# Chromatic scale: 12 equal frequency ratios of $2^{(1/12)}$ ["equal temperament"]
## = 12 "semitones" (12s) or "half-steps" = 6 "tones" (6t) or "whole steps"
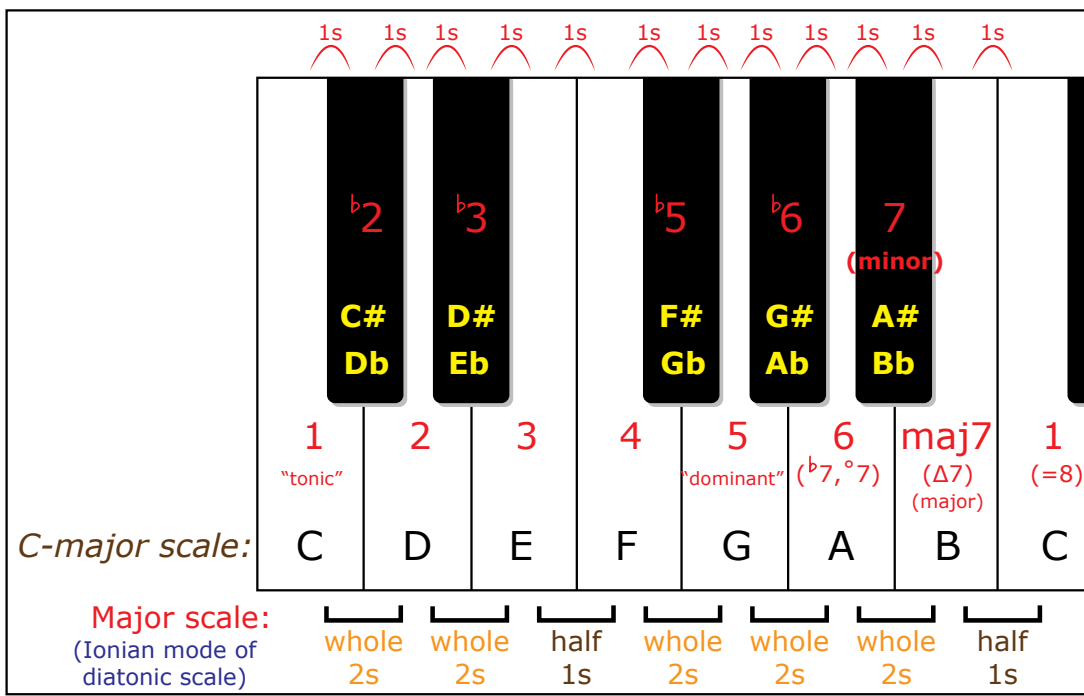


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**Interval = pitch ratio = number of semitones:**
- second (2) = 2 semitones = 1 whole step [examples: C–D, E–F♯]
- minor third (♭3, m3) = 3 semitones [examples: C–E♭, E–G]
- (major) third (3) = 4 semitones = 2 whole steps [examples: C–E, A–C♯]
- fourth (4) = 5 semitones [example: C–F, E–A, F–B♭]
- fifth (5) = 7 semitones [examples: C–G, D–A, B–F♯]
- sixth (6) = 9 semitones [example: C–A]
- (minor) seventh (7) = 10 semitones [examples: C–B♭, D–C]
- major seventh (maj7, Δ7) = 11 semitones [examples: C–B, D–C♯]
- diminished interval N (–N, °N, Ndim): *subtract one semitone*
- augmented interval N (+N): *add one semitone*

