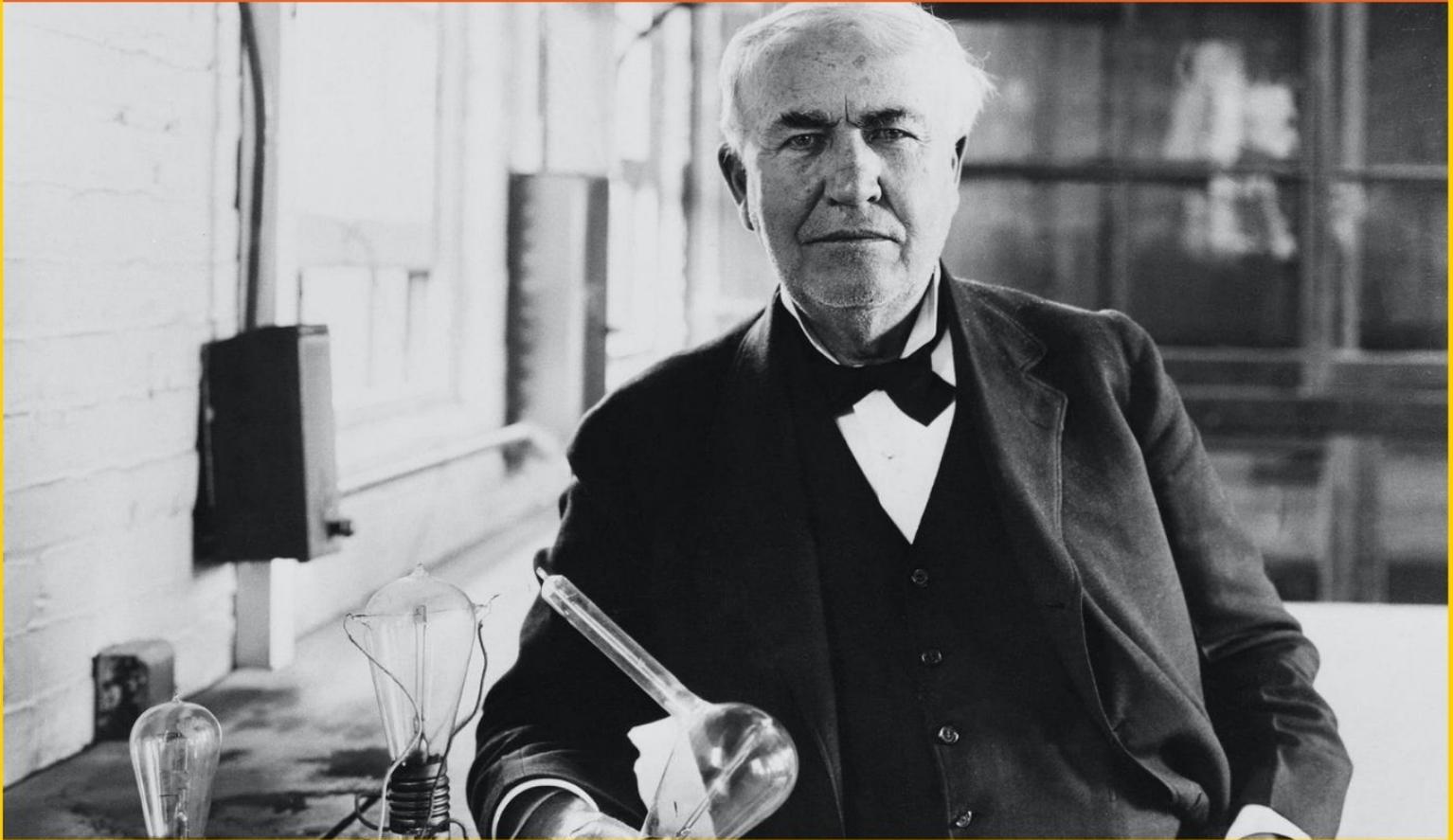


ENGLISH PLUS

WITH
ANSWER
KEY

PRACTICE WORKSHEETS



LISTENING

THOMAS EDISON

Listening Practice | Thomas Edison

1. Fill in the missing words

Thomas Edison

INTRODUCTION

Thomas Edison, born in 1847 and died in 1931, was an American inventor, one of the greatest inventors of all time. Edison began to work at an early age and continued to work right up until his death. Throughout his prolific career as an inventor, he was well known for his focus and determination. During his career Edison patented more than 1,000 [1] _____, including the electric light, the phonograph, and the motion-picture camera. These three inventions gave rise to giant industries- electric utilities, phonograph and record companies, and the film industry- thus changing the work and leisure [2] _____ of people throughout the world. The period from 1879 to 1900, when Edison produced and perfected most of his devices, has been called the Age of Edison.

EARLY INVENTIONS

Edison acquired his knowledge of electricity and telegraphy, which means use of a telegraph system to communicate at a [3] _____, as a teenager. In 1868, at age 21, he developed a telegraphic [4] _____ machine, the first of his inventions to be patented. The next year, Edison invented an improved version of the [5] _____ ticker, which printed stock [6] _____ quotations and gold [7] _____ on a paper tape. Unlike older stock [8] _____, Edison's was fully automatic, and it did away with the need for a [9] _____ attendant to operate each machine.

[10] _____ early inventions brought Edison no financial returns. The first invention to bring him money was [11] _____ improvement on the stock ticker. Edison created a [12] _____ mechanism by which all the receiving tickers [13] _____ be put in unison with the main sending apparatus. For this invention, Edison received \$40,000, which would be worth \$530,000 in 2000. He and a business partner, who operated a machine shop, used the money to start a new company to manufacture Edison's improved stock ticker. For the next five years Edison spent up to 18 hours a day in his workshop in Newark, New Jersey, inventing and manufacturing a variety of [14] _____ devices. One important device that he designed during this period was the quadruplex, a highly efficient telegraph that could send four messages at a time over a telegraph wire, instead of just one.

MENLO PARK LABORATORY

In 1876, Edison established a laboratory at Menlo Park, New Jersey, the first laboratory dedicated to industrial research in the world. Within ten years [15] _____ throughout the world knew of

Edison as the Wizard of Menlo Park.

The Telephone

Edison's first major achievement at Menlo Park was an improvement on the telephone. The telephone that [16] _____ Graham Bell patented in 1876 could not operate over distances of more than 3 to 5 km (2 to 3 mi). After hundreds of experiments, [17] _____ improved the telephone to such an extent that it could [18] _____ speech clearly over almost unlimited distances. In March 1878, Edison's telephone [19] _____ connected New York City to Philadelphia, Pennsylvania, a distance of 172 km (107 mi).

The Phonograph

While working on the telephone, Edison also worked on perhaps his most original invention. He had noticed how the phone's diaphragm, a thin membrane in the mouthpiece, vibrated in tune with the voice. He thought that if these vibrations [20] _____ somehow be recorded, so that the diaphragm could be made to [21] _____ in exactly the same manner at any future time, then speech, music, and other sounds could be preserved and reproduced. [22] _____ tested the strength of the diaphragm vibrations by holding a needle against the diaphragm with his finger, so that the needle pricked his finger with a force that varied with the loudness of the sounds.

In a later experiment, he applied one end of the needle to the diaphragm and the other end to a strip of waxed paper. He then pulled the paper along underneath the needle while repeatedly shouting, 'Hello!' The needle, activated by the vibrations of the diaphragm, created grooves in the [23] _____. When the paper was again pulled along underneath the needle, the needle followed the grooves it had formed earlier and [24] _____ [25] _____ the diaphragm, making the diaphragm reproduce [26] _____ shouts. This first crude experiment, performed in 1877, marked the beginning of the phonograph.

Edison obtained a patent on the phonograph in February 1878. By this time, he had replaced the waxed [27] _____ with [28] _____ cylinders covered with tinfoil. He [29] _____ further development of the [30] _____, however, for some years.

The Incandescent Lamp

After patenting the [31] _____, Edison set out to develop an incandescent lamp, [32] _____ [33] _____ produce light by heating a wire until it glowed [34] _____. People already used electric arc lights, which produced light by creating an arc of electricity between two wires. [35] _____, the blinding glare these arc lights gave off

made them unsuitable for home use. [36] _____, like others before him, conceived the idea of a [37] _____ with a glowing wire, or filament, made of a substance that could endure very high temperatures [38] _____ fusing, melting, or burning out. After hundreds of trials and more than a year of steady work, Edison [39] _____ a high-resistance carbon-thread filament that [40] _____ steadily for more than 40 hours. [41] _____ not the [42] _____ incandescent [43] _____ light, it was the first [44] _____ one because it used a small current and, in addition, lasted a long time without burning out.

Electric [45] _____ Distribution Systems

Edison realized that widespread use of [46] _____ light bulbs would require an efficient system of delivering electricity to homes and businesses. He developed [47] _____ plans for an entire distribution system for electric power. This system [48] _____ generating the current by means of a central dynamo, which is a device that turns mechanical energy into electricity, and then [49] _____ it in small quantities to [50] _____ of homes and commercial buildings. Edison even developed a greatly improved dynamo to [51] _____ the cost of generating electricity. The system Edison suggested in 1879 included the parallel circuits, safety fuses, insulating materials, and [52] _____ networks used in modern electrical systems.

By 1881 Edison had set up a complete electric lighting system at his Menlo Park home. That same year his system took top [53] _____ at the Paris Electrical Exhibition in [54] _____. In 1882 at Holborn Viaduct in London, the Edison Electric Lighting Company completed and began [55] _____ the first commercial generating station for incandescent lighting in the world. This installation used an [56] _____ main and feeder circuit to supply power for 2,000 lamps. [57] _____ in 1882 Edison established the first permanent [58] _____ light and power station for private consumers, called the Pearl Street generating station, in New York City.

