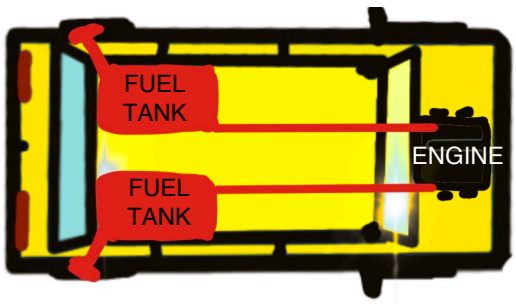
2. Understanding What Makes Your Car Go: The Fuel Tank, Engine and Brake System

Let's move our discussion to the car's engine now. We said earlier that, in order for the engine to start and then continue to run, it must receive gasoline (or other fuel). This fuel is brought in from where it is stored in the car's fuel tank. The fuel tank is usually found at the rear of your car on the left or right side depending upon the make (brand) of your car.

The fuel tank in your car is usually found in the rear of the car and may be on the right-hand or left-hand side. On your gas gauge on your dashboard you can usually find a little arrow which helps you remember the correct side when you pull into a gas station for refilling.



The fuel in the gas tank has to be pumped from the tank up to your engine. This pump is aptly called a fuel pump and can be found in various locations in cars. Sometimes it is found right next to the engine of the car or, as in many newer cars, it can be found within the gas tank itself.

Regardless of the pump's location, there are hoses known as fuel lines, which carry the gasoline from the tank to the car's engine.

Let's look a little more closely now at exactly what happens with the fuel when it arrives at the car's engine. Fuels, like gasoline or diesel, are extremely flammable meaning that they catch on fire exceptionally easily. Just their vapors can readily ignite. Understanding how to handle fuels is very important to avoid injury or death! We'll look at this in greater detail later in the course.

Gasoline and diesel are both poisonous and extremely flammable liquids. Avoid exposing these fuels to any sparks or source of accidental ignition.

We introduce this idea now because it's for this very reason that we use fuels like gasoline or diesel in our cars' engines to make them go. We purposefully ignite these dangerous fuels in our cars' engines, but do so in very controlled ways. Let's explore this more closely by looking a little at the chemistry of igniting gasoline.

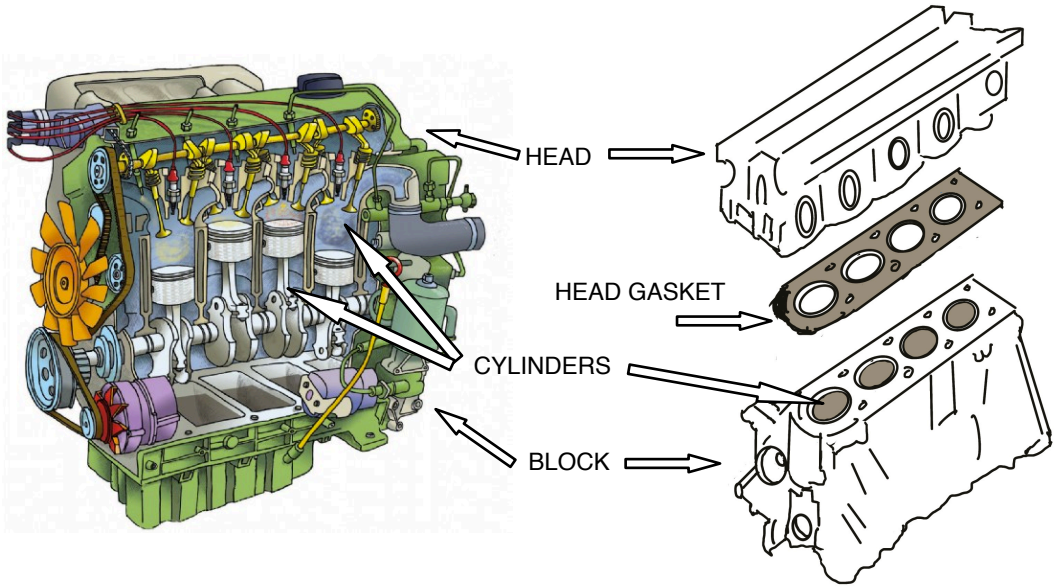
In order for gasoline to ignite, it must first be mixed with air, or more specifically, oxygen in the air. At the optimum mixture of gas and oxygen, a tiny spark will cause the gasoline to react with the oxygen, causing an extremely rapid reaction. This reaction results in the release of an enormous amount of energy held between the carbon and hydrogen atoms found in the gasoline. This explosion of energy also includes the release of an enormous amount of heat.

