Qualification Accredited

OCR
Oxford Cambridge and RSA

**A LEVEL**

Examiners' report

# CHEMISTRY B (SALTERS)

**H433**

For first teaching in 2015

## H433/02 Summer 2024 series

Version 1

# Contents


Introduction ........ 5
Paper 2 series overview ........ 6
Question 1 (a) (i) ........ 7
Question 1 (a) (ii) ........ 7
Question 1 (b) ........ 8
Question 1 (c) (i) ........ 8
Question 1 (c) (ii) ........ 9
Question 1 (c) (iii) ........ 9
Question 1 (d) ........ 10
Question 1 (e) (i) ........ 11
Question 1 (e) (ii) ........ 11
Question 2 (a) (i) ........ 12
Question 2 (b) (i) ........ 13
Question 2 (b) (ii) ........ 13
Question 2 (c) (i) ........ 14
Question 2 (c) (ii) ........ 15
Question 2 (d) (i) ........ 16
Question 2 (d) (ii) ........ 16
Question 2 (d) (iii) ........ 16
Question 2 (e) (i) ........ 17
Question 2 (e) (ii) ........ 18
Question 3 (a) (i) ........ 18
Question 3 (a) (ii) ........ 19
Question 3 (a) (iii) ........ 19
Question 3 (b)* ........ 20
Question 3 (c) (i) ........ 22
Question 3 (c) (ii) ........ 22
Question 3 (d) (i) ........ 23
Question 3 (d) (ii) ........ 23
Question 3 (e) (i) ........ 24
Question 3 (e) (ii) ........ 25
Question 4 (a) (i) ........ 25
Question 4 (a) (ii) ........ 25
Question 4 (a) (iii) ........ 26

Question 4 (b) .......... 27
Question 4 (c) .......... 28
Question 4 (d) (i) .......... 29
Question 4 (d) (ii) .......... 29
Question 5 (a) (i) .......... 30
Question 5 (a) (ii) .......... 30
Question 5 (a) (iii) .......... 31
Question 5 (a) (iv) .......... 31
Question 5 (b) (i) .......... 32
Question 5 (b) (ii) .......... 32
Question 5 (b) (iii) .......... 33
Question 5 (d)* .......... 34
Copyright information .......... 36

# Introduction

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

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. A selection of candidate answers is also provided. 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.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

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

# Paper 2 series overview

H433/02 is one of the three examination components for GCE A Level Chemistry B. This component, entitled 'Scientific literacy in chemistry', links together different areas of chemistry within different contexts, some practical, some familiar and some novel. The paper also includes questions based on a pre-released Advance Notice Article, included as an insert with the question paper. To do well on this paper, candidates need to have studied the pre-release material and to have researched some of the unfamiliar contexts included in this document. They also need to be comfortable applying their knowledge and understanding to unfamiliar contexts and be familiar with a range of practical techniques that they should recognise from completing the practical elements of the course.

It was very pleasing to see how well candidates tackled the maths content of the paper. Historically candidates have struggled with some of the calculations asked of them, however this year it is very pleasing to note that candidates of all abilities attempted most of the calculations and often scored some of the marks available. In addition, there was significant engagement with both Level of Response questions. Many candidates achieved at least a Level 2 on both questions, and the more successful candidates achieved a mark at Level 3 on Question 3 (b). There was also strong evidence that candidates had spent time with their teachers going through the Advance Notice Article 'Reactive Oxygen Species' as the quality and depth of responses on Question 5 as a whole were particularly pleasing.

It is also pleasing to note that there were very few papers where candidates either left questions unanswered or struggled to complete the paper. Candidates appeared to have made good use of their time and consequently they were able to structure their answers on the Level of Response questions in particular.

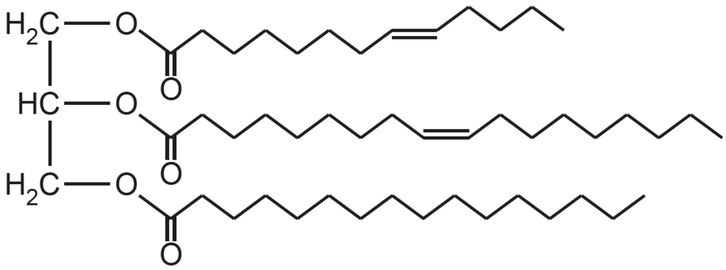
| Candidates who did well on this paper generally: | Candidates who did less well on this paper generally: |
|---|---|
| • performed standard calculations showing clear working and, where appropriate, conversion to the required number of significant figures in Questions 2 (a) (i), 2 (e) (i), 4 (a) (ii), 4 (d) (i) and 5 (a) (iv)<br>• were able to discuss ideas buffers and pH in Question 4, including using ideas about equilibria in Questions 4 (a) (iii) and 4 (d) (ii)<br>• showed a broad level of understanding of Organic Chemistry in Questions 1 (e), 3 (a), and all parts of Questions 3 (c) and 3 (d)<br>• produced detailed responses on both Level of Response questions that accessed Level 2 as a minimum<br>• were able to give good descriptions of practical activities in Questions 2 (e) (ii) and (3) (b). | • struggled to produce balanced chemical equations in Questions 1(a) (ii), 2 (c) (ii) and 5 (b) (iii)<br>• struggled to explain specificity of enzyme activity in a specific situation, often giving responses that were generalised rather than being explicit to the questions posed in Questions 3 (e) (i) and (ii). |

## Question 1 (a) (i)

**1** Trans fats are made from carboxylic acids with double bonds in a trans arrangement. They sometimes improve the texture of foods, but they are harmful to health.

**(a)** **Fig. 1.1** shows the structure of a fat molecule.

**Fig. 1.1**




**A**

**B**

**C**

**(i)** The side-chains formed by three carboxylic acids are labelled **A**, **B** and **C**.

Give the letter of the side-chain that is:

Saturated ...............

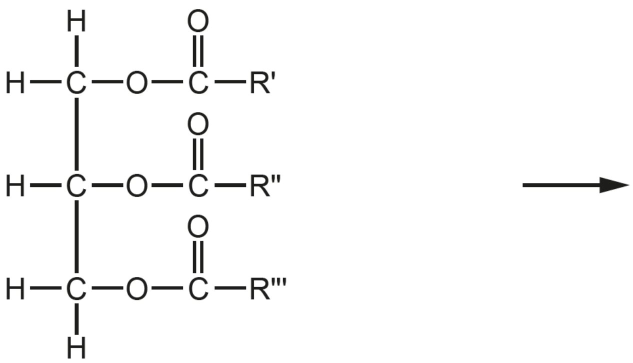
Trans unsaturated ...............

**[1]**

## Question 1 (a) (ii)

**(ii)** The fat molecule in **Fig. 1.1** can be represented as shown below.

Complete the equation for the hydrolysis of the fat with aqueous NaOH.




**[3]**

These first two questions provided candidates with an early opportunity to demonstrate their basic knowledge regarding organic molecules and organic reactions. In Question 1 (a) (i), most candidates scored the mark available, and the most commonly seen error was to identify compound B as the trans unsaturated molecule. All candidates did, however, correctly identify compound C as containing the saturated side chain.

