



Question writing

... a chemist's (with maths interest) perspective

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Purpose: why are you writing this question?



- Summative assessment?
 - High stakes to get it right! But questions also undergo rigorous checking.
- Formative assessment?
- Diagnostic questions to identify areas for revision?
- Questions to introduce new concepts?
- Revision questions for particular concepts?
- Problem-solving questions to stretch students' understanding?
- Questions to generate discussion?
 - If there is an issue with a question, it will serve this purpose unintentionally!

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Formative assessments



- Sometimes will want to closely mimic actual exam question formats, but (assuming no risk of mark mattering)...
 - “Traps” can be fair game to highlight common mistakes to students
 - More challenge (overall) than real exam so students are well-prepared, but a balance to be struck with not disheartening them
- Questions in quizzes/for classroom use e.g. as MWB tasks/... for monitoring progress can be similar to diagnostic questions

Diagnostic/hinge questions

- Should address a single point to check for (mis)understandings
- Consider using MCQs with distractor (incorrect) options chosen to correspond with particular misconceptions, and so the correct answer

does not stand out

Which of the following reactions will have an enthalpy change corresponding to the lattice enthalpy of formation for magnesium chloride?

- What if last option is left out?

- ☐ $\text{Mg}^+ (\text{g}) + \text{Cl}^- (\text{g}) \longrightarrow \text{MgCl} (\text{s})$
- ☐ $\text{Mg}^{2+} (\text{g}) + 2 \text{Cl}^- (\text{g}) \longrightarrow \text{MgCl}_2 (\text{s})$
- ☐ $\text{Mg} (\text{s}) + \text{Cl}_2 (\text{g}) \longrightarrow \text{MgCl}_2 (\text{s})$
- ☐ $\text{Mg} (\text{s}) + \frac{1}{2} \text{Cl}_2 (\text{g}) \longrightarrow \text{MgCl} (\text{s})$

New concepts questions



- Think what students are expected to know already and what new information to introduce
- How does the new idea link in with their existing knowledge?
- Do you need diagnostic questions at outset?

A mass spectrometer relies on the presence of ions, which it is able to separate by their mass to charge ratio. However, many samples we wish to study are neutral. The instrument therefore needs to use an ionisation technique to form these ions within the sample. We will first consider **electron ionisation (EI)**. This involves firing high energy electrons at the vaporised sample in order to remove electrons.

Which of the following equations is an accurate description of this electron ionisation process:

- ☐ $X(g) \longrightarrow X^-(g) + e^-$
- ☐ $X^+(g) + e^- \longrightarrow X(g)$
- ☒ $X(g) + e^- \longrightarrow X^+(g) + 2e^-$
- ☐ $X(g) + e^- \longrightarrow X^-(g)$

Targeted revision questions



- Can use collation of past exam questions (from the exam board you teach and others) on the topic as a starting point to see how a particular idea is assessed
- Questions for revising and reinforcing single concepts can be relatively formulaic and repetitive, but can vary scaffolding
- If relevant for student stage and level, more synoptic questions can also be appropriate and provide a higher challenge level

In a controlled combustion experiment, 5.00 g of hydrogen gas reacted with excess chlorine to form hydrogen chloride, with the conditions remaining constant throughout. The temperature was held at 50 °C while the pressure remained at 2.5×10^5 Pa. Calculate the volume of hydrogen chloride that was produced under these conditions, assuming it can be modelled as an ideal gas.

Questions which generate discussion...



- Ambiguity in phrasing?
- Not enough information provided?
- Certain assumptions not specified?
- Too difficult for context?
- Flawed handling of subject material, no correct answers in MCQ, ...
- BUT can also be purposefully done
 - can ask very open-ended questions
 - can investigate underlying assumptions and misconceptions

Challenge and exam questions



- Actually... these both combine many elements of the other question types discussed!
 - Challenge questions may have their challenge element arise from
 - introducing a new idea
 - combining the application of several ideas
 - ...
 - Good exam questions will include a variety of challenge levels:
 - some parts may be single-concept recall questions not unlike diagnostic questions
 - some may be standard single-concept questions (with different levels of scaffolding)
 - some may be challenging even for the highest-performing students