$\sqrt[12]{2} = 2^{\frac{1}{12}} = 1.0594\cdots$　　1オクターブ　2倍

C = 2^0 = 1.　　261.62 Hz
C# = $2^{1/12}$ = 1.05946.　　277.18 Hz
D　$2^{2/12}$ = 1.12246　　293.66 Hz
D#　$2^{3/12}$ = 1.18921
E　$2^{4/12}$ = 1.25992
F　$2^{5/12}$ = 1.33484
⋮
B:　$2^{11/12}$ = 1.88775
C:　$2^{12/12} = 2^1 = 2$.

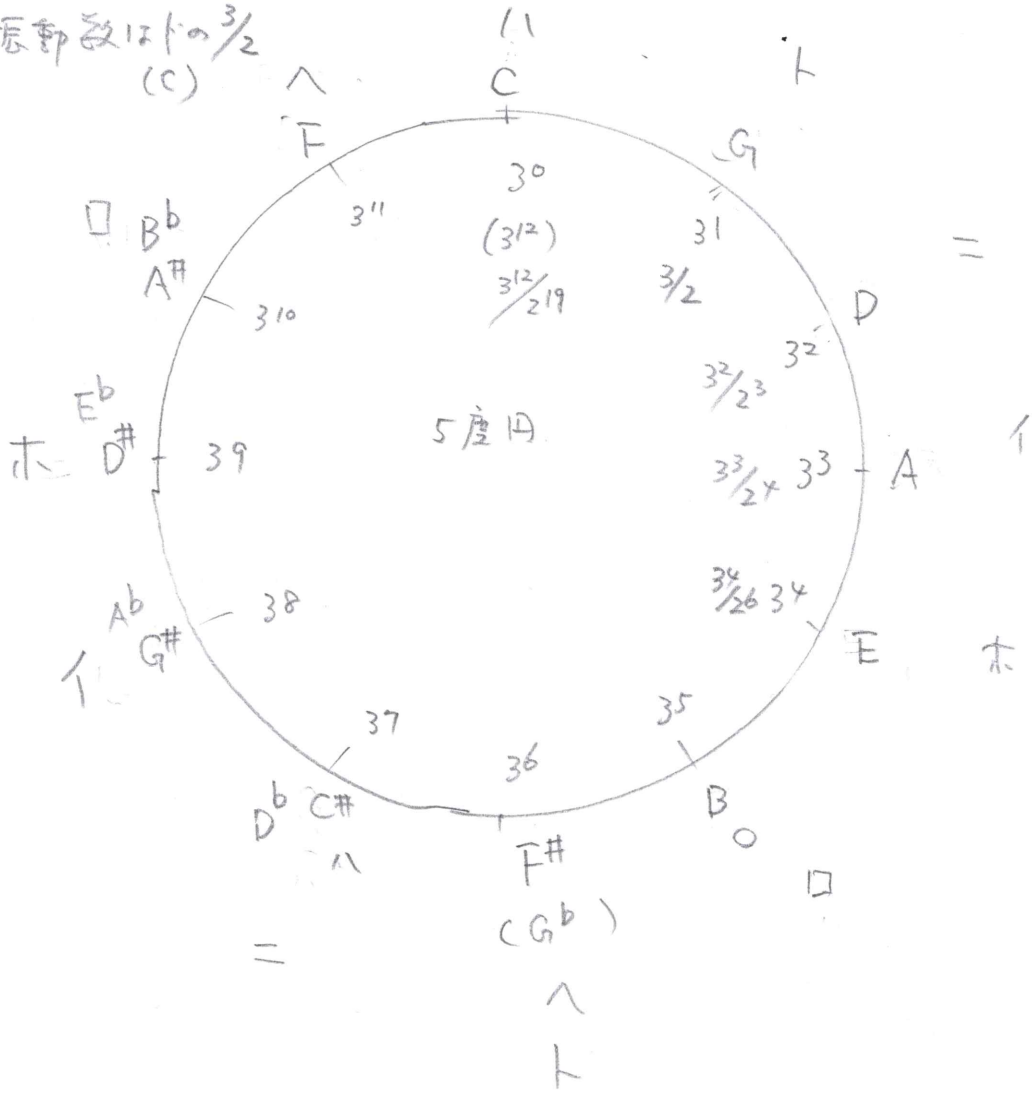
小方厚著
「音律と音階の科学」
ブルーバックス

F# $2^{6/12} = 2^{1/2}$ = 1.4142　減5度
A　$2^{9/12} = 2^{3/4}$ = 1.68179

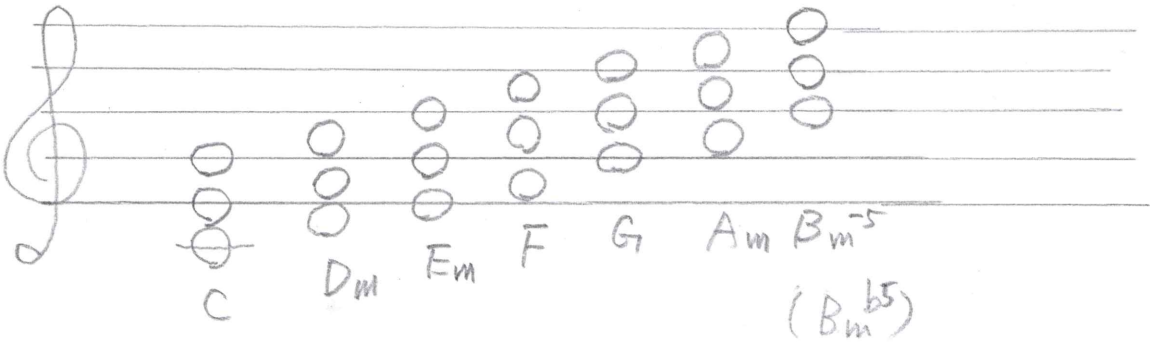
× 261.62 = 439.991
≒ 440 Hz

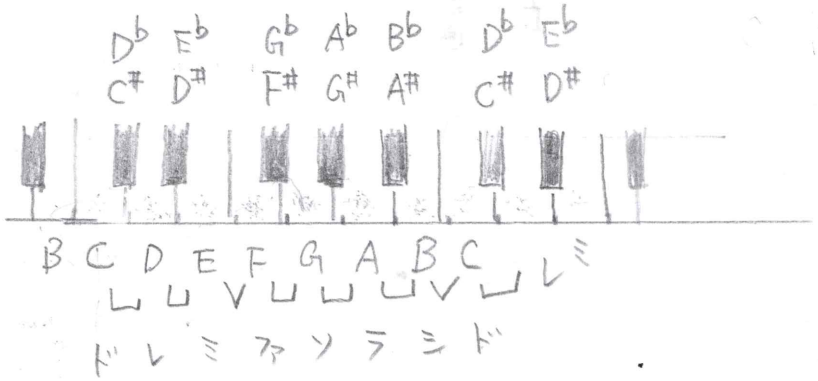
$\frac{3^{12}}{2^{19}}$ = 1.0136…

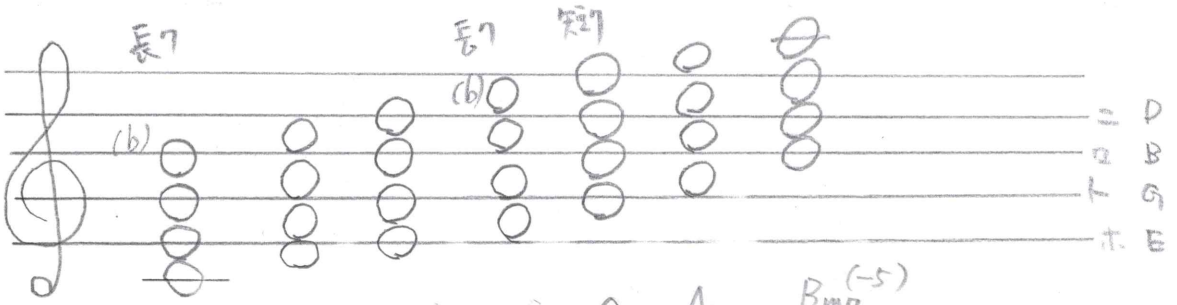
3倍音
ソの振動数はドの $\frac{3}{2}$



ダイアトニックコード







diminish 減らす 半音下げる

cf. augument
増やす 半音上げる

♭ ←ミミラレソドファ→ ♯

ハヘロホイヒトハ

ヘロホイニトハ (長調)

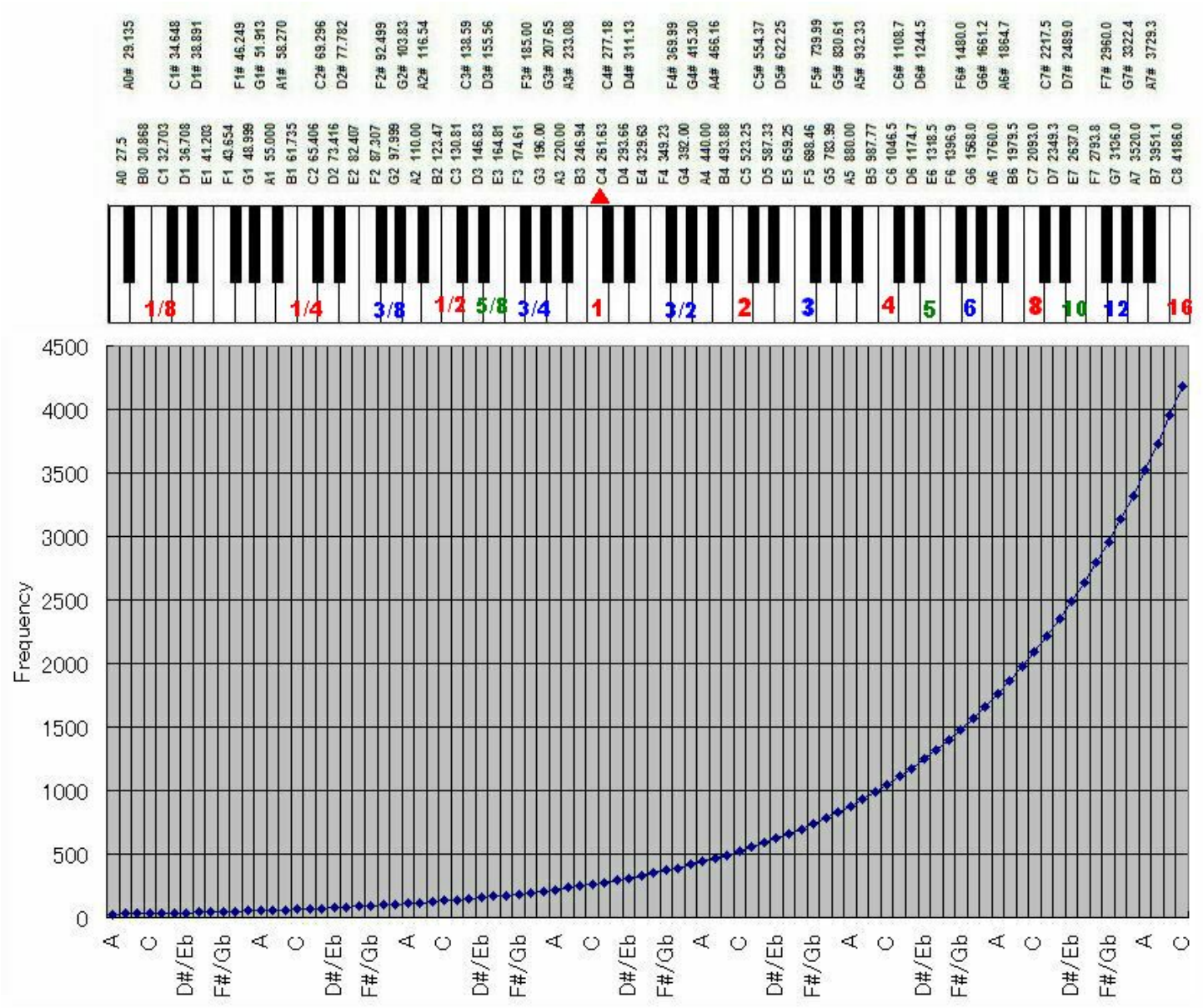
Relationship between music theory and mathematics

Correlation between scale and frequency

Frequency ratio $f_n / f_o = 2^{n/12}$ **(Well Temperament)**

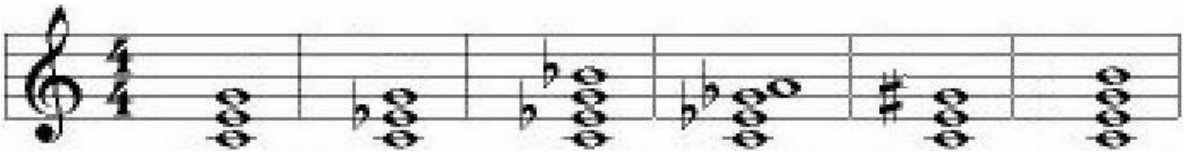
Interval	n	Ratio(Well)	Ratio(Pure)		Deviation(%)	Note	Frequency(Hz)
Unison	0	1.00000	1/1	=1.0000	0.00000	C	261.62600
Chroma	1	1.05946	135/128	=1.0547	-0.47756	C#(Db)	277.18300
2nd	2	1.12246	9/8	=1.1250	0.25380	D	293.66500
Minor 3rd	3	1.18921	6/5	=1.2000	1.07929	D#(Eb)	311.12700
Third	4	1.25992	5/4	=1.2500	-0.99210	E	329.62800
Perfect 4th	5	1.33484	4/3	=1.3333	-0.15065	F	349.22800
Diatonic tritone	6	1.41421	45/32	=1.4063	-0.79636	F#(Gb)	369.99400
Perfect 5th	7	1.49831	3/2	=1.5000	0.16929	G	391.99500
Minor 6th	8	1.58740	8/5	=1.6000	1.25989	G#(Ab)	415.30500
6th	9	1.68179	27/16	=1.6875	0.57072	A	440.00000
7th	10	1.78180	9/5	=1.8000	1.82026	A#(Bb)	466.16400
Major 7th	11	1.88775	8/15	=1.8667	-2.10820	B	493.88300
Octave	12	2.00000	2/1	=2.0000	0.00000	C	523.25100

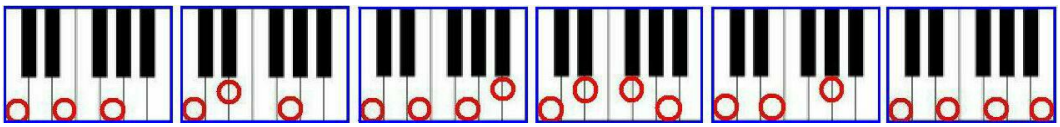
*** The beat caused by the frequency differences between the sounds of well temperament and the pure temperament makes harmonious feeling.**



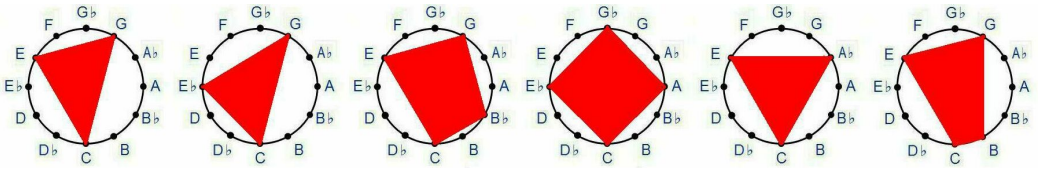
Typical chords and their frequency intervals

Major Minor 7th Diminish Augment Major 7th 9th, 11th, etc.



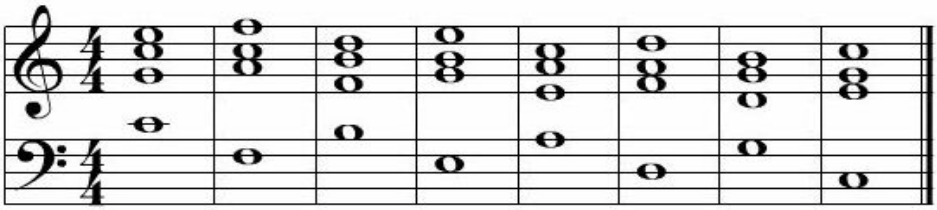


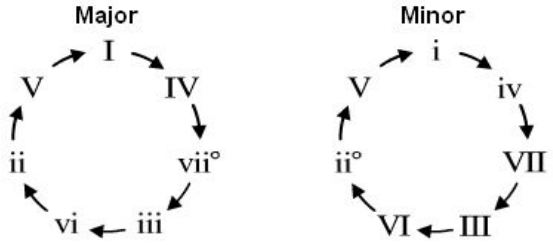
3rd (0.99%) 5th (0.17%) | Min 3rd (1.08%) 5th (0.17%) | 3rd (0.99%) 5th (0.17%) 7th (1.82%) | Min 3rd (1.08%) Dia 3(-0.8%) 6th (0.57%) | 3rd (0.99%) Min 6th (1.26%) | 3rd (0.99%) 5th (0.17%) Maj 7th (-2.11%)



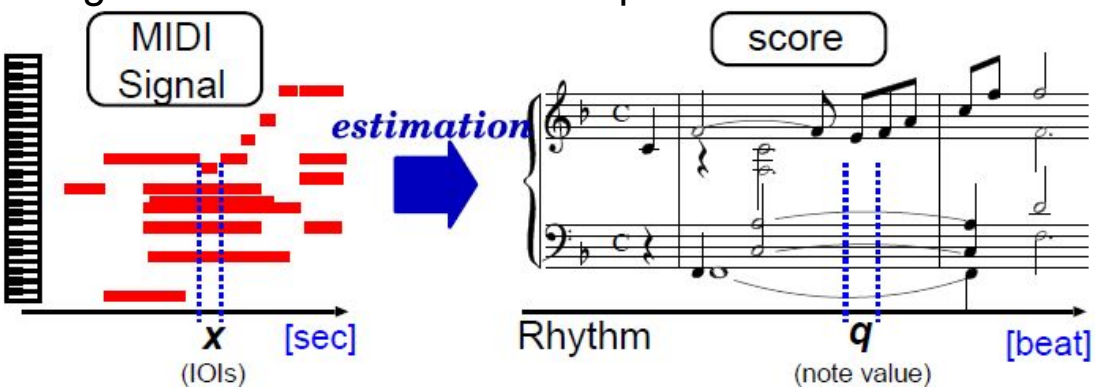
<-- Children's song, Enka, Folk, Rock -->
<---------- Classical music ---------->
<---------- Popular music, Latin ---------->
<---------- Jazz, Fusion ---------->

Chord Progression

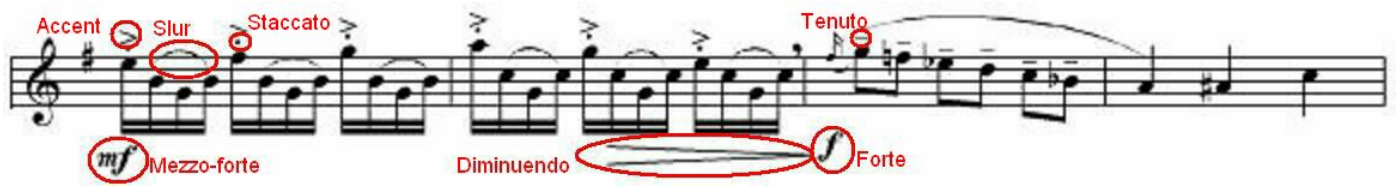




Rhythm recognition for automatic transcription

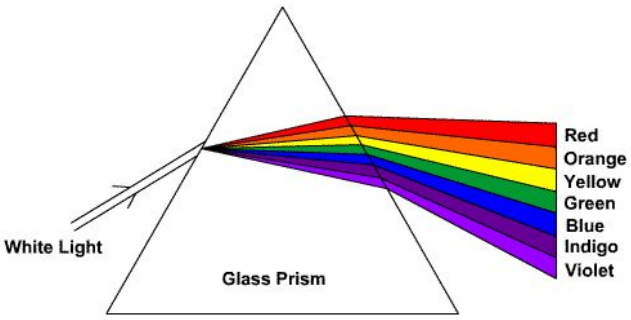


Music marks for expression

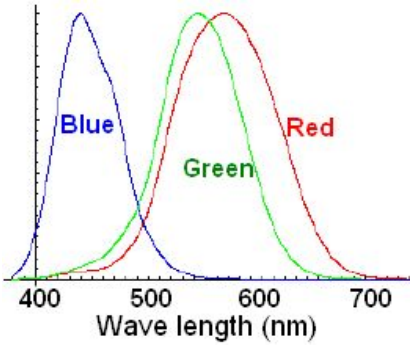


Construction of tone color (Wave form)

