

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 1: INTRODUCTION AND HOW CARS WORK

Car Identification Activity

Objective

Upon completion of this activity, you will be able to correctly identify an automobile by make, model, year, and type.

Tools

None

Supplies

None

Cautions

None

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Open the driver's door and look for the vehicle certification label.
- Identify the date of manufacture.
- Identify the vehicle manufacturer.
- Look in the front windshield and find the VIN. Write down the VIN.
- Look on the outside of the vehicle. The make and model are usually identified on the rear, front, or side of the vehicle. Note the make and model.
- Identify the vehicle type (e.g., subcompact, compact, mid-size, full-size, sports car, mini SUV, crossover SUV, SUV, SUT, compact pickup, mid-size pickup, full-size pickup, minivan, or van).
- Open the hood and find the vehicle emission control information (VECI) sticker. If you are unsure how to open the hood, refer to your owner's manual. A release latch should be under or near the steering column. Once the hood is popped, there is a safety latch on the outside.
- Look on the VECI sticker to determine the model year.
- Look on the VECI sticker to determine the size (e.g., 2.0 L) and type (e.g., gas or diesel) of engine in your vehicle.
- Look at the engine to try to determine the number of cylinders. Identifying the number of spark plugs may help you.
- Look at the engine design to determine the configuration (e.g., inline, V, slant, or opposed).
- Close the hood.

Activity Journal

1. When was the vehicle manufactured?
2. What company manufactured your vehicle?
3. What is your vehicle's VIN?
4. What are the make, model, and type of vehicle you investigated?
5. According to the VECI sticker, what is the model year of your vehicle?
6. What is the size, type, and configuration of your engine?
7. How many cylinders does your engine have?

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CHAPTER 2: BUYING AN AUTOMOBILE

Buying an Automobile Activity

Objective

Upon completion of this activity, you will be able to differentiate between MSRP, dealer invoice, and dealer cost.

Tools

Computer with Internet access, calculator (or use the calculator on the computer)

Supplies

None

Cautions

None

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Log onto your computer and open up an Internet browser.
- Type in the following Internet address - www.kbb.com.
- Click on *New Car Pricing*.
- Follow the instructions on the website to price out a car of your choice.
- Note the manufacturer, make, model, and year.
- Identify the dealer invoice.
- Identify the MSRP (manufacturer's suggested retail price).
- Click on *Incentives* to identify if any rebates or incentives are being issued at the present time. Subtract that amount from dealer invoice.
- Calculate the estimated dealer cost by subtracting another 3% (holdback) to represent the incentive a dealership may receive from the manufacturer to sell the vehicle. This number represents the estimated Dealer Cost.
- Calculate a reasonable offer ($1.04 \times$ Dealer Cost) for the vehicle.
- Calculate your cost for the vehicle by including your state's sale tax.
- Calculate your 20% down payment.
- Use a search engine (e.g., www.google.com) to find an online loan calculator (keyword: loan calculator). Calculate your monthly payment on the remaining balance if you financed the loan for 48 months at the current average interest rate.
- Log off your computer.

Activity Journal

1. What factors caused you to choose the specific type of car that you researched?
2. How does a monthly payment change by increasing the loan duration?
3. How does a monthly payment change by increasing the interest rate?
4. What is the current bank interest rate for new automobiles? Does the manufacturer offer low interest rate incentives?
5. How can automotive retailers sell vehicles under dealer invoice?

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CHAPTER 3: AUTOMOTIVE EXPENSES

Automotive Expenses Activity

Objective

Upon completion of this activity, you will be able to calculate automotive expenses.

Tools

Computer with Internet access, telephone, calculator (or use the calculator on the computer or a spreadsheet program such as Microsoft Excel)

Supplies

None

Cautions

None

Scenario 1

You have been saving years for your first car and have saved \$2,500. Recently you passed your driver's test and received your license. Your parents have agreed to match the amount of money that you have saved for your car, so your budget is now \$5,000. However this sum of money needs to last you six months until you get a summer job. You must calculate a six-month budget that will cover the car's purchase, insurance, fuel, registration, license, routine maintenance, and \$100 worth of unexpected repairs. Your parents have decided that they don't want you to take out any loans. Use a blank sheet of paper or a computer spreadsheet program to organize the data that you collect.

Procedure 1

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Log onto your computer and open up an Internet browser.
- Type in the following Internet address - www.autotrader.com.
- Look for possible vehicles. Remember that you only have \$5,000 to spend on the car and expenses.
- Note the manufacturer, make, model, year, and engine size.
- Note the cost of the vehicle.
- Call your local Department of Motor Vehicles (DMV) or check online for the cost of license plates, registration, and title transfer fees for the specific vehicle you are researching.
- Calculate the state sales tax (if applicable) on the vehicle. This tax is often collected by your local DMV if you bought a vehicle from a private party.
$$\text{Sales Tax} = \text{Vehicle Cost} \times \text{Sales Tax Percent in decimal form.}$$
- Complete research to identify the car's fuel efficiency in miles per gallon.
- Visit or call local gas stations to find out the average cost per gallon of fuel.

- Calculate 6-month expenditure on fuel costs if you travel 1,000 miles a month.
Fuel Costs = (6,000 miles/Fuel Efficiency) X Price of Fuel per gallon.
- Call a local insurance agent or check online for the cost of a six-month liability policy. Your parents want you to have 100/300/50 coverage. Gather at least three quotes from different insurance companies. Choose a policy from a company that best meets your needs.
- Budget for two oil and filter changes in the six-month period. Include labor costs if you do not intend to complete the service. Call repair facilities for estimates.
- Budget for one major tune-up in the six-month period. You will need to calculate the cost for spark plugs, spark plug wires (if applicable), distributor cap (if applicable), distributor rotor (if applicable), air filter, and fuel filter. (Note: A distributorless ignition system does not have a cap or rotor. Coil-on-plug ignition systems will not have spark plug wires.) Include labor costs if you do not intend to complete the service. Call repair facilities for estimates.
- Calculate your total car expenditures. To do this, add the following.
 - Vehicle Price
 - License Plates, Registration, and Title Transfer Fees
 - Sales Tax on Vehicle
 - Fuel Costs for Six Months
 - Insurance for Six Months
 - Two Oil Changes
 - Tune-Up
 - Unexpected Repairs (Estimate \$100)
- Compare your total car expenditures with the amount of money (\$5,000) that is available.
- Log off your computer.

Scenario 2

You have not saved much money for your first vehicle, but you have recently started working a part time job clearing \$7.00 an hour. Your parents have offered to give you \$1,000 towards your first vehicle and will co-sign a loan with you for another \$4,000. Now you have \$5,000 to spend towards a car. Your job should cover the loan payment and the costs for the monthly expenses. You purchased a vehicle for \$5,000 including the sales tax. You are curious to calculate how many hours a month you need to work to keep your car operational. Your goal is to calculate the average monthly cost of owning this vehicle. Use a blank sheet of paper or a computer spreadsheet program to organize the data that you collect.

Procedure 2

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Use an online loan payment calculator (keyword: loan calculator) to determine the monthly payments on a \$4,000 loan for 48 months at the current interest rate.
- Call a local insurance agent or check online for the cost of a six-month liability policy. Your parents want you to have 100/300/50 coverage. Since you have a loan on the car, the lending institution will also require collision and comprehensive

coverage. Gather at least three quotes from different insurance companies. Choose a policy from a company that best meets your needs.

- Calculate the cost of the insurance policy on a monthly basis.

$$\text{Insurance Cost per month} = \text{Insurance Cost for a six-month policy}/6$$

- Complete research to determine the fuel mileage per gallon (mpg) of the chosen vehicle.
- Visit or call gas stations to determine the cost of fuel per gallon.
- Calculate your monthly expenditure on fuel if you travel 1,000 miles a month.

$$\text{Fuel Cost per month} = (1,000\text{miles}/\text{mpg}) \times \text{Price of Fuel per gallon}$$

- Pro-rate (per month) the cost for licensing and registering your vehicle. Call your local Department of Motor Vehicles (DMV), Motor Vehicle Administration (MVA), or check online for the cost of license plates tags and registration fees for the specific vehicle you are researching.

$$\text{License and Registration Cost per month} = \text{Annual Cost}/12 \text{ months}$$

- Traveling 1,000 miles a month will determine that your vehicle will need an oil change every 3 months. Pro-rate (per month) the cost of an oil change.

$$\text{Oil Change Cost per month} = \text{Oil Change Price}/3 \text{ months}$$

- Pro-rate (per month) the cost of a tune up. You will need to calculate the cost for spark plugs, spark plug wires (if applicable), distributor cap (if applicable), distributor rotor (if applicable), air filter, and fuel filter. (Note: A distributorless ignition system does not have a cap or rotor. Coil-on-plug ignition systems will not have spark plug wires.) Include labor costs if you do not intend to complete the service. Call repair facilities for estimates. Estimate that your vehicle will need a major tune-up every two years.

$$\text{Tune-Up Costs per month} = \text{Cost for a Tune-Up}/24 \text{ months}$$

- Pro-rate (per month) the cost for one set of tires. With your driving habits, you will need to buy a new set of tires every four years. Check online or with a local tire distributor for the cost to replace the tires for your vehicle. You want to buy 50,000-mile tires with the following minimum UTQG ratings: Traction A, Temperature B, Treadwear 400. You also want new valve stems installed, the tires mounted and balanced, and the old tires properly disposed.

$$\text{Tire Cost per month} = \text{Cost Per Set of 4 Tires}/48 \text{ months}$$

- Pro-rate (per month) the cost for one battery. You live in a harsh climate and will probably need a new battery in the next four years. Check online or with a local battery distributor for the cost to replace the battery in your vehicle.

$$\text{Battery Cost per month} = \text{Battery Cost}/48 \text{ months}$$

- Pro-rate (per month) the cost for new windshield wiper blades. You will probably need to replace your wiper blades every year. Check online or with a local parts distributor for the cost to replace the wipers on your vehicle.

$$\text{Wiper Cost per month} = \text{Cost for Set of Wiper Blades}/12 \text{ months}$$

- Pro-rate (per month) the cost for two new headlamp bulbs in the next four years. Check online or with a local parts distributor for the cost for two new headlamp bulbs.

$$\text{Headlamp Cost per month} = \text{Cost for Two Headlamps}/48 \text{ months}$$

- Pro-rate (per month) the cost for one complete brake job in the next four years. Check online or with a local service facility for the cost to replace the brake pads/shoes and re-surface the rotors/drums.

$$\text{Brake Expense per month} = \text{Cost for Brake Job}/48 \text{ months}$$

- Calculate your total monthly expenses by adding the following:
 - Monthly Car Payment
 - Monthly Insurance Cost
 - Monthly Fuel Cost
 - License Plate Tags and Registration Fees Cost Pro-Rated Monthly
 - Oil Change Cost Pro-Rate Monthly
 - Tune-Up Cost Pro-Rated Monthly
 - Tire Cost Pro-Rated Monthly
 - Battery Cost Pro-Rated Monthly
 - Wiper Cost Pro-Rated Monthly
 - Headlamp Cost Pro-Rated Monthly
 - Brake Job Cost Pro-Rated Monthly
 - Miscellaneous Monthly Car Expenses
- Calculate the minimum number of hours you need to work each month to keep your car on the road.

$$\text{Hours Needed to Work} = \text{Total Monthly Expenses}/\$7.00$$

- Log off your computer.

