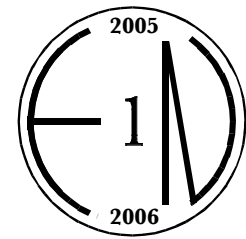


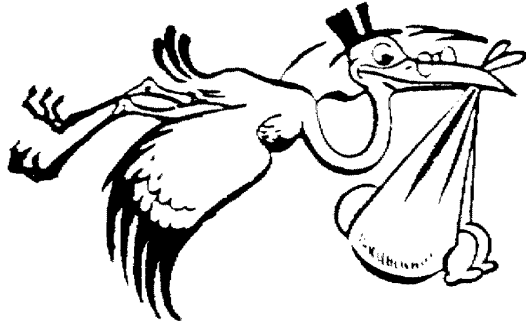
# Emmy Noether – Circle 1 for 2005-2006



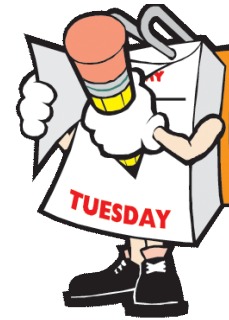
## Part I: Problems

### Problem 1:

Assuming that births are just as likely to occur on one day as on any other day, what is the probability of being born...



a) on a Tuesday?



- b) on February 28 in a non-leap year?
- c) on February 29 in a leap year?
- d) on February 29 in a non-leap year?
- e) on February 29 in any four-year period?
- f) on the first day of any month in a non-leap year?

February 28th

February 29th



### Problem 2:

Jane, Tobias, Mark, John, and Carbon each recycled a different number of cans (16, 17, 22, 25, 29) as well as a number of 'junk mail' letters (101, 102, 105, 136, 138).

We know that:

1. Jane recycled 80 more junk mail letters than cans;
2. Mark recycled a total of 124 cans and letters;
3. Carbon recycled the least number of cans;
4. John and Mark recycled a total of 289 cans and letters;
5. Tobias recycled the least number of letters;
6. John recycled fewer than 138 letters.



How many cans and how many junk mail letters did each person recycle?

### Problem 3:

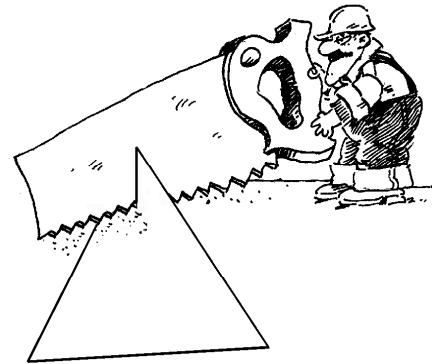
Show how to divide an equilateral triangle into;

- a) two triangles of equal area.
- b) three triangles of equal area.

Can you find more than one answer for either a) or b)?

### Extension:

Try to find at least three ways to subdivide an equilateral triangle into four triangles of equal area. Can you find more?



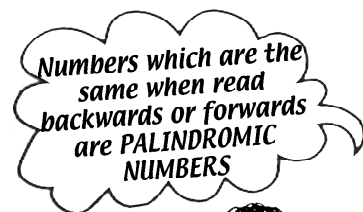
### Problem 4:

A palindrome is a number which is the same if its digits are reversed, e.g., 1331, 232, 77. The digit 0 is not used at the beginning/end of a palindrome, but can be used in the middle, e.g., 0110 is not allowed, but 1001 or 303 are.

- a) The nine single-digit numbers 1, 2, ..., 9 are the simplest palindromes. Show that there are only nine 2-digit palindromes as well.
- b) How many 3-digit palindromes are there?
- c) How many 4-digit palindromes are there?
- d) What do you notice about the number of 3-digit versus 4-digit palindromes? Why do you think this happens?
- e) How is the number of 3 and 4-digit palindromes related to the number of 1 and 2-digit palindromes? Why does this happen?

### Extensions:

1. What 2-digit number is a factor of all the 4-digit palindromes? Is it also a factor of the 3-digit palindromes?



Yes!  
4  
22  
131  
45854



2. Use your answers from a), b), and c) to fill in the number of palindromes with 1, 2, 3, or 4 digits. There is a pattern in the number of palindromes as the number of digits increases. Knowing this, what would you predict to be the number of 5-digit palindromes? 6-digit? 7-digit? 10-digit?

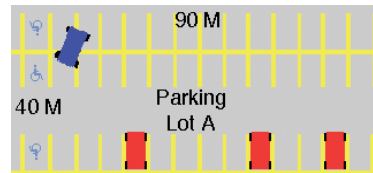
Explain why your predictions are correct.

Digits	Number of Palindromes
1	
2	
3	
4	
5	
6	
7	
10	

### Problem 5

A rectangular parking lot A is 90 meters long by 40 meters wide.

- How much less, in square meters, is the area of A than that of a square parking lot B with the same perimeter as A?
- If a parking lot must be at least 20 meters wide, and its length and width are whole numbers, how many other rectangular parking lots have the same area as A?



#### Extension:

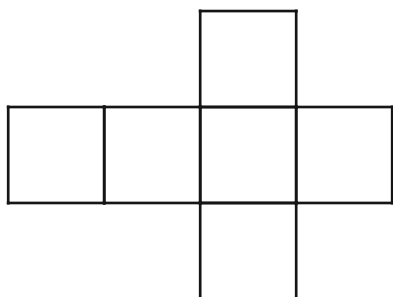
If a parking lot must be at least 20 meters wide, and its length and width are whole numbers, how many other rectangular parking lots have the same perimeter as A?

### Problem 6 (Suggested for groups of students)

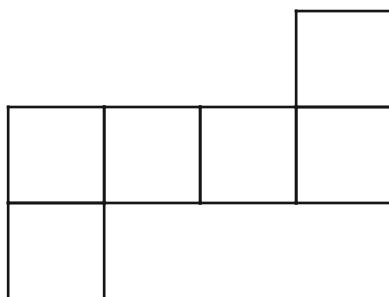
#### Minimal Waste Boxes

You are a manufacturer in need of cubic boxes for shipping chocolate eggs. Your design engineer has presented you with the three nets of cubes below as possible templates.

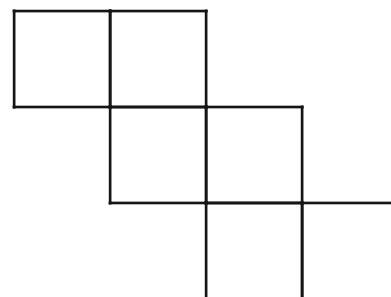
Net 1



Net 2



Net 3



- Using ONE of the given designs, determine the maximum number of boxes that can be cut from the grid below, and count the squares wasted. (You may rotate or flip the template in any manner you like.)
- Repeat a) for another design. Is there more waste, or less waste than before?



# BOXES

How many can you make?

***Extension:***

Using any of the given nets, or any other cube net you design, try to discover which net wastes the least number of squares.