The Edison Effect

While Edison was working on the electric light, he made a scientific [59] _____ that would become important to future generations. Edison noticed that particles of carbon from the filament blackened the [60] _____ of his [61] _____ bulbs. This effect was caused by the emission of [62] _____ from the filament, [63] _____ Edison made the discovery before he and other scientists knew the electron existed. Not [64] _____ 1897 did British physicist J. J. Thomson [65] _____ that the blackening observed by Edison was caused by the emission of [66] _____. This so-called Edison effect became the foundation

of all modern electronics. Radio, television, radar, and computers all depend on it.

In 1884 Edison [67] _____ a patent for a device based on the Edison effect. The device was designed to indicate variations in the output from electrical generators. The indicator [68] _____ ineffective because obtaining a good vacuum in devices at that time was [69] _____, but this was the first patent for a device that made use of the emission of electrons. It marked the beginning of the field of electronics.

GLENMONT

In 1884 Edison's first wife died of typhoid fever, and thereafter the inventor rarely returned to his laboratories at Menlo Park. After his second marriage in 1886, Edison bought Glenmont, a large country estate in West Orange, New Jersey, where he [70] _____ a new [71] _____. He remained there for 45 years. Glenmont and the laboratory are preserved as part of the Edison National Historic Site in West Orange and are open to the public.

[72] _____ Pictures

In 1888 Eadweard Muybridge, an English pioneer in stop-motion photography, showed Edison his photographs of horses in full [73] _____. Muybridge had taken the photographs using a series of cameras, equipped with fast-action shutters, which he [74] _____ along the side of a racetrack. The shutter of each camera was released when a horse broke through a string stretched across the track. By this method, [75] _____ obtained a series of pictures showing a short cycle of motion. The pictures [76] _____ be passed in [77] _____ succession in front of a peephole, giving the viewer the illusion that the horses were moving.

Muybridge's [78] _____ inspired [79] _____, who had already recorded sound, to think of recording movement photographically. He began work almost immediately on what was to become the first motion-picture camera. His first crude apparatus consisted of a photographically sensitive cylinder that revolved in synchrony with the camera shutter to take about 40 [80] _____ per second. In 1889 the Eastman Dry Plate and Film Company [81] _____ and patented a celluloid roll film, and Edison promptly replaced his [82] _____ cylinder with 15-m (50-ft) strips of the Eastman film. The new machine, completed in 1890, was the prototype of all modern motion-picture cameras.

For the showing of his motion pictures, Edison built a [83] _____, called the Kinetoscope, [84] _____ used positive film moving past a peephole. (Positive film shows the correct areas of light and darkness in a photograph, while the negative shows the opposite.) Although only one viewer at a time could see the film, it gave much clearer and steadier pictures than did available screen

and projector [85] _____ .

Edison's Studio

In 1893 Edison constructed the first motion-picture studio. The building was 15.2 m (50 ft) long and had a [86] _____ roof that could be raised to admit sunlight. The whole building was mounted on a pivot and could swing around to follow the sun. Edison had the walls on the inside painted black because this [87] _____ helped the cameras produce sharper [88] _____. In 1893 and 1894, Edison produced numerous one-minute films. His moving pictures included figures such as French ballet girls; Japanese dancers; American showman 'Buffalo Bill' Cody with accompanying Indians in the first Western [89] _____; and American prizefighter 'Gentleman Jim' Corbett sparring with other boxers.

The Electric Battery

In 1900 Edison set out to produce an improved electrical storage battery. Batteries convert chemical energy into electrical energy. In [90] _____ batteries, two metal rods, called electrodes, are connected by a circuit and immersed in a liquid, called an electrolyte. The rods chemically react with the electrolyte to [91] _____ a flow of electrons through the circuit. The storage batteries of the time were called lead-acid batteries because they had [92] _____ made of lead and lead dioxide and an electrolyte made of acid. They were heavy, [93] _____, difficult to recharge, and susceptible to [94] _____ corrosion. To reduce corrosion, Edison decided to use an alkaline solution instead of acid for the [95] _____ in his battery. Finding a suitable electrode, however, proved [96] _____. After conducting [97] _____ of experiments on various materials, Edison finally [98] _____ on a combination of nickel flake and nickel hydrate for the positive electrode and pure iron for the negative electrode. He used an [99] _____ of potassium hydroxide with a [100] _____ amount of lithium hydroxide.

By the time Edison had perfected his storage battery, he had spent eight years and a million dollars on it. The battery was widely used in [101] _____ cars and even to power submarines. People still use storage batteries based on Edison's original principles in [102] _____ for miners, powers signals along railroad tracks, isolated airway beacons, and emergency power supplies.

After his exhausting work on the alkaline storage battery, Edison [103] _____ turned his attention to the phonograph. In 1912 he marketed the Edison Diamond Disk Phonograph and disk records. These records measured about 6 mm (about 0.25 in) thick and had a surface of [104] _____ varnish, an early form of [105] _____ .

Rubber

In the 1920s it became apparent that in the event of a national emergency, the United States would not be able to obtain an adequate supply of rubber because it relied heavily on imports. At the age of 80, Edison set out to find plants that could grow in the United States and were suitable for producing rubber. In the next four years he tested 17,000 different plants, finding rubber in 1,200 of them but worthwhile quantities in only about 40. He chose to produce rubber from the goldenrod plant because it would grow in most parts of the [106] _____, it grew to [107] _____ in just one season, and it could be harvested by machines. These characteristics made the [108] _____ easy to grow and harvest on the [109] _____ scale required to produce rubber efficiently. By crossbreeding, Edison produced a goldenrod plant 4 m (13 ft) tall and raised its rubber content from 4 percent to 12 percent. Edison's assistants vulcanized (chemically strengthened) this rubber to make it useful for products about ten days before his death.

LIFE OF EDISON

Early Life

Thomas Alva Edison's family was part Dutch and part British. His ancestors, who [110] _____ the king in the American Revolution (1775-1783), fled to Canada with more than 30,000 others when the war ended. In 1837 Edison's [111] _____ became engaged in an unsuccessful revolution against the Canadian government and was forced to flee back to the United States. Thus, Thomas was born in [112] _____, Ohio, in 1847.

In 1854 the family settled in Port Huron, Michigan, where [113] _____ attended school for three months. This was his only [114] _____ public education. His mother continued his education, teaching him reading, writing, and arithmetic. She also read to him from well-known English writers, such as Edward Gibbon, William Shakespeare, and Charles Dickens.

Edison earned a job [115] _____ [116] _____, apples, and candy on the Detroit and Port Huron branch of the Grand Trunk Railroad when only 12 years old. Around this time his hearing began to decline, possibly due to a childhood attack of scarlet fever. Edison once said that he sometimes considered his partial deafness almost an asset, particularly when he [117] _____ to concentrate on an experiment. However, in a poignant entry in his diary some years later, he wrote, 'I haven't [118] _____ a bird sing since I was 12 years old.'

When 15 years old, while still working on the railroad, Edison bought a small secondhand printing press and 136 kg (300 lb) of type. He installed the press in a baggage car and soon began producing a newspaper, the Weekly Herald, which he printed, edited, and sold on the [119] _____

Trunk Railroad.

In the summer of 1862, Edison saved a boy from [120] _____ run over by a boxcar. The boy, only three years old, was the son of the [121] _____ in [122] _____ Clemens, Michigan. In gratitude, the stationmaster offered to teach Edison how to operate the telegraph. Edison had already experimented with the telegraph at home and gladly accepted the offer. For five [123] _____, he learned to send and receive dispatches, and for the next four years he traveled thousands of miles as a telegrapher. During this period he spent most of his salary on various laboratory and electrical instruments, which he [124] _____ take apart and rebuild.

Family Life

Edison met his first wife, Mary Stilwell, in 1871. She was 16 years old and working in one of his companies when the inventor first met her. Edison married Stilwell on [125] _____ Day of that year. They had a daughter, [126] _____, born in 1873, and two sons, Thomas, Jr., born in 1876, and William, born in 1878.

Soon after his first wife's death in 1884, Edison met and fell in love with Mina Miller, the daughter of a wealthy manufacturer. The two [127] _____ in February 1886. They had a [128] _____, Madeleine, born in 1888, and two sons, Charles and Theodore, born in 1890 and 1898.

[129] _____ focused on his work so much that he spent little time with his family. He [130] _____ most social situations, and he often wore dirty shirts and shabby working clothes. Many of his associates also spoke of Edison's virtues, [131] _____, such as good humor, even disposition, honesty, and [132] _____ affection for his family.

Attitude Toward Work

Edison worked on his experiments with extraordinary intensity. He lived in his laboratory, getting along on four hours of sleep a day and [133] _____ meals brought to him by an assistant. He often kept vigils of 48 and even 72 hours when an experiment neared [134] _____. Often, as in the cases of the [135] _____ light, the storage battery, and the [136] _____ on synthetic rubber, success or failure depended on the discovery of a [137] _____ material. In each case, he conducted thousands of experiments to find the right materials.

Before starting an experiment, Edison tried to read all the literature on the [138] _____ to avoid repeating experiments that other people had already conducted. Perhaps the best illustration of

Edison's working methods is his own famous statement: 'Genius is one percent inspiration and 99 percent perspiration.'

Honors

During Edison's lifetime, he [139] _____ honors from all [140] _____ of the world. In 1881 he was awarded the French Legion of Honor for developing electric power distribution systems. Italy made him a Grand Officer of the Crown in 1889, and he received awards from the [141] _____ of Chile, Britain, [142] _____, Russia, and many [143] _____ nations. American businessman Henry Ford spent several million dollars to erect a museum of [144] _____ in Dearborn, Michigan. The museum consisted largely of a collection of Edison's inventions. In 1929 the [145] _____ held a celebration, called Light's Golden Jubilee, to mark the 50th anniversary of the invention of the electric light.

