Knowledge Organiser – Energy Changes

Exothermic reactions:

Exothermic reactions **give out** heat to the surroundings so the temperature recorded on the thermometer **increases**.

Endothermic reactions:

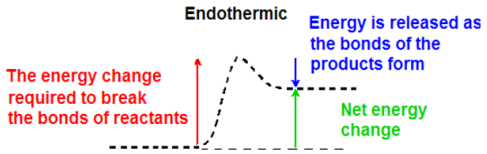
Endothermic reactions **take in** heat from the surroundings, so the temperature recorded on the thermometer **decreases.**

A chemical reaction takes place in two stages.

Step 1: Energy must be SUPPLIED to break bonds – this is ENDOTHERMIC

Step 2: Energy is RELEASED when new bonds are made – this is EXOTHERMIC.

When the reaction is ENDOTHERMIC - there is LESS energy required to break bonds than is released when bonds are formed.



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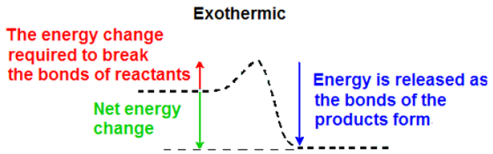
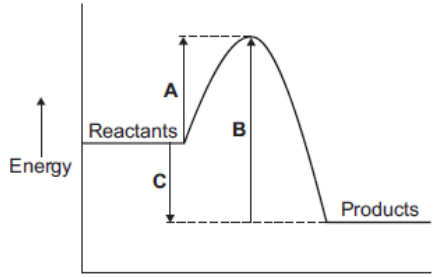
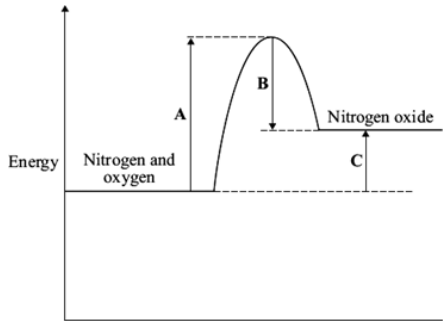


Spotting exothermic and endothermic reactions on exam questions:

Figure 2



This is an EXOTHERMIC reaction – the products are LOWER than the reactants. Showing less energy required to break the bonds than is released when bonds are formed.



This is an ENDOTHERMIC reaction – the products are HIGHER than the reactants. Showing more energy required to break the bonds than is released when bonds are formed.

On both diagrams:

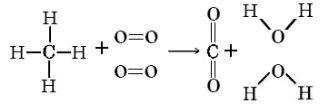
A = **Activation energy -** The energy needed to start a reaction. The activation energy is used to break bonds so that the reaction can take place.
B = Energy released as new bonds are formed.
C = Net energy change (often referred to as ENTHALPY)

HIGHER: Calculating energy (enthalpy) changes

You need the energy each bond needs to form/break. These will be given to you on the exam:

Bond	Bond enthalpy (kJ)	Bond	Bond enthalpy (kJ)
C—H	435	O=O	498
C—C	348	C=O	804
H—O	463	C=C	614

Consider the following equation:
Methane + oxygen → carbon dioxide + water



Step 1
Work out the type and number of bonds BROKEN, use the table provided to find the bond energy (enthalpy)

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, use the table provided to find the bond energy (enthalpy)

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.

1. What happens to energy during an exothermic reaction?
2. What happens to the temperature during an exothermic reaction?
3. What happens to energy in an endothermic reaction?
4. What happens to temperature in an endothermic reaction.
5. Is making bonds exo or endo?
6. Why is a polystyrene cup used to measure temperature change?
7. Why is a lid used?
8. Name a piece of equipment that could be used instead of a temperature probe
9. What is a dependent variable?
10. What is a independent variable?
11. Is the diagram for an exothermic or endothermic reaction?
12. Explain what activation energy means.
13. What would happen to the temperature in a reaction with a negative energy change?
14. What must particles do in order for a reaction to take place?
15. In the reaction below How many C-C bonds will break?
16. How many C-H bonds will break?
17. How many C-Cl bonds will form?
18. How many H-Cl bonds will form?
19. Bonds broken = 3068, bonds formed = 3172. What is the energy change of this reaction?