International Natural Sciences Tournament, 2010-2015
www.scitourn.ru
participants@scitourn.com || +7 (812) 958-73-27 || skype: scitourn
Saint-Petersburg State University
198504 Russia, Saint-Petersburg, Petrodvorets, Universtitetsky prospect, 26.

Problems of VI International Natural Sciences Tournament
11-16 November 2015, Saint Petersburg, Russia

Version 2, 20.09.2015. Contains 10 problems.

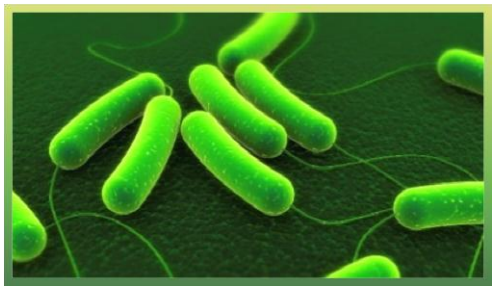
Methanol

It happens that dishonest producers of windshield washer fluids replace isopropanol with less expensive, but more hazardous to health methanol without notifying the consumer about it in any way. Methanol poisoning can lead to blindness and even death.

Propose a simple and rapid test method for detecting methanol in windshield washers in the presence of isopropanol and/or ethanol. The method should be accessible for a common motorist without special education. Can your method be used for detecting methanol in other practically important systems?

Bacteria on a leash

Currently, scientists are actively researching the possibility of creating new microorganisms for use in industry and agriculture (e.g. for microbiological synthesis). However, in everyday life (in an apartment, office, store...) people are rarely confronted with deliberate use of microorganisms.



Propose a new method of using microorganisms in everyday life, that is, in your opinion, the most attractive for implementation. Prove its feasibility, evaluate the expected benefits and risks.

participants@scitourn.com || +7 (812) 958-73-27 || skype: scitourn
Saint-Petersburg State University
198504 Russia, Saint-Petersburg, Petrodvorets, Universtitetsky prospect, 26.

Mission Impossible

In the movie "Mission Impossible" secret agent Ethan Hunt (Tom Cruise) uses a device disguised as chewing gum, which is basically a half-red half-green stick. When these halves are combined, an explosion occurs after 5 seconds.

Based on this principle of operation, make up the composition of your own similar "chewing gum", which will not explode when activated, but will evolve enough heat to:

1) warm up a frost-jammed padlock at the temperature of -20° C

2) light a fire in field conditions

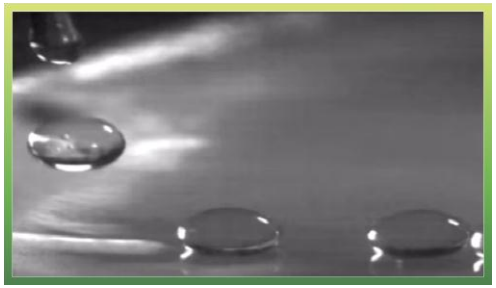
Is it possible to create a "chewing gum" suitable for both problems at the same time? For what other purposes one may use such a device?

The heating "gum" you propose should:

– be the same size and shape as a standard stick of gum.
– be activated by combining its two parts; its usage should not require any additional devices or materials; it should not release toxic gases.
– be safe when stored in package wrapping under normal conditions (in your pocket) and have a shelf life of at least 1 year.

Drops

When drops fall onto an oscillating liquid layer, they may remain on the surface up to several minutes without merging with the layer of liquid. This effect can be observed on a special vibrating table, as well as in the process of distillation, filtration or simply by dripping liquid from a certain height and with a certain speed.



Explain this phenomenon, determine the conditions under which it occurs, and, most importantly, propose a practical application for this phenomenon.

participants@scitourn.com || +7 (812) 958-73-27 || skype: scitourn
Saint-Petersburg State University
198504 Russia, Saint-Petersburg, Petrodvorets, Universtitetsky prospect, 26.

Glycol (from Clariant) *

Glycols form the base of heat transferring fluids used in food factories for cooling products during the manufacturing process. These coolants have a long, though finite, service life. After some time, due to the deterioration of operational properties, the user is confronted with the problem of utilization. Currently, methods of combustion and microbial decomposition are used for this purpose. Each of them has its own weaknesses and harms the environment. The volume of the coolant, which has to be recycled simultaneously, depends on the production capacity and typically is tens of tons.

Propose an economically feasible method of disposing glycol-containing heat transferring fluids, which will improve the technology of handling this type of waste and reduce the negative impact on the environment compared to the already known approaches.

* The team with the best solution of this problem will be awarded a visit to the Clariant laboratory in Europe. For more information about this contest, ask the organizing committee or visit our website www.scitourn.com

participants@scitourn.com || +7 (812) 958-73-27 || skype: scitourn
Saint-Petersburg State University
198504 Russia, Saint-Petersburg, Petrodvorets, Universtitetsky prospect, 26.

Alpechin

After the extraction of oil from olives there remains a liquid, which is called "alpechin" in Spanish. Most often, having found no better way to use it, alpechin is simply evaporated in the sun, and some dishonest manufacturers even dump it into rivers. This harms the environment because alpechin contains toxic phenolic compounds, and the annual volume of its production worldwide is about 30 million tons.

Propose an economically advantageous way to use alpechin, or a method of its disposal, which would be affordable by price and labor effort for small businesses that produce olive oil.

Fake milk

Counterfeit of natural milk is a serious problem in developing countries. Drinking adulterated milk is harmful and can lead to serious health problems when given to children.

What are the ways of counterfeiting milk? Suggest a method of analyzing milk, which would allow to distinguish between the natural product and the counterfeit. The method should be affordable for household use by people in developing countries.

To protect from sun protection

Every year about 6 thousand tons of sunscreen is washed away into the seas. In most cases, microcrystalline titanium dioxide is used as an UV filter in such creams, which is considered to be biologically harmless. However, in seawater, when titanium dioxide is exposed to sunlight, reactive compounds are formed and kill phytoplankton, which serves as food for fish.

Propose an effective UV filter in the form of a microcrystalline inorganic powder that would be safe both for humans and for marine life.

participants@scitourn.com || +7 (812) 958-73-27 || skype: scitourn
Saint-Petersburg State University
198504 Russia, Saint-Petersburg, Petrodvorets, Universtitetsky prospect, 26.

Gel pressure sensor

There are colored gel pads for controlling pressure distribution. Areas that are longtime exposed to higher pressure become lighter, and after some time the pad is restored. Today these pads are used to choose sports equipment, for example, saddles in equestrian (the «impression pad»). However, they are quite expensive and not widely available.

Where else gel pad-sensors with such operation principle could be used? Propose a method to produce them at home.

Stop the pine shoot beetle

In North America, there is a problem with pine shoot beetles, which destroy pine forests on huge areas. Suggest an economically feasible and environmentally safe method of saving forests from these pests.

The total number of problems will be 15, namely 5 problems for each day of competition.

The last 5 problems will be published on 11th October at the latest.

Note that the order of problems publication does not correspond to their distribution between tournament days.

When all 15 problems will be published, they will be separated into three blocks. Each of these blocks will be played on a certain tournament day, but on what exactly will be announced close to the tournament start.

At the current stage, we recommend you to pay equal attention to all of the presented problems.