When Edison died, the U.S. government considered turning off all electric current in the country for a minute or two as a tribute to him. It became [146] _____, however, that the operation of the [147] _____ electrical distribution systems of the nation could not be interrupted even for a moment without [148] _____ disastrous effects. [149] _____ Edison's lifetime, the system that he had pioneered had become essential to the nation's way of life.

Listening Practice | Thomas Edison (Advanced)

1. Fill in the missing words

[1] _____ Edison

INTRODUCTION

Thomas [2] _____, born in 1847 and died in 1931, was an American inventor, one of the [3] _____ [4] _____ of all time. [5] _____ [6] _____ to work at an early age and [7] _____ to work right up until his [8] _____. Throughout his [9] _____ career as an inventor, he was well [10] _____ for his [11] _____ and [12] _____. During his [13] _____ [14] _____ [15] _____ more than 1,000 [16] _____, including the [17] _____ light, the phonograph, and the motion-picture camera. [18] _____ three inventions gave rise to giant [19] _____ utilities, phonograph and record [20] _____, and the film industry—thus changing the work and leisure habits of [21] _____ [22] _____ the [23] _____. The [24] _____ from 1879 to 1900, when Edison produced and perfected most of his devices, has been called the Age of [25] _____.

EARLY [26]

[27] _____ acquired his knowledge of electricity and telegraphy, which means use of a telegraph system to [28] _____ at a distance, as a teenager. In 1868, at age 21, he [29] _____ a telegraphic [30] _____ machine, the first of his inventions to be patented. The next year, Edison invented an [31] _____ version of the stock ticker, [32] _____ printed stock market quotations and gold prices on a [33] _____ tape. [34] _____ older stock [35] _____, Edison's was fully automatic, and it did away with the need for a special [36] _____ to operate each machine. [37] _____ early [38] _____ brought Edison no [39] _____ returns. The first invention to bring him money was another [40] _____ on the stock ticker. Edison created a central [41] _____ by which all the receiving tickers could be put in unison with the main [42] _____ apparatus. For this invention, Edison received \$40,000, [43] _____ would be [44] _____ \$530,000 in 2000. He and a business partner, who operated a machine shop, used the money to start a new [45] _____ to manufacture [46] _____ improved stock [47] _____. For the next five years Edison [48] _____ up to 18 [49] _____ a day in his [50] _____ in Newark, New Jersey, inventing and [51] _____ a variety of [52] _____.

[53] _____. One important device that he designed during this period was the [54] _____, a highly efficient telegraph that [55] _____ send four messages at a time over a [56] _____ wire, instead of just one.

MENLO PARK LABORATORY

In 1876, Edison [57] _____ a laboratory at [58] _____ Park, New Jersey, the [59] _____ laboratory [60] _____ to industrial research in the [61] _____. [62] _____ ten [63] _____ [64] _____ throughout the world knew of Edison as the [65] _____ of Menlo Park.

The Telephone

Edison's [66] _____ [67] _____ [68] _____ at [69] _____ Park was an improvement on the telephone. The telephone that [70] _____ Graham Bell patented in 1876 [71] _____ not operate over distances of more than 3 to 5 km (2 to 3 mi). After hundreds of experiments, Edison improved the telephone to such an extent that it could [72] _____ speech clearly over almost [73] _____ distances. In March 1878, [74] _____ telephone system connected New York City to [75] _____, Pennsylvania, a distance of 172 km (107 mi).

The Phonograph

While [76] _____ on the [77] _____, Edison also worked on [78] _____ his most original invention. He had [79] _____ how the phone's [80] _____, a thin membrane in the mouthpiece, [81] _____ in tune with the voice. He thought that if these [82] _____ could somehow be [83] _____, so that the diaphragm could be made to vibrate in exactly the same manner at any future time, then speech, [84] _____, and [85] _____ [86] _____ could be [87] _____ and reproduced. Edison tested the strength of the diaphragm vibrations by [88] _____ a [89] _____ against the diaphragm with his finger, so that the needle pricked his finger with a force that varied with the loudness of the [90] _____.

In a later experiment, he applied one end of the [91] _____ to the [92] _____ and the other end to a [93] _____ of [94] _____ paper. He then pulled the [95] _____ along [96] _____ the needle while repeatedly [97] _____, 'Hello!' The needle, activated by the [98] _____ of the diaphragm, created [99] _____ in the paper. When the paper was again pulled [100] _____ underneath the needle, the needle followed the grooves it had formed earlier

and pushed against the diaphragm, making the diaphragm reproduce [101] _____ shouts. This first [102] _____ [103] _____, performed in 1877, marked the beginning of the phonograph.

Edison obtained a patent on the phonograph in February 1878. By this time, he had replaced the waxed [104] _____ with metal cylinders covered with [105] _____. He postponed further [106] _____ of the phonograph, however, for some [107] _____.

The [108] _____ Lamp

After patenting the phonograph, Edison set out to develop an [109] _____ lamp, [110] _____ would produce [111] _____ by heating a wire until it glowed [112] _____. People already used electric arc lights, which produced [113] _____ by creating an arc of electricity between two wires. However, the [114] _____ [115] _____ [116] _____ arc lights gave off made them unsuitable for home use. [117] _____, like others before him, conceived the idea of a [118] _____ with a glowing wire, or filament, made of a substance that could endure very high temperatures without fusing, melting, or [119] _____ out. [120] _____ hundreds of trials and more than a year of [121] _____ work, Edison [122] _____ a high-resistance [123] _____ [124] _____ that burned steadily for more than 40 hours. Although not the first incandescent electric light, it was the first practical one because it used a [125] _____ current and, in [126] _____, [127] _____ a long time [128] _____ [129] _____ out.

Electric [130] _____ Distribution Systems

Edison realized that widespread use of electric [131] _____ bulbs would require an [132] _____ system of [133] _____ electricity to homes and [134] _____. He developed detailed plans for an entire distribution system for electric power. This system included generating the current by [135] _____ of a [136] _____ dynamo, which is a device that turns [137] _____ energy into electricity, and then [138] _____ it in small [139] _____ to thousands of homes and [140] _____ [141] _____. Edison even [142] _____ a [143] _____ [144] _____ dynamo to [145] _____ the cost of generating electricity. The system [146] _____ [147] _____ in 1879 included the parallel circuits, safety fuses, insulating materials, and copper-wire [148] _____ used

in modern [149] _____ systems.

By 1881 Edison had set up a complete electric [150] _____ system at his Menlo Park home. That same year his [151] _____ took top honors at the [152] _____ Electrical Exhibition in France. In 1882 at [153] _____ Viaduct in London, the [154] _____ Electric Lighting Company completed and [155] _____ [156] _____ the first [157] _____ [158] _____ station for [159] _____ lighting in the world. This installation used an underground main and feeder circuit to supply power for 2,000 lamps. Later in 1882 Edison established the [160] _____ permanent incandescent [161] _____ and power station for private consumers, called the [162] _____ Street generating station, in New York City.

The [163] _____ Effect

[164] _____ [165] _____ was working on the electric light, he made a scientific [166] _____ that [167] _____ become important to future [168] _____. Edison noticed that [169] _____ of [170] _____ from the filament blackened the insides of his [171] _____ bulbs. This [172] _____ was caused by the emission of electrons from the filament, [173] _____ Edison made the [174] _____ before he and [175] _____ [176] _____ knew the [177] _____ existed. Not [178] _____ 1897 did British physicist J. J. [179] _____ prove that the blackening observed by Edison was [180] _____ by the emission of electrons. This so-called Edison effect [181] _____ the foundation of all [182] _____ electronics. Radio, television, radar, and computers all depend on it.

In 1884 [183] _____ received a [184] _____ for a device [185] _____ on the Edison [186] _____. The device was designed to [187] _____ variations in the output from electrical generators. The indicator proved ineffective because [188] _____ a good vacuum in [189] _____ at that time was [190] _____, but this was the first patent for a [191] _____ that made use of the emission of electrons. It marked the [192] _____ of the field of electronics.

GLENMONT

In 1884 [193] _____ first wife died of [194] _____ fever, and thereafter the inventor [195] _____ returned to his [196] _____ at Menlo Park. [197] _____ his second marriage in 1886, [198] _____ bought Glenmont, a

[199] _____ country estate in West [200] _____, New Jersey, where he established a new [201] _____. He [202] _____ there for 45 years.

[203] _____ and the laboratory are preserved as part of the Edison

[204] _____ Historic Site in West Orange and are open to the public.

Motion [205]

In 1888 Eadweard Muybridge, an English [206] _____ in stop-motion

[207] _____, showed Edison his photographs of horses in full [208] _____.

[209] _____ had taken the photographs using a [210] _____ of cameras, equipped with [211] _____ [212] _____, which he [213] _____ along the side of a [214] _____.

The shutter of each camera was released when a [215] _____ [216] _____ through a string [217] _____ across the track. By this method, Muybridge obtained a series of [218] _____

[219] _____ a short [220] _____ of motion. The pictures could be

[221] _____ in rapid [222] _____ in front of a [223] _____,

giving the [224] _____ the [225] _____ that the horses were moving.

