Examiners' Report

Principal Examiner Feedback

November 2021

Pearson Edexcel GCSE Chemistry

(1CH0) Paper 2H

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

November 2021
Publications Code xxxxxxxx*

This examination session was a supplementary one for those candidates who could not be awarded a grade in Summer 2021 or who wished to improve on the grade they were awarded at that time.
For this paper, the entry was extremely small, and it should be borne in mind that comments made reflect what was seen and does not represent what would be normally seen at a complete cohort level.

Question 1(b)

There were several good answers seen that answered the question 'Explain ….'. However, many candidates just made a simple point about a risk associated with nanoparticles such as 'they can penetrate through the skin' without further consequence and so could score 1 mark. Some answers such as 'they are very small' didn't warrant a mark.

Question 1(c)

Like 1(b), there were several good answers that scored both marks with the idea of the increased surface area and a greater rate of reaction, but there were those who limited their answers to the nanoparticles being very small without further development and again these did not score.

Question 2(a)

The majority of candidates scored at least one mark on this calculation. Many made an error with converting the units from cm^3 to dm^3, or missed that conversion out. Also there were a couple of instances where an interim answer was rounded to 1 sig fig. This should be discouraged and rounding should only take place for the final answer either to the same degree of accuracy as given for other values in the question or rounded to the number of specified sig figs or decimal places required.

Question 2(b)(i)

Candidates should read the question carefully before they start on their answer. Several candidates wrote about bond breaking and bond making which did not score as the question was about how the energy level diagram showed that dissolving ammonium chloride in water was endothermic. However, many candidates produced a well-constructed answer worthy of both marks.

Question 2(b)(ii)

Although the majority could draw the correct curve with the peak above the energy level of ammonium chloride solution, many candidates showed the activation energy as the difference between the ammonium chloride solution energy level and the peak of the curve. A few candidates drew a straight line from reactants to products which left them with an impossible task of scoring a mark for the activation energy.

Question 2(c)

A few candidates scored full marks on this item however many wrote about how the solid did not conduct electricity, but the solution did (for one mark) and then erroneously went on to write about delocalised electrons in the solution and not in the solid. The other significant error seen was when candidates wrote about molten ammonium chloride – again evidence showing that candidates do need to read the question carefully before starting their answer.

Question 3(a)

Most candidates gave the correct answer here.

Question 3(c)

Most gave a correct answer for the formula of the product as NO_2 with many scoring the second mark to balance the equation. Writing balanced equations is a skill that candidates should practice along with knowing the formulae of the common substances listed in the specification as well as using names clues to write the formula.

Question 3(d)

Although many identified carbon dioxide as being the product of combustion responsible for the greenhouse effect, many still had nitrogen dioxide in their mind from the previous item and tried to justify that as a product of combustion of diesel oil. Some were able to explain how carbon dioxide (and water vapour) help cause the greenhouse effect, but a good explanation was only seen by a few candidates. Most went down the route of ‘carbon dioxide traps heat’ with little amplification. A few wrote about the combustion gases (without identification) and how they got trapped in the atmosphere which warmed up the Earth.

Question 4(a)(i)

A few candidates mixed up recycling and disposal giving an incorrect answer here, but most were able to give a sensible problem such as the difficulty of sorting polymers into their individual types.

Question 4(a)(ii)

There were several candidates who gave an answer to their own question such as how polymers are disposed of, rather than that in the question paper which focussed a problem associated with disposal. So such answers as ‘they end up in landfill sites’ alone did not score. Only a few candidates gave an answer worthy of full marks.

Question 4(b)(i)

Many candidates identified the >C=C< as the functional group, a few other went for C-Cl. However some just circled the Cl atom and so did not score.

Question 4(b)(ii)

This proved quite tricky for many candidates with only a few scoring full marks. Errors included only having 5 carbon atoms in a line, double bonds remaining between the carbon atoms and not having the correct ratio of hydrogen to chlorine atoms.

