Isaac Chemistry

Andrea Chlebikova ac782@cam.ac.uk andrea.c@isaacscience.org

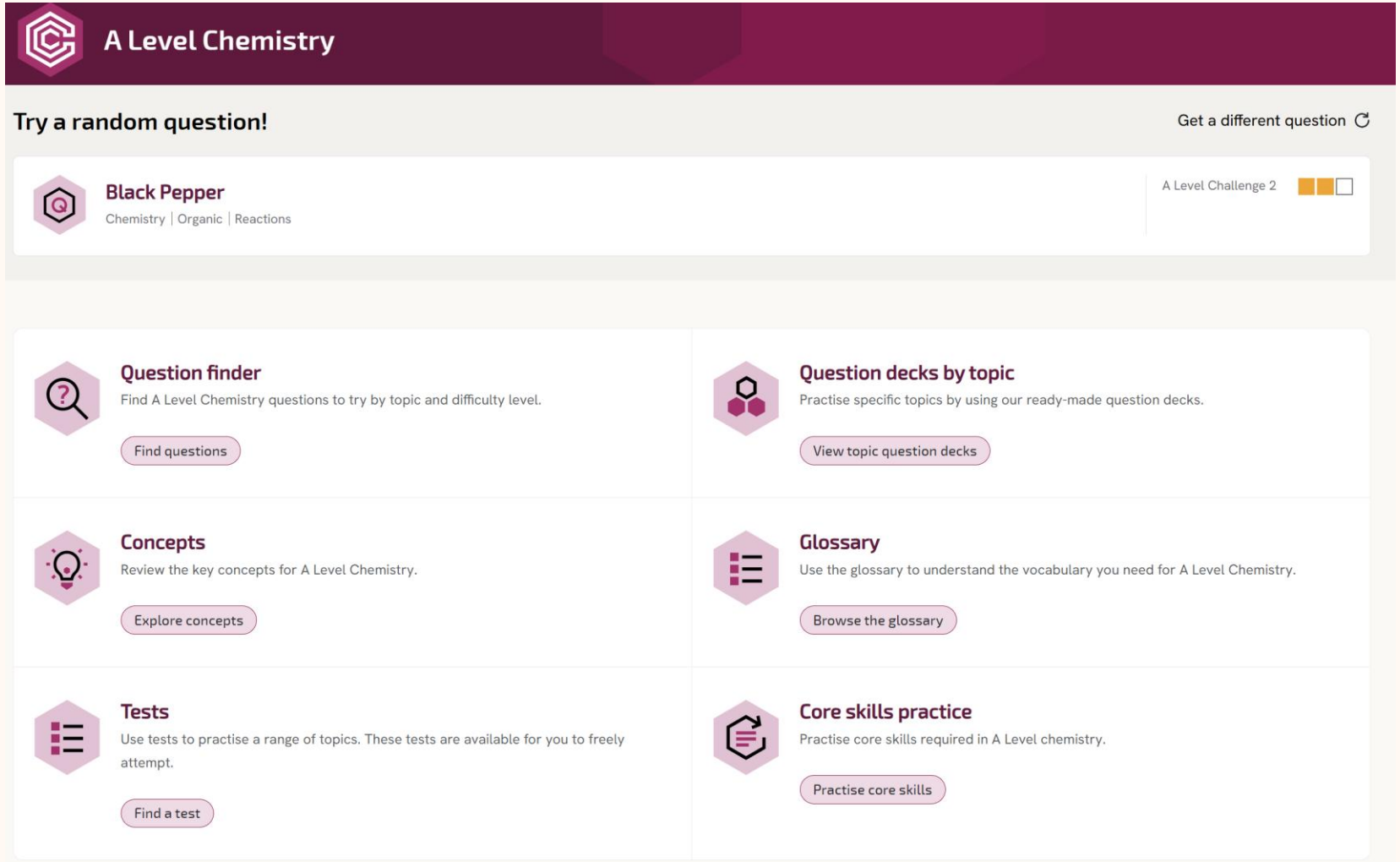
This symposium is generously funded by The Ogden Trust making physics matter

