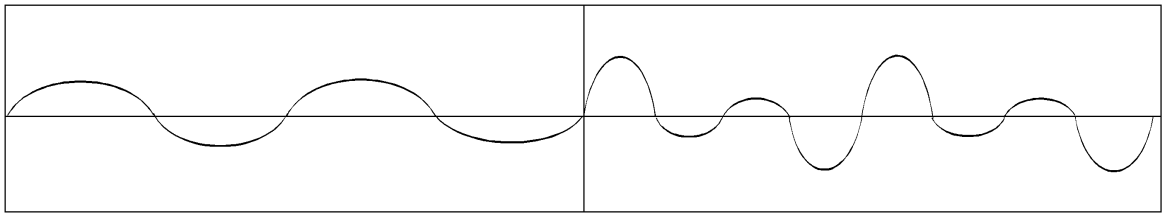
Chapter A, Additional Materials

THE OVERTONE SERIES

Sound is produced by mechanical vibration of an object or sounding body (such as a string, a metal bar, a reed, the vocal chords or the lips, a piece of wood, a drum head, or an air column). Moreover, sound is transmitted by vibrational motion (sound waves) through a medium such as air, water, or a solid material. Wave shapes may be simple, as in example A.15a, and then they produce what we know as a **pure tone** or also **sine tone**. Pure tones, such as the sound produced by a tuning fork, are unusual in a musical setting. Most often musical sounds are **complex tones**, and their wave forms are more complicated than the simple sine wave represented in example A.15a. An example of a more complex wave shape appears in example A.15b.

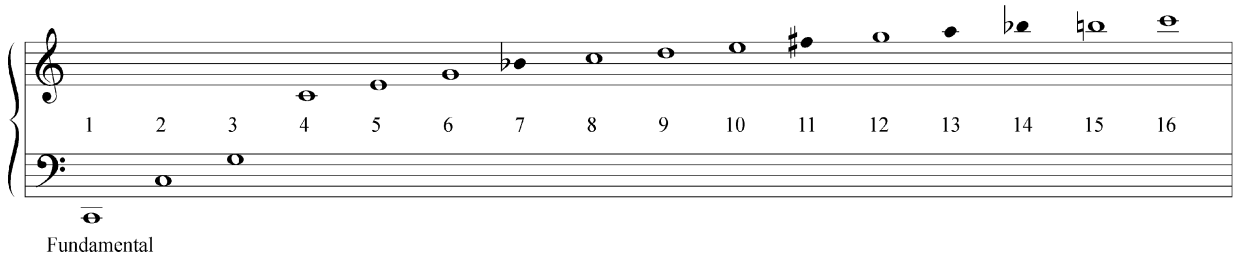
Example A.15

a. b.



Complex tones are actually made up of several pure tones that are combined. The different components that make up a complex tone are known as **partials**, **harmonics**, or **overtones**. When we strike a key on a piano, for instance, we hear a complex tone made up of the actual pitch we played plus a variety of partials or harmonics that sound above it and simultaneously with it. The pitch we actually played is known as **fundamental** because it is the lowest tone in the complex of partials. The rest of the tones that make up the complex (the overtones) sound above the fundamental. Although the fundamental is the pitch we really perceive clearly, a complex tone actually consists of a blend of fundamental and overtones. The complete set of overtones produced by a given pitch is known as the **overtone series**. Example A.16 shows the overtone series for the pitch C2 (the fundamental in this case), up to the sixteenth partial (the series continues, but the higher the partial, the weaker its acoustical effect). Notice that partials are numbered beginning with the fundamental (partial no. 1). Partials nos. 7, 11, 13, and 14 are only represented by an approximate notated pitch (their actual sound is "out of tune" with the notated pitch).

Example A.16



From a musical point of view, the overtone series is significant in various ways. In the first place, the sound produced by different instruments stresses different combinations of partials within the overtone series. These different combinations produce the different timbres of instruments. **Timbre** is the tone quality or tone color that distinguishes one instrument from another. From a different perspective, the order of intervals as they appear in the overtone series is also significant in several ways. As we have seen in this chapter, the most stable consonances are the U, 8ve, and P5 (the perfect consonances). The 8ve and 5th are represented by the first three partials in the overtone series. These partials thus define the most stable intervallic relationships in tonal music, and also, as we will see in chapters C, 1, and 2, the strongest tonal relationships in Western music, defined by pitches a 5th apart. The P4, also a perfect interval, appears as partial no. 4. All imperfect consonances, on the other hand, appear among partials 4-8. In other words, all the consonant intervals (including perfect and imperfect consonances, as well as the P4) can be found among the first eight partials in the series.