Question 4(b)(iv)

This should be a straightforward calculation at this level. However, several had problems working out the formula mass of the chloroethene molecule. The next step would be to multiply that formula mass by the number of monomer molecules in the polymer molecule, but many candidates took one number and divided by the other. Giving an answer to a required number of significant figures still remains a mystery to some candidates although it is a required maths skill for chemistry.

Question 5(b)

This was straightforward for many candidates but linking the group number with the number of electrons in the outer shell was seen more than linking the period number with the number of electron shells.

Question 5(c)(i)

It was disappointing to see how many could not answer this question correctly. This is a gas test that candidates would meet at an earlier stage than GCSE. Errors seen here included ‘put a lighted splint into the gas and it relights’ and mixing the test with that for hydrogen along with a range of other non-scoring suggestions.

Question 5(d)

Although this set-up has been used on past papers, only a few candidates managed to score marks here. The hint that zinc only reacts with oxygen above a particular temperature was ignored by most candidates, so only a few included the idea of heating the zinc. The most commonly scored mark was for passing the air over the (heated) zinc but very few made the point about no further change in gas volume.

Question 6(b)

Diagram drawing seems to be quite challenging for several candidates. Although there was some degree of latitude shown for what could be described as a gas syringe, probably fewer than half the candidates attempted to draw one as a means of collecting and measuring the volume of gas. The use of a stopper and delivery tube was widespread but some candidates didn’t see the need to have a sealed system.

Question 6(c)(i)

Most candidates gave the answer of using a water bath to control the temperature. Incorrect suggestions included using a Bunsen burner or even a thermometer.

Question 6(c)(ii)

Many could draw a correct tangent and a calculated gradient that fell within an acceptable range. Although some did have a correct tangent, errors were when calculating the gradient such as diving the horizontal difference by the vertical difference or miscalculating one of those differences. Most of those scoring 0 marks were where the volume of gas produced at 100 seconds was divided by the time.

Question 6(c)(iii)

Most candidates could correctly identify another variable that needed to be controlled.

Question 6(c)(iv)

Most candidates scored at least two marks here for making the points that with a decreasing temperature the particles would have lower energy which results in a lower rate of reaction. Only the most able candidates correctly made the important point about fewer successful collisions on decreasing the temperature.

Question 7ai_ii

Candidates would benefit from choosing a sensible scale when plotting graphs. The size of the grid provided will always for this, such as display reading of 200 for 2 cm on the vertical axis and a concentration of 0.1 mol dm^{-3} for 2 cm on the horizontal axis. This facilitates the plotting of the graph. It was disappointing to see a few candidates equally spacing out the readings on the horizontal axis or the readings on the vertical axis. Equally disappointing was to see the couple of candidates producing a correct plot, but not drawing a best fit curve.

Most candidates read their graph correctly for their answer to part (ii)

Question 7(b)

Writing ionic equations, along with balanced equations, is a skill that candidates should practice in preparation for a chemistry examination. It was disappointing to see how few could score full marks here. Errors included not having ions present, use of strange chemical formulae (eg AgN), incorrect formulae of ions and two negative ions combining together.

Question 7(c)

There were several really good answers to this 6-mark question. Those that were in the middle ground had good detail of two of the three ion identification tests but lacked relevant equations for the reactions involved. Those at the bottom end of the range generally knew little of the ion identification tests as indicated on the specification judging by the often random attempts of a chemical reaction such as 'filter the solution and evapourate it with a bunsen burner' (*sic*). There were several candidates who left this blank.

Question 8(b)

Most candidates knew how to carry out this calculation, although a few did struggle with its execution. Most obtained the first mark for the formula mass of $POCl_3$, although one candidate just added together the relative atomic masses not taking into account the number of Cl atoms. For some reason a couple of candidates erroneously worked out the percentage of phosphorus and so missed the second mark. The main reason for candidates not getting the second mark was for using an incorrect number of chlorine atoms when working the percentage.