Today

- What do we have available on Isaac Chemistry?
  - How do we find the various resources?
- Have a go at some Isaac Chemistry problems/using practice tools.
- Go through how to tackle some of the more challenging problems

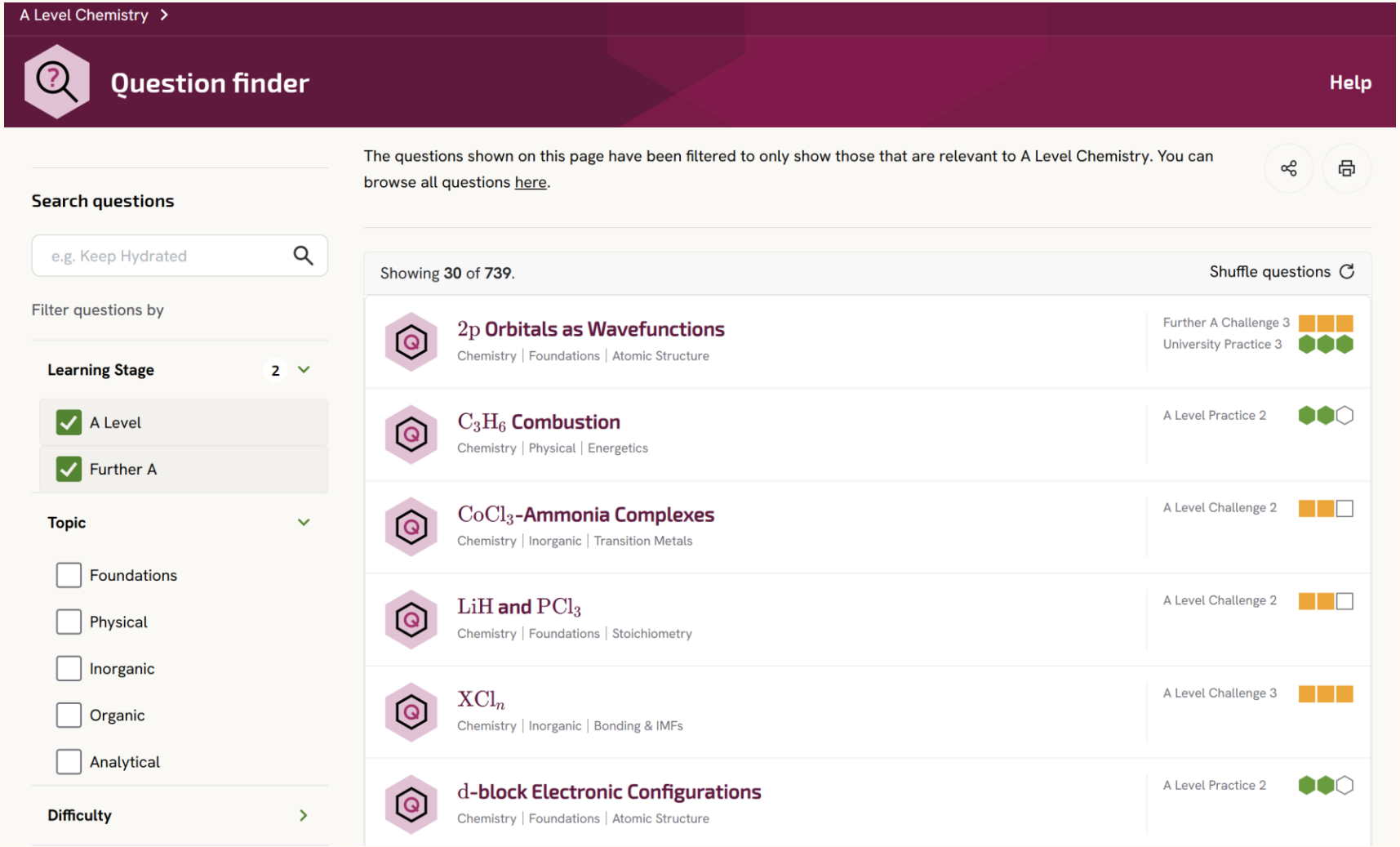
This symposium is generously funded by The Ogden Trust making physics matter

