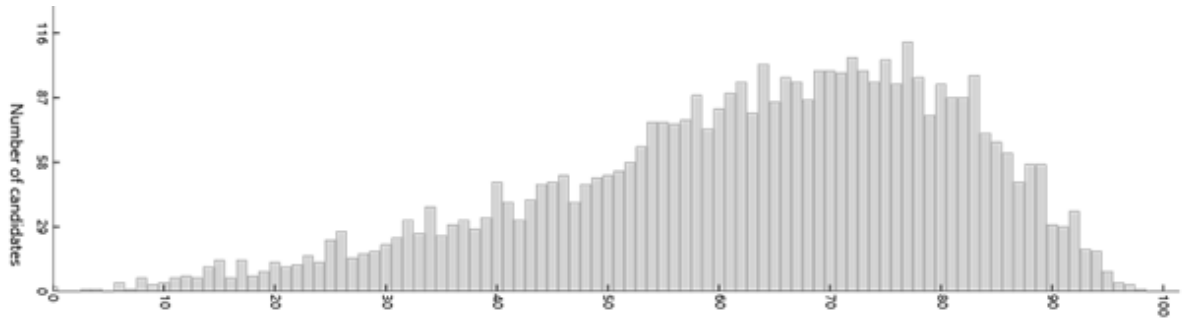
2020 ATAR course examination report: Chemistry

Year	Number who sat	Number of absentees
2020	4464	71
2019	4547	66
2018	4965	50
2017	5007	54

The number of candidates sitting and the number attempting each section of the examination can differ as a result of non-attempts across sections of the examination.

Examination score distribution–Written



Summary

This examination provided good coverage across the syllabus. There was a variety of questions, ranging from those needing a brief statement to those requiring a more detailed explanation. Many questions referred to real life applications of chemistry. Overall, the questions were accessible to candidates, with less reading required than in previous years.

Attempted by 4464 candidates	Mean 62.76%	Max 98.40%	Min 0.00%
Section means were:			
Section One: Multiple-choice	Mean 72.95%		
Attempted by 4462 candidates	Mean 18.24(/25)	Max 25.00	Min 0.00
Section Two: Short answer	Mean 58.48%		
Attempted by 4451 candidates	Mean 20.47(/35)	Max 34.54	Min 0.00
Section Three: Extended answer	Mean 60.14%		
Attempted by 4443 candidates	Mean 24.05(/40)	Max 39.32	Min 0.00

General comments

The increased means across all sections of the paper were a result of the accessible nature of the examination. Teacher and candidate feedback indicated that most were able to complete the examination in the three hours allocated.

Advice for candidates

- Respond to the specific question being asked. For example, if a question needs an explanation then a few words is not going to allow you to do this.
- Do not spend time writing answers that digress from the actual question.
- Textbooks are not the syllabus. Refer to the official syllabus documentation.

- Take care when writing the names of organic compounds. For example, the correct name is pentanamide, not pentamide (Question 26).
- Take care when identifying an amide functional group. It is not a ketone and an amine side-by-side.
- Ensure the lines representing the bonds in organic compounds are drawn carefully. For example, when attaching an alkyl group to a carbon chain, make sure the bond is drawn from the correct carbon atom on the chain to the carbon atom that attaches the alkyl group and not to another atom, such as hydrogen.
- When naming organic compounds, be careful to note that not all compounds with alkyl groups at angles are cis- or trans-.
- Make sure units are included when appropriate, even if there are no explicit statements saying to do so in the question. This includes units for voltage (volts, V) and mass.
- Writing 'like dissolves like' is not sufficient when explaining solubility. Instead, the various forces need to be identified and discussed.
- Avoid using abbreviations such as NVR or NR. Write answers in full e.g. 'no visible reaction' or 'no reaction', or whatever the question instructs.
- Become more familiar with the use of significant figures.
- When explaining the choice of indicator for a particular titration reaction, it is not enough to attribute it to acid/base strengths. The nature of the ions in the solution at the end of the titration need to be considered.
- Do not terminate the ends of polymers.
- Read questions carefully to determine whether collision theory or Le Châtelier's Principle is needed to answer a question. They are different things.
- Do not make a common error in thinking that ocean acidification means that the Earth's oceans are acidic. They are not. Ocean acidification means that the pH of the oceans is decreasing but it is still above 7, with this making it harder for shell formation. Seashells are not dissolving.

Advice for teachers

- All aspects of the syllabus are examinable including the contents of the Scientific Inquiry Skills and Science as a Human Endeavour sections.
- Keep up to date with IUPAC naming rules for organic compounds as changes to the rules can occur. For example, it is common practice to name 2, 3-dimethyl-but-2-ene as just dimethyl-but-2-ene but rule changes now require the '2, 3.'
- Encourage students to be specific in their answers and to avoid adding information just to 'fill up' the space allocated for an answer.
- Encourage students to practice drawing and naming organic structures, particularly when given just the molecular formula as the starting point. Remind students to look for situations involving isomers (structural and geometric).
- Give students the opportunity to practice calculations that don't have a well-practiced standard method for solving (i.e. a method that can be memorised). Encourage students to problem solve because not all calculations follow the same steps.
- Discourage the use of unofficial abbreviations in assessments. For example, NVR and NR are well known abbreviations but they are not official.
- Make sure students are fully aware of the information in the Data Booklet.
- Make students fully aware that Le Châtelier's Principle is a predictive tool and not linked to collision theory.
- Emphasise that ocean acidification does not mean that oceans are acidic/have a pH less than 7 and seashells are not dissolving. Rather, ocean acidification is a decrease in the pH of seawater with this interfering with seashell formation.