However, in Question 1 (a) (ii), a variety of answers were produced that seemed to indicate that candidates struggled to identify the products of hydrolysis and also to correctly balance the equation. Candidates were told in the question stem that they needed to use NaOH to bring about the hydrolysis but lost the mark for this as it was not balanced. They did, however, often score 1 mark for correctly identifying propan-1,2,3-triol as one of the products of the reaction. Very few candidates correctly identified the three sodium salts produced in the reaction.

## Question 1 (b)

**(b)** Long-chain carboxylic acids can be identified by converting them to their methyl esters and then using gas–liquid chromatography.

Write the equation for the conversion of RCOOH to its methyl ester using the appropriate alcohol.

**[2]**

Many candidates gave the correct molecular formula for methanol, $CH_3OH$, as the reactant needed to bring about the conversion to score 1 mark. Although they then correctly produced a structure for the ester, some did not score the second mark as they did not include a molecule of water, $H_2O$, in their balanced equation.

## Question 1 (c) (i)

**(c)** In gas–liquid chromatography, the methyl esters are injected into a stream of carrier gas and passed through a column containing the stationary phase.

**(i)** Name a suitable carrier gas.

........................................................................................................................................ **[1]**

## Question 1 (c) (ii)

**(ii)** What does the stationary phase consist of?

............................................................................................................................................

............................................................................................................................................ **[2]**

Question 1 (c) as a whole was looking at one of the methods of instrumental analysis studied by students as part of the specification. In Question 1 (c) (i), most candidates correctly stated that the carrier gas would be either nitrogen or argon. The most commonly seen incorrect responses were hydrogen or other Group 0 elements such as helium or neon.

In Question 1 (c) (ii), we saw a variety of responses. More successful responses correctly identified that the stationary phase consisted of 'a high boiling point liquid supported on a porous solid support'. Where candidates did not score either of these marks was often in giving an inaccurate description of the liquid used, terms such as viscous or inert were frequently seen in describing the liquid used. Most, however, did score one mark if they gave a description of a porous support, even if they did not include the word solid as part of their description.

## Question 1 (c) (iii)

**(iii)** Mass spectrometry can be used to identify the emerging esters.

Which property of the esters does mass spectrometry measure?

............................................................................................................................................ **[1]**

There was a surprising variety of answers here. More successful candidates on the paper did score this mark. However, there was a significant proportion of candidates who did not score. The more commonly seen incorrect responses included relative atomic mass, the functional groups present, or the fragments produced.

## Question 1 (d)

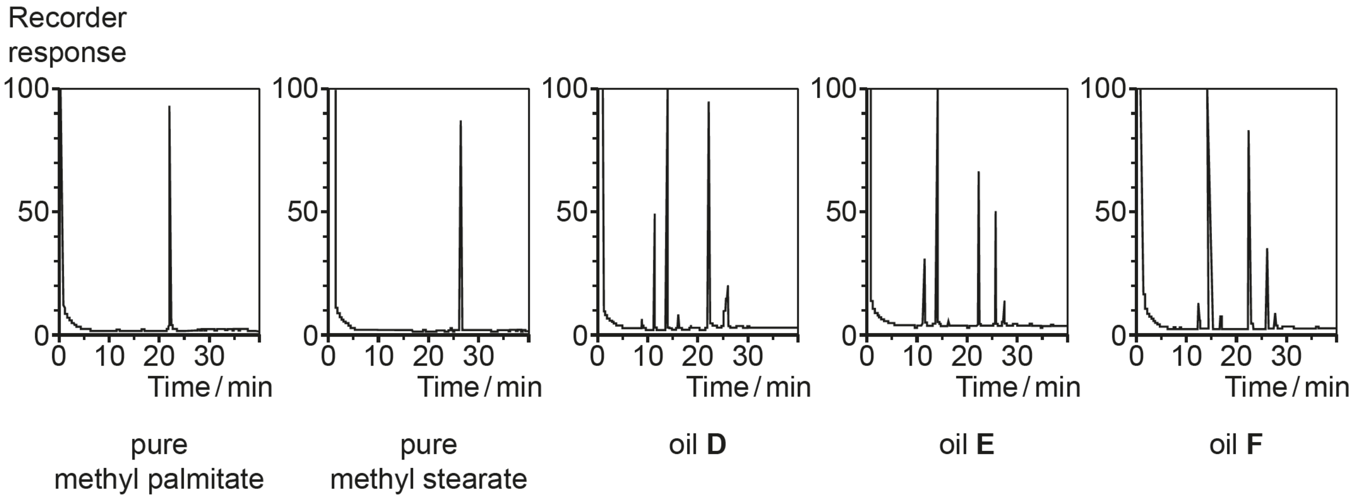
**(d)** Oils are fats which are liquid at room temperature. Many oils are made from palmitic and stearic acids, as well as other carboxylic acids.

To identify an oil, the methyl esters of the carboxylic acids, including methyl palmitate and methyl stearate, are made from the oil.

The oil can be identified from the gas–liquid chromatogram of the methyl esters using the ratio of methyl palmitate:methyl stearate from the peak heights.

Linseed oil has a methyl palmitate:methyl stearate ratio of 5:4.

Use the gas–liquid chromatograms below to decide which of the oils **D**, **E** or **F** is linseed oil.
Give your reasoning.




.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

....................................................................................................................................... **[4]**

In this question candidates were provided with some information about linseed oil and were then asked to analyse the gas-liquid chromatograms for three oils in order to identify which oil was linseed oil. In order for candidates to score full marks they had to clearly identify the retention times for the pure methyl esters from the control traces provided. They then needed to use these times to analyse oils D, E and F along with ratio of methyl palmitate:methyl stearate given in the stem of the question. By putting all of this information together candidates should have identified oil E as being the linseed oil, and then made a comment about the ratio of the peak heights (65:50) as being closest to the expected 5:4 ratio evident from the three test oils. Many candidates scored the first three marks but then gave a description of the peaks that was insufficient to score, e.g. 'The peaks are similar to those in the pure esters' or 'the higher peak at 22 minutes is methyl palmitate and the smaller peak is methyl stearate'.

## Question 1 (e) (i)

**(e)** Oleic acid, $C_{18}H_{34}O_2$, has the structural formula $CH_3(CH_2)_7CH=CH(CH_2)_7COOH$.

**(i)** The iodine value of a fat or carboxylic acid is the mass of iodine that will combine with 100 g of the substance, saturating the double bonds.

Calculate the iodine value of oleic acid.

iodine value = ........................................................ g **[2]**

This calculation was well done by the majority of candidates with a value of 90 (g) being seen to score 2 marks. The only commonly seen error was using 126.9 in the final calculation, rather than 253.8, producing a result of 45 g. Providing that candidates had shown their working and had calculated the number of moles of oleic acid correctly they could still score 1 mark.

## Question 1 (e) (ii)

**(ii)** A student suggests treating oleic acid with steam and $H_3PO_4$, using high temperature and pressure.

The student says that the product will be

$CH_3(CH_2)_7CH(OH)CH(OH)(CH_2)_7COOH$.

Comment on the student's statement.

........................................................................................................................................

........................................................................................................................................

........................................................................................................................................

