Kémia angolul
Szerkesztő: Sztáray Judit

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Kedves Diákok!

Remélem, az elmúlt nyáron sokat szórakoztatok, pihentetek és gyűjtöttétek az energiát az idegen nyelvű kémia szövegek fordítására! Szeptembertől újra indul az angol rovat és a fordítási verseny. Bízom abban, hogy a választott témák felkeltik az érdeklődéseteket, és kedvet kaptok egy kis angolozásra.
Következzen tehát most némi információ:
1. A beküldött fordításokat a lentebb közölt irányelvek szerint pontozzuk. Maximálisan 100 pontot lehet kapni egy hibátlan fordításra. Ha valaki véletlenül nem tudja befejezni a teljes szöveget határidőre, dolgozatát akkor is küldje be, hiszen a rész-szöveg fordításával elért pontok is beleszámítanak a pontversenybe. A pontverseny a tanév végével zárul majd le, az első három helyezett könyvjutalomban részesül.
2. Az elmúlt tanév tapasztalatai azt mutatják, hogy többen szeretnétek látni a már kijavított fordításotokat. Technikai okok miatt azt kérem, hogy küldjetek egy megcímzett és felbélyegzett borítékot a dolgozat mellett, és így azt vissza tudom küldeni annak, aki ezt igényli.
3. A formai követelmények nem változtak: **Minden egyes lap bal felső sarkában szerepeljen a beküldő teljes neve, iskolája és osztálya.** Törekedjetek az olvasható írásra, a nyomtatott formában beküldött dolgozatoknak külön örülök.
4. Mivel az angol tudást helyettetek senki más nem fogja megszerezni, kérek mindenkit, hogy önállóan dolgozzon, és szótáron, könyveken és az Interneten kívül más segítséget ne használjatok. Külön kérem az osztálytársakat, hogy ne együtt dolgozzanak, mert így nehéz eldönteni, hogy kinek a munkája a fordítás.
5. Néhány jó tanács: Figyeljetek oda az igeidők és a helyes magyar szórend használatára. Bár helyes eljárás, hogy a lefordított magyar szöveget „magyarosítjátok”, de ilyenkor nagyon figyeljetek oda, hogy ne írjatok többet a lefordított magyar szövegben, mint ami az eredeti angol szövegben szerepel.
A pontozás irányelvei:

- helytelen szóválasztás	– 1pont
- kimaradt szó	– 1 pont
- kimaradt mondat	– 3 pont

- helytelen egyeztetés, igeidő – 2pont
- rossz magyar szórend – 2pont
- helyesírási hiba – 1pont

Következzen tehát az idei tanév első angol szakszövege. Remélem, az augusztus 20-i élményeiteket még nem felejtettétek el, és kíváncsiak vagytok, hogy mi a tűzijátékok kémiai alapja. (A táblázatot nem kell lefordítani.)

Beküldési határidő: ***2005. november 4-ig:***
A fordítást a következő címre küldjétek:
KÖKÉL Kémia idegen nyelven
ELTE Kémiai Intézet
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The Chemistry of Fireworks

Fireworks have been the high lights of celebrations for centuries, and for most of this time designing fireworks was considered a craft, not a science. It is only recently that the term pyrotechnics has became known, as people have tried to understand the chemistry and physics behind creating fireworks.

During fireworks, the generated energy distributes in three very noticeable forms: a tremendous release of sound, bright light, and heat.

In making firework devices, a blend of oxidizing agent, reducing agent, coloring agent (metal salt), and binders are put into holders ca. 4 cm in diameter. When ignited, the firework produces both sound and light effects.

From lift-off to color release, a carefully choreographed sequence of events takes place, producing the desired effects. The power needed to lift each device into the air is provided by the highly exothermic combustion of black powder, a combination of 75% potassium nitrate, 15% charcoal, and 10% sulfur.

The sights and sounds of the explosions are the result of several chemical reactions taking place within the device as it ascends into the sky. Oxidizers produce the oxygen gas required to burn the mixture of reducing agents and to excite the atoms of the light-emitting compounds.

The most commonly used oxidizers are nitrates, composed of nitrate ions (NO_3^-) with metal cations. Potassium nitrate is used most often, which decomposes to potassium oxide, nitrogen gas, and oxygen gas:

$$2KNO_3 \rightarrow 2K_2O + N_2 + 2.5O_2$$

When reacting, nitrates release two of their three oxygen atoms. Because the oxidation does not result in the release of all available oxygen, the reaction is not as vigorous and is more controlled. Nitrates, however, are usually not used in firework explosions, because reactions of nitrates do not produce a temperature high enough to excite certain metal salts.

Chlorates, on the other hand, are more explosive oxidizers, since the chlorate ions (ClO_3^-) release all their oxygen upon reaction. The produced temperatures are between 1700 to 2000°C and hence made possible the creation of much more intense colors.

$$2KClO_3 \rightarrow 2KCl + 3O_2$$

Their disadvantage is being less stable mechanically than nitrates, and therefore more dangerous to handle. This instability results from the fact that although the chlorine atom has the potential to bond with four oxygen atoms, in chlorates it bonds with only three, leaving the chlorine atom unsaturated and reactive.

In perchlorate ion (ClO_4^-), each chlorine atom is bonded to its maximum number of oxygen atoms, and so perchlorates are more stable than chlorates. Yet, perchlorate is able to release all four of its oxygen atoms. So, perchlorates are not only more stable, but more oxygen-rich than chlorates. They, like chlorates, produce more vigorous reactions than nitrates.

$KClO_4 \rightarrow KCl + 2O_2$

The oxygen released by nitrates, chlorates, and perchlorates in the compartments of the firework devices immediately combines with the reducing agents to produce hot, rapidly expanding gasses. The most common reducing agents are sulfur and carbon (charcoal), which react with oxygen to produce sulfur dioxide and carbon dioxide respectively:

$$O_2(g) + S(s) \rightarrow SO_2(g)$$

$$O_2(g) + C(s) \rightarrow CO_2(g)$$

These reactions release a great deal of heat energy, so no only are the gases produced rapidly, they are hot and rapidly expanding gases. This contributes to the explosive force of the reactions.

There are two main mechanisms of color production in fireworks, incandescence and luminescence.

Incandescence, also known as black body radiation, is light produced from heat. Heat causes a substance to become hot and glow, initially emitting infrared, then red, orange, yellow, and white light as it becomes increasingly hotter. When the temperature of a firework is controlled, the glow of certain components, such as charcoal, can be manipulated to be the desired color (temperature) at the proper time. Metals, such as aluminum, magnesium, and titanium, burn very brightly and are useful for increasing the temperature of the firework.

Luminescence is light produced using energy sources other than heat. Sometimes luminescence is called 'cold light', because it can occur at room temperature and cooler temperatures. The energy absorbed by an atom rearranges its electrons from their lowest-energy state, called the ground state, up to a higher-energy state, called an excited state. The excess energy of the excited state is emitted as light, as the electrons descend to lower-energy states, and ultimately, the ground state. The amount of energy emitted is characteristic of the element, and the amount of energy determines the color of the light emitted. For example, when sodium nitrate is heated, the released energy is about 200 kJ/mol, which is the energy of yellow light.

Sometimes the salts needed to produce the desired color are unstable. Barium chloride (green) is unstable at room temperatures, so barium must be combined with a more stable compound (e.g., chlorinated rubber). In this case, the chlorine is released in the burning of the pyrotechnic composition, to then form barium chloride and produce the green color. Copper chloride (blue), on the other hand, is unstable at high temperatures, so the firework cannot get too hot. This is the reason why the blue color is one of the hardest one to make.

Pure colors require pure ingredients. Even trace amounts of sodium impurities (yellow-orange) are sufficient to overpower or alter other colors.

A firework would not be complete without the sound in the form of whistles or booms. When the pyrotechnical compositions are contained within the narrow tubes of the firework, the escaping gases produce the whistling sound. The tremendous booms heard at ground level are the result of the rapid release of energy into the air, causing the air to expand faster than the speed of sound. This produces a shock wave, a sonic boom.

Color	Compound
Red	strontium salts, lithium salts lithium carbonate, Li_2CO_3 = red strontium carbonate, $SrCO_3$ = bright red
Orange	Calcium salts calcium chloride, $CaCl_2$ calcium sulfate, $CaSO_4{\cdot}xH_2O$, where x = 0,2,3,5
Gold	incandescence of iron (with carbon), charcoal, or lampblack
Yellow	sodium compounds sodium nitrate, $NaNO_3$ cryolite, Na_3AlF_6
Electric White	white-hot metal, such as magnesium or aluminum barium oxide, BaO
Green	barium compounds + chlorine producer barium chloride, $BaCl^+$ = bright green
Blue	copper compounds + chlorine producer copper acetoarsenite (Paris Green), $Cu_3As_2O_3Cu(C_2H_3O_2)_2$ = blue copper (I) chloride, CuCl = turquoise blue
Purple	mixture of strontium (red) and copper (blue) compounds
Silver	burning aluminum, titanium, or magnesium powder or flakes

Sources:
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