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# CHAPTER 17

## Vehicle Systems and Maintenance

Good drivers make sure that their vehicles are safe to drive. Good drivers understand their vehicles' different systems and make sure that those systems are properly maintained.

### **LESSON ONE**

Checking Your Vehicle Before and After You Start the Engine

### **LESSON TWO**

Becoming Familiar with the Engine and Power Train

### **LESSON THREE**

Understanding and Maintaining Vehicle Systems

### **LESSON FOUR**

Suspension, Steering, Brakes, and Tires

## LESSON ONE

### OBJECTIVES

1. List several things on your vehicle that you can inspect before entering it.
2. List what to check after starting the engine.
3. Explain when to have your vehicle serviced.

◆ Before you enter your vehicle, check under the hood for items such as the coolant level.

# Checking Your Vehicle Before and After You Start the Engine

You've probably heard the old saying that an ounce of prevention is worth a pound of cure. That maxim is especially important for drivers.

Inspecting and caring for your vehicle before something goes wrong can save you both money and aggravation. More important, maintaining your vehicle can save your life.

Different makes and models are alike in some ways, different in others. To be able to check your particular model properly, you should refer to the owner's manual. If you don't have the manual for your vehicle, obtain a copy from a dealer or order one from the manufacturer. Manuals are also available in many bookstores. Keep the manual in your glove compartment so you'll have it handy when you need it.

## What Can You Inspect Before Entering Your Vehicle?

You don't need to be a mechanic to inspect your vehicle. You can check many items quickly and easily before driving. Make these checks at least once a month and before long drives.

In addition to the guidelines below, refer to Chapter 7 for other important predriving checks and procedures.

### Fluid Levels

- You can inspect the different fluid levels. Check:
- the engine oil (when the engine is cool and not running).
  - the level of coolant in the radiator overflow tank or radiator.
  - the transmission fluid and the fluid level in the power-steering and master-brake-cylinder reservoirs.
  - the battery fluid (if necessary for your battery).
  - the windshield-washer fluid.



## Belts, Hoses, and Wires

Before you enter your vehicle, inspect belts, hoses, and wires.

- Check the fan belt and the belts that run the power-steering and air-conditioning units. Many new vehicles have only one belt that drives these units. Belts may need tightening or adjustment. Replace frayed or cracked belts as soon as possible.
- Check all hoses and hose connections for leaks.
- Look for loose, broken, or disconnected wires. Also check for cracked insulation on wires.
- Make sure the battery cables are tightly connected and the terminals are free of corrosion.



◆ *Learning how to do your own maintenance can save you the cost and inconvenience of repairs.*

## What Can You Check After Starting the Engine?

Once your engine is running, you should make several routine checks to ensure that your vehicle is operating properly and safely.

### Gauges and Warning Lights

You have already read about the various gauges and warning lights that provide information about your vehicle. Check these gauges and lights regularly as you drive. They will warn you of a wide range of problems, such as low oil pressure or fuel level, engine overheating, and alternator malfunction.

### Brakes

Your vehicle's brake-warning light will make you aware of some—but not all—problems with your brake system.

For this reason, always test your brakes as soon as you begin driving. When you step on the brake pedal, you should feel firm resistance, and your vehicle should come to a smooth, straight stop. The pedal should stay well above the floor.

Specific warning signs of a brake system malfunction are discussed later in this chapter.

### TIPS

### FOR NEW DRIVERS

#### ***Having Your Vehicle Serviced or Repaired***

- To find a reliable mechanic or garage, ask friends and relatives for their recommendations. You can also call your local American Automobile Association.
- Ask the mechanic for a cost estimate of the work to be done.
- Find out for how long the mechanic will guarantee any work done. Save your bill or receipt.
- Know what you're paying for. If there's something you don't understand, ask for an explanation.
- If the mechanic replaces a part, ask to see the old part.
- Warranties may cover many repairs. Know what your warranty does and does not cover.

## SAFETY T

Always check radiator coolant level by looking at the radiator overflow tank. If additional coolant is needed, add it to the overflow tank, not to the radiator. Rarely should it be necessary to remove the radiator cap. If you do have to remove the radiator cap, do so *only when the radiator is cool*. If you remove the cap when the radiator is hot, boiling water could spurt out and scald you.

## Horn

Periodically check to make sure your horn works. If you're driving an unfamiliar vehicle, always locate and try the horn *before* you begin driving. Horn position on the steering wheel varies from vehicle to vehicle.

## Lights and Turn Signals

Vehicle safety checks find that nearly one out of four vehicles has at least one lightbulb or headlight burned out. Check all exterior lights and turn signals before you drive. Periodically have a friend or family member stand outside the vehicle and tell you if your brake lights work when you press the brake pedal.

## How Do You Know When Your Vehicle Should Be Serviced?

Your owner's manual contains guidelines for servicing and maintaining your vehicle. The guidelines vary, depending on the kind and amount of driving you do and on the manufacturer's recommendations.

Some systems and parts require more frequent attention than others. Recommended intervals for servicing may be based either on time or on miles driven. For example, your manual might recommend checking tire

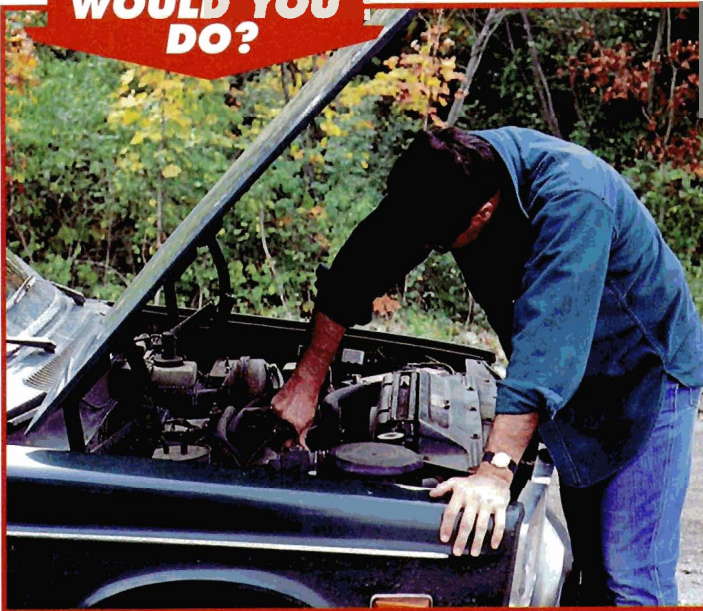
pressure once a month, changing the oil every few months, and having the suspension checked every 20,000 miles.

Keeping complete records will help you maintain a schedule of care. An easy way to keep track of repairs and maintenance is to keep a small notebook in your vehicle. Each time you or a mechanic services or repairs the vehicle, jot down exactly what was done and the date. Save your receipts in an envelope in the glove compartment.

## Lesson 1 Review

1. What kinds of problems might you spot as you check your vehicle before entering it?
2. What can you check after you start the engine?
3. What can help you determine when to have your vehicle serviced?

## WHAT WOULD YOU DO?



A friend has agreed to let you use her car while she's on vacation. What checks will you make before getting into her car? What checks will you make after starting the engine?

# Becoming Familiar with the Engine and Power Train

Many parts work together to produce a vehicle's power and motion. By keeping these parts operating smoothly, you help your vehicle run safely and fuel efficiently.

## How Does the Engine Work?

Your vehicle's engine is known as an **internal combustion engine**. It is called that because the power it produces comes from burning a mixture of fuel and air inside, rather than outside, the engine.

When you start your vehicle's engine, you're setting off a chain of events.