GASOLINE (OR DIESEL) + OXYGEN + SPARK = 

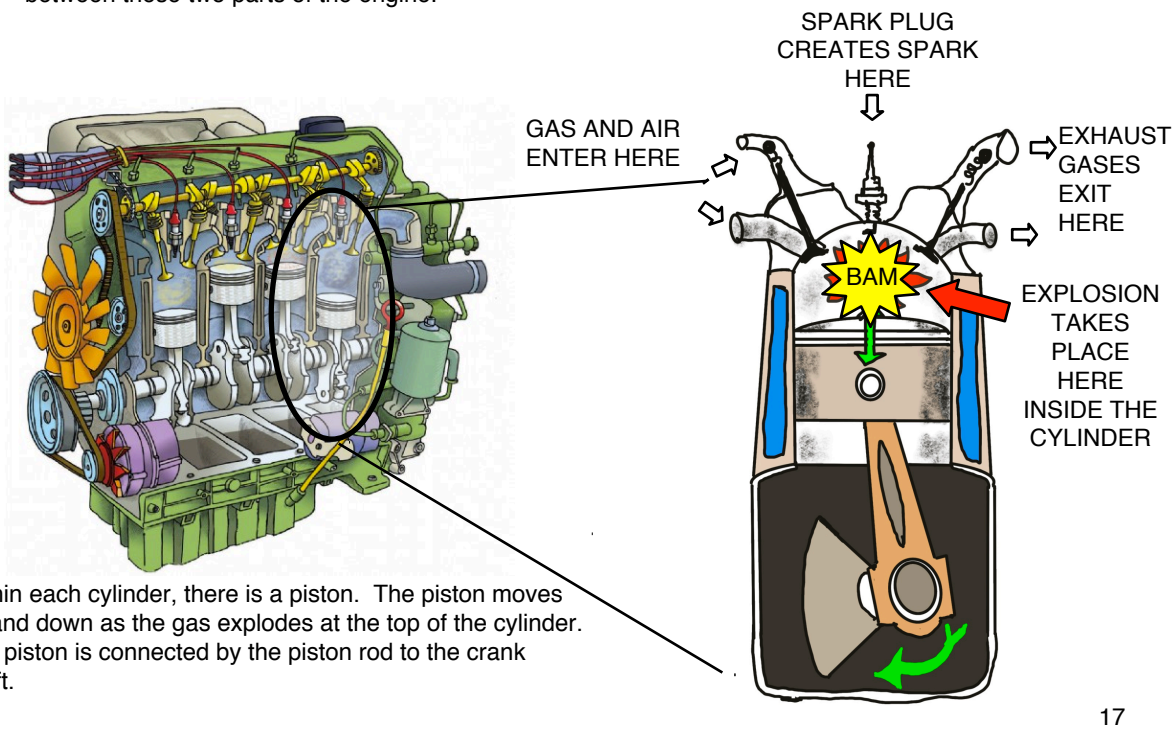
This reaction between your car's fuel and oxygen in the air takes place deep within your car's engine in a place known as the cylinders. These cylinders, like their name says, are cylindrical holes found within a very solid large chunk of steel known as the engine block. Most car engines

have 4-8 cylinders. You may have heard of an engine being a 4, 6 or 8 cylinder. This is where that name comes from. Look at the diagram to see where these cylinders are located.

So, it's within these very sturdy cylinders within the car's engine that the perfectly precise mixture of gas and oxygen are mixed and a tiny spark is created to cause the explosion to take place.



