5 Motor Vehicles

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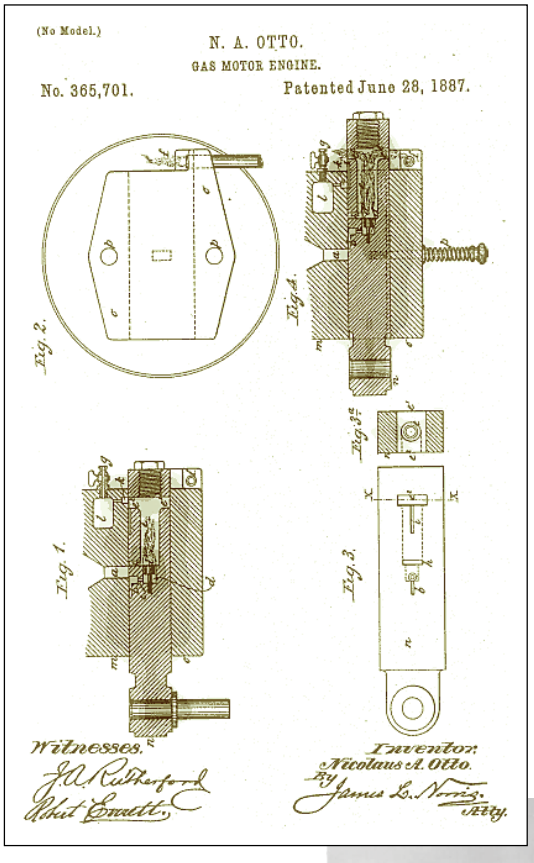
1 THE AUTOMOBILE: A REVOLUTIONARY INVENTION

Nikolaus August Otto and his first practical four-stroke internal-combustion engine.

The automobile as we know it today is the result of a long process of evolution that took place worldwide.

In 1769, the French engineer **Nicholas Joseph Cugnot** devised the **first self-propelled road vehicle**, a military tractor powered by a steam engine. One year later, Cugnot built a steam-driven tricycle that could carry four passengers.

In a steam engine the burning fuel heats water in a boiler, thus generating steam. The steam expands and pushes the pistons that turn a crankshaft, which then turns the wheels. Early self-propelled vehicles were developed with steam engines. But steam engines were very heavy and they proved a poor design for road vehicles, while they were very successfully used in locomotives. In the USA, many steam coaches were built in the second half of the 19th century.


(No Model.)

N. A. OTTO.

GAS MOTOR ENGINE.

No. 365,701. Patented June 28, 1887.

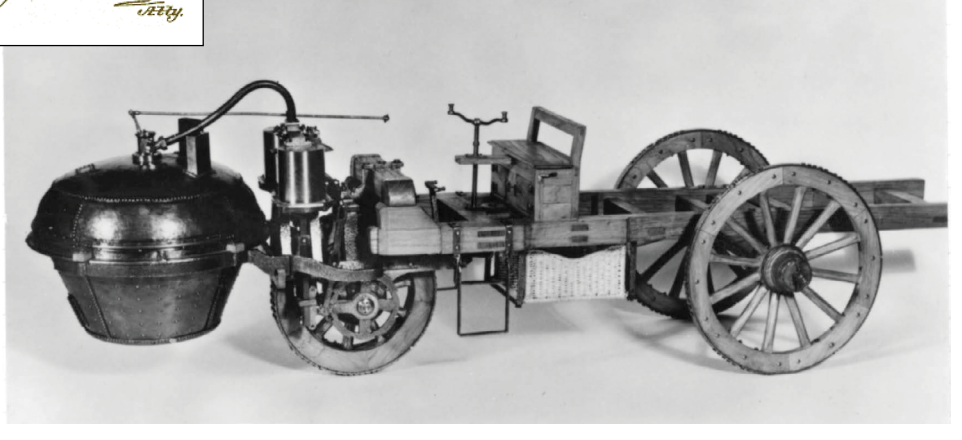
Fig. 2. Fig. 4. Fig. 3*. Fig. 1. Fig. 3.

Witnesses. Inventor: Nicolaus A. Otto. By James L. Norris, Atty.

Around 1830, the Scotsman **Robert Anderson** built the **first electric carriage**. Electric cars were powered by a small electric motor with rechargeable batteries. The vehicles were heavy and slow and needed to be recharged frequently. Both steam and electric road vehicles were abandoned in favour of **petrol-powered vehicles**. But electricity proved more successful for tramways and streetcars, where a constant supply of electricity was possible.

In 1876, **Nikolaus August Otto** built the first practical four-stroke internal-combustion engine. In an internal-combustion engine, the fuel is burnt inside the engine, while in a steam engine the fuel is burnt outside. The most common internal-combustion engine type is petrol powered.

The first petrol-powered vehicles were developed by **Gottlieb Daimler** and **Karl Benz**. In 1885, Karl Benz designed the first three-wheeler powered by an internal-combustion engine. In 1891, Benz built the first four-wheeler and he also devised a **chassis**. Engine design and car design were integral to one another, and almost all engine designers were also important automakers.



The first self-propelled road vehicle by Nicholas Joseph Cugnot.

CAR EVOLUTION IN THE 20TH CENTURY

By the early 1900s, petrol cars started to **outsell** all other types of motor vehicles. The first automobile to be mass-produced in the USA was the 1901, Curved Dash Oldsmobile, built by **Ransome Eli Olds**. Olds invented the basic concept of the **assembly line** and started the Detroit area automobile industry.

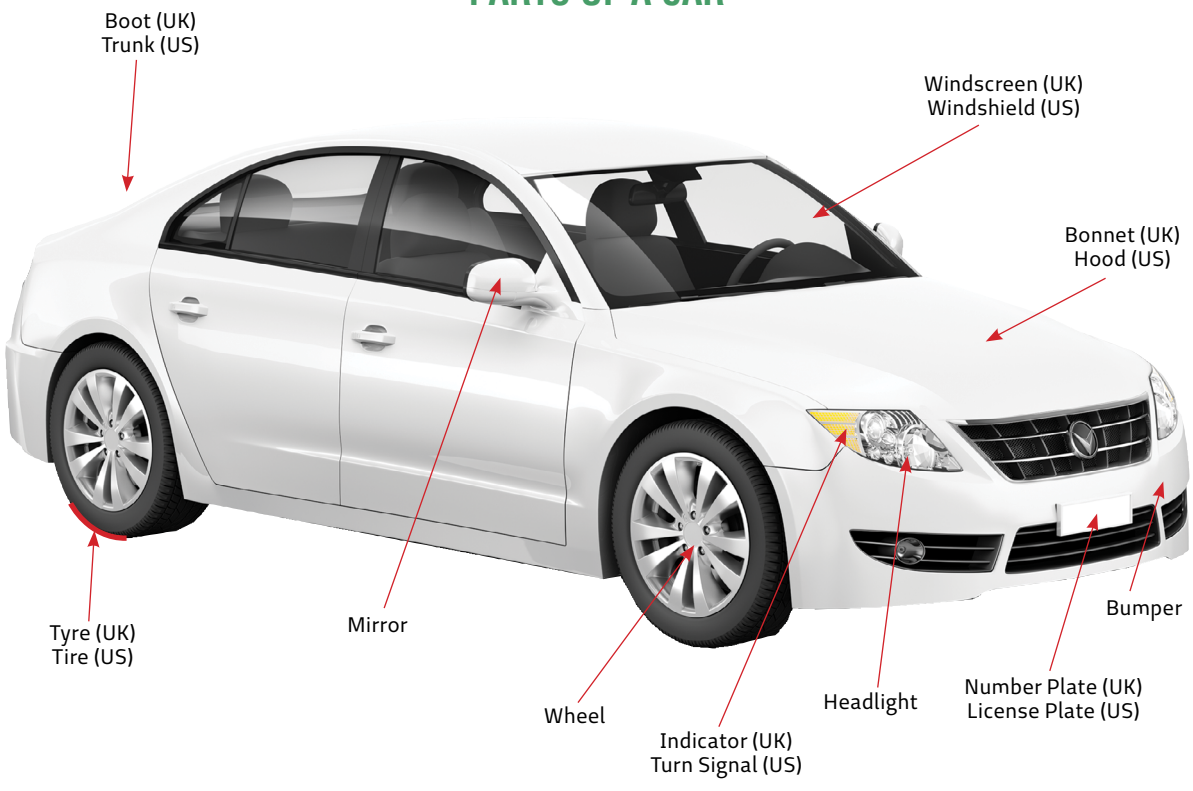
An **assembly line** is a system used in factories in which the products move past a line of workers, each of whom makes or checks one part.

Henry Ford installed the first **conveyor belt**-based assembly line in his car factory in Michigan in 1913. The assembly line reduced **production costs** for cars by reducing assembling time. Ford's famous **Model T** was assembled in ninety-three minutes. The Ford Motor Company was launched in 1903 and by 1927, 15 million Model Ts had been manufactured. The modern era of automobiles had begun.

Nowa days it is commonly believed that the internal-combustion engine is dead and that hybrid vehicles are the future of transportation even if the so-called renewable energy sources do not appear to be commercially viable yet.

Most car manufacturers world wide are trying to **cut** toxic emissions from their car's **exhausts** to less than five per cent of what they were 25 years ago.

PARTS OF A CAR



Reading Comprehension

Answer the following questions.

1 What did Cugnot devise in 1769?
2 How does a steam engine work?
3 What are the disadvantages of steam engines?
4 Who built the first electric motor?
5 What did Daimler and Benz build?
6 Who invented the assembly line?
7 Which was the first car to be mass produced in the USA?
8 Which innovation did Ford introduce?
9 What was the Model T?
10 What are automakers trying to do today?

Vocabulary

Match each of the following words with its Italian equivalent.

1 Steam	6 Streetcar	A Pistone	F Motore
2 Engine	7 Petrol	B Telaio	G Ricaricabile
3 Piston	8 Chassis	C Catena di montaggio	H Carburante
4 Crankshaft	9 Assembly line	D Vapore	I Albero a gomiti
5 Rechargeable	10 Fuel	E Benzina	J Tram

Scrambled Sentences

The following sentences go together to form a text about Gottlieb Daimler, one of the inventors of the car. Working in small groups put them into the right order.