Comments on specific sections and questions

Section One: Multiple-choice (25 Marks)

The multiple-choice questions were relatively easy with 11 questions (Questions 3, 6, 8, 9, 14, 15, 16, 21, 22, 24 and 25) being correctly answered by over 80% of candidates. Candidates found questions 4, 13, 17 and 19 the most challenging. Question 4 required candidates to identify all isomers, with the provision of just the molecular formula of the organic compound making this question challenging. Question 13 required candidates to recognise that dispersion forces and hydrogen bonding are, respectively, greater when the hydrocarbon chain is longer and there is 'less crowding' around the alcohol functional group. Question 17 required candidates to read the question carefully because acid-base indicators do not change colour at a specific pH value (the colour change occurs over a pH range). Question 19 required candidates to understand the relationships between oxidation, reduction, oxidising agents, reducing agents, strengths and how this relates to E^0 values.

Question 1 attempted by 4462 candidates	Mean 0.75(/1)	Max 1	Min 0
Question 2 attempted by 4462 candidates	Mean 0.76(/1)	Max 1	Min 0
Question 3 attempted by 4462 candidates	Mean 0.93(/1)	Max 1	Min 0
Question 4 attempted by 4462 candidates	Mean 0.48(/1)	Max 1	Min 0
Question 5 attempted by 4462 candidates	Mean 0.65(/1)	Max 1	Min 0
Question 6 attempted by 4462 candidates	Mean 0.85(/1)	Max 1	Min 0
Question 7 attempted by 4462 candidates	Mean 0.60(/1)	Max 1	Min 0
Question 8 attempted by 4462 candidates	Mean 0.88(/1)	Max 1	Min 0
Question 9 attempted by 4462 candidates	Mean 0.93(/1)	Max 1	Min 0
Question 10 attempted by 4462 candidates	Mean 0.77(/1)	Max 1	Min 0
Question 11 attempted by 4462 candidates	Mean 0.67(/1)	Max 1	Min 0
Question 12 attempted by 4462 candidates	Mean 0.55(/1)	Max 1	Min 0
Question 13 attempted by 4462 candidates	Mean 0.47(/1)	Max 1	Min 0
Question 14 attempted by 4462 candidates	Mean 0.87(/1)	Max 1	Min 0
Question 15 attempted by 4462 candidates	Mean 0.89(/1)	Max 1	Min 0
Question 16 attempted by 4462 candidates	Mean 0.86(/1)	Max 1	Min 0
Question 17 attempted by 4462 candidates	Mean 0.31(/1)	Max 1	Min 0
Question 18 attempted by 4462 candidates	Mean 0.77(/1)	Max 1	Min 0
Question 19 attempted by 4462 candidates	Mean 0.27(/1)	Max 1	Min 0
Question 20 attempted by 4462 candidates	Mean 0.79(/1)	Max 1	Min 0
Question 21 attempted by 4462 candidates	Mean 0.88(/1)	Max 1	Min 0

Question 22 attempted by 4462 candidates Mean 0.89(/1) Max 1 Min 0

Question 23 attempted by 4462 candidates Mean 0.66(/1) Max 1 Min 0

Question 24 attempted by 4462 candidates Mean 0.87(/1) Max 1 Min 0

Question 25 attempted by 4462 candidates Mean 0.87(/1) Max 1 Min 0

Section Two: Short answer (76 Marks)
Most candidates did well in this section, demonstrating a good understanding of the course content. The mean was 58.48%, which is about 6% higher than in 2019. Candidates performed best in Question 28 (poly(ethylene adipate),a biodegradable polymer), with a mean of 68.45%. Question 33 was found to be the most difficult in this section (mean of 39.53%), with a number of candidates making no attempt.

Question 26 attempted by 4405 candidates Mean 2.58(/4) Max 4 Min 0
This question was answered well by most candidates. The main issues encountered with naming compounds was shortening the name pentanamide to pentamide and not recognising the amide functional group, instead thinking it was a ketone and an amine. A common error with the drawing of structural formulae was bonds not drawn carefully enough, resulting in them not going between the correct atoms.

Question 27 attempted by 4389 candidates Mean 4.24(/8) Max 8 Min 0
A common error was candidates forgetting to balance equations, and not using the Standard Reduction Potential Table to determine if a reaction was possible. Also, while many candidates gave extensive descriptions of the reactants, quite a few did not describe the products adequately.

Question 28 attempted by 4388 candidates Mean 3.42(/5) Max 5 Min 0
Most candidates performed well in this question, with the most common error being terminating the ends of the polyester.