........................................................................................................................................ **[2]**

Incorrect responses here tended to be those where the candidate had focused on the reaction conditions given in the question stem rather than looking at the product formula.

Some responses suggested different reagents/temperature/pressure which would not bring about the required hydration of the alkene and so did not score any marks.

Other responses suggested that the conditions used would be successful – there was no mark for this – but that the product would contain a saturated chain (addition of $H_2$ across the double bond) and again this does not score any marks.

However, there were many candidates who did correctly recognise that under the reaction conditions given the hydration of the double bond would happen as a two-step reaction. This involved the addition of $H^+$ to create a carbocation that the $OH^-$ ion could then add onto, creating an alcohol which was a secondary alcohol but only contained one OH group per double bond. Where they provided such a detailed description, they clearly scored the first marking point from the mark scheme, but if they did not then draw a suitable structure for the final product they could not achieve the second mark.

## Question 2 (a) (i)

**2** This question is about some substances used as medicines.

**(a)**
**(i)** People use magnesium carbonate to neutralise excess stomach acid.

Magnesium carbonate reacts with hydrochloric acid in the stomach as shown in the equation.

$MgCO_3(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + CO_2(g) + H_2O(l)$

A tablet contains 305 mg of $MgCO_3$.

Calculate the volume of $CO_2$ (in $cm^3$) produced by this tablet at RTP.

Give your answer to an **appropriate** number of significant figures.

volume of $CO_2$ = .................................................. $cm^3$ **[4]**

This was a well-answered question across all candidates. Many candidates scored all 4 marks but where this was not the case then it was not unusual to see a score of 3 being achieved. There were two consistent errors evident. First of all, some candidates did not convert 305 mg into grams, and lost the first mark but then by use of ECF (Error Carried Forward) they scored the remaining 3 marks. The other common error was in failing to give the final answer to 3s significant figures, which was the appropriate number of significant figures expected for this calculation. Answers to 2 decimal places were seen, e.g. 86.83 $cm^3$, but were not permitted, resulting in a mark of 3 being given for this question.

## Question 2 (b) (i)

**(b)** People also use magnesium trisilicate ($Mg_2O_8Si_3$) to neutralise stomach acid.

**(i)** Complete the electron configurations of:

A Si atom: $1s^2$ ..........................................................................................................

A $Mg^{2+}$ ion: $1s^2$ ..........................................................................................................

**[2]**

## Question 2 (b) (ii)

**(ii)** The first ionisation enthalpy of silicon is larger than that of magnesium.

A student says that this is because silicon atoms are larger than magnesium atoms.

Comment on the student's statement, giving the correct chemistry where necessary.

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

.......................................................................................................................... **[4]**

Questions 2 (b) (i) and (ii) were linked and were looking at candidates' knowledge about atomic structure and periodic trends.

In Question 2 (b) (i), candidates were asked to give the electron configurations for an atom and an ion from elements in the same period of the periodic table. This was well answered with many candidates scoring 2 marks. Where some candidates lost a mark was in giving an incorrect outer arrangement for the silicon atom.

In Question 2 (b) (ii), candidates were given a statement about the first ionisation enthalpy (IE) of these elements and were asked to comment on the validity of the statement. Candidates should have realised that as these elements are both in period 3 of the periodic table, they both contain electrons on their outer shell that are in the same primary energy level, and so the effects of electron shielding would not be a factor in explaining the differences in IE values for the two elements. Although the question was asked from the perspective of the silicon atom and its IE value, answers could be given from the perspective of magnesium by use of reverse arguments (ORA).

A full range of marks was evident for this question. Some candidates accepted that silicon atoms were larger than magnesium atoms wrongly, and lost the first marking point, but could still score the other three marks. Some candidates recognised that as silicon contained 2 extra electrons compared to magnesium, that there were 2 additional protons (marking point 2) in the silicon nucleus. This consequently meant that there was a stronger attraction between the nucleus and the outer electrons (marking point 3) that resulted in the atomic radius being less for silicon compared to magnesium (or silicon atoms being smaller than magnesium atoms) and so scored a further mark (marking point 1). A common error that followed from these explanations was to simply repeat the information from the stem of the question i.e. 'so the first ionisation enthalpy is higher' rather than making a comment such as 'more energy is needed (to overcome the stronger nuclear attraction)'.

## Question 2 (c) (i)

**(c)** People use iron tablets if their bodies lack iron.

One type of iron tablet contains iron(II) sulfate.

**(i)** Iron(II) sulfate has the formula $FeSO_4{\bullet}xH_2O$.

When 5.6 g of $FeSO_4{\bullet}xH_2O$ is heated gently, 3.1 g of $FeSO_4$ is left.

Calculate the value of *x* in $FeSO_4{\bullet}xH_2O$, where *x* is a whole number.

*x* = .......................................................... **[3]**

This calculation was generally well done, and many candidates scored all 3 marks.

There were two common errors seen in this question. The more common error saw a mark was lost as a result of failing to convert their final value into an integer value as directed in the stem of the question.

The other less commonly seen error saw some candidates correctly calculate the mass of water lost, and subsequently the number of moles of water lost. They then incorrectly calculated the moles of $FeSO_4$ by using 5.6 g as the mass of the iron compound and arriving at the number of moles of $FeSO_4$ as 0.0369 mol. This then gave the value of x as 4 and this scored 2 marks rather than 3 as there was a single error evident in the calculation.

## Question 2 (c) (ii)

**(ii)** When $FeSO_4$ is heated more strongly, a brown solid ($M_r$ = 159.6) remains and two acidic gases are formed.

Suggest an equation for this reaction.

Give your reasoning.

Equation:

Reasoning: ....................................................................................................................................

....................................................................................................................................

....................................................................................................................................

**[3]**

This question provided quite a bit of differentiation in candidate responses. A small number of candidates did not engage with the question and left it blank. Some candidates tried to write equations that included other substances as reactants, e.g. water or oxygen.

Others recognised that there was a thermal decomposition reaction occurring but they included iron(III) hydroxide, $Fe(OH)_3$, as a product which they believed to be the brown solid produced. This was wrong as the $M_r$ value for this compound does not match the value given in the stem of the question, or that there are no hydrogen atoms present in the reactant iron(II) sulfate. In these situations, candidates did not score any of the marks.

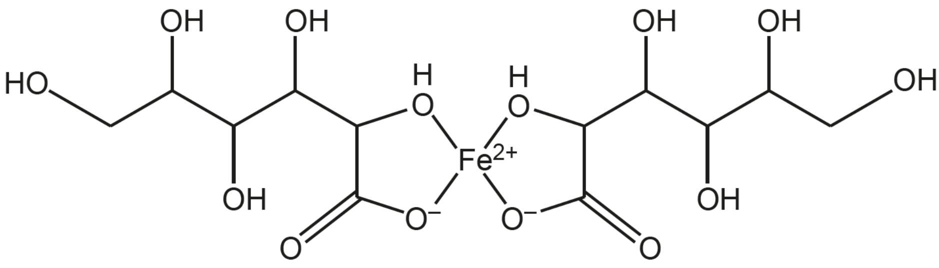
However, there were a significant number of candidates who recognised that an iron compound with an $M_r$ value of 159.6 probably contained 2 iron atoms and 3 oxygen atoms and so arrived at the formula $Fe_2O_3$ as one of the products, scoring 1 mark. Some recognised that $SO_2$ would be a product but also thought that the sulfur gases produced would dissolve in water to produce $H_2SO_3$ or $H_2SO_4$ as a co-product in their equation which resulted in the mark for the balanced equation being lost.