Isaac A Level Chemistry overview



This symposium is generously funded by The Ogden Trust making physics matter

Question finder



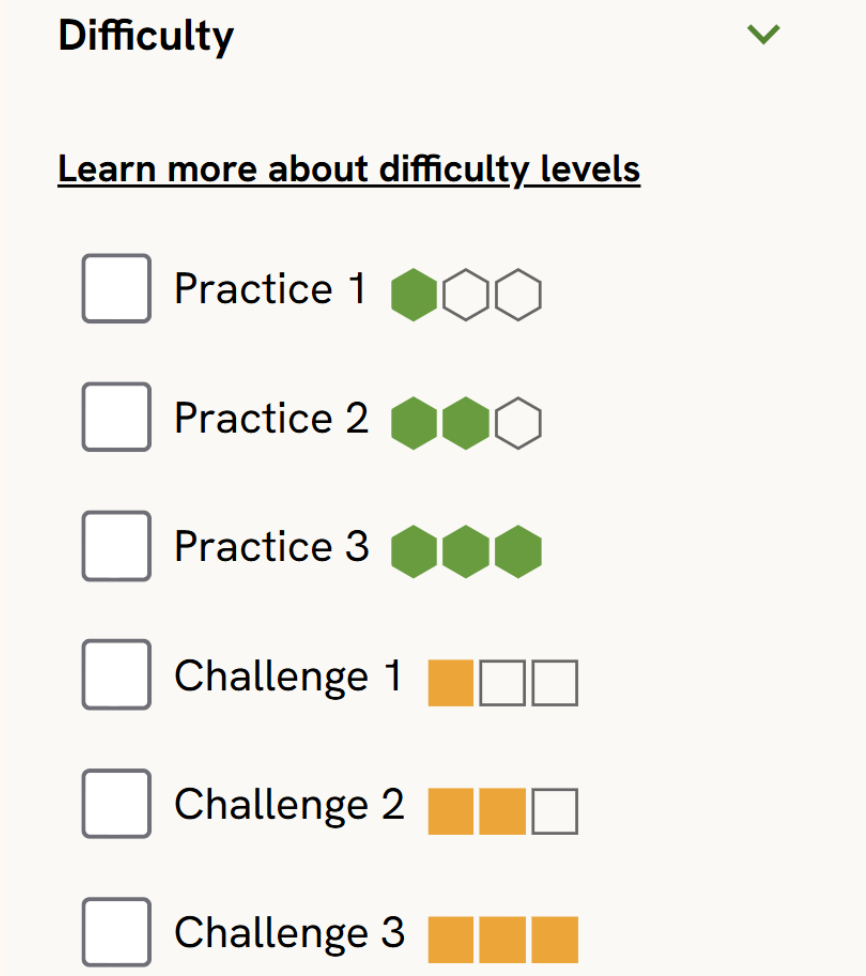
This symposium is generously funded by The Ogden Trust making physics matter

Questions: topics

- [x] Foundations
  - [ ] Numerical Skills
  - [ ] Atomic Structure
  - [ ] Stoichiometry
  - [ ] Gas Laws
- [x] Inorganic
  - [ ] Periodic Table
  - [ ] Bonding & IMFs
  - [ ] Redox
  - [ ] Transition Metals
- [x] Analytical
  - [ ] Chromatography
  - [ ] Mass Spectrometry
  - [ ] IR Spectroscopy
  - [ ] NMR Spectroscopy
  - [ ] Electronic Spectroscopy
- [x] Physical
  - [ ] Kinetics
  - [ ] Energetics
  - [ ] Entropy
  - [ ] Equilibrium
  - [ ] Acids & Bases
  - [ ] Electrochemistry
- [x] Organic
  - [ ] Functional Groups
  - [ ] Isomerism
  - [ ] Reactions
  - [ ] Aromaticity
  - [ ] Reactions (aromatics)
  - [ ] Polymers

This symposium is generously funded by The Ogden Trust making physics matter

Questions: difficulty



- Practice questions are similar to what one would expect to see in an exam paper for the relevant stage (difficulty increasing P1 → P3)
- Challenge questions require more problem solving/insights/… e.g. such as seen in C3L6 papers, Chemistry Olympiad, …

This symposium is generously funded by The Ogden Trust making physics matter

Question decks by topic

Question decks by topic

Decks by stage

- A Level

Decks by subject

- Physics
- Chemistry
- Maths
- Biology

The Chemistry topics below are ordered to allow for progression of ideas from one question deck to the next. To find a question deck on a specific topic, use `Ctrl+F` in your browser.