Light spectrum makes color

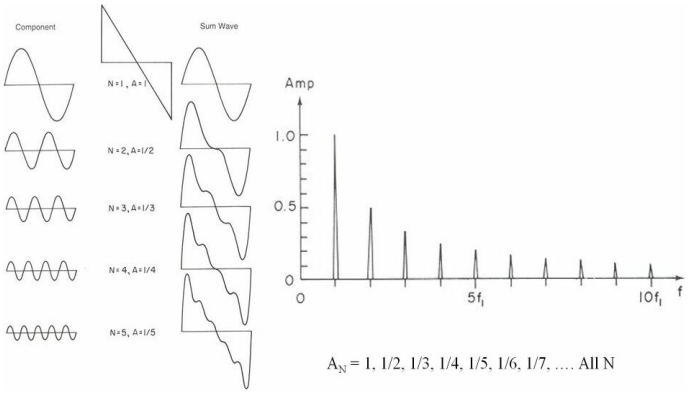


Relative spectral sensitivity of the three types of cones in the human retina

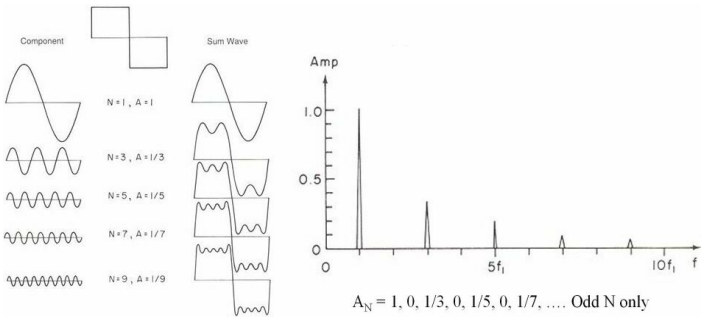


Sound spectrum makes tone color

* Tooth Wave



* Square Wave (Sounds like clarinet)



ADSR envelope

The contour of the ADSR envelope is specified using four parameters:

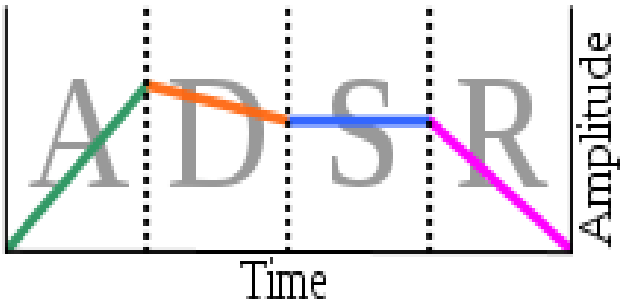
Attack : How quickly the sound reaches full volume after the sound is activated (the key is pressed).

Decay : How quickly the sound drops to the sustain level after the initial peak.

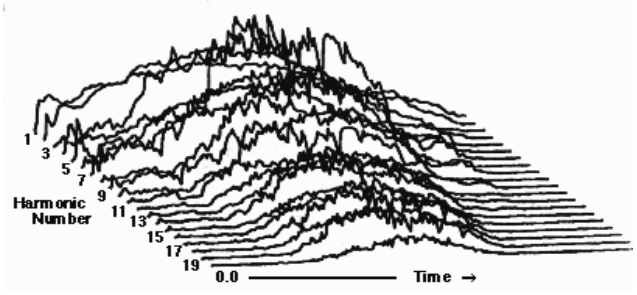
Sustain : The "constant" volume that the sound takes after decay until the note is released.

Release : How quickly the sound fades when a note ends (the key is released). Often, this time is very short.

Key-pressed ↓ Key-released ↓



Spectrum envelope



http://www.sfu.ca/sonic-studio

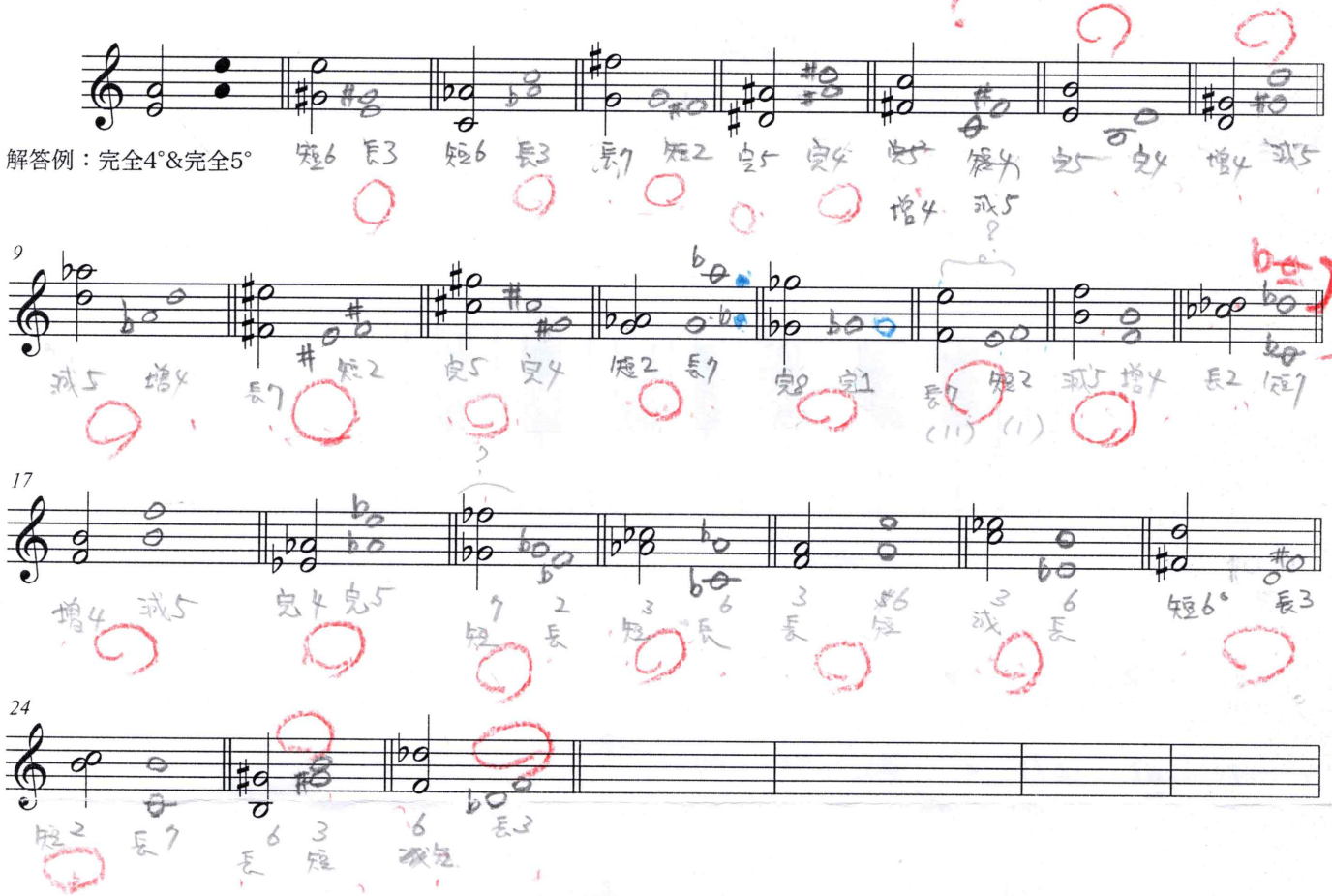
20200716

音程・コードの確認ですよ！

全音 長2度
半音 短2度

学園坂

1. 次の2音の音程と転回した音程も書いてください。



解答例：完全4°&完全5°

2. 次の和音のコードネームを書いてください。