GCSE Chemistry

Five Ways to Supercharge your Chemistry Teaching

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Poll:

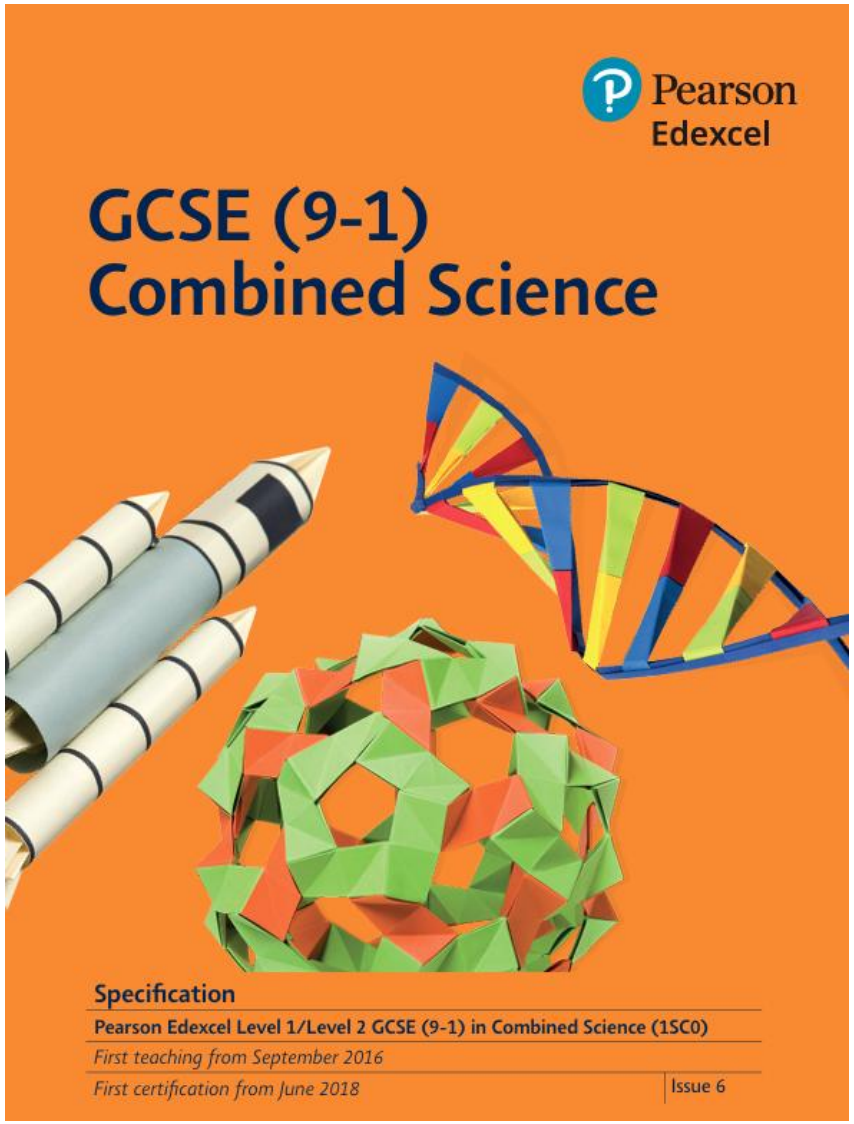
Tell us about yourself by answering the poll questions.

Welcome

Welcome to Five Ways to Supercharge your Chemistry Teaching.

