WHICH FUEL IS BEST?





Fuels are substances that are burned in order to obtain energy (heat, light etc). When fuels are burned they react with oxygen, which usually comes from the air, in a chemical reaction called Combustion

Fuel + oxygen → Energy + Water + Carbon Dioxide

We can use the energy produced from burning fuels to do things like cook food, heat water or make things move like inside the engine of a car.

The table below gives some information about some commonly used fuels. Which of these fuels is best depends on what we want to use it for. In a car engine, for example, the fuel is burned inside the engine itself, so they need fuels that are gases (or a liquid that when compressed can be easily turned into a gas) and that produce only gases when they are burned. A fuel also needs to be easy to carry quite a lot around on a vehicle so that it can travel a long way without re-fuelling. It must also be easy to re-fuel.

Fuel	Solid, Liquid or Gas (at 20˚C)	Combustion products	How the fuel is stored	Cost	Energy/gram (kilojoules)
Coal	Solid	Gases & ash	In a heap	Low	33
Diesel	Liquid	Gases	In a tank	Low	46
Ethanol	Liquid	Gases	In a tank	Moderate	143
Hydrogen	Gas	Gas	In cylinders at very high pressure or as a liquid at -253˚C	Low	56
Methane (Natural Gas)	Gas	Gases	In cylinders at very high pressure	High	48
Petrol	Liquid	Gases	In tanks	Low	50
Propane (liquid petroleum gas)	Gas	Gases	In cylinders as a liquid (under constant pressure)	Low	16
Wood	Solid	Gases & Ash	In a heap	Very low	30

ACTIVITY 1 – Interpreting Data

Use Microsoft Excel to create a bar graph of the energy transferred when 1 gram of each fuel is burnt. Arrange the fuels in order on your bar graph, starting with the fuel that transfers the most energy per gram?

Copy & Paste a copy of your graph into a Word Document and then answer the following questions

1. How does the energy transferred by burning 1g of hydrogen compare with the energy transferred by burning 1g of petrol?
2. How doe the energy transferred by burning 1g of coal compare with the energy transferred by burning 1g of wood?
3. Which two fuels are most appropriate for vehicle engines? Give your reasons.
4. Which other fuels could be used? Give your reasons?
5. Which fuel is most appropriate for space rockets? (Remember that Space rockets cost a very large amount of money to build and it is important to keep their mass as low as possible). Explain your reasons.
6. Why is natural gas a popular fuel for heating and cooking in homes?
7. Why coal is a suitable fuel for power stations?
8. What other factors, beside those shown in the table, do you think are important when choosing a fuel?

ACTIVITY 2

PRACTICAL INVESTIGATION

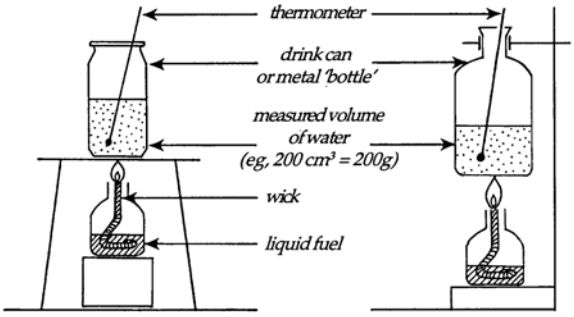
Energy content of fuels

PART ONE

Alcohols not only make good drink additives but are also useful fuels. Both methanol and ethanol have been used as substitutes for petrol. In this experiment, the energy released by burning alcohol is used to heat water. Knowing that 4.18 J of energy is required to heat 1 g (1mL) of water by 1 ℃, the quantity of energy released by combustion of the alcohol can be calculated.

EQUIPMENT:

- spirit burner
- Alcohols: methanol (CH_3OH), ethanol (CH_3CH_2OH) and Propanol ($CH_3CH_2CH_2OH$)
- Thermometer
- 250mL measuring cylinder
- steel can
- retort stand and clamp
- bench mat
- electronic balance
- safety glasses



PROCEDURE:

1. Measure out 200ml of cold water and pour it into a tin can.
2. Record the temperature of the water after 45 seconds.
3. Fill the burner half full with one of the 3 fuels to be tested. Record the weight of the burner + fuel.
4. Place the burner under the can so that it sits 2-3cm above the wick. Use the retort stand and clamp to secure it in place and then light it.
5. Stir the water gently with the thermometer to assist in even heating and check the temperature every 30 seconds or so.
6. When the temperature of the water has increased by about 20°C blow out the burner flame
7. Continue to stir the water until the temperature stops rising. Record the highest temperature.
8. Weigh the burner and the remaining fuel.

RESULTS:

Calculation	Ethanol	Propanol	Methanol
Mass of burner + fuel at START			
Mass of burner + fuel at END			
Mass of fuel burned			
Temperature of water at END			
Temperature of water at START			
Rise in temperature of water			
Mass of fuel burned ÷ Rise in temperature of water			

QUESTION: Which fuel gives the biggest temperature rise when 1 gram of fuel is burned?

PART TWO

CALCULATING THE ENERGY TRANSFERRED WHEN FUELS BURN

You compared the energy release by burning 1 gram of different fuels by comparing the rise in temperature of the same amount of water.

Scientists know that it take 4.2joules of energy to raise the temperature of 1 gram of water by 1°C. You can use this to measure the actual amount of energy transferred to the water when fuel is burned.

i.e Burning 1 gram of Fuel X raised the temperature of the water by 29°C. There was 150ml (150g) of water in the can, therefore the energy transfered to the water by burning 1g of Fuel X therefore is

4.2J x 150ml x 29°C = 18270 joule (J) This is rounded to 18 Kilojoule (kJ)

TASK: Calculate the amount of energy transferred to the water for each gram of the fuels you burned. Show you calculations and results in the following table:

Ethanol	Propanol	Methanol
Calculation:		
Result:		

QUESTIONS:

1. How do your figures compare to the values given to you in activity 1?

2. Suggest reasons for the (probably quite large) difference between your measurements and the correct values in Activity 1. **HINT:** Think about where else the heat may have been transferred.

3. Why didn't the errors in your figures matter very much when you were only **comparing** the energy transferred by burning different fuels rather than **measuring** them?