

Tuning Four Pitches

Most modern keyboard instruments and electronic tuners are tuned to what is called "equal temperament." This means that each half step is exactly equal to one twelfth of an octave. This is perhaps the best compromise for instruments (like pianos and organs) that cannot adjust their pitch on the fly. However, instruments which are capable of adjusting their pitch on the fly are capable of what is called "just intonation." Just intonation is a tuning system where we attempt to align each of the pitches of a chord to a partial in the harmonic series. This will result in a harmony that sounds more stable, rich, and intense. However, tuning justly requires some harmonic analysis and careful listening. The chart below shows us how to justly tune various common seventh chords.

Lower, Middle and Upper ET interval lists the size of the two component intervals in a given equally tempered (ET) seventh chord in semitones measured from the lower middle, upper middle, and upper pitch to the lowest pitch in a given seventh chord.

Lower, Lower Middle, Upper Middle, and Upper partial shows to which partials of a harmonic series to which we might tune each pitch in our ET seventh chord to achieve just intonation.

Lower, Middle, and Upper Just interval shows how to retune the Lower, Middle, and Upper ET intervals to tune the seventh chord justly to this combination of partials.

Lower, Middle, and Upper Adjustment measures how far to adjust the Lower and Upper ET intervals in cents (1 cent is 1/100th of a semitone) to achieve this just intonation.

Just Intonation for Common Seventh Chords

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
1	2	3	17	18	19	20	0.990	1.926	2.814	-1.05	-7.44	-18.64
1	2	3	16	17	18	19	1.050	2.039	2.975	4.96	3.91	-2.49
1	2	3	15	16	17	18	1.117	2.167	3.156	11.73	16.69	15.64
1	2	3	14	15	16	17	1.194	2.312	3.361	19.44	31.17	36.13
1	2	4	16	17	18	20	1.050	2.039	3.863	4.96	3.91	-13.69
1	2	4	15	16	17	19	1.117	2.167	4.092	11.73	16.69	9.24
1	2	4	14	15	16	18	1.194	2.312	4.351	19.44	31.17	35.08
1	2	4	13	14	15	16	1.283	2.477	3.595	28.30	47.74	-40.53
1	2	5	15	16	17	20	1.117	2.167	4.980	11.73	16.69	-1.96
1	2	5	14	15	16	19	1.194	2.312	5.287	19.44	31.17	28.69
1	2	5	13	14	15	17	1.283	2.477	4.644	28.30	47.74	-35.57
1	2	6	14	15	16	20	1.194	2.312	6.175	19.44	31.17	17.49
1	2	6	13	14	15	18	1.283	2.477	5.634	28.30	47.74	-36.62
1	2	7	13	14	15	19	1.283	2.477	6.570	28.30	47.74	-43.01
1	2	7	13	14	15	20	1.283	2.477	7.458	28.30	47.74	45.79
1	3	4	16	17	19	20	1.050	2.975	3.863	4.96	-2.49	-13.69
1	3	4	15	16	18	19	1.117	3.156	4.092	11.73	15.64	9.24
1	3	4	14	15	17	18	1.194	3.361	4.351	19.44	36.13	35.08
1	3	4	12	13	14	15	1.386	2.669	3.863	38.57	-33.13	-13.69
1	3	5	15	16	18	20	1.117	3.156	4.980	11.73	15.64	-1.96
1	3	5	14	15	17	19	1.194	3.361	5.287	19.44	36.13	28.69