Daimler Motor Company

A The Daimler Motor Company was founded in 1890 and soon developed a reputation for reliability.
B He worked in Britain, France and Belgium before being appointed technical director to the gas-engine company founded by Nikolaus Otto.
C Gottlieb Daimler was born in Germany in 1834. After training as a gunsmith he became an engineer.
D Together with another engineer named Wilhelm Maybach, he developed the first engine with a surface carburettor, that vaporized the petrol and mixed it with air.
E In the first road race held between Paris and Rouen in 1894, only the cars powered by Daimler engines completed the race.
F In 1889 Daimler and Maybach placed their engine into a horse carriage and drove the car at speeds of 11 miles per hour. They had thus produced the first four-wheeled automobile.
G This impressed Ferdinand Graf von Zeppelin, who decided to use Daimler engines in the airships he was building.
H After devising a four-speed gearbox and a belt-drive mechanism to turn the wheels, they decided to sell their cars.

Research Work

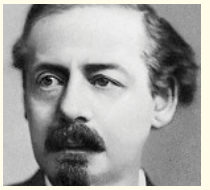
As you have just seen, the history of the evolution of the internal-combustion engine is a long one. Gather some further information about such early pioneers of the automobile development as Christiaan Huygens, Samuel Brown, Jean Joseph Étienne Lenoir, Alphonse Beau de Rochas, Siegfried Marcus and George Brayton.

Christiaan Huygens

Samuel Brown

Jean Joseph Étienne Lenoir

Alphonse Beau de Rochas


Siegfried Marcus

George Brayton

THE FUEL ENGINE

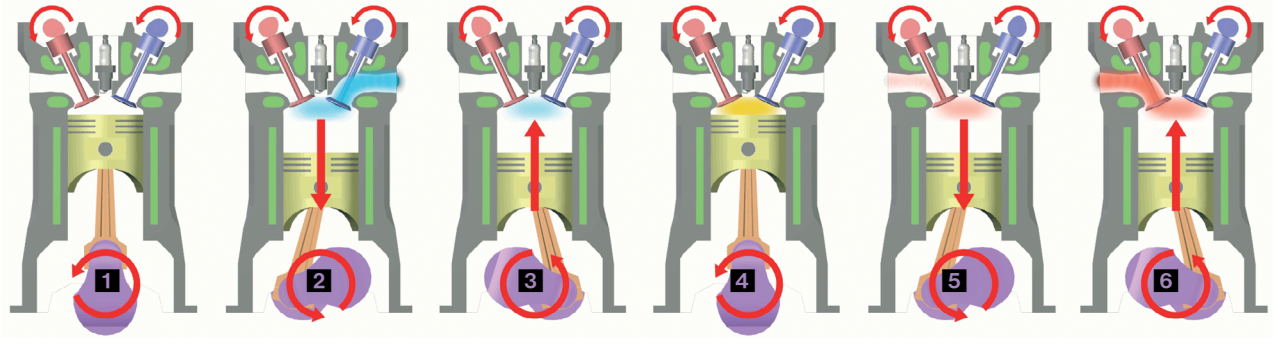
In an **internal-combustion engine** the combustion of the fuel takes places in a confined space, producing expanding gases that are used directly to provide mechanical power. Such engines are classified as reciprocating or rotary, spark ignition or compression ignition, and two-stroke or four-stroke; the most common combination, used from cars to lawn mowers, is the reciprocating, spark-ignited, four-stroke petrol engine.

THE FOUR-STROKE INTERNAL-COMBUSTION ENGINE

Almost all cars currently use what is called a **four-stroke combustion cycle** to convert petrol into motion. The four-stroke approach is also known as the **Otto cycle**, in honour of Nikolaus Otto, who invented it in 1876.

When you put a small **amount** of high energy fuel (like petrol) in a small enclosed space and **ignite** it, an incredible amount of energy is released in the form of expanding gas. This is what happens in an internal combustion engine where this energy is transformed into motion. In a car the linear motion is converted into rotational motion by the crankshaft, to which the connecting rods are attached. The Otto cycle consists of four strokes.

1. **Intake stroke –** The intake valve opens at a precise time to allow the mixture of vaporized fuel and air to enter the cylinder. The piston moves down and the air/fuel mixture is pushed into the cylinder by atmospheric pressure.
2. **Compression stroke –** After the piston has reached the bottom of the cylinder, it begins to move upward and the intake valve closes. At this point the cylinder is sealed. The air/fuel mixture is compressed by the cylinder which is moving upward and this increases the pressure and the temperature in the cylinder.
3. **Power stroke –** As the piston reaches the top of the cylinder, an electric spark is produced by the spark plug. This spark ignites the air/fuel mixture, thus creating an explosion. The mixture burns rapidly in the combustion chamber and the pressure in the cylinder increases, forcing the piston down in the cylinder. The power impulse is transmitted to the crankshaft through the connecting rod. The connecting rod transforms the reciprocating motion of the piston into the rotating motion of the crankshaft.
4. **Exhaust stroke –** When the piston reaches the bottom of the cylinder again, the exhaust valve opens to allow the burned gases to leave the cylinder through the exhaust port.



1. Starting position. 2. Initial stroke. 3. Compression stroke. 4. Ignition of fuel. 5. Power stroke. 6. Exhaust stroke.

Reading Comprehension

Activities

Answer the following questions.

1 Why is the four-stroke combustion cycle also called the Otto cycle?
2 What happens in an internal combustion engine?
3 How does air enter the cylinder?
4 When does the intake valve close?
5 Why do pressure and temperature increase during the compression stroke?
6 How is the air/fuel mixture ignited?
7 Where does the combustion take place?
8 When and why does the exhaust valve open?

Vocabulary

Explain the function of the following devices.

1 Intake valve

2 Spark plug

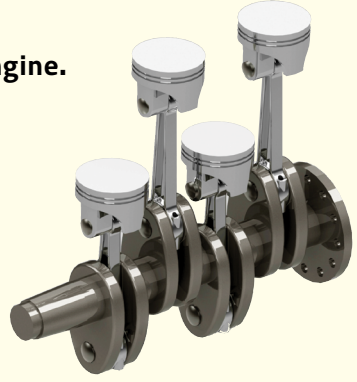
3 Connecting rod

4 Crankshaft

5 Exhaust valve

Writing

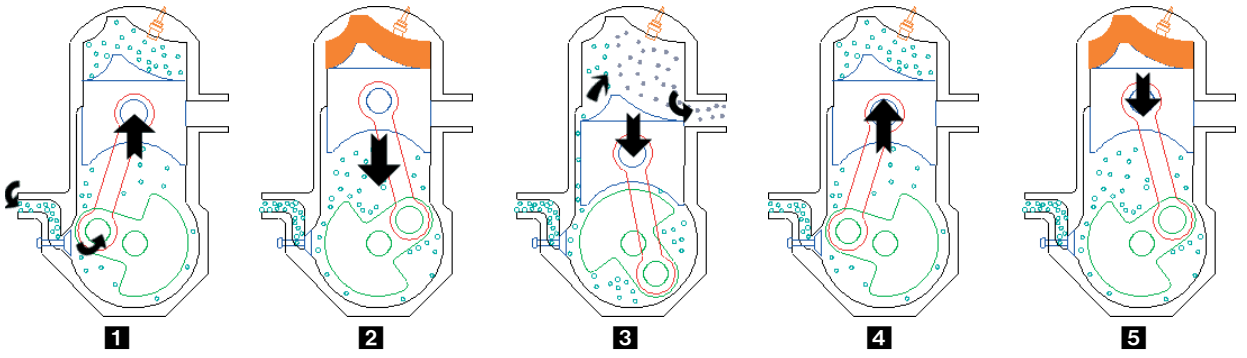
Describe the four strokes of an internal combustion engine.



2.2

THE TWO-STROKE INTERNAL-COMBUSTION ENGINE

In a **two-stroke internal-combustion engine** there are no valves as in a conventional four-stroke engine. Intake and exhaust are accomplished through ports, special holes cut into the cylinder wall, which are uncovered when the piston is in the down position. A two-stroke engine is equipped with a reed valve between the air-fuel intake and the **crankcase**. The air-fuel mixture enters the crankcase and is trapped there by the one-way reed valve. When the piston is forced down, the exhaust port is uncovered, and hot exhaust gases begin to leave the cylinder. As the piston is now in the down position, the crankcase becomes pressurized, and when the intake port is uncovered, pressurized air/fuel mixture enters the chamber. Both the intake and exhaust ports are open, but as the piston begins to move up, the



1. Starting position. 2. Intake. 3. Transfer exhaust. 4. Compression. 5. Power.

ports are closed off, and the air/fuel mixture is compressed and ignited. The hot gases increase in pressure, pushing the piston down with great force and creating work for the engine.
The four-stroke cycle is more efficient than the two-stroke cycle and is more commonly used for automotive and industrial purposes. The two-stroke type of internal-combustion engine is employed in utility applications which require small and inexpensive motors like chainsaws or small motorcycles.

Reading Comprehension

Activities

- **Answer the following questions.**

1 What is the main difference between two-stroke and four-stroke internal-combustion engines?
2 What are ports?
3 Which cycle is more efficient?
4 What is the two-stroke cycle used for?

Speaking

- **Explain how a two-stroke internal-combustion engine works.**

THE DIESEL ENGINE

3 2

The **diesel engine** was developed by the German engineer **Rudolph Diesel** in 1893. The diesel engine is **heavier** and **more powerful** than petrol engines. Diesel engines are widely used in heavy machinery, locomotives, ships, and automobiles.
A diesel engine is very similar in **build** to a petrol engine and it is based on the same four-stroke system as the Otto cycle.

The main difference in a diesel engine is that it has **no spark plug** to ignite the fuel. The diesel engine exploits the extreme heat generated by compression of air in the cylinder to ignite the fuel which is injected or sprayed into the cylinder at the end of the compression stroke, when the ratio of compression of the air charge is sufficiently high to ignite the fuel in

the combustion chamber. Petrol compression ratios stop at around 12:1, while diesel compression ratios reach the high 20s. The fuel first enters the cylinder and vaporizes. Then it must mix with oxygen. The better the fuel is atomized the better the fuel and hot air mix together. At that point the fuel burns immediately because of the high temperature of air in the cylinder. Diesel engines are heavier than petrol engines as they compress the air charge to a much higher pressure than petrol engines.

Reading Comprehension

Answer the following questions.

1 Who invented the diesel engine?
2 Where are diesel engines used?
3 What is the main difference between a petrol engine and a diesel engine?
4 Why does the fuel burn immediately?
5 Why are diesel engines heavier than petrol engines?

Vocabulary

In the text, find synonyms of the following words and expressions.

1 Gasoline
2 Devised
3 Cars
4 Uses
5 To cause something to catch fire
6 To reduce to fine particles

Writing

Fill in the blanks with the missing words.