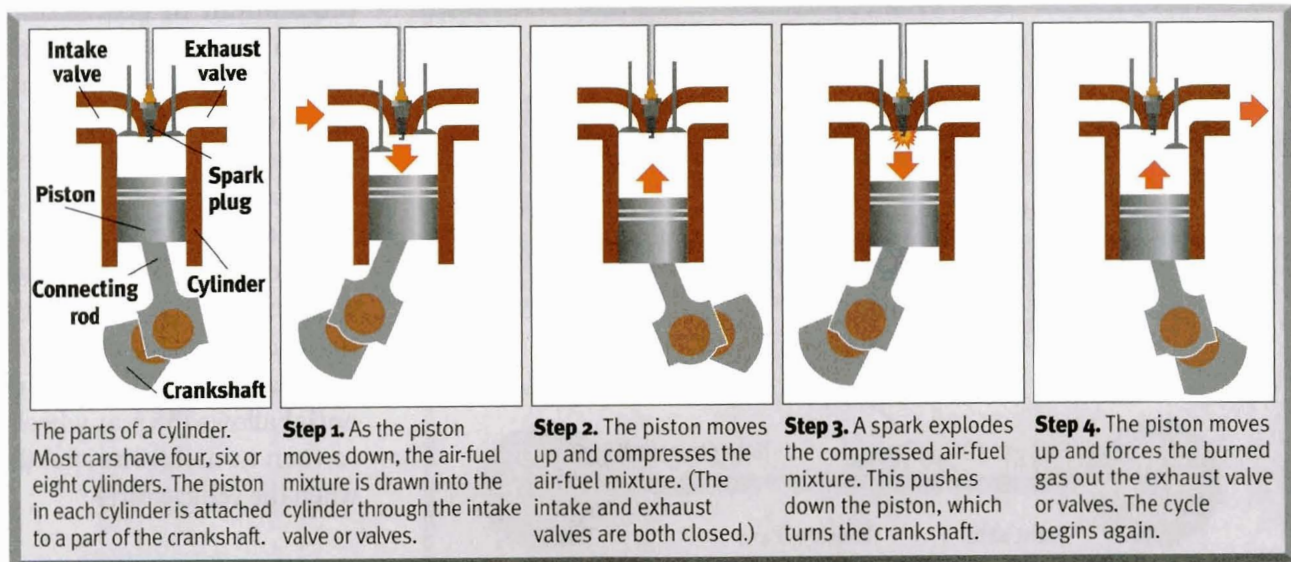
1. Turning the key in the ignition causes power to be drawn from the battery to a small electric starter motor, commonly called the starter.
2. The starter turns the flywheel of the engine. When the flywheel turns, it turns the crankshaft.
3. A piston in each **cylinder** of the vehicle is attached to the crankshaft. Most vehicles have 4, 6, or 8 cylinders. The more cylinders in a vehicle, the more power the engine has, but also the more gasoline the engine uses.

### OBJECTIVES

1. Explain how a typical vehicle engine works.
2. Tell what the power train is and what it does.
3. Describe four guidelines for maintaining the engine and power train.

### KEY TERMS

internal combustion engine  
cylinder  
spark plug  
piston  
crankshaft  
power train  
drive wheel  
differential



- In each cylinder, a **spark plug** produces a spark. This spark causes the fuel-air mixture inside the cylinder to explode. The explosion pushes down the **piston**, which turns the **crankshaft**.
- The continuous up-and-down motion of the pistons keeps the crankshaft turning. Power sent from the crankshaft is transmitted to the wheels, making the vehicle move.

## What Is the Power Train and What Does It Do?

Several parts of your vehicle work together to transmit power from the engine to the wheels. These parts make up the **power train**.

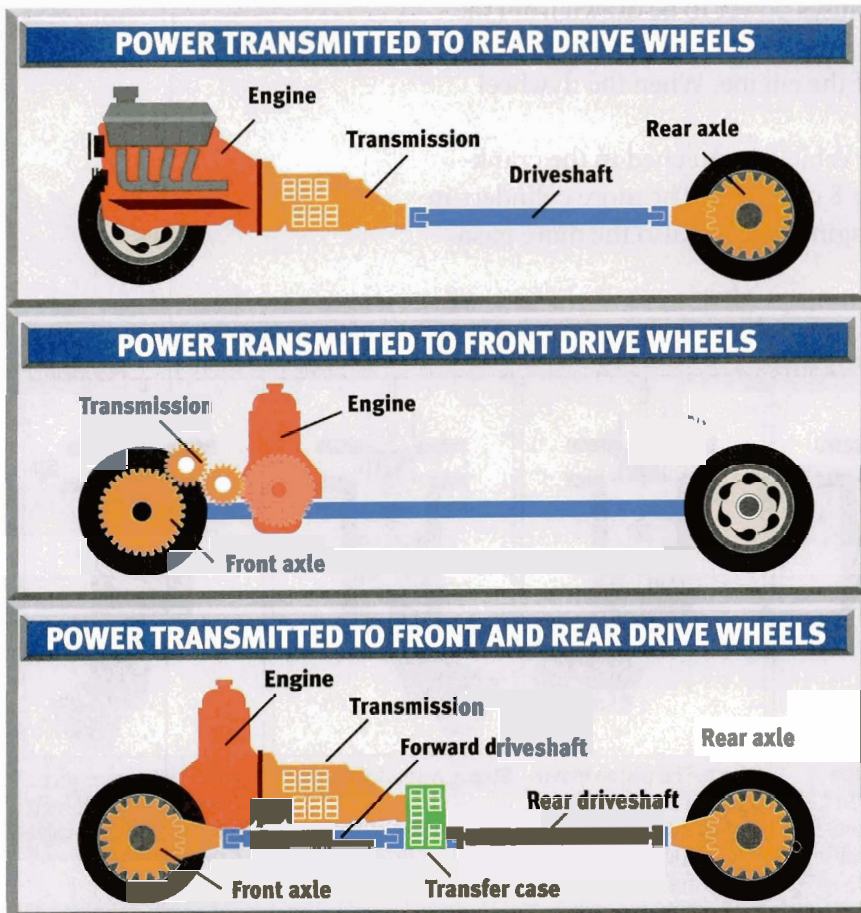
In most vehicles, the power train sends power from the engine to only two of the four wheels. The wheels that receive the power are called the **drive wheels**. If the two front wheels are the drive wheels, the vehicle has front-wheel drive. If the two rear wheels receive the power, the vehicle has rear-wheel drive. A vehicle has four-wheel drive

if all four wheels receive power.

The transmission is part of the power train. Gears in the transmission allow it to transfer power to the drive wheels. With a manual transmission, the driver uses the clutch pedal and the gearshift lever to shift gears and change the amount of power that goes to the drive wheels. With an automatic transmission, the clutch works automatically, so the gears are shifted automatically too.

In a vehicle with rear-wheel drive, the transmission is connected by a driveshaft to the differential, rear axle, and rear wheels. The **differential** allows the rear wheels to turn at different speeds when the vehicle turns.

◆ Power is transmitted differently to vehicles with rear-wheel drive, front-wheel drive, and four-wheel drive.





In a vehicle with front-wheel drive, engine power is sent to a combination transmission and differential and then directly to the front wheels.

## How Can You Maintain the Engine and Power Train?

Vehicles that are well maintained perform better, are more fuel efficient, and last longer than vehicles that are neglected.

Here are some basic guidelines for keeping your vehicle's engine and power train in top condition. Your owner's manual will give you additional specific recommendations.

### Check and Change the Oil Regularly

Check your vehicle's oil every second time you fill the fuel tank. Change the oil according to the recommendations in your owner's manual. Most manufacturers give two schedules for oil changes: one for normal use and one for severe use. Severe use is often described as plenty of short trips, stop-and-go driving, or regular travel in dusty conditions. Failure to follow the recommended schedule can void your warranty.

