

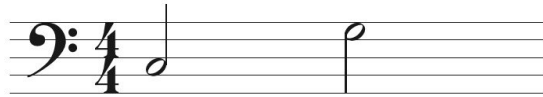
Tuning: A quick visit

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There are two kinds of tuning.

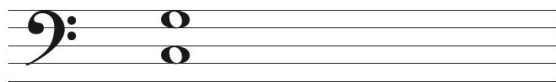
1. Linear Tuning

One note following another



2. Vertical Tuning

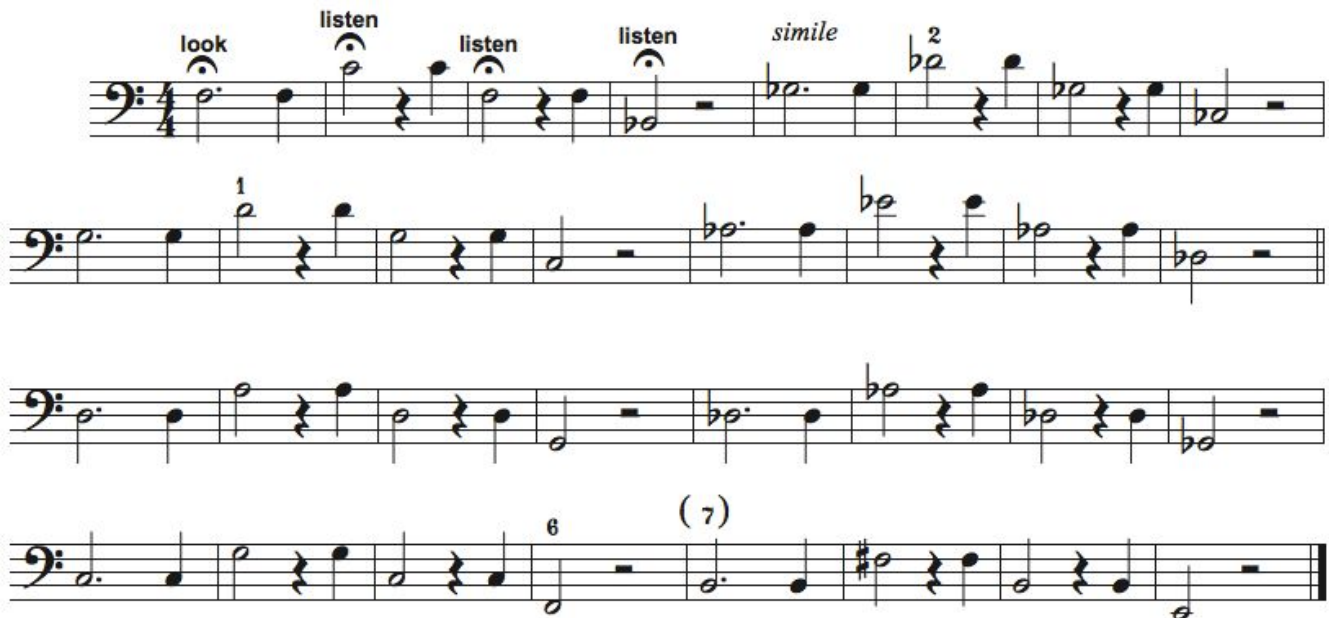
Two notes sounding together



Linear Tuning

Here's a useful exercise. When you see "look" check your pitch with a tuner. When you see "listen" close your eyes and use your ears before glancing at the tuner for confirmation.

Your ear is the tuner. The machine calibrates your ear.




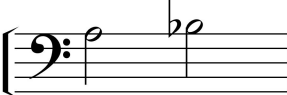
The exercise consists of four lines of music in bass clef, 4/4 time. The first line contains the following notes: G2 (quarter), A2 (quarter), B2 (quarter), C3 (quarter), D3 (quarter), E3 (quarter), F3 (quarter), G3 (quarter). Annotations above the notes are: "look" above G2, "listen" above A2, "listen" above B2, "listen" above C3, "simile" above D3, and "2" above E3. The second line contains: G3 (quarter), A3 (quarter), B3 (quarter), C4 (quarter), D4 (quarter), E4 (quarter), F4 (quarter), G4 (quarter). An annotation "1" is above the first G4. The third line contains: G4 (quarter), A4 (quarter), B4 (quarter), C5 (quarter), D5 (quarter), E5 (quarter), F5 (quarter), G5 (quarter). An annotation "2" is above the first G5. The fourth line contains: G5 (quarter), A5 (quarter), B5 (quarter), C6 (quarter), D6 (quarter), E6 (quarter), F6 (quarter), G6 (quarter). Annotations "6" and "(7)" are above the first G6 and A6 respectively.

Hertz, Cents and Beats

Hertz: *Hertz (Hz) = vibrations per second.* You may have heard the term ‘A 440.’ An object vibrating 440 times each second is vibrating at 440Hz and will sound the note ‘A’ above ‘middle C’ (C4).

Cents: Each 1/100 of a half step is a cent. If you are 20 cents sharp, you are 20/100 (or 1/5) of a half step sharp.

A change of one *100 cents* does not equal a change of one *100 Hertz*.
Look at this table:

Notation	Change (Hz)	Change (%)	Change (Cents)
	6.54 (110 – 116.54)	5.95%	100
	13.08 (220 – 233.08)	5.95%	100

Beats: When two notes are out of tune, you hear *beats* - that waving/pulsing quality of the two sound waves moving in and out of sync. The *closer* the notes get to a unison, the *slower* the beats sound. The “Grinders” exercises of Part One use slow glisses to help you listen for, and resolve, beats.

Pure intervals have beats of their own which are less obvious to the ear. Pick the right two notes, play them in tune and the beats can actually form a third note!

Perfect vs. Color Intervals

Perfect Intervals: Fourths, fifths and octaves. These intervals don’t change from major to minor keys. The table on the next page gives some examples.

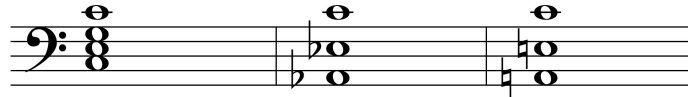
Color Intervals (Color Notes): Mostly thirds and sixths. These change from major to minor keys. The table on the next page gives some examples.

One should use the term “major third” but not “perfect third.” Conversely, one should refer to a “perfect fifth” but never a “major fifth.”

Equal vs. Just

Equal temperament: A compromise system in which all keys are the same but none are ideal. Most electronic tuners and midi devices use this system.

Just intonation: A system built on pure frequency ratios. For example, a just-tuned major third is built on a 5:4 ratio. Look at the three chords below...



Each of these chords has a C as the top note. In equal temperament, each C would be the same. In just intonation, each of these C's will be in a slightly different place to lock in those pure ratios. This table should help:

Interval	Ratio	Example	Top Note Adjustment
Octave	2:1		No change
Perfect 5 th	3:2		Up 2 cents (almost nothing)
Perfect 4 th	4:3		Down 2 cents (almost nothing)
Major 3 rd	5:4		Down 14 cents
Minor 3 rd	6:5		Up 16 cents
Major 6 th	5:3		Down 16 cents
Minor 6 th	8:5		Up 14 cents

Here's the same musical example with the adjustments needed for that C:

