History

From the first phonographs to the digital equipment of today, recording technology continues to revolutionize the way that people create, play and listen to music.

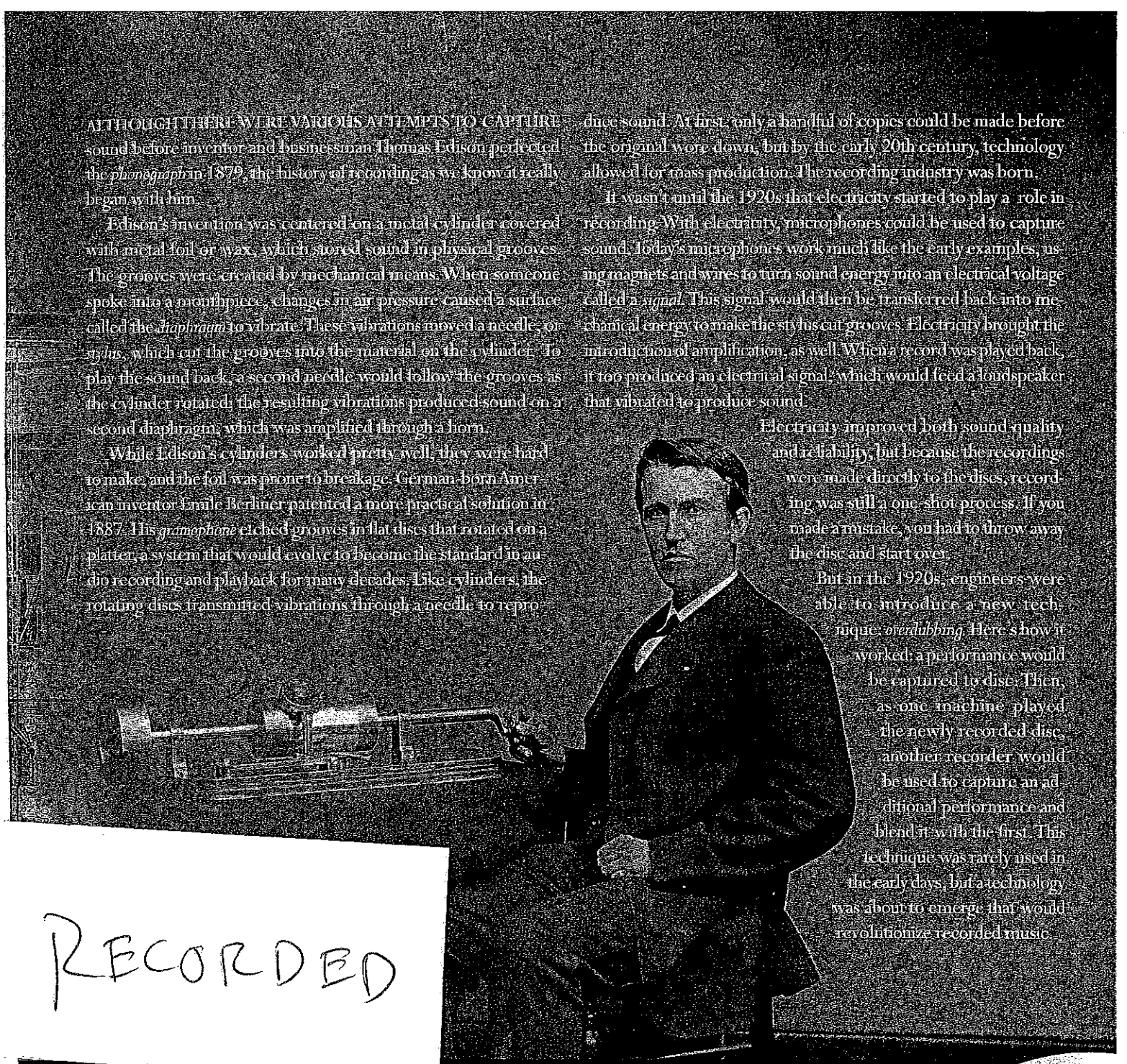
by Emile Menasché

ALTHOUGH THERE WERE VARIOUS ATTEMPTS TO CAPTURE sound before inventor and businessman Thomas Edison perfected the *phonograph* in 1879, the history of recording as we know it really began with him.

Edison's invention was centered on a metal cylinder covered with metal foil or wax, which stored sound in physical grooves. The grooves were created by mechanical means. When someone spoke into a mouthpiece, changes in air pressure caused a surface called the *diaphragm* to vibrate. These vibrations moved a needle, or *stylus*, which cut the grooves into the material on the cylinder. To play the sound back, a second needle would follow the grooves as the cylinder rotated; the resulting vibrations produced sound on a second diaphragm, which was amplified through a horn.