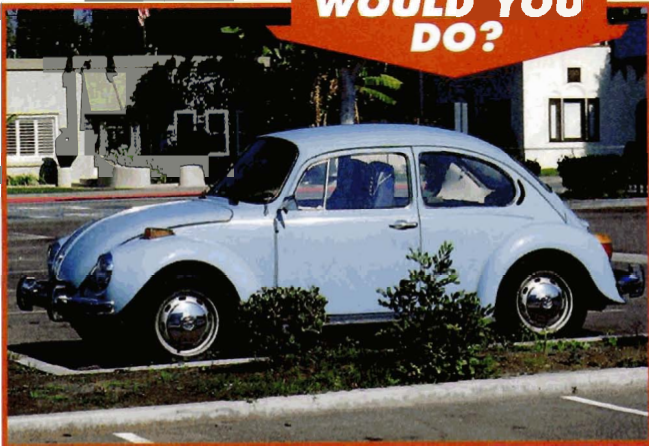
### Have Regular Tune-Ups

Some older vehicles require regular tune-ups, but most new ones do not have any need for such attention beyond regular checks and replacement of fluids and filters. Emission regulations require a vehicle's computer to make the necessary "tune-ups" as the vehicle ages to ensure the most complete combustion of fuel and to prevent pouring unburned hydrocarbons into the atmosphere. Consult your vehicle manual to determine your recommended tune-up intervals. Do a visual check of belts, hoses, and wires under the hood for any obvious signs of wear or problems as you check the oil—every second time you fill the vehicle's fuel tank.

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## Lesson 2 Review

1. What is an internal combustion engine, and how does it work?
2. What parts make up the power train, and how do they supply power to the wheels?
3. What are some of the tasks a mechanic might do when giving your vehicle a tune-up?



**WHAT WOULD YOU DO?**

*The used car you've just bought is running beautifully. You'd like to keep it that way. Describe the actions you will take to maintain your car in top shape.*

## LESSON THREE

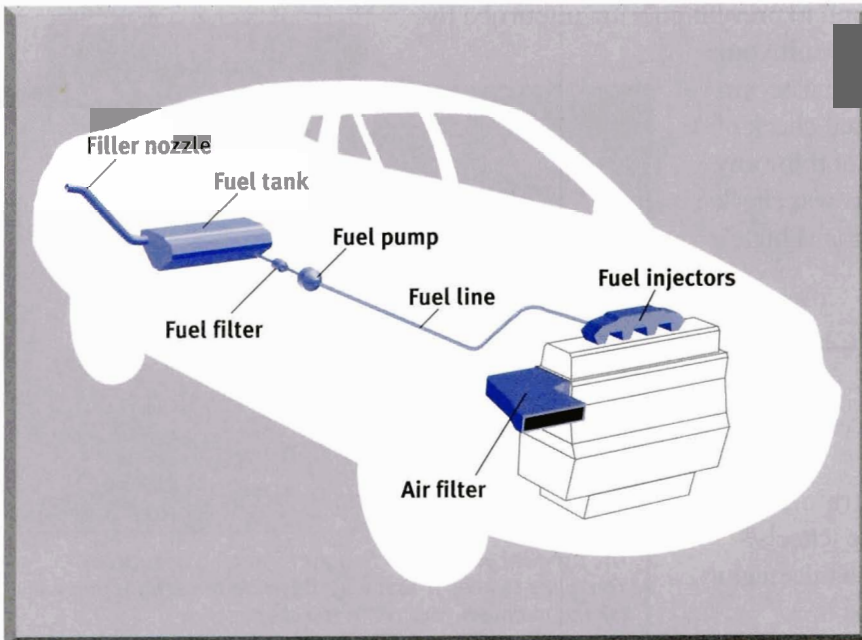
### OBJECTIVES

1. Explain how the fuel and exhaust systems work and how to maintain them.
2. Explain how the electrical and light systems work and how to maintain them.
3. Describe how the lubricating and cooling systems work and how to maintain them.

### KEY TERMS

electronic fuel-injection (EFI) system  
exhaust manifold  
muffler  
catalytic converter  
battery  
alternator  
engine control module (ECM)  
coolant  
antifreeze  
radiator

◆ *The fuel system both stores fuel and delivers the correct air-fuel mixture to the engine.*



# Understanding and Maintaining Vehicle Systems

Today it's easy to take motor vehicles for granted. But they are still among the most complicated machines ever invented. Every time you get behind the wheel, you take control of a network of many different systems that work together to make your vehicle work the way it does.

## How Do the Fuel and Exhaust Systems Work?

The fuel and exhaust systems in a vehicle must operate properly to maximize engine efficiency and minimize pollution.

### The Fuel System

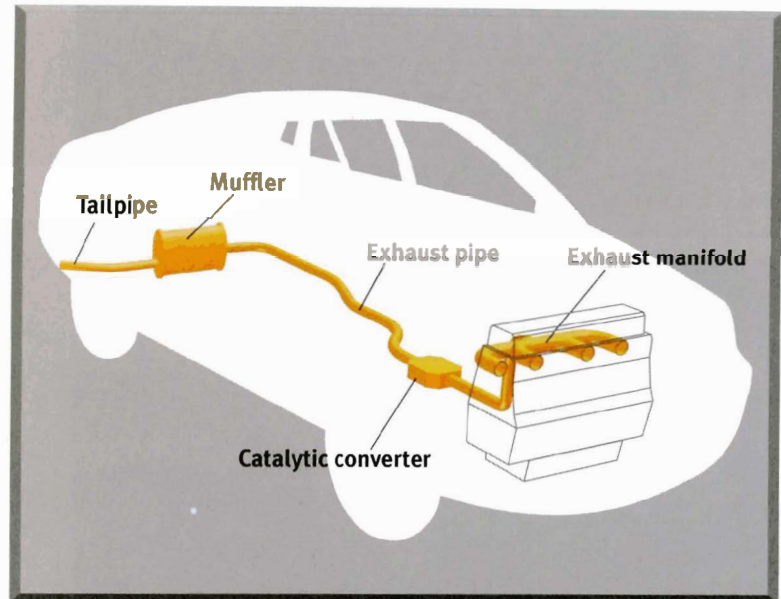
Your vehicle's fuel system includes the fuel tank, fuel lines, fuel pump, fuel filter, **electronic fuel-injection (EFI) system**, and air filter. Fuel is stored in the tank, where in some cases the fuel pump resides. The pump forces fuel through the fuel lines and filter. The air-fuel mixture forms a vapor that is injected at a specific time into each cylinder, where it is ignited by a spark plug.

Most vehicles now have electronic multipoint fuel-injection systems. Multipoint means that there is a separate nozzle or injector fed by a separate fuel line for each cylinder.

## The Exhaust System

The exhaust system serves two main purposes. First, it carries off carbon monoxide and other harmful gas by-products of combustion. Second, it muffles engine noise.

The pipes that make up the **exhaust manifold** collect unburned gases from the engine and carry them to the muffler. The **muffler** absorbs noise created from the explosions in the cylinders. Exhaust gases exit through the tailpipe. Pollution-control devices, such as the **catalytic converter**, reduce the amount of harmful gases coming from the tailpipe.



▼ The exhaust system carries off poisonous gases and muffles engine noise.

## How Can You Maintain the Fuel and Exhaust Systems?

To maintain your vehicle's fuel system, replace the air and fuel filters as needed.

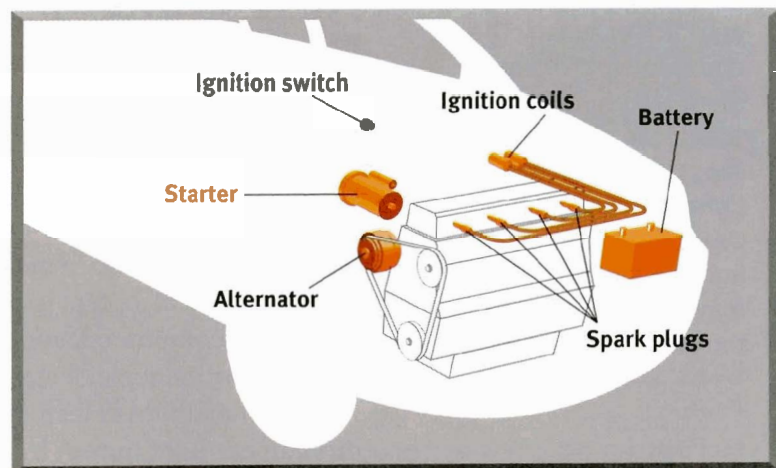
Most vehicles today operate on lead-free gasoline. Using leaded gasoline will destroy the catalytic converter.