The main portion of the engine is the block. Within the block are holes known as the cylinders. It's in the cylinders where the gas explodes! Above the block is the head. The head gasket seals the space between these two parts of the engine.



Within each cylinder, there is a piston. The piston moves up and down as the gas explodes at the top of the cylinder. The piston is connected by the piston rod to the crank shaft.

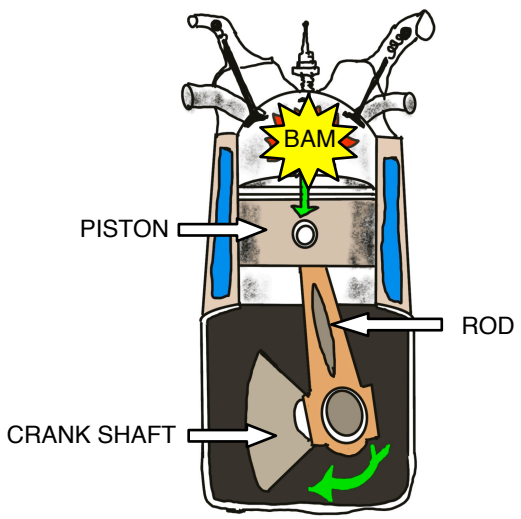
Where do you think this tiny spark comes from? If you said spark plug you're correct! Over the top of each cylinder we find a spark plug which provides a tiny spark which causes the fuel and oxygen mixture to react.

Here is a question for you: if your car has a four cylinder engine, how many spark plugs does your car have? If you said, "four" you're exactly right. You'll have the same number of spark plugs as you have engine cylinders.

Note that diesel engines work differently in this respect than gasoline-fueled vehicles. Instead of spark plugs, diesel engines have a glow plug which works to start the diesel and oxygen reaction. In this course we'll be focusing primarily on gasoline engines.

Up to now we have learned about explosions of gasoline and oxygen occurring inside the cylinders of your car's engine. How does this result in a car moving us down the road? Let's explore this connection next.

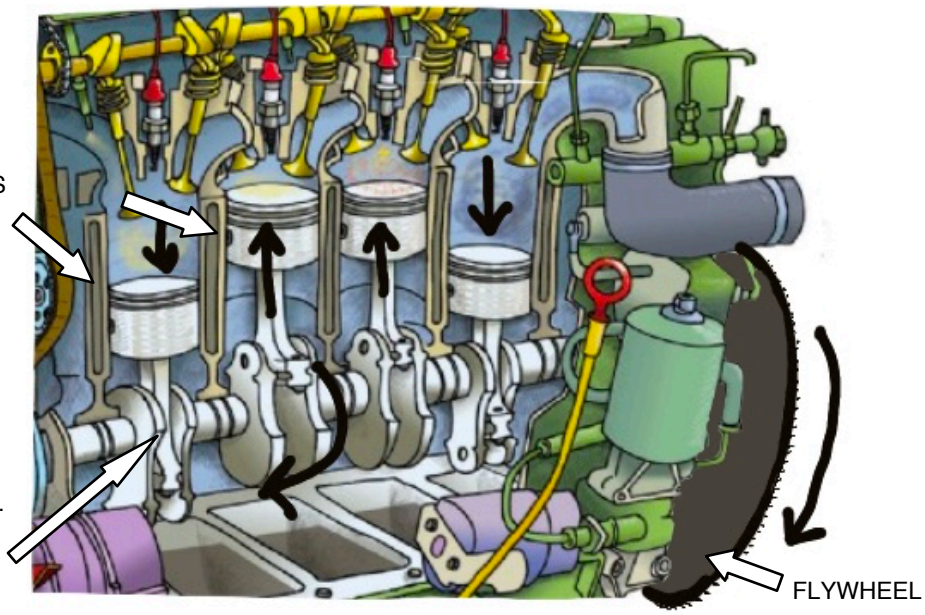
Recall that we said these explosions were happening within cylinders within the car's engine block. Within each cylinder you will find what is known as a piston. Think of a piston as being a sort of plunger which is also circular in shape and that can move up and down within the cylinder. On one side of the piston is the space where the gas and oxygen explosion occurs while on the opposite side we find a rod which connects to the piston.