1 The diesel engine is _____ and more powerful than the petrol engine.
2 The diesel engine is based on the _____ strokes system.
3 The diesel engine has no spark _____ to ignite the _____ .
4 The diesel engine exploits the extreme _____ generated by _____ of air in the _____ .

ENGINE SUBSYSTEMS

The engine has a number of systems that help it to do its job of converting fuel into motion. Here are some of the different subsystems used in modern engines.

THE IGNITION SYSTEM

The **ignition system** produces a high-voltage electrical charge and transmits it to the spark plugs **via** ignition wires. The charge flows to a distributor. The distributor has one wire going in the centre and four, six or eight wires (depending on the number of cylinders) coming out of it. These ignition wires send the charge to each spark plug. The engine is timed so that only one cylinder receives a spark from the distributor at a time.

THE COOLING SYSTEM

The **cooling system** in most cars consists of a radiator and water pump. Water circulates through passages around the cylinders and then travels through the radiator to cool it off. In some cars, as well as most motorcycles and lawn mowers, the engine is air-cooled. Air-cooling makes the engine lighter but hotter, generally **decreasing** engine life and performance.

THE AIR-INTAKE SYSTEM

Most cars are normally aspirated, which means that air flows through an air filter directly into the cylinders. High-performance engines are either **turbocharged** or **supercharged**, which means that air coming into the engine is first pressurized to increase performance. The amount of pressurization is called **boost**. A turbocharger uses a small turbine attached to the exhaust pipe to spin a compressing turbine in the incoming air stream. A supercharger is attached directly to the engine to spin the compressor.

THE STARTING SYSTEM

The starting system consists of an electric starter motor and a starter **solenoid**. When you turn the ignition key, the starter motor spins the engine a few revolutions so that the combustion process can start. The starter motor must overcome:

- all internal friction caused by the piston rings;
- the compression pressure of any cylinder;
- the energy necessary to open and close valves with the camshaft;
- all other things directly attached to the engine, like the water pump, the oil pump and the alternator.

Because so much energy is needed and because a car uses a 12-volt electrical system, hundreds of amps of electricity must flow into the starter motor. The **starter solenoid** is essentially a large electronic switch that can handle that much current. When you turn the ignition key, it activates the solenoid to power the motor.

THE LUBRICATION SYSTEM

The **lubrication system** makes sure that every moving part in the engine gets oil so that it can move easily. The two main parts which need oil are the pistons and any bearings that allow the crankshaft and the camshaft to rotate freely. In most cars, oil is sucked out of the oil pan by an oil pump, run through the oil filter to remove any grit, and then squirted under high pressure onto bearings and cylinder walls. The oil is then collected in the sump, and the cycle repeats.

THE FUEL SYSTEM

The **fuel system** pumps petrol from the petrol tank and mixes it with air so that the proper air/fuel mixture can flow into the cylinders. Fuel is delivered in three common ways: carburation, port fuel injection and direct fuel injection.

Fuel injectors.

- In **carburation**, a device called a carburettor mixes petrol with air as the air flows into the engine.
- In a fuel-injection engine, the right amount of fuel is injected individually into each cylinder either right above the intake valve (**port fuel injection**) or directly into the cylinder (**direct fuel injection**).

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WWW text

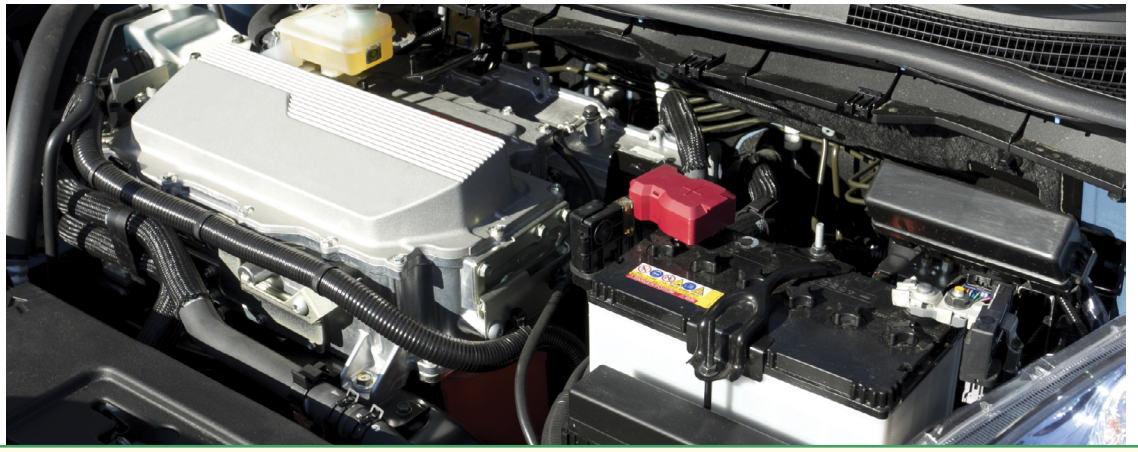
Satellite Navigation Systems for Cars

THE EXHAUST SYSTEM

The exhaust system consists of the exhaust pipe and the muffler. The muffler dampens the sound. The exhaust system also includes the catalytic converter.

THE ELECTRICAL SYSTEM

The electrical system consists of a **battery** and an **alternator**. The alternator is connected to the engine by a belt and generates electricity to recharge the battery. The battery makes 12-volt power for everything in the car that needs electricity (the ignition system, radio, headlights, windscreen wipers, power windows and seats) through the vehicle's wiring.



Reading Comprehension

Activities

- **Fill in the table below.**

SYSTEM	FUNCTION	SYSTEM	FUNCTION
ignition system		*lubrication system*	
cooling system		*fuel system*	
air-intake system		*exhaust system*	
starting system		*electrical system*	

Cloze Exercise

- **Complete the text with the following words: longer – pump – engine – temperatures – failures – power.**

The Cooling System

Inside the car's _____ 1, combustion occurs igniting the fuel air mixture. This explosion is converted into _____ 2 through the engine while producing a large amount of heat. These high _____ 3 are controlled with the help of the cooling system. A cooling system consists of a water _____ 4, thermostat, radiator hose, hose clamps, radiator, radiator cap and coolant. Your vehicles cooling system is crucial to making the engine last _____ 5 and perform better. An improperly maintained cooling system can result in the overheating of the engine, which in turn can cause major component _____ 6 within.

Matching

Activities

Match each component of the cooling system with its correct definition.

1 ___ Radiator
2 ___ Water pump
3 ___ Cooling fan
4 ___ Anti-freeze coolant
5 ___ Thermostat

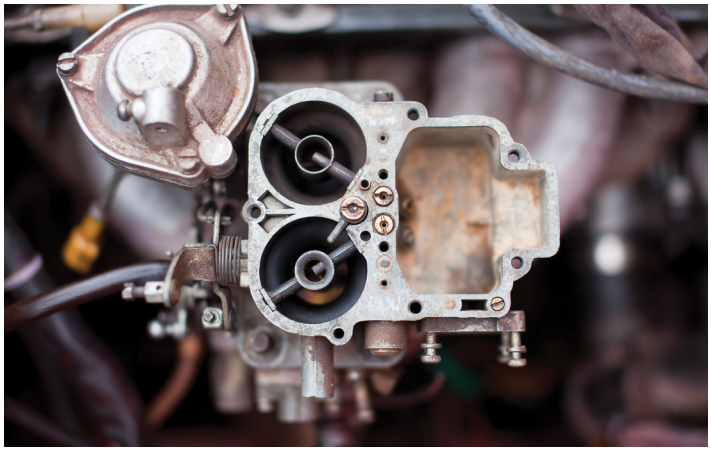
A This is the fluid used as a way to dissipate the great amount of heat an internal combustion engine creates. Its colour can vary from green, orange, blue and yellow, each having their own protective properties. Most new vehicles have an optimum operating temperature of around 93 degrees Celsius. Ethylene Glycol is generally used as a stabilizer to help keep the mixture in the cooling system from boiling or freezing depending on whether the vehicle is in use.
B It is a mechanical device that circulates the engine coolant/anti-freeze through the radiator and back to the engine. It is usually driven by an accessory drive belt or by the timing belt-chain.
C It is a temperature sensitive orifice in the cooling system that opens and closes according to engine temperature to regulate the flow of coolant-anti-freeze through the radiator and back to the engine. This enables the engine to be run at specific temperatures to optimize the performance and emissions levels of the vehicle.
D It is a finned box mounted at the front of the vehicle that the coolant is forced through so that air may pass across it and cool the anti-freeze-coolant. The fins act as heat syncs to help dissipate the heat.
E It is located directly behind the radiator, whether the vehicle is front or rear wheel drive. Its task is to pull air through the radiator at lower vehicle speeds to keep it from over-heating. It can either be mechanical (belt driven on the engine) or electric (mounted on the radiator, temperature controlled).

CAR COMPONENTS 3

The engine is the most important part of a vehicle. But a vehicle is a complex thing, made up of different auxiliary parts, whose quality and performance are equally important for the performance of the engine as a whole.
Let's have a look at some of these conponents.

THE CARBURETTOR 1 3

The idea behind an engine is to burn petrol to create pressure, and then turn the pressure into motion. Very little petrol (about 10 milligrams) is necessary during each combustion cycle.
The function of a **carburettor** is to mix just the right quantity of petrol with air so that the engine runs properly. If there is not enough fuel mixed with the air, the engine "runs lean" and that means that either it will not run or it will be damaged. If there is too much fuel mixed with air, the engine "runs rich" and either it will not run or it will run very smoky.
On new cars, fuel injection is becoming nearly universal because it provides better fuel efficiency and lower emissions. But nearly all older cars, and all small



equipment like lawn mowers and chain saws, use carburettors because they are less expensive.
A carburettor is essentially a tube. There is an adjustable plate across the tube called the **throttle plate** that controls how much air can flow through the tube. At some point in the tube there is a narrowing, called the **venturi**, and in this narrowing there is a hole, called a **jet**, that lets the vacuum draw in fuel.

Reading Comprehension

- **Answer the following questions.**

1 How much petrol is burnt during each combustion cycle?
2 What is the function of the carburettor?
3 What happens when an engine "runs lean"?
4 What happens when an engine "runs rich"?

Speaking

- **Describe a carburettor.**

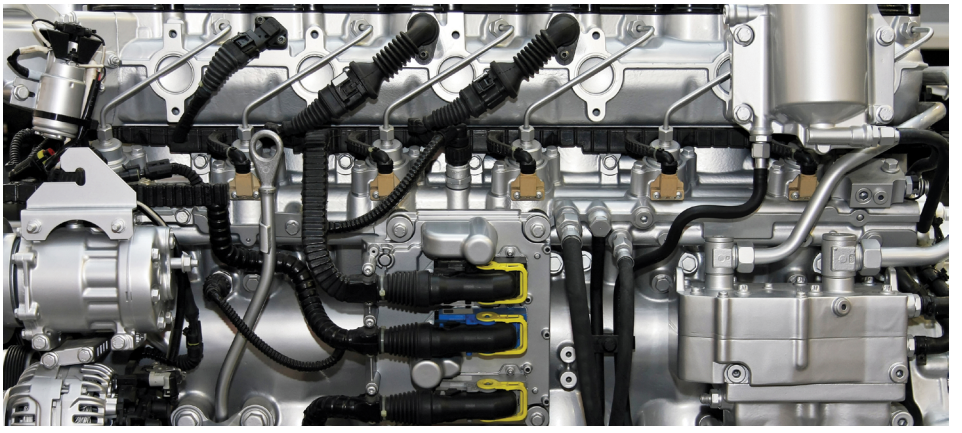
Vocabulary

- **Read the text again and find the word corresponding to the following definitions.**

1 A substance used to produce power by burning
2 A usually electronically-controlled system for injecting a precise amount of fuel into the cylinders of an internal combustion engine
3 A machine used for cutting grass
4 A portable power saw whose teeth link together to form an endless chain
5 A valve that regulates the flow of a fluid
6 Narrowing in a tube for measuring flow rate

FUEL INJECTION

Fuel injection is a technology used to mix fuel with air before combustion. In a fuel injection system, air is forced through nozzles without the use of a venturi and this is the reason why the power of the engine is increased and the control over the air/fuel mixture is more accurate.
Modern electronic systems are provided with sensors which monitor engine conditions and an **Electronic Control Unit** (ECU) which calculates the needed amount of fuel, thus improving fuel efficiency and reducing pollution.



INDIRECT FUEL INJECTION

Indirect fuel injection has been used in diesel engines since 1920s because of the higher energy required for diesel to evaporate.
Today most petrol engines are equipped with indirect injection systems. They may consist of one single nozzle, usually in the throttle housing, or more than one injectors, one in each cylinder.

DIRECT FUEL INJECTION

Many diesel engines are equipped with a **Direct Injection** system (DI). In **direct fuel injection** the nozzle is placed inside the combustion chamber. This system is more efficient than indirect injection but the engine tends to be noisier.
Some hi-tech petrol engines use this system as well, since it gives a better **volumetric efficiency**.

The **volumetric efficiency** of an engine is the ratio of volume of working substance actually admitted, measured at a specified temperature and pressure, to the full piston displacement volume; for a diesel engine, it is the ratio of the volume of air drawn into a cylinder to the piston displacement.

Reading Comprehension

Activities

- **Answer the following questions.**

1 What is fuel injection?
2 How is air mixed with fuel in a fuel injection system?
3 Why are fuel injection engines more powerful?
4 What do electronic fuel injection systems consist of?

Speaking

- **Explain the difference between direct and indirect fuel injection.**

Vocabulary

- **In the text above, find the equivalents of the following Italian words and expressions.**

1 Effusore
2 Potenza del motore
3 Sensori
4 Inquinamento
5 Camera di combustione
6 Iniettore

TYRES

3 3

Tyres are coverings fitted round the rim of a wheel usually made of reinforced rubber. The main purpose of a tyre is to absorb shocks and to provide a cushion between the vehicle and the road. For this reason, tyres have to be **robust** and **hard-wearing**, while maintaining **safe and controlled manoeuvrability** for the vehicle. Tyres are made up of different materials. As many as two hundred different materials can be used to create one tyre in order to provide optimum steering, braking, road holding and wear capabilities. The tread is the **grooved** outer layer that is in direct contact with the road. The rubber compound is designed to grip the road, withstand wear and

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WWW listening

Where Does All the Rubber from Worn Tyres Go?

Friction is the natural force that prevents one surface from sliding easily over another

tear, and resist the high temperatures generated by **friction**. The grooves and tread **sipes** on the shoulder of the tyre are specially designed to channel water away from the surface of the tyre, in order to guarantee maximum wet grip.

There are different rubber compounds, each one suitable for different driving conditions. For example, racing cars have tyres that can resist very high temperatures with optimum grip, enabling prolonged usage at high speeds. These tyres wear more rapidly than those of ordinary cars.

Reading Comprehension

- **Answer the following questions.**

1 What are tyres made of?
2 What is the main function of a tyre?
3 What is the tread of a tyre?
4 What is the purpose of the grooves and tread sipes?
5 What kind of tyres do racing cars have?

Vocabulary

- **In the text, find the English equivalents of the following Italian words and expressions.**

1 Cuscinetto
2 Manovrabilità
3 Tenuta di strada
4 Battistrada
5 Presa sul bagnato
6 Macchine da corsa

Listening

- **While listening about innovations in the field of tyres, fill in the blanks with the words you hear.**

Futuristic Airless Tyres

A South 1 tyre manufacturer, Hankook Tyre, has been developing a non-pneumatic futuristic tyre for a while. The concept was first launched a couple of years ago, when it was one integrated 2, combining the tyre and the rim in one piece.

Last 3, in Seoul, Hankook Tyre announced that it had successfully completed its ride and handling 4 on its fifth-generation airless tyre, dubbed the iFlex.

As the name suggests, NPTs do not require air 5, instead relying on a new type of eco-friendly material. Geometric 6 built into the material provide the bounce and springiness normally provided by air pressure. This iFlex version is designed to mount onto a traditional rim, making it compatible with current 7.

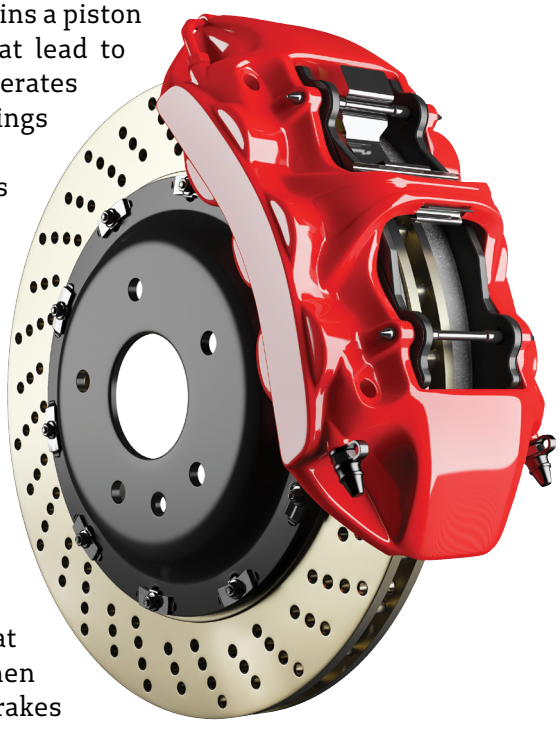
The company put the iFlex through a series of rigorous tests designed to push the futuristic tyres to their limits in five categories: durability, hardness, 8, slalom and speed. In the speed test, the electric car equipped with iFlex tyres reached 9 km/h. The impressive results in all five categories demonstrated that the NPTs could match 10 tyres in terms of performance.

Hankook Tyre currently has a number of projects underway, focusing on developing futuristic tyre products. For example, 'The Next Driving Lab,' a brand 11 that was initiated in 2013, is operated primarily to let talented engineers and 12 bring to life their wildest futuristic dreams for innovative driving 13.

Likewise, Hankook Tyre collaborates every two years with world-renowned design schools to host the 'Design Innovation' 14. This project allows students to propose and study future tyre concepts designed to generate safer, more 15, and more advanced tyre performances.

THE BRAKING SYSTEM

When you push the brake pedal, the force you exert is applied to a device called a master cylinder. The master cylinder contains a piston that pressurizes a network of hydraulic brake lines that lead to each of the vehicle's wheels. The brake fluid pressure operates the brakes by driving pistons that force replaceable linings against a rotating drum or disc.



Worn linings tend to overheat more easily than new linings and for this reason they must be replaced.

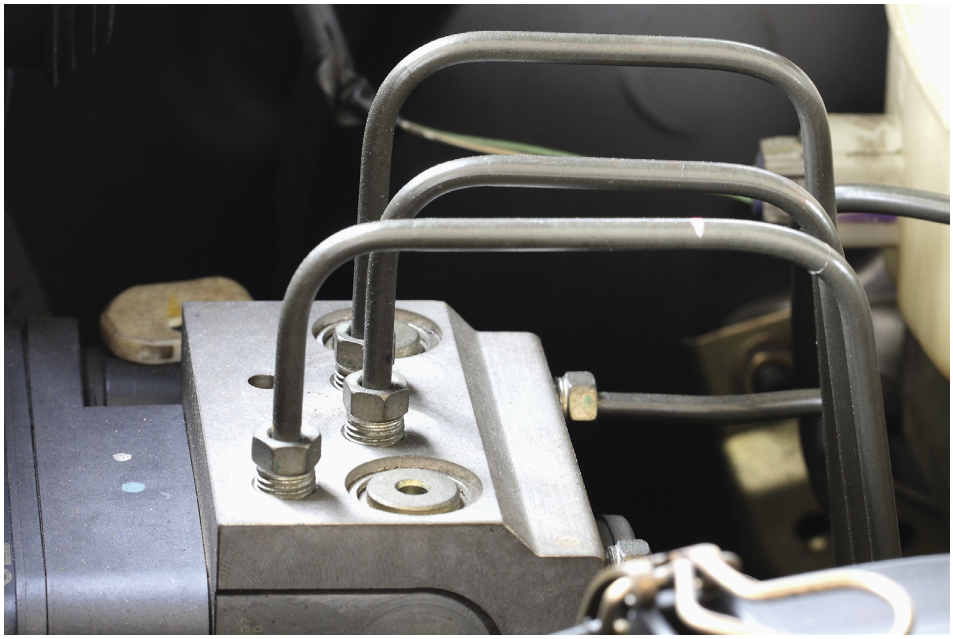
Brakes have greatly improved over the past few years. Some years ago, drum brakes were the most common brakes. Drum brakes employ a drum-shaped assembly that spins with the wheel. They are still used on the rear wheels of many vehicles. They work well but they tend to overheat. This overheating, called brake fade, causes a reduction in braking power and a lining damage.