How much maintenance or repair the exhaust system requires varies with the conditions under which you drive. Short trips, for example, are harder on a vehicle than long highway drives. Be on the lookout for loose, rusting, or damaged parts. Always have your exhaust system thoroughly inspected as part of a tune-up.

◆ The electrical system supplies energy to start the vehicle and sends electrical current to the spark plugs.

## How Do the Electrical and Light Systems Work?

The electrical and light systems help keep your vehicle running smoothly and safely.



## The Electrical System

The heart of your vehicle's electrical system is the battery. The **battery** provides the power to start the engine. It also enables you to operate, for a short time, such equipment as your radio and lights when the engine is not running.

After you turn the ignition key and start the vehicle, the battery supplies the electricity to fire the spark plugs, operate the stereo, air-conditioning, and other systems. The **alternator**, or generator, provides a constant charge for the battery. The **engine control module (ECM)** controls the electrical and other engine systems.

To prevent electrical overloads and damage to delicate electronic components, the electrical system is equipped with fuses,

usually located in a clearly labeled pod beneath the instrument panel or under the hood.

## The Light System

Your vehicle's light system enables you to see and be seen.

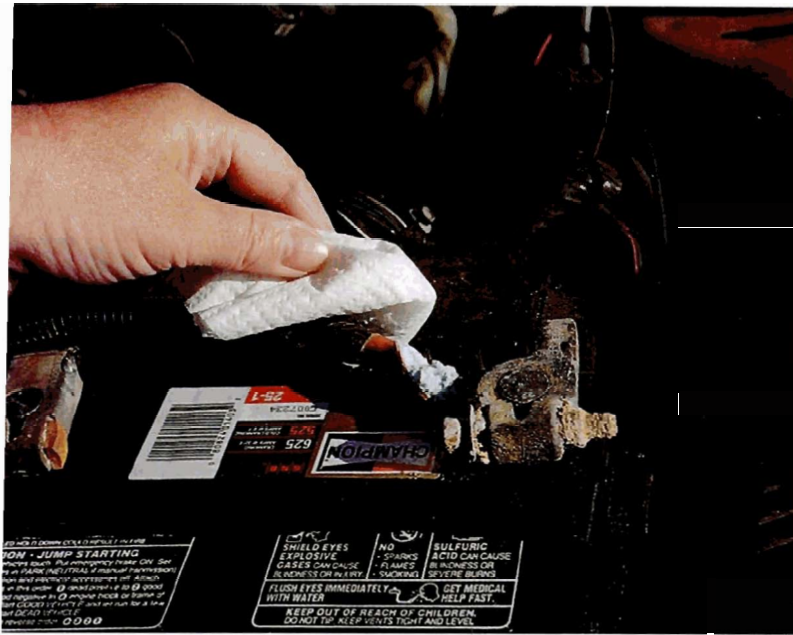
Exterior lights include headlights, taillights, side-marker lights, brake lights, signal lights, parking lights, and emergency flashers. Interior lights include the dome light on the inside roof of the vehicle and the various dashboard lights that provide you with information about the vehicle or warn you of malfunctions.

## How Can You Maintain the Electrical and Light Systems?

The first step in maintaining the electrical and light systems is to keep your battery in top working condition. Keep the battery terminals free of corrosion and the battery cables firmly connected. Most current batteries are maintenance-free, but if you have an older one, check the fluid level at least once a month, and add water when needed.

The electrical system is constantly monitored by the engine control module or computer. If it detects a problem, the "check engine" light on the instrument panel may come on.

Keep headlights clean and properly aligned. Even a thin layer of dirt can cut light output by as much as 90 percent. Misaligned lights



◆ In order to keep your battery in top working condition, keep terminals free of corrosion.

## FYI

If the "check engine" light comes on, make sure the gas cap or lid is fully tightened to the point of at least one click or notch. The emission control equipment is so sensitive that it can detect if the cap is not correctly tightened and will cause the warning light to come on. You may or may not need to computer reset it.

can reduce your ability to see the roadway and can momentarily blind oncoming drivers.

Check exterior lights at least once a week, and promptly replace any burned-out bulbs.

## How Do the Lubricating and Cooling Systems Work?

As the parts of your vehicle's engine move rapidly and rub against each other, they produce friction and heat. At the same time, the fuel-air explosions in the cylinders create more heat. Small wonder then that the engine temperature may exceed 4,000°F.

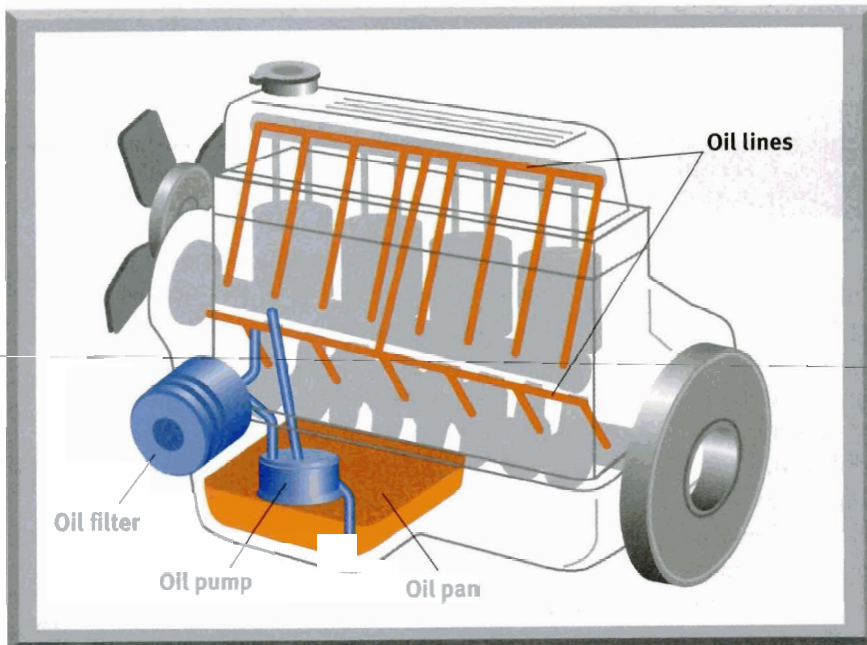
Too much heat can destroy your vehicle's engine. The lubricating and cooling systems are designed to keep that from happening.

### The Lubricating System

Oil is the key element in your vehicle's lubricating system. Coating engine parts with oil reduces friction, heat, and wear. Oil also helps clean internal engine surfaces and prevent rust and corrosion.

An oil pump moves oil from the oil pan, where it is stored, to all moving engine parts. The oil filter cleans the oil as it circulates.

In addition to oil, grease is used to lubricate parts of the vehicle, such as the steering system. Like oil, grease reduces friction and helps parts move smoothly.