Agenda

- Introduction
- Misconceptions in Chemistry
- Discussion
- Summary



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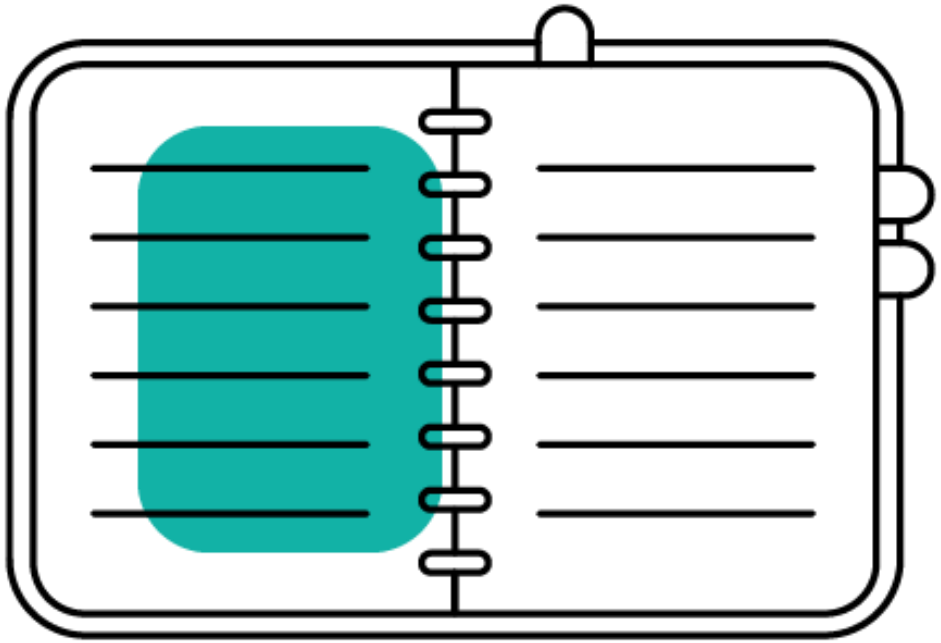
Misconceptions in Chemistry

In this session we are going to look at:

1. covalent bonding vs intermolecular forces
2. reacting masses calculations
3. calculating energy changes
4. explaining the products of electrolysis
5. half-equations in electrolysis.



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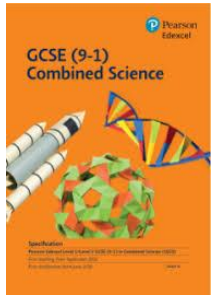
Specification Links



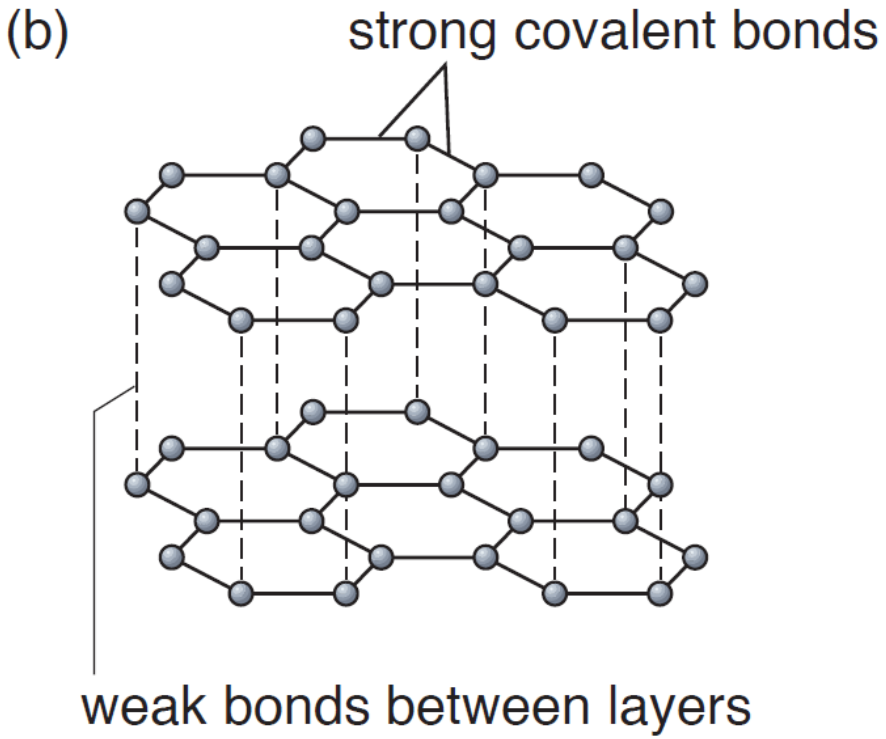
1.34	Explain the properties of typical covalent, simple molecular compounds limited to: a. low melting points and boiling points, in terms of forces between molecules (intermolecular forces).
1.48	Calculate masses of reactants and products from balanced equations, given the mass of one substance.
7.14	**Calculate the energy change in a reaction given the energies of bonds (in kJ mol^{-1}).**
3.25	Explain the formation of the products in the electrolysis, using inert electrodes, of some electrolytes, including: copper chloride solution, sodium chloride solution, sodium sulfate solution, water acidified with sulfuric acid, molten lead bromide (demonstration).
3.27	**Write half equations for reactions occurring at the anode and cathode in electrolysis.**

