

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE**

A323/02/INS

CHEMISTRY A

Unit 3: Ideas in Context plus C7
(Higher Tier)

INSERT

**Thursday 4 June 2009
Morning**

Duration: 60 minutes



MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- This insert contains the article required to answer question 1.

INFORMATION FOR CANDIDATES

- This document consists of 4 pages. Any blank pages are indicated.

The bioethanol dilemma

Life on Earth depends on energy from the Sun, which warms our atmosphere. But if too much energy is trapped by gases in the atmosphere, our globe warms up, and this can cause violent changes in the weather. Carbon dioxide from road vehicles is believed to add to this global warming.

28% of all carbon dioxide emissions in the United Kingdom come from the petrol and diesel burned by road traffic. The government is committed to a 20% reduction in these emissions by 2010. If the government is going to consider alternative fuels they need to carry out a whole Life Cycle Assessment for each fuel.

What is bioethanol?

Bioethanol is a fuel produced by fermentation of sugar. It is made from corn, maize, wheat or sugar beet. The plants absorb carbon dioxide from the air as they grow.

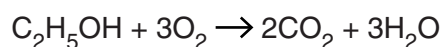
Most modern cars can use petrol with up to 5% of bioethanol added. Higher concentrations can only be used if car engines are modified.

The European Union (EU) recently issued a directive calling for biofuels to make up 5.75% of transport fuel needs by 2010. This table shows how use of bioethanol increased in some European countries during the years from 2005 to 2006.

	bioethanol consumption (energy units)	
	2005	2006
Austria	0	920
France	870	1750
Poland	330	610
Spain	1310	1330
Sweden	1680	1900
United Kingdom	500	560

Burning bioethanol

The mass of carbon dioxide produced by burning bioethanol can be calculated from this equation.



Burning pure bioethanol produces 70% less carbon dioxide than burning the same volume of petrol. The amount of carbon dioxide released can be cut by 3.5% just by putting 5% bioethanol into petrol.

Burning bioethanol releases 34% less energy than burning the same volume of petrol. So, the 'miles per gallon' figure for a car would be reduced by about one-third, and it would need to refuel more often. Some scientists believe that using bioethanol rather than petrol reduces total emissions of carbon dioxide by only about 13%. This is because of the pollution caused by the production process, and because bioethanol gets only about 70% of the mileage of petrol.

Using bioethanol can help reduce the amount of carbon monoxide and particulate carbon produced by vehicles. This improves air quality.

Can we make enough bioethanol?

The UK grows about 3.5 million tons too much of wheat each year. This could be used to make bioethanol without affecting the production of food. This wheat surplus could produce about 1 million tons of fuel, which is equivalent to 5% of the UK petrol market.

Most UK wheat crops are high starch varieties which produce the highest amount of bioethanol. One hectare of wheat would produce enough bioethanol to run an average car for about 30 000 miles. One lorry load of wheat will produce enough bioethanol for 100 000 miles of motoring.

Environmental benefits of using bioethanol as transport fuel

The UK Central Science Laboratory says that bioethanol requires 61% less energy to produce than petrol. Also less energy is used, and less pollution caused, when transporting it to the filling station.

Bioethanol is considered to be a sustainable material because it uses the Earth's resources in a way that can continue in the future. Photosynthesis absorbs carbon dioxide from the air as the fuel crops grow. The sugar produced is later processed into bioethanol. The carbon dioxide that was absorbed by the crops as they grew is returned to the air as the bioethanol is burned. This cycle can be continued indefinitely.

Blending bioethanol with petrol will help extend the life of the UK's own oil supplies. This means that we will not have to rely so much on other oil producing nations. Bioethanol is also biodegradable and far less toxic than fossil fuels.

This article continues on page 4.

What are the disadvantages of using bioethanol?

Growing crops to produce bioethanol would use a large area of cultivated land. It has been estimated that meeting the 5.75% EU target would use a quarter of the EU's arable land. Other concerns are a possible decline in soil fertility, a decrease in water availability and quality, and an increase in the use of fertilizers.

The UK may need to import bioethanol to obtain a large enough supply. If bioethanol is imported from the USA, it will likely come from maize, which uses fossil fuels at every stage of production. Fossil fuels are used in cultivation, production of fertilizers, harvesting, processing and transportation. Growing maize appears to use 30% more energy than the bioethanol produces when used as a fuel.

Food crops are replaced by fuel crops as demand for bioethanol increases. This drives food prices up. This leads to higher prices for animal products like chicken, beef, and cheese. Food prices are already increasing. The price of sugar has doubled with just 10% of the world's sugar harvest being converted to bioethanol.

The price of bread will rise as more wheat is used to make bioethanol.



The amount of grain required to make enough bioethanol to run one large car would feed the population of an African village.

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