Muybridge's visit inspired Edison, who had already recorded sound, to think of recording movement photographically. He began work [226] _____ immediately on what was to

[227] _____ the [228] _____ motion-picture camera. His

[229] _____ crude apparatus [230] _____ of a [231] _____ sensitive cylinder that revolved in synchrony with the camera shutter to take about 40 [232] _____ per

[233] _____. In 1889 the [234] _____ Dry Plate and Film Company

[235] _____ and [236] _____ a celluloid roll film, and Edison

[237] _____ replaced his [238] _____ [239] _____ with 15-m (50-

ft) strips of the Eastman film. The new machine, completed in 1890, was the prototype of all modern motion-picture [240] _____.

For the showing of his motion pictures, Edison built a mechanism, called the Kinetoscope, which used

positive film moving past a peephole. (Positive film shows the [241] _____ areas of

[242] _____ and darkness in a [243] _____, [244] _____ the

negative shows the [245] _____.) Although only one viewer at a time could see the film, it gave much clearer and steadier pictures than did available screen and projector devices.

[246] Studio

In 1893 Edison constructed the first motion-picture studio. The [247] _____ was 15.2 m (50

ft) long and had a [248] _____ roof that [249] _____ be raised to [250] _____ sunlight. The whole building was mounted on a pivot and could [251] _____ [252] _____ to follow the sun. Edison had the walls on the inside painted black because this [253] _____ helped the [254] _____ [255] _____ [256] _____ pictures. In 1893 and 1894, Edison produced numerous one-minute [257] _____. His moving [258] _____ included figures such as French [259] _____ girls; [260] _____ [261] _____; American showman 'Buffalo Bill' Cody with accompanying Indians in the first Western movie; and American [262] _____ 'Gentleman Jim' Corbett sparring with [263] _____ [264] _____.

The Electric Battery

In 1900 Edison set out to produce an [265] _____ electrical storage battery. Batteries [266] _____ [267] _____ energy into electrical [268] _____. In storage batteries, two metal rods, [269] _____ electrodes, are connected by a circuit and immersed in a liquid, [270] _____ an electrolyte. The rods [271] _____ react with the [272] _____ to produce a flow of electrons [273] _____ the circuit. The storage batteries of the time were called [274] _____ batteries [275] _____ they had electrodes made of lead and lead dioxide and an electrolyte made of acid. They were heavy, [276] _____, difficult to recharge, and susceptible to rapid [277] _____. To reduce corrosion, Edison [278] _____ to use an alkaline [279] _____ instead of acid for the [280] _____ in his [281] _____. [282] _____ a suitable electrode, however, proved [283] _____. After conducting thousands of experiments on various materials, [284] _____ finally decided on a combination of nickel [285] _____ and [286] _____ hydrate for the positive electrode and pure iron for the [287] _____ electrode. He used an [288] _____ of potassium hydroxide with a [289] _____ amount of lithium [290] _____.

By the time Edison had [291] _____ his [292] _____ battery, he had spent eight years and a million dollars on it. The battery was [293] _____ used in electric cars and even to power submarines. People still use storage [294] _____ [295] _____ on Edison's original [296] _____ in lamps for miners, powers [297] _____ [298] _____ railroad tracks, isolated airway beacons, and emergency power supplies.

[299] _____ his exhausting work on the alkaline storage battery, [300] _____

again turned his attention to the [301] _____. In 1912 he [302] _____ the Edison Diamond Disk Phonograph and disk records. These records measured [303] _____ 6 mm (about 0.25 in) thick and had a [304] _____ of Bakelite varnish, an early form of plastic.

Rubber

In the 1920s it became apparent that in the event of a [305] _____ [306] _____, the [307] _____ States would not be able to [308] _____ an [309] _____ supply of rubber because it [310] _____ heavily on [311] _____. At the age of 80, Edison set out to find [312] _____ that [313] _____ grow in the United States and were suitable for [314] _____ rubber. In the next four years he tested 17,000 [315] _____ plants, finding rubber in 1,200 of them but [316] _____ quantities in only about 40. He [317] _____ to produce rubber from the goldenrod plant because it [318] _____ grow in most [319] _____ of the [320] _____, it grew to maturity in just one season, and it [321] _____ be [322] _____ by machines. These characteristics made the plant easy to grow and harvest on the large [323] _____ required to [324] _____ rubber efficiently. By crossbreeding, Edison produced a goldenrod [325] _____ 4 m (13 ft) tall and [326] _____ its rubber content from 4 percent to 12 percent. Edison's assistants vulcanized (chemically [327] _____) this rubber to make it [328] _____ for products [329] _____ ten days before his death.

LIFE OF [330] _____

[331] _____ Life

Thomas Alva Edison's family was part [332] _____ and part British. His ancestors, who supported the king in the American Revolution (1775-1783), fled to Canada with more than 30,000 others when the war [333] _____. In 1837 Edison's father became [334] _____ in an [335] _____ [336] _____ [337] _____ the [338] _____ government and was forced to flee back to the [339] _____ [340] _____. Thus, Thomas was born in Milan, Ohio, in 1847.

In 1854 the family [341] _____ in Port [342] _____, Michigan, where Edison attended [343] _____ for three [344] _____. This was his only formal public [345] _____. His [346] _____ [347] _____ his education, teaching

him reading, writing, and arithmetic. She also read to him from well-known English writers, such as [348] _____ Gibbon, William Shakespeare, and Charles Dickens.

Edison earned a job selling [349] _____, apples, and candy on the [350] _____ and Port [351] _____ branch of the Grand Trunk [352] _____ when only 12 [353] _____ old. Around this time his hearing began to decline, possibly due to a childhood [354] _____ of [355] _____ fever. [356] _____ once said that he sometimes considered his partial [357] _____ [358] _____ an asset, particularly when he [359] _____ to concentrate on an experiment. However, in a [360] _____ entry in his diary some [361] _____ [362] _____, he wrote, 'I [363] _____ heard a bird sing since I was 12 [364] _____ old.'

When 15 [365] _____ old, while still [366] _____ on the railroad, [367] _____ [368] _____ a small secondhand printing press and 136 kg (300 lb) of type. He installed the [369] _____ in a baggage car and soon began producing a newspaper, the [370] _____ [371] _____, [372] _____ he printed, edited, and sold on the Grand Trunk Railroad.

In the summer of 1862, Edison saved a boy from being run over by a boxcar. The boy, only three years old, was the son of the stationmaster in [373] _____ [374] _____, [375] _____. In gratitude, the [376] _____ [377] _____ to teach [378] _____ how to operate the telegraph. [379] _____ had [380] _____ experimented with the telegraph at home and gladly accepted the offer. For five months, he [381] _____ to send and receive [382] _____, and for the next four years he [383] _____ thousands of miles as a [384] _____. During this period he [385] _____ most of his salary on [386] _____ [387] _____ and [388] _____ [389] _____, which he would take [390] _____ and rebuild.

Family Life

Edison met his first wife, Mary Stilwell, in 1871. She was 16 years old and [391] _____ in one of his companies when the inventor first met her. Edison [392] _____ Stilwell on Christmas Day of that year. They had a daughter, Marion, born in 1873, and two sons, Thomas, Jr., born in 1876, and William, born in 1878.

Soon [393] _____ his [394] _____ wife's death in 1884,

[395] _____ met and fell in love with Mina Miller, the daughter of a [396] _____ manufacturer. The two married in February 1886. They had a daughter, Madeleine, born in 1888, and two sons, Charles and Theodore, born in 1890 and 1898.

Edison focused on his work so much that he spent [397] _____ time with his family. He [398] _____ most social situations, and he often wore dirty shirts and shabby [399] _____ clothes. Many of his associates also spoke of Edison's virtues, however, such as good humor, even disposition, honesty, and genuine affection for his family.

Attitude Toward Work

[400] _____ worked on his experiments with extraordinary [401] _____. He lived in his laboratory, getting along on four hours of sleep a day and eating meals brought to him by an assistant. He [402] _____ kept vigils of 48 and even 72 hours when an experiment neared completion. [403] _____, as in the [404] _____ of the electric light, the storage battery, and the experiments on synthetic rubber, success or failure depended on the [405] _____ of a [406] _____ material. In each case, he conducted thousands of [407] _____ to find the right materials.

[408] _____ starting an experiment, [409] _____ tried to read all the literature on the [410] _____ to avoid repeating [411] _____ that other people had already [412] _____. [413] _____ the best illustration of [414] _____ working methods is his own famous statement: 'Genius is one percent inspiration and 99 percent perspiration.'

Honors

During [415] _____ lifetime, he [416] _____ [417] _____ from all parts of the world. In 1881 he was awarded the [418] _____ Legion of [419] _____ for developing electric power [420] _____. [421] _____ Italy made him a [422] _____ Officer of the Crown in 1889, and he received [423] _____ from the governments of Chile, [424] _____, Japan, [425] _____, and many [426] _____ nations. American [427] _____ Henry Ford spent several million [428] _____ to erect a [429] _____ of [430] _____ in Dearborn, Michigan. The [431] _____ [432] _____ largely of a collection of Edison's [433] _____. In 1929 the [434] _____ held a [435] _____, called Light's [436] _____ Jubilee, to mark the 50th anniversary of the invention of the electric

light.

When Edison died, the U.S. government [437] _____ [438] _____ off all [439] _____ current in the country for a minute or two as a [440] _____ to him. It [441] _____ apparent, however, that the operation of the great [442] _____ distribution [443] _____ of the nation [444] _____ not be interrupted even for a moment without possibly disastrous effects. Within [445] _____ lifetime, the [446] _____ that he had pioneered had become essential to the [447] _____ way of life.