Question 8(c)

There were a few blank responses here, but most candidates achieved at least one mark as they made an attempt at deciding which reaction took place based on the results given. There was a variety of ways that the candidates carried out the calculation; these are detailed in the mark scheme. Consequently, there was good number that scored full marks. Many worked out the mass of chlorine that had combined with the iron, but some then made errors in calculating the number of moles of atoms. Several went down the route of calculating the formula mass of $FeCl_2$, which was fine, but again some made errors in calculating the number of moles of atoms. It would help greatly is candidates could state their steps in a calculation eg 'mass of chlorine = ….'. This helps the candidate to clarify their thoughts and it enables the marker to understand the candidate's process of calculation rather trying to interpret often random numbers.

Question 8(d)

There were many candidates who could explain the trend in reactivity of the group 1 and of the group 7 elements, although some did try to justify why the group 7 elements are more reactive further down the group towards iodine. Having completed that, most then could make an explained judgement as to which pair of elements would be the most violent when they reacted together. A few candidates did rank the order of reactivity however a couple of candidates did manage to get the order in completely the wrong way.

A couple of candidates decided that rubidium + iodine would be the most violent, but did not back it up with a reasoned justification which would have enabled them to be credited with some marks.

Question 9(a)(i)

Although many candidates realised that carbon monoxide is produced when there is limited oxygen, but didn't quite finish the explanation as to why. There were some weak answers that just repeated the question – 'carbon monoxide is produced during incomplete combustion', showing they didn't understand what the question was about. There were a few candidates who misunderstood the word 'incomplete' in this context, by their thinking that not all the pentadecane had combusted.

Question 9(a)(ii)

Asking about why carbon monoxide is a toxic gas has appeared on several GCSE examination papers, so it was quite surprising to see how few scored full marks here. Many candidates did state that carbon monoxide combined with haemoglobin (or with red blood cells) but did not then develop that with a consequence. A few wrote about carbon monoxide being colourless and odourless so humans can't detect it which was why is was toxic.

Question 9(c)

This was quite a straightforward calculation for most candidates. Many appreciated that the reaction was exothermic, so a minus sign was needed in front of the final answer, but aside from that, most achieved the numerical answer of '42'. Where things went wrong, it often involved incorrectly calculating the energy to break bonds or the energy to make bonds. Few realised they only needed to consider just those that were actually broken and then those that were formed.

Question 9(d)

From the answers, it was clear that many did not appreciate that the question was about the products of combustion and subsequently cooling them produced droplets of water. Several tried to reason that it was somehow the water in the beaker that was evaporating and then condensing or that water vapour in the air was condensing.

Question 10(a)(ii)

It was disappointing to see the poor response to what is a straightforward question about using bromine water to distinguish between an alkene and an alkane. Few candidates scored full marks. Some scored two for the correct colour change seen when the bromine water was shaken with a sample of the alkene.

Question 10(a)(iv)

Many candidates suggested either reacting compound Z with magnesium or with a carbonate or with an alkaline solution, however, several of those missed out how their would actually show Z was an acid. Some tried to use an alternative indicator, but that didn't fir in with the with the question.

Question 10(b)

Just under a third of the candidates scored both marks for the calculation. Those scoring just one mark obtained for the number of moles of sucrose but then missed the ratio of moles of sucrose to moles of ethanol (1:4) from the second step of the calculation. Of the rest, those that attempted some form of calculation appeared not to know what to do.

