

# Matematica Senza Frontiere Junior

13-14 year old students

## Preliminary exercise tool

- Use a single answer sheet for each exercise. For each exercise, only one solution can be included, otherwise the answer will not be considered.
- Solve the exercise #1 in the foreign language that you prefer
- Partial solutions will still be considered
- During the assessment, it will be considered also the quality of the motivation provided in the answer (e.g., a scheme, a table, a drawing, an textual explanation)
- Particular attention will also be given to the care used in writing the solutions

### Exercise #1 (7 points)

The solutions must be written in one of the proposed languages, using at least 15 words.

Il signor Charley Slowpop sta per domandare in sposa la sua fidanzata quando il fratellino di questa irrompe con Fido. " Voi non potete determinare l'età di un cane dal numero di pieghe del suo collo" afferma il bambino mpertinente, "ma cinque anni fa mia sorella era quattro volte più vecchia di Fido, ora la sua età è solo tre volte quella di Fido."

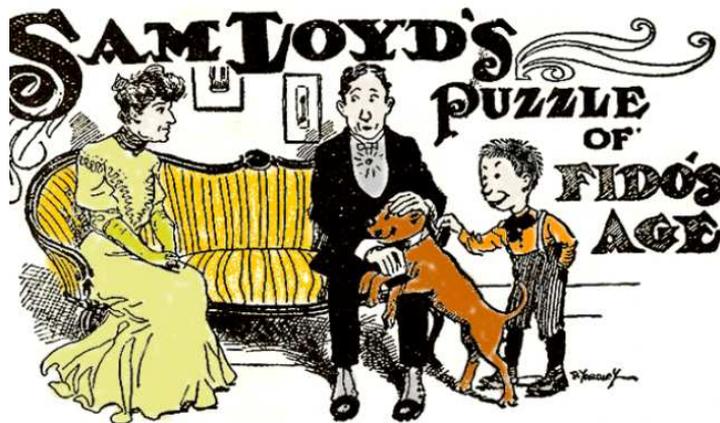
Il signor Charley Slowpop è proprio ansioso di conoscere l'età di Fido.

**Potete aiutarlo?**

Charley Slowpop estaba a punto de proponerle matrimonio a su novia cuando el hermanito de ésta y su perro irrumpieron en la sala. "No se puede determinar la edad de un perro por las arrugas que tiene en el lomo", dijo l'enfant terrible, "pero hace cinco años mi hermana era cuatro veces mayor que Fido... ¡y ahora su edad es sólo tres veces la de Fido!"

Charley Slowpop está muy ansioso por saber la edad de Fido.

**¿Alguien puede ayudarlo?**



(Sam Loyd is a trademarked name; the use for education purposes has been granted by the Sam Loyd Company, whose products can be accessed at [www.samloyd.com](http://www.samloyd.com))

Charles Slowpop était en train de faire sa demande de mariage à sa fiancée, lorsque le petit frère de celle-ci et son chien, Fido, entrèrent dans le salon.

"Tu ne peux pas reconnaître l'âge de Fido à son collier" dit l'enfant terrible, mais il y a cinq ans, ma soeur était quatre fois plus âgée que Fido, aujourd'hui, son age est trois fois celle de Fido!" Charles Slowpop aimerait connaître l'âge de Fido.

**Pouvez vous lui venir en aide?**

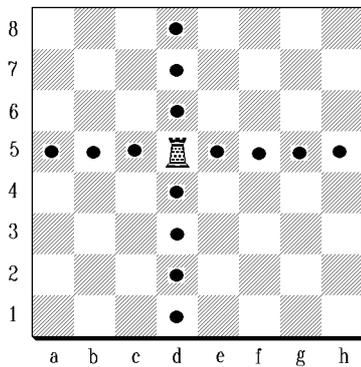
Herr Charley Slowpop ist im Begriffe um die Hand seiner Verlobte zu werben, als deren Bruder mit dem Hund Fido ins Zimmer tritt . "Sie können das Alter eines Hundes durch die Anzahl von Falten seines Halses nicht festsetzen" sagt der freche Knabe, "aber, heute vor fünf Jahren war meine Schwester vier Mal älter als Fido; heute ist das Alter meiner Schwester nur drei Mal größer"

Herr Charley Slowpop ist wirklich sehr gespannt, Fidos Alter zu kennen.

**Kannst du ihm helfen?**

## Exercise #2 (5 points) Covering with Rooks

According to the chess' rules, the rook can move vertically along a column as well as horizontally along a row. It can move any number of steps from its starting position. You can think of the rook as controlling all the squares lying on the row and column of its starting position.

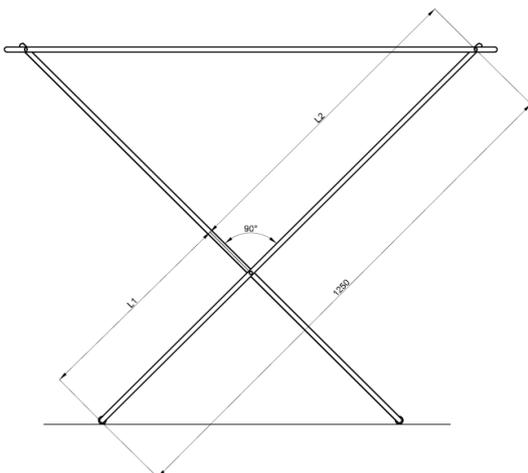


On a chessboard  $4 \times 4$ , four rooks are necessary to control or "dominate" all the squares of the chessboard. A square is said to be "dominated" by a piece when it is occupied or controlled by that piece.