A significant advancement came in the form of **disc brakes**, which today are used almost universally on front wheels and on many rear wheels. Disc brakes are provided with a metal disc, also called a rotor, that spins along with the wheel, and with a stationary caliper that squeezes the disc with replaceable friction material when the brakes are applied. Being continuously vented, disc brakes are much less likely to overheat.

All vehicles are also provided with a handbrake, also called emergency brake. This brake acts only on the rear wheels and is mechanically operated.

ANTI-LOCK BRAKING SYSTEM (ABS)

A vehicle's tyres generate the maximum deceleration when braking power is applied. Once the brakes lock and the wheels skid, deceleration is reduced and directional control is lost. Electronically controlled anti-lock braking systems have improved the vehicle's controllability and reduced stopping distances especially in wet road conditions.



INTERACTIVE e-BOOK CONTENUTI DIGITALI INTEGRATIVI san marco

WWW text

Dangers on the Road: Skids

Originally developed for **aircraft**, **ABS** works by limiting the pressure to any wheel which decelerates too rapidly, preventing it from skidding and allowing the driver to steer the vehicle.
This system uses a combination of **electronics and hydraulic controls** to allow normal braking up to the point of wheel lock-up. At that point the system intervenes to reduce fluid pressure and to keep the deceleration of the vehicle at its maximum given the road conditions.
ABS systems generally have speed sensors at each wheel that constantly feed information to a centrally located ABS computer. The computer uses these data to determine overall vehicle speed and to detect when a wheel begins to lock. In a four-channel ABS system each wheel is independently controlled. Pressure is therefore automatically reduced to only the wheel that is locking.
ABS provides **shorter stopping distances** in difficult situations than a conventional system, promoting at the same time directional stability and allowing steering.

Reading Comprehension

- **Answer the following questions.**

1 What is the purpose of brakes?
2 What is the master cylinder?
3 Which brake type was the most common until few years ago?
4 What is a brake fade?
5 What do disc brakes consist of?
6 Why are disc brakes much less likely to overheat?
7 What is the handbrake?
8 How does ABS work?

Writing

- **Fill in the gaps with the missing words.**

1 When you push the _____ pedal, the force you exert is applied to a device called a master cylinder.
2 Worn linings tend to _____ more easily than new linings and for this reason they need to be _____ .
3 _____ brakes employ a drum-shaped assembly that spins with the _____ .
4 Disc brakes are provided with a metal disc, also called a _____, that spins along with the wheel.

Cloze Exercise

- **Fill in the gaps with the words given: need – pressure – rotors – vibration – require – pedal – conditions.**

How Do I use ABS?

Apply steady and constant _____ 1 – do not take your foot off the brake _____ 2 until the vehicle has stopped. A noise or _____ 3 associated with the pulsing of the brake pedal indicates that the ABS is active.
If your brakes squeal under normal braking _____ 4, this may indicate that the pads are worn and _____ 5 replacing. A pulsating brake pedal every time you apply the brakes may indicate warped brake _____ 6 and/or seized brake calipers that _____ 7 servicing.

Speaking

- **Explain the purposes of ABS.**

WORD POWER

CAR TYPES

The main car types fall into the following categories that may slightly vary by company and location.

1 **Small or economy cars** are small light cars, especially used for short journeys in towns. In American English they are usually called **compact cars**.

2 **Saloons** are closed cars, where the area for the driver and passengers is closed off from the luggage and engine areas. They may have two or four doors. In the USA they are called **sedans**. There are family sedans as well as luxury sedans. A coupé is a closed two-door sedan.

3 **Convertibles** have a soft top that can be either lowered or removed. They generally have two doors. A famous two-door convertible car is the cabriolet. Four-door convertibles had almost disappeared by the end of the 1930s. A hardtop is a type of car which resembles a convertible in look and feel but without a removable roof.

4 **Sports cars** are low, usually open cars designed for travelling at high speeds.

5 **Hatchbacks** have a large sloping back, that opens like a door.

6 **Estate cars** have a large area for luggage behind the rear folding seats. In the USA they are called **station wagons**.

7 **Sport-utility vehicles (SUVs)** are bigger than ordinary cars and are made for travelling over rough ground. They are very popular today.

8 **Vans** are covered vehicles, with no side windows, generally used to transport goods or people.

9 **Pickup trucks** are small trucks which have low sides and which are generally used by builders or farmers.

1

2

3

4

5

6

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MATCHING

Match each car type with the corresponding image, then provide the Italian equivalents.

1 ☐ Convertible
2 ☐ Pickup truck
3 ☐ Compact car
4 ☐ Van
5 ☐ Estate car
6 ☐ Sports car

A

B

C

D

E

F

VOCABULARY

Explain in your own words the meaning of the following expressions.

1 Luggage area
2 Short journeys
3 Folding seats
4 Soft top
5 Rough ground
6 Removable roof

RESEARCH WORK

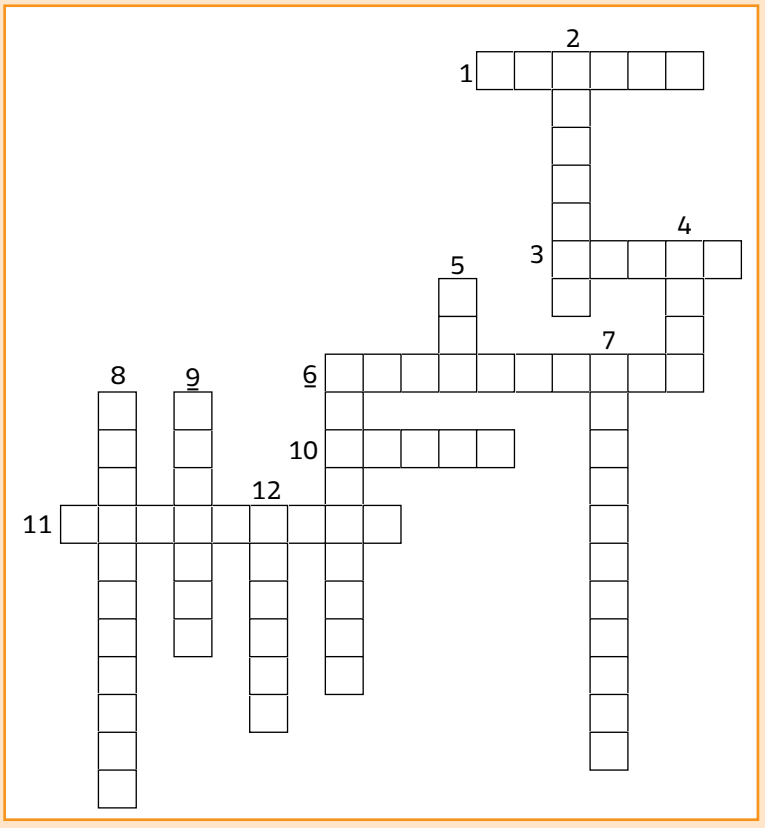
For each car type described above, find at least an example of a car model you know.

1 Economy car:
2 Saloon:
3 Convertible:
4 Sports car:
5 Hatchback.
6 Estate car:
7 Sport-utility vehicle:

CROSSWORD PUZZLE

Complete the crossword with the English equivalents of the Italian words below.

Across: 1 Berlina; **3** Merci; **6** Utilitaria; **10** Camion; **11** Sedili posteriori.
Down: 2 Bagaglio; **4** Portiera; **5** Furgone; **6** Familiare; **7** Decappottabile; **8** Finestrini laterali; **9** Viaggio; **12**. Motore.



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WWW listening

Most Common Car Problems

CAR INNOVATIONS 4

The car industry is constantly bringing us new technologies, whether it be for safety, environmental concerns, usefulness or simply for pure innovation.

Electric cars are quickly gaining ground. An **electric car** has a set of batteries that provides electricity to an electric motor. The motor turns a transmission, and the transmission turns the wheels.

Any vehicle that combines two or more sources of power that can directly or indirectly provide propulsion power is a **hybrid**.

So-called **renewables** such as solar and wind energy, however, do not seem commercially viable yet and cannot compete with fossil fuels.

One kilowatt of solar photovoltaic power costs at least five times the cost of oil power. Solar power is even less competitive against cheaper fossil fuels like coal and natural gas. A radically new technology – perhaps replacing the silicon in photovoltaic cells with polymers – will be needed to

make solar cost effective. Wind and biomass are closer than solar to becoming competitive with fossil fuels, but their capacity to supply large amounts of energy is limited.

HOW HYBRID CARS WORK

The **petrol-electric hybrid** car is a cross between a petrol-powered car and an electric car.

The engine in a hybrid car can be much smaller than the one in a conventional car and therefore more efficient. Most cars require a relatively big engine to produce enough power to accelerate the car quickly. Big engines are heavy, requiring a lot of energy every time they accelerate. Moreover, the displacement of their pistons is larger, so more fuel is required by each cylinder.

In a small engine, on the contrary, the efficiency can be improved by using smaller, lighter parts, by reducing the number of cylinders and by operating the engine closer to its maximum load.

Besides a smaller, more efficient engine, today's hybrids use many other tricks to increase fuel efficiency. A hybrid car can capture some of the energy you dissipate when you brake and store it in the battery to use later. It does this by using **regenerative braking**. That is, instead of just using the brakes to stop the car, the electric motor that drives the hybrid can also slow the car. In this way, the electric motor acts as a generator and charges the batteries while the car is slowing down. Hybrid cars do not need to rely on the petrol engine all of the time because they have an alternate power source — the electric motor and batteries. So they can sometimes turn off the petrol engine, for example when they stop at a red light. Finally, hybrid cars use special tyres that are both stiffer and inflated to a higher pressure than conventional tyres. The result is that they cause about half the drag of regular tyres.

Reading Comprehension

Activities

- **Answer the following questions.**

1 How does an electric car work?
2 Why aren't renewables a solution for cars?
3 What is a hybrid vehicle?
4 What is a petrol-electric hybrid car?
5 What are the differences between the engine of a conventional car and that of a hybrid car?
6 What is "regenerative braking"?
7 What kind of tyres do hybrid cars use?

