

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

**CORRIGÉ SUJET 1**

**Theme: Statistics**

Des éléments qu'on pourrait prendre en compte pour l'analyse du texte :

- The text is about the scientist **Sir Francis Galton** (1822-1911) who pioneered the application of statistical method to the study of human intelligence and developed some important and significant statistical techniques.

Pour l'argumentation en relation avec l'exercice

- Définition des termes statistiques du texte : " mean " et " median "
- Commenter le fait que la médiane est insensible à la variation des données extrêmes contrairement à la moyenne.

1)

a) Moyenne : 11.75 ; Médiane : 11.5 ; Mode : 14

2) The measure of central tendency that should be used to describe average is **mean**. Mean is the average of a set of data.

3) The favorite color would be the color appearing the most number of times. Use the **mode**.

4) The **mode** in this set would be 0 and these 0's are acting as outliers for the data. The **median** is least affected by outliers and would most likely give the more positive view of the grades. Averaging in 4 zeros would dramatically lower the mean.

On pourra évaluer la capacité à argumenter et à débattre et à interagir avec les interlocuteurs

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**CORRIGÉ SUJET 2**

**Theme: Sequence**

1) **Step 1** :  $C_1 = 3$  ,  $P_1 = 3 \times 1 = 3$

2) **a) Each line segment is divided in 4 line segments with length  $\frac{1}{3}$  of the previous one.**

$$L_2 = \frac{1}{3}; \quad C_2 = 3 \times 4 = 12 \text{ and } C_3 = 12 \times 4 = 48$$

**b)  $(C_n)$  is a geometric sequence with common ratio  $q = 4$  ;  $C_n = 3 \times 4^{n-1}$**

5) What happens as we let  $n$  tend to infinity?

Since  $\frac{4}{3} > 1$  ,  $\left(\frac{4}{3}\right)^{n-1}$  goes to infinity.

The perimeter has an infinite perimeter (circumference)

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**CORRIGÉ SUJET 3**

**Theme: Arithmetics**

Éléments à prendre en compte pour évaluer la capacité d'analyse et d'argumentation :

- L'élève pourra faire un résumé des informations du texte, donner son propre avis et insister sur les divers domaines d'utilisation des nombres.
- Dans l'exercice, l'élève sera amené à argumenter son choix en utilisant le vocabulaire approprié sur les nombres entiers, leurs diviseurs et leurs multiples.

Corrigé de l'exercice

1. This shows that 6 is a perfect number because it has only 3 factors different from itself: 1 and 2 and 3. The sum of those three numbers equals 6 so it is a perfect number.
2. 12 has exactly 5 factors that are different from 12 : 1 and 2 and 3 and 4 and 6 but their sum equals 16 so 12 can't be a perfect number.
3. The factors of 28 are 1 and 2 and 4 and 7 and 14 and 28 itself. The sum of the five factors that are different from 28 is 28 so it is a perfect number!
4. The first two perfect numbers are the product of a power of 2 with the difference between the next power of 2 and 1. It is also important to notice that the second factor of this product must be prime.

Let's try to build another number with this pattern: the next will be  $2^3 \times (2^4 - 1) = 8 \times 15$  but 15 is not prime because it is the product of 3 and 5. So this number is not a perfect one.

Let's try the next one which is:  $2^4 \times (2^5 - 1) = 16 \times 31$  and 31 is prime so the result 496 may be perfect. This is true because its factors are 1, 2, 4, 8, 16, 31, 62, 124 and 248 except 496 itself and their sum equals 496.

The next one is not perfect because  $2^5 - 1 = 31$  isn't prime and finally the number which is the result of  $2^6 \times (2^7 - 1) = 64 \times 127 = 8128$  is perfect because it is equal to the sum of 1 and 2 and 4064 and 4 and 2032 and 8 and 1016 and 16 and 508 and 254 and 32 and 127 and 64 which are all its factors different from itself.