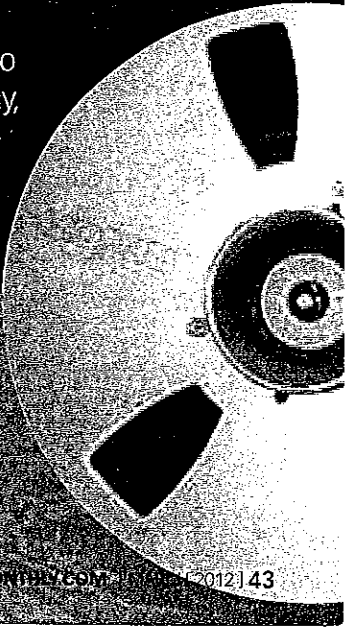
While Edison's cylinders worked pretty well, they were hard to make, and the foil was prone to breakage. German-born American inventor Emile Berliner patented a more practical solution in 1887. His *gramophone* etched grooves in flat discs that rotated on a platter, a system that would evolve to become the standard in audio recording and playback for many decades. Like cylinders, the rotating discs transmitted vibrations through a needle to reproduce sound. At first, only a handful of copies could be made before the original wore down, but by the early 20th century, technology allowed for mass production. The recording industry was born.

It wasn't until the 1920s that electricity started to play a role in recording. With electricity, microphones could be used to capture sound. Today's microphones work much like the early examples, using magnets and wires to turn sound energy into an electrical voltage called a *signal*. This signal would then be transferred back into mechanical energy to make the stylus cut grooves. Electricity brought the introduction of amplification, as well. When a record was played back, it too produced an electrical signal which would feed a loudspeaker that vibrated to produce sound.

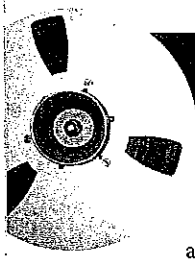


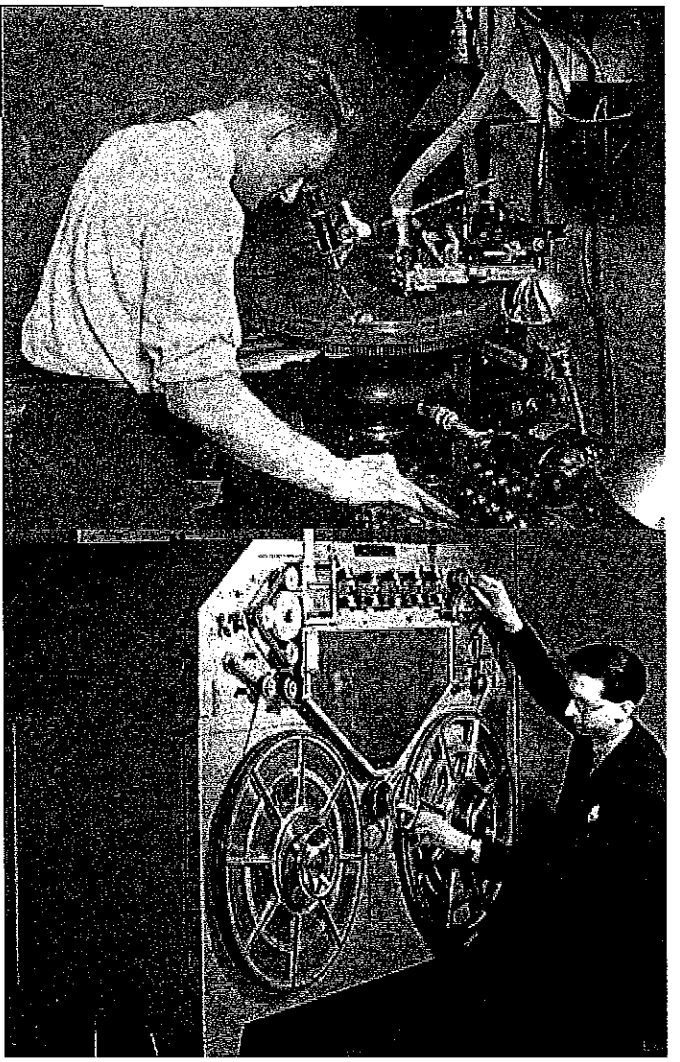
Electricity improved both sound quality and reliability, but because the recordings were made directly to the discs, recording was still a one-shot process. If you made a mistake, you had to throw away the disc and start over.