The "**What it contains**" column lists the difficulty levels of the questions and how many there are: for example, "7×P1" means seven questions of "Practice 1" difficulty. Generally, "Practice" questions are exam style, while "Challenge" questions use the same knowledge in a less familiar style and may require problem solving or combining of ideas. Some ratings are preliminary and subject to change, so feedback from teachers is very welcome. The table also shows which question types are used in each deck:

- **Quick**: show/hide the answer (not marked)
- **MCQ**: multiple-choice
- **Numeric**: enter a number (with or without units)
- **Symbolic**: enter an algebraic expression
- **Chemistry**: enter a chemical formula or chemical equation
- **Short-answer**: type a word or combination of words
- **Organic**: use the external structure editor to draw a structure and generate a SMILES string, then copy into Isaac for checking
- **Drag-and-drop**: drag pre-loaded options into gaps in text or a table

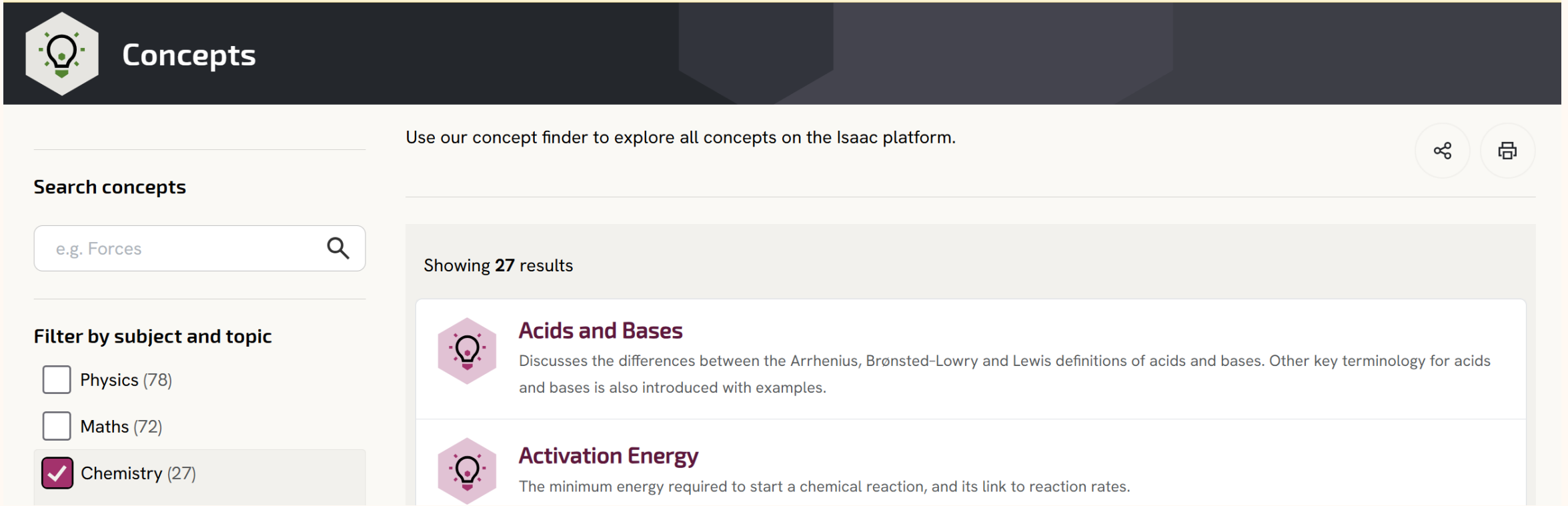
Stoichiometry and Inorganic Chemistry ›

Physical Chemistry ›

Organic Chemistry and Spectroscopy ›

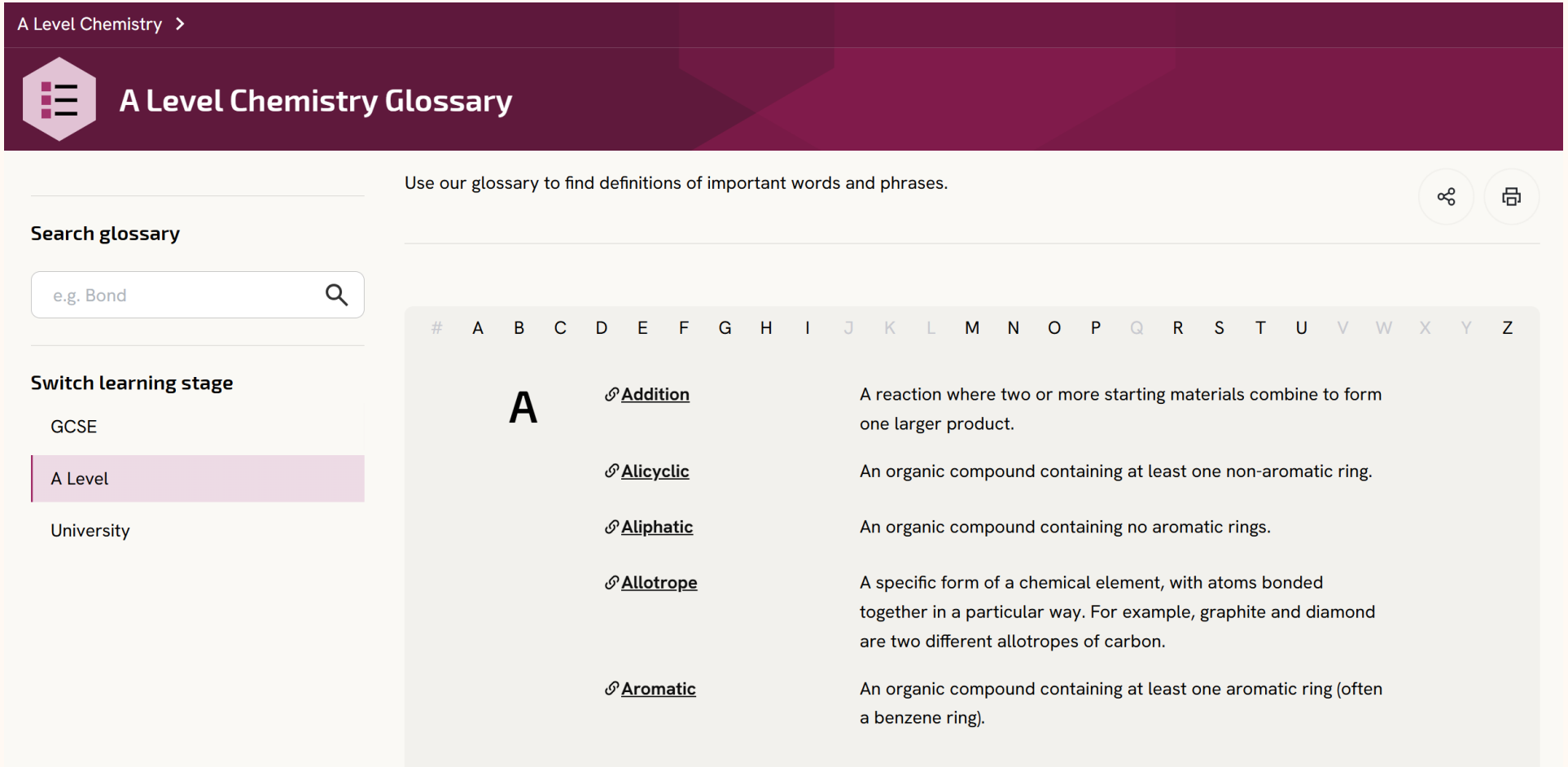
This symposium is generously funded by The Ogden Trust making physics matter

