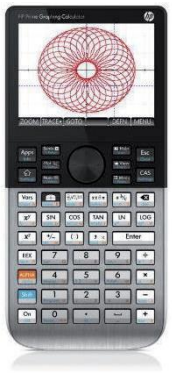
Sound Waves

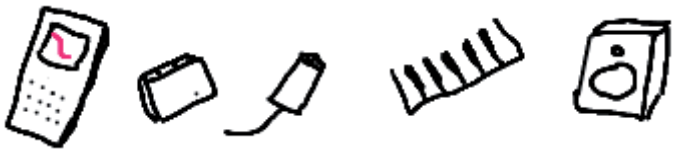
HP Prime



Duration: 1 hour

Objective: Characterise the type of a sinusoidal sound wave based on music played on a piano keyboard.

Equipment: HP Prime, StreamSmart, microphone, keyboard, loudspeaker



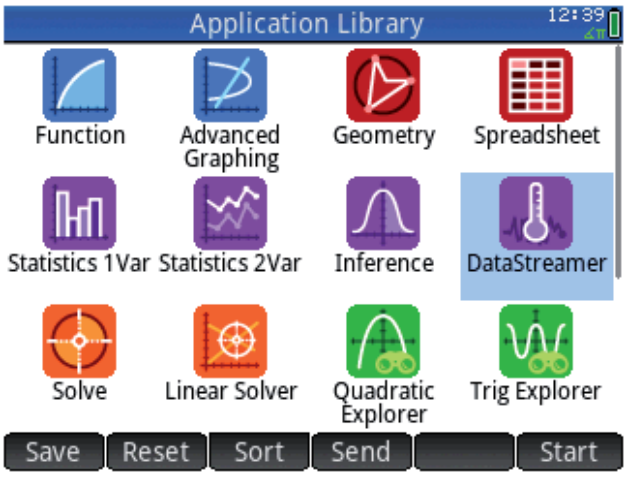
Task: Measure the period and calculate the frequency of the first seven notes played on a piano keyboard. Determine the type of the bass tone sound wave. You can use the Student Worksheet.

Step-by-step solution:

On the piano keyboard (if you have a computer with speakers you can use a virtual keyboard, which can be downloaded from the Web: http://www.bgfl.org/custom/resources_ftp/client_ftp/ks2/music/piano/) we will play the first 7 tones, and we record each tone using a microphone that is connected to the StreamSmart application.

When we press Start, the DataStreamer application will display a real-time audio recording done by a microphone.

Screenshots:



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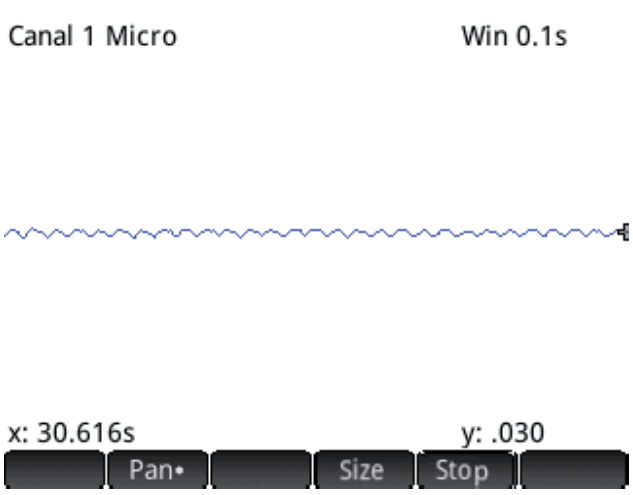
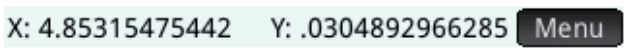
The picture opposite shows the first part of the recording of the first keyboard note.
The curve resembles a sinusoid.