Misconceptions in Chemistry

1.34

1. Covalent Bonds vs Intermolecular Forces

- What is a chemical bond?
- What is a covalent bond?
- What is an intermolecular force?



Example questions:

- Explain, in terms of particles it contains, why X has a low boiling point.
- Explain why water is a liquid at room temperature and not a solid.

Misconceptions in Chemistry

1.34

1. Covalent Bonds vs Intermolecular Forces

- Explain the meaning inter vs intra
- Highlight key terms required by mark schemes
- Construct a table comparing the properties of different types of substance

- Visual aids – diagrams
- Modelling kits
- Interactive Simulations e.g.
- Mnemonics

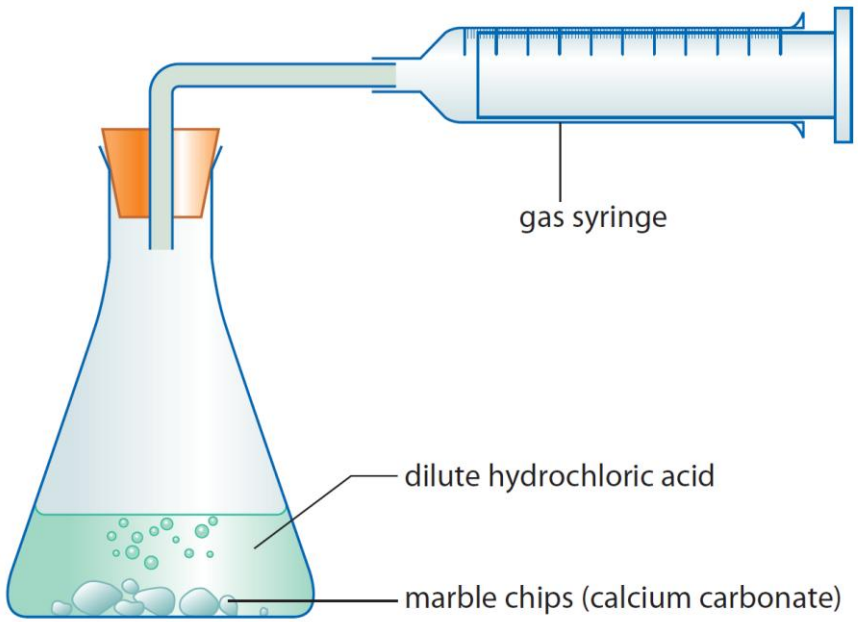
Question number	Answer	Additional guidance	Mark
	An explanation linking **weak** {forces between molecules / intermolecular forces} (1) (intermolecular forces need) little {heat/energy} required (1)	reject weak covalent bond for both mark points allow **weak** intermolecular bonds / **weak** bonds **between molecules** ignore easy to break ignore 'easier to separate molecules' ignore needs a low temperature to break	**(2)**

Misconceptions in Chemistry

1.48

2. Reacting Masses Calculations

- What is a mole? How can we calculate number of moles?
- What is the theoretical yield of a reaction?