But in the 1920s, engineers were able to introduce a new technique: *overdubbing*. Here's how it worked: a performance would be captured to disc. Then, as one machine played the newly recorded disc, another recorder would be used to capture an additional performance and blend it with the first. This technique was rarely used in the early days, but a technology was about to emerge that would revolutionize recorded music.



The ultra-modern Blade recording studio in Louisiana (left) evolved from Thomas Edison's phonograph.





An engineer uses a lathe to cut sound-producing grooves into a wax disc (top). Early reel-to-reel recorders used steel tape (below).

◀◀ THE TALE OF THE TAPE

In the 1930s, a new way of capturing sound came along: *magnetic tape.* Tape recorders don't use a stylus. Instead, motorized reels feed tape coated with magnetic particles over a device known as a *recording head.* This head reacts to the electric signal produced by microphones to create a pattern on the tape. When the tape passes over a *playback head*, it produces an electrical signal similar—or *analogous*—to the one it was fed. This *analog* signal would then feed the amplifier and speakers to produce sound.

The British Broadcasting Company (BBC) was the first to use such a recorder for a public radio broadcast. The machine was huge and dangerous. Because the reels rotated at 300-feet-per-minute, it took almost two miles of tape to produce a half-hour broadcast!

But as analog recording quickly evolved to be more practical, it opened many creative doors: A reel of tape could store much more music than a disc so that longer recordings could be made. The motors controlling the reels could be kept at a constant speed for more accurate recording and playback. Most important, tape could be started and stopped in the middle, allowing musicians and engineers to fix mistakes. Finally, tape could be edited and spliced together. This allowed musicians to record several takes of a performance and use the best parts for the final recording, or *master.*

Most of these recordings were still transferred to disc for public sale, but the discs themselves also began to change. Early records ran at 78 revolutions per minute (RPM), but in 1948, Columbia Records developed the 12-inch 33 1/3 RPM long-playing record (LP), which allowed fans to listen to longer performances without interruption—perfect for jazz and classical music. A year later, RCA came out with the 7-inch 45 RPM single. In just a few years, these little records would be delivering a new genre called rock & roll to millions of fans.

◀◀ THE STUDIO AS INSTRUMENT

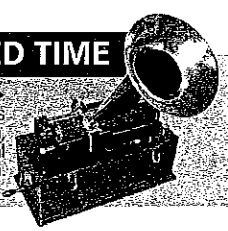
As record sales became a bigger business, people in the music industry started looking for ways to top their competitors. Engineers developed recording heads that could send independent signals across the width of the tape in separate *tracks.* The first examples were two-track *stereo*—which split the signal into left and right channels to offer more realistic sound quality.

But if you could send two signals to tape, why not more? Guitarist Les Paul answered this question by popularizing a technique known as *multitrack* recording.

Paul was a great musician, but he was also an inventor (Gibson/Epiphone's Les Paul models are named for him), and he loved to experiment with audio equipment in his home studio. He realized that installing a third head would allow a tape recorder to add more sound to a single piece of tape as it played back—without erasing what had been done before! Working with his wife, Mary Ford, Paul used his three-head multitrack machines to create many layers of sound, and his work earned 16 Top 10 hits between 1950 and '54. Paul was also the first person to use an 8-track recorder, which he had custom-made by the American company Ampex.

Despite Les Paul's experiments, most recording sessions were still set up to capture live performances, with at least the background music being played by an ensemble. Overdubs were reserved for vocals and additional sounds. But that all started to change in the 1960s.

▶▶ RECORDED TIME



1879 ▶▶ Thomas Edison creates the phonograph, the first practical recording system.

1906 Lee De Forest invents the vacuum tube, the first amplifier for electronic signals.

1917 The first lathe for cutting discs is introduced.

1928 The first electronically recorded records are released.

1929 The first magnetic recorder, the Blattnerphone, is developed.

1936 BASF creates plastic-based magnetic tapes; a year later, the company makes the first tape recording of a symphony in London.

Early recordings captured full ensembles playing live (top). Guitarist Les Paul popularized multitrack overdubbing (middle), allowing one musician to record multiple tracks using a three-head tape recorder (bottom).

PHOTOS: TOP: ERICH AUERBACH/GETTY IMAGES; BOTTOM: MICHAEL OCHS ARCHIVES/GETTY IMAGES

The Beatles were at the forefront of this transition. The band's first recordings were made on two- and three-track machines, but they, along with producer George Martin, started using the studio to create sounds that they couldn't reproduce live. Their 1966 album *Revolver* was a turning point, but it was 1967's *Sergeant Pepper's Lonely Hearts Club Band* that would transform the sound of popular music. Using four-track machines, the band recorded their own instruments and vocals as well as many outside sounds. The recordings were made in stages; the first set of tracks would be mixed and recorded to an open track—a technique known as *bouncing*—allowing the three original tracks to be reused for new overdubs. Although time-consuming, this produced the results the band wanted, and *Sgt. Pepper's* remains a landmark recording to this day.