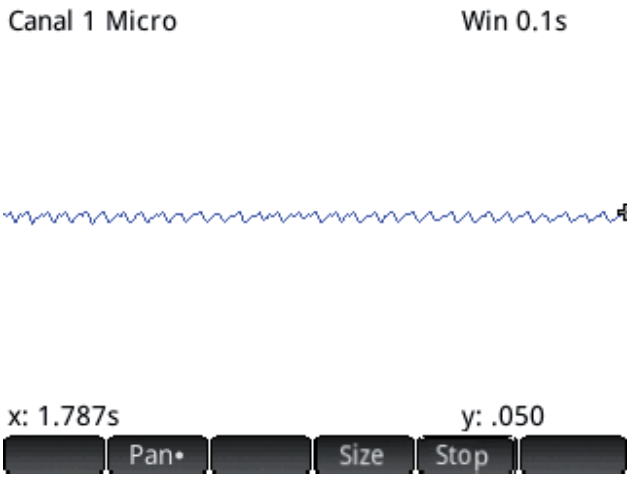


The sinusoidal curve is more apparent after export and zoom.
The sound wave from the piano spreads through the air between the speaker and the microphone. The wave is mechanical, gradual and periodic because the curve represents periodic function of time: The undulation repeats itself in equal intervals of time.



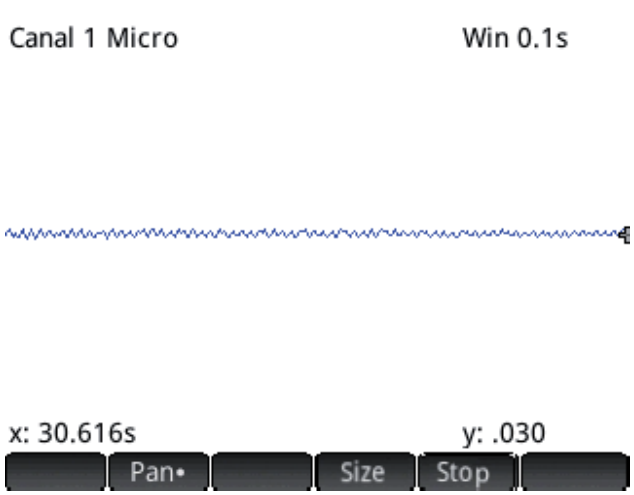
The frequency and period are related and this relationship can be expressed by the equation: $f = 1/T$.
We measure the period (a time interval between two peaks of the sinusoid): 0.015 s, representing a frequency of about 67 Hz. It means „C“ of the first octave.

In the following tone we observe a shorter period (sine curve segments are shorter): 0.0135 s, i.e., frequency of 74 Hz, which corresponds to the „D“ note of the first octave.

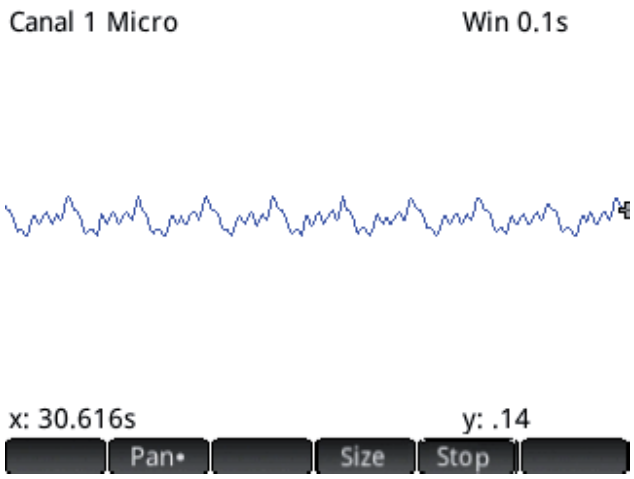


Low tones have a low frequency, while the high notes have a high frequency.

The tone frequency in the next octave is twice as big (e.g. „C“ of the second octave has frequency 2x67 = 134 Hz).
The opposite picture shows a curve, which we obtained by pressing the last keyboard key. The period is very short (very short sections of the sinusoid). The tone is very high.



When we look at the bass tone (we select DOUBLE BASS on the virtual keyboard), we get a curve which doesn‘t have a sinusoidal shape.
It contains several overtones.



Sound waves: Student Worksheet

HP Prime

Fill in the lines and the table below:
The shape of curves observed in the StreamSmart application:

Definition of periodic gradual mechanical waves:

Keyboard key	Period (s)	Frequency (Hz)	Musical tone
C			
D			
E			
F			
G			
A			
H			

Establish a link between the frequency and tone height (high or low):

Compare the frequency of the same note in the same octave, and the frequency of the same note one octave higher:
