



**Leaving Cert Chemistry**

**Free Notes**

**Thermo Chemistry**



## Thermo chemistry

- This is a branch of chemistry which studies the heat changes which occur/accompany a chemical reaction
- Since chemical reactions produce heat (exothermic) and some absorb heat (endothermic).

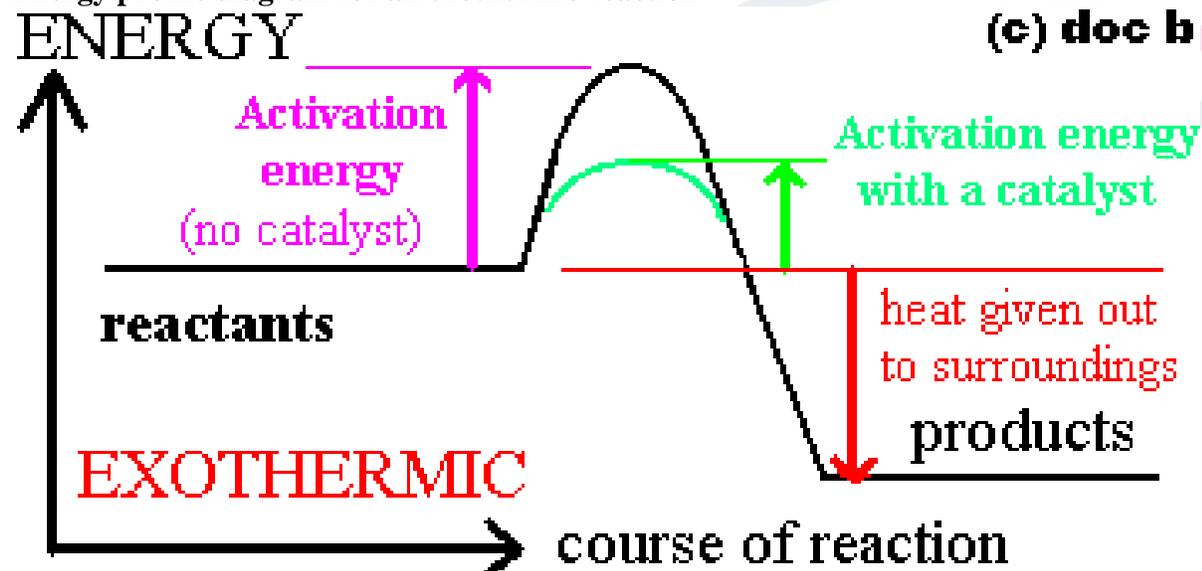
### Q) Why do we study heat changes?

- 1) For safety reasons, why?
- 2) Fuel engines (different fuels when burned release different amounts of energy.
- 3) This information is important to dieticians, why?

### Exothermic reactions:

- This is a chemical reaction in which **HEAT IS GIVEN OFF** to its surroundings
- The products formed have **LESS ENERGY THAN THE STARTING MATERIAL**

### Energy profile diagram for an exothermic reaction



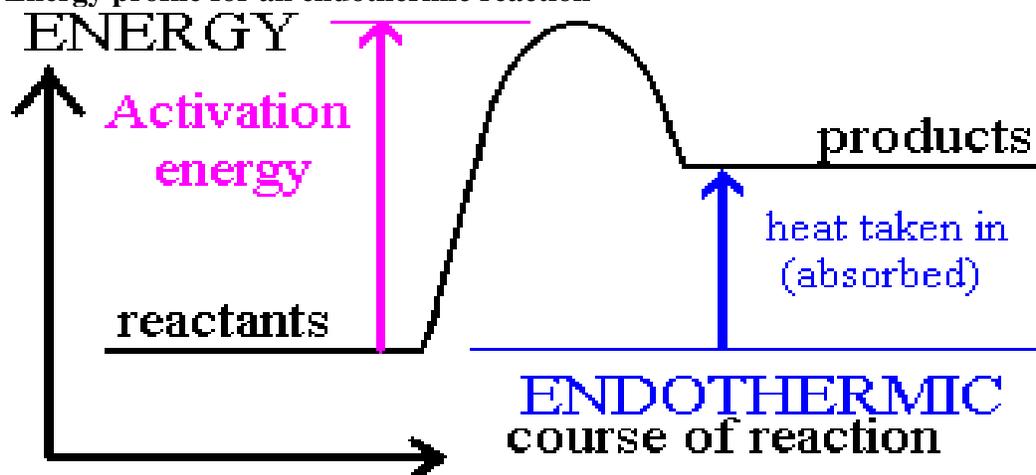
### Everyday examples of exothermic reactions

- 1) Burning fossil fuels e.g. coal
- 2) Adding concentrated acid to water
- 3) Burning up of food in our digestive system supply us with energy.

### Endothermic reaction

- This is a chemical reaction in which heat **is taken in form** from its surroundings
- The products have more energy than the reactants

### Energy profile for an endothermic reaction



### Everyday examples of an endothermic reaction

- 1) Reaction of sherbet put into water
- 2) Photosynthesis

### 3 suitable fuels that gives off heat

- 1) The alkanes e.g. methane (natural gas), propane and butane (bottled gas)

### Advantages of methane as a fuel:

- 1) Easily piped
- 2) High kilogram calorific value (high energy output)
- 3) Plentiful supply

### Sources of methane:

- Crude oil (also produced in rubbish dumps, slurry pits)
- One problem associated with methane is that it is a green house gas.