For candidates at the upper grades this question proved to be a good discriminator as only a small proportion of candidates scored all 3 marks on this topic.

## Question 2 (d) (i)

**(d)** Other iron tablets contain iron(II) gluconate. This contains the complex shown in **Fig. 2.1**.

**Fig. 2.1**




**(i)** The complex contains two gluconate ions.

What **type** of ligand is the gluconate ion?

............................................................................................................................................ **[1]**

## Question 2 (d) (ii)

**(ii)** Name the **type** of bonds between the O atoms and $Fe^{2+}$ ions in the structure.

............................................................................................................................................ **[1]**

## Question 2 (d) (iii)

**(iii)** Suggest the shape around the $Fe^{2+}$ ion in **Fig. 2.1**.

............................................................................................................................................ **[1]**

Questions 2 (d) (i) to (d) (iii) were intended to be a quick look at transition metal complexes and in general they were well-answered by most candidates

It was not unusual to see candidates scoring all three marks here, but where this did not happen it was often as a result of naming the bonds in Question 2 (d) (ii) incorrectly as ionic. This may have been as a result of candidates looking at Fig 2.1 and spotting the central iron atom as $Fe^{2+}$ which is bonded to the 2 oxygen ions of the gluconate anion. The question does specifically ask for the bonds between the oxygen **atoms** (of the OH groups) and the $Fe^{2+}$ ions in the structure.

## Question 2 (e) (i)

**(e)** A student does a titration to find the mass of iron in an iron tablet.

The student follows these instructions:

- Dissolve three iron tablets in 1.5 mol dm$^{-3}$ sulfuric acid and make up to 0.250 dm$^3$ in a volumetric flask.
- Pipette out 25.0 cm$^3$ portions and titrate with 0.00277 mol dm$^{-3}$ $KMnO_4$ solution.

The equation is:

$$5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \rightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l)$$

The student obtains a mean titre of 25.5 cm$^3$.

**(i)** Calculate the mass of iron (in mg) in **one** iron tablet.

mass of iron in one tablet = ................................................... mg **[4]**

This is a type of calculation that candidates should be familiar with. Titrimetric analysis is a technique that candidates should have been familiar with, and this experiment is one that they ought to have carried out at some point during their work on transition metal chemistry.

Many candidates correctly calculated the number of moles of $MnO_4^-$ correctly to score the first mark, but at this point it was not unusual to see candidates getting into a muddle. They knew that they need to use the equation given and multiplied by 5 at this point to determine the number of moles of iron. This was not enough to score a mark, as the question required them to calculate the mass of iron in the solution and so they should have multiplied by 55.8 to obtain the mass of iron in their 25 cm$^3$ aliquot. Some candidates at this point divided by 8 and tried to relate their answer to the moles of acid from the stoichiometry of the equation. This resulted in them losing marking point 2, but if they then scaled up their value to identify a mass of iron compound in the original 250 cm$^3$ they could still score marking point 3. For many candidates, marking points 1 and 3 were the only marks that they scored on this question.

Some candidates did carry out the calculation up to marking point 3 correctly but then either did not divide by 3 to get the mass of one tablet or did not convert from grams back into mg and so did not score marking point 4.

These multi-step calculations often cause issues for candidates, as they find it difficult to order their thoughts to tackle this in a systematic manner. It was not unusual to see a plethora of numbers written across the answer space provided, where candidates had tried a variety of approaches to arrive at a value, they believed to be consistent with what they might have expected for the mass of iron in a single tablet.

## Question 2 (e) (ii)

**(ii)** The student uses a volumetric pipette to transfer 25.0 $cm^3$ of the acidic solution to a conical flask.

Give the practical details of the student's next steps to get an accurate mean titre.

........................................................................................................................................

........................................................................................................................................

........................................................................................................................................

........................................................................................................................................

........................................................................................................................................

.................................................................................................................................. **[3]**

This question was well answered by many candidates with most scoring at least 2 of the available marks. The only commonly seen error was candidates including an indicator (often phenolphthalein) as they believed that this would be needed to see a colour change at the end point. They often gave the correct colour change (turns to a permanent pink colour), but the use of an indicator was contradictory for this marking point.

## Question 3 (a) (i)

**3** Enzymes are proteins made up of amino acids.

**(a)** Dipeptides are made by a condensation reaction between two amino acids.

Some students have a solid that is a dipeptide of alanine and serine.

**(i)** The 'R-groups' for alanine and serine are $–CH_3$ and $–CH_2OH$.

Draw a possible structure for this dipeptide.

**[2]**

This question was well answered. Most candidates scored both marks as they correctly drew a structure that included the correct peptide link and included all of the remaining structure also correctly drawn. Where marks were lost was occasionally by drawing an ester link between the two amino acids. This unfortunately meant that candidates also did not score the second marking point, as their final structure was also incorrect as it contained two $NH_2$ groups.

## Question 3 (a) (ii)

**(ii)** The link between the amino acids is often described as a peptide bond.

Give another chemical name for the link.

................................................................................................................................................ **[1]**

Few candidates scored the mark for this question. Candidates were imprecise in their terminology as they did not identify the link as a secondary amide, and often simply referred to the bond as an amide.

## Question 3 (a) (iii)

**(iii)** Explain why the reaction between the amino acids is **not** called addition.

................................................................................................................................................

................................................................................................................................................

................................................................................................................................................ **[1]**

Many candidates simply stated that this was a condensation reaction which was insufficient to score the mark. Others stated that it was not addition as a small molecule was eliminated, and again this was insufficient. The only acceptable response here was for candidates to state that a molecule of water was eliminated in the reaction to form the dipeptide from the two amino acids, alanine and serine, named in the question.

## Question 3 (b)*

**(b)*** The students boil the dipeptide from **(a)** with 6 mol dm$^{-3}$ hydrochloric acid.
They want to show that the resulting mixture contains alanine and serine.
They use paper chromatography and solutions of alanine and serine.

Describe what they would do and draw the results they would expect to obtain.

$R_f$ value of alanine = 0.40
$R_f$ value of serine = 0.28

........................................................................................................................

........................................................................................................................

........................................................................................................................

........................................................................................................................

........................................................................................................................

........................................................................................................................