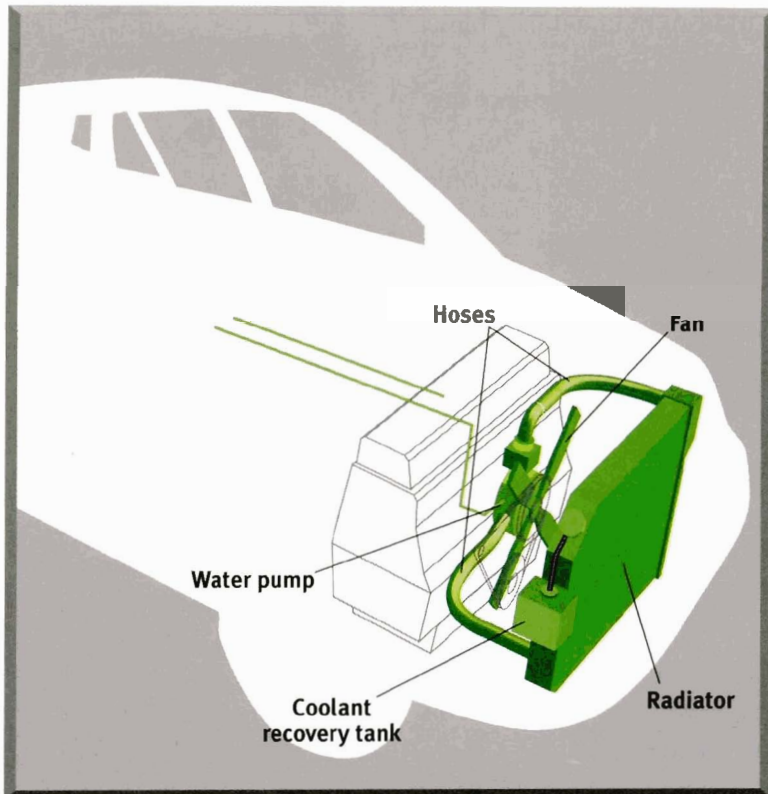
## Energy Tips

The engine control module or computer in a modern vehicle automatically adjusts the engine's systems for whatever grade of fuel you use. Some engines will perform better with higher, more expensive grades of fuel, but most will not. See your owner's manual for the manufacturer's recommendations.

## FYI

Each year, electrical system failures disable more vehicles than the combined next two causes of vehicle breakdowns.

◆ The lubricating system reduces heat by coating the parts of the engine with oil.



◆ *The so-called water-cooled engine actually uses a coolant in its cooling system.*

coolant through the radiator and the circulating network. A fan forces the air through the **radiator** to cool the liquid. A thermostat in the system works to control the flow of the coolant in order to maintain the best operating temperature.

## The Cooling System

The purpose of the cooling system is to keep your vehicle's engine from overheating. To do this, the cooling system circulates **coolant**—a mixture of water and antifreeze—through the engine by means of a network of pipes, channels, and connecting hoses.

**Antifreeze** has a lower freezing point and higher boiling point than pure water. Without it, the liquid in the cooling system would freeze in very cold weather and could boil over in hot weather, especially in traffic jams and on long trips. Frozen or boiling coolant does not circulate, and this can cause the engine to overheat.

Your vehicle's coolant is stored in the radiator and in the radiator overflow tank. A water pump pumps the

## CONNECTIONS

### Science

Carbon monoxide is an odorless, colorless, and tasteless gas. Small amounts of carbon monoxide can make you sleepy or nauseated or give you a headache by interfering with the ability of your red blood cells to carry oxygen. Large amounts of carbon monoxide can kill you.

Avoid driving a vehicle that has an exhaust leak or a broken tailpipe. Such defects allow carbon monoxide and other harmful exhaust gases to be trapped beneath the vehicle, even when it is

moving. These gases may leak up into the vehicle's interior:

To guard against carbon monoxide poisoning, also avoid:

- running a vehicle's engine in a closed garage.
- sitting in a parked vehicle with the windows closed, the engine running, and the heater on.
- driving with the trunk lid up.
- driving with the rear window of a station wagon open.
- stopping so close to the vehicle ahead that your heater or air conditioner draws in exhaust gases from that vehicle's tailpipe.

## How Can You Maintain the Lubricating and Cooling Systems?

Checking and changing the oil and oil filter regularly is the key to maintaining your vehicle's lubricating system. Low oil pressure allows the engine to become too hot, which may cause excessive wear of moving parts.

Keep in mind that the oil-pressure gauge or warning light does not indicate how much oil is in the engine, but it will signal a drop in oil pressure. To check the actual level of oil, use the oil dipstick. *Never* drive your vehicle with insufficient oil: you could destroy the engine. The engine oil level can only be checked after the engine has been turned off for some period of time, preferably an hour or more. This is necessary to give the oil time to drain back into the oil pan from throughout the engine. Checking it before that has happened will give you a false low reading.

Driving with an overheated engine can also damage your vehicle. If the temperature gauge or warning light indicates overheating, stop driving as soon as possible. Let the engine cool before you look for the cause of the problem.

To maintain the cooling system, use the proper coolant, and check the fluid level whenever the vehicle is serviced. Also check the fan belt and connecting hoses. Have the cooling system completely drained, flushed, and refilled every two years.

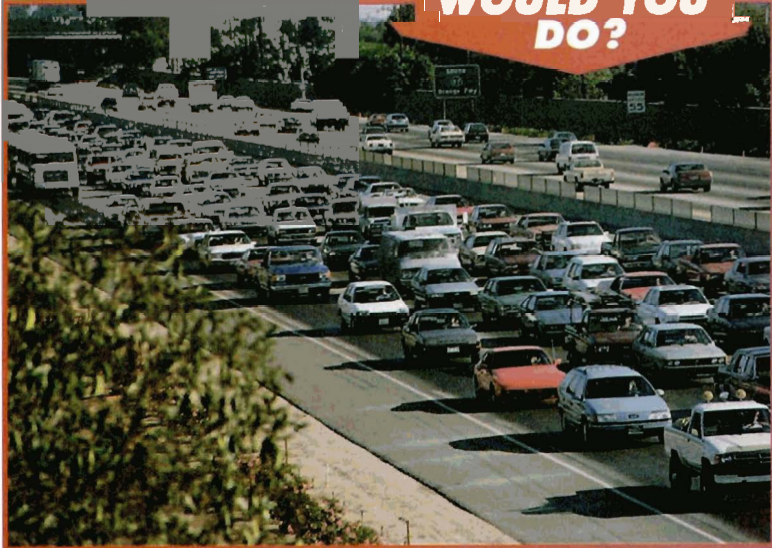
### Lesson 3 Review

1. Why is it important to keep the fuel and exhaust systems of your vehicle in good condition?
2. Explain how your vehicle uses electricity, and name the source of electrical power in your vehicle.
3. How do the lubricating and cooling systems work?



◆ You can learn to use a dipstick to check whether or not your vehicle needs more oil.

**WHAT WOULD YOU DO?**



*You've been stuck in bumper-to-bumper traffic for nearly an hour on a hot summer day. The temperature warning light has just come on. How will you handle this situation? What safety precautions will you take?*

## LESSON FOUR

### OBJECTIVES

1. Describe four vehicle systems that are important for comfort and safety.
2. Describe warning signs of possible problems with the suspension, steering, or tires.

### KEY TERMS

strut  
shock absorber  
hydraulic pressure  
disc brake  
drum brake  
tread

# Suspension, Steering, Brakes, and Tires

Your comfort and safety in a vehicle depend not only on how well you drive but also on how your vehicle handles. To protect yourself and others, make sure your vehicle's suspension, steering, and brake systems as well as all four tires are in good operating condition.

