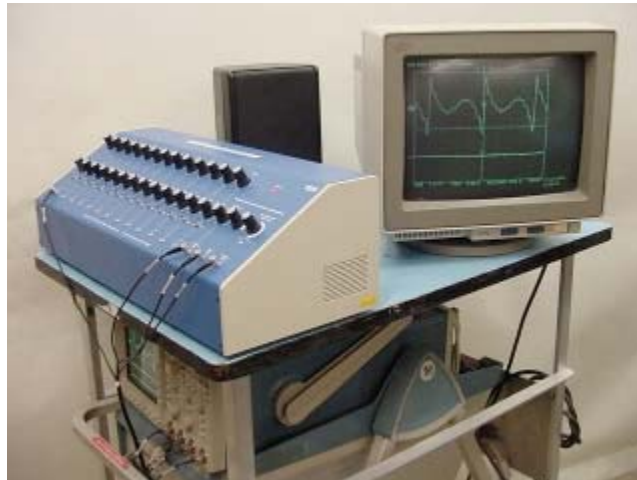


Answer #340

The answer is (c): The sound will remain at the same pitch but with a different timbre. This can be heard on an mpeg video, while you watch the first harmonic being removed, by clicking your mouse on the photograph below.



Although the tone quality of the sawtooth wave becomes much more "nasal" when the fundamental is removed, its pitch remains the same. This is due primarily to two effects:

1. *Difference tones*: Inasmuch as the sound of the sawtooth wave is *loud*, your ear mechanism creates a *difference tone* between each pair of adjacent harmonics, all of which are at the frequency of the fundamental. This is a *physical* phenomenon due to the non-linearities in the ear mechanism that converts the mechanical vibrations of the ear drum into the wave vibrations of the fluid in the middle ear. The difference tones are then part of the wave progressing along the basilar membrane, and are sensed in the basilar membrane as the frequency of the fundamental.

2. *Periodicity pitch*: When the ear senses all of the harmonics of the sawtooth wave, it associates these harmonics with their fundamental, and learns to identify the pitch of the complex wave with that of the fundamental, whether or not the fundamental is actually present.

Although the fundamental may or may not be present in varying degree in the actual wave, your ear senses the frequency of the wave as that of the fundamental in all cases. The change in the actual amplitude of the fundamental, from any source, creates a variation in the *timbre* of the wave.

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