Example questions:

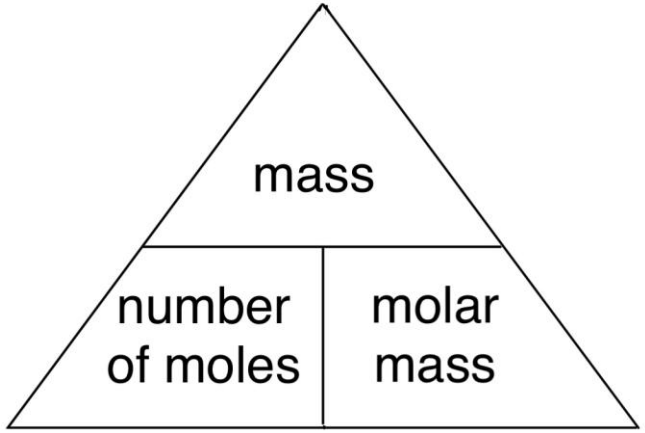
- Calculate the maximum mass of Y that could be formed from x g of Z.
- Calculate the mass of X that has been produced.

Misconceptions in Chemistry

1.48

2. Reacting Masses Calculations

- Practice re-arranging equation / changing the subject
- Introduce / use a formula triangle
- Students write own method using worked example
- Supplement with past paper question examples



- Simple experiments
- Flowcharts e.g.

balanced equation → M_r → moles → ratio → moles to mass

Misconceptions in Chemistry

1.48

2. Reacting Masses Calculations – example question

There are several stages to the production of sulfuric acid in industry. The equation shows a reaction forming sulfuric acid.

$$SO_3 + H_2O \rightarrow H_2SO_4$$

Calculate the maximum mass of sulfuric acid that could be produced from 400 tonnes of sulfur trioxide, SO_3. (relative formula masses: $SO_3 = 80$, $H_2SO_4 = 98$)

(2)

.....

.....

maximum mass of sulfuric acid = ... tonnes

Misconceptions in Chemistry

2. Reacting Masses Calculations – example question

Mark Scheme

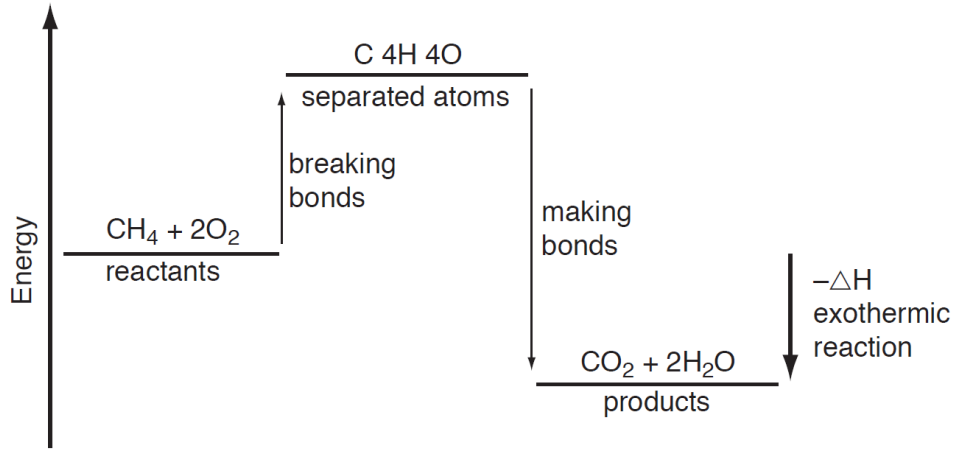
Question number	Answer	Additional guidance	Mark
(i) Group A	final answer of 490 with or without working scores 2 400 =5 (1) 80 5 x 98 = 490 (1) OR 98 =1.225 (1) 80 1.225 x 400 = 490 (1)	 80/ 400 x 98 = 19.6 scores 1 allow ecf for MP2 only if MP1 uses 80 and 98 80/98 x 400 = 326.5 scores 1 allow ecf for MP2 only if MP1 uses 80 and 98 allow 490000 **kg** only if unit given allow 49000000 0 **g** only if unit given	**AO 2-1 (2)**

Misconceptions in Chemistry

7.14

3. Calculating Energy Changes

- What do the terms exothermic and endothermic mean?
- Is the breaking / formation of bonds exothermic or endothermic?
- What is the overall energy change of a reaction?