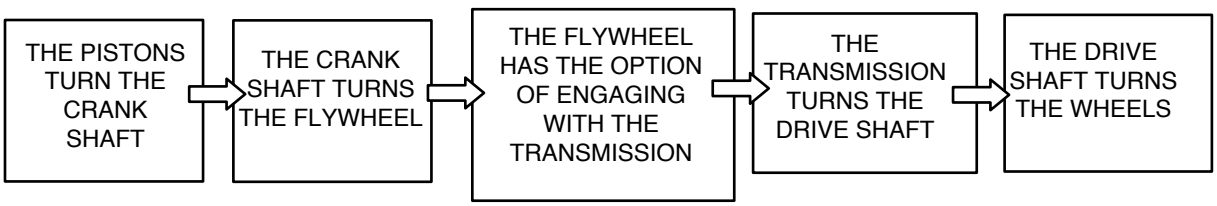
As the piston moves up and down, it moves the attached rod which pushes to one side of the crank shaft. This causes the crank shaft to turn. This turning motion is transferred to the flywheel which transfers it to the transmission.

As the explosions occur within the upper portions of the cylinders, the piston moves due to the huge amount of energy being thrust upon it. Consequently, the rods (attached to the pistons) get moved up and down. The rods in turn are attached to a rotating shaft. As the rods move up and down, they continue to rotate the shaft. This shaft is known as the crank shaft. Find these components in the diagram below.

The explosions are designed to occur in a very special sequence which results in a continual smooth rotation of the crank shaft. One end of the crank shaft is attached to a large, heavy wheel known as the flywheel. The flywheel then has the opportunity to engage or disengage eventually with the transmission. There are several other components which come into play during this process, but this is the main idea of the process. Take a look at these parts below.



Each cylinder is designed to have its explosion at a very specific time in relation to the other cylinders. This allows the pistons to move at various times which ultimately results in the crank shaft being able to move in a continuous, smooth rotation.



THE TRANSMISSION (BRIEFLY)

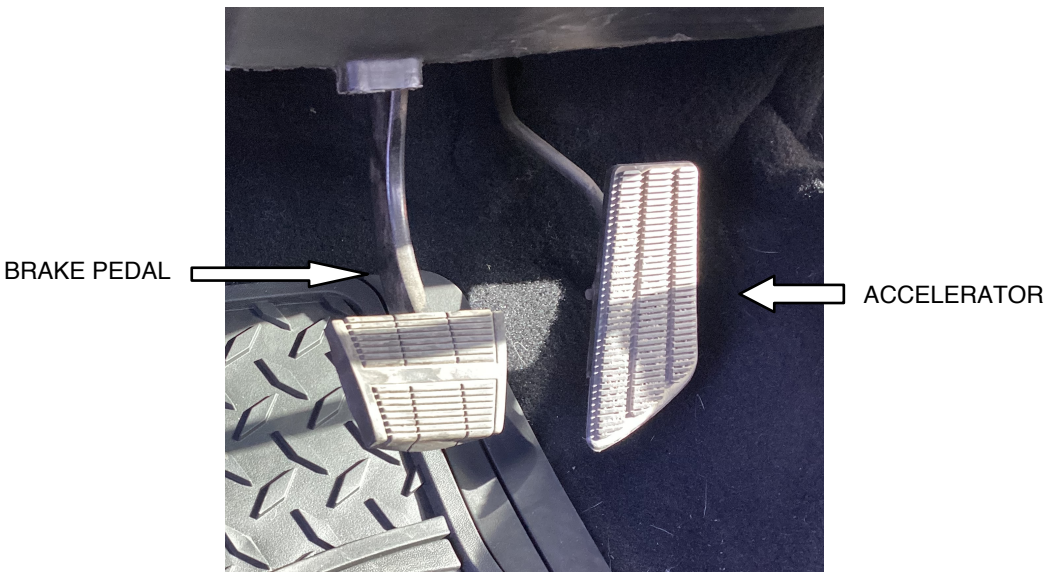
The transmission will eventually turn what is known as the drive shaft. The drive shaft connects to the wheels of your car. As the drive shaft gets turned, the wheels turn also. This is how the explosions inside your car's engine make your car go down the road.