## What Vehicle Systems Are Important for Comfort and Safety?

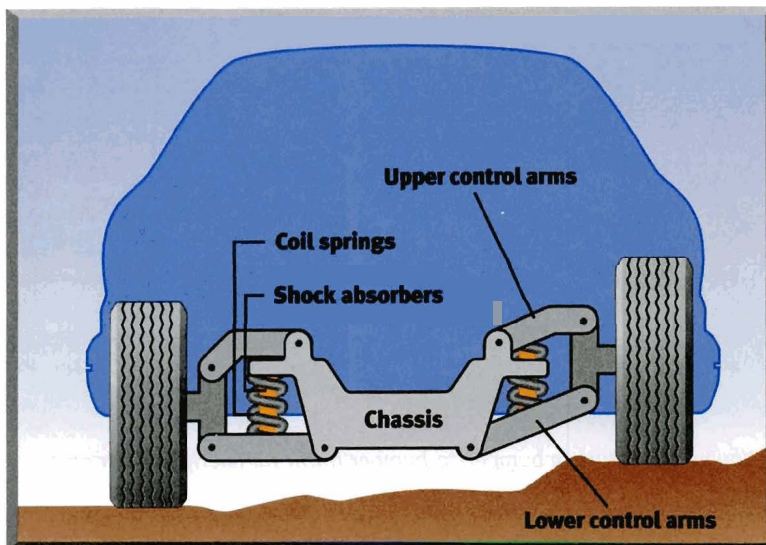
The suspension, steering, and brake systems, and tires, work together to give you control over your vehicle and to provide a comfortable ride.

### The Suspension System

The suspension system supports your vehicle's weight, cushions the ride, and helps keep the vehicle stable when you drive over bumps or uneven roadway surfaces.

Most vehicles today use suspensions—especially in the front of the vehicle—where the spring and shock absorber are contained in one unit called a **strut**.

◆ *The suspension system cushions the vehicle's frame against bumps in the road.*



The springs soften the impact of bumps in the roadway. If your vehicle had only springs, however, it would continue bouncing after hitting a bump. This bouncing would reduce the contact between the tires and the road and make it harder for you to control the vehicle.

The **shock absorbers**—or shocks, as they're commonly called—work to control bouncing. By absorbing the shocks of driving, they make the ride smoother and help you maintain steering and braking control.



## The Steering System

The steering system enables you to turn the front wheels. The steering wheel is connected to the front wheels by a steering shaft and movable rods.

The front wheels are designed to remain in an upright position and move up and down over bumps, even when they are turned.

## The Brake System

Brakes slow or stop a vehicle by applying **hydraulic pressure**—pressure created by the force of a liquid—against the four wheels. Stepping on the brake pedal forces brake fluid from the master brake cylinder through the brake-fluid lines to the wheel cylinders. There are two types of brakes: disc brakes and drum brakes.

**Disc brakes** In a **disc brake**, pressure squeezes the brake pads against a flat metal wheel disc, producing the friction needed to stop the wheel from turning.

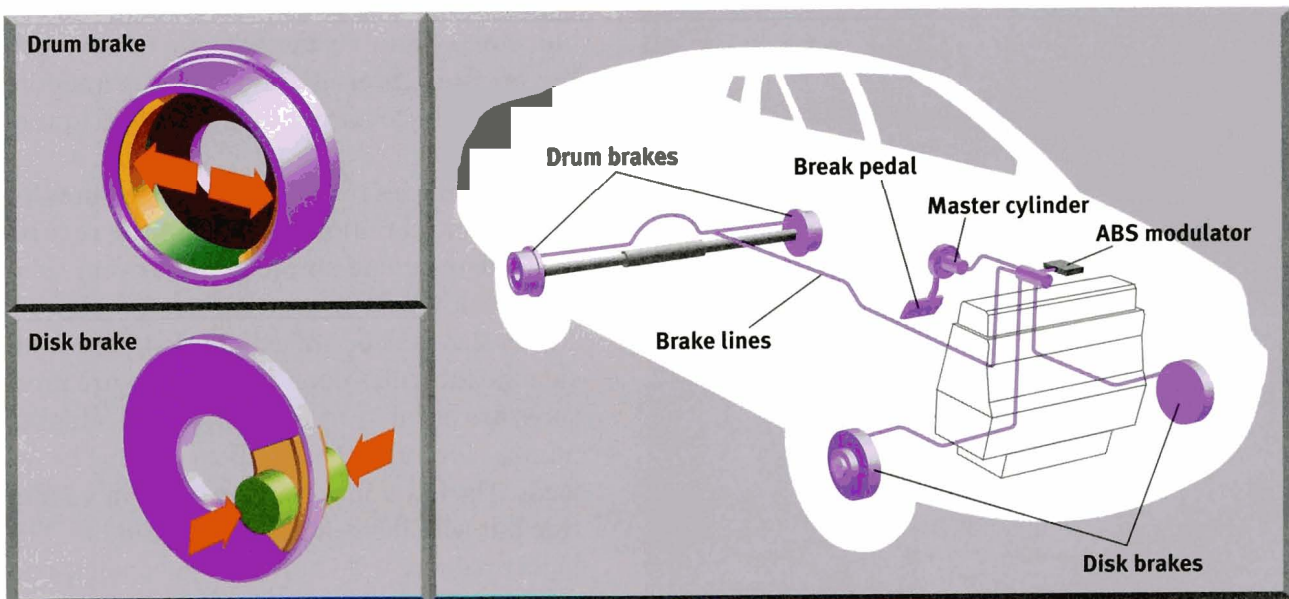
All new vehicles now have disc brakes on the front wheels. Many have them on the rear wheels as well. All new vehicles now also have power brakes, which require less pressure on the brake pedal than older non-power systems. Power brakes do *not*, however, shorten a vehicle's stopping distance.

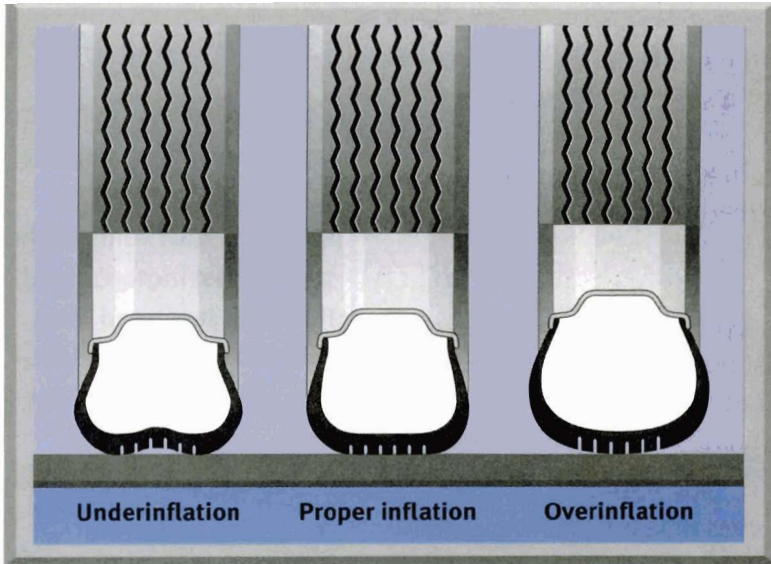
**Drum brakes** In a **drum brake**, the fluid pressure causes the brake shoes to push against the brake lining. The lining then presses against the round hollow metal drum inside the wheel. Friction slows and stops the wheel's turning motion.

## SAFETY TIPS

You can check for sufficient tread depth by inserting a quarter in the tread. It should at least come to the top of Washington's head. If there is less tread than this, the tire will not function safely in even a light rain.

◆ A hydraulic brake system gives all four wheels stopping power.





◆ It is important for fuel efficiency and traction that a vehicle's tires be properly inflated.

◆ The vehicle manufacturer often places maximum tire air pressure on the inside of the door.

**Parking brake** A parking brake is a mechanically operated brake that is separate from the hydraulic brake system. Attached by cable to the rear wheels, it is used to prevent a parked vehicle from rolling.

## The Tires

A driver's control of a vehicle depends largely on the condition of the tires. Nevertheless, more than 40 percent of nearly 250,000 vehicles inspected between 1982 and 1993 had defective tires.

**Tire inflation** Tires must be inflated properly to provide maximum traction and control. Too little tire pressure (underinflation) or too much tire pressure (overinflation) reduces traction, makes a vehicle harder to handle, and lowers fuel efficiency.