Question 10(c)

Few candidates appreciated~~Most candidates managed to score some marks for this question, but few scored full marks here. There were some clear misconceptions with candidates interpreting the data as some talked twrote about how quickly impurities were removed while others discussed the shape of the graph. Many candidates failed to take any data from the graph to state the optimum masses of salt A and salt B required, or to identify the percentage of impurities removed at these points.~~

~~Well answered overall with many candidates identifying improved resistance to corrosion and improved appearance to gain both marks. However, some candidates lost marks simply by stating that gold is unreactive and not linking this to why this property is used in electroplating. A few candidates also incorrectly stated that gold is used for electroplating as it does not conduct electricity.~~

~~Not well answered overall, with some candidates discussing ideas of reactivity to explain why hydrogen forms rather than sodium at the cathode – not answering what had been asked in the question.~~

~~Explaining what happens in electrolysis continues to be a weak area for candidates. Very few marks were awarded here with confusion between electrons and ions, and no apparent understanding of why the concentration of the solution does not change during electrolysis with copper electrodes. There wasis also a misconception that the loss and gain of electrons at the electrodes are the cause of the changes in mass.~~ that in one formula unit of $C_{12}H_{22}O_{11}$ there was 45 atoms. Missing this out in the calculation led to calculating the number of $C_{12}H_{22}O_{11}$ molecules and a mark of 1. Unfortunately, there were several candidates who did not know where to start on this calculation.

~~This question was well answered overall, with most candidates correctly using the term 'excess'.~~

~~Some candidates got the correct response for this question and clearly showed their working out. Candidates that had done shown some working out usually scored 1 or 2 marks although they had not gotten may not have obtained the correct final answer. A number of candidates incorrectly calculated the relative formula mass of water to be 26 – multiplying the H_2 by 5 but not the O. There were a few completely blank responses, although 1 mark was available just for calculating the relative formula mass of water.~~

~~**Question 7(a)**~~

~~This wasis a question about carrying out a practical to determine the order of reactivity of metals. It was very badly answered throughout, with very few candidates mentioning any practical activity at all. Some attempted to explain the order of reactivity but without any reference to practical work, and some used the metals and their sulfate salts interchangeably. Where marks were awarded, they were usually for identifying the mixing of some of the metals with some of the salts. There were very few marks awarded for any~~

observations. ManyLots of candidates gave detailed responses about displacement of less reactive metals but did not relate this to the practical activity at all.

Question 7(b)

Many candidates scored a mark for correctly stating that aluminium is higher than carbon on the reactivity series. There were fewer that then went on to state that carbon cannot displace aluminium or that there would be no reaction between the carbon and aluminium oxide. A number of answers stated that aluminium has strong bonds that require a lot of energy to break – and so not answering the question that was asked.

Question 7(d)(i – ii)

Many candidates correctly calculated the relative formula mass and then the number of moles of $TiCl_4$ in the reaction for part (i) of the question.

Part (ii) of the question was usually left blank or given an answer relating to the observations that would be made if there were excess magnesium. Candidates did not seem to understand what they were being asked to do for this part of the question. Where attempts were made to show the excess of magnesium, students generally did not mention the 2:1 ratio for the reaction and gave an answer with a 1:1 ratio.

Question 7(e)

Most candidates correctly identified filtration as the correct method of separating, but fewer managed to score a second marking point. They did not say either to add the hydrochloric acid to the mixture, or to wash the residue after filtration and could not score a second marking point. Although it was not part of the marks awarded, a significant number of students stated that the titanium would pass through the filter paper in spite of being told that it was insoluble in the question. There were also a number ofseveral responses suggesting distillation as a suitable separation method.

Question 8(a)

The most common answer to this question was related to pollution and suggested that candidates were answering the question as to why hydrogen may be a better fuel than hydrocarbons. There was little understanding shown of chemical cells, or hydrogen-oxygen cells.

Question 8(b)

It wasis obvious that candidates struggled to produce ionic and half equations and many responses here were either left blank or filled with words or state symbols. Very few candidates scored both marking points although some responses were awarded a mark for including electrons on the left- hand side of the equation.

