Your notes

GCSE Chemistry: revision notes

Bond energies

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Breaking and making bonds (Higher)

- During a chemical reaction, energy must be supplied to break bonds in the reactants. **Bond breaking** is endothermic.
- Energy is released when bonds form in the products. **Bond making** is exothermic.
- If more energy is released making new bonds than is needed to break the old ones, the reaction is exothermic. If less is released, it is endothermic.

Calculating the energy change (Higher)

- Energy change = energy needed to break bonds – energy released making bonds.
- A negative answer means the reaction is exothermic; a positive answer means it is endothermic.
- Bond energies are measured in **kJ/mol**.

Worked example (Higher)

- $H_2 + Cl_2 \rightarrow 2HCl$. Bond energies: H–H 436, Cl–Cl 242, H–Cl 431 **kJ/mol**.
- Bonds broken: 436 + 242 = 678 **kJ/mol**.
- Bonds made: 2 × 431 = 862 **kJ/mol**.
- Energy change = 678 – 862 = –184 **kJ/mol**, so the reaction is exothermic.

Tips (Higher)

- Draw the **displayed formula** of each molecule to count every bond, including double bonds such as O=O and C=O.
- Multiply by the numbers in the balanced equation: $2H_2O$ contains four O–H bonds.

Worked examples

Find the energy change for $H_2 + Cl_2 \rightarrow 2HCl$. (Bond energies: H–H 436, Cl–Cl 242, H–Cl 431 kJ/mol)

Energy needed to break the bonds in the reactants. **436 + 242 = 678 kJ/mol**

Energy given out making the bonds in the products: two H–Cl bonds. **2 × 431 = 862 kJ/mol**

Energy change = bonds broken – bonds made. **678 – 862 = –184**

More energy is given out than taken in, so it is exothermic.

Answer: –184 kJ/mol (exothermic)

Key terms

Bond energy	The energy needed to break one mole of a particular bond, in kJ/mol.
Bond breaking	An endothermic process that needs energy.
Bond making	An exothermic process that releases energy.
Overall energy change	Energy to break bonds minus energy released making bonds.
Displayed formula	A formula that shows every atom and every bond in a molecule.
kJ/mol	Kilojoules per mole, the unit of bond energy.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. Is breaking bonds endothermic or exothermic? (Higher)
2. Is making bonds endothermic or exothermic? (Higher)
3. How is the overall energy change calculated? (Higher)
4. The energy change is –92 kJ/mol. What type of reaction is it? (Higher)
5. When is a reaction endothermic? (Higher)
6. How many O–H bonds are in $2H_2O$? (Higher)
7. What is the unit of bond energy? (Higher)
8. Bonds broken need 1000 kJ/mol and bonds made release 1200 kJ/mol. What is the energy change? (Higher)

Answers

1. Endothermic
2. Exothermic
3. Energy to break bonds – energy released making bonds
4. Exothermic
5. When more energy is needed to break bonds than is released making bonds
6. Four

Your notes

7. kJ/mol
8. –200 kJ/mol

What to do next

Practise 10 questions on this topic

Try 6 exam questions, with mark schemes

Read the lesson, one step at a time

Free revision for GCSE and KS3 at lycolearn.co.uk. Some notes are for one exam board only, and say so in brackets.

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