TOEFL Listening Lesson 9

Setting: A college-level *Music Theory* class.

Questions

1. What is the main topic of the lecture?

A. The influence of jazz on classical composers

B. The role of mathematical patterns in classical music

C. The history of musical instruments in Europe

D. The development of modern electronic music

2. According to the professor, what is one reason symmetry is used in classical compositions?

A. To make pieces easier to perform from memory

B. To imitate ancient Greek architectural principles

C. To give the music a balanced and satisfying structure

D. To create unpredictable melodic lines

3. What does the professor say about the Fibonacci sequence in music?

A. It is used to determine tuning systems in Western scales

B. It has no practical application in composition

C. It helps composers determine the tempo of each section

D. It has been used to structure pieces, including climaxes and key changes

4. Why does the professor mention Johann Sebastian Bach?

A. To show how composers rejected math in favor of emotion
B. To provide an example of complex mathematical techniques in composition
C. To explain the origin of the golden ratio in music
D. To describe innovations in musical instruments during his era

5. Why does the professor mention the ratio 3:2?

A. To describe a type of scale used in ancient times
B. To show how composers avoid dissonance
C. To explain a rhythmic pattern called a polyrhythm
D. To illustrate how a sonata is divided into three main parts

Script

Professor:
Today, we're going to explore something that fascinates both musicians and mathematicians: the use of mathematical patterns in classical music compositions. From the structure of symphonies to the intervals in a scale, math and music are deeply intertwined. Some composers even used mathematical ideas intentionally to guide their creative process.

Let's begin with one of the most well-known concepts: symmetry. In music, symmetry appears in many forms. For instance, the ABA structure of many classical movements is a simple form of reflectional symmetry—the piece begins with a theme (A), moves into a contrasting section (B), and then returns to the original theme (A). This symmetrical approach creates a sense of balance and resolution that listeners intuitively recognize and appreciate.

Another type of mathematical structure found in music is the Fibonacci sequence. Some composers—most famously Béla Bartók—used the Fibonacci sequence and the golden ratio in structuring their music. For those unfamiliar, the Fibonacci sequence is a series of numbers where each number is the sum of the two preceding ones: 1, 1, 2, 3, 5, 8, 13, and so on. When applied to music, a composer might place a key change or thematic shift at a point in the piece that corresponds to a Fibonacci number or use the golden ratio to divide a movement into sections.

Bartók, for example, structured some of his compositions so that the climax occurs at the golden section—roughly 61.8% into the piece. This gives the music a natural-feeling arc, one that mirrors patterns found in nature.

Let’s also consider rhythm and meter. Musical time signatures often reflect mathematical regularity. A piece in 4/4 time, for example, has four beats per measure and the quarter note gets one beat. But composers frequently manipulate rhythm to create tension and complexity. Polyrhythms—where two different rhythmic patterns are played simultaneously—are a good example. A 3:2 polyrhythm, in which one part plays three beats in the same time another plays two, illustrates how musicians can layer patterns to create interesting textures. This kind of ratio-based rhythm is common not just in classical music but also in jazz and various world traditions.

You might also have heard of the term “canon,” as in Pachelbel’s Canon. A canon is a musical form where a melody is repeated and layered in such a way that each voice enters at a different time, often at regular intervals. The relationships between these entries are mathematically precise. Johann Sebastian Bach was a master of using these techniques—especially in his “Art of the Fugue.” He would take a theme and subject it to inversion, retrograde, augmentation, and diminution—essentially flipping the melody upside-down, playing it backward, doubling the note lengths, or cutting them in half. These are all examples of mathematical transformations applied to music.

Bach's fugues are not only beautiful but also astonishing in their complexity and logic. His work shows how deeply structure and pattern can coexist with emotional expression.

Moving into harmony, we can observe the mathematical relationships in intervals and scales. The octave, for instance, is based on a frequency ratio of 2:1. A note at 440 Hz (like the A above middle C) has its octave above at 880 Hz. Similarly, a perfect fifth—the interval between the first and fifth notes of a major scale—has a frequency ratio of 3:2. These simple whole-number ratios are what give consonant intervals their pleasing sound.

The circle of fifths, a tool for understanding key relationships, is another example of how music theory is guided by math. By moving through a series of perfect fifths, you can navigate all 12 keys in Western music, eventually arriving back at your starting point. It's a closed loop—cyclical, elegant, and mathematically sound.

Some modern composers, such as the minimalists Steve Reich and Philip Glass, take mathematical ideas even further. They often use processes like phasing—where identical patterns are played at slightly different speeds, creating shifting textures over time. While not strictly classical, these composers continue the tradition of using math as a foundation for musical exploration.

To summarize, math in classical music appears in structure, rhythm, harmony, and even compositional techniques. Whether it's the careful balance of a sonata form or the calculated layering of a fugue, understanding the mathematics behind the music can deepen our appreciation for its artistry.

Answers

1. What is the main topic of the lecture?

✅ **Correct answer:** B. The role of mathematical patterns in classical music

2. According to the professor, what is one reason symmetry is used in classical compositions?

✅ **Correct answer:** C. To give the music a balanced and satisfying structure

3. What does the professor say about the Fibonacci sequence in music?

✅ **Correct answer:** D. It has been used to structure pieces, including climaxes and key changes

4. Why does the professor mention Johann Sebastian Bach?

✅ **Correct answer:** B. To provide an example of complex mathematical techniques in composition

5. Why does the professor mention the ratio 3:2?

✅ **Correct answer:** C. To explain a rhythmic pattern called a polyrhythm