### 2) Hydrogen

- Fuel that may be relied on for the future
- Currently and previously used in space ships and other larger aircraft

### Advantages:

- 1) Environmentally friendly  
 $\text{H}_2 + \frac{1}{2} \text{O}_2 \rightarrow \text{H}_2\text{O}$  (water is the only by product formed) ☺
- 2) High energy output

### Disadvantages of hydrogen:

- 1) Very expensive fuel

- 2) Transporting hydrogen can be dangerous (explosive reaction when 2 hydrogen's reacts with 2 oxygen's)

### **Sources of hydrogen:**

- 1) Dehydrocyclisation (hydrogen is produced as a by product)
- 2) Electrolysis of acidified water (water and hydrogen is produced)  
However this is an expensive method

### **3) Ethyne ( $C_2H_2$ )**

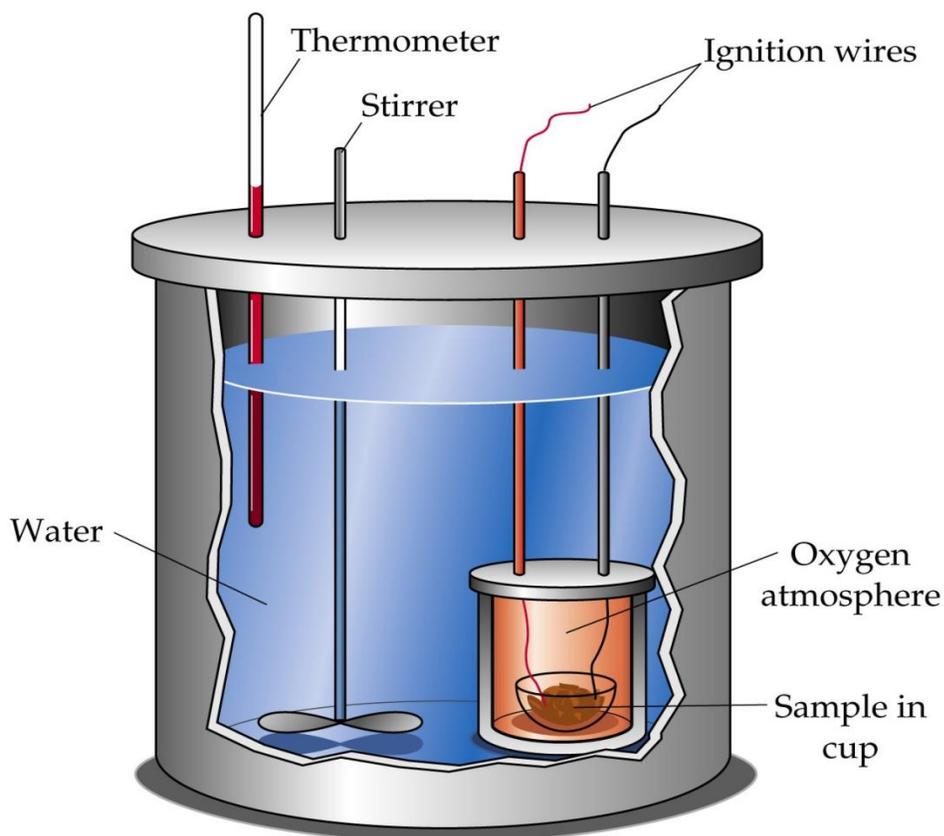
- This is used in oxyacetylene torches for welding metals (produces a very hot flame when burned in oxygen)

### **Q) Define heat of combustion**

- This is the heat change when **one mole** of a substance is completely burned in **excess oxygen**.

### **Q) How can the heat of combustion of a substance be measured accurately?**

- Use a bomb calorimeter
- A container used for determining heat changes (the name comes from an old unit of heat called the calorie; 1 calorie = 4.18 joules)
- Consists of a small steel container (the bomb) and a screw on cap.
- The sample of fuel to be measured is put inside the crucible of the bomb
- The bomb is placed into a beaker of water
- Oxygen is pumped into the bomb and the sample is ignited by electric wires.
- The temperature is then recorded by recording the rise in temperature and we then find heat of combustion
- The calculation is not meant to be examined on the current course, therefore it will not be discussed further



**Examples of heat of combustion:**

| fuel     | formula | heat of combustion<br>( $\Delta H$ ) KJ mol <sup>-1</sup><br>at 25°C | Kilogram calorific<br>value in kJ kg <sup>-1</sup> |
|----------|---------|----------------------------------------------------------------------|----------------------------------------------------|
| Methane  |         | -890                                                                 | 55,625                                             |
| Ethane   |         | -1560                                                                | 52,000                                             |
| Propane  |         | -2220                                                                | 50,454                                             |
| Butane   |         | -2877                                                                | 49,603                                             |
| Hexane   |         | -4194                                                                | 48,603                                             |
| Ethanol  |         | -1371                                                                | 29,804                                             |
| Carbon   |         | -393                                                                 | 32,750                                             |
| Hydrogen |         | -286                                                                 | 143,000                                            |

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