Before we explore more complicated ideas about your car's transmission, let's go back a few steps to the process where fuel is delivered to your car's engine.

THE ACCELERATOR

You are likely aware that you can control the speed of your car by the amount of gasoline you deliver to the cylinders in your car's engine. The more gasoline you deliver, the faster your car's engine will run and the faster you can potentially go. The mechanism which controls the rate of gasoline delivery is the accelerator, sometimes called the gas pedal or foot-feeder. This pedal is found on the floor board of your car beneath the steering wheel. Note it has a rectangular shape in a vertical orientation and is always farthest to the right.

The accelerator is directly connected to the fuel pump of your car through an electrical circuit. The farther down you press on the accelerator, the faster the fuel pump turns. We'll look at the remaining pedals on the floorboard next and then come back to our discussion of the transmission.



THE BRAKE SYSTEM

While we're looking down on the floor board beneath your steering wheel, let's look at the other pedals you might find there. All cars will have at least one more pedal beneath the steering wheel which is the brake pedal. This pedal is what you use to slow or stop your car. The brake pedal is found immediately to the left of the accelerator. Find it in the photo above.

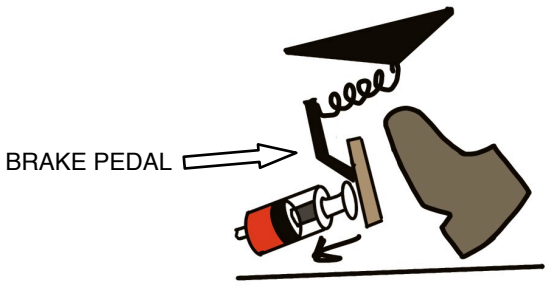
While the accelerator is used to increase the speed of your car, the brake pedal is used to slow down and eventually stop your car. To understand how the brakes work in your car, let's think first about the hand brake system you might find on a bike.

You know that by squeezing the brake handles on the handlebar of a bike, a thin cable connected to the brake handle activates a pinching mechanism which squeezes down upon the rim of your bike's wheel. The harder you squeeze the handle, the harder the wheel gets pinched and the quicker you slow down and come to a stop. Because a bike is relatively lightweight and top speeds are around 20 mph, it's not very difficult to bring your bike to a stop. The stopping is a result of friction between the pinching mechanism and the rim of your bike wheel.

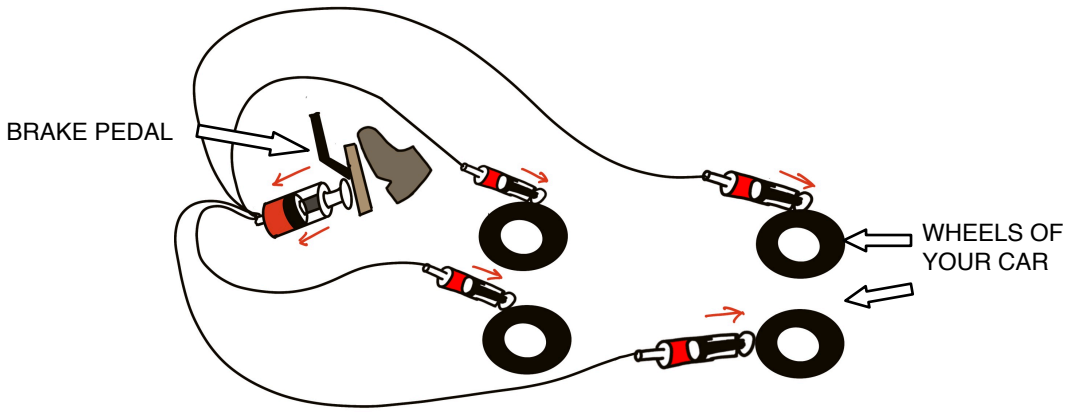
Think now about your car. Your car weighs several times the weight of your bike. A four-door sedan averages about 3000 pounds. Now think about how fast your car can go compared to your bike. While top speeds on a bike are 15-20 mph, a car can easily go 60-70 mph and, many times, even faster. Do you think you're strong enough to directly apply enough friction to your wheels to get them to come to a stop? Even with covered wagons used by pioneers and settlers, a long lever was used to apply friction to a rotating wheel. There must be a way to get our heavy, fast-moving cars to stop without using every ounce of our strength each and every time. Let's look now at these braking systems more closely.