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
1	3	5	12	13	14	16	1.386	2.669	4.980	38.57	-33.13	-1.96
1	3	6	14	15	17	20	1.194	3.361	6.175	19.44	36.13	17.49
1	3	6	12	13	14	17	1.386	2.669	6.030	38.57	-33.13	3.00
1	3	7	12	13	14	18	1.386	2.669	7.020	38.57	-33.13	1.96
1	3	8	12	13	14	19	1.386	2.669	7.956	38.57	-33.13	-4.44
1	3	9	12	13	14	20	1.386	2.669	8.844	38.57	-33.13	-15.64
1	4	5	15	16	19	20	1.117	4.092	4.980	11.73	9.24	-1.96
1	4	5	14	15	18	19	1.194	4.351	5.287	19.44	35.08	28.69
1	4	5	13	14	16	17	1.283	3.595	4.644	28.30	-40.53	-35.57
1	4	5	12	13	15	16	1.386	3.863	4.980	38.57	-13.69	-1.96
1	4	6	14	15	18	20	1.194	4.351	6.175	19.44	35.08	17.49
1	4	6	13	14	16	18	1.283	3.595	5.634	28.30	-40.53	-36.62
1	4	6	12	13	15	17	1.386	3.863	6.030	38.57	-13.69	3.00
1	4	7	13	14	16	19	1.283	3.595	6.570	28.30	-40.53	-43.01
1	4	7	13	14	16	20	1.283	3.595	7.458	28.30	-40.53	45.79
1	4	7	12	13	15	18	1.386	3.863	7.020	38.57	-13.69	1.96
1	4	8	12	13	15	19	1.386	3.863	7.956	38.57	-13.69	-4.44
1	4	9	12	13	15	20	1.386	3.863	8.844	38.57	-13.69	-15.64
1	5	6	14	15	19	20	1.194	5.287	6.175	19.44	28.69	17.49
1	5	6	13	14	17	18	1.283	4.644	5.634	28.30	-35.57	-36.62
1	5	6	12	13	16	17	1.386	4.980	6.030	38.57	-1.96	3.00
1	5	7	13	14	17	19	1.283	4.644	6.570	28.30	-35.57	-43.01
1	5	7	13	14	17	20	1.283	4.644	7.458	28.30	-35.57	45.79
1	5	7	12	13	16	18	1.386	4.980	7.020	38.57	-1.96	1.96
1	5	8	12	13	16	19	1.386	4.980	7.956	38.57	-1.96	-4.44
1	5	9	12	13	16	20	1.386	4.980	8.844	38.57	-1.96	-15.64
1	6	7	13	14	18	19	1.283	5.634	6.570	28.30	-36.62	-43.01
1	6	7	13	14	18	20	1.283	5.634	7.458	28.30	-36.62	45.79
1	6	7	12	13	17	18	1.386	6.030	7.020	38.57	3.00	1.96
1	6	8	12	13	17	19	1.386	6.030	7.956	38.57	3.00	-4.44
1	6	9	12	13	17	20	1.386	6.030	8.844	38.57	3.00	-15.64
1	7	7	13	14	19	20	1.283	6.570	7.458	28.30	-43.01	45.79
1	7	8	12	13	18	19	1.386	7.020	7.956	38.57	1.96	-4.44
1	7	9	12	13	18	20	1.386	7.020	8.844	38.57	1.96	-15.64
1	8	9	12	13	19	20	1.386	7.956	8.844	38.57	-4.44	-15.64
2	3	4	11	12	13	14	1.506	2.892	4.175	-49.36	-10.79	17.51
2	3	4	16	18	19	20	2.039	2.975	3.863	3.91	-2.49	-13.69
2	3	4	15	17	18	19	2.167	3.156	4.092	16.69	15.64	9.24
2	3	4	14	16	17	18	2.312	3.361	4.351	31.17	36.13	35.08
2	3	5	11	12	13	15	1.506	2.892	5.370	-49.36	-10.79	36.95

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
2	3	5	10	11	12	13	1.650	3.156	4.542	-35.00	15.64	-45.79
2	3	5	9	10	11	12	1.824	3.474	4.980	-17.60	47.41	-1.96
2	3	5	15	17	18	20	2.167	3.156	4.980	16.69	15.64	-1.96
2	3	5	14	16	17	19	2.312	3.361	5.287	31.17	36.13	28.69
2	3	6	11	12	13	16	1.506	2.892	6.487	-49.36	-10.79	48.68
2	3	6	10	11	12	14	1.650	3.156	5.825	-35.00	15.64	-17.49
2	3	6	9	10	11	13	1.824	3.474	6.366	-17.60	47.41	36.62
2	3	6	14	16	17	20	2.312	3.361	6.175	31.17	36.13	17.49
2	3	7	10	11	12	15	1.650	3.156	7.020	-35.00	15.64	1.96
2	3	8	11	12	13	17	1.506	2.892	7.536	-49.36	-10.79	-46.36
2	3	8	10	11	12	16	1.650	3.156	8.137	-35.00	15.64	13.69
2	3	8	9	10	11	14	1.824	3.474	7.649	-17.60	47.41	-35.08
2	3	9	11	12	13	18	1.506	2.892	8.526	-49.36	-10.79	-47.41
2	3	9	11	12	13	19	1.506	2.892	9.462	-49.36	-10.79	46.20
2	3	9	10	11	12	17	1.650	3.156	9.186	-35.00	15.64	18.64
2	3	9	9	10	11	15	1.824	3.474	8.844	-17.60	47.41	-15.64
2	3	10	11	12	13	20	1.506	2.892	10.350	-49.36	-10.79	35.00
2	3	10	10	11	12	18	1.650	3.156	10.176	-35.00	15.64	17.60
2	3	10	9	10	11	16	1.824	3.474	9.961	-17.60	47.41	-3.91
2	3	11	10	11	12	19	1.650	3.156	11.112	-35.00	15.64	11.20
2	3	11	9	10	11	17	1.824	3.474	11.010	-17.60	47.41	1.05
2	4	5	11	12	14	15	1.506	4.175	5.370	-49.36	17.51	36.95
2	4	5	15	17	19	20	2.167	4.092	4.980	16.69	9.24	-1.96
2	4	5	14	16	18	19	2.312	4.351	5.287	31.17	35.08	28.69
2	4	5	13	15	16	17	2.477	3.595	4.644	47.74	-40.53	-35.57
2	4	6	11	12	14	16	1.506	4.175	6.487	-49.36	17.51	48.68
2	4	6	8	9	10	11	2.039	3.863	5.513	3.91	-13.69	-48.68
2	4	6	7	8	9	10	2.312	4.351	6.175	31.17	35.08	17.49
2	4	6	13	15	16	18	2.477	3.595	5.634	47.74	-40.53	-36.62
2	4	7	8	9	10	12	2.039	3.863	7.020	3.91	-13.69	1.96
2	4	7	13	15	16	19	2.477	3.595	6.570	47.74	-40.53	-43.01
2	4	7	13	15	16	20	2.477	3.595	7.458	47.74	-40.53	45.79
2	4	8	11	12	14	17	1.506	4.175	7.536	-49.36	17.51	-46.36
2	4	8	8	9	10	13	2.039	3.863	8.405	3.91	-13.69	40.53
2	4	8	7	8	9	11	2.312	4.351	7.825	31.17	35.08	-17.51
2	4	9	11	12	14	18	1.506	4.175	8.526	-49.36	17.51	-47.41
2	4	9	11	12	14	19	1.506	4.175	9.462	-49.36	17.51	46.20
2	4	9	7	8	9	12	2.312	4.351	9.331	31.17	35.08	33.13
2	4	10	11	12	14	20	1.506	4.175	10.350	-49.36	17.51	35.00
2	4	10	8	9	10	14	2.039	3.863	9.688	3.91	-13.69	-31.17