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**Corrigé du sujet : The origins of Trigonometry  
Thème : Géométrie**

**Si nécessaire, et notamment si le candidat n'est pas en Term S, le jury rappellera (ou guidera vers) les formules de cosinus et sinus dans un triangle rectangle.**

3. a) Verify that  $35^\circ 25' \approx 35.4^\circ$

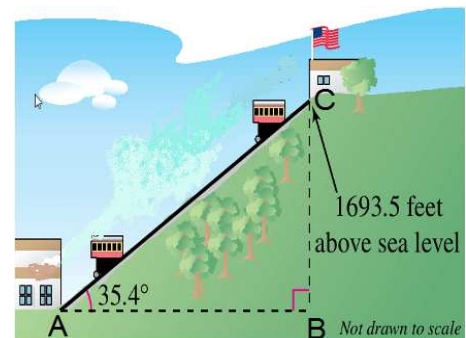
$$1' = \left(\frac{1}{60}\right)^\circ \text{ therefore } 35^\circ 25' = 35^\circ + \left(\frac{25}{60}\right)^\circ \approx 35.4^\circ$$

b) the vertical rise of the railway cars.

$$\sin(\widehat{BAC}) = \frac{BC}{AC} \text{ So } BC = AC \times \sin(\widehat{BAC})$$

$$BC = 876.1 \times \sin(35.4^\circ)$$

$$BC \approx 502.5 \text{ feet}$$



c) the elevation of the bottom landing ?

$$1693.5 - 502.5 = 1191$$

The bottom landing is 1191 feet above sea level.

d) rate : 300 feet per minute. How long is the trip ?

$$\text{speed} = \frac{\text{distance}}{\text{time}} \text{ hence } \text{time} = \frac{\text{distance}}{\text{speed}}, \text{ consequently : } t = \frac{876.1}{300} \approx 2.92$$

The trip is approximately 2.92 minutes long, that is 2 min 55 sec.

e) The road sign in US...



The American road sign reads the quotient  $\frac{\text{vertical rise}}{\text{horizontal distance}}$  in percentage, that is :  $\frac{BC}{AB} = \tan(\widehat{BAC}) \approx 71\%$

More about road signs ?



In Europe, the road sign for that dangerous steep road would be quite different, it would read  $\frac{\text{vertical rise}}{\text{travelling distance}}$  in percentage, that is :

$$\frac{BC}{AC} = \sin(\widehat{BAC}) \approx 58\%$$

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**CORRIGÉ SUJET 5**

**Commentary**

The candidate can highlight the fact young people read less books, but the author supposes the different ways to read have changed with the arrival of the new technologies. He can either comment on that point of view or comment on the results of the studies mentioned in the text and give a personal opinion on the phenomenon. He can also give his opinion using his personal experience.

**Exercise**

1. 16 Students read three books precisely.

2.  $20+22+16 = 58$ . 58 students out of 125 read three books or less.  
In percentages  $(58/125) * 100 = 46.4 \%$

3. The mode is the datum with the highest frequency. It's 2

4. The mean (average) is

$1*20+2*22+3*16+4*13+5*12+6*10+7*8+8*8+9*6+10*7+11*3 ) / 125 = 4.488$  ( about 4.5).

Decreasing by 35 % equals multiplying by 0.65.

The mean in 2014 was  $4.448 * 0.65 = 2.9172$  (about 3).

5. The number of values is 125. It's an odd number .If the values are classified in increasing order, the medium is the  $(125 + 1) / 2 = 63$ rd value.

53 values are smaller than (or equal to) 3 and 66 are smaller than 4.

The 63rd value is 4.  $med = 4$

It means that half the students read less than 4 books in one year

(The candidate can speak about the median as “the value in the middle “or as “the value which cuts the set in two sets with equal sizes“....)

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**SUJET 7**

**Theme: Maths and music: sequences, ratios, equalities**

Part 1: The students can tell that Fibonacci numbers are also linked with nature like in the pine cone, the sunflower, some trees, and flowers, they are linked with the Fibonacci spiral which is nearly the same as the shape of a nautilus. They can also speak about the golden rectangle that we can find in architecture and paintings.

If they don't know a lot about Fibonacci, they can explain what is a sequence, and what are the sequences they know, what are the use of it.

Part 2:

- 1)  $u_{n+1} = u_n + u_{n-1}$  or, to obtain a number of the Fibonacci sequence, we have to add the two previous numbers of the sequence.

2) 
$$\frac{a+b}{a} = 1 + \frac{b}{a} = 1 + \frac{1}{\varphi}.$$

3)  $1 + \frac{1}{\varphi} = \varphi$ ,  $\varphi + 1 = \varphi^2$  which can be rearranged to  $\varphi^2 - \varphi - 1 = 0$ .