Concept pages



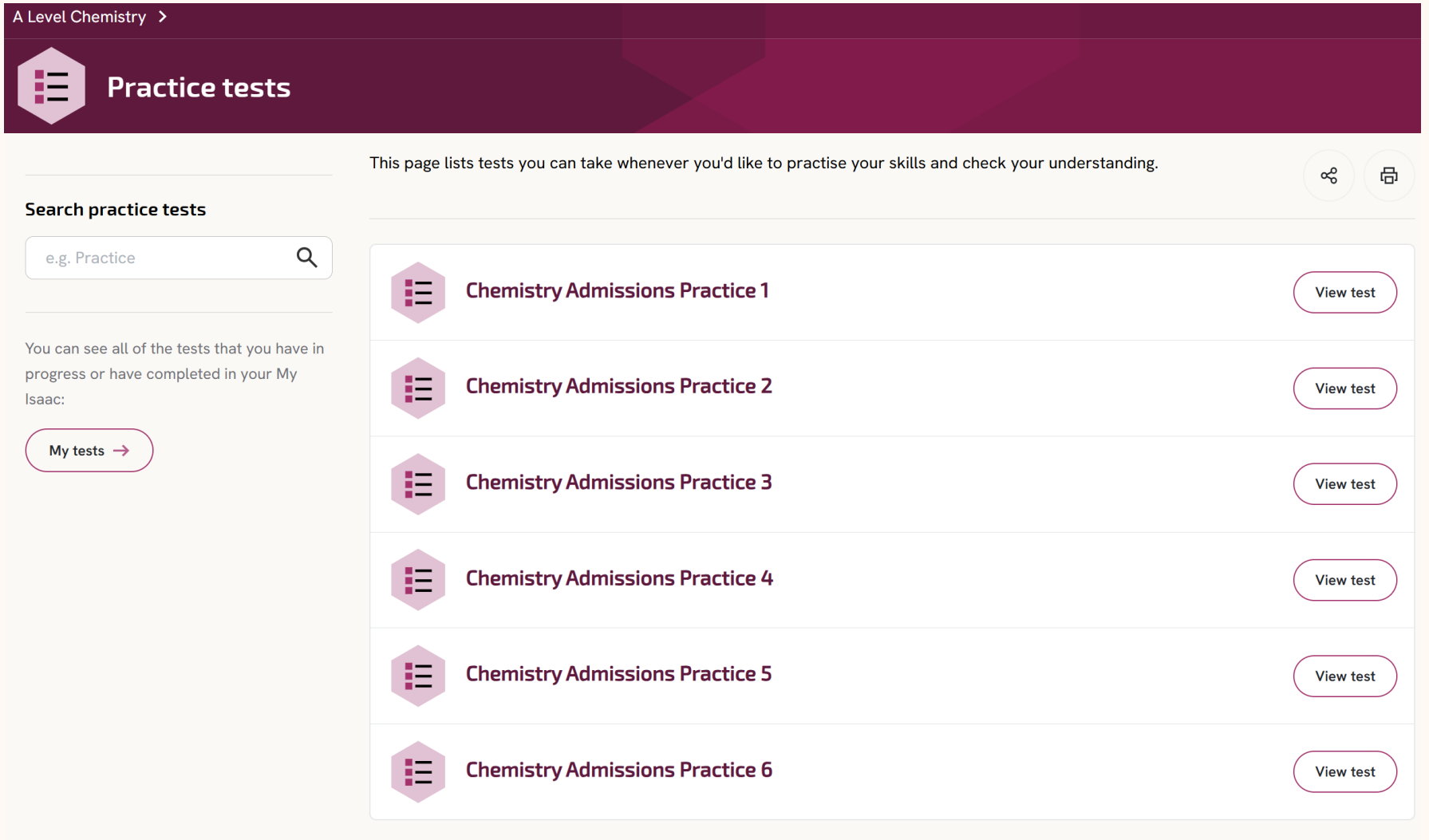
This symposium is generously funded by The Ogden Trust making physics matter