Vocabulary

- **Match a word in the first or second column with a word in the third of fourth one, then provide the Italian equivalent.**

1 Petrol	4 Fuel	A efficiency	D light
2 Electric	5 Power	B cells	E engine
3 Photovoltaic	6 Red	C source	F motor

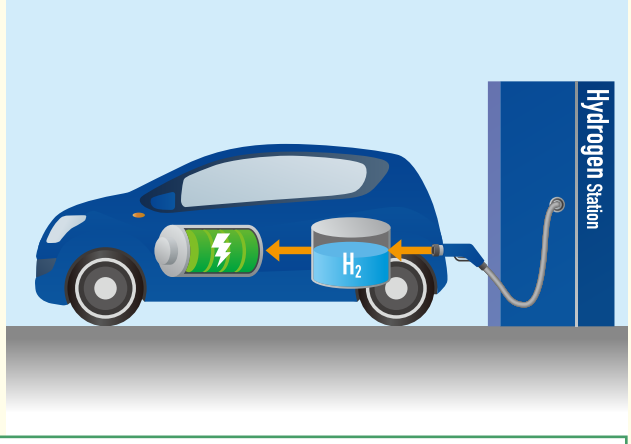
Cloze Exercise

Activities

- **While reading the following text on hydrogen cars, fill in the blanks with the words provided: catalysts – electric – power – recharged – storage – wind – reaction – greenhouse – oil – cleaner – natural – water.**

Hydrogen Cars

Hydrogen can be generated using _____ 1 and gas, or, even better, using _____ 2 power, solar power, or any other source of electricity. The idea of using hydrogen to generate _____ 3 has been around since the first half of the 19th century.
Hydrogen cars use _____ 4 motors, but their electricity comes from hydrogen, processed in a chemical _____ 5 that takes place inside a fuel cell. Though the only thing that comes out of these cars' tailpipes is _____ 6 vapour, the hydrogen they run on is mostly made from _____ 7 gas through a process that releases significant amounts of _____ 8 gases into the atmosphere.
Emerging technologies for producing hydrogen could eventually make fuel-cell cars _____ 9 and cheaper. In the future, instead of using solar power to generate electricity, and then using that electricity to split water, it may be possible to engineer _____ 10 to absorb sunlight and use its energy to split water. That would make hydrogen cars simpler and cheaper. But for now, the main advantage of hydrogen cars over electric cars is that they can be _____ 11 more quickly.
Another problem of hydrogen cars is the _____ 12 of hydrogen. As any other gas, hydrogen tends to spread out. Putting it in a car means squeezing it down lo a reasonable size, which does not seem easy.



17 Listening

- **While listening to the latest news about next generation cars, fill in the blanks with the words you hear.**

The Car of the Future

The car of the future will be the most _____ 1 computer you will ever own, packing the processing power of a supercomputer into a box the size of a car _____ 2, according to American _____ 3 maker Nvidia.
Nvidia is best known for supplying powerful graphics processors for video game consoles and _____ 4 computers, but _____ 5 years ago the company started adapting its chips for use in cars. The third generation Audi A8, which was launched in _____ 6, was the first car to use an Nvidia graphics processor to power its 3D _____ 7 system display.
Today, there are _____ 8 million cars on the road with Nvidia's processors inside – including models from Telsa, Volkswagen, Honda and Mercedes as well as Audi.
An increased demand for high quality _____ 9 displays inside cars – including dashboard navigation systems, virtual instrument clusters and rear _____ 10 entertainment systems – has pushed automakers to look beyond their traditional suppliers to obtain a technological edge.
The Tesla Model S, for example, features a 17-inch _____ 11 display in the middle of the dashboard, which replaces almost every physical button in the car. It can be used to control everything from the _____ 12 conditioning to the suspension settings and even the sunroof.

(Adapted from www.telegraph.com.uk)

DESIGNING A CAR ADVERTISEMENT

An **advertisement** (or **ad**) is a short text whose aim is to persuade the reader to buy commercial products.
Since the average reader looks at an advert for a few seconds, the design must catch the viewer's attention and the message has to be given quickly. First of all, you must identify the target audience for your product, that is your potential customers. Every product appeals to a target market, but some fit more potential buyers than others.

STRUCTURE AND LANGUAGE

An advertisement on TV or radio is called a **commercial**.
The written part of an advertisement is the **copy** and the **copywriter** is the person who writes it. A **campaign** is an advertising which lasts over a certain period and uses a number of different ads.
The main idea of the advertisement, that is the message, is usually expressed through a slogan, a phrase that is easy to remember.
The **layout** (that is how the ad is arranged on the page) is also very important and the **headline** (line printed in large type) is the key part of the ad as it must attract people's attention. A headline can arouse the reader's curiosity, announce some news or promise about a product, or ask the reader to think about something.
A short text is generally placed under the headline. The ending may be a **call to action**.
The language of advertising is generally simple, but it makes use of particular linguistic features. Among the phonological figures are **rhymes**, **assonances** (similarity between the vowel sounds of two words), and **alliterations**, while syntactical and rhetorical figures like **repetitions** (both structural and lexical), **puns** (humorous use of a word that has two meanings or of different words that sound the same), **similes** and **metaphors** contribute to convey a deep and allusive meaning.
Imperatives are often used as a way to suggest or recommend a particular product.
Adjectives and **adverbs** are largely used too, especially superlative forms. **Hyperbole** – that is exaggeration – is also common.
Persuasive language must appeal to the public's senses in order to create an emotional response.
Music and other sound effects add to the overall effect of commercials.

Reading Comprehension

- **Look at the ads below and identify some of the elements mentioned above. Focus, in particular, on the following points:**
  - **characteristics of slogans/headlines;**
  - **type of language;**
  - **use of adjectives and adverbs;**
  - **hyperboles;**
  - **use of imperatives;**
  - **"power" words.**

Writing

- **Choose a car commercial you have seen on TV and analyse it, focusing on the following key points:**
  - **images;**
  - **music;**
  - **language.**

  Does the commercial appeal to you? Why/why not? Who do you think the commercial is targeting? Are there any stereotypes? What power words are used?

Speaking

- **Look at the cars below, and for each of them think who the target of a possible ad could be. Then create a slogan to advertise each car.**

AUTO	TARGET	SLOGAN

Writing

- **Now create your own ad or commercial. First, start with the product analysis, then decide the target audience and, finally, think of a catchy phrase as a slogan. Add pictures, and/or music and present it to the rest of the class.**

5 MOTORCYCLES

A **motorcycle** is a two-wheeled motor-driven road vehicle without pedal propulsion. The first motorcycle was invented in 1867 in the USA by Howard Roper. It was a two-cylinder steam-engine motorcycle powered by coal.

In 1885, Gottlieb Daimler devised the first gas-engine motorcycle. It consisted of an **engine attached to a wooden bike**. Daimler employed a new engine invented by the engineer Nicolaus August Otto in 1876, the four-stroke internal-combustion engine.

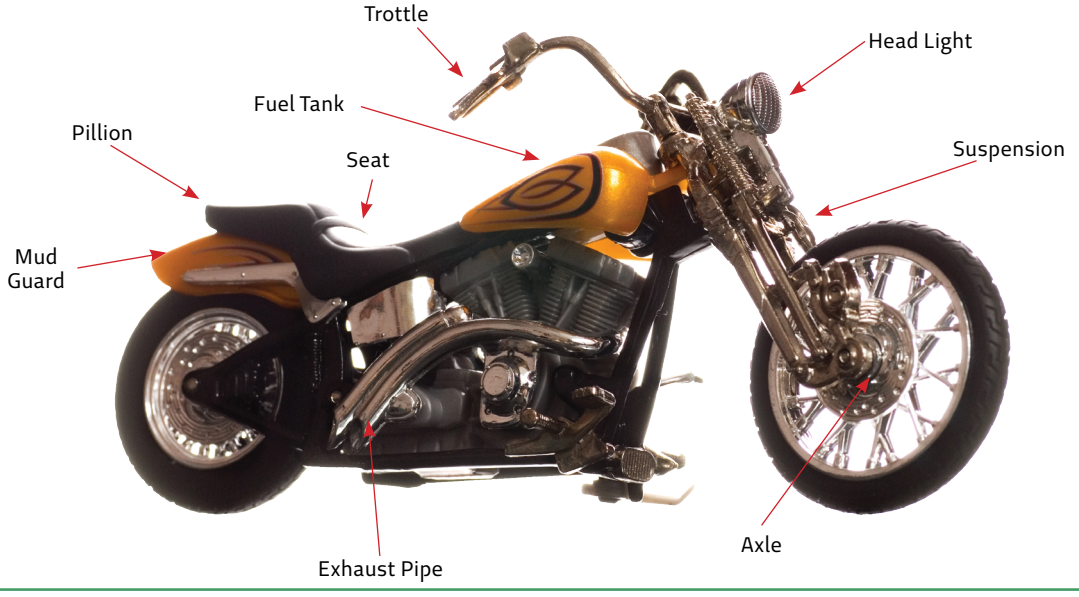
Many of the nineteenth century engineers and inventors who worked on early motorcycles often developed other inventions, especially in the field of automobiles.

In 1895, De Dion-Buton developed an engine that would revolutionize the motorcycle industry by making mass production possible. It was a small and light four-stroke engine that used a battery and coil ignition.

In 1903, William Harley and his friends Arthur and Walter Davidson founded the Harley-Davidson Motor Company. Their motorcycle had a **quality engine**, so it could prove itself in races, though the company planned to manufacture it as a transport vehicle. The first Harley-Davidson was sold in Chicago.

Today motorcycles are rather popular transport vehicles especially among young people. But in the US, the age of the average bike buyer has increased during the past few years. And sales of Harley-Davidsons are soaring among men in their forties. Trying on a crash helmet for the first time, taking your first lessons, passing Compulsory Basic Training (CBT), buying a 125 cc bike... They are all steps on the road to becoming a motorcycle rider, but it's not until you have bought your first big bike that you feel you are really qualified to call yourself a motorcyclist. It's quite a decision, too, as very often the shape and nature of the rest of your motorcycling life depends on that first choice. But what has motorcycling got to offer? The sporting riders' desire to discover the abilities and limits of themselves and their machines, the horizon, widening pleasures of travelling on two wheels and the delights of traffic, and avoiding commuting.

PARTS OF A MOTORBIKE



Reading Comprehension

Activities

- **Answer the following questions.**

1 What is a motorcycle?
2 What did Roper invent?
3 Who invented the first gas-engine motorbike?
4 What did De Dion-Buton devise in 1895?
5 What were the main features of the first Harley-Davidson motorcycles?
6 What are the advantages of motorcycling?

Matching

- **Match a word in the first and second column with one in the third of fourth one, then provide the Italian equivalents.**

1 Two-wheeled	4 Young	A people	D propulsion
2 Pedal	5 Bike	B industry	E vehicle
3 Wooden	6 Motorcycle	C buyer	F bike

Cloze Exercise

- **While reading the following safety tips for motor bikers, fill in the blanks with the words given: colour – limits – speed – brakes – goggles – levels – turn – drivers – boots – mirrors – durable – chain – helmet – headlights.**

Motorcycling Safety Tips

Before you hit the road after a long winter, give your bike the once-over.

