

Matematica Senza Frontiere Junior

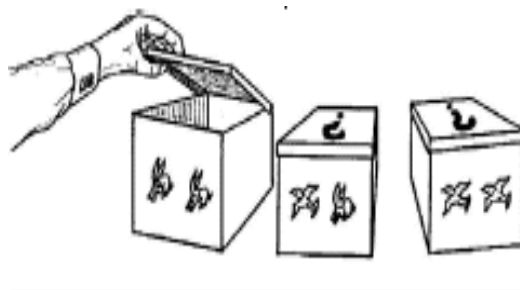
13-14 year old students

14th March 2013

- ? 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.



David le magicien entre en scène et présente au public trois grosses boîtes.

Sur l'une sont dessinés deux lapins, sur une autre sont dessinées deux colombes et sur la troisième un lapin et une colombe.

Les yeux bandés, David demande à un spectateur de placer deux lapins dans une boîte, deux colombes dans une autre et enfin un lapin et une colombe dans la dernière boîte de façon que le contenu de chaque boîte ne corresponde pas à son dessin.

David déclare alors qu'il lui suffit de sortir un seul animal d'une seule des trois boîtes pour trouver le contenu de chaque boîte.

Expliquer son raisonnement.

Il mago Davide entra in scena e presenta al pubblico tre grandi scatole. Su una sono disegnati due conigli, su un'altra due colombe e sulla terza un coniglio e una colomba. Gli occhi bendati, Davide chiede ad uno spettatore di inserire due conigli in una scatola, due colombe in un'altra e, infine, un coniglio e una colomba nell'ultima in modo che il contenuto di ogni scatola non corrisponda alla decorazione esterna.

Davide dichiara che gli basta togliere un solo animale da una sola scatola per indovinare il contenuto di ogni scatola.

Spiegare il suo ragionamento.

David el mago sale a escena y presenta al público tres cajones gruesos.

Sobre el primero ha dibujado dos conejitos, sobre el segundo dos palomas, y sobre el tercero un conejito y una paloma.

Vendados los ojos, David la pide a un espectador que ponga dos conejitos en un cajón, dos palomas en otro y por fin un conejito y una paloma en el último cajón, de tal manera que lo que contiene cada cajón no corresponda con el dibujo.

Entonces David declara que no le hace falta sacar más de un animal de un solo cajón para saber lo que contiene cada cajón.

Explicad su razonamiento.

David, der Zauberer betritt die Bühne und zeigt dem Publikum drei Kisten. Auf eine dieser Kisten sind zwei Kaninchen gemalt, auf eine andere zwei Tauben, auf die dritte eine Taube und ein Kaninchen.

Mit verbundenen Augen bittet David einen Zuschauer, in eine Kiste zwei Tauben, in eine andere zwei Kaninchen und in die letzte ein Kaninchen und eine Taube zu setzen. Dabei soll das Bild auf der Kiste in keinem Fall mit dem Inhalt übereinstimmen.

Nun behauptet David, daß es ihm genüge, nur eine der drei Kisten ein einziges Tier zu entnehmen, um den Inhalt aller Kisten herauszufinden.

Erkläre, was sich der Zauberer dazu überlegen muß.

Exercise #2 (10 points) Happy Floor

Paola must tile her kitchen pavement and must select the tile shape from the following alternatives: equilateral triangles, squares, regular pentagons and regular hexagons. Knowing that the tiles, no matter which shape, all have sides of the same length, **if Paola wanted to use 2 shapes from the ones listed, which two would she select? Draw or cut and paste four different possibilities for tiling the floor that Paola can select.**

Exercise #3 (5 points) Panoramix and the Magic Potion.



It is 9:00 pm (21:00) on October 18, 2012.

**When will Panoramix be able to serve his super-soup?
Write the reasoning used on the answer sheet.**

Exercise #4 (7 points) Triangles Everywhere

Aldo plays the drums and one day he picks up two drumsticks that each measure 28 cm in length. He looks for a third drumstick (whose length is a whole number) so that he can form a triangle. How many centimeters, at MOST, **can the perimeter of the triangle be?**

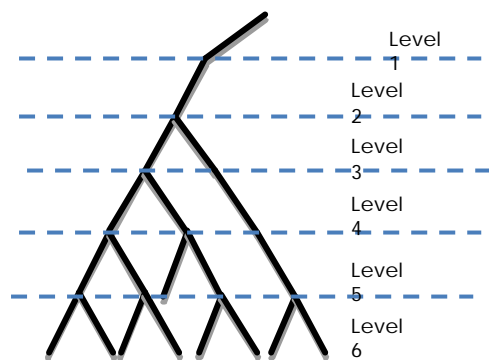
Motivate your answer.