Activity Journal

1. Why should you obtain several insurance quotes?
2. What is the second most costly pro-rated monthly expense?
3. Why is it important to budget for expenses?
4. How could you reduce your monthly expenses?

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CHAPTER 4: REPAIR FACILITIES

Repair Facilities Activity

Objectives

Upon completion of this activity, you will be able to:

- Choose a quality repair facility.
- Interpret a repair invoice.

Tools

Computer with Internet access

Supplies

None

Cautions

None

Procedure 1 Choosing a Repair Facility

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Interview at least three adults that have been driving for at least ten years each. Ask questions related to choosing repair facilities (e.g., Where do you bring your car for service? Why do you bring your car there? What do you look for when choosing a repair facility?).
- Log onto your computer and open up an Internet browser.
- Type in the following Internet address - www.ase.com.
- Click on *Motorists*.
- Click on and view *Why Motorists Should Look for an ASE-Certified Technician (Multimedia Tutorial)*.
- Using the ASE website, review the characteristics of a *Blue Seal Shop*.
- Use the *Find a Blue Seal Shop* link to see if any repair facilities in your geographical area meet the quality standards.
- Go to www.aaa.com.
- Click on *Automotive*.
- Click on *Learn More* under the *AAA Approved Auto Repair* tab. Read this link to learn about AAA Approved Auto Repair benefits.
- Use the *AAA Facility Search* tool to locate facilities in your geographical area.
- Go to www.motorist.org.
- Click on *Motorists* and then on *How to Pick a Repair Shop*. Review the content on this site. Then click on *MAP in Your Community* to locate accredited automotive shops.

- Review any old repair invoices that you may be able to obtain. Compare responses from the interviews, ASE Blue Seal Shop search, and AAA Approved Auto Repair search. See if any of the facilities meet all four criteria: (1) recommended by someone you interviewed; (2) ASE Blue Seal Shop; (3) AAA Approved Auto Repair facility; and (4) Motorist Assurance Program Accredited Automotive Shops.
- Log off your computer.

Procedure 2 Interpreting a Repair Invoice

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Interview at least three adults that have been driving for at least ten years each. Ask questions related to repair invoices and estimates (e.g., What do you expect to see on a repair invoice? Do you have any old repair invoices I could review? Did you ever have a dispute with an auto repair shop with a repair? If so, what did you do?).
- Log onto your computer and open up an Internet browser.
- Complete an Internet search using *Auto Repair Law* as the search phrase. Some states have comprehensive auto repair laws, others do not. Michigan Department of State has a well designed brochure titled *A Guide to the Auto Repair Law – For Mechanics and Repair Facilities*. Complete an Internet search to find this brochure that is available online. Repair invoices should have the car's VIN, year, make, model, odometer reading, and date of repair. It should also list parts and labor costs, the name of the parts installed, guarantee (if applicable), and whether the parts were rebuilt, new, or used.
- Log off your computer.

Activity Journal

1. What are characteristics of a quality auto repair facility?
2. Why should you look for a facility that has ASE certified technicians?
3. What are auto repair facilities required to provide in estimates and repair invoices in your geographical location?
4. What should you do if you have a dispute with the service facility over the quality or price of an auto repair?

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CHAPTER 5: SAFETY AROUND THE AUTOMOBILE

Automotive Safety Activity

Objective

Upon completion of this activity, you will be able to identify the location of emergency and safety equipment.

Tools

None

Supplies

None

Cautions

Do not use an automotive lift unless properly supervised.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Locate fire extinguishers in the garage. Read all labels so you become familiar with the fire extinguishers. Note the type of fire extinguisher accessible in the garage.
- If you are in a school laboratory or shop setting, locate the load capacity ratings on the automotive lift(s). Note the ratings.
- If there are automotive lifts available, locate the lift safety and caution labels. Read them.
- If there is an eyewash station, read the instructions on how to use it.
- Locate the rag waste can for combustible materials.
- Identify where the closest telephone is for emergencies.
- If you are in a school laboratory or shop setting draw an overhead (bird's eye) view of the garage layout on a separate piece of paper. Note the location of fire extinguishers, eyewash stations, exits, trashcans, rag waste can, extension lights, electrical outlets, automotive lifts, supply cabinets, tools, workbenches, and safety glasses. List as many items as possible to make yourself familiar with the garage.

Activity Journal

1. What types of fire extinguishers are located in the garage?
2. What are the load capacities of the automotive lifts (if applicable)?
3. What are some safety rules when using an automotive lift?
4. What do you have to be cautious about when using an automotive lift?
5. How do you use an eyewash station?

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CHAPTER 6: BASIC TOOLS

Basic Tools Activity

Objective

Upon completion of this activity, you will be able to correctly identify basic tools that are used in automotive shops.

Tools

None

Supplies

None

Cautions

None

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Obtain a pen or pencil and a piece of paper. Your instructor will have tools displayed for you to identify. Each tool will be labeled with a number (e.g., 1, 2, 3).
- Each student will be at a different tool. You will have one minute to inspect and identify the tool.
- Once you have identified the tool, write its correct name on your paper with the corresponding number.
- Rotate every minute to identify the next tool until you have identified all the tools that your instructor displayed.
- At the end of the rotation, your instructor will assign you a tool. When called on you will be required to identify the assigned tool and describe/demonstrate how it is used.
- Clean and put away all tools.

Activity Journal

1. How are pliers different than wrenches?
2. What is the difference between a socket and a ratchet?
3. In what ways is a spark plug socket different from a regular deep well socket?
4. Why is it important to be able to identify and know the function of basic tools?

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CHAPTER 7: AUTO CARE AND CLEANING

Interior Cleaning Activity

Objective

Upon completion of this activity, you will be able to clean the inside of a vehicle.

Tools

Vacuum

Supplies

Detail towels, shop rags, bucket, car wash soap, Q-Tips (or similar), auto glass cleaner, vinyl cleaner, fabric cleaner, lint-free cloths, multipurpose cleaner

Cautions

Read all product labels.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Pull out all floor mats. Shake out, wipe clean, or vacuum as necessary.
- Clean all garbage out of the vehicle and put in the trash can. Recycle aluminum cans, plastic, and paper. Remember to clean out the door pockets and storage areas.
- Thoroughly vacuum the headliner, seats, back window area, door panels, floor mats, trunk, sun visors, and carpet.
- Wet a shop rag with soap and water and wipe down the doorjambes and the seal around the trunk area.
- Spray a vinyl cleaner on a detail towel to clean and protect vinyl and rubber components (e.g., the dash, door panels, and weather-stripping around the doors and trunk). Do not use cleaner on the gas pedal, brake pedal, clutch pedal, or steering wheel. Using cleaners on these components may cause a hazardous driving condition for the operator of the vehicle.
- Use Q-Tips (or similar) to clean tight areas like the heater vents and radio controls.
- Use the appropriate fabric cleaner to get stains out of the seats, carpet, and trunk. Always read the directions on the product label. Use detail towels to scrub and dry the fabric. Test in an inconspicuous area.
- Spray auto glass cleaner on windows and wipe off with lint free cloths. Clean all mirrors and both sides of the windows.
- Put the clean floor mats back in the vehicle.
- Open the hood. Wet a shop rag with a multipurpose cleaner and wipe grime, dirt, and dust from the engine compartment. Close the hood.
- Dump the debris out of the shop vacuum into a trash can.

- ❑ Clean and put away all tools and supplies.

Activity Journal

1. What are some tools and supplies needed to properly clean the inside of a vehicle?
2. Why is it important to read and understand all product labels?
3. Why do you think it is important to test cleaners in inconspicuous areas?
4. What product can be used to clean and condition weather-stripping?
5. How did Q-Tips or a similar product help you in cleaning your vehicle?

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CHAPTER 7: AUTO CARE AND CLEANING

Exterior Cleaning Activity

Objective

Upon completion of this activity, you will be able to clean the outside of a vehicle.

Tools

Hose, bucket, window squeegee, chamois, wash mitt, shop rags, and tire brush

Supplies

Car wash soap, whitewall/blackwall cleaner, and water

Cautions

Read all product labels.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- If the vehicle has been in the sun, let it cool. Never wash a hot vehicle.
- Rinse out the wash bucket. Put about 1/4 cup of car wash soap into the bucket and fill with warm water. Read the product label for exact water to soap ratios.
- Rinse off the wash mitt.
- Rinse the vehicle thoroughly from top to bottom with a hose. Get off as much loose dirt as possible before scrubbing.
- Wash the vehicle one section at a time, scrubbing with a wash mitt. Work your way from the top to the bottom. Periodically rinse off the section that you just scrubbed. The key is to make sure the car wash soap doesn't begin to dry while you are still washing.
- Wash and rinse the wheels and the wheel wells.
- Rinse the wash mitt thoroughly.
- Give the whole vehicle a final rinse. Dry the vehicle with a chamois. Wet the chamois before using it to make it soft.
- Use a damp shop rag to clean the inside of the doorjamb.
- Spray whitewall/blackwall cleaner on the tires and scrub with the tire brush. Rinse off thoroughly. Always read the labels on the products that you use.
- Use a squeegee to dry off the windows.
- Pop the hood and trunk and dry the surrounding lip with a shop rag.
- Clean and put away all tools and supplies.

Activity Journal

1. Why do you think you should rinse the vehicle thoroughly before scrubbing?

2. What water to soap ratio was recommended?
3. Why should you wash one section of the vehicle at a time?
4. Why should you wet the chamois before using it?

