loosening of nuts and bolts Ring spanner- Tightening and loosening of nuts and bolts Tubular spanner- Tightening and loosening of nuts and bolts Socket spanners- useful in restricted spaces where common types of spanners cannot be used Adjustable wrenches- This wrench has jaws that can be adjusted to fit nuts and bolt heads of various sizes Torque wrenches- Important nuts and bolts in automobile work have to be tightened with a specified amount of torque, because excessive torque may result in their breakage while less torque they will remain loose Screw driver- The screw driver is used to drive, or turn screws Hammers- To flatten and bend the surface. To repair dents. Dolly- To flatten and bend the surface. To repair dents. Pliers- Used to grip and cut sheets	Any 4 Types- ½ mark each
	d)	State four major body repairs.	02
	Ans	<ul style="list-style-type: none">• Dent repairs• Rust removal• Side body panel repairs• Front and rear body panel repairs	Any four - ½ mark each



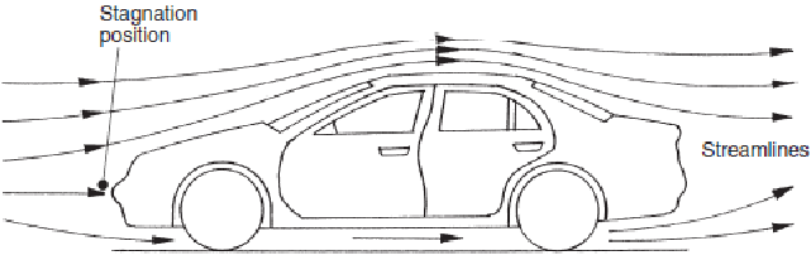
	<ul style="list-style-type: none"> • Top panel body repairs • Interior body panel repairs • Body pillars repair • Panel shrinking 	
	e) List two security systems used in modern cars with importance.	02
Ans	<p>ABS (Anti-lock braking system) - It allows the wheels of the vehicle to maintain contact with the road surface.</p> <p>Air bags- To slow the passenger's speed to zero with little or no damage.</p> <p>Seat Belt- To keep a person from flying through the windshield or hurdling toward the dashboard or steering wheel when the car where the person is suffers an abrupt stop.</p> <p>Night Vision System- It allows the driver to see well beyond the reach of the car's headlights. This technology helps drivers detect and avoid potentially dangerous situations.</p> <p>Tyre Pressure Monitoring Systems (TPMS)- They are a way of warning a driver that a tyre is incorrectly inflated, which will decrease the safety and performance of the vehicle, and increase the risk of an accident.</p> <p>Parking sensors – They are proximity sensors for road vehicles designed to alert the driver to obstacles while parking.</p> <p>Collision Warning System- An advanced safety technology that monitors a vehicle's speed, the speed of the vehicle in front of it, and the distance between the vehicles.</p> <p>Electronic Stability Control-It improves vehicle's handling, particularly at the limits where the driver might lose control of the vehicle.</p> <p>Traction control- It helps limit tire slip in acceleration on slippery surfaces.</p> <p>Blind Spot Detector- The system is expected to enhance road safety by reducing collisions with unseen vehicles during lane change maneuvers.</p>	Any 2 Types- 1 mark each
	f) List any two paint methods along with their significance.	02
Ans	Spraying- This technique is versatile and economic, both in time and	Any 2



		<p>cost, and is a much easier way to deliver consistent, quality finished.</p> <p>Dipping- This method is mostly used by larger body shops or manufacturers because it requires dipping an entire piece into a tub of paint. It's great when you want to coat a part entirely, and is mostly employed for primer and other base layers before the sandpaper is applied to the surface.</p> <p>Brushing- This method is useful for Small areas, Hard to reach places, Areas covered after repairs, fine detailing work, Touch ups.</p>	Types- 1 mark each
	g)	State types of seat belts with application.	02
	Ans .	<p>Lap Belts- It is a two-point safety belt that straps the rider in, crossing at the hips.</p> <p>Shoulder Belts (Sash) - It restrains the rider across the torso, secured at the shoulder and hip.</p> <p>Three-Point Belts- This belt stretches across your torso and your lap, securing you at three fixed points. It also spreads the impact of a crash across your torso, reducing the likelihood of injury.</p> <p>Five-Point Harness- It secures the passenger over both shoulders, at both hips, and between the legs.</p> <p>Automatic Seat Belts- These were intended to offer the same protections as three-point belts, but with an added level of convenience.</p> <p>Belt-in-Seat (BIS)- It is a variation of the three-point safety belt where the point secured above the shoulder is actually in the backrest of the seat instead of the frame of the car.</p>	Any 2 Types- 1 mark each
Q. 2		Attempt any THREE of the following	12
	a)	Compare conventional auto body with unitized body	04



