Pearson Edexcel

# Examiners' Report
# Principal Examiner Feedback

## January 2023

Pearson Edexcel International GCSE
in Chemistry (4CH1) Paper 2C

**Q1**

Part (a) was straightforward for most candidates, with the most common error being incorrectly identifying the atom as being in period 2, rather than period 3.

In (b), most candidates were easily able to find the mass number of atom W. However, the reason for the 3+ charge on X was less well answered: incorrect replies frequently stated that "X is in Group 3". Although strictly not correct, references to "X loses 3 electrons" were accepted. Most definitions of isotopes used information about proton and neutron numbers from the table.

**Q2**

All three multiple-choice questions were accessible in (a), although it was surprising that (iii) was correct more frequently than (i).

In (b), almost all candidates counted 5 different elements in the compound, but only about two-thirds of candidates counted 32 atoms in the molecule.

**Q3**

Less than half of candidates correctly identified B as the answer in (a), with C a popular wrong answer, probably because candidates did not know that all ammonium salts are soluble.

In (b), candidates who had learned this method usually produced concise, complete answers. For candidates who selected a correct method, washing was the mark most frequently omitted, or put in the wrong place in the method. However, several candidates assumed that the question was about a soluble salt (despite both the equation being given), and so described a crystallisation process. A smaller number of students simply evaporated to dryness: students should be reminded that this is never correct for either soluble or insoluble salts.

The points were usually correctly plotted in (c), although the first point was frequently incorrectly shown at (0. 16). Examiners appreciate that drawing a curve is more challenging than a straight line, but the curve did need to go through (or close to) all points, and not simply be a "join the dots" series of lines. The final part was poorly answered, showing that this part of the specification is not as well-known. Several candidates simply subtracted 30°C from 90°C and looked up the solubility at 60°C. Even those who did appreciate what they were expected to do did not show their working on the graph as asked or did some further irrelevant processing of their value after subtracting.

**Q4**

Candidates need to read the question and answer what they have been asked so that, in (a)(i), descriptions of the uses of fractions scored no marks. Those that did describe fractional distillation almost always scored the first mark for heating or vaporising crude oil. The idea of vapours rising up the column, by contrast, was very rarely seen – although candidates did know that there was a temperature gradient, although this was often poorly expressed. The mark scheme tried to compensate for poor descriptions of the final marking point – very few candidates referred to condensation taking place as the vapour rose to temperatures below the boiling point. Indeed, the examiners suspect that many candidates think that vapours are 'sucked' out of the fractionating column. The uses of fractions were well-known in (ii), although candidates should note that "fuel" is essential when describing a use for kerosene, as aircraft are generally made from aluminium alloys.

The description of cracking frequently referred to 'separation', showing some confusion with fractional distillation, rather than decomposition or splitting of large molecules. Note that the question says that alkenes are a product, so this was not credited as an alternative to smaller molecules being produced. The question in (b)(ii) has often been asked in this format, so candidates should know that they are being asked to describe **both** 'unsaturated' and 'hydrocarbon'. Those who did define both frequently scored all 3 marks, although there were some weak definitions of 'unsaturated' which referred to not having enough hydrogens attached. The test for unsaturation was usually well known. Some candidates got the colour change the wrong way round or referred to uv light; others chose an incorrect test, usually limewater.

**Q5**

Candidates are not secure in their knowledge of metal structure, with many vague answers to (a). There did seem to be understanding that layers slid over each other in a metal, but the composition of these layers was either omitted or incorrectly described as electrons. Candidates who drew a diagram usually found it easier to score the marks.

The whole of (b) was poorly answered, mostly because it required precise language and understanding from candidates. The conduction of electricity in (i) was invariably incorrectly assigned to moving electrons, not ions. Both ideas were poorly expressed in (ii). Many candidates were unclear about positive sodium ions being attracted to the negative electrode – with atoms (or even molecules!) of sodium being mentioned. Once at the electrode, the idea of 'reduction' was very rarely seen although small numbers of candidates did appreciate that sodium ions gained electrons. The equation for the discharge on chloride ions is asked almost every exam series: only about one-third of candidates were able to write it correctly. About one-quarter of candidates scored in (iv), mostly for appreciating that sodium was more reactive than hydrogen so was less likely to be discharged.