Glossary



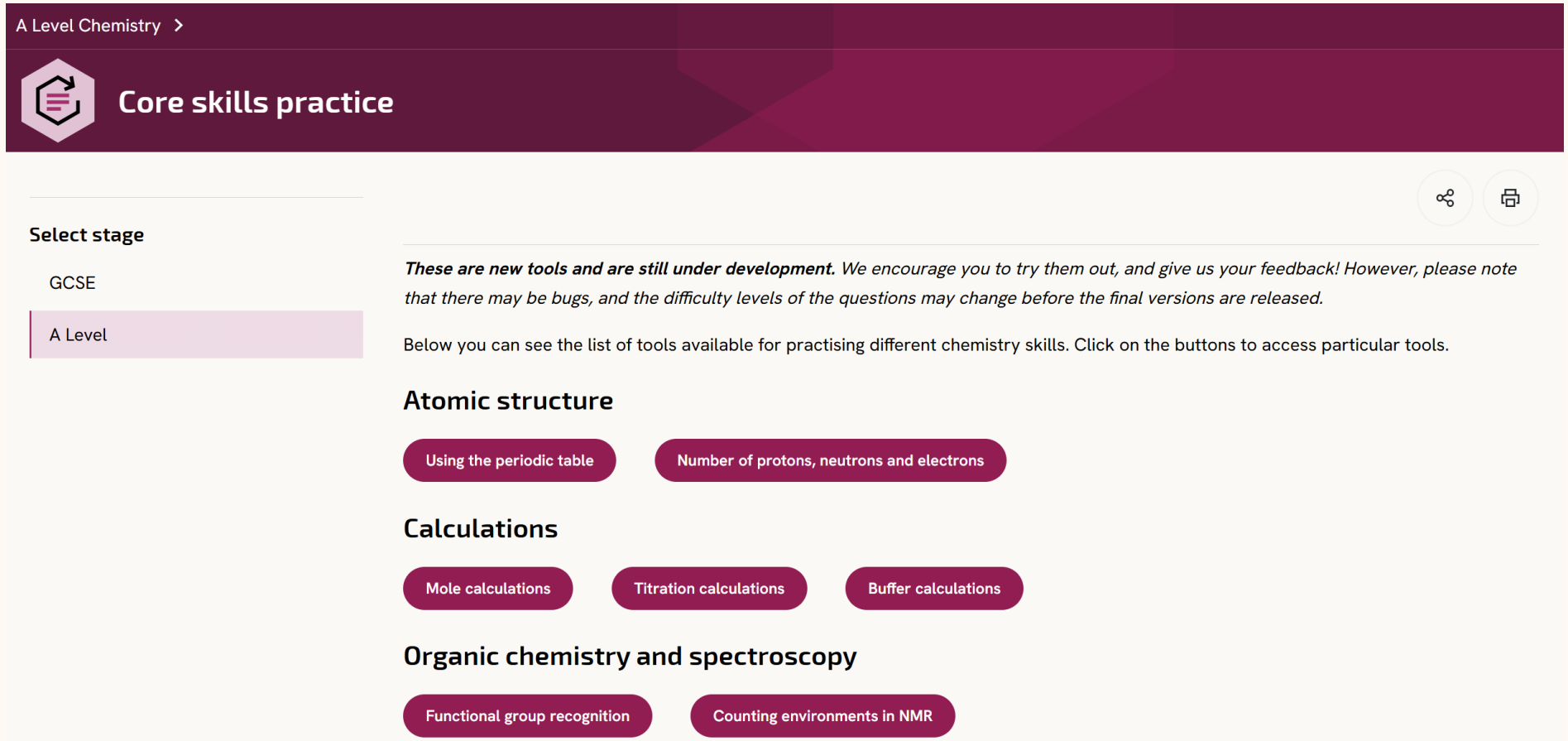
This symposium is generously funded by

Tests



This symposium is generously funded by The Ogden Trust making physics matter

Core skills practice tools



This symposium is generously funded by The Ogden Trust

making physics matter

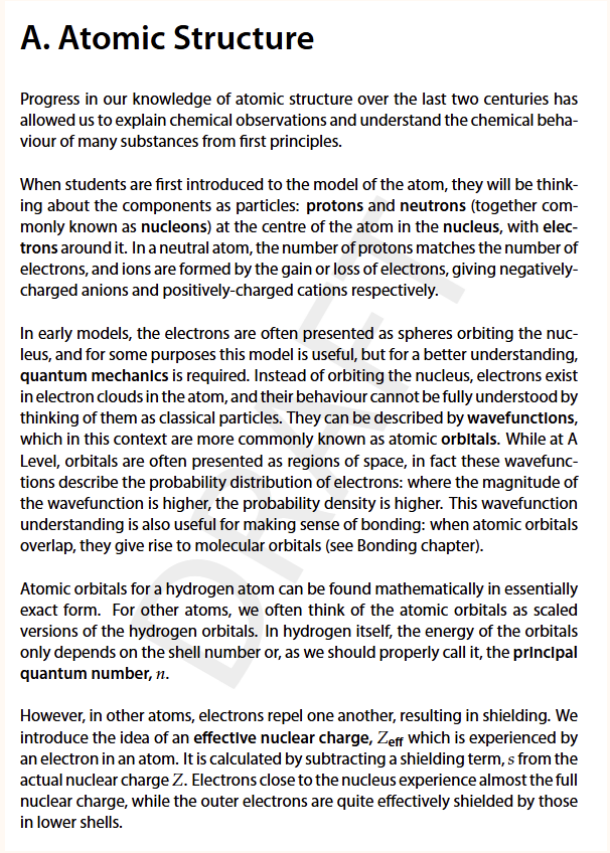
Questions to tackle now...

- Showcasing Isaac Chemistry: https://isaacscience.org/question_decks#ipts25_fri_6b
- Practising Problem Solving in Chemistry: https://isaacscience.org/question_decks#ipts25_fri_6b_ext
- Try the chemistry core skills practice tools

This symposium is generously funded by The Ogden Trust making physics matter

Isaac Chemistry content is expanding

- More core skills practice tools, concept pages and glossary entries



A. Atomic Structure

Progress in our knowledge of atomic structure over the last two centuries has allowed us to explain chemical observations and understand the chemical behaviour of many substances from first principles.

When students are first introduced to the model of the atom, they will be thinking about the components as particles: **protons** and **neutrons** (together commonly known as **nucleons**) at the centre of the atom in the **nucleus**, with **electrons** around it. In a neutral atom, the number of protons matches the number of electrons, and ions are formed by the gain or loss of electrons, giving negatively-charged anions and positively-charged cations respectively.