	Ans	Conventional auto body	Unitized body	
		As the name suggests, these vehicles use two separate components for the vehicle's frame: a ladder-type frame sits under the body itself.	This setup integrates the frame into the body construction so it's a single piece.	Any 4 points- 1 mark each
		In some vehicles half frame is fixed in the front end on which engine gear box and front suspension is mounted.	In this type of construction, there is no frame.	
		The rubber mountings used in conventional frame between frame and suspension are replaced by more stiff mountings.	All the assembly units are attached to the body and all the functions of the frame carried out by the body itself.	
		Because of this some of the vehicle load is shared by the frame also. This type of frame is heavier in construction.	This frame is used nowadays in most of the cars. Due to elimination of long frame it is cheaper and due to less weight most economical also.	
		It has the advantage when the vehicle is met with accident the front frame can be taken easily to replace the damaged chassis frame.	Repairing is difficult.	
		This ladder frame resists twisting better than a unibody vehicle, so it's generally preferred for towing or carrying heavy loads and for aggressive off-road driving.	Because it doesn't rely on heavy steel rails like those of a body-on-frame vehicle, unibody construction cuts significant weight out of the vehicle, allowing for better fuel economy.	
	b)	Explain effect of streamlining body on performance of vehicle with		04

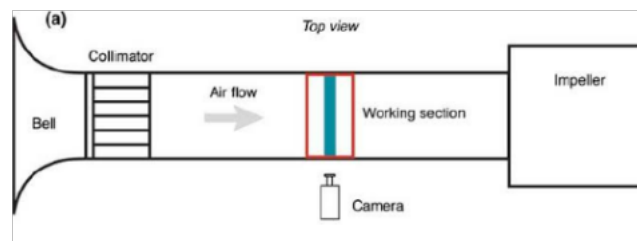
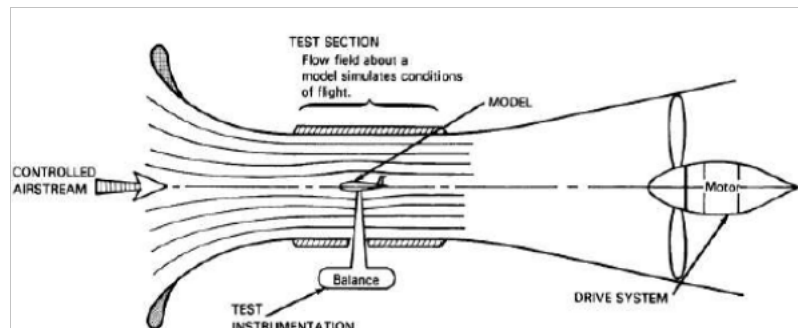
		sketch	
	Ans	<ul style="list-style-type: none"> • More fuel efficiency • Higher speeds • Good Aesthetic and stylish appearance of car. • More stability of car at higher speed • Reduces noise level • More favourable comfort characteristics • Improvement of driving characteristics (stability, handling, traffic safety) 	<p>Any 3 points, 1 mark for figure,</p> <p>(Other suitable figure should also be given marks)</p>
	c)	Select body for truck and justify its use.	04