Modern cars have what is known as a hydraulic brake system. While its name sounds complicated, it's not a difficult concept to understand. Pretend that beneath the brake pedal of

your car, the pedal is attached to the plunger of a syringe (the part that slides up and down to push out medicine). When you press down on the pedal, the plunger moves down. When you release your foot pressure, a spring pulls the pedal and attached plunger back to its original position. Look at the diagram here.



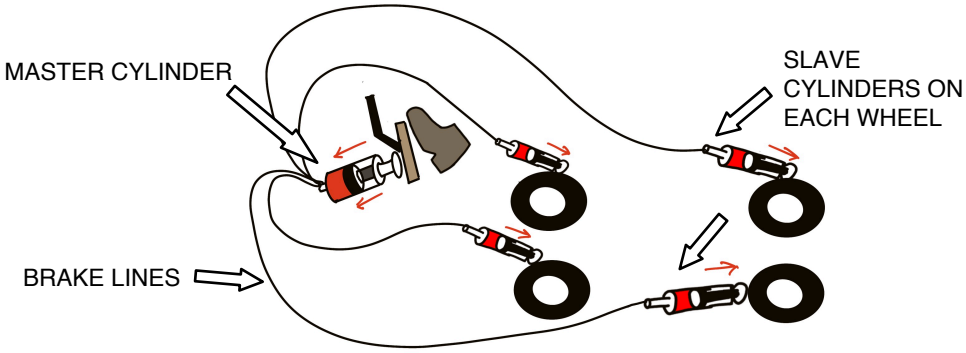
Now, pretend that on the "needle end" of the syringe there is a set of four tubes each leading out to a wheel of your car. On the end of each of these tubes, we find another syringe similar in shape to the "big" one beneath the brake pedal. Let's fill the entire syringe and tube system with a liquid. In "real life" this liquid is called brake fluid. Let's make sure the big syringe is completely filled as well as all the tubes leading to the smaller syringes. Note the positions of the plungers on the smaller cylinders in the diagram below.

