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Examiners' report

CHEMISTRY A

H432

For first teaching in 2015

H432/01 Autumn 2021 series

Version 1

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

	Reports for the November 2021 series will provide a broad commentary about candidate performance, with the aim for them to be useful future teaching tools. As an exception for this series, they will not contain any questions from the exam paper nor examples of candidate responses.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

A full copy of the exam paper and the mark scheme can be downloaded from OCR.

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Paper 1 series overview

H432/01 is the first of the three examination components for GCE Chemistry A. This component is focused on physical and inorganic chemistry and brings together topics from modules 3 and 5 of the specification, including relevant practical techniques. In this paper and H432/02 there is more of an emphasis on knowledge and understanding of the assessment outcomes from the specification, as compared to H432/03 which involves more application of knowledge. The paper consists of two sections, comprised of multiple choice questions and a mixture of short and long response questions respectively.

Candidates who did well on this paper generally did the following:	***Candidates who did less well on this paper generally did the following:***
• Produced clearly structured working for calculations – 18(d), 20(b)(i), 20(b)(ii), 20(c), 22(b)(i), 22(b)(ii), 22(c) • Produced clear and concise responses for the two Level of Response Questions – 17(b)(ii) and 22(c) • Were able to explain the in enthalpy of solution of magnesium halides – 16(c)(iv) • Were able to explain why MnO_4^{2-} disproportionated using electrode potentials and equilibrium shifts • Had a strong recall of transition metal chemistry – 17(a), 17(b) • Gave responses to the correct number of significant figures or decimal places – 18(d), 20(b)(ii), 20(c), 21(b)(i) • Able to process experimental results – 18, 21, 22.	• Found it difficult to apply what they had learned to unfamiliar situations • Produced unstructured responses to Level of Response questions which were lacking in depth or explanation, or, contained contradictory information – 17(b)(ii) and 22(c) • Did not clearly set out calculations, making it difficult for marks to be given for working – 18(d), 20(b)(i), 20(b)(ii), 20(c), 22(b)(i), 22(b)(ii), 22(c) • Did not give responses to calculations to the specified number of significant figures or decimal places – 18(d), 20(b)(ii), 20(c), 21(b)(i) • Either did not realise the need to convert between units or use the scale from the graph for some calculations, or found this difficult – 20(b), 21(b).

Comments on responses by question type

Multiple choice questions

Some candidates showed good practice by using the space around the multiple choice response to show working. There is no penalty for giving a wrong response.

	**AfL**	Practice multiple choice questions can improve the skill in solving and identifying the distractors. Exposure to this type of question style will decrease the time taken over each question. These can often form the basis of end of topic tests. Multiple choice question banks can be found via the resource-finder page on the OCR web site: https://www.ocr.org.uk/qualifications/resource-finder/ and details on how to use the online versions of the multiple choice quizzes can be found on: https://www.ocr.org.uk/Images/594811-digital-mcq-quiz-instructions.pdf

Level of response questions

The first Level of Response Question – 17(b)(ii) - was generally well attempted with many candidates achieving L1 by finding the formula of A by using the percentage composition data. Candidates who often scored L2 did so via the identification of the three stereoisomers and gave a logical sequence to their response. Candidates should be encouraged to show the mirror images of the optical isomers without further rotation. They should also focus on the connectivity of the ligand to the metal ion. Few candidates were able to identify the structure of B and to produce an ionic equation for the ligand substitution.

	**OCR support**	Further support can be found in the transition elements delivery guide: https://www.ocr.org.uk/qualifications/as-a-level-gce-chemistry-a-h032-h432-from-2015/delivery-guide/module-cam05-module-5-physical-chemistry-and-transition-elements/delivery-guide-cadg016-transition-elements

In the second Level of Response Question – 22(c) – the higher-attaining candidates had a good understanding of how a buffer was made by making the conjugate base and by having some of the weak acid remaining. Lower-attaining candidates often did not mention this and used the OH^- ion as the conjugate base. Descriptions often moved on to an attempt to explain how the buffer solution worked, which was not asked for in the question. Higher-attaining candidates were able to calculate the pH but many candidates did not take into account the final amount of nitrous acid after partial neutralisation. Lower-attaining candidates often used the weak acid calculation route.

The mass of N_2O_3 was generally well calculated with a few omissions of the ratio or an incorrect relative formula mass. Candidates should be encouraged to display their working and link the numbers to the appropriate chemical, citing moles or concentration.

	**OCR support**	Further support can be found in the pH and Buffers delivery guide: Delivery Guide for OCR AS/A Level Chemistry A

Themes in candidate responses

Transition metals

17(a): Only the higher-attaining candidates scored full marks. Candidates should be encouraged to focus on the requirements of the question. Despite the question asking for them, many did not include any of the electron arrangements. Those that gave correct electron configurations for the two ions often did not say they were empty/full to back up their explanations.

Many candidates often did not mention ions for the transition metal definition. Lower-attaining candidates used the idea of electrons in the outer shell rather than the higher energy level. They also thought it was the elements not the ions that had to have a partially filled d-sub-shell.

Calculation-based questions

16(c)(iii): This was an enthalpy solution/hydration cycle. Many candidates were successful in calculating the value from the information given.

18(d): This was a percentage by mass calculation. Many candidates correctly calculated the number of moles of thiosulphate and used the ratio to calculate the moles of iodine. Many candidates then either linked this, incorrectly, to the number of moles of iodide or used an incorrect mole ratio to find the moles of Cu^{2+}. Multiplication by the relative formula mass of copper was well understood and some candidates gained error carried forward marks for their calculation of the percentage.