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
2	4	11	8	9	10	15	2.039	3.863	10.883	3.91	-13.69	-11.73
2	4	11	7	8	9	13	2.312	4.351	10.717	31.17	35.08	-28.30
2	5	6	11	12	15	16	1.506	5.370	6.487	-49.36	36.95	48.68
2	5	6	10	11	13	14	1.650	4.542	5.825	-35.00	-45.79	-17.49
2	5	6	9	10	12	13	1.824	4.980	6.366	-17.60	-1.96	36.62
2	5	6	14	16	19	20	2.312	5.287	6.175	31.17	28.69	17.49
2	5	6	13	15	17	18	2.477	4.644	5.634	47.74	-35.57	-36.62
2	5	7	10	11	13	15	1.650	4.542	7.020	-35.00	-45.79	1.96
2	5	7	13	15	17	19	2.477	4.644	6.570	47.74	-35.57	-43.01
2	5	7	13	15	17	20	2.477	4.644	7.458	47.74	-35.57	45.79
2	5	8	11	12	15	17	1.506	5.370	7.536	-49.36	36.95	-46.36
2	5	8	10	11	13	16	1.650	4.542	8.137	-35.00	-45.79	13.69
2	5	8	9	10	12	14	1.824	4.980	7.649	-17.60	-1.96	-35.08
2	5	9	11	12	15	18	1.506	5.370	8.526	-49.36	36.95	-47.41
2	5	9	11	12	15	19	1.506	5.370	9.462	-49.36	36.95	46.20
2	5	9	10	11	13	17	1.650	4.542	9.186	-35.00	-45.79	18.64
2	5	9	9	10	12	15	1.824	4.980	8.844	-17.60	-1.96	-15.64
2	5	10	11	12	15	20	1.506	5.370	10.350	-49.36	36.95	35.00
2	5	10	10	11	13	18	1.650	4.542	10.176	-35.00	-45.79	17.60
2	5	10	9	10	12	16	1.824	4.980	9.961	-17.60	-1.96	-3.91
2	5	11	10	11	13	19	1.650	4.542	11.112	-35.00	-45.79	11.20
2	5	11	9	10	12	17	1.824	4.980	11.010	-17.60	-1.96	1.05
2	6	7	10	11	14	15	1.650	5.825	7.020	-35.00	-17.49	1.96
2	6	7	8	9	11	12	2.039	5.513	7.020	3.91	-48.68	1.96
2	6	7	13	15	18	19	2.477	5.634	6.570	47.74	-36.62	-43.01
2	6	7	13	15	18	20	2.477	5.634	7.458	47.74	-36.62	45.79
2	6	8	11	12	16	17	1.506	6.487	7.536	-49.36	48.68	-46.36
2	6	8	10	11	14	16	1.650	5.825	8.137	-35.00	-17.49	13.69
2	6	8	9	10	13	14	1.824	6.366	7.649	-17.60	36.62	-35.08
2	6	8	8	9	11	13	2.039	5.513	8.405	3.91	-48.68	40.53
2	6	8	7	8	10	11	2.312	6.175	7.825	31.17	17.49	-17.51
2	6	9	11	12	16	18	1.506	6.487	8.526	-49.36	48.68	-47.41
2	6	9	11	12	16	19	1.506	6.487	9.462	-49.36	48.68	46.20
2	6	9	10	11	14	17	1.650	5.825	9.186	-35.00	-17.49	18.64
2	6	9	9	10	13	15	1.824	6.366	8.844	-17.60	36.62	-15.64
2	6	9	7	8	10	12	2.312	6.175	9.331	31.17	17.49	33.13
2	6	10	11	12	16	20	1.506	6.487	10.350	-49.36	48.68	35.00
2	6	10	10	11	14	18	1.650	5.825	10.176	-35.00	-17.49	17.60
2	6	10	9	10	13	16	1.824	6.366	9.961	-17.60	36.62	-3.91
2	6	10	8	9	11	14	2.039	5.513	9.688	3.91	-48.68	-31.17