	Ans	<p>Following points are to be considered while selecting truck body</p> <ul style="list-style-type: none"> • Vehicle application- What exactly will the truck be used for? Will it carry dry goods, perishable products, parts, piping materials, compressors, construction material, or a combination of items? How much will the maximum load weigh? Will the truck pull a trailer? If so, what length? How much total weight, including trailer, is cargo? • Body type and dimensions- Related to the type of cargo it is going to carry. Also, ground clearance is to be considered. How much space will cargo require? How will cargo be loaded and unloaded? Does cargo need extra protection from climate and theft? Are there specific temperature requirements for the cargo? • Matching the chassis with the body- How much load the truck is going to carry? What kind of road surface the truck has to travel on? • Cargo requirements and access- Type of cargo like solid, liquid or gaseous. How will cargo loading and unloading be handled? Will it be from the rear of the truck, the side, or both? What type and size doors will be needed? • Using available resources such as fleet management companies, dealers, shop managers. • Expected vehicle lifecycle- How long will the truck be kept in operation? • Decide which body material works best- What region or climate will the truck operate in? If it operates in highly corrosive environments with harsh winters or coastal regions with salty sea air, then -consider alternative materials to conventional steel, such as aluminum, fiberglass and other composites. 	Any 4 points- 1 mark each
	d)	Describe with neat sketch wind tunnel testing of car body	04
	Ans	<ul style="list-style-type: none"> • A wind tunnel is a research tool developed to study the effects of air moving over or around solid objects. • Air is blown or sucked through a duct equipped with a viewing port and instruments where models or geometrical shapes are mounted for study. 	Explanation - 3 marks, figure-1 mark

- Wind tunnel testing is a trial and error process.
- External flow tunnels - Used to study the external flow through the chassis
- Climatic tunnels - Used to evaluate the performance of door systems, braking systems etc. under various climatic conditions.

(Other suitable figure should also be given marks)



• Types of Wind Tunnel Testing

Force Test

- Force measurement requires a force to be exerted (lift & drag forces so termed force test)
- The balance can measure only two forces: lift & drag



		<p>Pressure Tests</p> <ul style="list-style-type: none"> • Insert tiny tubes into the model surface or airstream and connect them to a pressure measuring device. • Lowered pressure over the wing surface reduced the pressure in the manometer tubes and draws the water level up to a high level. • The lower the pressure, the higher the water level goes. <p>Flow Patterns</p> <ul style="list-style-type: none"> • Allow the streamlines of air flow to look at the body's aerodynamic properties. • Tufting allows for the flow pattern visualization. 	
Q. 3		Attempt any THREE of the following	12
	a)	Explain effect of aerodynamic drag on vehicle performance with sketch	04
	Ans	<ul style="list-style-type: none"> • As a vehicle moves forward the motion of the air around it gives rise to pressures that vary over the entire body surface • Uneven and unbalanced stresses develop on the automobile body and chassis • Deformation of body and chassis due to prolonged application of unbalanced forced • Fuel economy goes down • Difficulty while steering due to unbalanced forces • More noise is produced due to interaction with flowing air 	Any 4 points, 1 mark each
	b)	Describe types of sheet metal used in body construction along with its characteristics	04
	Ans	<ul style="list-style-type: none"> • Steel- thermal, chemical or mechanical resistance, manufacturing efficiency and durability. The improvement or development in the steel industry made the steel stronger, lightweight and stiffer than the earlier. The best reason for using steel as a body structure is its 	Any 2 types- 2 marks each for