Exercise #5 (10 points) The Fibonacci Tree

The graph shown here represents the branching out of a tree . The number of NEW branches at each level, is given by the Fibonacci sequence: 1,1,2,3,5,8 ... in which every number is obtained by the sum of the preceeding 2 numbers.

How many branches will there be on the 20th level ?



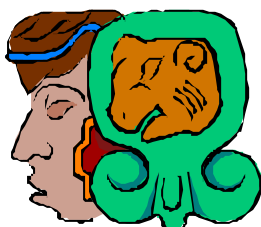
Exercise #6 (7 points) Refreshment Stands

Luigi's school has organized a 6 km run with 9 refreshment stands that are equally spaced along the 6 km run. Luigi has been assigned to the 7th refreshment stand while his friend Carlo has been assigned to a refreshment stand that is 2,400 m from the start of the run.

Which refreshment stand is Carlo in, and how far is the end of the run from Luigi's refreshment stand?



Exercise #7 (10 points) Sacred and Profane



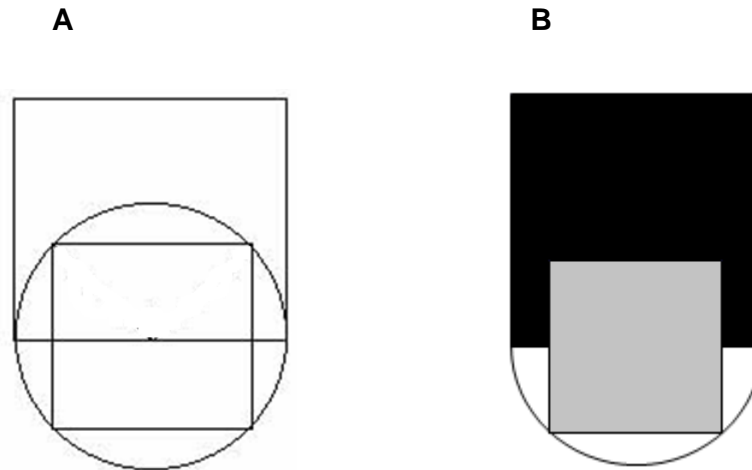
The Maya used 2 calendars: one was sacred and one was agricultural. The first one was reserved for the Gods and included 260 days divided into 13 months of 20 days each; the second calendar included 365 days divided into 18 months of 20 days each, plus a period of 5 painful days, where no one worked and everyone had to fast.

Every how many years does the first day of the year of the sacred calendar coincide with the first day of the year of the agricultural calendar? And every how many years with the agricultural calendar? Motivate your answer.

Exercise #8 (5 points) Factory Logo

Mr. Rossi wants to change his company logo. He likes geometric shapes and is studying one that he really likes. He draws a circle and two squares.

- one side of one of the squares is the diameter of the circumference.
- the other square, is drawn in the same circumference, so that he has a drawing like the one shown here (Fig A) that he colors (Fig B).



What is the ratio between the area colored in black and the one colored in grey?

Exercise # 9 (10 points) Dinner at AnnaMaria's

AnnaMaria has invited her friends for a Happy Hour to celebrate summer. Not all of the guests are on time, so AnnaMaria asks her husband Marcello to accompany the first 5 guests into the living room while she waits for the other guests to arrive.

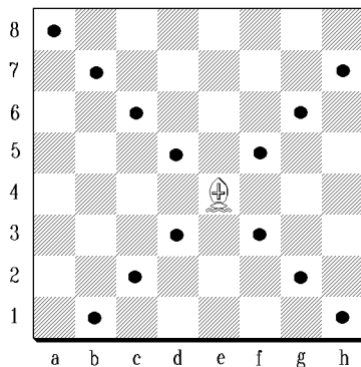
Marcello, who loves to play with numbers, asks his five friends (Carlo, Piera, Carla, Laura, Claudio) in how many ways they can sit in a row on the sofa so that they are always alternating man - woman.

Help AnnaMaria and Marcello's friends to find the answer. Indicate how you proceeded.

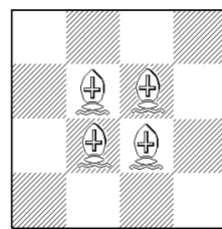


Exercise # 10 (7 points) Covering with the Bishop

In Chess, the Bishop moves diagonally and moves as many squares as he wants from his start position.



We can also think that the Bishop controls all the squares in his diagonal that can be either a white diagonal or a black diagonal. On a particular chessboard, 4x4, four Bishops are necessary to control or dominate the entire chessboard. A square is said to be dominated by a Bishop if it is occupied by the Bishop physically or it is controlled by the Bishop. For example:



- a) *What is the minimum number of Bishops necessary to dominate all of the squares in a 8x8 chessboard?*
- b) *What is the minimum number of Bishops necessary if the chessboard is 7x7? Motivate your answers.*