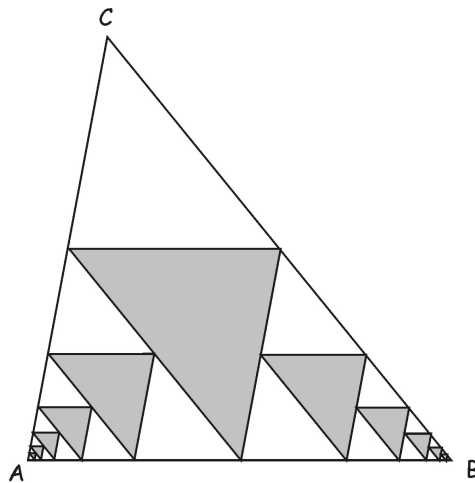


PROBLEM OF THE MONTH: January 2013

MATHEMATICS

What fraction of the area of the triangle ABC does the infinite sequence of shaded median triangles occupy (see figure)?

A median triangle is obtained by connecting the midpoints of the sides of a given triangle.



PHYSICS

Two identical railroad cars are moving side-by-side on parallel horizontal tracks with the same initial velocity and without friction. Snow is falling (vertically). A person, standing on the roof of the first car facing forward, keeps brushing some snow off the roof by repeatedly moving a broom left-to-right and right-to-left (i.e. the snow leaves the roof perpendicular to the tracks as seen by the person). A person on top of the other car does nothing. Will either of the two cars get ahead, and, if so, which one? Explain your answer.

CHEMISTRY

Suppose you invite a friend to your house. As you are having a snack in the kitchen, she asks you to demonstrate what a chemical reaction looks like. You immediately decide to impress her with your knowledge of chemistry, and you tell her: "Oh, I can show you quite a few reactions just with the substances found in my kitchen, laundry and living room!" What are the reactions you would demonstrate to her?

For each reaction, please:

- Name the substances could you use (for example, sugar, table salt, etc.).
- Write the chemical equations of the reaction.
- Describe the experimental conditions (for example, "I'll dissolve a teaspoon of X in a cup of water, add Y gradually and heat the solution").
- Describe the results you expect to obtain (for example "I expect a color change from blue to white")..

BIOLOGY

It is known that milk of mammals varies in its fat content from as low as 2% in, for example, monkeys, wolves, and cows to as high as 65% in whales, polar bear, and hares. How would you explain this fact? Provide at least 2 additional examples of animals having low and high milk fat content and explain why do you think it is happening in each particular case.