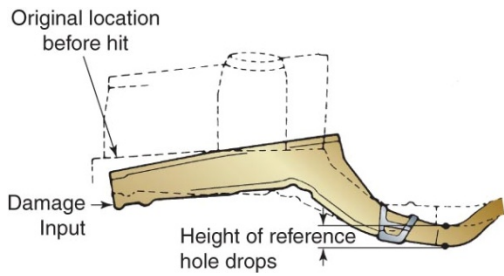
	<p>natural capability to absorb the impact energy produced in a crash.</p> <ul style="list-style-type: none"> ● Aluminium- Use of aluminium can possibly decrease the weight of the vehicle. Its low weight and high specific energy absorption and precise strength are its most significant characteristics. Aluminium is resistant to corrosion. ● Magnesium- It is 33% lighter than aluminium and 75% lighter than steel elements. Magnesium components have many mechanical disadvantages that need a unique design for utilisation to automotive products. Magnesium has lower tensile strength, fatigue strength, and creep strength compared to Aluminium. The modulus and hardness of magnesium alloys are lower than aluminium, while the thermal expansion coefficient is greater. As it has low mechanical strength, pure magnesium cannot be used, must be alloyed with other components. The most common alloying components for room temperature applications is Mg-Al-Zn group, which include aluminium, manganese, and zinc. 	characteristics
	c) State four major body repair shop equipments with their uses	04
Ans	<p>Air Compressor- An air compressor is the source of compressed air for an automotive service facility. Air tools are driven by the compressed-air system.</p> <p>Air Wrenches- Air wrenches, or impact wrenches, provide a very fast means of installing or removing threaded fasteners. An impact wrench uses compressed air to rotate a driving head.</p> <p>Bench Grinder- A bench grinder can be used for grinding, cleaning, or polishing operations</p> <p>Drills- Drills are used to create holes in metal and plastic parts. Some drills are portable; others are mounted on a workbench or the floor. Drills use different-size bits to create the size of hole needed.</p> <p>Drill Press- A drill press is a large, floor- or bench-mounted drill needed for drilling large holes, deep holes, or a great number of holes in several parts.</p> <p>Welder- A welder uses high electric current to create a hot electric spark, or arc, to melt and fuse metal parts together</p>	½ mark each for 4 types, ½ mark each for uses




		Soldering Gun- A soldering gun or soldering iron is used to join wires during electrical repairs	
	d)	Explain with relevant justification body repair by filler-forming with solder.	04
	Ans	<p>The purpose of body fillers is to restore the body contour and provide a smooth surface ready for priming.</p> <p>It is the traditional method of repairing car bodies. It involves the deposition of solder (not pure lead) onto body panels to fill dents and bridge holes, before final finishing. Although plastic fillers are now commonplace in body shops, for classic, vintage and veteran vehicles, body soldering remains the preferred option because of following reasons-</p> <ol style="list-style-type: none"> 1. Solders have much better ductility and strength characteristics than plastic fillers 2. Solder is waterproof, plastic fillers are not 3. Solders will not delaminate on further impact whereas plastic fillers can. 4. Body soldering is in the purist tradition. 	Explanat ion- 4 amrks
Q. 4		Attempt any THREE of the following	12
	a)	State requirements of automobile bodies	04
	Ans	<ul style="list-style-type: none"> • The body should be light. • It should have minimum number of components. • It should provide sufficient space for passengers and luggage. • It should withstand vibrations while in motion. • It should offer minimum resistance to air. • It should be cheap and easy in manufacturing. • It should be attractive in shape and colour. • It should have uniformly distributed load. 	Any 4 points, 1 mark each



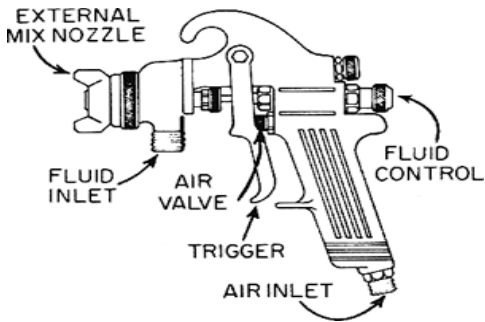
	<ul style="list-style-type: none">• It should have long fatigue life.• It should provide good vision and ventilation.	
b)	List out the types of resins and explain its characteristics	04
Ans	<ul style="list-style-type: none">• Carbon-Fiber Composites• ABS,• Polyethylene,• Polystyrene,• Polycarbonate.• Polyester,• Vinyl Ester,• Epoxy,• Polyurethane. <p>Characteristics</p> <ul style="list-style-type: none">• They weigh about one-fifth as much as steel, but are as good or better in terms of stiffness and strength.• They also do not rust or corrode like steel or aluminum.• They could significantly increase vehicle fuel economy by reducing vehicle weight.• They are rigid with high strength to weight ratio• Good electrical resistance• Resistance to chemical and weather is high• They have good stiffness (related to automobile skin to limit buckling)• Good corrosion resistance.	Any 4 types with their uses