To go further:

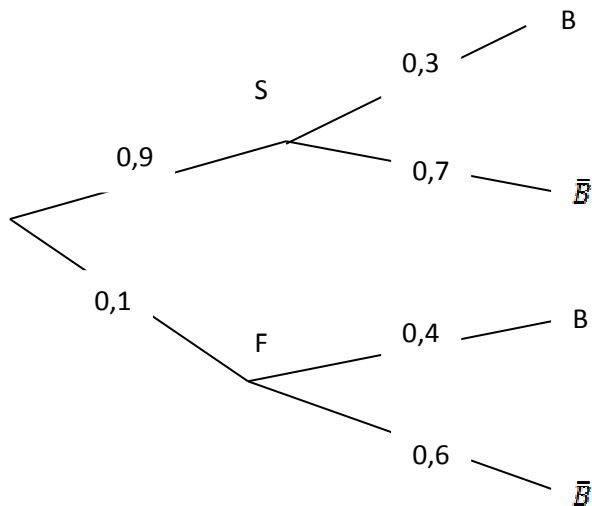
- It could be asked to solve the equation if the student is in T S or T ES.
- It could be asked to tell what is a sequence, what is an arithmetic sequence, a geometric one, using the vocabulary linked to it (common ratio, common difference), and may be to prove the sum of an arithmetic or geometric sequence.
- It could be asked a method to simplify a ratio, what is a HCF.
- It could be asked if the student know other famous numbers (like prime numbers: what are they, is there an easy way to find them (The sieve of Erathostène), or pi, or e...)

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**CORRIGÉ SUJET 8**

**Theme: Conditional probabilities**

1)



2)  $P_S(B) = 0.3$

The probability that the student is a boy knowing that the student learns Spanish is 0.3

3)  $P(S \cap B) = 0.9 \times 0.3 = 0.27$

The probability that the student is a boy and learns Spanish is 0.27

4)  $P(B) = 0.9 \times 0.3 + 0.1 \times 0.4 = 0.31$

The probability that the student is a boy is 0.31

5)  $P_B(S) = \frac{P(S \cap B)}{P(B)} = \frac{0.27}{0.31} \approx 0.87$

The probability that the student learns Spanish knowing that he is a boy is 0.87

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**CORRIGÉ SUJET 9**

1) For all the squares there are two possibilities: white or black.

There are 478 squares ( $25 \times 25 - 7 \times 7 \times 3$ )

So there are  $2^{478}$  possibilities.

2) There is only one totally white QR code and its probability is  $\frac{1}{2^{478}}$ .

3) For a half-black QR code, there are 239 ( $478/2$ ) black squares and 239 white squares.

The probability of this is:  $\binom{478}{239} \times \frac{1}{2^{478}}$



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**CORRIGÉ SUJET 10**

**Thème: Les suites**

1) a)  $u_1 = 1 + 0.05 = 1.05$   $u_2 = 1.05 + 0.05 = 1.1$ .

b) At each step we add 0.05 so the sequence is an arithmetic one and 0.05 is the common difference  $d$ . We get:  $u_n = u_0 + n d = 1 + 0.05 \times n$ .

c) So  $u_6 = 1 + 0.05 \times 6 = 1.30$  thus the level of the sea in 2100 would reach 1.30 m according to this hypothesis.

2) a) As the level of the sea will rise by 12,25% at each period, we can say that :

$$v_{n+1} = v_n + \frac{12.25}{100} v_n = \left(1 + \frac{12.25}{100}\right) v_n = 1.1225 v_n.$$

So this is a geometric sequence and the common ratio is 1.1225.

So we get:  $v_n = v_0 \cdot 1.1225^n = 1.1225^n$ .

b)  $v_6 = 1.1225^6 \approx 2$ . So  $v_6 - v_0 \approx 2 - 1 = 1$  and  $u_6 - u_0 = 1.3 - 1 = 0.3$ .

According to the first hypothesis, the sea would rise by 0.3m but according to the second one this elevation would reach 1meter in 90 years and more than 0.5m in 60 years because  $v_4 > 1.5$ . It means that, according to that hypothesis more than 150 million people should move away to survive before 2070.