Example questions:

- Calculate the overall change in heat energy…
- Calculate the energy change, in kJ mol^{-1}, for the reaction.

Misconceptions in Chemistry

7.14

3. Calculating Energy Changes

- Reinforce covalent bonding, especially displayed formulae
- Students work out method using a worked example
- Importance of correct equation

- Energy diagrams
- Simple experiments
- Mnemonics
- Visual reminders

energy used to break bonds in reactants	-	energy released when bonds form in products	=	overall energy change

Misconceptions in Chemistry

7.14

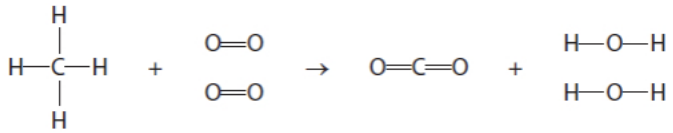
3. Calculating Energy Changes – example question

The energies of some bonds are shown in Figure 8.

bond	bond energy in kJ mol^{-1}
C—H	435
O═O	496
C═O	805
H—O	463

Figure 8

Methane burns in oxygen to form carbon dioxide and water. The equation shows the structures of the molecules.



Calculate the energy change, in kJ mol^{-1}, for this reaction.

(4)

.....

Misconceptions in Chemistry

7.14

3. Calculating Energy Changes – example question

Mark Scheme

Question number	Answer	Additional guidance	Mark
	-730 as final answer with or without working scores 4 +730 as final answer with or without working scores 3 bonds broken = (4 x 435) + (2 x 496) = 2732 **(1)** bonds made = (2 x 805) + (4 x 463) = 3462 **(1)** energy change = broken – made **(1)** [2732 – 3462] = -730 (kJ mol^{-1}) **(1)**	allow ECF	**(4)**

Misconceptions in Chemistry

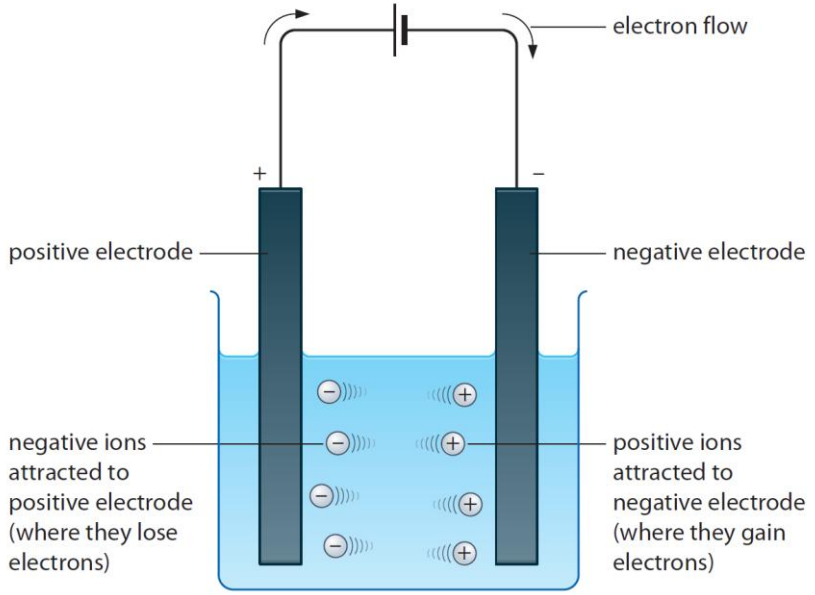
3.25

4. Explaining the Products of Electrolysis

- What is electrolysis?
- In the electrolysis of molten compounds, what is formed at the anode / cathode?
- In the electrolysis of aqueous substances, what is formed at the anode / cathode?