Part (c) showed the usual division into those who could do calculations and those who could not. Those who could not use the data to find the mass of copper and oxygen were at an obvious disadvantage, although several candidates used the Mr of copper oxide instead of copper. As always, a number of expressions to calculate moles were the wrong way up. Candidates should also note that, in a

"Show that…" calculation, they need to show the ratio in whole numbers i.e. explain that 0.06 : 0.06 is the same as 1 : 1. As with all calculations, candidates who set out their answer logically found it easier to remember the correct method. The joy of a "Show that…" calculation is that candidates are given the answer to work towards so that, if they get a ratio of 1 : 5 (as some did), they can go back and work out where they went wrong. Instead, candidates tried to argue that 1 : 5 was "nearly 1 : 1"!

**Q6**

Across all parts of (a), the average candidate score was about half the available marks. Questions like (i), where students are asked to annotate a diagram, are always difficult as students frequently don't see the question. This question was left blank in a significant number of cases. The ester structure was usually either fully correct, or wrong – although a small number of candidates did score 1 mark for the ester group. As so few candidates had drawn a correct structure, the name was unsurprisingly frequently incorrect.

About half of the candidates in (b) knew that a dynamic equilibrium is a reaction where the rates of the forward and backward reactions are the same. The second mark was rarely seen. Those who did attempt it usually said that the concentrations (or amounts) or products and reactants were the same (or equal), rather than staying constant.

A surprisingly small proportion of candidates knew that sulfuric acid catalyses esterification reactions in (c)(i). The titration question in (ii) seemed to catch several candidates out – partly because it may have been unexpected in the context of an esterification. Accounts varied, probably in line with student practical experience, from the very basic to the proficient. Even in the very best answers, rinsing of the burette was never mentioned although, conversely, most candidates appreciated the need for an indicator. There was a great deal of confusion about the location of the (acidic) reaction mixture and the (alkaline) sodium hydroxide, so that the burette was frequently filled with acid, rather than sodium hydroxide. For this reason, examiners did not look for a correct colour change for the indicator, but just that a colour change took place. Swirling was seen in better answers – note that a conical flask is swirled, not shaken, in a titration. Some candidates added dropwise for the whole titration – this did not score, as no chemist would waste time doing this, rather than adding dropwise near the endpoint. The idea of measuring an initial and final volume was usually included in candidate answers, as was the idea of repeating the experiment. However, candidates did not score the final mark for simply repeating and taking an average – there needed to be a reference to obtaining concordant titre values. It was disappointing that, for a question involving recall of a standard practical technique, the mean mark was only a little over 2 out of 6 marks.

**Q7**

The dot-and-cross diagram in (a) proved challenging. Most candidates showed the bond pairs between N and H. However, the N-N bond bond was frequently shown with 2 pairs of shared electrons. Even those who did show a single bond then omitted the non-bonding pairs on nitrogen.

Although the examiners thought that structuring the calculation would help in (b), this wasn't always the case. Some candidates simply completed a bond energy calculation in (i) or (ii). This scored full marks, unless candidates added extra steps having calculated an enthalpy change. Many candidates don't seem to appreciate the sign convention used in chemistry. This meant that incorrect signs were seen in (iii) but, more seriously, that candidates could not give a good explanation in (iv). The problem is that many candidates don't seem to appreciate that breaking bonds in endothermic (+DH) and that forming bonds is exothermic (-DH). Too many answers refer to both processes as 'making' – or both process as endothermic.

The calculation in (c) was not straightforward, as could be expected from the final question on the paper, and (0) and (1) were very common marks. Again, those candidates who set out their calculation methodically scored significantly better than those that gave line after line of jumbled answer. Of those who made an attempt at the question, the first two marks were usually well scored, but the change from gas volumes to concentration with the 1100 $cm^3$ of water meant that the third marking point was more challenging. It was a shame to see candidates give excellent answers, but finish with an answer which was not to 3SF, as required by the question, and therefore losing a mark. As with all calculations, candidates are strongly encouraged NOT to round at intermediate stages of their calculation, but only to round at the end. Small numbers of candidates still truncate to only one figure eg 1570 / 24000 = 0.0651666… being shown as 0.06. They would never do this in Maths – so they should also not do it in Chemistry!