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CHAPTER 7: AUTO CARE AND CLEANING

Waxing Activity

Objective

Upon completion of this activity, you will be able to wax the finish on a vehicle.

Tools

None

Supplies

Detail towels, wax applicator, automotive wax, bug and tar remover, auto glass cleaner, lint-free cloths

Cautions

Read all product labels.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Wash and dry the vehicle according to the *Exterior Cleaning Lab*. You should not wax a dirty vehicle.
- Use bug and tar remover to clean any stubborn spots. Read the product's label before use.
- Read the back of the wax bottle/can. Follow directions supplied by the product manufacturer.
- Do not wax a hot vehicle or one that is in direct sunlight.
- Dampen the wax applicator. This will help in applying a thin consistent layer. Apply the wax to the applicator and then to the finish. Some products suggest using linear motions while others suggest large circular motions. Read and follow the directions on the wax container.
- Wax one area at a time. Do not get wax on trim, molding, logo badges, or black plastic parts. It can be extremely difficult to remove wax from these pieces.
- The wax will dry to a haze. The drying time depends on the temperature and humidity in the air.
- Wipe off the dry section with a clean detail towel. You should always let one section dry at a time, while applying wax to the next section.
- Continue waxing and drying until the vehicle is complete.
- Wipe down the whole vehicle to ensure that you haven't left any wax haze on the finish.

- ❑ Spray auto glass cleaner on windows and wipe off with lint-free cloths. Clean all mirrors and both sides of the windows. If your vehicle has a rear window defroster, use linear motions in the direction of the heating wires.
- ❑ Clean and put away all tools and supplies.

Activity Journal

1. Why should you use bug and tar remover before you wax?
2. Why should you dampen the wax applicator before use?
3. Why did you wax one area at a time?
4. Why should you wipe down the whole vehicle in the end?
5. What type of motion (linear or circular) did the product label indicate to use?

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CHAPTER 8: FLUID LEVEL CHECK

Fluid Level Check Activity

Objective

Upon completion of this activity, you will be able to safely check the fluid level in various vehicle components.

Tools

Safety goggles, basic hand tools

Supplies

Shop rags, correct type and amount of fluids that need to be added

Cautions

Read owner's manual to identify the correct type of fluids to be used. Never remove a hot radiator cap.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety goggles.
- Reread the procedures in the text to correctly check and add fluids. Since variations can occur from one vehicle manufacturer to another and from one model to another, reread your owner's manual for specific procedures and type of fluids.
- Pop open the hood.
- Check the engine oil level. If low, add the correct weight of oil. Do not overfill.
- Check the transmission fluid level. If low, add the correct type of fluid. Do not overfill.
- Check the power steering fluid level. If low, add the correct type of fluid. Do not overfill.
- Check the brake fluid level. If low, add the correct type of fluid. Do not overfill.
- Check the clutch fluid (manual transmissions only) level. If low, add the correct type of fluid. Do not overfill.
- Check the differential fluid level where applicable. If low, add the correct type of fluid.
- Check the coolant level. Do not remove a hot radiator cap. Check the fluid in the overflow reservoir. Add the correct type and mixture of antifreeze if necessary.
- Check the battery electrolyte level if applicable. Some battery caps are not removable. *Caution: Batteries contain sulfuric acid. If necessary, add only distilled water.*
- Check the windshield washer fluid level. Add as necessary.
- Clean and put away all tools and supplies.

Activity Journal

1. What type and weight of oil did your owner's manual recommend to use?
2. What type of transmission fluid is recommended to use in your vehicle?
3. What color was your vehicle's antifreeze? What might this indicate?
4. What color was your windshield washer fluid?
5. What type of power steering fluid did your owner's manual recommend to use?

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CHAPTER 9: ELECTRICAL SYSTEM

Battery Activity

Objective

Upon completion of this activity, you will be able to safely clean and test the battery.

Tools

Safety goggles, rubber gloves, basic hand tools, VOM (volt-ohm meter/multimeter), battery load tester, battery hydrometer, wire brush, battery terminal cleaner, battery post spreader (top mount batteries only), battery terminal puller (top mount batteries only), parts cleaning brush, mixing cup

Supplies

Shop rags, baking soda, distilled water, anti-corrosion spray

Cautions

It is a must to wear safety goggles and rubber gloves while performing this activity. Know where the eyewash station is and how to use it. Battery electrolyte will eat through clothing. Do not touch the battery against your shirt or pants. Electrolyte will irritate your skin. If you do get electrolyte on your skin, clean promptly with soap and water. Do not allow flames or sparks near battery gases. Battery gases can explode.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety goggles.
- Remove rings and watches.
- Complete a visual inspection on the battery. Check for loose battery cables, corroded terminals, deposits on connections, cracks or leaks in the case, and frayed or broken cables.
- Make sure the ignition switch is in the off position. Remove the ignition key.
- Remove the negative (-) battery cable. Use a puller if the connections are top mount.
- Remove the positive (+) battery cable. Be careful not to touch the wrench against the body of the vehicle or engine components. A spark could occur causing the battery to explode. Use a puller if the connections are top mount.
- Remove the battery hold-down bracket. Use penetrating oil (e.g., WD-40) if rusted.
- Put on rubber gloves.
- Remove the battery from the vehicle and set in a utility sink. Do not turn the battery upside-down or on its side.
- Use a battery post cleaner tool to remove corrosion from the posts.
- Make a water/baking soda solution - 1/8 cup of baking soda to 1 cup of warm water.

- Dip the part's brush in the solution and scrub the battery. Do not allow the solution to enter the battery.
- Rinse the battery thoroughly with clean water.
- Dry with a shop rag.
- Connect the VOM. Positive (+) first, then the Negative (-). Note the voltage reading.
- Remove VOM. Negative (-) first, then Positive (+).
- Connect a load tester to the battery. Positive (+) first, then Negative (-).
- Adjust the setting on the load tester to the correct voltage.
- Hold the load button down for 10 seconds (or as specified in the load tester manual). Note the reading.
- If the battery has removable vent caps, remove them at this time. Ask the instructor (if available) or consult your owner's manual if unsure. To test the specific gravity in each cell, you will use a battery hydrometer. Squeeze and release the bulb so the electrolyte (water and acid mixture) enters the battery hydrometer. Complete this procedure for each cell (there should be six cells). Note the readings of each cell. A fully charged battery will have a specific gravity rating between 1.254-1.280.
- Check the electrolyte level. The fluid in each cell should be even with the bottom of the filler ring. If the fluid is low, add only distilled water.
- Replace the vent caps.
- Before putting the battery back in the vehicle, clean where the battery mounts into the vehicle with the baking soda and water solution. Rinse with clean water.
- Clean the battery cable ends with a wire brush or battery terminal cleaner tool.
- Carefully put the battery back into the vehicle.
- Install the battery hold-down bracket. Lubricate bracket threads with penetrating oil. Make sure battery is secure.
- Connect the positive (+) battery cable.
- Connect the negative (-) battery cable.
- Coat terminals with anti-corrosion spray. Be careful not to spray the vehicle's finish.
- Clean and put away all tools and supplies.
- Reset the radio stations and clock.

Activity Journal

1. What is the typical surface voltage of a fully charged battery? What was the voltage reading of your battery?
2. Why is it important to avoid getting baking soda inside the battery? Why do you think a baking soda solution works to clean a battery?
3. What is the typical specific gravity reading of a fully charged battery?
4. How many volts does each cell produce in an automotive battery?
5. Why is it important not to create a spark when connecting and disconnecting a battery?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 9: ELECTRICAL SYSTEM

Charging Activity

Objective

Upon completion of this activity, you will be able to safely test the alternator.

Tools

Safety glasses, basic hand tools, VOM (volt-ohm meter/multimeter), current clamp

Supplies

Shop rags

Cautions

Keep your hands away from moving components.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety glasses.
- Connect the vehicle's exhaust to the shop exhaust evacuation system or park the vehicle outside. Apply the parking brake.
- Identify the battery, alternator, voltage regulator (may be inside the alternator), and alternator drive belt.
- Set the VOM to Volts DC. Place the red lead on the positive battery post and the black lead on the negative battery post. With the vehicle not running, note the battery voltage. (Typical is between 12.5 to 12.8 volts.)
- While the VOM is still connected, start the engine. Keep away from moving parts. After the engine is running, note the volts. (Typical is between 13.8 to 14.8).
- While the engine is running, turn on the headlights. Note what happens to the volt reading.
- While the engine is running (and the headlights still on), turn on the blower (heater) to HI. Note what happens to the volt reading.
- Turn off the engine and disconnect the VOM.
- Use a current clamp with an induction lead to record alternator amperage output. Put the induction lead over the main positive alternator wire (usually the largest diameter). Follow the directions that come with the induction lead.
- Start the engine. While the engine is running, note the amps.
- With the engine running, turn on the headlights. Note what happens to the amps reading.
- While the engine is running (and the headlights still on), turn on the blower (heater) to HI. Note what happens to the amps reading.

- Turn off the engine.
- Inspect your vehicle to identify whether your alternator uses a Serpentine or V-belt. Check the belt for wear (oil soaked, cracked, frayed, pieces missing, or glazed). If excessively worn, replace the belt.
- Check the alternator drive belt tension. If loose, tighten it. *Note: Many automotive drive belts have self-tensioners -- consult a service manual specific to the vehicle to see if the tensioner is adjustable.*
- Check the battery cables for tightness on the battery mounts. Tighten if necessary.
- Check the alternator terminals for burn marks or cracked connections.
- Clean and put away all tools and supplies. Disconnect shop exhaust evacuation system (if applicable).

Activity Journal

1. How many volts were present at the battery with the vehicle off?
2. How many volts were present when the engine was running with no accessories on?
3. What was the initial change to the voltage reading when accessories were turned on?
4. How many amperes were present when the engine was running with no accessories on?
5. What change occurred when accessories were turned on?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 9: ELECTRICAL SYSTEM

Starting Activity

Objective

Upon completion of this activity, you will be able to safely test the starter.

