Examiners' Report
Principal Examiner Feedback

January 2024

Pearson Edexcel International Advanced Subsidiary Level In Chemistry (WCH13)
Paper 01: Practical Skills in Chemistry I

General Comments

The paper provided opportunities for candidates to show some of their basic understanding of practical chemistry, such as organic qualitative tests and experiments based on titrations. Hence questions such as 1b and 2a-c proved to be the most accessible. However, a significant proportion of the cohort found it challenging to consider experiments beyond their direct experience, even when the question gave a full description of the procedure followed or involved use of key skills from the specification, such as question 3.

The mean mark for the paper was around 24 marks.

Question 1

The majority of candidates could name the alkene and alcohol group in (a), though significantly fewer recognised the ketone. Many thought it was an aldehyde or a carboxylic acid. The tests in (b) were very well known, with over 60% of candidates scoring full marks. Candidates nearly always used the bromine water test for the alkene and it was pleasing to see so many correct initial colours. The majority of candidates used phosphorus(V) chloride to test for an alcohol, with very little evidence of 'white smoke' seen in previous series. A small minority used alternative tests, such as use of sodium or acidified dichromate(VI). In the case of the latter test, it was frustrating to often see the omission of the acid.

Around a third of candidates were able to deduce the m/z ration of the fragment in (c)(i), with difficulties in interpreting skeletal formula the most common issue. The recognition that fragmentation leads to formation of an ion and a free radical was noted by around a fifth of candidates. The most common misconception was the idea that an electron is produced.

Question 2

Though most candidates handled (a) competently a small number misunderstood the term 'concordant'. In these cases, 23.80 was circled, but nearly always followed by the use of the correct values to determine the mean in (b). This suggests this minority were confusing concordant with anomaly. Very few candidates did not recall the colours associated with phenolphthalein in (c)(i), with most giving the correct colour change. The calculation in (c)(ii) allowed candidates of all abilities to gain significant credit. The most common omission was the scaling factor from 25 cm^3 to 250 cm^3. Given that most titration problems use samples of a bulk solution it's a little surprising to see this occur relatively frequently. Despite the use of **bold** text in the stem, too many otherwise sound candidates lost a mark as they did not give their answer to two significant figures.

In (d) just under a quarter of candidates appreciated that the other acids must be present in small amounts. Many thought that only citric acid would react with the NaOH(aq), often with the claim that this was because the other acids were weak.

In (e)(i) it was clear that only a few candidates knew how to deal with this common laboratory error. Many suggested adding more citric acid or lemon juice to compensate for the extra water, others thought that the excess water could simply be removed. Given that making a solution using a volumetric flask is such a key skill in the year 1 core practical tasks, this was somewhat surprising. In (e)(ii) most candidates could deduce what effect a more concentrated or dilute solution would have on the mean titre. However, this was only rarely linked to an attempt to

explain why the concentration may have changed. Precision of chemical language was an issue for some here, with descriptions of the sodium hydroxide evaporating, rather than water, not receiving credit.

Question 3

In (a) many candidates simply repeated an idea from the stem, that the iodine containing compounds did not burn off as they were not organic. On its own this was not enough to score. Only a small number realised that these compounds were ionic, and most who scored the mark did so by considering the boiling point of these compounds. A significant number of answers were based on the properties of **iodine**, which hadn't been formed at this stage in the process. Hence answers such as 'iodine has a high boiling point' could not score.

Around 45% of candidates could correctly calculate the concentration of the hydrogen peroxide solution in (b). Those who missed out on the second mark nearly always failed to spot the relevance of the ratio in the equation and tried various manipulations of concentration = moles ÷ volume to arrive at an answer.

Only a small proportion of candidates could successfully derive both half equations in part (c)(i). The iodide to iodine half equation was most accessible, though it was relatively commonplace to see the half equation reversed or with electrons being added to the left hand side. It seemed as though very few candidates followed a systematic route to construct the hydrogen peroxide half equation, with molecular oxygen commonly seen as a product and reactant. A small number of candidates still managed to write a balanced equation in (c)(ii) despite at least one incorrect half equation in (c)(i). Reading the question with care was evidently required in (c)(iii) as a significant number described the colour of iodine in cyclohexane not in aqueous solution.

