



International Natural Sciences Tournament, 2010-2015

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

Version 1, 20.08.2015. Contains 5 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.

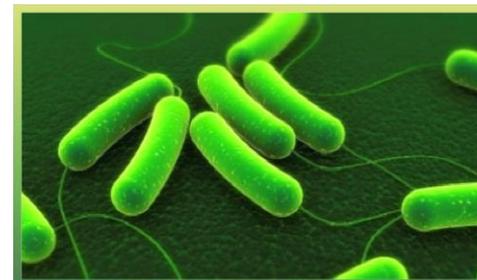
Propose a simple and rapid test method for detecting methanol in windshield washers in the presence of isopropanol and/or ethanol. The method should be accessible for a common motorist without special education. Can your method be used for detecting methanol in other practically important systems?



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.





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.





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

The next 5 problems will be published until 20th September, and the last 5 problems on 11th October at the latest.

Note that this is not the distribution of problems 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.

* 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