Example questions:

- Explain the observations made at each of the electrodes.
- Explain how these products are formed from the ions in this electrolysis of X.



Misconceptions in Chemistry

4. Explaining the Products of Electrolysis

- Students to draw and label diagrams
- Grid of rules for determining products of electrolysis

	Product formed at anode	Product formed at cathode
Molten compounds		
Aqueous compounds		

Misconceptions in Chemistry

3.27

5. Redox and Half Equations

- What is reduction / oxidation / redox?
- How do we know if a species has been oxidised / reduced?
- How many electrons does a species lose / gain in oxidation / reduction?
- Are electrons on the left / right of the equation for oxidation / reduction half-equations?

Example questions:

- Explain how the half-equation shows that the X ions are oxidised/reduced.
- Write the balanced half-equation for this reaction.

Misconceptions in Chemistry

3.27

5. Redox and Half Equations

- Definition grid for reduction and oxidation
- Re-cap formation of ions
- Link to Periodic Table for ion charges

- Card-sorting activities
- Practice Problems
- Diagrams to illustrate electron transfer
- Step-by-step guide to writing half-equations
- Key word bingo
- Memory guides e.g. A Negative ION – anion

	reduction	oxidation
oxygen		
hydrogen		
electrons		

Misconceptions in Chemistry

3.27

5. Redox and Half Equations

Writing half-equations can follow a 3-step guide:

1. Write the formula of the atom/molecule/ion at the start and at the end of the reaction. E.g. $H_2 \rightarrow H^+$
2. Balance the number of atoms in the equation on both sides. $H_2 \rightarrow 2H^+$
3. Balance the charges with electrons. If the species has become positive, then it has lost electrons and been oxidised. Balancing electrons must now go on the right hand side. E.g. $H_2 \rightarrow 2H^+ + 2e^-$

Repeat for the reduced species as necessary.

Misconceptions in Chemistry

7.14

5. Redox and Half-equations – example questions

Chlorine is one of the products of the electrolysis. The half-equation for the production of chlorine is

$$2Cl^- \rightarrow Cl_2 + 2e$$

Explain how the half-equation shows that chloride ions are oxidised.

(2)

.....

.....

When molten zinc chloride is electrolysed, zinc ions, Zn^{2+}, form zinc atoms.

Write the half equation for this reaction.

(2)

.....

(c) In an electrolysis experiment, oxide ions, O^{2-}, form oxygen gas, O_2.

Write the balanced half equation for the reaction.

(2)

.....

Misconceptions in Chemistry

7.14

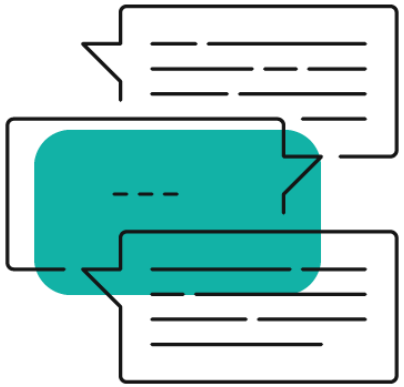
5. Redox and half-equations – example questions

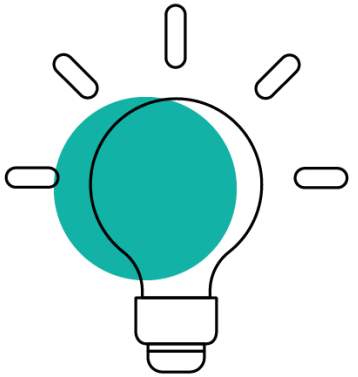
Mark Scheme

(ii)	An explanation linking • electron(s) (1) • (have been) lost/removed (1) conditional on electrons	ignore reference to number of electrons do not allow negative charge chlorine gains electrons (0) allow chlorine loses electrons (1)	**(2)**