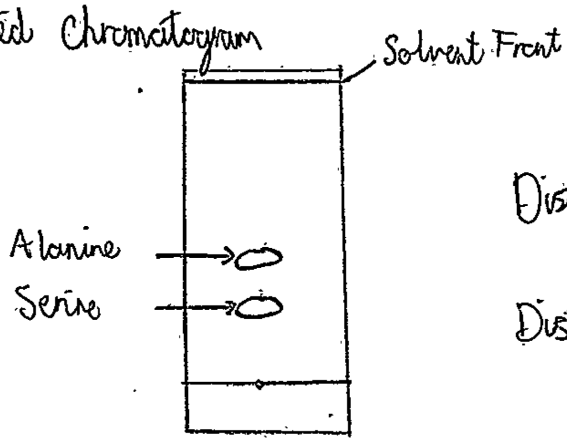
Drawing:

**[6]**

## Exemplar 1

The students hydrolyse the dipeptide by heating with 6 moldm$^{-3}$ HCl under reflux. Once cooled, the students should neutralise the solution with a Carbonate, eg $NaHCO_3$. Then with a piece of chromatography paper, draw a pencil line 1cm above the base. Spot the mixture using a capillary tube and then place in a beaker containing a chromatography solvent so that it goes half way up to the pencil line. Cover with a lid. Take out the paper just before the solvent reaches the top of the paper and mark the solvent front. Add ninhydrin to identify the amino acid spots

Drawing: Expected Chromatogram




If distance from Pencil Line to Solvent Front is 10cm

Distance to centre of Alanine Spot = 4cm

Distance to centre of Serine Spot = 2.8cm

**[6]**

Extra answer space if required.

Calculate the $R_f$ of each spot by dividing the Distance from Pencil Line to Centre of Spot by distance from Pencil line to solvent front. Calculated $R_f$ values should roughly be 0.4 and 0.28 to be expected results

Chromatography is a practical technique that students should be very familiar with as they first study it at KS3, then again at KS4 and they then use it here in the analysis of a dipeptide. Therefore, it was not surprising to see that most candidates were scoring marks that were at least at Level 2 with many being able to move onto Level 3.

Exemplar 1 has been selected as it shows a response that was a very good match to the Level 2 descriptor. It did not move on to Level 3 as it contains an omission that was quite common with answers at this Level. Candidates at Level 2 and 3 very often produced a response that was well-structured and communicated their ideas effectively including most relevant fine detail from the indicative science points on the mark scheme.

Where this response fails to reach Level 3 is that the candidate has not identified the need to include samples of the pure amino acids as spots on their chromatogram. There were two key aspects of the practical work that were felt to be crucial if the experiment described was to be successful, and if either of these was not included then the response should be given a mark at Level 2 rather than Level 3. One of these key practical details was the need to include the pure amino acid samples as part of the chromatogram, the other was the requirement to include a locating agent, or the use of a UV lamp, to identify the position of the colourless spots in order to compare their relative positions and/or calculate the $R_f$ values.

The exemplar illustrates a well-structured response that contains most of the essential practical details and a lot of fine detail in the method. The diagram produced is well labelled with 2 spots evident for the hydrolysed dipeptide mixture, there is a description of how to calculate the Rf values that is accurate. Therefore, this is a well communicated answer, so it meets the communication aspect of a Level of Response question, but through a crucial omission it does not meet the Level 3 descriptor and so was given a mark of 4.

## Question 3 (c) (i)

**(c)** The amino acid chain of a protein is often twisted into a helix.

**(i)** What name is given to the helix part of the protein structure?

.................................................................................................................................... **[1]**

## Question 3 (c) (ii)

**(ii)** Name the main bonds that hold the helix in shape.

.................................................................................................................................... **[1]**

These two questions followed on from the basic ideas explored in Question 3 (a), by looking at the fundamental structure and bonding of proteins. Candidates on the whole scored well here as they correctly identified that the helix forms the secondary structure in Question 3 (c) (i) and that it is hydrogen bonds that are the main bonds that hold the helix into its shape in Question 3 (c) (ii). For Question 3 (c) (i), we did allow candidates to refer to this as the alpha helix, but in Question 3 (c) (ii) we did not allow reference to ionic, covalent bonds or disulfide bridges. These were deemed to be contradictory if they were identified as being evident in addition to the accepted answer.

## Question 3 (d) (i)

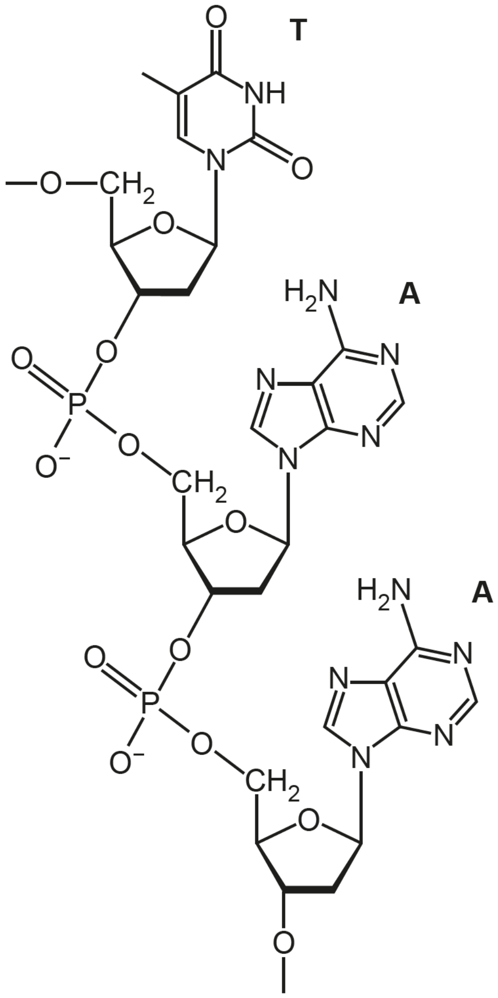
**(d)** Deoxyribonucleases are enzymes that break down DNA.

One of their functions is to break down incorrectly coded DNA.

Deoxyribonucleases work by hydrolysing the bonds formed by condensation between the phosphate groups and deoxyribose.

**(i)** **Fig. 3.1** shows the structure of a DNA chain.

**Fig. 3.1**




Draw an arrow on **Fig. 3.1** pointing to **one** of the bonds hydrolysed under the action of a deoxyribonuclease. **[1]**

## Question 3 (d) (ii)

**(ii)** Give the **general** name of the parts in **Fig. 3.1** labelled **A** and **T**.

........................................................................................................................................ **[1]**

Question 3 (d) focused in on the structure and bonding in DNA specifically. Candidates were given information to outline how the enzyme deoxyribonuclease works to hydrolyse the DNA chain and they were then asked in Question 3 (d) (i) to indicate on Fig 3.1 where the enzyme would act to break down the DNA chain. A number of sites were possible all of which were acceptable, as they would result in the bonds between the $PO_4$ groups, and the ribose molecules being broken. In Question 3 (d) (ii), candidates were asked to identify the general name given to molecules A and T identified in Fig 3.1. The expected answer here was (nitrogenous) bases which most candidates recognised. The only commonly seen error in this part of the question was to give the names of A (adenine) and T(thymine), possibly as a result of candidates not reading the question carefully.

## Question 3 (e) (i)

**(e)** Some deoxyribonucleases are specific. They only cause hydrolysis of certain parts of the DNA chain.

**(i)** Explain this specificity in terms of the enzyme active site.

........................................................................................................................................

........................................................................................................................................

........................................................................................................................................

........................................................................................................................................ **[2]**

Many candidates gave answers to this question that illustrated the general model of enzyme – substrate activity by referencing the 'lock and key' model. This was acceptable for 1 mark, however, because the question was trying to focus in on how deoxyribonucleases bring about the hydrolysis of DNA, candidates could only score a second mark if they made reference to how the enzyme interacted with DNA chains.