Most vehicles require different pressures for the front and rear tires. To find the recommended maximum air pressures for your vehicle, check your owner's manual or look for a sticker that may be affixed to a doorpost or inside the fuel filler door. Usually two tire pressures are listed—one for normal and a higher number for long trips or when carrying heavy loads. The lower number may result in a softer ride but will likely mean lower tread life. The higher number will improve both handling and wear at the cost of some ride quality.



**Tire tread** The grooved outer surface of a tire is its **tread**. On wet or slippery surfaces, the amount of tread on your tires determines how much traction your vehicle will have. Compared with tires that have good tread, overly worn tires have double the risk of skidding and are also more likely to go flat or blow out.

Tires should be replaced when the depth of the tread is  $\frac{1}{16}$  inch. To help you judge tread depth, all tires have tread wear bars that run across the tire.

**Tire rotation** Front tires generally wear faster than rear tires. To equalize tire wear, have your vehicle's tires rotated about every 5,000 to 6,000 miles. Rotating tires means switching their position from front to rear and sometimes from one side to the other. Check your owner's manual for the recommended tire-rotation pattern.

When tires are rotated, they often need to be balanced. This helps ensure that weight is evenly distributed as the wheel turns. Balanced tires provide better steering control, a smoother ride, and longer tire life.

## What Are Some Warning Signs of Vehicle Problems?

Sometimes vehicle problems appear unexpectedly. More often, though, advance warnings signal that a part or system needs attention.

◆ *Have a mechanic check the vehicle if any warning signs of suspension or brake problems appear.*

### Suspension and Steering Problems

Most problems affecting the suspension and steering system develop gradually as a result of wear. Watch for the following warning signs.

- There is too much play (free movement) in the steering wheel. With rack and pinion power steering, there should be virtually no play in the wheel. In a manual system, there should be no more than 2 inches of play.
- The steering wheel vibrates or is difficult to turn.
- The front end of the vehicle wobbles or shimmies.
- The vehicle bumps as you turn the wheel while driving on a smooth road.
- The vehicle pulls to one side as you drive.
- The vehicle bounces too much after hitting a bump.
- Tread wear on the front tires is uneven.

Have a mechanic check your vehicle if any of these warning signs appear. The front end of your vehicle may need aligning, the tires may need to be balanced, or some other problem may need correction.



## ADVICE FROM THE EXPERTS



### Richard Russell

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*Tires are arguably the most important safety feature on your vehicle. The four small patches of rubber in contact with the road determine how you stop, steer, and go. Don't think of buying new tires as a "grudge buy." Tires are the one area where a purchase decision can directly affect the safety of your vehicle. This is not an area to try to save money. Generally speaking, the more you spend on a tire, the better the grip it will provide and the safer you will be.*

### Brake Problems

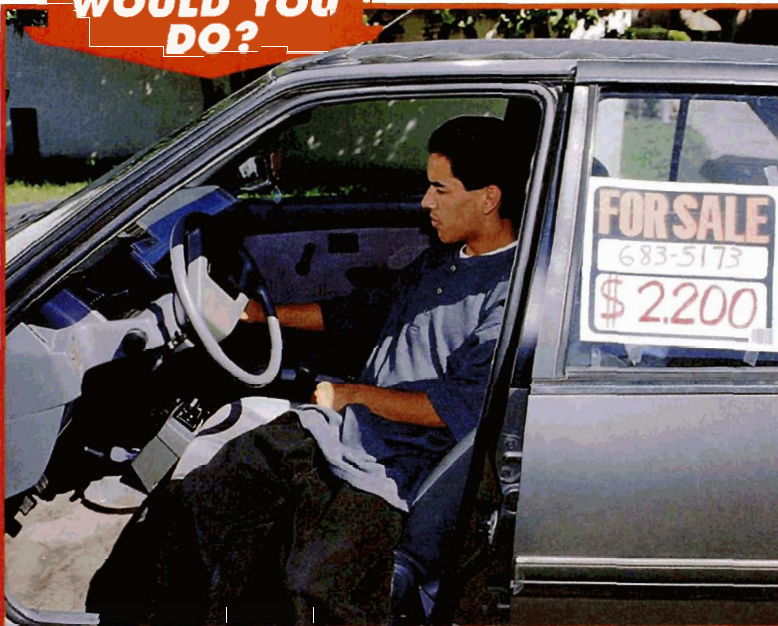
See Chapter 14 for a description of brake failure. Neglecting a problem with the brake system can have fatal consequences. Check with a mechanic if any warning signs appear.

### Tire Problems

Inspecting your tires regularly *before* you drive will help avoid problems on the road. Watch for the following warning signs of tire troubles:

- tread wear bars appear, indicating less than  $\frac{1}{16}$  inch tread
- areas of little or no tread—"bald" spots
- uneven wear
- bulges
- embedded nails, glass, or metal
- frequent pressure loss in one particular tire, suggesting a slow leak

### WHAT WOULD YOU DO?



*You just test-drove this car. As you stepped on the brake, the car pulled to the right. What could cause this problem? Would you buy the car?*

## Lesson 4 Review

1. How are the steering, suspension, brakes, and tires important to your safety?
2. What are some warning signs that indicate tire problems?

## Graphing Braking Distances

After you apply the brakes, the distance it takes to come to a stop depends in part on the speed at which your vehicle is moving.

The formula for figuring out braking distance is

$$D = S \times \frac{1}{10}S \div 2.4$$

where  $S$  = speed and  $D$  = distance in feet.

Here is how you would figure braking distance at 35 mph.

$$D = 35 \times (\frac{1}{10} \times 35) \div 2.4$$

$$D = 35 \times 3.5 \div 2.4$$

$$D = 51.04$$

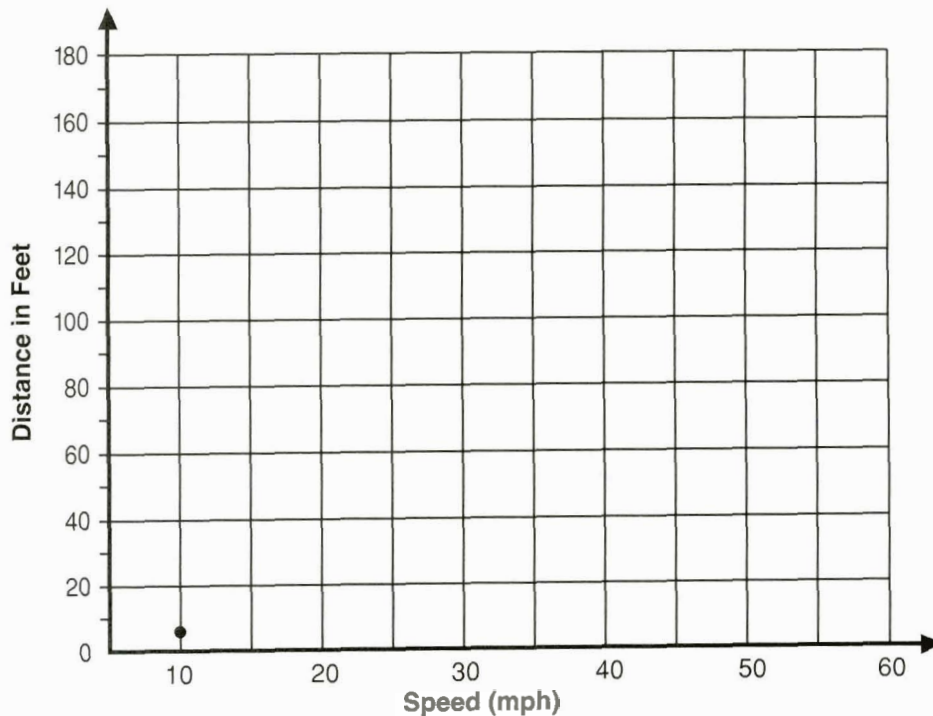
Thus, braking distance at 35 mph is 51.04 feet, or a little more than 17 yards.