Tools

Safety glasses, basic hand tools, VOM (volt-ohm meter/multimeter), current clamp, blocks for chocking tires, jack and jack stands (or an automotive lift)

Supplies

Shop rags

Cautions

Keep your hands away from moving components.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety glasses.
- Connect the vehicle's exhaust to the shop exhaust evacuation system or park vehicle outside.
- Apply the parking brake. Raise the end of the vehicle where the engine is located with a jack and support with jack stands (or use an automotive lift to raise the whole vehicle). Another method is to use drive-on ramps. Chock the tires on the opposite end of the vehicle before lifting when using the jack and jack stands method or drive-on ramps.
- Identify the starter, solenoid, ignition switch, battery, positive battery cable, negative battery cable, and fuse panel.
- Use the correct size wrench to check the starter mounting bolts. If they are loose, tighten them.
- Lower vehicle after identification.
- Set the VOM to Volts DC. Connect the red lead to the positive post and the black lead to the negative post on the battery. At this time the vehicle should not be running. Note the battery voltage. (Typical is between 12.5 and 12.8 volts.)
- This step disables the vehicle's engine so it should not start. If you are in a school lab, obtain approval before proceeding. Disable the ignition system or fuel system by removing the coil wire (if distributor type ignition system), fuel injection wires (throttle body fuel injection only), inertia switch (Ford), fuel pump cutoff switch, or pull a fuse to disable the ignition system or fuel system. Do not make guesses. If

unsure, bring vehicle to a qualified technician or obtain a service manual specific to the vehicle.

- Crank the engine over for 5 seconds and note the Volts while the engine is turning over. Keep away from moving parts. The engine should not start. (Typically, the voltage may drop to 9.5 volts.) Always refer to a manual specific to the vehicle being testing for exact acceptable readings. If voltage drop exceeds acceptable readings, the starter may have too much resistance. Refer to a service manual to perform other voltage drop tests between cable leads.
- Use a current clamp with an induction lead to read the current draw on the starter. While the ignition or fuel is still disconnected, put the current clamp induction lead over the main positive starter wire (usually the largest diameter one going to the starter). Follow the instructions with induction lead/VOM or a manual specific for the vehicle. Crank the engine over for 5 seconds and note the amperes. Keep away from moving parts. (Typically, the amps will read between 150 and 350, but always refer to a manual specific to the vehicle for exact acceptable readings.) Too much current draw may indicate a faulty starter.
- Reconnect the coil wire, fuel injection wires, or other method that was used to disable the fuel or ignition system.
- Check battery cable tightness on battery mounts. Tighten if necessary. When using a wrench to tighten battery cables, make certain that the wrench does not touch any metal on the vehicle.
- Clean and put away all tools and supplies. Disconnect shop exhaust evacuation system (if applicable).

Activity Journal

1. How many volts were present at the battery with the vehicle off?
2. What did you do to disconnect the fuel or ignition system on the vehicle being tested?
3. What did the battery voltage drop do when cranking over the engine?
4. How many amperes were drawn to the starter while cranking?
5. Were all your readings acceptable according to the manual specific to your vehicle?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 10: LUBRICATION SYSTEM

Oil and Filter Change Activity

Objective

Upon completion of this activity, you will be able to safely change the oil and filter on a vehicle.

Tools

Safety glasses, basic hand tools, correct size wrench for oil plug, oil filter wrench, jack and jack stands (or an automotive lift), oil drain pan, funnel, blocks for chocking tires (jack and jack stands method or when using drive-on ramps)

Supplies

Shop rags, latex gloves, correct type and amount of oil, oil filter

Cautions

Hot oil can cause burns.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety glasses.
- Warm the engine 5 to 10 minutes to loosen the contaminants and to thin the oil for draining.
- Put on latex gloves. Prolonged contact with used oil may cause skin cancer.
- Raise the engine end of the vehicle with jack and jack stands or lift the whole vehicle on an automotive lift. Another method is to use drive-on ramps. Chock the tires on the opposite end of the vehicle when using the jack and jack stands method, when using a drive-on lift, or drive-on ramps. Apply the parking brake.
- Locate the drain plug on the oil pan and position the oil drain pan to catch the oil.
- Use the correct size wrench to loosen (turn counter-clockwise) the oil drain plug. Use a shop rag to protect your hand from the hot oil. Keep a steady inward pressure on the plug to avoid the hot oil from running down your arm. If oil seems too hot to touch, allow the oil to cool.
- Make sure the oil will hit the oil drain pan.
- While the oil is draining, use an oil filter wrench to loosen and remove the oil filter.
- Set the oil filter in the oil drain pan so the oil can drain out of it.
- Make certain the old oil filter gasket comes off with the old filter. If it is stuck on the engine block, remove and discard it.
- Wipe off the oil filter mounting base and the area around the oil drain plug.
- Put a thin film of clean oil on the new oil filter-mounting gasket. This oil helps to seal the gasket. A dry gasket may tear when the filter is installed causing leaks.

- Read the instructions on the filter. Install the oil filter by rotating it clockwise. Once the gasket contacts the engine, tighten it according to the instructions - usually 1/2 to 1 full turn. A filter wrench may be necessary. Do not over tighten.
- Prior to reinstalling the drain plug, wipe off its threads and the sealing surface with a shop rag. Make certain that the plug's threads and gasket are in good condition before reinstalling. Replace if necessary.
- Install the drain plug by hand and temporarily tighten finger tight. Do not cross-thread the plug. Tighten the plug with the correct size of wrench until it is snug. Do not over tighten. If unsure how tight to get the plug, consult the owner's manual for torque specifications. Over tightening can cause thread damage, while under tightening may result in oil leakage.
- If you are in a school laboratory setting, have the instructor inspect the oil plug and filter.
- Lower the vehicle if you used a jack and jack stands method or an automotive lift.
- Locate and remove the oil filler cap. It is usually located on the valve cover. Using a funnel, pour the correct amount and type of oil into the filler opening. (Make sure the API and SAE ratings match what is listed in your owner's manual.)
- Start the engine and check for leaks. Extra attention should be given to the oil filter gasket and drain plug gasket. The oil pressure warning light may stay on for up to 5 seconds. If the light stays on longer than 5 seconds, shut the engine off and check for leaks. After about 30 seconds, shut off the engine. This amount of time is ample to circulate the oil throughout the engine and to fill the oil filter. If you used drive-on ramps, carefully back down them at this time.
- Let the engine sit for a couple of minutes to ensure a proper reading. Be sure the car is on level ground.
- Check the oil level on the dipstick and correct if necessary. Do not overfill.
- Recycle your old oil and filter. Do not throw away in the garbage. Bring them to the proper recycling facilities.
- Fill out and place an oil change sticker in the vehicle.
- Return all tools and clean up any oil spills with floor dry.
- If you are in a school laboratory setting, have the instructor check the oil level before closing the hood.

Activity Journal

1. Why should the engine be warm when changing the oil?
2. What SAE rating did your owner's manual suggest to use?
3. What API rating did your owner's manual suggest to use?
4. Why did you put a thin film of oil on the new oil filter gasket?
5. How many quarts of oil did your engine take?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 11: FUEL SYSTEM

Fuel System Activity

Objectives

Upon completion of this activity, you will be able to:

- Identify the components of the fuel system.
- Change the air filter on a vehicle.
- Change the CCV filter on a vehicle.
- Change the PCV valve on a vehicle.
- Change the fuel filter on a vehicle.

Tools

Safety glasses, basic hand tools, jack and jack stands (or an automotive lift), blocks for chocking tires (jack and jack stands method or when using drive-on ramps), shop vacuum, drain pan

Supplies

Shop rags, replacement parts (e.g., air filter, CCV filter, PCV valve, fuel filter) specific to your vehicle

Cautions

Have a fire extinguisher handy when working on the fuel system.

Procedure 1 Component Identification

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. Due to the variations in locations of components, a manual specific to vehicle would assist you in identifying component locations.

- Put on your safety glasses.
- Identify the location of the PCV valve.
- Identify the location of the CCV filter.
- Determine if the vehicle has multi-port fuel injectors, throttle body fuel injectors, or a carburetor.
- Identify the location of the air filter.
- Remove the fuel cap and clean the sealing surface. Replace the fuel cap after cleaning.
- Raise the end of the vehicle where the engine is located with a jack and support with jack stands (or use an automotive lift or drive-on ramps). Chock the tires on the opposite end of the vehicle when using the jack and jack stands method, when using a drive-on lift, or drive-on ramps. Apply the parking brake.
- Identify the location of the fuel filter.
- Identify the location of the fuel tank.
- Identify the location of the fuel lines.
- Identify the location of the fuel pump.

- Lower the vehicle.
- Look in the owner's manual and note the octane rating suggested for the vehicle.
- Clean and put away all tools.

Procedure 2 Changing the Air Filter

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. Due to the variations in air filter locations and replacement procedures, a manual specific to vehicle would assist you in filter replacement.

- Put on your safety glasses.
- Locate the air filter housing. On carbureted vehicles, the air filter housing usually sits on top of the engine directly over the carburetor. On fuel-injected vehicles, the air filter may be mounted on the engine or near the inner fender of the vehicle.
- Loosen the cover by removing the clips, screws, or wing nuts.
- Remove the cover.
- Note the position of the filter in the housing.
- Remove the old filter and compare to the replacement. It is not recommended to blow out the filter with air pressure. The air pressure can tear the filter element thus allowing dirt to enter the engine.
- Wipe out or vacuum the housing. Do not get dirt in the throttle body or air intake housing.
- Install the new air filter.
- Reinstall the air filter housing cover.
- Clean and put away all tools.

Procedure 3 Changing the CCV Filter

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. Due to the variations in CCV filter locations and replacement procedures, a manual specific to vehicle would assist you in filter replacement.

- Put on your safety glasses.
- Locate the air filter housing. On carbureted vehicles, the air filter housing usually sits on top of the engine directly over the carburetor. On fuel-injected vehicles, the air filter may be mounted on the engine or near the inner fender of the vehicle.
- Loosen the cover by removing the clips, screws, or wing nuts.
- Remove the cover.
- The CCV filter is commonly located inside the air filter housing.
- Remove the hose that attaches to the CCV filter.
- Remove the retaining clip.
- Remove the CCV filter.
- Install the new CCV filter.
- Reinstall the air filter housing cover.
- Clean and put away all tools.

Procedure 4 Changing the PCV Valve

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. Due to the variations in PCV valve locations and replacement procedures, a manual specific to vehicle would assist you in valve replacement.

- Put on your safety glasses.
- Locate the PCV valve. The PCV valve is usually located at the end of a hose and pushed into the valve cover.
- Remove the old PCV valve. It is usually just a push in connection.
- Compare the old valve to the new one.
- Install a new PCV valve.
- Clean and put away all tools.

Procedure 5 Changing the Fuel Filter

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. Due to the variations in Fuel Filter locations and replacement procedures, a manual specific to vehicle would assist you in filter replacement.