Listening Practice | Thomas Edison

1. Fill in the missing words

Thomas Edison

INTRODUCTION

Thomas Edison, born in 1847 and died in 1931, was an American inventor, one of the greatest inventors of all time. Edison began to work at an early age and continued to work right up until his death. Throughout his prolific career as an inventor, he was well known for his focus and determination. During his career Edison patented more than 1,000 [1] inventions, including the electric light, the phonograph, and the motion-picture camera. These three inventions gave rise to giant industries-electric utilities, phonograph and record companies, and the film industry-thus changing the work and leisure [2] habits of people throughout the world. The period from 1879 to 1900, when Edison produced and perfected most of his devices, has been called the Age of Edison.

EARLY INVENTIONS

Edison acquired his knowledge of electricity and telegraphy, which means use of a telegraph system to communicate at a [3] distance, as a teenager. In 1868, at age 21, he developed a telegraphic [4] vote-recording machine, the first of his inventions to be patented. The next year, Edison invented an improved version of the [5] stock ticker, which printed stock [6] market quotations and gold [7] prices on a paper tape. Unlike older stock [8] tickers, Edison's was fully automatic, and it did away with the need for a [9] special attendant to operate each machine.

[10] These early inventions brought Edison no financial returns. The first invention to bring him money was [11] another improvement on the stock ticker. Edison created a [12] central mechanism by which all the receiving tickers [13] could be put in unison with the main sending apparatus. For this invention, Edison received \$40,000, which would be worth \$530,000 in 2000. He and a business partner, who operated a machine shop, used the money to start a new company to manufacture Edison's improved stock ticker. For the next five years Edison spent up to 18 hours a day in his workshop in Newark, New Jersey, inventing and manufacturing a variety of [14] electrical devices. One important device that he designed during this period was the quadruplex, a highly efficient telegraph that could send four messages at a time over a telegraph wire, instead of just one.

MENLO PARK LABORATORY

In 1876, Edison established a laboratory at Menlo Park, New Jersey, the first laboratory dedicated to industrial research in the world. Within ten years [15] people throughout the world knew of

Edison as the Wizard of Menlo Park.

The Telephone

Edison's first major achievement at Menlo Park was an improvement on the telephone. The telephone that [16] **Alexander** _____ Graham Bell patented in 1876 could not operate over distances of more than 3 to 5 km (2 to 3 mi). After hundreds of experiments, [17] **Edison** _____ improved the telephone to such an extent that it could [18] **carry** _____ speech clearly over almost unlimited distances. In March 1878, Edison's telephone [19] **system** _____ connected New York City to Philadelphia, Pennsylvania, a distance of 172 km (107 mi).

The Phonograph

While working on the telephone, Edison also worked on perhaps his most original invention. He had noticed how the phone's diaphragm, a thin membrane in the mouthpiece, vibrated in tune with the voice. He thought that if these vibrations [20] **could** _____ somehow be recorded, so that the diaphragm could be made to [21] **vibrate** _____ in exactly the same manner at any future time, then speech, music, and other sounds could be preserved and reproduced. [22] **Edison** _____ tested the strength of the diaphragm vibrations by holding a needle against the diaphragm with his finger, so that the needle pricked his finger with a force that varied with the loudness of the sounds.

In a later experiment, he applied one end of the needle to the diaphragm and the other end to a strip of waxed paper. He then pulled the paper along underneath the needle while repeatedly shouting, 'Hello!' The needle, activated by the vibrations of the diaphragm, created grooves in the [23] **paper** _____. When the paper was again pulled along underneath the needle, the needle followed the grooves it had formed earlier and [24] **pushed** _____ [25] **against** _____ the diaphragm, making the diaphragm reproduce [26] **Edison's** _____ shouts. This first crude experiment, performed in 1877, marked the beginning of the phonograph.

Edison obtained a patent on the phonograph in February 1878. By this time, he had replaced the waxed [27] **paper** _____ with [28] **metal** _____ cylinders covered with tinfoil. He [29] **postponed** _____ further development of the [30] **phonograph** _____, however, for some years.

The Incandescent Lamp

After patenting the [31] **phonograph** _____, Edison set out to develop an incandescent lamp, [32] **which** _____ [33] **would** _____ produce light by heating a wire until it glowed [34] **brightly** _____. People already used electric arc lights, which produced light by creating an arc of electricity between two wires. [35] **However** _____, the blinding glare these arc lights gave off

made them unsuitable for home use. [36] **Edison** _____, like others before him, conceived the idea of a [37] **light** _____ with a glowing wire, or filament, made of a substance that could endure very high temperatures [38] **without** _____ fusing, melting, or burning out. After hundreds of trials and more than a year of steady work, Edison [39] **developed** _____ a high-resistance carbon-thread filament that [40] **burned** _____ steadily for more than 40 hours. [41] **Although** _____ not the [42] **first** _____ incandescent [43] **electric** _____ light, it was the first [44] **practical** _____ one because it used a small current and, in addition, lasted a long time without burning out.

Electric [45] Power Distribution Systems

Edison realized that widespread use of [46] **electric** _____ light bulbs would require an efficient system of delivering electricity to homes and businesses. He developed [47] **detailed** _____ plans for an entire distribution system for electric power. This system [48] **included** _____ generating the current by means of a central dynamo, which is a device that turns mechanical energy into electricity, and then [49] **distributing** _____ it in small quantities to [50] **thousands** _____ of homes and commercial buildings. Edison even developed a greatly improved dynamo to [51] **reduce** _____ the cost of generating electricity. The system Edison suggested in 1879 included the parallel circuits, safety fuses, insulating materials, and [52] **copper-wire** _____ networks used in modern electrical systems.

By 1881 Edison had set up a complete electric lighting system at his Menlo Park home. That same year his system took top [53] **honors** _____ at the Paris Electrical Exhibition in [54] **France** _____. In 1882 at Holborn Viaduct in London, the Edison Electric Lighting Company completed and began [55] **operating** _____ the first commercial generating station for incandescent lighting in the world. This installation used an [56] **underground** _____ main and feeder circuit to supply power for 2,000 lamps. [57] **Later** _____ in 1882 Edison established the first permanent [58] **incandescent** _____ light and power station for private consumers, called the Pearl Street generating station, in New York City.

The Edison Effect

While Edison was working on the electric light, he made a scientific [59] **discovery** _____ that would become important to future generations. Edison noticed that particles of carbon from the filament blackened the [60] **insides** _____ of his [61] **light** _____ bulbs. This effect was caused by the emission of [62] **electrons** _____ from the filament, [63] **although** _____ Edison made the discovery before he and other scientists knew the electron existed. Not [64] **until** _____ 1897 did British physicist J. J. Thomson [65] **prove** _____ that the blackening observed by Edison was caused by the emission of [66] **electrons** _____. This so-called Edison effect became the foundation

of all modern electronics. Radio, television, radar, and computers all depend on it.

In 1884 Edison [67] **received** _____ a patent for a device based on the Edison effect. The device was designed to indicate variations in the output from electrical generators. The indicator [68] **proved** _____ ineffective because obtaining a good vacuum in devices at that time was [69] **difficult** _____, but this was the first patent for a device that made use of the emission of electrons. It marked the beginning of the field of electronics.

GLENMONT

In 1884 Edison's first wife died of typhoid fever, and thereafter the inventor rarely returned to his laboratories at Menlo Park. After his second marriage in 1886, Edison bought Glenmont, a large country estate in West Orange, New Jersey, where he [70] **established** _____ a new [71] **laboratory** _____. He remained there for 45 years. Glenmont and the laboratory are preserved as part of the Edison National Historic Site in West Orange and are open to the public.

[72] Motion Pictures

In 1888 Eadweard Muybridge, an English pioneer in stop-motion photography, showed Edison his photographs of horses in full [73] **gallop** _____. Muybridge had taken the photographs using a series of cameras, equipped with fast-action shutters, which he [74] **arranged** _____ along the side of a racetrack. The shutter of each camera was released when a horse broke through a string stretched across the track. By this method, [75] **Muybridge** _____ obtained a series of pictures showing a short cycle of motion. The pictures [76] **could** _____ be passed in [77] **rapid** _____ succession in front of a peephole, giving the viewer the illusion that the horses were moving.

Muybridge's [78] **visit** _____ inspired [79] **Edison** _____, who had already recorded sound, to think of recording movement photographically. He began work almost immediately on what was to become the first motion-picture camera. His first crude apparatus consisted of a photographically sensitive cylinder that revolved in synchrony with the camera shutter to take about 40 [80] **pictures** _____ per second. In 1889 the Eastman Dry Plate and Film Company [81] **produced** _____ and patented a celluloid roll film, and Edison promptly replaced his [82] **bulky** _____ cylinder with 15-m (50-ft) strips of the Eastman film. The new machine, completed in 1890, was the prototype of all modern motion-picture cameras.

For the showing of his motion pictures, Edison built a [83] **mechanism** _____, called the Kinetoscope, [84] **which** _____ used positive film moving past a peephole. (Positive film shows the correct areas of light and darkness in a photograph, while the negative shows the opposite.) Although only one viewer at a time could see the film, it gave much clearer and steadier pictures than did available screen

and projector [85] **devices** _____ .

Edison's Studio

In 1893 Edison constructed the first motion-picture studio. The building was 15.2 m (50 ft) long and had a [86] **hinged** _____ roof that could be raised to admit sunlight. The whole building was mounted on a pivot and could swing around to follow the sun. Edison had the walls on the inside painted black because this [87] **background** _____ helped the cameras produce sharper [88] **pictures** _____. In 1893 and 1894, Edison produced numerous one-minute films. His moving pictures included figures such as French ballet girls; Japanese dancers; American showman 'Buffalo Bill' Cody with accompanying Indians in the first Western [89] **movie** _____; and American prizefighter 'Gentleman Jim' Corbett sparring with other boxers.