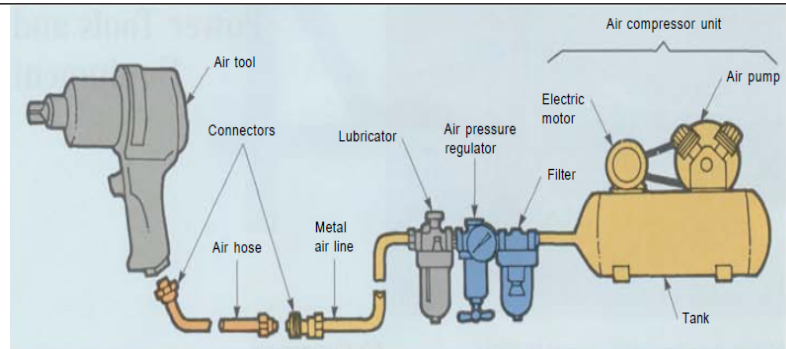
	<p>c) With neat sketch explain electronic straightening and measurement system</p>	<p>04</p>
<p>Ans</p>	<ul style="list-style-type: none"> • Vehicle straightening involves using high-powered hydraulic equipment, mechanical clamps, chains and measuring systems. • May involve the replacement of welded panels that are damaged. • Straightening refers to using alignment equipment to pull the damaged metal back to its original shape • The vehicle is held stationary on the equipment • Clamps and chains are attached to damaged area and a hydraulic system pulls out the damage • Measurements are made at reference points while pulling to return the vehicle to its original dimensions. <div data-bbox="613 926 1114 1199" data-label="Image">  </div>	<p>Any 3 points, 1 mark for sketch (Other suitable figure should also be given marks)</p>
	<p>d) Describe with neat sketch repairing of rusted body panels</p>	<p>04</p>
<p>Ans</p>	<ul style="list-style-type: none"> • It's important to start with a clean surface. Using one clean dry cloth, apply a wax and grease remover and wipe clean with another. • Remove the paint from the rusted area and the surrounding area (approximately 50mm) by machine or hand sanding with 24-36 grit sandpaper. • Treat rusted metal by brushing on rust converter. • Mix the required amount of fibre filler or metal tech with glass fibre filler - use a one part hardener to fifty part filler ratio and ensure the tone is visibly continuous before proceeding. • Immediately apply a thin layer to the repair surface and gradually 	<p>Procedure 3 marks, sketch 1 mark (Other suitable figure should also be given marks)</p>

	<p>apply remaining filler until it's slightly higher than the surrounding edge of the repair.</p> <ul style="list-style-type: none"> • Once the product has fully cured or hardened (if mixed correctly, this should take 20-30 minutes) it will be ready to be sanded by hand or machine using 40-80 grit sandpaper. • Sand back until the filler is level with the surrounding panel. • Clean the surface thoroughly and repeat steps three and four using car filler instead of fibre filler. <div data-bbox="397 688 1125 932">  </div>	
	<p>e) Describe the concept of crash test of new vehicle.</p>	<p>04</p>
<p>Ans</p>	<ul style="list-style-type: none"> • A range of destructive crash tests are conducted to simulate the most common types of crashes including frontal impact, side impact, run-off-road, rear-end and pedestrian strikes. The effect on adult and child occupants is assessed. • In all physical crash tests, dummies are used to measure the forces and likely injuries a driver, passenger or vulnerable road user such as a pedestrian or cyclist may sustain during a crash. • The data gathered from the dummies is assessed, along with an inspection of physical vehicle deformation, on-board hazards and performance of in-built restraint systems, and scored determined for each respective crash test. • Dummies in the crashed cars have sensors, and sometimes cameras are put on board to see what happens on the inside. • Dummies are then taken out after the test, the equipment are removed and photos are taken to document what did or didn't happen, like if an airbag didn't deploy or if a door came open. 	<p>Explanat ion- 4 marks</p>

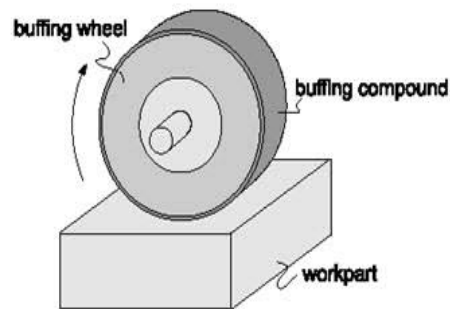


Q. 5		Attempt any TWO of the following	12
	a)	Justify the use of plastic parts in automobile along with its applications.	06
	Ans	<ul style="list-style-type: none">● (Credit should be given to appropriate answer)● Plastics are majorly processed into automotive components and parts owing to their ease of manufacturing, possible sourcing from renewable raw materials and relative ease of improved design.● Further, automotive plastics play a key role in performance and safety innovations in commercial vehicles, HMVs, modern cars and SUVs.● They are usually strong, durable, scratch resistance, recyclable, resistive against abrasion, improve noise and vibration control and permit integration, moulding, and design of automobile components.● The major factors that are driving the growth of automotive plastics industry are prospective of automotive plastic in volume reduction in consumption of fuel by abbreviating the total weight of the automobile, rising prices of steel and irons and enhanced durability and strength of advanced automotive plastic.● In advanced cars, there is almost 50% plastic of the overall vehicle volume, but bestow only 10% of the entire vehicle weight which makes cars light in weight and augments the fuel economy.● Engineered plastics are fast becoming the future for automotive industries.● Various reports have shown that chemical companies have developed ways to reduce plastic's environmental footprint with bio-sourced and recyclable materials.● A bioplastic is a substance made from organic biomass sources, unlike conventional plastics, which are made from petroleum. Bioplastics are produced from renewables, with two main agricultural sources—starch-based, derived mostly from sugar cane; and corn, potatoes, beets, and oil polymers.	Any 4 points, 1 mark each

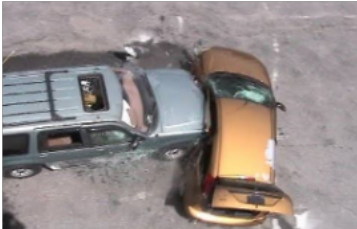
	<ul style="list-style-type: none"> • Also, improvements in recycling processes have influenced manufacturers to use high performance products. • Plastics undergo five different stages while recycling, such as sorting, washing, shredding, identification & classification and extruding into final component or product. 	
	<p>b) Explain with neat sketch the use of following painting equipments</p>	<p>06</p>
<p>Ans</p>	<p>i) Spray Gun- They are used to spray paint over automobile body evenly</p> <div style="text-align: center;">  </div> <p>ii) Compressor- An air compressor is the source of compressed air for an automotive service facility. All the pneumatic tools like air wrenches, air hammers. Blow guns etc. run on compressed air.</p>	<p>1 mark each for explanation and sketch (Other suitable figure should also be given marks)</p>



iii) **Buffing machine-** It used to shine metal, wood, or composites using a cloth wheel impregnated with cutting compounds or rouges. The cloth buff "holds" or "carries" the compound, while the compound does the cutting.



c) Explain with neat sketches damages in car body due to side swipe collision. 06

	<p>Ans</p> <ul style="list-style-type: none"> • A side impact accident happens when a car is hit on its side at an approximate 90-degree angle. Another name for these accidents is "T-bone" accidents. There are no major structural barriers between a driver and a passenger in the car that is struck in a T-bone collision, which means that serious injuries to them are highly likely. • As sideswipes often involve grazing or glancing blows between vehicles, it seems reasonable that damage and injuries would be minimal. • The reality is usually far more complicated. When a driver immediately recognizes and corrects a lane change error, the sideswipe is often nothing more than a glancing blow. • Depending on the vehicles and the circumstances involved, sideswipe collisions cause extensive damage and serious injuries. • Studies found that sideswipes often involved a driver's failure to look in front of him, look in the rearview mirror, or compensate for a blind spot. Sideswipe events occur between vehicles moving in the same direction and traveling in parallel lanes but also under other circumstances. <div style="text-align: center;">  </div>	<p>Explanation 4 marks, figure 2 marks</p> <p>(Other suitable figure should also be given marks)</p>
<p>Q. 6</p>	<p>Attempt any TWO of the following</p>	<p>12</p>
	<p>a) Describe repairing procedure of old vehicle and state major equipments required</p>	<p>06</p>