Although most answers in (d) suggested a level of familiarity with the use of a separating funnel, a small yet noticeable number of candidates provided little or no evidence that they had used the equipment. Such responses tended to focus on inappropriate techniques such as distillation or described separation of a solid from a solution using gravity filtration. Probably the most common type of answer appreciated the need to add both the aqueous solution from Step 4 and cyclohexane to the separating funnel and the subsequent removal of the aqueous layer. A small number described the iodine as being primarily present in the lower layer, putting this mark at risk, whilst others didn't take note of the density data to help structure their answer or removed the aqueous layer by pouring it out of the top of the flask rather than using the tap.

Better candidates appreciated the finer detail of the process, especially the need to shake or invert the funnel. Only a small number recognised the need to loosen the stopper / open the tap to relieve the pressure generated by the evaporation of the volatile solvent. Use of drying agents and washing solutions such as sodium hydrogencarbonate were seen, as used in the preparation of a halogenoalkane. Although not required in this separation, their inclusion was not penalised.

Many candidates did not recognise the serious health hazard symbol in (e)(i) and tried all sorts of creative responses based on their interpretation of the picture. Hence discussion of a wide range of respiratory or heart conditions were seen. Most could suggest at least one sensible additional precaution in (e)(ii). However the use of masks as an alternative to fume cupboards was a common response that was not worth credit. Despite the guidance in the question, gloves and safety glasses were seen by many of the marking team.

Question 4

Nearly all candidates could successfully recall and manipulate the equation to determine the density in (a)(i). In (a)(ii) and (iii) the full range of marks were seen. A small, but noticeable number of candidates used a single large square per data point on the x-axis, resulting in a non-linear scale, whilst others used 5 small squares per 10%, which meant once plotted the points covered less than half the available space horizontally. Similar issues were seen on the y-axis, generally when candidates used a scale from 0 to 1 g cm^{-3}, leaving a large area of dead space at the bottom of the graph paper. Whilst a number of excellent curves were observed, the majority of the cohort attempted to produce a straight line of best fit. Use of extrapolation lines to determine a value in (a)(iii) were common, but a small number showed no working on their graph, and simply estimated an answer by eye. This did not score credit.

In (b)(i) a large number of candidates appreciated the idea that heating under reflux would lead to further oxidation and so the formation of a carboxylic acid. The more nuanced point that the distillation system allows removal of the aldehyde before this can happen was less frequently seen. A surprising number of candidates had little appreciation of the impact the reversed water flow might have on the system and even those who noted that the condenser would not fully fill or have air bubbles, didn't link this back to the effect on cooling.

The calculation in (c) showed that many candidates can process data of enthalpy experiments effectively. A small number used the mass of ethanol in $Q = mc\Delta T$, but whilst most candidates understand how to scale their value to per mol in (iii), a lack of a negative sign or use of an inappropriate number of significant figures cost them the mark.

Part (d) proved a challenging end to the paper for many. The generic point about less heat losses enabled most to achieve some credit, but less than 50% of candidates went on to discuss the role of the oxygen or the copper coil effectively. Oddly, a number who did make reference to the copper claimed it was a good insulator, perhaps thinking back to previous question based on simple calorimetry in polystyrene cups.

Based on their performance on this paper, students are offered the following advice:

- read the information given in the question carefully, noting any instructions given in bold type
- practice deducing the number of each type of atom from skeletal formulae
- ensure you know the meanings of concordant results and anomalous results
- take care to give **final** answers to an appropriate number of significant figures, either using the specific guidance in the question, or by modelling your answer on the level of precision of data used in the question.
- ensure each time you carry out a core practical, you are able to describe how to use each piece of equipment as well as justify the method followed
- check graphs carefully before deciding whether a curve or a straight line is most appropriate