The Electric Battery

In 1900 Edison set out to produce an improved electrical storage battery. Batteries convert chemical energy into electrical energy. In [90] **storage** _____ batteries, two metal rods, called electrodes, are connected by a circuit and immersed in a liquid, called an electrolyte. The rods chemically react with the electrolyte to [91] **produce** _____ a flow of electrons through the circuit. The storage batteries of the time were called lead-acid batteries because they had [92] **electrodes** _____ made of lead and lead dioxide and an electrolyte made of acid. They were heavy, [93] **bulky** _____, difficult to recharge, and susceptible to [94] **rapid** _____ corrosion. To reduce corrosion, Edison decided to use an alkaline solution instead of acid for the [95] **electrolyte** _____ in his battery. Finding a suitable electrode, however, proved [96] **difficult** _____. After conducting [97] **thousands** _____ of experiments on various materials, Edison finally [98] **decided** _____ on a combination of nickel flake and nickel hydrate for the positive electrode and pure iron for the negative electrode. He used an [99] **electrolyte** _____ of potassium hydroxide with a [100] **small** _____ amount of lithium hydroxide.

By the time Edison had perfected his storage battery, he had spent eight years and a million dollars on it. The battery was widely used in [101] **electric** _____ cars and even to power submarines. People still use storage batteries based on Edison's original principles in [102] **lamps** _____ for miners, powers signals along railroad tracks, isolated airway beacons, and emergency power supplies.

After his exhausting work on the alkaline storage battery, Edison [103] **again** _____ turned his attention to the phonograph. In 1912 he marketed the Edison Diamond Disk Phonograph and disk records. These records measured about 6 mm (about 0.25 in) thick and had a surface of [104] **Bakelite** _____ varnish, an early form of [105] **plastic** _____ .

Rubber

In the 1920s it became apparent that in the event of a national emergency, the United States would not be able to obtain an adequate supply of rubber because it relied heavily on imports. At the age of 80, Edison set out to find plants that could grow in the United States and were suitable for producing rubber. In the next four years he tested 17,000 different plants, finding rubber in 1,200 of them but worthwhile quantities in only about 40. He chose to produce rubber from the goldenrod plant because it would grow in most parts of the [106] country, it grew to [107] maturity in just one season, and it could be harvested by machines. These characteristics made the [108] plant easy to grow and harvest on the [109] large scale required to produce rubber efficiently. By crossbreeding, Edison produced a goldenrod plant 4 m (13 ft) tall and raised its rubber content from 4 percent to 12 percent. Edison's assistants vulcanized (chemically strengthened) this rubber to make it useful for products about ten days before his death.

LIFE OF EDISON

Early Life

Thomas Alva Edison's family was part Dutch and part British. His ancestors, who [110] supported the king in the American Revolution (1775-1783), fled to Canada with more than 30,000 others when the war ended. In 1837 Edison's [111] father became engaged in an unsuccessful revolution against the Canadian government and was forced to flee back to the United States. Thus, Thomas was born in [112] Milan, Ohio, in 1847.

In 1854 the family settled in Port Huron, Michigan, where [113] Edison attended school for three months. This was his only [114] formal public education. His mother continued his education, teaching him reading, writing, and arithmetic. She also read to him from well-known English writers, such as Edward Gibbon, William Shakespeare, and Charles Dickens.

Edison earned a job [115] selling [116] newspapers, apples, and candy on the Detroit and Port Huron branch of the Grand Trunk Railroad when only 12 years old. Around this time his hearing began to decline, possibly due to a childhood attack of scarlet fever. Edison once said that he sometimes considered his partial deafness almost an asset, particularly when he [117] wanted to concentrate on an experiment. However, in a poignant entry in his diary some years later, he wrote, 'I haven't [118] heard a bird sing since I was 12 years old.'

When 15 years old, while still working on the railroad, Edison bought a small secondhand printing press and 136 kg (300 lb) of type. He installed the press in a baggage car and soon began producing a newspaper, the Weekly Herald, which he printed, edited, and sold on the [119] Grand

Trunk Railroad.

In the summer of 1862, Edison saved a boy from [120] **being** _____ run over by a boxcar. The boy, only three years old, was the son of the [121] **stationmaster** _____ in [122] **Mount** _____ Clemens, Michigan. In gratitude, the stationmaster offered to teach Edison how to operate the telegraph. Edison had already experimented with the telegraph at home and gladly accepted the offer. For five [123] **months** _____, he learned to send and receive dispatches, and for the next four years he traveled thousands of miles as a telegrapher. During this period he spent most of his salary on various laboratory and electrical instruments, which he [124] **would** _____ take apart and rebuild.

Family Life

Edison met his first wife, Mary Stilwell, in 1871. She was 16 years old and working in one of his companies when the inventor first met her. Edison married Stilwell on [125] **Christmas** _____ Day of that year. They had a daughter, [126] **Marion** _____, born in 1873, and two sons, Thomas, Jr., born in 1876, and William, born in 1878.

Soon after his first wife's death in 1884, Edison met and fell in love with Mina Miller, the daughter of a wealthy manufacturer. The two [127] **married** _____ in February 1886. They had a [128] **daughter** _____, Madeleine, born in 1888, and two sons, Charles and Theodore, born in 1890 and 1898.

[129] **Edison** _____ focused on his work so much that he spent little time with his family. He [130] **avoided** _____ most social situations, and he often wore dirty shirts and shabby working clothes. Many of his associates also spoke of Edison's virtues, [131] **however** _____, such as good humor, even disposition, honesty, and [132] **genuine** _____ affection for his family.

Attitude Toward Work

Edison worked on his experiments with extraordinary intensity. He lived in his laboratory, getting along on four hours of sleep a day and [133] **eating** _____ meals brought to him by an assistant. He often kept vigils of 48 and even 72 hours when an experiment neared [134] **completion** _____. Often, as in the cases of the [135] **electric** _____ light, the storage battery, and the [136] **experiments** _____ on synthetic rubber, success or failure depended on the discovery of a [137] **suitable** _____ material. In each case, he conducted thousands of experiments to find the right materials.

Before starting an experiment, Edison tried to read all the literature on the [138] **subject** _____ to avoid repeating experiments that other people had already conducted. Perhaps the best illustration of

Edison's working methods is his own famous statement: 'Genius is one percent inspiration and 99 percent perspiration.'

Honors

During Edison's lifetime, he [139] **received** _____ honors from all [140] **parts** _____ of the world. In 1881 he was awarded the French Legion of Honor for developing electric power distribution systems. Italy made him a Grand Officer of the Crown in 1889, and he received awards from the [141] **governments** _____ of Chile, Britain, [142] **Japan** _____, Russia, and many [143] **other** _____ nations. American businessman Henry Ford spent several million dollars to erect a museum of [144] **industry** _____ in Dearborn, Michigan. The museum consisted largely of a collection of Edison's inventions. In 1929 the [145] **museum** _____ held a celebration, called Light's Golden Jubilee, to mark the 50th anniversary of the invention of the electric light.

When Edison died, the U.S. government considered turning off all electric current in the country for a minute or two as a tribute to him. It became [146] **apparent** _____, however, that the operation of the [147] **great** _____ electrical distribution systems of the nation could not be interrupted even for a moment without [148] **possibly** _____ disastrous effects. [149] **Within** _____ Edison's lifetime, the system that he had pioneered had become essential to the nation's way of life.

Listening Practice | Thomas Edison (Advanced)

1. Fill in the missing words

[1] **Thomas** _____ Edison

INTRODUCTION

Thomas [2] **Edison** _____, born in 1847 and died in 1931, was an American inventor, one of the [3] **greatest** _____ [4] **inventors** _____ of all time. [5] **Edison** _____ [6] **began** _____ to work at an early age and [7] **continued** _____ to work right up until his [8] **death** _____. Throughout his [9] **prolific** _____ career as an inventor, he was well [10] **known** _____ for his [11] **focus** _____ and [12] **determination** _____. During his [13] **career** _____ [14] **Edison** _____ [15] **patented** _____ more than 1,000 [16] **inventions** _____, including the [17] **electric** _____ light, the phonograph, and the motion-picture camera. [18] **These** _____ three inventions gave rise to giant [19] **industries-electric** utilities, phonograph and record [20] **companies** _____, and the film industry-thus changing the work and leisure habits of [21] **people** _____ [22] **throughout** _____ the [23] **world** _____. The [24] **period** _____ from 1879 to 1900, when Edison produced and perfected most of his devices, has been called the Age of [25] **Edison** _____.

EARLY [26] INVENTIONS

[27] **Edison** _____ acquired his knowledge of electricity and telegraphy, which means use of a telegraph system to [28] **communicate** _____ at a distance, as a teenager. In 1868, at age 21, he [29] **developed** _____ a telegraphic [30] **vote-recording** _____ machine, the first of his inventions to be patented. The next year, Edison invented an [31] **improved** _____ version of the stock ticker, [32] **which** _____ printed stock market quotations and gold prices on a [33] **paper** _____ tape. [34] **Unlike** _____ older stock [35] **tickers** _____, Edison's was fully automatic, and it did away with the need for a special [36] **attendant** _____ to operate each machine. [37] **These** _____ early [38] **inventions** _____ brought Edison no [39] **financial** _____ returns. The first invention to bring him money was another [40] **improvement** _____ on the stock ticker. Edison created a central [41] **mechanism** _____ by which all the receiving tickers could be put in unison with the main [42] **sending** _____ apparatus. For this invention, Edison received \$40,000, [43] **which** _____ would be [44] **worth** _____ \$530,000 in 2000. He and a business partner, who operated a machine shop, used the money to start a new [45] **company** _____ to manufacture [46] **Edison's** _____ improved stock [47] **ticker** _____. For the next five years Edison [48] **spent** _____ up to 18 [49] **hours** _____ a day in his [50] **workshop** _____ in Newark, New Jersey, inventing and [51] **manufacturing** _____ a variety of [52] **electrical** _____

[53] **devices** . One important device that he designed during this period was the [54] **quadruplex** , a highly efficient telegraph that [55] **could** send four messages at a time over a [56] **telegraph** wire, instead of just one.