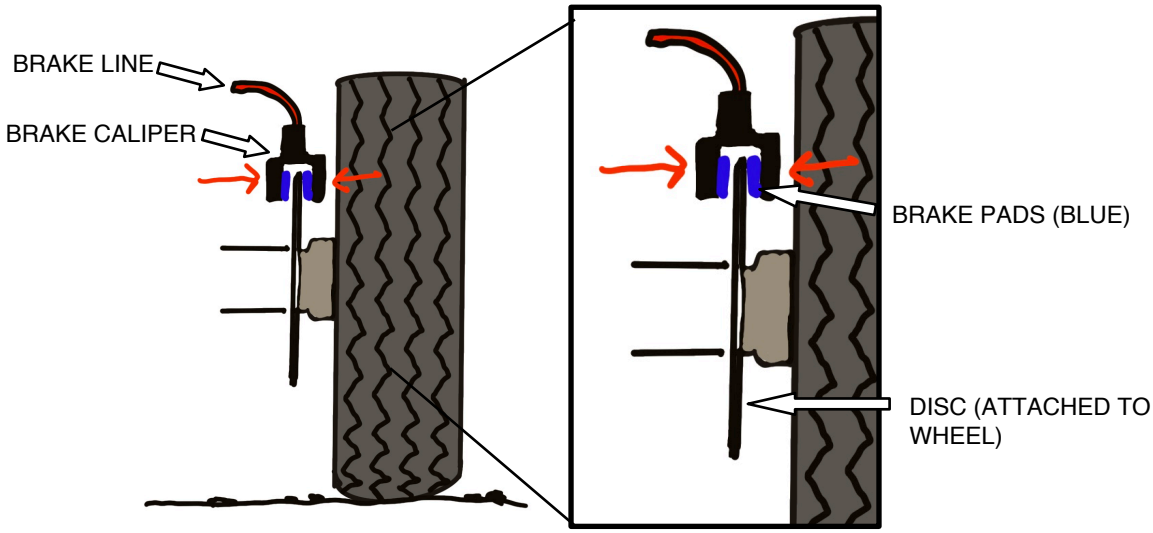


When the "big" syringe plunger is pressed down by your foot, what will happen to the plungers on the little syringes at each wheel? If you said, "they'll move outward," you're correct! If we connect these little syringes to devices which can press or pinch a rotating disc connected to the wheel, we can slow and eventually stop the rotation of the wheel.

By adjusting the size of the syringes, we can multiply our force applied to the syringes down at the wheels. The "big" syringe in cars is known as the master brake cylinder. The small syringes

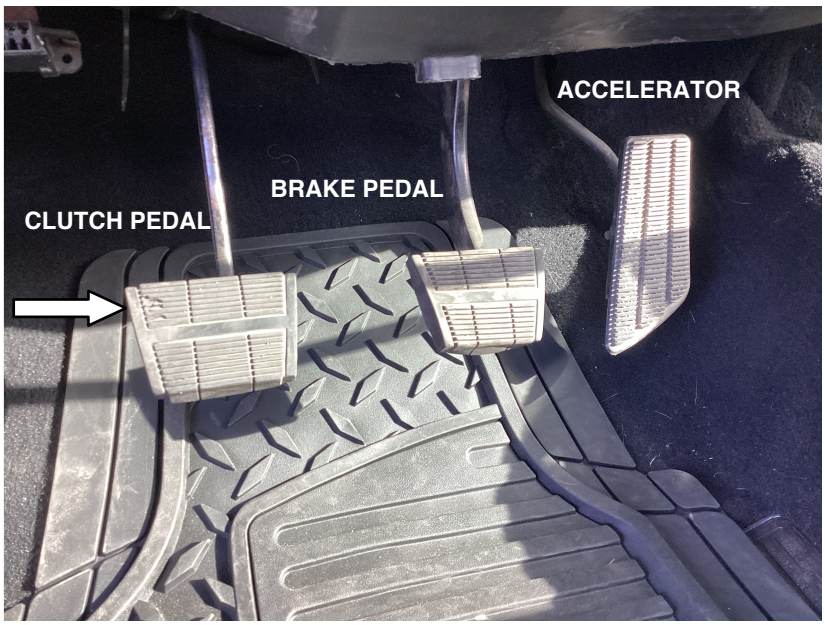
down at the wheels are known as the slave cylinders. A small amount of force applied to the master cylinder can result in a great amount of force applied at the slave cylinders. The tubes that transfer the brake fluid between the cylinders are known as brake lines.





Attached to the slave cylinder is a mechanism known as the caliper. When activated, the caliper pinches the disk (attached to the wheel). The caliper has a special surface known as the brake pad. The brake pad is where the actual friction is applied by the caliper to the disc which is affixed to the wheel. The brake pads do an enormous job of slowing and stopping your car and eventually do need to be replaced. Maintaining the appropriate amount of brake fluid is also important. Monitoring the health of your car's brake system is usually done by an auto service technician.

Let’s go back to our discussion of the pedals we find beneath the steering wheel of your car. To the left of the brake pedal, you may or may not find a third pedal. The possibility of this third pedal is directly related to the type of transmission your car has. If your car has an automatic transmission, you will not have a third pedal. If your car has a standard or manual transmission, your car *will* have a third pedal. We'll learn more about this in our next lesson.



If your car has a standard or manual transmission, you will find a third pedal alongside the brake pedal. This pedal is the clutch pedal.

LESSON 2 REVIEW QUESTIONS

Fill in the blank with the appropriate word or phrase. Check your work by referring to the answer key found in the appendix.

