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Quarter tone

A **quarter tone** (play) is a pitch halfway between the usual notes of a chromatic scale or an interval about half as wide (aurally, or logarithmically) as a semitone, which itself is half a whole tone. Quarter tones divide the octave by 50 cents each, and have 24 different pitches.

Quarter tones, or the **quarter-tone scale** (**24 equal temperament**), was proposed by 19th-century music theorists Heinrich Richter in 1823[1] and Mikha'il Mishaqah about 1840.[2] Composers who have written music using this scale include: Pierre Boulez, Julián Carrillo, Mildred Couper, George Enescu, Alberto Ginastera, Gérard Grisey, Alois Hába, Ljubica Marić, Charles Ives, Tristan Murail, Krzysztof Penderecki, Giacinto Scelsi, Ammar El Sherei, Karlheinz Stockhausen, Tui St. George Tucker, Ivan Alexandrovich Wyschnegradsky, and Iannis Xenakis. (See List of quarter tone pieces.)

Trumpet with 3 normal valves and a quartering on the extension valve (right)

Contents

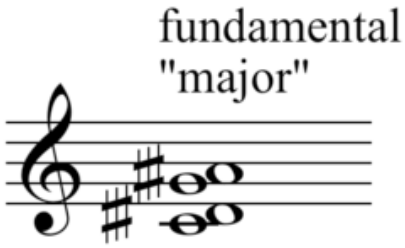
Types of quarter tones

The term *quarter tone* can refer to a number of different intervals, all very close in size. For example, some 17th- and 18th-century theorists used the term to describe the distance between a sharp and enharmonically distinct flat in mean-tone temperaments (e.g., D♯–E♭).[1] In the quarter-tone scale, also called **24-tone equal temperament** (24-TET), the quarter tone is 50 cents, or a frequency ratio of $\sqrt[24]{2}$ or approximately 1.0293, and divides the octave into 24 equal steps (equal temperament). In this scale the quarter tone is the smallest step. A semitone is thus made of two steps, and three steps make a **three-quarter tone** play or neutral second, half of a minor third. The 8-TET scale is composed of three-quarter tones (Play). Four steps make a whole tone play .

In just intonation the quarter tone can be represented by the septimal quarter tone, 36:35 (48.77 cents), or by the undecimal quarter tone, 33:32 (53.27 cents), approximately half the semitone of 16:15 or 25:24. The ratio of 36:35 is only 1.23 cents narrower than a 24-TET quarter tone. This just ratio is also the difference between

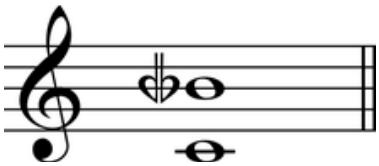
a minor third (6:5) and septimal minor third (7:6).

Quarter tones and intervals close to them also occur in a number of other equally tempered tuning systems. 22-TET contains an interval of 54.55 cents, slightly wider than a quarter-tone, whereas 53-TET has an interval of 45.28 cents, slightly smaller. 72-TET also has equally tempered quarter-tones, and indeed contains three quarter-tone scales, since 72 is divisible by 24. The smallest interval in 31 equal temperament (the "diesis" of 38.71 cents) is half a chromatic semitone, one-third of a diatonic semitone and one-fifth of a whole tone, so it may function as a quarter tone, a fifth-tone *or* a sixth-tone.



Composer Charles Ives chose the four-note chord above (C–D♯–G–A♯) as good possibility for a "fundamental" chord in the quarter-tone scale, akin not to the tonic but to the major chord of traditional tonality.[3] Play chord or Play scale

Composer Ben Johnston, to accommodate the just septimal quarter tone, uses a small "7" (𝍖) as an accidental to indicate a note is lowered 49 cents, or an upside down "∠" (𝍘) to indicate a note is raised 49 cents,[4] or a ratio of 36:35.[5] Johnston uses an upward and downward arrow to indicate a note is raised or lowered by a ratio of 33:32, or 53 cents.[5] The Maneri-Sims notation system designed for 72-et uses the accidentals 𝅀 and 𝅁 for a quarter tone (36:35 or 48.77 cents) up and down.



The "subminor seventh": B𝄬=A♯, 19 quarter tones. It approximates the harmonic seventh, B𝄞♭. Maneri-Sims notation: B𝅁♭

Playing quarter tones on musical instruments

Any tunable musical instrument can be used to perform quarter tones, if two players and two identical instruments, with one tuned a quarter tone higher, are used. As this requires neither a special instrument nor special techniques, much quarter toned music is written for pairs of pianos, violins, harps, etc. The retuning of the instrument, and then returning it to its former pitch, is easy for violins, harder for harps, and slow and relatively expensive for pianos.

The following deals with the ability of single instruments to produce quarter tones. In Western instruments, this means "in addition to the usual 12-tone system".

Because many musical instruments manufactured today (2018) are designed for the 12-tone scale, not all are usable for playing quarter tones. Sometimes special playing techniques must be used.

Quarter tone clarinet by Fritz Schüller

Conventional musical instruments that *cannot* play quarter tones (except by using special techniques—see below) include:

- Most standard or unmodified non-electronic keyboard instruments, such as pianos, organs, and accordions
- Fretted string instruments such as guitars, bass guitars, and ukuleles (though on these it is possible to play quarter tones by pitch-bending, with special tunings, or with customized necks)
- Pitched percussion instruments, if standard techniques are used, and if the instruments are not tunable
- Western wind instruments that use keys or valves
  - Woodwind instruments, such as clarinets, saxophones, flutes, and oboes (though with many of these, it is still possible using non-standard techniques such as special fingerings or by the player manipulating their embouchure, to play at least *some* quarter tones, if not a whole scale)

- Valved brass instruments (trumpet, tuba) (though, as with woodwinds, embouchure manipulation, as well as harmonic tones that fall closer to quarter-tones than half-tones, make quarter-tone scales possible; the horn technique of adjusting pitch with the right hand in the bell makes this instrument an exception)

Conventional musical instruments that *can* play quarter tones include

- Electronic instruments:
  - Synthesizers, using either special keyboard controllers or continuous-pitch controllers such as fingerboard controllers, or when controlled by a sequencer capable of outputting quarter-tone control signals.
  - Theremins and other continuously pitched instruments
- Fretless string instruments, such as the violin family, fretless guitars, fretless electric basses, ouds, and members of the huqin family of instruments.
- String instruments with movable frets (such as the sitar)
- Specially fretted string instruments (such as the Turkish bağlama).
- Fretted string instruments specially tuned to quarter tones
- Pedal steel guitar
- Wind instruments whose main means of tone-control is a slide, such as trombones, the tromboon invented by P. D. Q. Bach, the slide trumpet and the slide whistle
- Specially keyed woodwind instruments. A quarter tone clarinet was built by Fritz Schüller (1883–1977) of Markneukirchen, and a quarter tone mechanism for flutes by Eva Kingma.
- Valved brass instruments with extra, quarter-tone valves, and natural brass instruments that play through the 11th and 13th partials of the harmonic series
- Kazoo
- Pitched percussion instruments, when tuning permits (e.g., timpani), or using special techniques

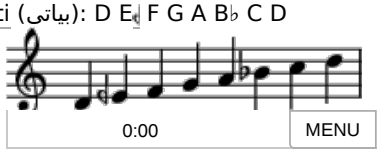
Other instruments can be used to play quarter tones when using audio signal processing effects such as pitch shifting.

Quarter-tone pianos have been built, which consist essentially of two pianos with two keyboards stacked one above the other in a single case, one tuned a quarter tone higher than the other.

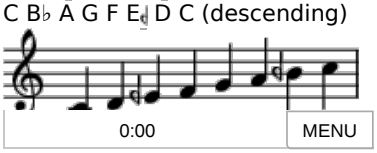
Music of the Middle East

Many Persian dastgah and Arabic *maqamat* contain intervals of three-quarter tone size; a short list of these follows.[6]

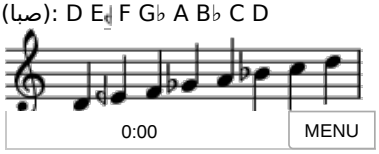
1. Bayati (بیاتی): D E𝄳 F G A B♭ C D



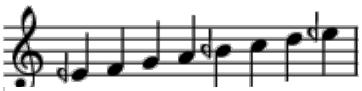
2. Rast (راست):
   C D E𝄳 F G A B𝄳 C (ascending)
   C B♭ A G F E𝄳 D C (descending)



3. Saba (صبا): D E𝄳 F G♭ A B♭ C D



4. Sigah (سه گاه): E𝄳 F G A B𝄳 C D E𝄳



5. ‘Ajam (عجم)
6. Hoseyni

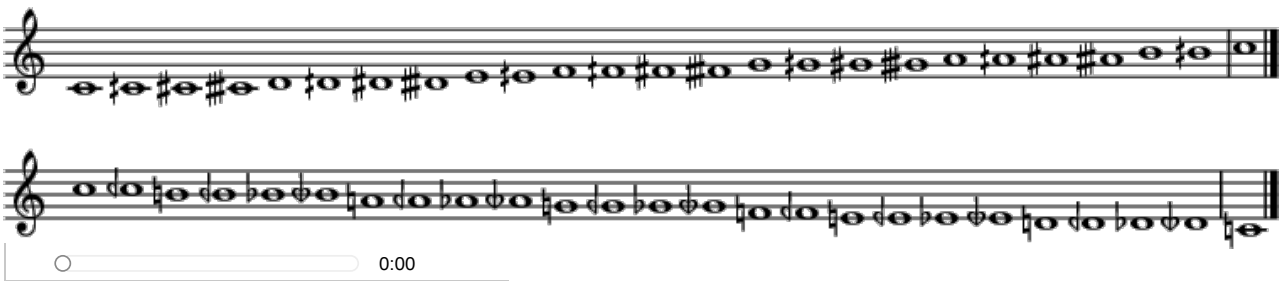
The Islamic philosopher and scientist Al-Farabi described a number of intervals in his work in music, including a number of quarter tones.

Assyrian/Syriac Church Music Scale:[7]

1. Qadmoyo (Bayati)
2. Trayono (Hussayni)
3. Tlithoyo (Segah)
4. Rbiʿoyo (Rast)
5. Hmishoyo
6. Shtithoyo (ʿAjam)
7. Shbiʿoyo
8. Tminoyo

Quarter tone scale

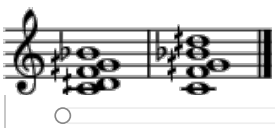
Known as *gadwal* in Arabic,[8] the **quarter tone scale** was developed in the Middle East in the eighteenth century and many of the first detailed writings in the nineteenth century Syria describe the scale as being of 24 equal tones.[9] The invention of the scale is attributed to Mikhail Mishaqa whose work *Essay on the Art of Music for the Emir Shihāb (al-Risāla al-shihābiyya fi 'l-ṣināʿa al-mūsīqiyya)* is devoted to the topic but also makes clear his teacher Sheikh Muhammad al-Attar (1764–1828) was one of many already familiar with the concept.[10]



The quarter tone scale may be primarily a theoretical construct in Arabic music. The quarter tone gives musicians a "conceptual map" they can use to discuss and compare intervals by number of quarter tones, and this may be one of the reasons it accompanies a renewed interest in theory, with instruction in music theory a mainstream requirement since that period.[9]

Previously, pitches of a mode were chosen from a scale consisting of seventeen tones, developed by Safi al-Din al-Urmawi in the thirteenth century.[10]

Composer Charles Ives chose the chord C–D♯–F–G♯–B♭ as good possibility for a "secondary" chord in the quarter-tone scale, akin to the minor chord of traditional tonality. He considered that it may be built upon any degree of the quarter tone scale[3] Here is the secondary "minor" and its "first inversion":

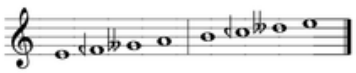


In popular music

The Japanese multi-instrumentalist and experimental musical instrument builder Yuichi Onoue developed a 24-TET quarter tone tuning on his guitar.[11] Several quarter-tone albums have been recorded by Jute Gyte, a one-man avantgarde black metal band from Missouri, USA.[12][13] Another quartertone metal album was issued by the Swedish band Massive Audio Nerve.[14] Australian psychedelic rock band King Gizzard & the Lizard Wizard's album *Flying Microtonal Banana* heavily emphasizes quarter-tones.