MENLO PARK LABORATORY

In 1876, Edison [57] **established** a laboratory at [58] **Menlo** Park, New Jersey, the [59] **first** laboratory [60] **dedicated** to industrial research in the [61] **world** . [62] **Within** ten [63] **years** [64] **people** throughout the world knew of Edison as the [65] **Wizard** of Menlo Park.

The Telephone

Edison's [66] **first** [67] **major** [68] **achievement** at [69] **Menlo** Park was an improvement on the telephone. The telephone that [70] **Alexander** Graham Bell patented in 1876 [71] **could** not operate over distances of more than 3 to 5 km (2 to 3 mi). After hundreds of experiments, Edison improved the telephone to such an extent that it could [72] **carry** speech clearly over almost [73] **unlimited** distances. In March 1878, [74] **Edison's** telephone system connected New York City to [75] **Philadelphia** , Pennsylvania, a distance of 172 km (107 mi).

The Phonograph

While [76] **working** on the [77] **telephone** , Edison also worked on [78] **perhaps** his most original invention. He had [79] **noticed** how the phone's [80] **diaphragm** , a thin membrane in the mouthpiece, [81] **vibrated** in tune with the voice. He thought that if these [82] **vibrations** could somehow be [83] **recorded** , so that the diaphragm could be made to vibrate in exactly the same manner at any future time, then speech, [84] **music** , and [85] **other** [86] **sounds** could be [87] **preserved** and reproduced. Edison tested the strength of the diaphragm vibrations by [88] **holding** a [89] **needle** against the diaphragm with his finger, so that the needle pricked his finger with a force that varied with the loudness of the [90] **sounds** .

In a later experiment, he applied one end of the [91] **needle** to the [92] **diaphragm** and the other end to a [93] **strip** of [94] **waxed** paper. He then pulled the [95] **paper** along [96] **underneath** the needle while repeatedly [97] **shouting** , 'Hello!' The needle, activated by the [98] **vibrations** of the diaphragm, created [99] **grooves** in the paper. When the paper was again pulled [100] **along** underneath the needle, the needle followed the grooves it had formed earlier

and pushed against the diaphragm, making the diaphragm reproduce [101] **Edison's** _____ shouts. This first [102] **crude** _____ [103] **experiment** _____, performed in 1877, marked the beginning of the phonograph.

Edison obtained a patent on the phonograph in February 1878. By this time, he had replaced the waxed [104] **paper** _____ with metal cylinders covered with [105] **tinfoil** _____. He postponed further [106] **development** _____ of the phonograph, however, for some [107] **years** _____.

The [108] **Incandescent** Lamp

After patenting the phonograph, Edison set out to develop an [109] **incandescent** _____ lamp, [110] **which** _____ would produce [111] **light** _____ by heating a wire until it glowed [112] **brightly** _____. People already used electric arc lights, which produced [113] **light** _____ by creating an arc of electricity between two wires. However, the [114] **blinding** _____ [115] **glare** _____ [116] **these** _____ arc lights gave off made them unsuitable for home use. [117] **Edison** _____, like others before him, conceived the idea of a [118] **light** _____ with a glowing wire, or filament, made of a substance that could endure very high temperatures without fusing, melting, or [119] **burning** _____ out. [120] **After** _____ hundreds of trials and more than a year of [121] **steady** _____ work, Edison [122] **developed** _____ a high-resistance [123] **carbon-thread** [124] **filament** _____ that burned steadily for more than 40 hours. Although not the first incandescent electric light, it was the first practical one because it used a [125] **small** _____ current and, in [126] **addition** _____, [127] **lasted** _____ a long time [128] **without** _____ [129] **burning** _____ out.

Electric [130] **Power** Distribution Systems

Edison realized that widespread use of electric [131] **light** _____ bulbs would require an [132] **efficient** _____ system of [133] **delivering** _____ electricity to homes and [134] **businesses** _____. He developed detailed plans for an entire distribution system for electric power. This system included generating the current by [135] **means** _____ of a [136] **central** _____ dynamo, which is a device that turns [137] **mechanical** _____ energy into electricity, and then [138] **distributing** _____ it in small [139] **quantities** _____ to thousands of homes and [140] **commercial** [141] **buildings** _____. Edison even [142] **developed** _____ a [143] **greatly** [144] **improved** _____ dynamo to [145] **reduce** _____ the cost of generating electricity. The system [146] **Edison** [147] **suggested** _____ in 1879 included the parallel circuits, safety fuses, insulating materials, and copper-wire [148] **networks** _____ used

in modern [149] **electrical** systems.

By 1881 Edison had set up a complete electric [150] **lighting** system at his Menlo Park home. That same year his [151] **system** took top honors at the [152] **Paris** Electrical Exhibition in France. In 1882 at [153] **Holborn** Viaduct in London, the [154] **Edison** Electric Lighting Company completed and [155] **began** [156] **operating** the first [157] **commercial** [158] **generating** station for [159] **incandescent** lighting in the world. This installation used an underground main and feeder circuit to supply power for 2,000 lamps. Later in 1882 Edison established the [160] **first** permanent incandescent [161] **light** and power station for private consumers, called the [162] **Pearl** Street generating station, in New York City.

The [163] **Edison** Effect

[164] **While** [165] **Edison** was working on the electric light, he made a scientific [166] **discovery** that [167] **would** become important to future [168] **generations**. Edison noticed that [169] **particles** of [170] **carbon** from the filament blackened the insides of his [171] **light** bulbs. This [172] **effect** was caused by the emission of electrons from the filament, [173] **although** Edison made the [174] **discovery** before he and [175] **other** [176] **scientists** knew the [177] **electron** existed. Not [178] **until** 1897 did British physicist J. J. [179] **Thomson** prove that the blackening observed by Edison was [180] **caused** by the emission of electrons. This so-called Edison effect [181] **became** the foundation of all [182] **modern** electronics. Radio, television, radar, and computers all depend on it.

In 1884 [183] **Edison** received a [184] **patent** for a device [185] **based** on the Edison [186] **effect**. The device was designed to [187] **indicate** variations in the output from electrical generators. The indicator proved ineffective because [188] **obtaining** a good vacuum in [189] **devices** at that time was [190] **difficult**, but this was the first patent for a [191] **device** that made use of the emission of electrons. It marked the [192] **beginning** of the field of electronics.

GLENMONT

In 1884 [193] **Edison's** first wife died of [194] **typhoid** fever, and thereafter the inventor [195] **rarely** returned to his [196] **laboratories** at Menlo Park. [197] **After** his second marriage in 1886, [198] **Edison** bought Glenmont, a

[199] **large** _____ country estate in West [200] **Orange** _____, New Jersey, where he established a new [201] **laboratory** _____. He [202] **remained** _____ there for 45 years.

[203] **Glenmont** _____ and the laboratory are preserved as part of the Edison

[204] **National** _____ Historic Site in West Orange and are open to the public.

Motion [205] Pictures

In 1888 Eadweard Muybridge, an English [206] **pioneer** _____ in stop-motion

[207] **photography** _____, showed Edison his photographs of horses in full [208] **gallop** _____.

[209] **Muybridge** _____ had taken the photographs using a [210] **series** _____ of cameras,

equipped with [211] **fast-action** _____ [212] **shutters** _____, which he [213] **arranged** _____ along

the side of a [214] **racetrack** _____. The shutter of each camera was released when a

[215] **horse** _____ [216] **broke** _____ through a string [217] **stretched** _____ across the

track. By this method, Muybridge obtained a series of [218] **pictures** _____

[219] **showing** _____ a short [220] **cycle** _____ of motion. The pictures could be

[221] **passed** _____ in rapid [222] **succession** _____ in front of a [223] **peephole** _____,

giving the [224] **viewer** _____ the [225] **illusion** _____ that the horses were moving.

Muybridge's visit inspired Edison, who had already recorded sound, to think of recording movement photographically. He began work [226] **almost** _____ immediately on what was to

[227] **become** _____ the [228] **first** _____ motion-picture camera. His

[229] **first** _____ crude apparatus [230] **consisted** _____ of a [231] **photographically** sensitive

cylinder that revolved in synchrony with the camera shutter to take about 40 [232] **pictures** _____ per

[233] **second** _____. In 1889 the [234] **Eastman** _____ Dry Plate and Film Company

[235] **produced** _____ and [236] **patented** _____ a celluloid roll film, and Edison

[237] **promptly** _____ replaced his [238] **bulky** _____ [239] **cylinder** _____ with 15-m (50-

ft) strips of the Eastman film. The new machine, completed in 1890, was the prototype of all modern

motion-picture [240] **cameras** _____.

For the showing of his motion pictures, Edison built a mechanism, called the Kinetoscope, which used

positive film moving past a peephole. (Positive film shows the [241] **correct** _____ areas of

[242] **light** _____ and darkness in a [243] **photograph** _____, [244] **while** _____ the

negative shows the [245] **opposite** _____.) Although only one viewer at a time could see the film, it

gave much clearer and steadier pictures than did available screen and projector devices.

[246] Edison's Studio

In 1893 Edison constructed the first motion-picture studio. The [247] **building** _____ was 15.2 m (50

ft) long and had a [248] **hinged** roof that [249] **could** be raised to [250] **admit** sunlight. The whole building was mounted on a pivot and could [251] **swing** [252] **around** to follow the sun. Edison had the walls on the inside painted black because this [253] **background** helped the [254] **cameras** [255] **produce** [256] **sharper** pictures. In 1893 and 1894, Edison produced numerous one-minute [257] **films**. His moving [258] **pictures** included figures such as French [259] **ballet** girls; [260] **Japanese** [261] **dancers**; American showman 'Buffalo Bill' Cody with accompanying Indians in the first Western movie; and American [262] **prizefighter** 'Gentleman Jim' Corbett sparring with [263] **other** [264] **boxers**.

The Electric Battery

In 1900 Edison set out to produce an [265] **improved** electrical storage battery. Batteries [266] **convert** [267] **chemical** energy into electrical [268] **energy**. In storage batteries, two metal rods, [269] **called** electrodes, are connected by a circuit and immersed in a liquid, [270] **called** an electrolyte. The rods [271] **chemically** react with the [272] **electrolyte** to produce a flow of electrons [273] **through** the circuit. The storage batteries of the time were called [274] **lead-acid** batteries [275] **because** they had electrodes made of lead and lead dioxide and an electrolyte made of acid. They were heavy, [276] **bulky**, difficult to recharge, and susceptible to rapid [277] **corrosion**. To reduce corrosion, Edison [278] **decided** to use an alkaline [279] **solution** instead of acid for the [280] **electrolyte** in his [281] **battery**. [282] **Finding** a suitable electrode, however, proved [283] **difficult**. After conducting thousands of experiments on various materials, [284] **Edison** finally decided on a combination of nickel [285] **flake** and [286] **nickel** hydrate for the positive electrode and pure iron for the [287] **negative** electrode. He used an [288] **electrolyte** of potassium hydroxide with a [289] **small** amount of lithium [290] **hydroxide**.

By the time Edison had [291] **perfected** his [292] **storage** battery, he had spent eight years and a million dollars on it. The battery was [293] **widely** used in electric cars and even to power submarines. People still use storage [294] **batteries** [295] **based** on Edison's original [296] **principles** in lamps for miners, powers [297] **signals** [298] **along** railroad tracks, isolated airway beacons, and emergency power supplies.

[299] **After** his exhausting work on the alkaline storage battery, [300] **Edison**

again turned his attention to the [301] **phonograph** _____. In 1912 he [302] **marketed** _____ the Edison Diamond Disk Phonograph and disk records. These records measured [303] **about** _____ 6 mm (about 0.25 in) thick and had a [304] **surface** _____ of Bakelite varnish, an early form of plastic.

Rubber

In the 1920s it became apparent that in the event of a [305] **national** _____ [306] **emergency** _____, the [307] **United** _____ States would not be able to [308] **obtain** _____ an [309] **adequate** _____ supply of rubber because it [310] **relied** _____ heavily on [311] **imports** _____. At the age of 80, Edison set out to find [312] **plants** _____ that [313] **could** _____ grow in the United States and were suitable for [314] **producing** _____ rubber. In the next four years he tested 17,000 [315] **different** _____ plants, finding rubber in 1,200 of them but [316] **worthwhile** _____ quantities in only about 40. He [317] **chose** _____ to produce rubber from the goldenrod plant because it [318] **would** _____ grow in most [319] **parts** _____ of the [320] **country** _____, it grew to maturity in just one season, and it [321] **could** _____ be [322] **harvested** _____ by machines. These characteristics made the plant easy to grow and harvest on the large [323] **scale** _____ required to [324] **produce** _____ rubber efficiently. By crossbreeding, Edison produced a goldenrod [325] **plant** _____ 4 m (13 ft) tall and [326] **raised** _____ its rubber content from 4 percent to 12 percent. Edison's assistants vulcanized (chemically [327] **strengthened** _____) this rubber to make it [328] **useful** _____ for products [329] **about** _____ ten days before his death.

LIFE OF [330] **EDISON**

[331] **Early** _____ **Life**

Thomas Alva Edison's family was part [332] **Dutch** _____ and part British. His ancestors, who supported the king in the American Revolution (1775-1783), fled to Canada with more than 30,000 others when the war [333] **ended** _____. In 1837 Edison's father became [334] **engaged** _____ in an [335] **unsuccessful** _____ [336] **revolution** _____ [337] **against** _____ the [338] **Canadian** _____ government and was forced to flee back to the [339] **United** _____ [340] **States** _____. Thus, Thomas was born in Milan, Ohio, in 1847.

In 1854 the family [341] **settled** _____ in Port [342] **Huron** _____, Michigan, where Edison attended [343] **school** _____ for three [344] **months** _____. This was his only formal public [345] **education** _____. His [346] **mother** _____ [347] **continued** _____ his education, teaching

him reading, writing, and arithmetic. She also read to him from well-known English writers, such as [348] **Edward** Gibbon, William Shakespeare, and Charles Dickens.

Edison earned a job selling [349] **newspapers**, apples, and candy on the [350] **Detroit** and Port [351] **Huron** branch of the Grand Trunk [352] **Railroad** when only 12 [353] **years** old. Around this time his hearing began to decline, possibly due to a childhood [354] **attack** of [355] **scarlet** fever. [356] **Edison** once said that he sometimes considered his partial [357] **deafness** [358] **almost** an asset, particularly when he [359] **wanted** to concentrate on an experiment. However, in a [360] **poignant** entry in his diary some [361] **years** [362] **later**, he wrote, 'I [363] **haven't** heard a bird sing since I was 12 [364] **years** old.'

When 15 [365] **years** old, while still [366] **working** on the railroad, [367] **Edison** [368] **bought** a small secondhand printing press and 136 kg (300 lb) of type. He installed the [369] **press** in a baggage car and soon began producing a newspaper, the [370] **Weekly Herald**, [372] **which** he printed, edited, and sold on the Grand Trunk Railroad.

In the summer of 1862, Edison saved a boy from being run over by a boxcar. The boy, only three years old, was the son of the stationmaster in [373] **Mount Clemens**, [375] **Michigan**. In gratitude, the [376] **stationmaster** [377] **offered** to teach [378] **Edison** how to operate the telegraph. [379] **Edison** had [380] **already** experimented with the telegraph at home and gladly accepted the offer. For five months, he [381] **learned** to send and receive [382] **dispatches**, and for the next four years he [383] **traveled** thousands of miles as a [384] **telegrapher**. During this period he [385] **spent** most of his salary on [386] **various** [387] **laboratory** and [388] **electrical** [389] **instruments**, which he would take [390] **apart** and rebuild.

Family Life

Edison met his first wife, Mary Stilwell, in 1871. She was 16 years old and [391] **working** in one of his companies when the inventor first met her. Edison [392] **married** Stilwell on Christmas Day of that year. They had a daughter, Marion, born in 1873, and two sons, Thomas, Jr., born in 1876, and William, born in 1878.

Soon [393] **after** his [394] **first** wife's death in 1884,

[395] **Edison** _____ met and fell in love with Mina Miller, the daughter of a [396] **wealthy** _____ manufacturer. The two married in February 1886. They had a daughter, Madeleine, born in 1888, and two sons, Charles and Theodore, born in 1890 and 1898.

Edison focused on his work so much that he spent [397] **little** _____ time with his family. He [398] **avoided** _____ most social situations, and he often wore dirty shirts and shabby [399] **working** _____ clothes. Many of his associates also spoke of Edison's virtues, however, such as good humor, even disposition, honesty, and genuine affection for his family.

Attitude Toward Work

[400] **Edison** _____ worked on his experiments with extraordinary [401] **intensity** _____. He lived in his laboratory, getting along on four hours of sleep a day and eating meals brought to him by an assistant. He [402] **often** _____ kept vigils of 48 and even 72 hours when an experiment neared completion. [403] **Often** _____, as in the [404] **cases** _____ of the electric light, the storage battery, and the experiments on synthetic rubber, success or failure depended on the [405] **discovery** _____ of a [406] **suitable** _____ material. In each case, he conducted thousands of [407] **experiments** _____ to find the right materials.

[408] **Before** _____ starting an experiment, [409] **Edison** _____ tried to read all the literature on the [410] **subject** _____ to avoid repeating [411] **experiments** _____ that other people had already [412] **conducted** _____. [413] **Perhaps** _____ the best illustration of [414] **Edison's** _____ working methods is his own famous statement: 'Genius is one percent inspiration and 99 percent perspiration.'

Honors

During [415] **Edison's** _____ lifetime, he [416] **received** _____ [417] **honors** _____ from all parts of the world. In 1881 he was awarded the [418] **French** _____ Legion of [419] **Honor** _____ for developing electric power [420] **distribution** _____ [421] **systems** _____. Italy made him a [422] **Grand** _____ Officer of the Crown in 1889, and he received [423] **awards** _____ from the governments of Chile, [424] **Britain** _____, Japan, [425] **Russia** _____, and many [426] **other** _____ nations. American [427] **businessman** _____ Henry Ford spent several million [428] **dollars** _____ to erect a [429] **museum** _____ of [430] **industry** _____ in Dearborn, Michigan. The [431] **museum** _____ [432] **consisted** _____ largely of a collection of Edison's [433] **inventions** _____. In 1929 the [434] **museum** _____ held a [435] **celebration** _____, called Light's [436] **Golden** _____ Jubilee, to mark the 50th anniversary of the invention of the electric

light.

When Edison died, the U.S. government [437] **considered** [438] **turning** off all [439] **electric** current in the country for a minute or two as a [440] **tribute** to him. It [441] **became** apparent, however, that the operation of the great [442] **electrical** distribution [443] **systems** of the nation [444] **could** not be interrupted even for a moment without possibly disastrous effects. Within [445] **Edison's** lifetime, the [446] **system** that he had pioneered had become essential to the [447] **nation's** way of life.