Responses such as 'the active site is a complementary shape to the substrate which allows it to bind to the substrate and break it down' would only score 1 mark as this is a generic answer and there is no mention of DNA.

A better response such as 'The active site has a complementary shape to the correct bases on DNA, that allows them to react as only the correct part of the chain will fit.' would score 2 marks as it is giving an answer that addresses marking points 1 and 2 and the question set rather than just being a generalised comment on enzyme-substrate complexes.

## Question 3 (e) (ii)

**(ii)** Suggest why the removal of incorrectly coded DNA helps to maintain the accurate replication of genetic information.

..............................................................................................................................................

..............................................................................................................................................

..............................................................................................................................................

.............................................................................................................................................. **[2]**

In this question the first mark was for a specific piece of knowledge being given i.e. DNA codes for amino acids, or codes for a specific sequence of amino acids.

The second mark was for the idea that if the incorrect coding was not removed then a non-functioning protein could be produced, or that the genetic information that is passed on would be incorrect, or it could lead to a mutation or cancerous cell being produced.

But it was recognised that candidates might use a reverse argument here and state that by removing the incorrect coding the mutation would not be passed on, or the faulty enzyme would not be produced, etc. So many candidates often scored 1 mark here if they could suggest an acceptable explanation of how the removal of incorrectly coded DNA was beneficial.

## Question 4 (a) (i)

**4** Some students investigate ethanoic acid and its reactions.

**(a)** Ethanoic acid, $CH_3COOH$, is a weak acid with $K_a = 1.7 \times 10^{-5}\,mol\,dm^{-3}$.

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$ **Equation 4.1**

**(i)** Write the expression for $K_a$.

$K_a$ =

**[1]**

## Question 4 (a) (ii)

**(ii)** Calculate the pH of a 0.15 $mol\,dm^{-3}$ solution of $CH_3COOH$.

pH = ............................................................ **[2]**

This question was in two parts. Question 4 (a) (i) was where candidates could demonstrate their ability to apply their knowledge about pH and weak acids to a specific example. Many candidates lost a mark here as they gave the definition or $K_a$ rather than writing their answer in terms of the species identified in equation 4.1. Where candidates used the equation, they consistently scored this mark.

In Question 4 (a) (ii), candidates needed to use their expression from Question 4 (a) (i) to calculate a value for the pH of 0.15 M ethanoic acid. The first part of this involved a re-arrangement of their expression to make $[H^+]$ the subject of the expression. Even if they had used a general expression, this mark was still available provided that they could demonstrate that they had achieved this by inserting the values given in the question, or from the Data Sheet, into the correct position of their re-arranged expression. As a result of this approach many candidates scored 2 of the 3 marks available on Question 4 (a). If candidates struggled to rearrange their expression correctly, then a rescue mark was available for the correct evaluation of their expression provided that the pH value obtained lay between pH 2 and pH 5.

## Question 4 (a) (iii)

**(iii)** A student says that the pH would be higher if the ethanoic acid was stronger.

Comment on this statement.

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

.......................................................................................................................................... **[2]**

This question created some confusion among candidates over the difference between the strength of an acid, the concentration of an acid and the pH value of an acid.

Some candidates incorrectly stated that as ethanoic acid is a weak acid, the only way that its pH value could be made higher was to increase the concentration of the acid. This is incorrect, as the only way to increase its pH value is to make the concentration lower.

Also, some candidates stated that if ethanoic acid was a stronger acid, that this would produce an increase in the concentration of hydrogen ions, $H^+$, which would result in a higher pH value. Again, this statement is partially true as a stronger acid would give a higher $[H^+]$ but this in turn would result in a lower pH value.

**Misconception**

Candidates clearly struggle to make the link between strength of an acid and its ability to produce hydrogen ions. They are confusing ideas about higher concentration producing a more acidic solution with a lower pH value. They also appear to be struggling with the concept of strong and weak acids being linked to ideas about equilibria and the extent to which an acid produces hydrogen ions in solution.

**Practical Opportunity**

If possible, centres should try to reinforce this area of study by designing a practical activity looking at a range of strong and weak acids, such as hydrochloric acid, nitric acid, ethanoic acid and possibly citric acid all with a range of different concentrations. Students could then use pH probes to measure the pH values and to try to explain their findings using ideas about pH and equilibria. A well-designed practical activity should help to embed and reinforce crucial ideas that are discussed theoretically with concrete examples.

## Question 4 (b)

**(b)** The students carry out a reaction between a $0.15\,mol\,dm^{-3}$ solution of sodium hydroxide and a $0.15\,mol\,dm^{-3}$ solution of ethanoic acid.

- Student 1 says that equal volumes will be needed for complete reaction as the substances react in a 1:1 mole ratio in the equation.
- Student 2 says that less sodium hydroxide is required since ethanoic acid is a weak acid.

Which student is **wrong**?

Explain the error using **Equation 4.1**.

..............................................................................................................................................

..............................................................................................................................................

..............................................................................................................................................

.............................................................................................................................................. **[2]**

This question was one where candidates often struggled to express their ideas effectively. There were many responses where they recognised that a neutralisation reaction was occurring that would remove hydrogen ions from the system. However, in many cases this was not linked to equation 4.1 and so they often did not score the second mark for identifying that the position of equilibrium would shift to the right to replace the hydrogen ions removed by the hydroxide ions during the neutralisation reaction.

Other incorrect responses tried to make a case for less hydroxide being required as a result of the ethanoic acid being a weak acid and only partially ionising. This would mean that the number of hydrogen ions available would be less than the concentration of the ethanoic acid and so it would not react in a 1:1 ratio.

## Question 4 (c)

**(c)** For the salt of a weak acid and a strong base,

$[OH^-]^2 = [\text{salt}] \times K_w/K_a$

Use this formula to work out the pH of a 0.075 mol dm$^{-3}$ sodium ethanoate solution.

(The value of $K_w$ is given in the Data Sheet.)

pH = .......................................................... **[3]**

### Exemplar 2

$[OH^-]^2 = [0.075] \times \frac{1\times10^{-14}}{1.7\times10^{-5}}$

$= 4.41176 \times 10^{-11}$

$[OH^-] = [H^+]$

$pH = -\log(6.64\times10^{-6})$

$= 5.178$

$[OH^-] = \sqrt{4.41176... \times 10^{-11}} = 6.64 \times 10^{-6}$

pH = 5.2 **[3]**

Many candidates tackled this calculation successfully and determined that the pH of the sodium ethanoate solution was 8.8(2) and scored all 3 marks.

The majority of candidates who did not score full marks often did manage to score 2 of the available 3 marks as shown in Exemplar 2 above. They quite often were able to use the expression given in the stem of the question to calculate a value for the concentration of hydroxide ions. Provided that they then gave a clear indication that they believed that $[OH^-] = [H^+]$ and used the value calculated in the expression $pH = -\log_{10}[H^+]$ they could score a second mark for a pH value of 5.2.