By the time the Beatles went into the studio for the last time as a group to record *Abbey Road* in 1969, eight-track recording was becoming common. By the mid-1970s, 16- and 24-track recorders were the standard. The latter used tape two inches wide to produce incredible sound quality. Technology also allowed machines to be synchronized, so that two 24-track decks could be used to record 48 separate tracks without bouncing.

In the late 1970s, Japanese companies TASCAM and FOSTEX miniaturized multitrack recording by inventing machines that would record four tracks on a compact cassette tape. Affordable and easy to use, these machines made multitrack recording practical for nonprofessionals for the first time.

◀◀ DISC TO DISK

Analog recording remained the standard through the 1970s and '80s, but as the '70s ended, a completely new technology emerged: *digital recording*. Instead of printing an electrical signal to a piece of tape, a digital recorder converted the analog electrical signal to a computer code. This data would then be reconverted to analog signal for playback. Digital recording eliminated the hiss that analog tape produced. Digital recordings were also easier to copy without losing sound quality.

Digital technology opened the door to completely new ways of creating and recording music, eventually replacing tape with sampling, sequencing, and hard disk recording. Today, these are the most common tools used in both home and professional studios.

A *sampler* is any device that can capture and store a short digital recording (a *sample*) and play it back. When samplers first appeared, they didn't have enough memory to capture long performances. But engineers found that samplers were ideal for two things: playing back one note at a time and playing short passages. Using a controller such as a piano-style keyboard, musicians could use these samples to replicate the sound of acoustic instruments (one note at a time) or play short drum patterns and other performances, known as loops. Such loops became the foundation for hip-hop, electronica, and other modern dance styles.

● 1942 The first stereo tape recordings are made in Berlin.

◀◀ 1947 Ampex produces its first tape recorder.

● 1950 Les Paul adds an extra head to his Ampex tape recorder to create overdubs.

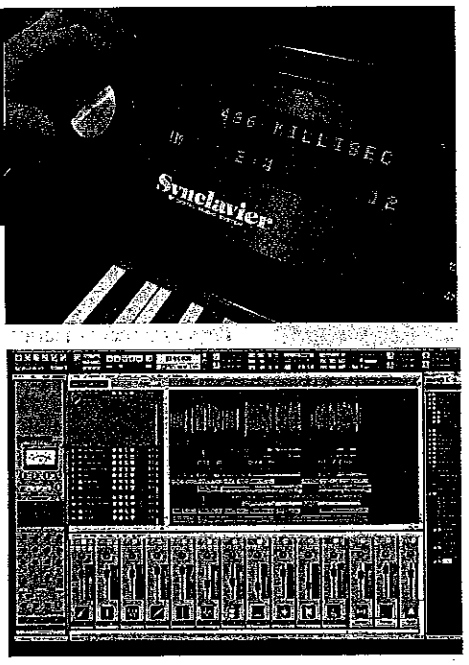
● 1955 Ampex's Selective Synchronous Recording system makes overdubbing practical.

● 1958 The first stereo records are released.

● 1963 The compact cassette tape is released.

◀◀ 1967 The Beatles release *Sergeant Pepper's Lonely Hearts Club Band*.

● 1968 Ampex releases the first commercial 16-track recorder, which uses 2-inch wide tape.



The Synclavier (top) was among the first hard disk workstations. Software like Cakewalk's SONAR combines audio and MIDI recording and can run on a home computer.

Samplers became especially popular when used with devices known as *sequencers*. These offered an entirely new way to capture music. Instead of recording and playing back audio from a singer or instrumentalist, a sequencer stored information about the notes played into them, then used that information to trigger sounds in any compatible electronic instrument. Early sequencers used analog electrical pulses and other technologies, but they really caught on with the development of the Musical Instrument Digital Interface (MIDI) in the mid-1980s.