- Put on safety glasses.
- Locate the fuel filter.
- Relieve the fuel pressure. Check manual specific to your vehicle for procedure.
- Place a drain pan under the fuel filter.
- Remove the fuel filter. Some fuel filters need special tools to remove clips. If the fuel filter is threaded, use two line wrenches to prevent damage to the fuel lines.
- Clean the connections and threads.
- Install the new filter with flow arrow in the direction of the engine.
- Start engine and check for leaks. It may take a couple of cranks to fill the lines and new filter.
- Clean and put away all tools.

Activity Journal

1. Why shouldn't you blow out air filters with compressed air?
2. Where was your vehicle's air filter located?
3. Where was your vehicle's fuel filter located?
4. If fuel filters are threaded, why should you use two wrenches to loosen the connection?
5. Where is the fuel pump located on your vehicle?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 12: COOLING SYSTEM AND CLIMATE CONTROL

Air Conditioning Activity

Objective

Upon completion of this activity, you will be able to inspect and identify components within the air conditioning system.

Tools

Safety glasses

Supplies

None

Cautions

Keep your hands away from moving components.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety glasses.
- Connect the vehicle's exhaust to the shop exhaust evacuation system or park the vehicle outside. Apply the parking brake.
- Identify and locate the accumulator/receiver-drier.
- Identify and locate the compressor.
- Identify and locate the condenser.
- Identify and locate the evaporator.
- Turn the A/C controls to high and start the engine.
- Inspect the front of the compressor. The clutch on the front of the pulley should be turning.
- Smell inside the car as the A/C is blowing air. If the blower vents are releasing unpleasant odors, fungi/mold may be present in the ducts. This commonly indicates that the evaporative drain tube may be clogged.
- Inspect the evaporator drain tube. Water should be dripping from the tube. If water is dripping inside the vehicle, the evaporator drain tube may be clogged. This drain tube is located between the engine compartment and passenger compartment (this area is also known as the firewall) and releases water to the underside of the vehicle. If the drain becomes clogged, it can be cleaned by probing a long dull object into it. Some drain tubes need to be removed to be cleaned. Shut off the engine before crawling under the vehicle to clean the drain hose. Go to www.airsept.com to learn how to neutralize the odor after cleaning the drain tube. You will need to use an anti-microbial product to kill the mold that will also stop the odor from returning.

- Inspect the condenser fins. If debris is found, rinse free with a garden hose.
- Inspect the drive belts for cracks, splits, glazing, or oil-soaked. Replace if necessary.
- Inspect the drive belt tension. Tighten if necessary/applicable.
- Inspect the A/C hoses. Look for any signs of refrigerant oil leakage around fittings. If the fittings look wet, your system may be losing refrigerant. If it is, have it inspected by a qualified technician.

Activity Journal

1. What is the purpose of the condenser?
2. What is the purpose of the evaporator?
3. Why is it necessary to use an anti-microbial product when working to eliminate A/C odors?
4. How would debris in the condenser fins effect A/C system?
5. What would wet areas around A/C hose fittings indicate?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 12: COOLING SYSTEM AND CLIMATE CONTROL

Cabin Air Filter Activity

Objective

Upon completion of this activity, you will be able to replace the cabin air filter on a vehicle.

Tools

Safety glasses

Supplies

None

Cautions

None

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety glasses.
- Check your owner's or vehicle specific service manual to see if your vehicle has a cabin air filter. Cabin air filters are located in the HVAC duct. The filter may be accessible from under the hood or more commonly inside the passenger's compartment under the dash and behind the glove compartment. Some vehicles have two filters in the duct.
- Locate the cabin air filter location using the owner's or service manual.
- Identify how the filter is secured in place and remove. If you cannot determine how to replace, go to your local auto parts store and look at the replacement. Sometimes instructions are included inside the package.
- If accessible, use a vacuum to remove any debris. Wipe the area with a slightly damp shop towel. Then use a dry towel to remove any moisture.
- Install new filter and reverse the procedure for reassembly.

Activity Journal

1. What is the purpose of a cabin air filter?
2. Where was your vehicle's cabin air filter?
3. What types of tools were necessary to remove your cabin air filter?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 12: COOLING SYSTEM AND CLIMATE CONTROL

Cooling System Activity

Objectives

Upon completion of this activity, you will be able to:

- Safely test, inspect, and service the cooling system.
- Observe thermostat operation.

Tools

Safety glasses, funnel, garden hose, coolant tester, candy thermometer, portable electric burner, pan, basic hand tools

Supplies

Shop rags, correct type and amount of antifreeze, test thermostat

Cautions

Hot engine coolant can cause severe burns. Never remove a hot radiator cap.

Procedure 1 Inspection and Testing the Cooling System

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. A manual specific to the vehicle that you are inspecting could assist you in component identification.

- Put on your safety glasses.
- Let the engine cool. Never open a hot cooling system, it could spray pressurized coolant over 200 degrees F. Coolant can actually be above water's boiling point (212 degrees F). System pressure and antifreeze mixed with water raises the boiling point of the coolant.
- Identify and locate the radiator.
- Identify and locate the upper radiator hose.
- Identify and locate the lower radiator hose.
- Identify and locate the heater hoses.
- Identify and locate the heater core.
- Identify and locate the water pump.
- Identify and locate the radiator petcock (drain).
- Identify and locate the thermostat housing.
- Identify and locate the radiator cap.
- Place a shop rag over the radiator cap. Be certain that the cooling system is cool and pressure is relieved. Remove the radiator cap by twisting it while pushing down.
- Inspect and clean the radiator cap. Look for cracks in the rubber gasket.
- Note the pressure rating on the cap.
- Look inside the radiator. Clean the neck where the cap is installed.

- Before using the coolant tester, rinse it out with clean water.
- Use the coolant tester to test the coolant's freezing and boiling points. Squeeze the bulb to pull antifreeze into tester. Note the coolant's freezing and boiling points.
- Look at the coolant in the tester. Note whether the coolant is clean or dirty.
- Top off the coolant in the radiator if necessary. Use the correct type and mixture of antifreeze.
- Replace the radiator cap. Make sure it is on all the way. There is usually an arrow to line it up with the overflow hose.
- Check the coolant level in the coolant recovery tank. Add as necessary. Use the correct type and mixture of antifreeze.
- Inspect the radiator fins. They should be clean and straight. If debris is found, rinse free with a garden hose.
- Inspect the drive belts for cracks, splits, glazing, or oil-soaked. Replace if necessary.
- Inspect the drive belt tension. Tighten if necessary/applicable.
- Inspect the radiator hoses. Worn hoses will be excessively stiff or real spongy.
- Look for signs of coolant loss on hose connections, under the water pump, and in the radiator fins.
- Clean and put away all tools.

Procedure 2 Thermostat Operation

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. This lab uses a test thermostat to view thermostat operation.

- Put on safety glasses.
- Fill a pan about 3/4 full with warm water.
- Put a candy thermometer in the pan.
- Suspend the test thermostat in the pan with a piece of wire.
- Put pan on the electric burner and turn on high.
- Observe the thermostat as the water is heated. Note the temperature of the water when the thermostat starts to open. Note the temperature of the water when the thermostat fully opens.
- Turn off the electric burner.
- Let the water cool and observe the thermostat closing.
- Remove the test thermostat.
- Clean and put away all tools and supplies.

Activity Journal

1. What is the purpose of the heater core?
2. What are the freezing and boiling points of your coolant?
3. Why is it necessary to let the antifreeze cool before removing the radiator cap?
4. How would debris in the radiator fins effect the cooling of the engine?
5. At what temperature did the test thermostat fully open?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 13: IGNITION SYSTEM

Ignition System Activity

Objectives

Upon completion of this activity, you will be able to:

- Install spark plugs.
- Inspect, test, and install spark plug wires.
- Inspect and install distributor cap and rotor on distributor and conventional ignition systems.

Tools

Safety glasses, spark plug socket, ratchet wrench, VOM, shop vacuum, spark plug gap gauge, spark plug wire removing tool, fender cover, basic hand tools

Supplies

Shop rags, spark plugs, distributor cap and rotor (if applicable), spark plug wires (if desired to change), anti-seize compound, dielectric grease

Caution

Let the engine cool. Hot engine components can cause burns.

Procedure 1 Installing Spark Plugs

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety glasses.
- Let the engine cool.
- Use a fender cover to protect the vehicle's finish.
- Disconnect one spark plug wire at the spark plug by firmly grasping the boot and turning back and forth to loosen (or use a spark plug wire boot puller). Never pull on the cable - you could break the fragile wire inside. Only have one wire removed and replaced at a time to avoid mixing up the engine's firing order. On systems with coil-on-plug (COP) technology, remove the COP.
- Loosen the spark plug one complete turn with the ratchet wrench and spark plug socket.
- Vacuum around the spark plug with a shop vacuum. This will minimize the possibility of dirt getting inside the cylinder.
- Remove the spark plug the rest of the way.
- Inspect the spark plug's condition. Note whether the insulator is cracked, oil deposits are present, electrode worn, blow-by on ceramic, or carbon deposits are present.
- Adjust the gap on the new spark plug. Use a service manual or refer to the vehicle emission control information sticker under the hood of the vehicle for gap specifications. Make sure you are using the correct replacement spark plug. Double

check your numbers and compare to the old plug. Different brands will use different numbers. The plug and electrode length should look similar to the old plug.

- Some vehicles use a spark plug that has an O-ring washer. If your engine uses this type, make certain that the ring is placed over the threads. Other engines commonly use a tapered seat, where no ring is necessary.
- Put a small dab of anti-seize compound on the upper threads of the spark plug. Thread the spark plug in by hand. Finish tightening the spark plug using manufacturer's torque specifications. (A common rule of thumb is to tighten O-ring style plugs 1/4 turn past finger tight and tighten tapered style plugs 1/16th of a turn past finger tight. Do not over tighten.)
- Put a dab of dielectric grease in the boot of the spark plug wire.
- Replace the spark plug wire or COP unit. A snap/click should be felt.
- Repeat the procedure for remaining spark plugs.
- Clean and put away all tools.

