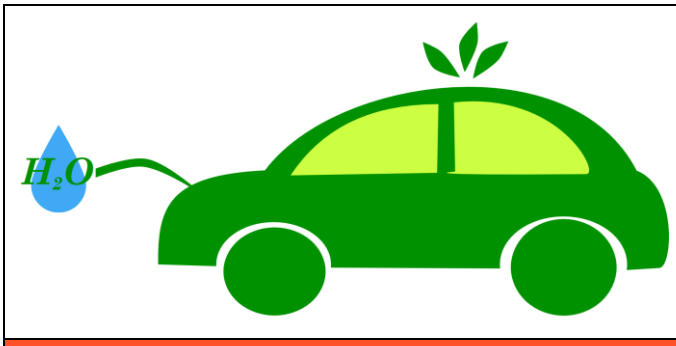

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BREAKTHROUGH: H_2-O-CAR IS THE FUTURE OF TRANSPORTATION ***By Kim Lonhak***

IN THIS ISSUE

Generating Energy Using Pure Water

You can even use water left in your water bottle to get you that extra kilometer!

On January of 2003, the Chinese company Unomax Co. Ltd published an article entitled "Are Water Powered Cars the Future of Transportation?" explaining the possibility of developing an automobile engine that functions using pure water only, with no other additives to enhance the process. The company claims that the process is absolutely applicable and it is highly unlikely that they will encounter any "complications," as the article suggests. Their intention is to create a high-efficiency vehicle that uses an abundant, eco-friendly resource such as water to fuel cars without emitting toxic gases such as carbon dioxide. In their article, the company addresses previous attempts in developing an eco-friendly fuel. However, they claim that their design contains a unique generator which splits the supplied water (H_2O) into its components, hydrogen and oxygen, through a chemical reaction. Despite the lack of details present on the nature of the chemical reaction mentioned earlier, Unomax claims that it is a unique reaction that decreases the amount of energy required to perform the process of splitting. The following excerpt is quoted from the recently published article by Unomax:

> *Our model design is carefully structured to ensure zero emissions to the environment. Our goal is to use water, drinking water or any other type of water, to fuel our specially designed car that we like to call "H_2-O-Car." Our professional chemists collaborated to make use of the chemical properties of the universal compound water. The mechanism of our H_2-O-Car is as follows. To begin with, our unique generator is installed into the interior of the car, and it is responsible for breaking the water molecule into its two components, hydrogen and oxygen using a chemical reaction. Our generator is very unique in the aspect that it does not use batteries to split the water molecule into its components. In the next step, the two produced gases are transferred into compartments, where hydrogen is recombined with oxygen to produce energy. This recombination of hydrogen and oxygen produces huge amounts of chemical energy which will be converted into mechanical energy used to move the vehicle. This energy will enable hydrogen and oxygen, derived from water, to act as a fuel.*

This article was translated from Chinese

Student Instructions:

You are a chemistry specialist working in the manufacturing department at *PetroGas* and your job is to create a report critiquing the H_2-O-Car developed by Unomax and to present it at a conference held to debate the possibility of mass producing the product.

In your report, you should include the following points.

1) Write and balance the chemical equation for the combustion of hydrogen gas in the presence of oxygen to produce liquid water.
   Don't forget to include the enthalpy change!

2) Using the enthalpy changes, construct two energy profiles, one for the reaction of the electrolysis of water and one for the combustion of hydrogen gas in the presence of oxygen.
   Don't forget to include:
   - the balanced chemical reactions,
   - labelled axes,
   - enthalpy changes and
   - identification of reactions as exothermic or endothermic.

   Write a brief discussion comparing these energy profiles.

3) Is the proposed product plausible in terms of thermodynamic principals? Why or why not?
   Use quantitative data to support your claim.

4) Write and balance the chemical equations of the combustion of gasoline and diesel.

   - Calculate the enthalpy change for the combustion of gasoline and for the combustion of diesel using the standard enthalpies of formation provided below.
   - In addition to enthalpy change, what are other factors should be considered when assessing the desirability of the fuel?

Data Table

Compound	**ΔH_f (kJ/mol)**
C_8H_{18} (Gasoline) [1]	-249.9
O_2 [2]	0
CO_2 [2]	-393.5
H_2O [2]	-285.8
$C_{12}H_{23}$ (Diesel) [3]	-303.5

5) Write a final statement summarizing your findings. Should production of the H_2-O-Car be pursued?

References:
1. Tosun, I. *The Thermodynamics of Phase and Reaction Equilibria.* Elsevier: Radarweg, **2013**; p. 676.
2. *CRC Handbook of Chemistry and Physics, 85th ed*. CRC Press: Boca Raton, **2005**; section 5.
3. https://moodle.fct.unl.pt/pluginfile.php/262324/mod_resource/content/1/1_NISTThermodynamicTables.pdf (Accessed Jan. 18, 2019).