Question 8(c)

Candidates made good attempts at this question, and more than half scored 1 of the two available marks. Many would have scored both marks, however it was more common to see the molecular formula mass of oxygen used as 16 rather than the 32 that it is, and then incorrectly calculated the number of moles of oxygen to be 3 rather than the correct value of 1.5. Other mistakes were with getting calculations mixed up and dividing numbers that should have been multiplied. There were a number of responses of 768, calculated by multiplying the mass by the relative formula mass and therefore using the incorrect formula.

Question 8(d)

This 6- mark question was not as well answered as the other one on the paper. Some candidates gave an explanation relating to the equilibrium associated with the Haber Process rather than the one asked about in the question and gave incorrect information about the effect of temperature on equilibrium position because it was learned from the Haber Process rather than applied to this reaction. Level 1 answers correctly determined that a higher temperature would increase the rate of reaction, although this was not usually related to the rate of attaining equilibrium. Most marks scored here related to describing how temperature and catalysts affected the rate of reaction, and there were far fewerless answers that discussed the equilibrium.

Question 9(a)

Approximately a third of responses scored both marks here, with many of the remaining answers scoring one mark. The most common mistake was not to realise that the information given was about an ion rather than an atom, and so candidates completed the calculation assuming that the element contained 54 protons. A few candidates realised that they had been given information about an ion, but then added two protons to the electron number rather than subtracting it.

Question 9(b)(i)

Overall, this question was well answered, although the majority of answers stated 'same number of protons and electrons' rather than just protons. Where candidates were wrong it was because they stated that isotopes have the same number of protons and neutrons.

Question 9(b)(ii)

Most candidates who attempted this question scored both marks, although there were a number of blank responses for this question. Sometimes a mark was lost because the candidate rounded the correct answer to 28. A few responses looked as though they may be attempting to carry out empirical formula calculations and scored zero.

Question 9(c)

This question was well answered overall with many candidates achieving at least a level 2 response – either by explaining the properties ionic, covalent and metallic compounds without identifying the bonding as asked in the question, or by identifying metallic bonding and explaining the properties of metals. Some candidates did not correctly identify ionic and simple covalent compounds and had the properties of these mixed up. Some candidates that achieved a level 2 response did not achieve level 3 only because they did not identify the bonding in the different substances.

Question 10(a)(i)

This question was poorly answered overall, with candidates offering generic suggestions or improvements to carrying out the titration overall rather than relating to the mass of potassium hydroxide as was asked for in the question. Many answers indicated that the candidates did not understand what the question was asking them to do, and there were also a lot of blank responses. The most common mark awarded was to use a pipette to measure the volume of potassium hydroxide solution more accurately than a measuring cylinder. Common incorrect responses included reading equipment at eye level, repeating (but not to concordant results) and rinsing equipment out with water before use.

~~**Question 10(b)**~~

~~The majority of responses to this question scored either 4 marks or 0 marks and there were a significant number of blank responses here. Where candidates attempted the calculation incorrectly there were issues with getting equations the wrong way round (concentration = moles x volume) or putting values for volume where moles should be and attempting to calculate concentration using the two volume values given in the question.~~

~~**Question 10(c)**~~

~~This was the lowest scoring question on the paper, with more than half of the responses left blank. Whilst the last question on the paper should be one of the most challenging, some marks could have been awarded with some straightforward calculations. In this case there was one mark available for converting molar concentration into mass concentration and the relative formula mass was given.~~

General Comments

As mentioned in one of the earlier comments, it would help candidates with their train of thought in calculations if they set them out in a logical manner, clearly stating what was happening at each stage. This would also help with the marking as it then easier to see where errors have been made and then to carry that error forward in subsequent steps.

It would prove useful for candidates to practice certain skills – writing and balancing equations and writing ionic equations, drawing diagrams of common chemical apparatus, plotting and drawing graphs, and practice a variety of different calculations as exemplified by this examination paper.~~Candidates often make the mistake of answering what they think that the question is asking rather than what is actually being asked.~~

~~Questions relating to practical work are often poorly answered.~~

~~Calculation questions suggest that recall of formula triangles is poor.~~