- Place eight rooks on a chessboard  $8 \times 8$  so that all 64 squares are dominated.
- How many rooks are necessary to dominate all the squares in a  $50 \times 50$  chessboard? Please motivate your answer.

## Exercise #3 (7 points) How high is it?

The two support legs share the same length and, when opened, are perpendicular. The legs are 1,25 m long and are connected in a point that divides the legs into 2 parts, the longer part is  $\frac{3}{2}$  times the shorter part (see diagram below).

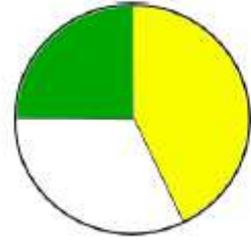


Before opening the package, the mother asks Paolo to compute the height of the drying rack when opened because she wants to be sure that the rack cannot be seen from the terrace, which has a parapet of 1.10 m.

**How high is the drying rack? Is it hidden by the parapet? Motivate your answer.**

#### Exercise #4 (10 points) The uncolored part

The fourth part of a circle (shown in the figure below) was coloured black and  $\frac{4}{7}$  of the remaining part was coloured grey. [Note for the instructors: we assume that these sheets are printed using a B/W printer]



*Write the numeric expression that summarizes the computations needed to identify the fourth part of the circle that was not coloured and identify this part.*

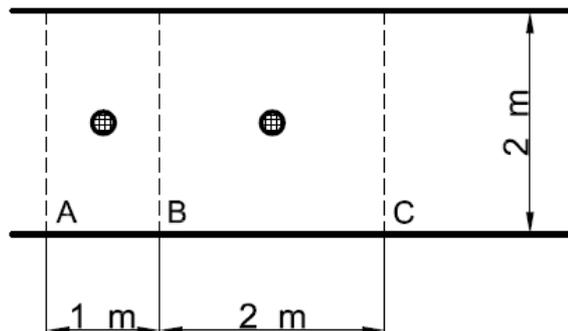
#### Exercise #5 (5 points) In the brook

Peter and Frank are enjoying some time out near the LYS brook. With a strainer, stolen from mom, they decide to look for macro-invertebrates. Very easy! These small animals live at the bottom of the brook.

They agree on the following rules:

- 1: they fish the animals in turns, Peter starts.
- 2: They choose a point of the brook that has a constant width of 2 metres and is shallow
- 3: they start from the position A, Peter measures 1 meter further down the bank and he sets this as position B. He puts the strainer in the middle of the identified area, collects the material, and passes the strainer to Frank, who continues, starting from position B, doubling the length identified previously and hence arriving to position C.

The game continues with the same rule of doubling the distance.



Now, *answer the following questions*:

1. After five turns, how many metres from point A have they moved along the bank?
2. Based on the table below, which shows how many macro-invertebrate samples they found during each turn, in which stretch did they find the highest density of macro-invertebrates (unit  $/m^2$ ) ?

Turn	samples
Peter	15
Frank	8
Peter	20
Frank	13

3. What is the average density of the stretch?

## Exercise #6 (7 points) Monica's Birthday

Wednesday, April 4 2012, Monica meets Steven.  
Monica would like to know the day of the week on which her birthday will be next year. Her cousin Steven, who is a swot, with some logical reasoning and some simple calculations has found the solution. Given that Monica's birthday is May 13<sup>th</sup>, **can you figure out how Steven did?**



## Exercise #7 (5 points) Geometry with Origami

A book of Origami illustrates the following method to obtain, without using a ruler or compass, regular polygons, starting with a square piece of paper.

- fold the sheet of paper in half, the square will have sides that measure 20 cm (see figure 1, 2)
- take the top sheet and fold it so that the vertex A falls exactly on the fold line. (figure 2, 3)
- cut the folded sheet, following line AB (figure 3)
- open the folded sheet (figure 4)

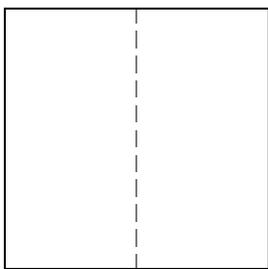


Fig. 1

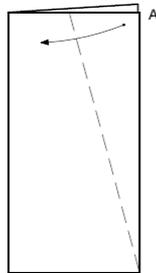


Fig. 2

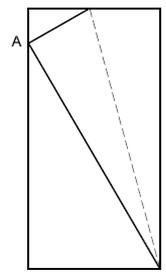


Fig. 3

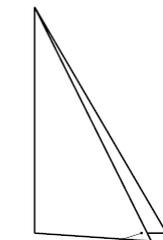


Fig. 4

**What kind of triangle have you obtained? Motivate your answer.**

## Exercise #8 (10 points) Odds or evens?

The expression  $(b-c+b) \cdot a$  with integers  $a, b, c$  yields an odd number as answer.

**State which of the following statements is correct:**

- 1) Both  $a$  and  $c$  are odd numbers
- 2) Both  $a$  and  $c$  are even numbers
- 3) If  $a$  is even,  $c$  can be either even or odd.
- 4) If  $a$  is odd,  $c$  can be either even or odd.
- 5) If  $a$  is even,  $c$  is odd and vice versa.

**Exercise #9 (7 points) Particular dates**

List all the dates with eight digits that are symmetrical between the slashes. (e.g., 21/12/2112)

**Exercise #10 (10 points) Sequence of cards**



We have a deck of cards in which the symbols



on every card can vary from 1 to 13..

**Considering this sequence of cards:**



**Draw the covered card so that you get a well-known sequence!**