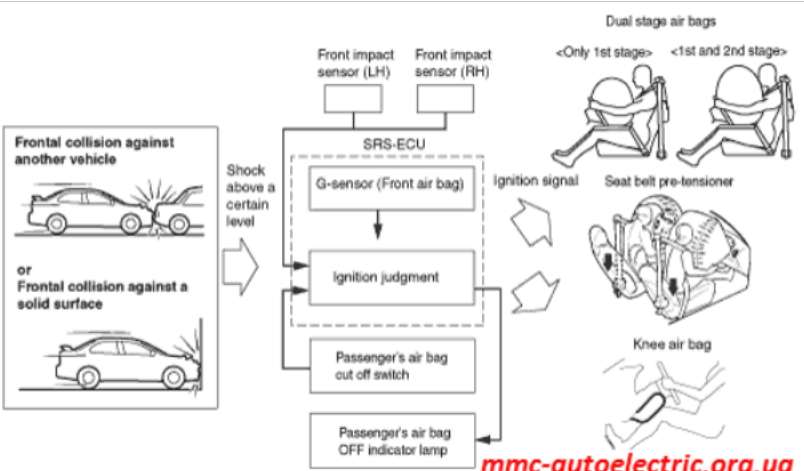


	<p>Ans</p> <ul style="list-style-type: none">• Select vehicle which came for repainting. Then collect all major equipment required for painting are sandpaper having grit no. 60-80, 1500-2000, putty and hardener, buffer machine, painting solution like primer, base colour, clear coats, spray gun.• Firstly take sandpaper having grit no. between 60-80, then remove the all old paint from the vehicle body.• Then take some putty on thin sheet and mixed some small amount of hardener in putty and mixed properly after then apply on vehicle body in same proportion.• Then after 10-20 minutes take buffer machine and stick 2000 grit no. Sandpaper and smooth the body of vehicle on which paint is apply.• After smoothen the body, vehicle is ready for painting process.• Then vehicle take in special room called paint booth in which required temperature is maintain for painting.• After take spray gun and fill with primer and apply on body of vehicle.• Then filled a base colour taken from mixture room which is colour of vehicle then apply 2-3 layer of colour after 10 minute intervals of each coat.• Then apply clear coat on vehicle for protection of base colour and make the colour is glossy and attractive.• This is all process of repainting of old vehicle. <p>Major equipment required</p> <ul style="list-style-type: none">• Grit paper (Sandpaper)• Buffing Machine• Putty and Hardener	<p>Procedure 4 marks, Any 2 equipments 1 mark each</p>
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	b)	Explain with neat sketch working of dual stage air bags	06
Ans	<ul style="list-style-type: none">• A dual-stage airbag has two inflator modules connected to one airbag. Each inflator module has a different power rating; say for example, a 70% charge in one inflator and a 30% charge in the other.• With a typical dual-stage airbag system, the “first” firing utilizes one charge of propellant and initially deploys the airbag. If needed and called for by the airbag “brain,” the “second” firing utilizes the other propellant charge and more fully inflates the bag during the few milliseconds of the collision.• The way the system is supposed to work, in a minor impact with a properly seated and belted occupant, the airbag system may		Explanat ion 4 marks, figure 2 marks (Other suitable figure should also be given