Ancient Greek tetrachords

The enharmonic genus of the Greek tetrachord consisted of a ditone or an approximate major third, and a semitone, which was divided into two microtones. Aristoxenos, Didymos and others presented the semitone as being divided into two approximate quarter tone intervals of about the same size, while other ancient Greek theorists described the microtones resulting from dividing the semitone of the enharmonic genus as unequal in size (i.e., one smaller than a quarter tone and one larger).[15][16]



Greek Dorian enharmonic genus: two disjunct tetrachords each of a quarter tone, quarter tone, and major third. Play

Interval size in equal temperament

Here are the sizes of some common intervals in a 24-note equally tempered scale, with the interval names proposed by Alois Hába (neutral third, etc.) and Ivan Wyschnegradsky (major fourth, etc.):

interval name	size (steps)	size (cents)	midi	just ratio	just (cents)	midi	error (cents)
octave	24	1200	play	2:1	1200.00	play	0.00
semidiminished octave	23	1150	play	35:18	1151.23	play	− 1.23
supermajor seventh	23	1150	play	27:14	1137.04	play	+12.96
major seventh	22	1100	play	15:8	1088.27	play	+11.73
neutral seventh, major tone	21	1050	play	11:6	1049.36	play	+ 0.64
neutral seventh, minor tone	21	1050	play	20:11	1035.00	play	+15.00
large just minor seventh	20	1000	play	9:5	1017.60	play	−17.60
small just minor seventh	20	1000	play	16:9	996.09	play	+ 3.91
supermajor sixth/subminor seventh	19	950	play	7:4	968.83	play	−18.83
major sixth	18	900	play	5:3	884.36	play	+15.64
neutral sixth	17	850	play	18:11	852.59	play	− 2.59
minor sixth	16	800	play	8:5	813.69	play	−13.69
subminor sixth	15	750	play	14:9	764.92	play	−14.92
perfect fifth	14	700	play	3:2	701.96	play	− 1.96
minor fifth	13	650	play	16:11	648.68	play	+ 1.32
lesser septimal tritone	12	600	play	7:5	582.51	play	+17.49
major fourth	11	550	play	11:8	551.32	play	− 1.32
perfect fourth	10	500	play	4:3	498.04	play	+ 1.96
tridecimal major third	9	450	play	13:10	454.21	play	− 4.21
septimal major third	9	450	play	9:7	435.08	play	+14.92
major third	8	400	play	5:4	386.31	play	+13.69
undecimal neutral third	7	350	play	11:9	347.41	play	+ 2.59
minor third	6	300	play	6:5	315.64	play	−15.64
septimal minor third	5	250	play	7:6	266.87	play	−16.87
tridecimal five-quarter tone	5	250	play	15:13	247.74	play	+ 2.26
septimal whole tone	5	250	play	8:7	231.17	play	+18.83
major second, major tone	4	200	play	9:8	203.91	play	− 3.91
major second, minor tone	4	200	play	10:9	182.40	play	+17.60
neutral second, greater undecimal	3	150	play	11:10	165.00	play	−15.00
neutral second, lesser undecimal	3	150	play	12:11	150.64	play	− 0.64
15:14 semitone	2	100	play	15:14	119.44	play	−19.44
diatonic semitone, just	2	100	play	16:15	111.73	play	−11.73
21:20 semitone	2	100	play	21:20	84.47	play	+15.53

28:27 semitone	1	50	play	28:27	62.96	play	−12.96
33:32 semitone	1	50	play	33:32	53.27	play	−3.27
unison	0	0	play	1:1	0.00	play	0.00

Moving from 12-TET to 24-TET allows the better approximation of a number of intervals. Intervals matched particularly closely include the neutral second, neutral third, and (11:8) ratio, or the 11th harmonic. The septimal minor third and septimal major third are approximated rather poorly; the (13:10) and (15:13) ratios, involving the 13th harmonic, are matched very closely. Overall, 24-TET can be viewed as matching the 11th and 13th harmonics more closely than the 7th.

See also

- Musical temperament
- List of quarter tone pieces
- List of meantone intervals

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External links

- "quarter-tone / 24-edo (http://www.tonalsoft.com/enc/q/quarter-tone.aspx)", *TonalSoft.com*.