- Test the lights, brakes, and _____ 1 signals.
- Check the oil and fuel _____ 2.
- Make sure the _____ 3 are positioned correctly.
- Adjust the _____ 4 according to the manufacturer's specs.

When you're on the open road, remember there's not much between you and the pavement.

- Pick a high-quality _____ 5 that fits well. If it doesn't have a face shield, pair it up with _____ 6 or glasses with safety lenses.
- Wear pants in a bright _____ 7. It will help other drivers see you better.
- Choose _____ 8 non-slip gloves.
- Wear _____ 9 or sneakers that cover your ankles.

When you are out on the road, help keep yourself safe.

- Always wear a helmet that fits right.
- Know your bike's _____ 10.
- Stick to the _____ 11 limit.
- Be respectful of other _____ 12.
- Make sure other drivers can see you. Don't ride in blind spots and always use your _____ 13.
- Brake smart. Use both _____ 14 at the same time, slow and steady.

18 Listening

Listen to the following information about St.Ives Festival of Motorcycles and then answer the questions below.

St. Yves Festival of Motorcycles

1 On which day does the St. Ives Festival of Motorcycles take place?
- A On Saturday 28th June
- B On Sunday 28th June
- C On Sunday 28th July

2 At what time does the festival take place?
- A From 10 pm to 4 am
- B From 10 am to 2 pm
- C From 10 am to 4 pm

3 Where is St. Ives?
- A It's in Lincolnshire
- B It's a district of London
- C It's in Cambridgeshire

4 Where will the event take place?
- A At the local stadium
- B In the town centre
- C In the surrounding area

5 Who runs the event?
- A A local motorcycle club
- B The local sports centre
- C A motorcycle company

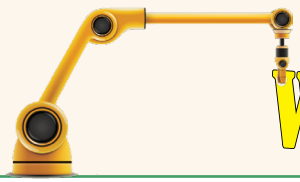
6 How much is the entrance ticket?
- A It's £5
- B It's free
- C It's £10

7 What is the main aim of the festival?
- A To entertain young people
- B To raise money for charities
- C To sell motorcycles

8 What can you eat at the festival?
- A Ice creams, burgers and pizza
- B Only vegetarian dishes
- C No food is available

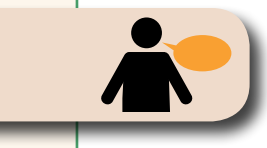
9 Where can you find booking forms for the event?
- A online
- B At the Tourist Information Office
- C At the local sports centre

10 Who is the festival for?
- A Only for motor cyclers
- B For anyone, including families with children
- C For teenagers



WORK IT OUT

Moving around the City



Public transportation is the most popular form of transport in a city. Public vehicles include buses, above-ground light train and underground trains. Taxis are private vehicles that people hire for a short period of time to reach a particular place in or outside a city. Public transportation vehicles are cheaper to use than private vehicles and they are a solution to the problem of traffic and parking congestion in our cities.

Here are some common **phrasal verbs** we use when we talk about transport:

– to get on a bus/motorbike/train;
e.g. *Hurry up! Let's get on this bus!*
– to get off a bus/motorbike/train;
e.g. *Get off the train at the next stop.*
– to wait for the bus/train/taxi;
e.g. *I have been waiting for the bus for 20 minutes.*
– to get in the car/taxi;
e.g. *As soon as you get in the car, fasten your seatbelt.*
– to get out of the car/taxi.
e.g. *I got out of the taxi and walked down the street.*

When you are in a new town or city you may need to know where a place or building is. In this case you may ask for directions.

Here is a list of the main **expressions** used to **give directions**. Don't forget to say "Excuse me" before you ask a person.

- Go straight on.
- Go along this road/Cordelia St.
- Turn right/left into...
- Take the first/second/next road on your right/left.
- Go past Queensland Art Gallery.
- Cross over the bridge.
- Go towards the town centre.

CLOZE EXERCISE

Complete the following conversations, then role-play them with your desk-mate.

A Choose among: gate – welcome – like – next – you – trip – change – time.

At the Bus Station

Sam: I'd 1 two tickets to Sun Park, please.
Clerk: Here 2 are. That'll be £8.20.
Sam: Here you are.
Clerk: And here's your 3.
Sam: What time is 4 bus?
Clerk: 11.30, from 5 7, downstairs.
Sam: And what 6 does the bus arrive at Sun Park?
Clerk: 12.18 p.m.
Sam: Thanks a lot.
Clerk: You're 7. Have a good 8.

B Choose among: number – way – stops – off – railway – tell.

On the Bus

Jane: Does this bus go to the 1 station?
Conductor: No, you are going the wrong 2. Get 3 at the bank and take 4 35 to Summer Place.
Jane: Oh, I see...Could you 5 me when to get off, please?
Conductor: It's two 6 after this one.
Jane: Thank you very much.

C Choose among: best – a – please – in – appointment – change – make.

Taking a Taxi

Paul: Crown Conference Centre, 1.
I've an 2 at 11.30.
Taxi driver: I think we can 3 it. I'll do my 4.
[...]
Taxi driver: Here we are, sir. Just 5 time. £9.50, please.
Paul: Thanks 6 lot. Keep the 7.

Listening

While listening to the following conversation, fill in the blanks with the words you hear.

Buying a Train Ticket

A: When does the Liverpool train 1, please?
B: At 10.25. From platform 2.
A: Is it a 3 train?
B: No, it isn't. The direct one is at 4.
A: Which 5 is the direct one from?
B: Platform 6.
A: What time does it 7 in Liverpool?
B: 12.40.
A: A 8 to Liverpool, then.
B: A day return or an ordinary return?
A: An 9, please. How much is it?
B: £70.
A: Here is £100.
B: Here is your 10.
A: Thank you.
B: You're welcome.

SPEAKING

You work at Dublin Bus Station information desk. A traveller wants some information about the pre-paid smartcard. Look at the information below and then in couples role-play the conversation.

Dublin Bus

Dublin Bus Prepaid Smartcards

Perfect even if you don't get the bus every day.

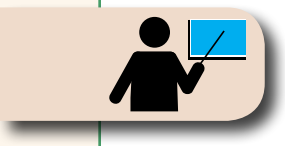
Dublin Bus Prepaid Smartcards make more sense.
They save you time and money over using cash. They let you get the bus as much as you like, as often as you like. You can now use them on non-consecutive days, which means you can use them on any days you choose within one year.
Buy yours now at any one of over 400 ticket agents throughout Dublin.

ROLE PLAY

Look at a map of Brisbane, Australia. Imagine you are in front of the Brisbane Convention and Exhibition Centre. In pairs, ask and give directions for the places below.
Ex. Excuse me, could you tell me the way to the Riverside Hotel, please?

1 Queensland Museum South Bank
2 The State Library of Queensland
3 The Suncorp Stadium
4 Regatta Park
5 Shopping Centre "The Markets"

Linking Words



Linking words help you to connect ideas and sentences, both in speaking and writing. There are many types of linking words, serving different purposes. Here are some of the most frequently used.

– **Adding information**: *and, also, besides.*

Ideas are often linked by *and*. In a list, you put a comma between each item, but not before *and*.

e.g. *The fuel system pumps petrol from the petrol tank and mixes it with air.*

Also is used to add an extra idea or emphasis.

e.g. *The exhaust system also includes the catalytic converter.*

Besides adds extra information to the point you are making.

e.g. *Electric vehicles don't run on petrol. Besides, they don't emit carbon dioxide.*

– **Giving a reason**: *because, because of, since, as.*

Because introduces the reason for something.

e.g. *Fuel injection has become nearly universal because it provides better fuel efficiency and lower emissions.*

Because of also introduces the reason for something but it must be followed by a noun.

e.g. *Fossil fuels are increasingly less attractive because of climate change.*

Since and *as* mean "because".

e.g. *As the piston is now in the down position, the crankcase becomes pressurized.*

– **Giving a result:** *therefore, so, so that, consequently, as a result.*

Therefore, so, consequently and as a result are all used in a similar way.

e.g. *Our company is expanding. Therefore, we are taking on extra staff.*

So is more informal and it is generally used in spoken language.

e.g. *The battery was completely discharged so we replaced it.*

– **Contrasting ideas**: *but, however, although, though, while.*

But is more informal than *however*.

e.g. *Drum brakes work well but they tend to overheat.*

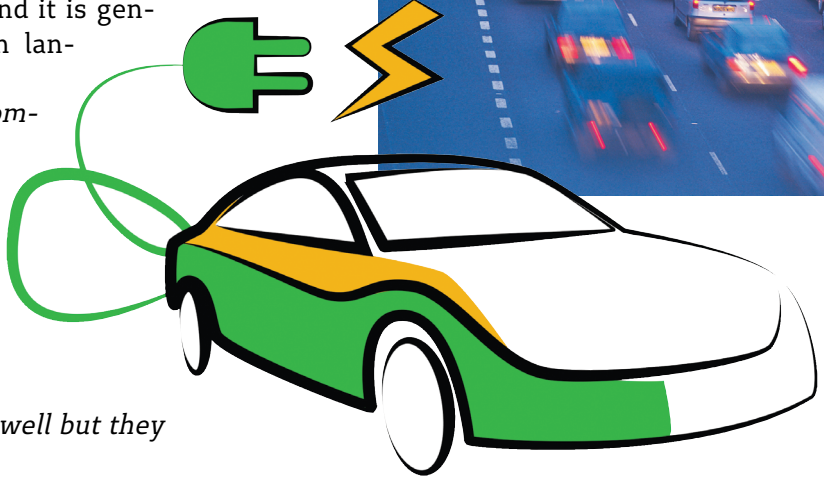
Cars are an essential part of everyday life. However, they are major polluters and cause damage to our natural environment.

Although/though introduce an idea of contrast. With these words, you must have two halves of a sentence.

e.g. *Though hybrid vehicles are now growing in popularity still few people are actually using them.*

While is used to show how two things are different from each other.

e.g. *Gasoline engines are typically 30% efficient while diesel engines can convert over 45% of the fuel energy into mechanical energy.*



WRITING

Connect each pair of sentences using a linking word.

1 Hydrogen seems the ideal fuel of the future. It is a non-polluting fuel.
2 The Earth has plenty of hydrogen available in the form of water. Separating it may prove to be quite difficult.
3 It is not easy to store hydrogen. It tends to spread out.
4 Hydrogen is highly flammable. It has the potential to be dangerous.
5 Several hydrogen cars are now in existence. Most of them are concept cars.
6 Hybrid cars have an alternative power source – the electric motor. They can sometimes turn off the petrol engine.
7 Hybrid cars use tyres with a higher pressure. They cause half the drag of regular tyres.
8 Big engines require a lot of energy every time they accelerate. Small engines need less energy as they are more efficient.

CLOZE EXERCISE

While reading the article below, fill in the blanks with the linking words provided: therefore – since – besides (X2) – also (X2) – while – as – and (X2) – though – because.

The Driverless Car Debate

Companies like Google, Bosch, Tesla, Nissan Mercedes-Benz, and Audi have already started testing self-driving cars on the roads.

Robot cars like Google's use GPS to know their location 1 are equipped with sensors, laser illuminating detection and ranging (LIDAR), radar, high-powered cameras and learning algorithm software to know how close they are to another vehicle. They 2 detect the surrounding environment to identify signage, pedestrians and cyclists near the car. 3 the cars use the sensing capabilities and software to choose a safe speed, accelerate, brake and make turns, while anticipating other vehicle's actions. 4 commuters can sit back, sleep, or eat while the car does the driving for them.

Some predict the fully autonomous vehicles will be on the road in a few years, 5 others say it won't happen in our lifetime.

According to a recent estimate of motor vehicles fatalities from U.S. National Highway Traffic Safety Administration, 32,675 people died in car crashes last year. 6 the majority of these accidents are caused by human error, self-driving cars could potentially reduce the rate of automobile-related deaths – and save the U.S. over $400 billion in total annual costs of accidents.

7 reducing the rate of motor vehicle accidents caused by human error, autonomous vehicles could 8 reduce the rate of traffic and congestion on the roads 9 the robot cars will be able to travel at a much higher speed and closer to other cars. This will then ultimately decrease the amount of time Americans spend traveling, while also increasing productivity 10 people won't actually have to drive the car.

According to a recent Google's accident report, 11 the driverless cars have been in 14 minor accidents over the past six years, these accidents were the fault of other drivers 12 couldn't be blamed on the company's technology.

(Adapted from www.techtimes.com)

I VERBI MODALI

Per **verbi modali** si intende una serie di verbi che fungono da ausiliari e hanno un'unica forma per tutte le persone. In italiano corrispondono ai verbi "dovere", "potere", "volere".
Must viene usato per impartire un ordine, per parlare di un obbligo o di una necessità, o per esprimere una supposizione:

Es: You must come back early. → *Devi rientrare presto.*
I must stop smoking. → *Devo smettere di fumare.*
James must be ill. → *James deve essere malato.*

Must si usa solo per azioni riferite al tempo presente o futuro. Per i tempi mancanti si ricorre a *have to*:

Es: Last year I had to buy a new car. → *L'anno scorso dovetti comprare un'auto nuova.*

Have to può sostituire *must* anche alla forma affermativa del tempo presente. È bene comunque ricordare che *have to* esprime sempre un obbligo esterno, imposto da qualcuno o dalla situazione contingente:

Es: We have to wear uniforms at school. → *A scuola dobbiamo indossare la divisa.*

Nella forma negativa *mustn't* esprime divieto, mentre *don't have to* esprime mancanza di necessità:

Es: You mustn't phone me. → *Non devi telefonarmi. (Cioè ti proibisco di farlo).*
You don't have to phone me. → *Non devi telefonarmi. (Cioè, non è necessario che tu lo faccia).*

Shall viene usato solo alla prima persona singolare e plurale per offrirsi di fare qualcosa e per formulare una proposta o un suggerimento:

Es: Shall I close the door? → *Vuoi che chiuda la porta?*
Shall we go to the cinema? → *Perché non andiamo al cinema?*

Il condizionale *should* si usa invece per formulare un consiglio, un suggerimento o una raccomandazione:

Es: You are too fat. You should eat less. → *Sei troppo grasso. Dovresti mangiare meno.*

Anche il verbo **can** ha un'unica forma per il presente e una per il passato (*could*). Nei modi e nei tempi mancanti, esso viene sostituito da altre forme verbali. Significa "potere" oppure "saper fare", "riuscire a fare".
Can viene usato per:

- esprimere abilità o capacità;
  Es: I can play the piano. → *So suonare il piano.*
  Can you ski? → *Sai sciare?*
- chiedere, concedere o negare un permesso in contesto informale;
  Es: Can I go out, please? → *Posso uscire, per favore?*
  You can't smoke in here. → *Non si può fumare qui dentro.*
- chiedere a qualcuno di fare qualcosa;
  Es: Can you help me? → *Puoi aiutarmi?*

– esprimere una deduzione negativa.
  Es: That woman can't be Jane. She's too tall. → *Quella donna non può essere Jane. È troppo alta.*

Could è la forma del passato remoto ma anche del condizionale presente di *can*. Viene quindi usato per fare richieste in modo più formale rispetto a *can*:
  Es: Last night I couldn't sleep. → *La scorsa notte non sono riuscita a dormire.*
  Could you lend me your bike? → *Potresti prestarmi la tua bici?*

Could si usa anche per esprimere una deduzione:
  Es: This postcard could be from Jack. He's in Scotland now. → *Questa cartolina potrebbe essere di Jack. È in Scozia ora.*

To be able to è la forma verbale che sostituisce le forme mancanti di *can/could*:
  Es: I haven't been able to phone you. → *Non sono riuscita a telefonarti.*
  He won't be able to meet me tomorrow. → *Domani non potrà incontrarmi.*

Il verbo modale **may** è usato per esprimere possibilità, probabilità o improbabilità:
  Es: She may arrive by the 9 o'clock train. → *Potrebbe arrivare con il treno delle 9.*

Si usa inoltre per chiedere un permesso in un contesto formale:
  Es: May I go out, Miss Jones? → *Posso uscire, signorina Jones?*

Might è il condizionale di *may* e rispetto a quest'ultimo esprime un maggior grado di incertezza:
  Es: I might come home late tomorrow. → *Può darsi che domani rientri tardi.*
  It might rain tomorrow. → *Può darsi che piova domani.*

1 Put 'must' or 'have to' in the following sentences.

1 You ____ do your homework.
2 You ____ study hard if you want to pass your exam.
3 Guests ____ leave the key of their rooms at the reception.
4 You ____ be punctual.
5 You ____ fill in the form.
6 I ____ remember to lock the door.
7 Helen ____ write a report for tomorrow.
8 He ____ be about forty years old.
9 They ____ work on Sunday too.
10 I ____ return home early.

2 Put 'mustn't' or 'don't/doesn't have to' in the following sentences.

1 You ____ play football in the school gym.
2 You ____ park in this area.
3 I can lend you my car. You ____ take the bus.
4 You ____ cook. We can go to the restaurant.
5 You ____ waste time.
6 James ____ drive to work. He lives near his office.
7 You ____ drive too fast.
8 It isn't raining. You ____ take an umbrella.
9 Children ____ eat too many sweets.
10 You ____ tell me everything (**two possible versions**).

3 Insert 'have to' to in the correct tense form.

1 Yesterday I do the washing up.
2 I left at 7.00 and I call a taxi because I missed the bus.
3 I call Peter tomorrow.
4 I don't like go to school on Saturdays.
5 I went to the post office because I buy some stamps.

4 Write suggestions for the following situations using 'should/shouldn't'.

1 Bob is very fat.
2 I am always late in the morning.
3 Jim is always tired.
4 Tom always gets bad marks in English.
5 I have a headache.
6 Henry's car is broken.

5 Translate the following sentences into English.

1 Il campanello suona! Deve essere Alice.
2 Non c'è bisogno che mi aiuti.
3 Devi alzarti un po' prima se vuoi essere puntuale.
4 Dovresti studiare di più.
5 Dovevamo incontrarci alle otto, ma il mio treno era in ritardo.
6 È tardi! Devi andare a letto.
7 Dovremmo lavorare sodo per comprarci una macchina nuova.
8 Non dovresti fumare così tanto.
9 Non c'è bisogno che fai i compiti oggi. Domani è domenica.
10 Il cancello è chiuso. Devono essere fuori.

6 Complete the following sentences with 'can' or 'can't'.

1 ____ you play chess?
2 Where's Jane? I ____ see her.
3 ____ I have a glass of water, please?
4 It's very cold. ____ you close the window, please?
5 Jane and Mike ____ go to school because they are ill.
6 Where's my passport? I ____ find it.
7 ____ I borrow your bike, please?
8 I don't believe you. That ..... be true.

7 Put 'can' or 'may' in the following sentences.

1 ____ you ski?
2 You ____ park in front of the cinema.
3 ____ I open the window, Mr Brown?
4 Who ____ tell me the way to the post office?
5 It ____ snow tomorrow.
6 She ____ be working in the garden.
7 You ____ come to the cinema with us if you want.
8 ____ I help you?
9 The train ____ be late.
10 He ____ arrive late tonight.

8 Put 'can', 'can't', 'could', 'couldn't', 'may' or 'might' in the following sentences.

1 I ____ come to your party tomorrow because I have to study hard for my exam.
2 I ____ do my homework. ____ you help me, please?
3 Yesterday I had a headache, so I ____ go to school.
4 When my father was young, he ____ swim very well.
5 Excuse me, sir, ____ I close the window?
6 I ____ buy the tickets because I had no time.
7 I ____ buy those shoes because they were too expensive.
8 Are you joking? I ____ believe you!
9 We ____ go to the cinema tonight. There's a good film on.
bl I don't know yet but I ____ leave next Friday.

9 Translate the following sentences into English.

1 Può darsi che stiano ancora dormendo.

2 Potresti aiutarmi per favore?

3 Quella macchina non può essere di Tom. È troppo vecchia.

4 Domani non potrò aiutarti con i lavori di casa.

5 La scorsa estate non siamo mai potuti andare in spiaggia perché faceva troppo freddo.

6 Non so guidare.

7 Può darsi che l'anno prossimo mi trasferisca a Milano.

8 Puoi telefonarmi più tardi? Sto lavando la macchina.

9 Oggi non sono riuscita a telefonare a Mark.

10 Puoi dirmi la strada per la stazione, per favore?

10 Fill in the gaps with a suitable modal verb.

1 Laura has travelled a lot. She speak a lot of languages.
2 You smoke in public places. It's forbidden.
3 You eat so many sweets if you want to lose weight.
4 It's later than I thought. I go now.
5 you play tennis?
6 Don't worry! I help you with your homework.
7 I help you with the housework?
8 Yesterday I go out because I had a lot of things to do at home.
9 You eat more vegetables because they are good for your health.
10 She go skiing because she broke her leg.