Question 29 attempted by 4428 candidates Mean 6.97(/11) Max 11 Min 0
Part (a) was answered well by most candidates. Although part (b) directed candidates to use collision theory to explain the effect of removing methane, many used Le Châtelier's Principle, suggesting they did not read the question carefully. A similar situation arose in part (c), with many candidates not referring to the graph in their answer.

Question 30 attempted by 4415 candidates Mean 3.45(/7) Max 7 Min 0
Part (a) required students to identify the atom that was oxidised/reduced and not the entire molecule, as many did. Most candidates recognised that the solution in the electrolytic cell was a buffer and many gave a detailed definition of what a buffer was. This definition was not needed in the answer. Instead, candidates were required to explain how a buffer works. Also, the added SO_2 did not react with the buffer. Rather, the SO_2 reacted with H_2O to produce H^+ ions and it was these ions that the buffer responded to.

Question 31 attempted by 4402 candidates Mean 5.06(/9) Max 9 Min 0
Part (a) required candidates to have knowledge of the equilibria that occur when CO_2 is absorbed into the Earth's oceans and most demonstrated this. Part (b) saw many candidates write that seashells dissolve because of ocean acidification. These candidates were reflecting a common misconception about ocean acidification – seashells are carbonates and carbonates dissolve in an acid. Candidates need to understand that the name of the process (ocean acidification) is quite misleading – the Earth's oceans are not acidic because their pH is still above 7. Part (c) showed that many candidates did not know what the United Nations Kyoto Protocol was about and serves as a reminder that all parts of the syllabus are examinable.

Question 32 attempted by 4434 candidates Mean 8.36(/13) Max 13 Min 0
Parts (c)(i) showed that many candidates did not know the scientific definition of validity. Many confused it with accuracy. In part (e), a common response was 'like dissolves like' but this answer is inadequate. Candidates needed to refer to specific intermolecular forces.

Question 33 attempted by 3880 candidates Mean 3.56(/9) Max 9 Min 0
Candidates needed to develop their own method for synthesising an ester and many found it difficult to express their ideas logically/sequentially. Selecting the right reactants from the list was critical to answering this question successfully, as was a knowledge of the reactions of alcohols.

Question 34 attempted by 4354 candidates Mean 6.80(/10) Max 10 Min 0
Candidates needed to read the question carefully and make sure they answered part (a) by applying Le Châtelier's Principle and part (b) by using collision theory. Some candidates used Le Châtelier's Principle and collision theory interchangeably and included unnecessary information about the Haber Process.

Section Three: Extended answer (88 Marks)
Most candidates did well in this section. The mean was 60.14%, which is about 16% higher than in 2019, with this most likely reflecting the greater length of the 2019 examination. Candidates performed best in Question 38 (empirical formula), with a mean of 76.17%. Question 39 proved to be effective in discriminating among candidates, with non-standard methods required in performing calculations.

Question 35 attempted by 4379 candidates Mean 7.52(/11) Max 11 Min 0
This question was answered well by the majority of candidates.

Question 36 attempted by 4417 candidates Mean 11.74(/16) Max 16 Min 0
Part (e) was the most challenging part of this question with many candidates unable to fully explain ion movement through a salt bridge. Candidates needed to be specific when identifying which ions were moving where and not just state 'ions.' Greater detail than simply stating 'anions move to the anode and cations to the cathode' was needed. Also, candidates need to remember to include units, with the omission of V or volts for part (d) being quite common.

Question 37 attempted by 4410 candidates Mean 9.61(/17) Max 17 Min 0
This was a relatively straightforward titration question. Some minor errors, which should have been easily avoided, were not converting millilitres into litres and not giving numerical answers to the required number of significant figures. Many candidates also needed to provide better explanations for indicator selection, focusing on the pH of the solution at the equivalence point. It is not sufficient to say that the titration involved a weak acid and a strong base.

Question 38 attempted by 4284 candidates Mean 12.19(/16) Max 16 Min 0
This question was a standard empirical formula calculation, the methodology of which should have been quite familiar to candidates. Most candidates, therefore, did quite well in this question.

Question 39 attempted by 3697 candidates Mean 3.99(/12) Max 12 Min 0
This was the most challenging question in Section Three. This is most likely because there was no standard method to calculate the required quantities. Candidates needed to carefully analyse the data and apply their knowledge of stoichiometry. Part (a) involved simple calculations. Many candidates, however, did not realise that the loss in mass was due to a gas escaping. In part (b), the percentage efficiency created confusion with candidates, with many unsure whether they needed to divide or multiply to get the final answer. Many candidates did not recognise that part (c) was a limiting reagent calculation.

Question 40 attempted by 4333 candidates Mean 7.87(/16) Max 16 Min 0
Parts (a) and (g) challenged many candidates. The low mean of 38.23% for part (a) indicated that many candidates did not know the structure of biodiesel. In part (g) candidates needed to apply their knowledge of green chemistry and relate it to biodiesel, something which many candidates found challenging.