MIDI, which is still used for many forms of music performance and production, allows instruments, sound effects, and sequencers to communicate, even when they're made by different companies. With MIDI, digital signals known as *note messages* are generated when you play a keyboard or some other controller. A sequencer stores these note messages in its memory, and can use them to trigger sounds in *any* MIDI device. What made MIDI so revolutionary—and still makes it pretty darn cool—is the way that messages can be edited and rerouted to change both the sound and nature of a performance. Since each note is stored separately, MIDI sequencers let users change attributes like a note's pitch, timing, length, tempo, and more. You can use it to fix individual mistakes or as a creative tool—for example, trying out a new harmony or time signature. Thanks to MIDI and sampling, *notation software* like Sibelius, Finale, and Notion— originally designed to create sheet music—now lets you record a performance and hear a full orchestra play it back.

Personal computers soon brought both MIDI and sequencing into the software realm. This technology would mate with a new type of audio recorder to create the powerful *digital audio workstations* (DAWs) that we use today.

◀◀ A NEW AGE DAWNS

While tape remained popular well into the 1990s, the emergence of the hard drive as a recording medium would soon spell its demise. Early hard disk recorders were limited by the storage capability of the disks themselves, and the first examples could record only a few minutes of music. Yet even this had its uses: Engineers could edit audio recordings in ways that would have been very difficult using the old cut-and-splice tape techniques. More important, they could create multiple versions of an edit, and if they made a mistake, they could "undo" it without damaging the original.

Early hard disk recorders like the Synclavier were expensive standalone units that could cost as much as a house. In 1991, a California company called Digidesign released the first version of ProTools. It offered only four tracks, but worked on a Macintosh computer, making it more affordable.

Other companies soon started making hard disk recording software and hardware. Each new version seemed to offer more tracks, better audio fidelity, and new sound-shaping features. But the biggest advantage remains the ability to edit a multitrack recording without actually erasing the original performance, making it easy to rearrange musical parts *after* they've been recorded. The computer screen offers a visual representation of the sound—something the people splicing tape never had. At first, hard disk recorders and sequencers were separate programs, but by the mid-1990s, they would meet under a single umbrella, giving users the ability to record MIDI and audio tracks side-by-side. The modern DAW was born.

◀◀ IT'S ABOUT TIME!

Once producers and musicians started using MIDI and audio together, they realized that audio had one major disadvantage. With MIDI, it was easy to change the tempo or the pitch of a performance. With digital audio, as with analog tape, speeding things up made the pitch higher; slowing them down made it lower.

In the late 1990s, technology that let users change the tempo of an audio file without changing its pitch (and vice versa) appeared. Programs like ACID by Sonic Foundry (now Sony Creative) and Ableton Live paved the way. Soon, standard DAWs like Pro Tools, Apple's Logic and GarageBand, Cakewalk's SONAR, Steinberg's Cubase, and others would offer similar capabilities.

Today, great-sounding recorders can be found in tiny handheld devices, while features that once required a powerful computer system can now be found on smartphones and tablets. Instead of using a lathe to etch a record, you can create an MP3 and share your recording with the world within seconds!

● 1975 Digital recording begins to be used in some professional studios.

● 1977 The Synclavier becomes the first Digital Audio Workstation.

▲▲ 1979 TASCAM releases the first four-track cassette recorder.

● 1981 Philips demonstrates the CD. MIDI becomes a standard digital interface.

● 1990 Opcode's Studio Vision combines digital audio and MIDI recording.

● 1991 Digidesign introduces Pro Tools, the first hard-disk multitrack for personal computers.

● 1998 Sonic Foundry releases ACID music software.

● 2001 Ableton releases Live 1.0.

● 2004 Apple releases GarageBand software.

● 2011 Recording software appears on mobile devices.

MUSIC TECH
RECORDED HISTORY (article) Name: _____

Short Answer:

1. When was the phonograph perfected?

2. Who invented the phonograph?

3. What was the main difference between a phonograph and a gramophone?

4. Which type of recording devices used a stylus?

5. What does RPM stand for?

6. What does LP stand for?

7. How many tracks are in a stereo recording?

8. Which band was at the forefront of the transition to overdubbing in the studio?

9. Name one style of music that uses loops?

10. What does MIDI stand for?

Extended response (use complete sentences):

1. In your own words, describe how a phonograph works?

2. What role did electricity play in the beginning of the recording industry?

3. Explain overdubbing in your own words.

4. What are four reasons analog recording evolved to be more practical?

5. Why does a recorder with more tracks allow the recordings it produces to be of a higher quality?

6. What were two advantages of digital recording over analog recording?

7. In the author's opinion, what makes MIDI so great?

8. What is the main advantage of a hard disk recorder?

Essay: Choose <u>two</u> of the following audio recording devices:

phonograph, gramophone, electric tape recorder (multitrack recorder), digital recorder (sampler), or hard disk recorder.

Create a Venn Diagram illustrating their similarities and differences.

#1:

#2: