

**BACCALAURÉAT GÉNÉRAL
ÉPREUVE SPÉCIFIQUE DES SECTIONS EUROPÉENNES
MATHÉMATIQUES – ANGLAIS**

SUJET 8

**Math'n music
Sequence and...**

Ce sujet comporte 2 pages. L'usage de tout modèle de calculatrice, avec ou sans mode examen, est autorisé.

Throughout history, many scales have been created and employed in the design of musical instruments. Some of these, in fact, have largely been developed by heuristics; some notes simply sound good together, and thus can be turned into a scale.

Among the earliest well-known tuning systems based on mathematics, though, was that of the Greek mathematician Pythagoras. Legend has it that Pythagoras actually got the idea for his tuning system by hearing blacksmiths hammer metal and learning that the hammers' masses were in simple integer ratios.

He found that mathematically, the note's pitch is inversely proportional to the length of the string. For example if we halve the length of the string, we create the exact same note, but one Octave higher.

This happens on a guitar when we play a note at the 12th fret. Positioning our finger at the 12th fret position makes the string exactly half as long as its full length with no finger on any frets.

The inverse proportion means that if we play $\frac{1}{2}$ of the string, we get the frequency of vibration of the string 2 times.

Frequency increases directly as the length of the string is decreased. Pythagoras figured out the fundamental mathematics of all stringed instruments.

Source: Mathematics, Music, and the Guitar by David Hornbeck July 25, 2013

I. Explain what the text deals with and comment on it.

II. Exercise

Here is a spreadsheet giving the frequencies of different musical notes. We can consider that these frequencies are the first terms of a sequence.

	A	B	C	D	E
1		Note			Frequency (Hz)
2	1	A	=	La	27.50
3	2	Bb	=	Sib	29.14
4	3	B	=	Si	30.87
5	4	C	=	Do	32.70
6	5	C#	=	Do#	34.65
7	6	D	=	Re	36.71
8	7	Eb	=	Mib	38.89
9	8	E	=	Mi	41.20
10	9	F	=	Fa	43.65
11	10	F#	=	Fa#	46.25
12	11	G	=	Sol	49.00
13	12	G#	=	Sol#	51.90

1.

- a. Between these four formulas, which one(s) could be typed in cell **D3** and expanded in the cells below:

$$\begin{aligned} &=D2+1.059 & =D2+1.64 \\ &=D2*1.059 & =27.50*1.059^{A3} \end{aligned}$$

- b. Make a conjecture about the way to compute the frequencies one after the other.

- c. Supposing that this conjecture is true, give two ways to find the frequency in the cell **D14**.

2. On the guitar below, we measured the distances between the first frets:

	A	B
1	Between...	Distance (in)
2	Nut and 1st fret	1.436
3	1st and 2nd frets	1.356
4	2nd and 3rd frets	1.280
5	3rd and 4th frets	1.208
6	4th and 5th frets	1.140
7	5th and 6th frets	1.076
8	6th and 7th frets	1.016
9	7th and 8th frets	0.959
10	8th and 9th frets	0.905
11	9th and 10th frets	0.854
12	10th and 11th frets	0.806
13	11th and 12th frets	0.761

Explain how you would

estimate the length (in inches) of one string (between nut and saddle)?