1. Fuel for your car's engine is stored in the _____ beneath your car.

2. The part of your car which pumps gas from the fuel tank to the engine is known as the _____.

3. The fuel pump can be found alongside the engine of your car or _____ the fuel tank itself.

4. Gasoline is considered to be highly _____.

5. Gas is mixed with _____ and then ignited within the _____ of your car's engine.

6. It's the _____ which provides the spark to ignite the gas in your car's engine.

7. The explosion within the cylinder of your car's engine presses upon the _____ inside the block of your engine.

8. The piston inside the cylinder is connected to the crankshaft of the engine by the part known as the _____.

9. As the crankshaft gets rotated by the rods inside the engine, it causes the _____ to begin moving.

10. The flywheel then can come into contact with the _____ which eventually causes the _____ to turn which ultimately turns the wheels of your car.

11. The floor pedal of your car which allows your car to receive more fuel is the _____.

12. The floor pedal which slows or stops your car from moving is the _____ pedal.

13. A third pedal to the left of the brake pedal is the _____ and is found only in vehicles with a _____ transmission.

Indicate whether the statements below are true or false. Check your work by referring to the appendix.

_____1. Gasoline is considered to be very flammable and should be handled carefully.

_____2. Gas in your car is stored in your fuel tank and is pumped to the engine by the water pump.

_____3. Because gas is so flammable, it is used to create a controlled explosion of energy inside the engine of your car which allows your engine to power your car.

_____4. The location where the combustion of gasoline takes place in the engine is known as the cylinder.

_____5. Spark plugs create the source of the spark to ignite the gasoline in the cylinder of your car.

_____6. When the gas inside the cylinder of your car combusts, it presses upon the piston which pushes downward on the rod.

_____7. The crankshaft in your car's engine is attached to the rods which are attached to the pistons in your car's engine.

_____8. As the crankshaft is turned, it transfers this energy to the flywheel which has the option of engaging with gears within the transmission of your car.

_____9. The transmission of your car is connected to the drive shaft which is connected to the wheels of your car and when energized, your car will move down the road.

_____10. The pedal on the floor board of your car which makes more gas get pumped to the engine is the clutch pedal.

_____11. If you press on the brake pedal of your car, your car will move faster down the road.

_____12. The brakes of your car work to slow your car down and do so by transferring a force from the brake pedal to the calipers on each wheel of your car.

_____13. The tubes which carry brake fluid from the master cylinder near the brake pedal back to the slave cylinders back at each wheel of your car are called brake lines.

_____14. All cars, whether they have a manual or automatic transmission, have a clutch pedal on the floor board of the driver's seat.

_____15. The battery of your car has two posts: a negative post and a happy post. :)

Read each question below. Choose the one best response.

1. Gasoline in your fuel tank is moved to your engine by the

a. water pump.

b. sump pump.

c. fuel pump.

d. gas station pump.

2. If you want to increase the speed that your car is traveling you should press on the

a. brake pedal

b. accelerater

c. clutch

d. accelerator.

3. Gasoline must be mixed with which element before it will combust properly?

a. hydrogen

b. potassium

c. carbon dioxide

d. oxygen

4. Which response below tells the correct sequence of transfer of energy from the engine to the wheels?

a. piston, rods, crankshaft, flywheel, transmission, drive shaft, wheels.

b. rods, piston, cylinder, flywheel, crankshaft, transmission, wheels.

c. piston, crankshaft, rods, flywheel, driveshaft, wheels, transmission.

d. wheels, driveshaft, transmission, flywheel, crankshaft, pistons, rods.

5. Pressure exerted on the master cylinder of the brakes is transferred to

a. the slave cylinders in the transmission.

b. the slave cylinders in the engine.

c. the pistons at the brake caliper.

d. the slave cylinders at the brake caliper.

6. Choose the best sequence of events regarding how a car starts:

a. the key turns the ignition switch which activates the engine which starts the starter motor.

b. the ignition switch turns the key which activates the starter which starts the fuel pump.

c. the key turns the ignition switch which activates the starter motor which "turns over" the engine.

d. the dog chases the cat which chases the mouse which eats the pizza.