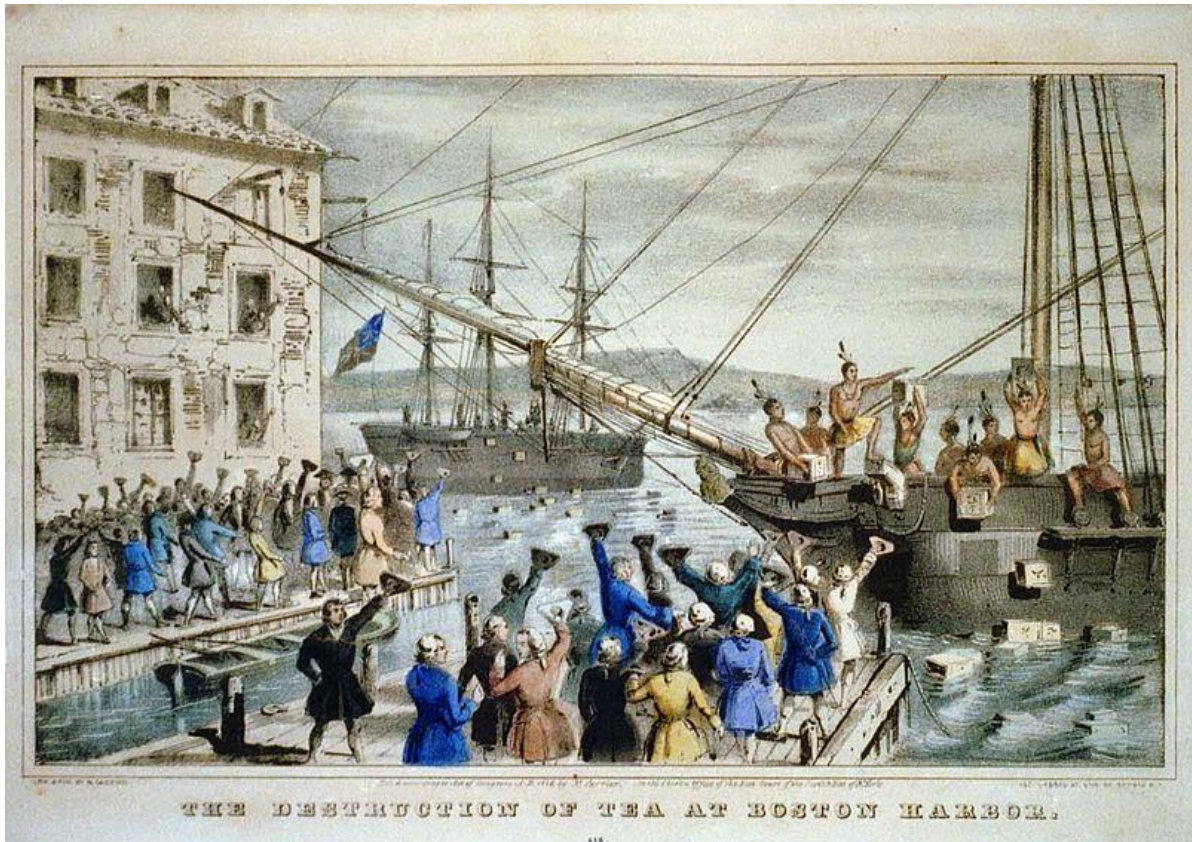




ICHTo Problem set 2026

HUNGARIAN QUALIFIERS



P1 - UNSINKABLE TEA

In December 1773, a group of American colonists boarded British ships docked in Boston Harbor. During what later became known as the Boston Tea Party, they threw 342 chests of tea into the sea, in protest against British taxation. The freezing, salty water quickly soaked through the containers, ruining all the tea and causing a major financial loss for the British.

Suppose, however, that the British had anticipated this act of defiance. Imagine they sought chemical means to preserve their tea against the assault of the sea. Your task is to propose such a protective treatment that would shield ordinary, commercially available teabags from the freezing, salty waves, yet dissolve entirely in boiling water, without significantly altering the taste, odor or texture of the beverage, so it may still be prepared and consumed in the manner originally intended. The chemical treatment should be harmless to health, and your solution must include the detailed manufacturing process of such teabags. You may use any currently available knowledge to solve the problem, but regarding materials and equipment, you are limited only to what was available approximately 250 years ago, at the time of this historical event.



P2 - STARRY NIGHT, STARRY DAY

In Vincent van Gogh, the well-known Dutch post-impressionist painter produced more than 1,000 paintings during his lifetime and was famously infatuated by the colours he used. Many of his paints contained organic pigments, although considered to be the most vibrant hues available in his time, with age started to change their appearance. By now, only a few of his paintings showcase a truly red pigment, as all deteriorated to pinks, maroons, and oranges. More often than not, paints change their appearance due to a reaction with a component of the air: such as oxygen, humidity or other gases (such as carbon dioxide, sulfur oxides, or nitrous oxides).

An intentionally colour-changing painting might be a visually pleasant way to monitor the state of our living spaces. Propose a pigment, or a mixture of pigments, which could be used to produce conventional artworks, and if placed into a room, a change in its appearance can monitor the level of a component of the airspace in the room. The change must be due to a chemical reaction between the pigment and a component of the airspace, commencing on the canvas. This change must be reversible, with a shelf-life comparable to that of a conventional painting, reasonably sensitive and responsive. Your solution must detail the manufacturing process of the pigment, the stimuli of the change, the sensitivity of the pigment, the timeframe and repeatability of the reaction, and the chemical basis of this reaction.



P3 - LIFE VESTS FOR AIRSHIPS

Airships - the graceful soarers of the sky - were once imagined as the future of air travel, and as environmental considerations are given increasingly higher priority, they might as well become so. Their popularity declined after tragic accidents such as the Hindenburg's disaster and were outcompeted by the much faster, cheaper, and more controllable airplanes. Catastrophes often result in tighter safety regulations, such as increased number of lifeboats after the sinking of the Titanic.

Your task is to design a life vest that can be used to keep people afloat in the air instead of water. Your device should work by the same principle as inflatable life vests on airplanes, inflating by gas release when triggered during an emergency (i.e. not a parachute-like device). Explain how your device can be stored and used safely. Would it be possible to control the amount of lift provided?



P4 - NO MORE TEARS

To quote BBC's Philomena Cunk, one of the greatest mysteries of life is "Why do we cry, if onions are the ones getting hurt?" Onions are capable of producing a molecule called syn-propanethial-S-oxide by a multi-step enzymatic reaction upon damage of the plant's tissues, as such when dicing them up with a knife. This causes a lacrimatory effect upon reaching one's eyes, making the person tear up – the body's attempt to wash the irritative substance away from the sensitive membranes. There are a number of kitchen tricks to lessen the effects, but it would be nice to have a device that directly neutralises the irritating compounds.

Your task is to design a tool that can mitigate the irritation by enabling absorption or chemical conversion of the relevant substances in a non-enclosed space, while also leaving the onions themselves palatable and posing no harm to the user. At which part of the process would your device act? How efficient and durable would your device be?



P5 - STRIKING LEAD

Lead is a metal often found as a contaminant in tap water, especially in buildings with outdated plumbing systems. This is a serious health hazard, as consumption of lead-containing water for extended periods of time causes neurological and developmental problems, as well as cardiovascular diseases. Unfortunately, once lead is absorbed by the tissues, it is very difficult for the body to effectively dispose of it. Therefore, monitoring lead concentrations in our living spaces, especially in our drinking water is essential.

Propose a simple protocol to measure the lead concentration in tap water, and determine whether the water sample is safe to consume. Your proposed solution should only utilise equipment and materials available in a typical high-school chemistry laboratory or pharmacy.