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**CORRIGÉ SUJET 11**

**Thème: Arithmétique**

**Properties of the number 2015**

3. A prime number is a natural number with exactly two divisors: 1 and itself.
4. a) The “ones digit” is the digit immediately to the left of the decimal point. Every natural number ending with a 5 (or with 5 as the ones digit) can be divided by 5.  
b) The conversion would be: *“Since it can be divided by 5, its ones digit is a five”*. This statement is false: 10 is a counter-example.
5. We can find it by multiplying the three smallest prime numbers :  $2 \cdot 3 \cdot 5 = 30$
6. a) The eight divisors of 2015 are :  $\{ 1 ; 5 ; 13 ; 31 ; 65 ; 155 ; 403 ; 2015 \}$   
b) A sphenic number is one that can be written  $n = p \cdot q \cdot r$ , where  $p$ ,  $q$  and  $r$  are distinct prime numbers.  
Then the set of divisors of  $n$  can only be :  $\{ 1 ; p ; q ; r ; pq ; pr ; qr ; n \}$

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**CORRIGÉ SUJET 12**

**Thème: Fonctions**

**Logarithms**

Éléments à prendre en compte pour évaluer la capacité d'analyse et d'argumentation :

- Intérêt de la fonction logarithm (rendre les calculs plus rapides)
- Contexte historique (les calculs astronomiques nécessitaient de multiplier de grands nombres).
- Eventuellement expliquer la dernière phrase.

1. For example;  $2 \times 3 = 6$  . The image of 2 under  $f$  is 0.69 315.  
The image of 3 under  $f$  is 1.09 861.  
The image of 6 under  $f$  is 1.79 176 which is equal to  $0.69\ 315 + 1.09\ 861$ .
2. As for any number  $a$  , we have  $a \times 1 = a$  , the image of 1 under  $f$  has to be 0.
3.  $21 = 7 \times 3$  . The image of 7 under  $f$  is 1.94 591.  
The image of 3 under  $f$  is 1.09 861.  
The image of 21 is then  $1.94\ 591 + 1.09\ 861 = 3.04\ 452$   
Using the same method, we find  $f(22) = 3.09\ 105$
4. To the division of two numbers of the first row corresponds the subtraction of the images under  $f$ .
5. For example,  $10 \div 5 = 2$  and  $f(10) - f(5) = 2.30\ 259 - 1.60944 = 0.69\ 315 = f(2)$ .
6.  $0.1 = 1 \div 10$  , so  $f(0.1) = - 2.30\ 259$ .  
 $0.5 = 1 \div 2$  , so  $f(0.5) = - 0.69\ 315$ .  
 $1.5 = 3 \div 2$  , so  $f(1.5) = 1.09\ 861 - 0.69\ 315 = 0.40\ 546$ .
7. For any number  $a$  , we have  $a \times 0 = 0$  . If 0 had an image under  $f$ , all the numbers would have the same image.  
 $3^5 = 3 \times 3 \times 3 \times 3 \times 3$  , so the image of  $3^5$  is equal to 5 times the image of 3. This is  $5 \times 1.09\ 861 = 5.49\ 305$ .

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**CORRIGÉ SUJET 13**

**Theme: Geometry and algebra**

**Aspect Ratios of Monitors Screen**

**1)**

a) Largeur  $w=15$ , hauteur notée  $h$ . On a  $w/h=5/4$  donc  $h=12$ .

b) D'après le théorème de Pythagore : la diagonale a pour longueur :

$$\sqrt{15^2 + 12^2} = \sqrt{369} \approx 19.2 \text{ inches.}$$

**2)**

a) Notons  $w$  la largeur de l'écran. Sa hauteur est  $\frac{3}{4}w$ . Nous avons :

$$w^2 + \left(\frac{3}{4}w\right)^2 = 20^2.$$

On en déduit :  $\frac{25}{16}w^2 = 20^2 \Leftrightarrow \frac{5}{4}w = 20 \Leftrightarrow w = 16$ . La hauteur est donc

$$h = \frac{3}{4}L = \frac{3}{4} \times 16 = 12.$$

b) Connaître la longueur de la diagonale ne suffit bien sûr pas. Par exemple si la forme était carrée et la diagonale la même que précédemment on trouverait

$$w = h = 10\sqrt{2} \approx 14.1.$$

**3)** Le choix du 2<sup>ème</sup> écran est meilleur. (ce qui n'est pas surprenant car sa forme est plus proche de celle d'un carré)

***Éléments à prendre en compte pour évaluer la capacité d'analyse et d'argumentation :***

- Faire la distinction entre « taille » d'un écran et sa « forme »
- Savoir justifier un choix en donnant des arguments précis.
- Quelques développements sur le nombre d'or seraient les bienvenus.
- Capacité à prendre des initiatives et à interagir avec les professeurs dans la dernière question.