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
2	6	11	10	11	14	19	1.650	5.825	11.112	-35.00	-17.49	11.20
2	6	11	9	10	13	17	1.824	6.366	11.010	-17.60	36.62	1.05
2	6	11	8	9	11	15	2.039	5.513	10.883	3.91	-48.68	-11.73
2	6	11	7	8	10	13	2.312	6.175	10.717	31.17	17.49	-28.30
2	7	7	13	15	19	20	2.477	6.570	7.458	47.74	-43.01	45.79
2	7	8	10	11	15	16	1.650	7.020	8.137	-35.00	1.96	13.69
2	7	8	8	9	12	13	2.039	7.020	8.405	3.91	1.96	40.53
2	7	9	10	11	15	17	1.650	7.020	9.186	-35.00	1.96	18.64
2	7	10	10	11	15	18	1.650	7.020	10.176	-35.00	1.96	17.60
2	7	10	8	9	12	14	2.039	7.020	9.688	3.91	1.96	-31.17
2	7	11	10	11	15	19	1.650	7.020	11.112	-35.00	1.96	11.20
2	7	11	8	9	12	15	2.039	7.020	10.883	3.91	1.96	-11.73
2	8	9	11	12	17	18	1.506	7.536	8.526	-49.36	-46.36	-47.41
2	8	9	11	12	17	19	1.506	7.536	9.462	-49.36	-46.36	46.20
2	8	9	10	11	16	17	1.650	8.137	9.186	-35.00	13.69	18.64
2	8	9	9	10	14	15	1.824	7.649	8.844	-17.60	-35.08	-15.64
2	8	9	7	8	11	12	2.312	7.825	9.331	31.17	-17.51	33.13
2	8	10	11	12	17	20	1.506	7.536	10.350	-49.36	-46.36	35.00
2	8	10	10	11	16	18	1.650	8.137	10.176	-35.00	13.69	17.60
2	8	10	9	10	14	16	1.824	7.649	9.961	-17.60	-35.08	-3.91
2	8	10	8	9	13	14	2.039	8.405	9.688	3.91	40.53	-31.17
2	8	11	10	11	16	19	1.650	8.137	11.112	-35.00	13.69	11.20
2	8	11	9	10	14	17	1.824	7.649	11.010	-17.60	-35.08	1.05
2	8	11	8	9	13	15	2.039	8.405	10.883	3.91	40.53	-11.73
2	8	11	7	8	11	13	2.312	7.825	10.717	31.17	-17.51	-28.30
2	9	9	11	12	18	19	1.506	8.526	9.462	-49.36	-47.41	46.20
2	9	10	11	12	18	20	1.506	8.526	10.350	-49.36	-47.41	35.00
2	9	10	11	12	19	20	1.506	9.462	10.350	-49.36	46.20	35.00
2	9	10	10	11	17	18	1.650	9.186	10.176	-35.00	18.64	17.60
2	9	10	9	10	15	16	1.824	8.844	9.961	-17.60	-15.64	-3.91
2	9	11	10	11	17	19	1.650	9.186	11.112	-35.00	18.64	11.20
2	9	11	9	10	15	17	1.824	8.844	11.010	-17.60	-15.64	1.05
2	9	11	7	8	12	13	2.312	9.331	10.717	31.17	33.13	-28.30
2	10	11	10	11	18	19	1.650	10.176	11.112	-35.00	17.60	11.20
2	10	11	9	10	16	17	1.824	9.961	11.010	-17.60	-3.91	1.05
2	10	11	8	9	14	15	2.039	9.688	10.883	3.91	-31.17	-11.73
3	4	5	12	14	15	16	2.669	3.863	4.980	-33.13	-13.69	-1.96
3	4	5	11	13	14	15	2.892	4.175	5.370	-10.79	17.51	36.95
3	4	5	15	18	19	20	3.156	4.092	4.980	15.64	9.24	-1.96
3	4	5	14	17	18	19	3.361	4.351	5.287	36.13	35.08	28.69