In early models, the electrons are often presented as spheres orbiting the nucleus, and for some purposes this model is useful, but for a better understanding, **quantum mechanics** is required. Instead of orbiting the nucleus, electrons exist in electron clouds in the atom, and their behaviour cannot be fully understood by thinking of them as classical particles. They can be described by **wavefunctions**, which in this context are more commonly known as atomic **orbitals**. While at A Level, orbitals are often presented as regions of space, in fact these wavefunctions describe the probability distribution of electrons: where the magnitude of the wavefunction is higher, the probability density is higher. This wavefunction understanding is also useful for making sense of bonding: when atomic orbitals overlap, they give rise to molecular orbitals (see Bonding chapter).

Atomic orbitals for a hydrogen atom can be found mathematically in essentially exact form. For other atoms, we often think of the atomic orbitals as scaled versions of the hydrogen orbitals. In hydrogen itself, the energy of the orbitals only depends on the shell number or, as we should properly call it, the **principal quantum number**, n.

However, in other atoms, electrons repel one another, resulting in shielding. We introduce the idea of an **effective nuclear charge**, Z_{eff} which is experienced by an electron in an atom. It is calculated by subtracting a shielding term, s from the actual nuclear charge Z. Electrons close to the nucleus experience almost the full nuclear charge, while the outer electrons are quite effectively shielded by those in lower shells.

- GCSE content (also suitable for KS3)
- Book collating A Level questions
- What would you most like to see?

This symposium is generously funded by The Ogden Trust making physics matter