**Chord = 2+ intervals starting at "root" of chord**
- major = 3 and ♭3 [e.g. 1–3–5, C = C–E–G, D = D–F♯–A]
- minor = ♭3 and 3 [e.g. 1–♭3–5, Cm = C–E♭–G, Am = A–C–E]
- (dominant) seventh = 3 and ♭3 and ♭3 [e.g. 1–3–5–7, C7 = C–E–G–B♭, G7 = G–B–D–F]
- minor seventh = ♭3 and 3 and ♭3 [e.g. 1–♭3–5–7, Cm7 = C–E♭–G–B♭, Dm7 = D–F–A–C]
- major seventh = 3 and ♭3 and 3 [e.g. 1–3–5–maj7, Cmaj7 = C–E–G–B, Dmaj7 = G–B–D–F♯]
- ninth = 3 and ♭3 and ♭3 and 3 [ e.g. 1–3–5–7–1(=9), G9 = G–B–D–F–A]
- augmented = 3 and 3 [e.g. 1–3–♯5, C+ = C–E–G♯, E+ = E–G♯–C, G♯+ = G♯–C–E]
- diminished = ♭3 and ♭3 [e.g. 1–♭3–♭5, C– = Cdim = C–E♭–G♭]
- diminished seventh = ♭3 and ♭3 and ♭3 [e.g. 1–♭3–♭5–♭7(=6), Cdim7 = C–E♭–G♭–A, Adim7 = A–C–E♭–G♭]

Changing the root of a chord X: X/R means play X with R on the bottom. e.g. C/E = E–G–C–... (= inversion of C)]

Transposition = shift all pitches by same interval [ e.g. transposing down by 4th gives F→C, B♭→F, ...]

# Standard Guitar tuning: E

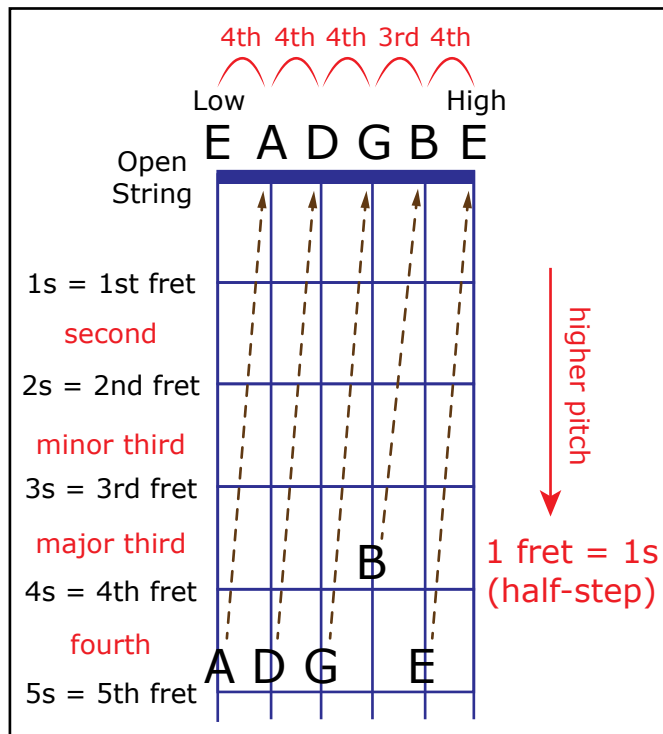This image has been removed due to copyright restrictions.
Please see the image on page http://www.guitarnoise.com/images/features/guitar-tuning-pegs.jpg

4th 4th 4th 3rd 4th

Low    High
E A D G B E

Open String

1s = 1st fret
second
2s = 2nd fret
minor third
3s = 3rd fret
major third
4s = 4th fret
fourth
5s = 5th fret

B

A D G    E

higher pitch

1 fret = 1s (half-step)

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o = strum the "open" string

x = do not strum! (or mute by touching)

## Em chord diagram:

o       o  o  o

1
2   ②   ③
3
4
5

E  B  E  G  B  E
1  5  1  ♭3 5  1

Compare: ♭3 to 3!

## E (major) chord:

o          o  o

1              ①
2   ②   ③
3
4
5

E  B  E  G♯  B  E
1  5  1  3   5  1

fingering ("voicing") is not unique! *another* Em chord:

x  x  x

starts on 7th fret!  ⑦           ①
8                 ②
9            ③
10
11

E  G  B

finger numbering:

2
3     1
4
T

a few more simple chords:

o  o  o

1
2      ②
3  ③            ④
4
5
G chord

G  B  D  G  B  G

x        o     o

1              ①
2      ②
3  ③
4
5
C chord

C  E  G  C  E

x  x  o

1
2      ①     ②
3         ③
4
5
D chord

D  A  D  F♯

x  x  o

1              ①
2      ②     ③
3
4
5
D7 chord

D  A  C  F♯

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18.303 Linear Partial Differential Equations: Analysis and Numerics
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