Procedure 2 Inspecting and Installing Spark Plug Wires

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on safety glasses.
- Let engine cool.
- Use a fender cover to protect the vehicle's finish.
- Disconnect one spark plug wire at the spark plug by firmly grasping the boot and turning back and forth to loosen (or use a spark plug boot puller). Never pull on the cable - you could break the fragile wire inside. Remove one wire at a time to avoid mixing up the engine's firing order.
- Disconnect the other end of the same spark plug wire at the distributor cap on distributor ignition vehicles or on the coil pack on electronic (distributorless) vehicles.
- Use the VOM to test the resistance of the spark plug wire. As a general rule, spark plug wires should have no more than 7,000 ohms of resistance per foot.
- Inspect the spark plug wire's condition for cracks, punctures, or burn marks. Note its condition.
- If replacing, remove the spark plug wire from the vehicle - noting the routing.
- Compare the old wire to the new one.
- Route the new wire, using the original clips or brackets.
- Put a dab of dielectric grease in the boot at both of the ends.
- Reinstall the spark plug wire on both ends. A snap/click should be felt.
- Repeat procedure for remaining spark plug wires, replacing one at a time.
- Start the engine.
- Clean and put away all tools.

Procedure 3 Inspecting and Installing a Distributor Cap and Rotor

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on safety glasses.
- Let engine cool.
- Use a fender cover to protect the vehicle's finish.
- Locate the distributor cap. Do not remove the spark plug wires at this time.
- Remove the distributor cap by the screws or clips.
- Turn cap upside down and inspect it for cracks and burns.
- Inspect the terminals inside the cap for corrosion.
- Remove the rotor from the distributor. Screws are used to attach some rotors, while others just pull off.
- Inspect the rotor's terminal for corrosion.
- If replacing the distributor cap, remove one spark plug wire on the old cap and replace it in the same place on the new cap. Use dielectric grease in each boot end. Continue until all wires have been transferred.
- Reinstall rotor (or replace with new one if needed). Replace the cap and rotor as a set.
- Replace the cap and secure by the screws or clips.
- Clean and put away all tools.

Activity Journal

1. Why should you grasp the boot of the spark plug wire and not the cable itself when removing the wire?
2. Why should you vacuum around a spark plug before removing it?
3. What did you put on the upper threads of the spark plug? Why?
4. What did you put in the boot of the spark plug wire? Why?
5. What is the gap on your engine's spark plugs?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 14: SUSPENSION AND STEERING SYSTEM

Suspension and Steering Activity

Objective

Upon completion of this activity, you will be able to safely inspect and perform basic service procedures on suspension and steering components.

Tools

Safety glasses, jack and jack stands (or automotive lift), blocks for chocking tires, grease gun

Supplies

Shop rags, chassis grease

Cautions

Be sure to chock wheels and use jack stands before going under a vehicle.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety glasses.
- Perform a bounce test. To test the shocks and/or struts on a vehicle push down as hard as you can on the end that you want to test and then let go. The vehicle should come to a rest after one cycle. If it cycles more than once, the shocks, struts, or springs could be worn.
- Raise the vehicle with a jack and support with jack stands or lift the whole vehicle on an automotive lift.
- Chock the tires on the opposite end of the vehicle when using the jack and jack stands method.
- Inspect the shocks/struts for signs of leakage. Note their condition.
- Identify and locate the outer tie rods, ball joints, and other steering linkage. If unsure of the location of components, use a manual specific to the vehicle to assist you. Note whether the vehicle uses a parallelogram steering system or a rack and pinion steering system.
- If the vehicle has springs (leaf or coil), identify them at this time. Inspect the springs for cracks or breaks.
- Identify, locate, and grease the grease fittings. Look for points that pivot. Place the grease gun on the grease zerk. Just pump the grease gun enough to fill the cavity. Excess grease can drop on the inside of the wheel and throw the wheel off balance - wipe off all excess grease with a shop rag. Be sure to use the correct type of grease for your vehicle.

- Do not oil or grease rubber components. Grease can cause rubber to swell and crack prematurely.
- Lower the vehicle.
- Locate the power steering pump. Check the fluid with the engine off. Some dipsticks have a full cold and a full hot line. Add correct type of fluid if necessary. Check the owner's manual for fluid specifications.
- Clean and put away all tools.

Activity Journal

1. How many grease fittings did your vehicle have?
2. Why should you wipe off excess grease?
3. Did all the pivoting points have grease fittings? Why or why not?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 14: SUSPENSION AND STEERING SYSTEM

Tire Inspection and Rotation Activity

Objectives

Upon completion of this activity, you will be able to safely:

- Inspect tires for wear.
- Rotate tires.

Tools

Safety glasses, jack and jack stands (or automotive lift), tread depth gauge, tire pressure gauge, lug wrench (manual or pneumatic), torque wrench, basic hand tools

Supplies

Shop rags, anti-seize compound

Cautions

Never use only a jack to support a vehicle. Use approved jack stands for safety.

Procedure 1 Tire Inspection

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety glasses.
- Check the owner's manual, tire placard (commonly inside driver's door), or tire sidewall for correct tire pressure. It should be noted that the pressure rating on the tire sidewall is the maximum pressure. The recommended tire pressure is calculated according to type of tire, weight of vehicle, and the desired ride. Tire inflation changes with temperature. For every 10 degrees Fahrenheit drop in temperature, tire pressure is lowered by 1 psi.
- Use a tire pressure gauge to check the tire pressure on each tire. Do not forget to check the air pressure in the spare tire.
- Adjust the air pressure as necessary.
- Check the tread depth on each tire using the tread depth gauge. Note the readings in 1/32nd's (industry standard) of an inch.
- Check all tires for wear. Look for bald spots (wheel out of balanced), wear on one edge (camber incorrect), wear in the center (over inflated), both edges worn (under inflated), cupped (worn parts), and feathering (incorrect toe).
- Identify the current UTQG ratings (traction, temperature, treadwear) on each tire.
- Clean and put away all tools.

Procedure 2 Tire Rotation

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety glasses.
- Check the owner's manual for recommended tire rotation patterns.
- Remove wheel covers if applicable. Check the owner's manual for procedure. Some covers (hubcaps) have locking mechanisms that need to be removed first.
- Loosen lug nuts one complete turn with a lug wrench, but no further.
- Use jack and jack stands (or an automotive lift) to raise and support the vehicle.
- Note the position of each tire.
- Remove the lug nuts on each tire.
- Remove each tire and move it to the new location according to the owner's manual recommendations.
- Apply anti-seize compound to the wheel stud threads.
- Start all lug nuts by hand. Do not cross-thread nuts.
- Spin the nuts on with a lug wrench and snug. Use a star pattern when tightening lug nuts. Do not use a pneumatic wrench at this time.
- Lower the vehicle just until the tires touch the ground.
- Check the owner's manual or specification's chart for torque recommendations.
- Use a torque wrench or color-coded torque sticks with an impact wrench to tighten the lug nuts on each wheel. When tightening, use a star pattern. Failure to torque wheels may result in warped brake rotors. Under torqued wheels may allow the wheel to work loose and come off when driving, causing a hazardous situation.
- Completely lower the vehicle.
- Recheck all lug nuts with the torque wrench.
- Replace wheel covers.
- Clean and put away all tools.

Activity Journal

1. What were the recommended pressure ratings for your vehicle's tires?
2. How tight did you tighten your wheels in lb-ft?
3. Why is it necessary to torque wheels?
4. Most new passenger tires come with 11/32nd's of an inch of tread (truck and SUV tires may differ). How much tread did each of your tires have?
5. Why is it important to rotate tires?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 15: BRAKING SYSTEM

Brake Inspection Activity

Objective

Upon completion of this activity, you will be able to safely inspect the disc brakes on a vehicle.

Tools

Safety glasses, torque wrench, jack and jack stands (or an automotive lift), blocks for chocking tires, ruler, fender cover, basic hand tools

Supplies

Shop rags, anti-seize compound, correct type and amount of brake fluid

Cautions

Brake fluid will burn the eyes. Wear safety glasses and know the location of the eyewash station. Brake fluid will strip paint. Avoid dripping brake fluid on a vehicle's finish. Do not mix different types (DOT 3, 4, 5) of brake fluid.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety glasses.
- Pop open the hood.
- Use a fender cover to protect the vehicle's finish.
- Check the fluid in the master cylinder. On some reservoirs, the fluid level can be checked by simply looking at the clear reservoir. On others, the cap may need to be removed. Some master cylinder caps screw on, others have clips, while others snap off. The fluid should be about 1/4th of an inch from the top (or at the full line on clear reservoirs). Read the owner's manual if unsure.
- Identify the type (DOT 3, 4, 5) of brake fluid that is recommended for your braking system.
- If necessary, add the correct type of fluid. Do not spill fluid on the vehicle's finish - it will strip paint.
- Chock one back tire.
- Remove the front wheel covers.
- Loosen front wheel lug nuts one turn.
- Jack up the front of the vehicle and support with jack stands (or use an automotive lift).
- Completely remove the lug nuts and the front wheels.

- Identify brake system components: caliper, inner and outer brake pads, brake rotor, rubber brake lines, and steel lines. Use a manual specific to your vehicle if you are unsure of component locations.
- Inspect rubber brake lines for cracks. Rubber lines are used to allow for turning and suspension travel (up and down movements).
- Use a ruler to measure the brake pad thickness. Measure only the pad, not the metal backing. Brake pads with less than 1/8th of an inch are usually considered worn out. Measure both inner and outer pad on disc brakes.
- Inspect rotors for grooves. Large grooves indicate brake pads are completely worn.
- Replace the wheels.
- Start all lug nuts by hand. Snug up lug nuts in a star pattern.
- Lower vehicle just until the tires are touching the ground.
- Tighten lug nuts in a star pattern to manufacturer's torque specifications.
- Lower the vehicle completely.
- Double check lug nut torque tightness.
- Replace wheel covers.
- Clean and put away all tools.

Activity Journal

1. What should you be aware of when handling brake fluid?
2. What is the condition of your brake pads and rotors?
3. Why do auto manufacturers use rubber hoses to connect to brake calipers?
4. What are some visual signs of a worn brake rotor?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 16: DRIVETRAINS

Drivetrain Activity

Objective

Upon completion of this activity, you will be able to safely inspect drivetrain components.

Tools

Safety glasses, wheel chocks, jack and jack stands (or an automotive lift), grease gun, basic hand tools

Supplies

Shop rags, grease, transmission fluid (if needed), differential fluid (if needed)

Cautions

Be sure to chock wheels and use jack stands before going under a vehicle.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. A manual specific to your vehicle can assist you in component identification and specific service procedures. Whenever adding fluids, consult your owner's manual for correct fluid specifications.

- Put on your safety glasses.
- Raise the vehicle with jack and jack stands or on an automotive lift. Chock the tires on the opposite end of the vehicle when using the jack and jack stands method.
- Identify whether your vehicle is front-wheel drive, four-wheel drive, all-wheel drive, or rear-wheel drive.
- Identify the location of the transmission.
- Determine whether your transmission is manual, automatic, or continuously variable.
- Identify the location of the drive shaft, constant velocity shafts, and/or U-joints.
- Some U-joints can be greased. Look for a grease zerk. If applicable, use the grease gun to lube the joint. U-joints do not hold much grease, so pump the gun slowly. Some four-wheel drive vehicles have front drive shafts with slip joints with a grease zerk.
- If your vehicle has CV joints, check the rubber boots for cracks. If cracks are present, the boots should be replaced by a qualified technician.
- If your vehicle has a manual transmission, check the fluid at this time (use owner's or vehicle specific manual to assist you) only if the vehicle is level. If the vehicle is not level, you will need to lower the vehicle. Commonly this task is completed by removing a plug. The oil should be at the bottom of the hole. Add the correct type and amount of fluid if necessary. Replace the plug.
- Lower the vehicle.

- If your vehicle has an automatic transmission, check the fluid at this time. Commonly this task is completed by starting the vehicle and letting it run in park or neutral (the dipstick often indicates whether the vehicle should be in park or neutral). Pull out the dipstick, wipe it off, and reinstall. Pull it back out and read the level. Add the correct type and amount of fluid if necessary.
- Replace the dipstick.
- Recheck the fluid.
- If your vehicle has a continuously variable transmission, check the fluid at this time. Follow the owner's or service manual for procedure.
- On rear-wheel, four-wheel, and all-wheel drive vehicles, check the differential fluid. Add the correct type and amount fluid if necessary.
- Clean and put away all tools.

Activity Journal

1. What is your vehicle's drivetrain system?
2. What type of transmission does your vehicle have? How do you know?
3. Why do you think that an engine in a front-wheel drive vehicle is positioned differently than a rear-wheel drive vehicle?
4. What type of transmission fluid is recommended for your vehicle?
5. Why do you think cracks in CV boots could harm the joint?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 17: EXHAUST AND EMISSIONS SYSTEM

Exhaust and Emissions Activity

Objective

Upon completion of this activity, you will be able to safely inspect exhaust and emission components.

Tools

Safety glasses, hammer, jack and jack stands (or an automotive lift), wheel chocks

Supplies

Shop rags

Cautions

Let the exhaust system cool. Engine components stay hot for long periods of time.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. A manual specific to your vehicle can assist you in component identification and specific service procedures.

- Put on your safety glasses.
- Raise the vehicle with jack and jack stands or on an automotive lift. Chock the tires on the opposite end of the vehicle when using the jack and jack stands method.
- Identify the tail pipe. Inspect for holes, corrosion, and loose or broken hangers.
- Identify the muffler. Inspect for holes, corrosion, and loose or broken hangers.
- Take a hammer and lightly tap on the muffler. If it sounds like there is loose material inside, the muffler might be worn.
- Identify the intermediate exhaust pipe. Inspect for holes, corrosion, and loose or broken hangers. Inspect the connection to the catalytic converter.
- Identify the catalytic converter. Inspect the heat shield. It should be secure. Use large steel hose clamps to secure the heat shield if a weld is broken.
- Identify the exhaust pipe in front of the catalytic converter. Inspect for holes, corrosion, and loose or broken hangers. Inspect the connection at the exhaust manifold(s). The pipe should be secure. Look for cracks or black marks on the exhaust manifold(s). A black carbon mark identifies a leak.
- Identify the oxygen sensor(s). Often oxygen sensors are placed between the catalytic converter and the exhaust manifold. Some vehicles also have oxygen sensors after the catalytic converter. Oxygen sensors have wires going to them. Inspect the connection and wire insulation.
- Identify the evaporative emissions canister. It is commonly located near the fuel tank. Inspect the rubber lines that are attached to it.

- Lower the vehicle.
- Pop the hood open.
- Identify the exhaust manifold(s) from inside the engine compartment. Look for black carbon deposits.
- Identify the PCV valve. It is usually located on the valve cover or between the valve cover and the air filter housing. Inspect the hoses for cracks.
- Identify the EGR valve.
- Connect the vehicle's exhaust to the shop exhaust evacuation system or park outdoors.
- Start the vehicle.
- Listen for and locate any exhaust leaks.
- On a blank sheet of paper draw a picture of your exhaust system. On your drawing label all exhaust components, clamps, and hangers. Identify any holes or corrosion on your drawing.
- Clean and put away all tools.

Activity Journal

1. Why might tapping on the muffler with a hammer identify whether or not the muffler is worn?
2. Were the exhaust system components on your vehicle connected by welds or clamps?
3. Overall, how would you rate the condition of your vehicle's exhaust system?

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CHAPTER 18: ALTERNATIVE FUELS AND DESIGNS

Payback Period Activity

Objective

Upon completion of this activity, you will be able to calculate payback period on an alternative fueled vehicle.

Tools

Computer with Internet access, calculator (or use the calculator on the computer)

Supplies

None

Cautions

None

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Log onto your computer and open up an Internet browser.
- Type in the following Internet address - www.kbb.com.
- Click on *New Car Pricing*.
- Follow the instructions on the website to price out two similar vehicles. Choose one vehicle that is gasoline powered and one that is a hybrid. For example, in 2007 Toyota produced a gasoline Camry and a hybrid (gasoline-electric) Camry.
- Note the manufacturer, make, model, year, and highway mpg of both vehicles. For this activity, use MSRP as the comparable price.
- Use a table to organize your data.

	Manufacturer	Make	Model	Year	Hwy MPG	MSRP
Conventional						
Hybrid						

- Calculate the MSRP difference. (Hybrid MSRP – Conventional MSRP = MSRP Difference)
- Note the current cost of fuel.
- Calculate the fuel cost per mile for each vehicle.
- \$ gal/mpg = Cost Per Mile
- Calculate the Cost Per Mile difference.
- Conventional Cost Per Mile - Hybrid Cost Per Mile = Cost Per Mile Difference
- Calculate the number of miles to break even.

- MSRP Difference/Cost per Mile Difference = # of miles to break even with the initial investment
- Note: This number only takes into consideration the cost of fuel and no other maintenance costs or environmental benefits.
- Log off your computer.

Activity Journal

1. What other factors could increase or decrease the payback period?
2. What are environmental benefits of choosing a hybrid?
3. How would negotiating a better deal on the hybrid impact the payback period?
4. How would tax credits or other incentives on the hybrid impact the payback period?
5. What would happen to the payback period if fuel price doubled?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 19: AUTOMOTIVE ACCESSORIES

Automotive Accessories Activity

Objective

Upon completion of this activity, you will be able to estimate the cost of accessories for a vehicle.

Tools

Computer with Internet access, calculator (or use the calculator on the computer)

Supplies

None

Cautions

None

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Identify a vehicle of your choice. Note the manufacturer, make, model, and year.
- Make a list of accessories that you would like to add to the vehicle. Examples include anything from mud guards to car covers to rear spoilers to a trailer hitch.
- Log onto your computer and open up an Internet browser.
- Type in the following Internet address - www.autoanything.com.
- Use this Internet site to estimate the cost of the accessories. If you choose accessories that need professional installation or finishing (e.g., parts that need to be painted by a body shop), call local service centers for estimates.
- Use a search engine (e.g., Google) to find other suppliers of automotive accessories.
- Compare prices from multiple sources.
- Organize your information in a table or use a spreadsheet program such as Microsoft Excel.
- Log off your computer.

Activity Journal

1. What types of accessories did you choose and why?
2. What factors contribute to the overall cost?
3. Were all the accessories that you wanted available for your vehicle? If not, explain why.
4. How much did the price of a similar accessory vary from one vendor to another?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 20: COMMON PROBLEMS AND ROADSIDE EMERGENCIES

Changing a Flat Tire Activity

Objective

Upon completion of this activity, you will be able to safely change a spare tire. The purpose of this lab is to simulate changing a flat tire on the side of the road.

Tools

Torque wrench, wheel chocks, and tools in the vehicle (e.g., jack, lug wrench)

Supplies

Shop rags, anti-seize compound, gloves

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Read the owner's manual to find the location of the spare tire, jack, lug wrench, and jacking location.
- Remove the jack, lug wrench, and spare tire from vehicle.
- Set the emergency/parking brake.
- Remove the wheel cover on the flat tire. Using the lug wrench provided with the vehicle, loosen lug nuts one complete turn.
- Read the owner's manual to determine where to place the jack under the vehicle. These types of jacks are less stable than large floor jacks - so make sure you put the jack where the manufacturer recommends.
- Chock (block) one wheel at the opposite end of the vehicle. Jack up the vehicle.
- Remove the lug nuts.
- Put on gloves.
- Using your legs (not your back), remove the flat tire (watch out for dangerous cords that might be sticking out from a blown tire). Lay the flat tire on the ground under the vehicle. If the jack failed, it could help to keep the vehicle from crushing you.
- Carefully lift the spare tire into place.
- Start all lug nuts by hand (cone end towards wheel) and snug with the lug wrench using a star pattern. Move the flat tire out from under the vehicle.
- Slowly lower the vehicle just until the tire touches the ground.
- Finish tightening up the spare with a lug wrench. Completely lower the vehicle.
- If you are in a school laboratory, have the instructor check the spare.
- If you were completing this activity for practice, replace your original tire by repeating the procedure. Use a torque wrench to correctly torque the original wheel's lug nuts.

- Check the tire pressure in all the tires, including your vehicle's spare tire. Tire pressure information is found on the tire placard located on the driver's door jamb.
- Put the spare, jack, and lug wrench neatly back into the vehicle.

Activity Journal

1. Where is the spare tire located on your vehicle?
2. Is the spare tire different than the rest of your vehicle's tires?
3. What are some precautions you should take when lifting a tire?
4. Why did you chock (block) a tire on the opposite end of the vehicle while changing a flat tire?
5. What is the recommended torque specification for your vehicle's wheels?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 20: COMMON PROBLEMS AND ROADSIDE EMERGENCIES

Jump-Starting Activity

Objective

Upon completion of this activity, you will be able to safely jump-start a vehicle.

Tools

Safety goggles, jumper cables

Supplies

Shop rags

Cautions

It is a must to wear safety goggles while performing this activity. Know where the eyewash station is and how to use it. Do not allow flame or sparks near battery gases. Battery gases can explode. Make sure you follow the correct procedure for hooking up the cables. Never try to jump-start a frozen battery. Keep your hands away from moving engine components.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance.

- Put on your safety goggles.
- Remove rings and watches.
- Complete a visual inspection on the battery. Check for loose battery cables, corroded terminals, deposits on connections, cracks or leaks in the case, and frayed or broken cables. Correct problems if necessary.
- Maneuver the booster vehicle near the vehicle with the discharged battery. Do not let the two vehicles touch.
- Turn off the ignition switch, lights, and accessories in both vehicles. Place both vehicles in Park (automatic transmission) or Neutral (manual transmission) and engage the parking brake.
- Identify the positive (+) and negative (-) posts on both batteries. Do not assume the color of the cable reflects if the post is positive (+) or negative (-). Look for the positive (+) or negative (-) on each battery.
- Open the vent caps if possible. Do not remove vent caps on sealed batteries. Make certain that the cells are full with electrolyte to the bottom of the filler neck. If not, add distilled water. Do not overfill. Never try to jump-start a frozen battery. Once the fluid level has been checked, replace the vent caps.
- Make sure the battery cables are tight on the terminals.
- Connect the positive jumper cable clamp (usually red) to the positive (+) terminal on the discharged battery. Do not allow jumper cables to touch any other part of the

vehicle or each other. Note: Some vehicles have junction blocks to connect the positive cable to instead of connecting directly to the battery. Always check owner's manual before proceeding.

- Connect the other positive jumper cable clamp to the positive (+) terminal of the booster vehicle.
- Connect the negative jumper cable clamp (usually black) to the negative (-) terminal of the booster vehicle.
- Put shop rags over both batteries.
- Connect the other negative jumper cable clamp to a clean metal part of the discharged vehicle's engine block or frame. Position the clamp as far away from the battery as possible. This connection will usually spark when clamped. This spark indicates a completed circuit. Do not make this connection directly to the battery. A spark near the battery could result in an explosion.
- Start the engine on the booster vehicle and rev the engine slightly. Allow the battery to charge for 15 minutes.
- Turn off all accessories (e.g., heater, lights). Anyone near should stand clear of the discharged vehicle while you attempt to start.
- Do not crank the engine for more than 20 seconds at a time. Starter damage could result.
- Allow starter to cool for a minimum of 2 minutes between cranking sessions.
- If the discharged vehicle's battery turns over very slow, allow the battery to charge for an additional 15 minutes.
- If the engine starts, proceed with the following.
- Disconnect the negative (-) jumper cable from the previously discharged vehicle. Do not allow jumper cables to touch any other part of the vehicle or each other.
- Disconnect the negative (-) jumper cable from the booster vehicle.
- Disconnect the positive (+) jumper cable from the booster vehicle.
- Disconnect the positive (+) jumper cable from the previously discharged vehicle.
- Neatly put away jumper cables for future use.
- Allow previously discharged vehicle to idle for 15 to 30 minutes.
- Identify what (e.g., lights being left on) caused the battery to go dead on the previously discharged vehicle.
- Shut off vehicle and try to restart.
- If battery continues to be discharged, test the battery and alternator.
- Clean and put away all tools and supplies. Wash your hands thoroughly.

Activity Journal

1. What caused the disabled vehicle's battery to be discharged?
2. Why is important to follow the correct cable hook-up procedure when jump-starting a battery?
3. What and where should the last connection be made when jump-starting a battery?

4. Why do you think you should turn off all of the vehicle's accessories?
5. Why shouldn't you crank the disabled vehicle's engine for more than 20 seconds?

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CHAPTER 20: COMMON PROBLEMS AND ROADSIDE EMERGENCIES

Lighting Activity

Objective

Upon completion of this activity, you will be able to replace various lights on a vehicle.

Tools

Safety glasses, basic hand tools, VOM (volt-ohm meter/multimeter), Phillips screwdriver, flat-head screwdriver, nut drivers, torx screwdrivers, rubber gloves

Supplies

Shop rags

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. Use the following list as a guide. Not all vehicles will have all the lights listed. Note any lights that do not work.

- Put on your safety glasses.
- Passenger's side headlight - high and low beam.
- Driver's side headlight - high and low beam.
- Front passenger's side marker - comes on with headlights.
- Front driver's side marker - comes on with headlights.
- Rear passenger's side marker - comes on with headlights.
- Rear driver's side marker - comes on with headlights.
- Rear passenger's taillight - comes on with headlights.
- Rear driver's taillight - comes on with headlights.
- License plate light - comes on with headlights.
- Rear passenger's brakelight - you need to press the brake pedal.
- Rear driver's brakelight - you need to press the brake pedal.
- Turn key to on position, but do not start engine.
- Front passenger's turn signal.
- Front driver's turn signal.
- Rear passenger's turn signal.
- Rear driver's turn signal.
- Backup lights - key is on, gear in reverse, parking brake on, but engine is not running.
- Cornering lights - a bright light that comes on that helps to see around a corner. The corresponding turn signal light needs to be on.
- Glove box light.
- Storage box lights.
- Instrument gauge lights.

- Shift indicator lights.
- Map lights.
- Fog lights.
- Engine compartment light.
- Trunk compartment light.
- Other lights.

Notes

If any of the lights you checked need replacing, follow a manual specific to your vehicle for replacement procedures. Most vehicle owner's manuals will show you how to replace basic light bulbs. If your vehicle has composite style headlights, do not touch the bulbs. If you accidentally touch the bulb, clean it off with rubbing alcohol. Try not to force plastic parts, some easily break. If the bulb still doesn't light after replacing the bulb, test the socket for voltage with a light tester or VOM (volt-ohm meter). When replacing bulbs, use dielectric grease in the sockets/connectors to inhibit corrosion.

Activity Journal

1. Why is it important to keep all the lights working on a vehicle?
2. Did your vehicle have any lights not listed in the activity?
3. Why do you think you shouldn't touch composite light bulbs?
4. If you test the socket for voltage, how many volts should be present?
5. Why do you think some bulbs have two wires/filaments in them?

AUTO UPKEEP: BASIC CAR CARE, MAINTENANCE, AND REPAIR

CHAPTER 20: COMMON PROBLEMS AND ROADSIDE EMERGENCIES

Replacing Wipers Activity

Objective

Upon completion of this activity, you will be able to replace wiper blades on a vehicle.

Tools

Safety glasses

Supplies

New wiper blades

Cautions

After removing the wiper blade from the wiper arm, do not allow the wiper arm to snap back and hit the windshield. This forceful action could cause the windshield to crack.

Procedure

Check off when completed. If you have any questions during the duration of this activity, stop and ask the instructor (if available) for assistance. Use the following list as a guide. Read the instructions that accompany the replacement wiper blades. The following are the three most common types of wiper arm connectors.

Hook Style

- Put on your safety glasses.
- Compare the new wiper to the old wiper to ensure you have the correct length.
- Read the instructions that accompany the replacement wiper blade.
- Raise the wiper blade assembly up from the windshield and locate the lock assembly.
- Remove any covers if applicable. A wiper blade may have a little cover over the blade lock assembly. If yours has a cover, push the cover tabs to release the cover.
- Grip the blade firmly with your fingers on both sides where the wiper arm connects to the wiper blade.
- Press the lock tab to release the wiper blade from the wiper arm.
- Move the blade assembly toward the wiper arm to release the wiper arm hook.
- Remove the old blade assembly once it is free from the wiper arm hook.
- Install the new wiper blade. Position the wiper arm hook in front of the groove on the wiper blade. Slide the wiper blade into the wiper arm by pushing the blade away from the wiper arm hook. You should here a clicking sound when it locks into place.
- Repeat the above steps for other wipers on the vehicle. Remember, some vehicles also have rear wipers.
- Check the windshield washer fluid reservoir. Add fluid as needed and test the wipers. Some rear wipers have a separate reservoir in the rear of the vehicle.

Pin/Side Lock Style

- Put on your safety glasses.
- Compare the new wiper to the old wiper to ensure you have the correct length.
- Read the instructions that accompany the replacement wiper blade.
- Raise the wiper blade assembly up from the windshield and locate the lock assembly.
- Grip the blade firmly with your fingers.
- Locate the locking button. Inspect the attachment to determine how to remove the wiper blade. Some pin/side lock wipers have a slot to insert a small screwdriver to release the spring tension or a spring lock that requires being pulled up. Other styles require flexing the blade away from the windshield at the pivoting points to release spring tension.
- Remove the old blade assembly once it is free from the wiper arm pin.
- Install the new wiper blade. Usually you only need to push the wiper onto the pin. You should here a clicking sound when it locks into place.
- Repeat the above steps for other wipers on the vehicle. Remember, some vehicles also have rear wipers.
- Check the windshield washer fluid reservoir. Add fluid as needed and test the wipers. Some rear wipers have a separate reservoir in the rear of the vehicle.

Straight/Bayonet Connector Style

- Put on your safety glasses.
- Compare the new wiper to the old wiper to ensure you have the correct length.
- Read the instructions that accompany the replacement wiper blade.
- Raise the wiper blade assembly up from the windshield and locate the lock assembly.
- Grip the blade firmly with your fingers.
- Detach the blade by pressing a locking latch. Some types require little screws to be removed.
- Move the blade assembly away from the wiper arm to remove the old blade assembly.
- Install the new wiper blade. Reverse the procedure to reinstall, sliding the wiper blade toward the wiper arm. You should here a clicking sound when it locks into place. If the bayonet connector used two little screws and lock washers, be careful not to drop them when reinstalling.
- Repeat the above steps for other wipers on the vehicle. Remember, some vehicles also have rear wipers.
- Check the windshield washer fluid reservoir. Add fluid as needed and test the wipers. Some rear wipers have a separate reservoir in the rear of the vehicle.

Notes

It is best to replace wipers in pairs and the whole blade, not just the rubber “refill” component. If the metal pivoting points and spring mechanisms have worn out, the blade will apply uneven

pressure across the windshield. Skipping, chattering, or streaking wipers can cause a hazardous driving condition.

Activity Journal

1. Why is it important to replace the wipers when they are worn?
2. What type of wiper blade arms (hook, pin/side lock, or straight/bayonet) did your vehicle have?
3. What parts of the wipers wear out?
4. Were the instructions that accompanied the wipers helpful? Why or why not?
5. What difficulties did you encounter when replacing the wipers?