Make a graph to show how braking distance changes in relation to speed.

## Try It Yourself

1. First, use the formula to figure the stopping distance for these speeds:  
20 mph 30 mph 40 mph 50 mph 60 mph
2. On a sheet of graph paper, write the speeds along the bottom of the graph at regular intervals, as shown below.
3. On the left side of the graph, write distances in regular intervals, as shown below.
4. For each distance you figure, put a dot at the appropriate place on your graph.
5. Finally, draw a line from the first dot to the second, from the second to the third, and so on, beginning with the dot at the shortest braking distance.

What conclusion can you draw from your graph?



# CHAPTER 17 REVIEW

## KEY POINTS

### Lesson One

1. At least once a month, before entering your vehicle, check fluid levels, belts and hoses, and connections.
2. After starting the engine, check gauges and warning lights, and test your brakes and horn.
3. Service your vehicle according to the kind and amount of driving and manufacturer recommendations.

### Lesson Two

1. An internal combustion engine burns a mixture of fuel and air. In each cylinder, a spark causes the mixture to explode, pushing down the piston, turning the crankshaft.
2. The power train sends engine power to the wheels through the transmission.
3. Regularly check and change the oil, check the transmission fluid, and change filters.

### Lesson Three

1. The fuel pump forces fuel from the tank to the fuel-injection system to mix with air. The vapor is ignited in the cylinders. Unburned

gases from the engine exit through the tailpipe. Replace filters as needed. Have your exhaust system inspected at least twice a year.

2. The battery is the source of electrical power. Keep headlights clean and aligned, and replace any burned-out bulbs.
3. Lubricating and cooling systems keep heat from destroying the engine by sending oil to moving engine parts. A mixture of fluid and antifreeze cools the engine.

Change oil and oil filters regularly. Use coolant, and check the fluid level when the vehicle is serviced.

### Lesson Four

1. The suspension supports a vehicle's weight, cushions the ride, and stabilizes the vehicle; the steering system enables the front wheels to turn; brakes stop the vehicle; tires help it grip the road.
2. Warnings of possible suspension problems include too much play in the wheel; front-end wobble; and pulling to one side.

## PROJECTS

1. In an owner's manual, find the sections that deal with the vehicle systems discussed in this chapter. What information does the manual provide that applies specifically to the particular make and model vehicle? In what other ways does the manual help the owner maintain the vehicle?
2. Research and report on the various types of tires, including summer, all-season, and winter or snow tires. What are the advantages and limitations of each? Where should you

put two new tires or snow tires on a vehicle with front-wheel drive?

### interNET CONNECTION



To learn how car systems have changed with the use of computers, visit Glencoe's Web site.

[drivedred.glencoe.com](http://drivedred.glencoe.com)

# CHAPTER 16 REVIEW

## CHAPTER TEST

Write the letter of the answer that best completes each sentence.

1. A driver interested in fuel efficiency would
  - a. buy a vehicle with 4 cylinders.
  - b. buy a vehicle with 8 cylinders.
  - c. buy a vehicle with 16 cylinders.
2. When buying a vehicle, most people
  - a. pay with a credit card.
  - b. pay cash.
  - c. take out a loan.
3. Before buying a vehicle, consider
  - a. how clean it is.
  - b. how many passengers you will have.
  - c. whether it is a convertible.
4. A driving record and marital status can affect
  - a. the cost of your insurance.
  - b. the purchase price of a vehicle.
  - c. your concentration at the wheel.
5. Expensive vehicles
  - a. cost more to insure than inexpensive vehicles.
  - b. cost less to insure than inexpensive vehicles.
  - c. use less fuel than inexpensive vehicles.
6. The death rate in the smallest vehicles is
  - a. lower than that in the largest vehicles.
  - b. the same as that in the largest vehicles.
  - c. twice as high as that in the largest vehicles.
7. The *Blue Book* is a guide to
  - a. vehicle dealerships in the United States.
  - b. the average price paid to dealers for various used vehicles.
  - c. different types of vehicle engines.
8. Liability insurance
  - a. protects you against claims if you are at fault in a collision.
  - b. is available to drivers over 21 years of age.
  - c. protects you if you are accused of lying.

9. The purchase price of a vehicle is
  - a. one of the many expenses associated with owning a vehicle.
  - b. the only expense in owning a vehicle.
  - c. generally lower than it was ten years ago.
10. Bodily injury insurance covers
  - a. any damages to the body of your vehicle.
  - b. the death or injury of other people while you are driving.
  - c. only the driver of a vehicle.

Write the word or phrase that best completes each sentence.

- |                              |            |
|------------------------------|------------|
| fuel consumption             | warranty   |
| comprehensive insurance      | financing  |
| uninsured motorist insurance | deductible |
11. A(n) \_\_\_\_\_ is a written guarantee that the seller will repair your vehicle.
  12. If your vehicle is damaged by anything other than a collision, \_\_\_\_\_ will pay the bills.
  13. There can be large differences in \_\_\_\_\_ among different vehicle models.
  14. Vehicle dealers can offer you a(n) \_\_\_\_\_ arrangement when you buy a new vehicle.
  15. If you are involved in a collision with a hit-and-run driver, \_\_\_\_\_ can protect you.

## DRIVER'S LOG

In this chapter, you have learned some considerations to keep in mind when you are ready to buy a vehicle. Write a paragraph in response to each of the following questions.

- Describe the guideposts you use to measure maturity. Which do you need to work on?
- What will you look for when you buy a vehicle? What do you think your choice will say about your maturity? Why?

# CHAPTER 17 REVIEW

## CHAPTER TEST

Write the letter of the answer that best completes each sentence.

1. A catalytic converter is part of a vehicle's
  - a. transmission.
  - b. exhaust system.
  - c. fuel system.
2. You should check your engine oil
  - a. while your engine is running.
  - b. before starting your engine.
  - c. every 12,000 miles.
3. Springs and shock absorbers are parts of a vehicle's
  - a. transmission.
  - b. front-end alignment.
  - c. suspension system.
4. Most vehicles' engines are
  - a. turbine engines.
  - b. external combustion engines.
  - c. internal combustion engines.
5. When you step on your brake pedal, you should feel
  - a. firm resistance.
  - b. no resistance.
  - c. the floor.
6. The temperature of a vehicle's engine may exceed
  - a. 212°F.
  - b. 500°F.
  - c. 4,000°F.
7. You should rotate your vehicle's tires to
  - a. equalize tire wear.
  - b. increase fuel efficiency.
  - c. improve suspension.
8. Most vehicles today operate on
  - a. lead-free gasoline.
  - b. leaded gasoline.
  - c. diesel fuel.

9. Many vehicles are equipped with
  - a. a power clutch.
  - b. drum brakes on the front wheels and disc brakes on the back wheels.
  - c. disc brakes on the front wheels and drum brakes on the back wheels.
10. Your vehicle's alternator
  - a. controls suspension.
  - b. mixes oxygen with gasoline.
  - c. supplies electricity to run the engine.

Write the word or phrase that best completes each sentence.

pistons   hydraulic pressure   power train  
muffler   electrical system   owner's manual

11. The parts of a vehicle that transmit the engine's power to the wheels make up the \_\_\_\_\_.
12. The heart of a vehicle's \_\_\_\_\_ is called the battery.
13. Brakes slow or stop a vehicle by applying \_\_\_\_\_ against the four wheels.
14. A(n) \_\_\_\_\_ contains specific guidelines for servicing and maintaining a vehicle.
15. The pipes that make up the exhaust manifold collect unburned gases from the engine and carry them to the \_\_\_\_\_.

## DRIVER'S LOG

In this chapter, you have learned how the systems that operate a vehicle function and what the maintenance requirements of these systems are. Based on your observations, do most drivers pay attention to these maintenance requirements? Write a paragraph about what you would tell those who do not.