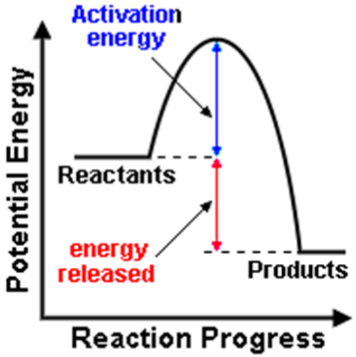
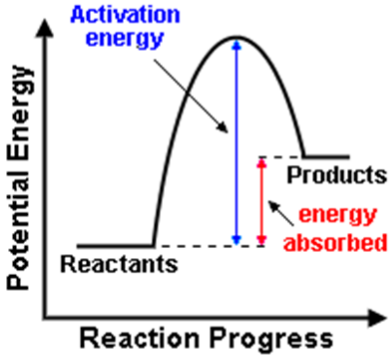
Section 1 Energy Changes Key Terms	
1 Conservation of energy	Energy is **not created or destroyed**, only **transferred from one store to another**
2 Exothermic	A reaction that **transfers energy to the surroundings** so the **temperature of the surroundings increases**, e.g. **combustion** and **neutralisation** reactions. Used in **self-heating cans** and **hand warmers**.
3 Endothermic	A reaction that **takes in energy from the surroundings** so the **temperature of the surroundings decreases**, e.g. **thermal decomposition**. Used in **sports injury packs.**
4 Activation energy	The **energy needed** for **particles to successfully react**.
5 Breaking bonds	**Energy is needed** to break bonds.
6 Forming bonds	**Energy is released** when bonds are formed.

7 Exothermic Energy Profile



8 Endothermic Energy Profile

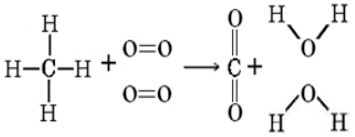


9 Energy released from forming bonds is **greater than** the energy needed to break bonds. (HT)

10 Energy released from forming bonds is **less than** the energy needed to break bonds. (HT)

Section 3—Bond Enthalpies

Consider the following equation:
Methane + oxygen -> carbon dioxide + water



Step 1
Work out the type and number of bonds BROKEN,
4 x C – H = 4 x 435 = 1740
2 x O=O = 2 x 498 = 996
Total energy needed = 2736

Step 2
Work out the type and number of bonds MADE
2 x C=O = 2 x 804 = 1608
4 x H–O = 4 x 463 = 1852
Total energy released = 3460

To work out the overall enthalpy (energy) change use:

Enthalpy = sum of bonds – sum of bonds
Change broken formed

So, 2736 – 3460 = -724 kJ This is EXOTHERMIC.

Section 4—Electrical Cells Chemistry only

The difference in the reactivity of two metals causes **displacement.** However, if you use this difference and place the metals into an electrolytic solution a current will flow which can be detected on a voltmeter.

This is the basis of the original cell.

Explaining why it happens

The voltage is produced due to the relative differences in reactivity of the metals.

The **MORE** reactive metals **FORCES** the less reactive metal to **ACCEPT** electrons.

Section 5—Hydrogen Fuel Cells Chemistry only

Fuel cells are special type of electric cell. They don't need recharging or replacing. The fuel tank needs refilling occasionally.

The fuel is **HYDROGEN**. It reacts with **OXYGEN** from the air. This is an **EXOTHERMIC** reaction. The process is very efficient.

Advantages of fuel cell	Disadvantages of fuel cell
Direct energy transfer – chemical into electrical. (No heat is lost through transfer)	Hydrogen is explosive, difficult to transport and store.
Less polluting – only water is produced	There is limited availability to refuel cells.
Fuel cells last longer than rechargeable batteries	Its is expensive to produce.

REDOX reaction
The hydrogen forms H^+ ions releasing electron

$2H_2 \rightarrow 4H^+ + 4e^-$ (Oxidation)

Electrons move through the wire, ions travel in the electrolyte. The oxygen ions are reduced in the fuel cell

$4H^+ + O_2 + 4e^- \rightarrow 2H_2O$ (Reduction)

The overall reaction is:

$2H_2 + O_2 \rightarrow 2H_2O$