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
3	4	6	12	14	15	17	2.669	3.863	6.030	-33.13	-13.69	3.00
3	4	6	11	13	14	16	2.892	4.175	6.487	-10.79	17.51	48.68
3	4	6	14	17	18	20	3.361	4.351	6.175	36.13	35.08	17.49
3	4	7	12	14	15	18	2.669	3.863	7.020	-33.13	-13.69	1.96
3	4	8	12	14	15	19	2.669	3.863	7.956	-33.13	-13.69	-4.44
3	4	8	11	13	14	17	2.892	4.175	7.536	-10.79	17.51	-46.36
3	4	9	12	14	15	20	2.669	3.863	8.844	-33.13	-13.69	-15.64
3	4	9	11	13	14	18	2.892	4.175	8.526	-10.79	17.51	-47.41
3	4	9	11	13	14	19	2.892	4.175	9.462	-10.79	17.51	46.20
3	4	10	11	13	14	20	2.892	4.175	10.350	-10.79	17.51	35.00
3	5	6	12	14	16	17	2.669	4.980	6.030	-33.13	-1.96	3.00
3	5	6	11	13	15	16	2.892	5.370	6.487	-10.79	36.95	48.68
3	5	6	10	12	13	14	3.156	4.542	5.825	15.64	-45.79	-17.49
3	5	6	14	17	19	20	3.361	5.287	6.175	36.13	28.69	17.49
3	5	6	9	11	12	13	3.474	4.980	6.366	47.41	-1.96	36.62
3	5	7	6	7	8	9	2.669	4.980	7.020	-33.13	-1.96	1.96
3	5	7	10	12	13	15	3.156	4.542	7.020	15.64	-45.79	1.96
3	5	8	12	14	16	19	2.669	4.980	7.956	-33.13	-1.96	-4.44
3	5	8	11	13	15	17	2.892	5.370	7.536	-10.79	36.95	-46.36
3	5	8	10	12	13	16	3.156	4.542	8.137	15.64	-45.79	13.69
3	5	8	9	11	12	14	3.474	4.980	7.649	47.41	-1.96	-35.08
3	5	9	6	7	8	10	2.669	4.980	8.844	-33.13	-1.96	-15.64
3	5	9	11	13	15	18	2.892	5.370	8.526	-10.79	36.95	-47.41
3	5	9	11	13	15	19	2.892	5.370	9.462	-10.79	36.95	46.20
3	5	9	10	12	13	17	3.156	4.542	9.186	15.64	-45.79	18.64
3	5	9	9	11	12	15	3.474	4.980	8.844	47.41	-1.96	-15.64
3	5	10	6	7	8	11	2.669	4.980	10.494	-33.13	-1.96	49.36
3	5	10	11	13	15	20	2.892	5.370	10.350	-10.79	36.95	35.00
3	5	10	10	12	13	18	3.156	4.542	10.176	15.64	-45.79	17.60
3	5	10	9	11	12	16	3.474	4.980	9.961	47.41	-1.96	-3.91
3	5	11	10	12	13	19	3.156	4.542	11.112	15.64	-45.79	11.20
3	5	11	9	11	12	17	3.474	4.980	11.010	47.41	-1.96	1.05
3	6	7	12	14	17	18	2.669	6.030	7.020	-33.13	3.00	1.96
3	6	7	10	12	14	15	3.156	5.825	7.020	15.64	-17.49	1.96
3	6	8	12	14	17	19	2.669	6.030	7.956	-33.13	3.00	-4.44
3	6	8	11	13	16	17	2.892	6.487	7.536	-10.79	48.68	-46.36
3	6	8	5	6	7	8	3.156	5.825	8.137	15.64	-17.49	13.69
3	6	8	9	11	13	14	3.474	6.366	7.649	47.41	36.62	-35.08
3	6	9	12	14	17	20	2.669	6.030	8.844	-33.13	3.00	-15.64
3	6	9	11	13	16	18	2.892	6.487	8.526	-10.79	48.68	-47.41

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
3	6	9	11	13	16	19	2.892	6.487	9.462	-10.79	48.68	46.20
3	6	9	10	12	14	17	3.156	5.825	9.186	15.64	-17.49	18.64
3	6	9	9	11	13	15	3.474	6.366	8.844	47.41	36.62	-15.64
3	6	10	11	13	16	20	2.892	6.487	10.350	-10.79	48.68	35.00
3	6	10	5	6	7	9	3.156	5.825	10.176	15.64	-17.49	17.60
3	6	10	9	11	13	16	3.474	6.366	9.961	47.41	36.62	-3.91
3	6	11	10	12	14	19	3.156	5.825	11.112	15.64	-17.49	11.20
3	6	11	9	11	13	17	3.474	6.366	11.010	47.41	36.62	1.05
3	7	8	12	14	18	19	2.669	7.020	7.956	-33.13	1.96	-4.44
3	7	8	10	12	15	16	3.156	7.020	8.137	15.64	1.96	13.69
3	7	9	6	7	9	10	2.669	7.020	8.844	-33.13	1.96	-15.64
3	7	9	10	12	15	17	3.156	7.020	9.186	15.64	1.96	18.64
3	7	10	6	7	9	11	2.669	7.020	10.494	-33.13	1.96	49.36
3	7	10	10	12	15	18	3.156	7.020	10.176	15.64	1.96	17.60
3	7	11	10	12	15	19	3.156	7.020	11.112	15.64	1.96	11.20
3	8	9	12	14	19	20	2.669	7.956	8.844	-33.13	-4.44	-15.64
3	8	9	11	13	17	18	2.892	7.536	8.526	-10.79	-46.36	-47.41
3	8	9	11	13	17	19	2.892	7.536	9.462	-10.79	-46.36	46.20
3	8	9	10	12	16	17	3.156	8.137	9.186	15.64	13.69	18.64
3	8	9	9	11	14	15	3.474	7.649	8.844	47.41	-35.08	-15.64
3	8	10	11	13	17	20	2.892	7.536	10.350	-10.79	-46.36	35.00
3	8	10	5	6	8	9	3.156	8.137	10.176	15.64	13.69	17.60
3	8	10	9	11	14	16	3.474	7.649	9.961	47.41	-35.08	-3.91
3	8	11	10	12	16	19	3.156	8.137	11.112	15.64	13.69	11.20
3	8	11	9	11	14	17	3.474	7.649	11.010	47.41	-35.08	1.05
3	9	9	11	13	18	19	2.892	8.526	9.462	-10.79	-47.41	46.20
3	9	10	6	7	10	11	2.669	8.844	10.494	-33.13	-15.64	49.36
3	9	10	11	13	18	20	2.892	8.526	10.350	-10.79	-47.41	35.00
3	9	10	11	13	19	20	2.892	9.462	10.350	-10.79	46.20	35.00
3	9	10	10	12	17	18	3.156	9.186	10.176	15.64	18.64	17.60
3	9	10	9	11	15	16	3.474	8.844	9.961	47.41	-15.64	-3.91
3	9	11	10	12	17	19	3.156	9.186	11.112	15.64	18.64	11.20
3	9	11	9	11	15	17	3.474	8.844	11.010	47.41	-15.64	1.05
3	10	11	10	12	18	19	3.156	10.176	11.112	15.64	17.60	11.20
3	10	11	9	11	16	17	3.474	9.961	11.010	47.41	-3.91	1.05
4	5	6	13	16	17	18	3.595	4.644	5.634	-40.53	-35.57	-36.62
4	5	6	12	15	16	17	3.863	4.980	6.030	-13.69	-1.96	3.00
4	5	6	11	14	15	16	4.175	5.370	6.487	17.51	36.95	48.68
4	5	6	14	18	19	20	4.351	5.287	6.175	35.08	28.69	17.49
4	5	7	13	16	17	19	3.595	4.644	6.570	-40.53	-35.57	-43.01

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
4	5	7	13	16	17	20	3.595	4.644	7.458	-40.53	-35.57	45.79
4	5	7	12	15	16	18	3.863	4.980	7.020	-13.69	-1.96	1.96
4	5	8	12	15	16	19	3.863	4.980	7.956	-13.69	-1.96	-4.44
4	5	8	11	14	15	17	4.175	5.370	7.536	17.51	36.95	-46.36
4	5	9	12	15	16	20	3.863	4.980	8.844	-13.69	-1.96	-15.64
4	5	9	11	14	15	18	4.175	5.370	8.526	17.51	36.95	-47.41
4	5	9	11	14	15	19	4.175	5.370	9.462	17.51	36.95	46.20
4	5	10	11	14	15	20	4.175	5.370	10.350	17.51	36.95	35.00
4	6	7	13	16	18	19	3.595	5.634	6.570	-40.53	-36.62	-43.01
4	6	7	13	16	18	20	3.595	5.634	7.458	-40.53	-36.62	45.79
4	6	7	8	10	11	12	3.863	5.513	7.020	-13.69	-48.68	1.96
4	6	7	12	15	17	18	3.863	6.030	7.020	-13.69	3.00	1.96
4	6	8	8	10	11	13	3.863	5.513	8.405	-13.69	-48.68	40.53
4	6	8	12	15	17	19	3.863	6.030	7.956	-13.69	3.00	-4.44
4	6	8	11	14	16	17	4.175	6.487	7.536	17.51	48.68	-46.36
4	6	8	7	9	10	11	4.351	6.175	7.825	35.08	17.49	-17.51
4	6	9	12	15	17	20	3.863	6.030	8.844	-13.69	3.00	-15.64
4	6	9	11	14	16	18	4.175	6.487	8.526	17.51	48.68	-47.41
4	6	9	11	14	16	19	4.175	6.487	9.462	17.51	48.68	46.20
4	6	9	7	9	10	12	4.351	6.175	9.331	35.08	17.49	33.13
4	6	10	8	10	11	14	3.863	5.513	9.688	-13.69	-48.68	-31.17
4	6	10	11	14	16	20	4.175	6.487	10.350	17.51	48.68	35.00
4	6	11	8	10	11	15	3.863	5.513	10.883	-13.69	-48.68	-11.73
4	6	11	7	9	10	13	4.351	6.175	10.717	35.08	17.49	-28.30
4	7	7	13	16	19	20	3.595	6.570	7.458	-40.53	-43.01	45.79
4	7	8	12	15	18	19	3.863	7.020	7.956	-13.69	1.96	-4.44
4	7	8	8	10	12	13	3.863	7.020	8.405	-13.69	1.96	40.53
4	7	9	12	15	18	20	3.863	7.020	8.844	-13.69	1.96	-15.64
4	7	10	4	5	6	7	3.863	7.020	9.688	-13.69	1.96	-31.17
4	7	11	8	10	12	15	3.863	7.020	10.883	-13.69	1.96	-11.73
4	8	9	12	15	19	20	3.863	7.956	8.844	-13.69	-4.44	-15.64
4	8	9	11	14	17	18	4.175	7.536	8.526	17.51	-46.36	-47.41
4	8	9	11	14	17	19	4.175	7.536	9.462	17.51	-46.36	46.20
4	8	9	7	9	11	12	4.351	7.825	9.331	35.08	-17.51	33.13
4	8	10	8	10	13	14	3.863	8.405	9.688	-13.69	40.53	-31.17
4	8	10	11	14	17	20	4.175	7.536	10.350	17.51	-46.36	35.00
4	8	11	8	10	13	15	3.863	8.405	10.883	-13.69	40.53	-11.73
4	8	11	7	9	11	13	4.351	7.825	10.717	35.08	-17.51	-28.30
4	9	9	11	14	18	19	4.175	8.526	9.462	17.51	-47.41	46.20
4	9	10	11	14	18	20	4.175	8.526	10.350	17.51	-47.41	35.00

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
4	9	10	11	14	19	20	4.175	9.462	10.350	17.51	46.20	35.00
4	9	11	7	9	12	13	4.351	9.331	10.717	35.08	33.13	-28.30
4	10	11	8	10	14	15	3.863	9.688	10.883	-13.69	-31.17	-11.73
5	6	7	10	13	14	15	4.542	5.825	7.020	-45.79	-17.49	1.96
5	6	7	13	17	18	19	4.644	5.634	6.570	-35.57	-36.62	-43.01
5	6	7	13	17	18	20	4.644	5.634	7.458	-35.57	-36.62	45.79
5	6	7	12	16	17	18	4.980	6.030	7.020	-1.96	3.00	1.96
5	6	8	10	13	14	16	4.542	5.825	8.137	-45.79	-17.49	13.69
5	6	8	12	16	17	19	4.980	6.030	7.956	-1.96	3.00	-4.44
5	6	8	9	12	13	14	4.980	6.366	7.649	-1.96	36.62	-35.08
5	6	8	11	15	16	17	5.370	6.487	7.536	36.95	48.68	-46.36
5	6	9	10	13	14	17	4.542	5.825	9.186	-45.79	-17.49	18.64
5	6	9	12	16	17	20	4.980	6.030	8.844	-1.96	3.00	-15.64
5	6	9	9	12	13	15	4.980	6.366	8.844	-1.96	36.62	-15.64
5	6	9	11	15	16	18	5.370	6.487	8.526	36.95	48.68	-47.41
5	6	9	11	15	16	19	5.370	6.487	9.462	36.95	48.68	46.20
5	6	10	10	13	14	18	4.542	5.825	10.176	-45.79	-17.49	17.60
5	6	10	9	12	13	16	4.980	6.366	9.961	-1.96	36.62	-3.91
5	6	10	11	15	16	20	5.370	6.487	10.350	36.95	48.68	35.00
5	6	11	10	13	14	19	4.542	5.825	11.112	-45.79	-17.49	11.20
5	6	11	9	12	13	17	4.980	6.366	11.010	-1.96	36.62	1.05
5	7	7	13	17	19	20	4.644	6.570	7.458	-35.57	-43.01	45.79
5	7	8	10	13	15	16	4.542	7.020	8.137	-45.79	1.96	13.69
5	7	8	12	16	18	19	4.980	7.020	7.956	-1.96	1.96	-4.44
5	7	9	10	13	15	17	4.542	7.020	9.186	-45.79	1.96	18.64
5	7	9	6	8	9	10	4.980	7.020	8.844	-1.96	1.96	-15.64
5	7	10	10	13	15	18	4.542	7.020	10.176	-45.79	1.96	17.60
5	7	10	6	8	9	11	4.980	7.020	10.494	-1.96	1.96	49.36
5	7	11	10	13	15	19	4.542	7.020	11.112	-45.79	1.96	11.20
5	8	9	10	13	16	17	4.542	8.137	9.186	-45.79	13.69	18.64
5	8	9	9	12	14	15	4.980	7.649	8.844	-1.96	-35.08	-15.64
5	8	9	12	16	19	20	4.980	7.956	8.844	-1.96	-4.44	-15.64
5	8	9	11	15	17	18	5.370	7.536	8.526	36.95	-46.36	-47.41
5	8	9	11	15	17	19	5.370	7.536	9.462	36.95	-46.36	46.20
5	8	10	10	13	16	18	4.542	8.137	10.176	-45.79	13.69	17.60
5	8	10	9	12	14	16	4.980	7.649	9.961	-1.96	-35.08	-3.91
5	8	10	11	15	17	20	5.370	7.536	10.350	36.95	-46.36	35.00
5	8	11	10	13	16	19	4.542	8.137	11.112	-45.79	13.69	11.20
5	8	11	9	12	14	17	4.980	7.649	11.010	-1.96	-35.08	1.05
5	9	9	11	15	18	19	5.370	8.526	9.462	36.95	-47.41	46.20

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
5	9	10	10	13	17	18	4.542	9.186	10.176	-45.79	18.64	17.60
5	9	10	9	12	15	16	4.980	8.844	9.961	-1.96	-15.64	-3.91
5	9	10	6	8	10	11	4.980	8.844	10.494	-1.96	-15.64	49.36
5	9	10	11	15	18	20	5.370	8.526	10.350	36.95	-47.41	35.00
5	9	10	11	15	19	20	5.370	9.462	10.350	36.95	46.20	35.00
5	9	11	10	13	17	19	4.542	9.186	11.112	-45.79	18.64	11.20
5	9	11	9	12	15	17	4.980	8.844	11.010	-1.96	-15.64	1.05
5	10	11	10	13	18	19	4.542	10.176	11.112	-45.79	17.60	11.20
5	10	11	9	12	16	17	4.980	9.961	11.010	-1.96	-3.91	1.05
6	7	7	13	18	19	20	5.634	6.570	7.458	-36.62	-43.01	45.79
6	7	8	8	11	12	13	5.513	7.020	8.405	-48.68	1.96	40.53
6	7	8	10	14	15	16	5.825	7.020	8.137	-17.49	1.96	13.69
6	7	8	12	17	18	19	6.030	7.020	7.956	3.00	1.96	-4.44
6	7	9	10	14	15	17	5.825	7.020	9.186	-17.49	1.96	18.64
6	7	9	12	17	18	20	6.030	7.020	8.844	3.00	1.96	-15.64
6	7	10	8	11	12	14	5.513	7.020	9.688	-48.68	1.96	-31.17
6	7	10	10	14	15	18	5.825	7.020	10.176	-17.49	1.96	17.60
6	7	11	8	11	12	15	5.513	7.020	10.883	-48.68	1.96	-11.73
6	7	11	10	14	15	19	5.825	7.020	11.112	-17.49	1.96	11.20
6	8	9	10	14	16	17	5.825	8.137	9.186	-17.49	13.69	18.64
6	8	9	12	17	19	20	6.030	7.956	8.844	3.00	-4.44	-15.64
6	8	9	7	10	11	12	6.175	7.825	9.331	17.49	-17.51	33.13
6	8	9	9	13	14	15	6.366	7.649	8.844	36.62	-35.08	-15.64
6	8	9	11	16	17	18	6.487	7.536	8.526	48.68	-46.36	-47.41
6	8	9	11	16	17	19	6.487	7.536	9.462	48.68	-46.36	46.20
6	8	10	8	11	13	14	5.513	8.405	9.688	-48.68	40.53	-31.17
6	8	10	5	7	8	9	5.825	8.137	10.176	-17.49	13.69	17.60
6	8	10	9	13	14	16	6.366	7.649	9.961	36.62	-35.08	-3.91
6	8	10	11	16	17	20	6.487	7.536	10.350	48.68	-46.36	35.00
6	8	11	8	11	13	15	5.513	8.405	10.883	-48.68	40.53	-11.73
6	8	11	10	14	16	19	5.825	8.137	11.112	-17.49	13.69	11.20
6	8	11	7	10	11	13	6.175	7.825	10.717	17.49	-17.51	-28.30
6	8	11	9	13	14	17	6.366	7.649	11.010	36.62	-35.08	1.05
6	9	9	11	16	18	19	6.487	8.526	9.462	48.68	-47.41	46.20
6	9	10	10	14	17	18	5.825	9.186	10.176	-17.49	18.64	17.60
6	9	10	9	13	15	16	6.366	8.844	9.961	36.62	-15.64	-3.91
6	9	10	11	16	18	20	6.487	8.526	10.350	48.68	-47.41	35.00
6	9	10	11	16	19	20	6.487	9.462	10.350	48.68	46.20	35.00
6	9	11	10	14	17	19	5.825	9.186	11.112	-17.49	18.64	11.20
6	9	11	7	10	12	13	6.175	9.331	10.717	17.49	33.13	-28.30

Lower ET interval (semitones)	Middle ET interval (semitones)	Upper ET interval (semitones)	Lowest partial	Lower middle partial	Upper middle partial	Upper partial	Lower just interval (semitones)	Middle just interval (semitones)	Upper just interval (semitones)	Lower adjustment (cents)	Middle adjustment (cents)	Upper adjustment (cents)
6	9	11	9	13	15	17	6.366	8.844	11.010	36.62	-15.64	1.05
6	10	11	8	11	14	15	5.513	9.688	10.883	-48.68	-31.17	-11.73
6	10	11	10	14	18	19	5.825	10.176	11.112	-17.49	17.60	11.20
6	10	11	9	13	16	17	6.366	9.961	11.010	36.62	-3.91	1.05
7	8	9	12	18	19	20	7.020	7.956	8.844	1.96	-4.44	-15.64
7	8	9	10	15	16	17	7.020	8.137	9.186	1.96	13.69	18.64
7	8	10	10	15	16	18	7.020	8.137	10.176	1.96	13.69	17.60
7	8	10	8	12	13	14	7.020	8.405	9.688	1.96	40.53	-31.17
7	8	11	10	15	16	19	7.020	8.137	11.112	1.96	13.69	11.20
7	8	11	8	12	13	15	7.020	8.405	10.883	1.96	40.53	-11.73
7	9	10	6	9	10	11	7.020	8.844	10.494	1.96	-15.64	49.36
7	9	10	10	15	17	18	7.020	9.186	10.176	1.96	18.64	17.60
7	9	11	10	15	17	19	7.020	9.186	11.112	1.96	18.64	11.20
7	10	11	8	12	14	15	7.020	9.688	10.883	1.96	-31.17	-11.73
7	10	11	10	15	18	19	7.020	10.176	11.112	1.96	17.60	11.20
8	9	9	11	17	18	19	7.536	8.526	9.462	-46.36	-47.41	46.20
8	9	10	11	17	18	20	7.536	8.526	10.350	-46.36	-47.41	35.00
8	9	10	11	17	19	20	7.536	9.462	10.350	-46.36	46.20	35.00
8	9	10	9	14	15	16	7.649	8.844	9.961	-35.08	-15.64	-3.91
8	9	10	10	16	17	18	8.137	9.186	10.176	13.69	18.64	17.60
8	9	11	9	14	15	17	7.649	8.844	11.010	-35.08	-15.64	1.05
8	9	11	7	11	12	13	7.825	9.331	10.717	-17.51	33.13	-28.30
8	9	11	10	16	17	19	8.137	9.186	11.112	13.69	18.64	11.20
8	10	11	9	14	16	17	7.649	9.961	11.010	-35.08	-3.91	1.05
8	10	11	10	16	18	19	8.137	10.176	11.112	13.69	17.60	11.20
8	10	11	8	13	14	15	8.405	9.688	10.883	40.53	-31.17	-11.73
9	9	10	11	18	19	20	8.526	9.462	10.350	-47.41	46.20	35.00
9	10	11	9	15	16	17	8.844	9.961	11.010	-15.64	-3.91	1.05
9	10	11	10	17	18	19	9.186	10.176	11.112	18.64	17.60	11.20