Where candidates did not arrive at either of these values it was often as a result of failing to calculate the $[OH^-]$ correctly, often by failing to take the square root of the values inserted into the expression given. In this situation a mark of 0 was often the final outcome as they also tended not to make a clear indication of the link between $[OH^-]$ and $[H^+]$ and simply used $[OH^-]$ in their pH calculation.

## Question 4 (d) (i)

**(d)** A student makes a buffer solution by mixing 20 $cm^3$ of 0.15 mol $dm^{-3}$ ethanoic acid with 10 $cm^3$ of 0.15 mol $dm^{-3}$ sodium ethanoate solution.

**(i)** Calculate the value of $[H^+]$ in the student's buffer solution.

$[H^+]$ = .......................................... mol $dm^{-3}$ **[2]**

Many candidates started their calculation by writing '$K_a$ =' and then giving the expression for this constant. They then substituted in the values given for the concentrations of ethanoic acid, sodium ethanoate and the value of $K_a$ previously given and used their calculators to arrive at a value of $1.7 \times 10^{-5}$ mol $dm^{-3}$ which was incorrect. This was incorrect as they did not take into consideration the volumes of each solution used to prepare the buffer. However, they were given one mark as in order to arrive at their final value they would have had to rearrange the expression correctly.

Another incorrect value that was accepted for 1 mark was $8.5 \times 10^{-6}$ mol $dm^{-3}$ which is arrived at where candidates have recognised that the volumes of solutions are different but have got the ratio of the substances inverted. This gives $[H^+] = K_a/2$ as their expression, but once more to arrive at this they have had to rearrange the $K_a$ expression correctly and so were allowed one mark for the evaluation their data.

## Question 4 (d) (ii)

**(ii)** The student adds a small amount of acid to this buffer.

Explain why the pH changes very little.

Use **Equation 4.1**: $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

.......................................................................................................................................... **[2]**

Most candidates scored one mark here for correctly stating that by adding a small amount of acid the equilibrium would move to the left-hand side to remove the extra hydrogen ions added. Very few candidates recognised that the [$H^+$] remained constant due to the large concentrations of acid and salt solutions used to prepare the buffer, and that by adding only a small amount of acid these concentrations would remain essentially unchanged which would maintain the value of $K_a$.

## Question 5 (a) (i)

**5** This question concerns the Advance Notice Article 'Reactive Oxygen Species' that is included as an insert with this paper.

**(a)** The article contains a paragraph describing the cause of the hole in the ozone layer.

**(i)** Chlorine radicals are formed when CFCs are 'shredded' with ultraviolet radiation, as in:

$$HF_2C—Cl \longrightarrow HF_2C + Cl$$

Draw 'half curly arrows' on the CFC structure above to show the electron movement when this initiation reaction occurs. **[1]**

## Question 5 (a) (ii)

**(ii)** State the **type** of bond breaking that occurs in **(a)(i)**.

Explain why you have chosen this answer.

.......................................................................................................................................

.......................................................................................................................................

....................................................................................................................................... **[1]**

Question 5 was often well-answered by candidates as they have had access to the source material prior to taking the examination. Provided that they have studied the material carefully with the support of their teachers then they tend to engage fully with a topic that is often an extension of one area of the curriculum.

In this article, candidates are guided to consider the chemistry of radical species from both a familiar area – CFCs and ozone – and in an unfamiliar context in biochemical situations involving proteins and other molecules found in cells within the human body.

In Questions 5 (a) (i) and (ii), candidates were asked to identify changes that would occur in an initiation step where UV radiation interacts with a CFC molecule, and to identify the type of bond breaking that takes place.

Many candidates scored these marks as they were able to indicate, by the use of curly arrows, how the bond between C and Cl would break, and then they correctly identified the type of bond breaking as homolytic fission because it produced two radicals, or because in breaking the bond one electron went to each atom that was part of the original bond.

## Question 5 (a) (iii)

**(iii)** Write equations for **two** propagation reactions in which chlorine radicals catalyse the breakdown of ozone.

Equation 1:

Equation 2:

**[2]**

In this question, it was clear that students had considered the propagation reactions that occur in the stratosphere involving CFCs as they could construct appropriate equations that involved a chlorine radical as a reactant in equation 1 and as a product in equation 2. Candidates very often scored 2 marks here.

## Question 5 (a) (iv)

**(iv)** The article says:
'A single gram of freon will often destroy as much as 70 kg of ozone.'

Calculate how many ozone molecules are destroyed by **one** C*l* radical if 1.0 g of $CHClF_2$ destroys 70 kg ozone.

Give your answer in standard form to **1** decimal place.

number of ozone molecules = ........................................................ **[3]**

There was some evidence to suggest that candidates may have been rushing to complete the paper at this point as they may have moved on to question 5(d) which was worth 6 marks and then returned to this question afterwards.

Many candidates scored 2 marks for correctly calculating the number of moles of Freon in 1 g, and the number of moles in 70 kg of ozone. Where they sometimes went wrong was in trying to make use of the Avogadro constant to calculate the numbers of molecules involved as they often only did this for one of the reactants, usually ozone.

The other common error was where they calculated the ratio correctly as 126,253.3 but did not convert this to 1 decimal place and into standard form as instructed in the question – this gives the correct value as $1.3 \times 10^5$ for the number of ozone molecules that are destroyed.

## Question 5 (b) (i)

**(b)**
**(i)** Draw a 'dot-and-cross' diagram for an $H_2O_2$ molecule.

**[1]**

This was usually well done. This is a skill that candidates develop at GCSE and ought to be able to use at this level. There were very few errors made with this diagram and most candidates scored this mark.

## Question 5 (b) (ii)

**(ii)** Explain why the H-O-O bond angle in $H_2O_2$ is less than 109.5°.

Use your diagram from **(b)(i)**.

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

....................................................................................................................................... **[3]**

In this question candidates needed to be able to identify from their dot and cross diagram in b(i) that the central oxygen atom(s) were surrounded by 4 electron pairs/regions of electron density, but also that 2 of these areas consisted of lone pairs of electrons and also 2 pairs of bonding electrons. This was crucial as the second mark for this question was for recognising that the lone pairs of electrons caused greater repulsion of other electron pairs which would close up the bond angle. Many candidates did not score this mark as they often simply stated that the bond angle would reduce by 2.5° for each lone pair, without explaining why this would happen. The final mark here was for correctly stating that the bond angle would be 104.5°.

Many candidates scored the first and last marking points as they were able to relate their diagrams to what they knew about the structure and bonding in a water molecule which is very similar electronically.

## Question 5 (b) (iii)

**(iii)** Write two half-equations to show how $H_2O_2$ can either act as an oxidising agent or a reducing agent 'depending on the company it keeps'.

Oxidising agent:

Reducing agent:

**[3]**

This question originally looked as if it would be simple to write a mark scheme for. However, it soon became apparent that as a result of their preparation candidates were writing a wider range of equations than was originally expected. They were identifying species containing oxygen atoms that could be derived from the flow chart given in the Advance Notice Article and so in recognition of this additional guidance was given that allowed for any correctly balanced HALF-EQUATIONS to score the marks available.

Both half equations needed to contain hydrogen peroxide in order to score.