	<p>deploy the airbag using only the lower power charge.</p> <ul style="list-style-type: none"> • This minimizes the chance of an occupant being injured in any way by the deployment of the airbag. It is this desire to prevent airbag-induced injuries that has brought about the creation of dual-stage airbags in the first place. If just one charge fires off, then it is possible for a deployed airbag to fire off a second time. • This minimizes the chance of an occupant being injured in any way by the deployment of the airbag. It is this desire to prevent airbag-induced injuries that has brought about the creation of dual-stage airbags in the first place. If just one charge fires off, then it is possible for a deployed airbag to fire off a second time. 	marks)
c)	<p>Explain protective and anti-corrosive methods used in automobile along with their significance</p>	06
Ans	<p>Cavity Wax Injection</p> <ul style="list-style-type: none"> – This process is somewhat more expensive than others; however, the long term effectiveness of the method has shown it to be a good value for many car owners. – The process involves taking a heavy wax type material that contains rust and corrosion inhibitors and spraying it into all of the box sections of the body of your car. – The wax material is able then to reach the under-surface of the car 	Any 3 methods, 2 marks each



body where it works to prevent rust and corrosion.

- If the outside of the car body is damaged or scratched, the protective wax invisibly seeps out to the surface of the paint and seals the crack in order to prevent corrosion.

Barrier Coatings

- One of the easiest and cheapest ways to prevent corrosion is to use barrier coatings like paint, plastic, or powder. Powders, including epoxy, nylon, and urethane, are heated to the metal surface to create a thin film.
- Plastic and waxes are often sprayed onto metal surfaces.
- Paint acts as a coating to protect the metal surface from the electrochemical charge that comes from corrosive compounds.
- Today's paint systems are actually a combination of different paint layers that serve different functions. The primer coat acts as an inhibitor, the intermediate coat adds to the paint's overall thickness, and the finish coat provides resistance to the environmental factors.
- The biggest drawback with coatings is that they often need to be stripped and reapplied. Coatings that aren't applied properly can quickly fail and lead to increased levels of corrosion.
- Coatings may also contain volatile organic compounds, which can make them vulnerable to corrosion.

Hot-Dip Galvanization

- This corrosion prevention method involves dipping steel into molten zinc.
- The iron in the steel reacts with the zinc to create a tightly-bonded alloy coating which serves as protection.
- Compared to other corrosion prevention methods, galvanization is known for lower initial costs, sustainability, and versatility.
- Unfortunately, galvanization can't be done on-site, meaning



companies have to pull equipment out of work to be treated.

- Some equipment may simply be too large for the process, forcing companies to abandon the idea altogether.
- In addition, if the process isn't done properly, the zinc can chip or peel. And high exposure to environmental elements can speed up the process of zinc wear, leading to increased maintenance check-ups.
- Lastly, the zinc fumes that release from the galvanizing process are toxic.

Alloyed Steel (Stainless)

- Alloyed steel is one of the most effective corrosion prevention methods around, combining the properties of various metals to provide added strength and resistance to the resulting product.
- Corrosion-resistant nickel, for example, combined with oxidation-resistant chromium results in an alloy that can be used in oxidized and reduced chemical environments.
- Different alloys provide resistance to different conditions, giving companies greater flexibility.
- Despite its effectiveness, alloyed steel is very expensive. Companies with limited financial resources will likely have to turn to other methods.
- Monitoring surface conditions are critical, as cracks or scratches can result in an increase of corrosion. Companies also need to make sure the agents used in maintenance don't include corrosion properties.

Cathodic Protection

- Cathodic protection protects against galvanic corrosion, which occurs when two different metals are put together and exposed to a corrosive electrolyte.



- To prevent this, the active sites on the metal surface need to be converted to passive sites by providing electrons from another source, typically with galvanic anodes attached on or near the surface.
- Metals used for anodes include aluminum, magnesium, or zinc.
- While cathodic protection is highly effective, anodes need to be checked often which can drive up costs of maintenance.
- They also increase the weight on the attached structure and aren't always effective in high-resistivity environments.
- Finally, anodes lead to increased water flow on ships and other underwater equipment.

Soap and Water

- Regardless of the anti-corrosion method, none of them are more effective than soap and water.
- Keeping your vehicle clean and free from dirt and grime is the surest way to avoid rust and corrosion.
- When you wash your car, you should also use a high pressure spray nozzle to clean the undercarriage of your vehicle.
- Washing and waxing your vehicle regularly is the best method of preventing rust and corrosion. It is also the cheapest.