20(c): This question asked the candidate to calculate K_p. Some candidates made full use of tables which allowed for credit to be given through error carried forward. Some candidates did not successfully calculate the number of moles at equilibrium but completed the subsequential steps.

Lower-attaining candidates divided the mole fraction by the partial pressure rather than performing a multiplication and omitted the square relationship within the K_p expression. Candidates should remember to provide written indications of what it is they are working out – presenting the calculations without any annotations and structure can make it harder for error carried forward marks to be given.

21(b)(i): This question asked the candidate to determine the activation energy and to use the graph to calculate the temperature that an investigation was carried out.. Some candidates gained full credit and successfully calculated the activation energy. Others did not use the 10^{-3} scale in the 1/T axis and/or calculated a gradient that was out of tolerance.

20(b)(iii): A significant number of candidates tried to calculate the temperature by rearranging and substituting into the Arrhenius equation rather than to use the graph. Only a few candidates were successful in obtaining the value for lnK and then using the graph to find 1/T.

22(b)(ii): This question asked the candidates to calculate the enthalpy change and then to deduce the value for the enthalpy change of neutralisation. Very few candidates scored full marks. Candidates often confused the enthalpy change for the value of q. They were unsuccessful in dividing the enthalpy change by 2 or to use the correct number of moles of water to calculate the enthalpy change of neutralisation. Both reactions were exothermic, and the negative signs were often omitted.

Questions on rates of reaction

21(a)(i): Most candidates found the order with respect to $S_2O_3^{2-}$ by comparing experiments 1 and 2. Fewer students were able to comment on sufficient data from other experimental comparisons to show that it was 0 order with respect to H^+.

21(a)(ii) Few students proposed $S_2O_3^{2-}$ as the only reactant in step one. Very few candidates were able to suggest the two steps, ensuring that overall charges as well as the atoms balance.

	OCR support	Further guidance on rates of reaction can be found at: https://www.ocr.org.uk/Images/371956-experiments-on-rates-of-reaction.doc

Electrode potentials

19(a)(i): Most candidates were able to draw a circuit containing a voltmeter and the chromium half-cell but very few candidates included the H^+ in the MnO_4^-/Mn^{2+} cell.

19(a)(ii) and (b)(i): Most candidates were able to construct the equation for the overall cell reaction and to use oxidation numbers to explain disproportionation.

19(b)(ii): Only a few candidates were able to link the electrode potentials and equilibrium shifts. Many candidates did not clarify which redox system they were referring to and only stated one of the ions. Often only one equilibrium shift was mentioned, and it was not linked to any redox system. Centres should advise candidates to use the redox system numbers found within the question to aid communication. Candidates should avoid using the terms 'higher/lower' to compare the E cell values.

	OCR support	Further guidance on electrode potentials can be found in our delivery guide: Delivery Guide for OCR AS/A Level Chemistry A

Enthalpy changes

16(c)(iv): This question involved the qualitative explanation of the effect of ionic charge and ionic radius on the exothermic value of a lattice enthalpy and enthalpy change of hydration. These then needed to be linked to enthalpy change of solution. Only a few candidates were able to gain credit describing lattice enthalpy and hydration enthalpy becoming more exothermic down the group. A significant number of candidates described trends in ionisation energies, reactivity, intermolecular bonding and/or electronegativity. They only scored the mark for the trend in ionic radius going down the group. Candidates should focus on the use of correct terminology as atomic radius is incorrect in this context. Some candidates are still using 'smaller/less' to describe 'less exothermic'.

	Misconception	Some candidates linked ionisation energy rather than lattice enthalpy and enthalpy change of hydration.

Key teaching and learning points – comments on improving performance

Candidates could improve their performance in this examination by further practice on the skills required to complete multiple choice questions. The candidates should produce clearly structured working in their calculation questions so that methods are understood and followed. Further practice in linking experimental observations with theoretical understanding would improve the quality of descriptions and understanding, e.g. 18(e), (f), and 22(b)(ii). The candidates should make sure that they use the appropriate terminology, e.g. 16(a), 16 (c)(iv) and 19(b)(ii). They could develop their ability to write ionic equations. The candidates should improve their ability to process experimental results from graphical data, focusing on the relationship to that of a straight line (y=mx+c).

	OCR support	Links to selected legacy coursework tasks and PAG practice question sets can be found on OCR Interchange: Legacy tasks: https://interchange.ocr.org.uk/Downloads/ALevel_Chem_legacy_tasks.zip?downloadId=877732 PAG practice questions: https://interchange.ocr.org.uk/Downloads/H432_H433_Chemistry_PAG_Practice_Question_Sets.zip Exam hints for students can be found at: https://www.ocr.org.uk/Images/592305-exam-hints-for-students.pdf

Guidance on using this paper as a mock

This paper should be used in conjunction with H432/02 and H432/03. Candidates should sit the paper under examination conditions in the allotted time. The marked paper should be reviewed, in conjunction with the mark scheme, by the student to identify the terminology and structure required within the questions to achieve full credit. Internal moderation will add validity to the credit given.

	OCR support	Further topic tests can be constructed via: https://www.ocr.org.uk/Images/587672-building-a-topic-test-in-exambuilder.docx Students could use the revision check list at: https://www.ocr.org.uk/Images/592327-student-revision-checklist.docx

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