In the first equation as an oxidising agent the peroxide molecule needed to be on the left-hand side of the equation, and as it was a half-equation we also needed to see electrons being added on this side of the equation.

Similarly for the half-equation for a reducing agent, hydrogen peroxide needed to be present as a reactant where it was losing electrons as a product of the reaction.

The marks were given for balanced equations where not only were the atoms present balanced, but the charges were balanced also. Each equation was treated independently so that it was possible for candidates to score a mark for one equation even if the other equation was incorrect.

The final mark was given in recognition of candidates displaying an understanding of redox in terms of electron transfer.

An oxidising agent would accept electrons i.e. the peroxide molecule is reduced, and a reducing agent would donate electrons i.e. the peroxide molecule is oxidised. This mark could be given even if both of the equations written were incorrect provided that the electrons were on the correct side of each half-equation.

By treating all three marking points as independent marks it was possible for candidates to score 3 marks from non-interdependent equations. For example:

$H_2O_2 + e^- \rightarrow OH + OH^-$ would score for the reaction as an oxidising agent as it is balanced in terms of the atoms and the total charge – this equation is from the ANA and shows one reaction to produce hydroxyl radicals (OH) from hydrogen peroxide

$H_2O_2 \rightarrow O_2 + 2H^+ + O_2 + 2e^-$ would score for showing a reaction of hydrogen peroxide acting as a reducing agent to produce molecular oxygen, as it is also balanced in terms of the atoms and total charge.

This pair of equations would also score the third mark as they show electrons as a reactant in equation 1 and as a product in equation 2.

This pair of equations are not dependent upon one another and so each can score a mark as they are answering the question set, and there is also no requirement for the electrons to be balanced from one half-equation to the other.

Any equations that were written that did not contain electrons could not score a mark and so candidates who quoted the equation for the Fenton reaction using $Fe^{2+}$ and $Fe^{3+}$ could not score a mark for that particular equation even if it was balanced in terms of the atoms present.

## Question 5 (d)*

**(d)*** Of the three reactive oxygen species, hydroxyl radicals cause the most damage to the body. Hydrogen peroxide and superoxide are damaging in the presence of iron.

Give examples from the article that show that these statements are correct.

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

................................................................................................................................................. **[6]**

The final question on the paper was the second opportunity for candidates to produce an extended piece of writing in order to show their understanding of an area of chemistry they have studied but in an unfamiliar context. As a Level of Response question examiners were directed to read the whole of the response in order to determine the most appropriate level to assign a mark to, based on the scientific content evident, and the descriptor provided for each level in the mark scheme. They then were asked to consider the communication aspect of the response and to choose the most appropriate mark for the response depending upon how well candidates had structured and communicated their ideas.

In the exemplar shown below, the candidate has identified some of the key points for each of hydroxyl radicals, hydrogen peroxide molecules and the superoxide anion. Although there are a number of points identified in the mark scheme these are not exhaustive as candidates could quote further examples for each species that would support their arguments. The response shown in the exemplar has structured their answer well as there is a line of reasoning displayed where they present their answer with an attempt at a logical structure – hydroxyl radicals first, then hydrogen peroxide followed by the superoxide ion. The candidate has included a significant amount of detail regarding the hydroxyl radicals and also identified some key features surrounding the role of hydrogen peroxide, but there is very little content discussing the superoxide ion. Therefore, this response could be classed as either 'Making most of the points from TWO reactive oxygen species (ROS)' or 'Makes some of the points from all three ROS' which are the descriptors for Level 2, and so this response was given 4 marks.

In order to progress this to Level 3 the candidate could have included equations for the Fenton reaction showing how this reaction produces hydroxyl radicals when hydrogen peroxide comes into contact with iron containing compounds such as haemoglobin in red blood cells and in the process destroys the cells reducing the ability of the blood to transport oxygen around the body.

Also, the section on the superoxide anion was particularly brief and this could have been extended to include an equation showing how the superoxide anion loses its extra electron to the $Fe^{3+}$ ions, produced as a product of the Fenton reaction, and in doing so re-created $Fe^{2+}$ ions that could go onto produce more hydroxyl radicals as part of a catalytic cycle.

## Exemplar 3

Hydroxyl radicals are extremely reactive and can react with the first molecules in their path. This could be a protein, lipid or DNA and this reaction itself forms another radical. These radicals can destroy proteins or cause DNA mutations which can lead to cancer. Hydrogen Peroxide itself can spread throughout a cell but when it reaches $Fe^{2+}$, reacts to form an OH radical, this can then damage any nearby molecule, DNA in the nucleus or if it comes into contact with a red blood cell can react with the iron present, destroying the cells. This continues until all available iron is used up. However Superoxide can react with $Fe^{3+}$, forming $Fe^{2+}$ and allowing the Fenton Reaction to restart and more OH radicals to be produced.

# Copyright information

Question 1 (d): Salters Activities and Assessment Pack Heinemann 2000 ISBN 0435631217, Page 274.

# Supporting you

## Teach Cambridge

Make sure you visit our secure website **Teach Cambridge** to find the full range of resources and support for the subjects you teach. This includes secure materials such as set assignments and exemplars, online and on-demand training.

**Don't have access?** If your school or college teaches any OCR qualifications, please contact your exams officer. You can forward them this link to help get you started.

## Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

## Access to Scripts

We've made it easier for Exams Officers to download copies of your candidates' completed papers or 'scripts'. Your centre can use these scripts to decide whether to request a review of marking and to support teaching and learning.

Our free, on-demand service, Access to Scripts is available via our single sign-on service, My Cambridge. Step-by-step instructions are on our website.

## Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

## OCR Professional Development

Attend one of our popular professional development courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses for your subject on **Teach Cambridge**. You'll also find links to our online courses on NEA marking and support.

## Signed up for ExamBuilder?

**ExamBuilder** is a free test-building platform, providing unlimited users exclusively for staff at OCR centres with an Interchange account.

Choose from a large bank of questions to build personalised tests and custom mark schemes, with the option to add custom cover pages to simulate real examinations. You can also edit and download complete past papers.

Find out more.

## Active Results

Review students' exam performance with our free online results analysis tool. It is available for all GCSEs, AS and A Levels and Cambridge Nationals (examined units only).

Find out more.

**You will need an Interchange account to access our digital products. If you do not have an Interchange account please contact your centre administrator (usually the Exams Officer) to request a username, or nominate an existing Interchange user in your department.**

**Need to get in touch?**

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

Call us on
**01223 553998**

Alternatively, you can email us on
**support@ocr.org.uk**

For more information visit
- **ocr.org.uk/qualifications/resource-finder**
- **ocr.org.uk**
- **facebook.com/ocrexams**
- **twitter.com/ocrexams**
- **instagram.com/ocrexaminations**
- **linkedin.com/company/ocr**
- **youtube.com/ocrexams**

**We really value your feedback**

Click to send us an autogenerated email about this resource. Add comments if you want to. Let us know how we can improve this resource or what else you need. Your email address will not be used or shared for any marketing purposes.

**I like this** **I dislike this**

Please note – web links are correct at date of publication but other websites may change over time. If you have any problems with a link you may want to navigate to that organisation's website for a direct search.

CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT



OCR acknowledges the use of the following content: N/A