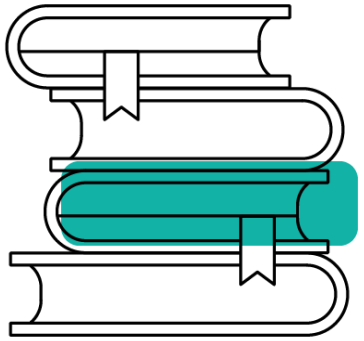
Question number	Answer	Additional guidance	Mark
	$Zn^{2+} + 2e^{(-)} \rightarrow Zn$ (2)	if not fully correct, allow 1 for Zn^{2+} + (any number) $e^{(-)}$ → (anything) allow ZN, zn allow multiples reverse reaction scores (0) ignore state symbols $Zn^{2+} \rightarrow Zn - 2e^{(-)}$ (0)	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)	$2O^{2-} \rightarrow O_2 + 4e^{(-)}$ (2) OR $O^{2-} \rightarrow O + 2e^{(-)}$ (1) $2O \rightarrow O_2$ (1)	Unbalanced equation (1)	**(2)**





Questions



Summary – Misconceptions in Chemistry

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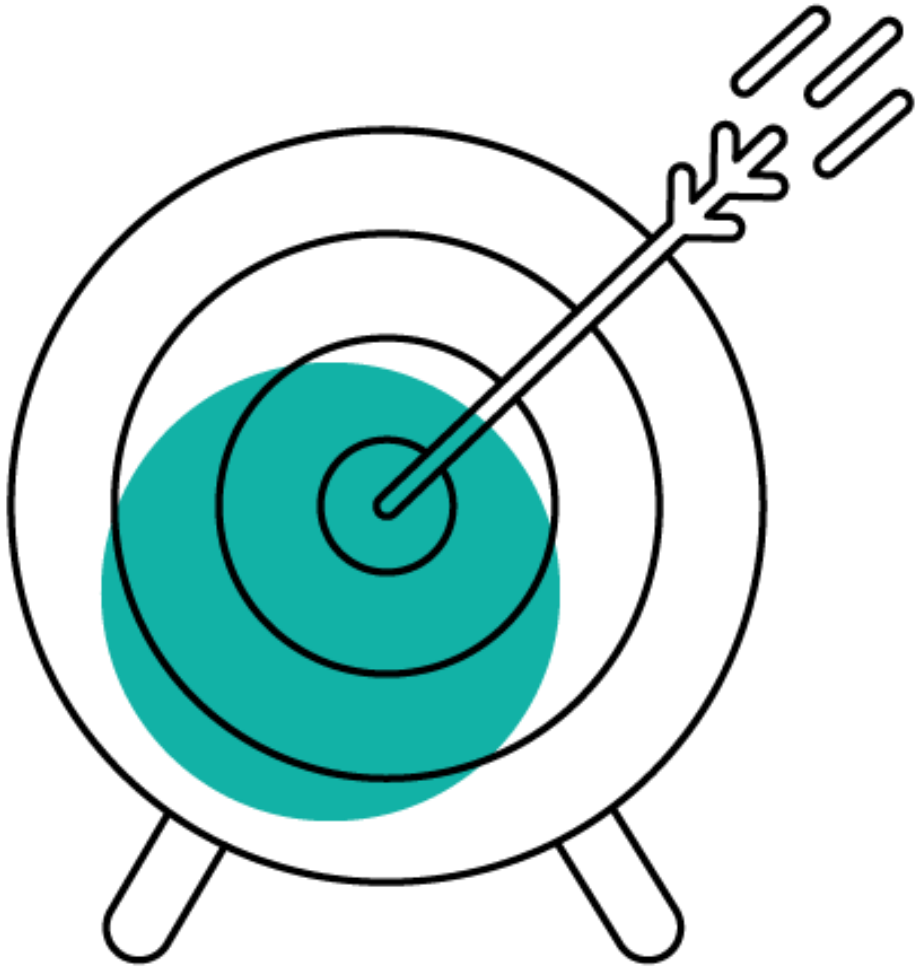

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