Cambridge Chemistry Challenge Lower 6th

Feedback on Questions

Question 1

The inspiration for this question was the novel uses of titanium dioxide in the removal of atmospheric pollutants. The paper started with some redox chemistry; these questions were designed to be an easy opener and the majority of candidates completed these well, although particular attention should be paid to balancing equations. Part (c) expected candidates to use information on physical properties to determine structure and bonding and to move away from the over-simplistic assumption that all metal/non-metal compounds are ionically bonded. The Hess's cycle required a careful application of standard enthalpy definitions to keep track of the linked chemical changes. Only the best candidates managed to completed this part but it is worth re-emphasising to candidates the fact that mean bond enthalpies are endothermic. When we moderated the best scripts we were careful to ensure that full credit was given for transferrable errors.

It was surprising how few of even the best candidates could draw a plausible dot-and-cross diagram for nitrogen dioxide with many structures ending up with more than the theoretical maximum number of electrons in the outer shell of nitrogen!

The equations in (f) and (g) were generally well answered although not all candidates recognised that $HONO_2$ was in fact HNO_3; however, most managed to spot that O_2NO^- was NO_3^-. In (f)(iii) many candidates tried to involve titanium species in the net reaction, forming products such as titanium nitrate.

Few students appreciated that the evolution of a gas would increase entropy. Although the concept of entropy is not usually introduced until the second year of A-level, we felt sufficient information was given in the question for candidates to be able to attempt this question. We apologise for the lack of precision in (h)(iii) with reference to the direction of temperature change; any correct chemistry was credited. In (j) many students were able to solve the linear equation, however, there were often mistakes with units and signs.

Question 2

The obvious inspiration for this question is the recent outbreak of microcephaly caused by mosquitos carrying the Zika virus. The insecticide molecules used in the control of insects gave us the opportunity to extend students in their understanding of *inter alia* mass spectrometry, which is studied in the first year of 6th form Chemistry courses. As in question 1, the early parts were designed to be an easy opener and were generally very well done by the best candidates.

Candidates should be encouraged to consider whether the magnitude of their numerical answers is reasonable; for example it is unlikely that 0.5 g of starting material will react with 35 litres of bromine water or indeed that that the maximum number of blueberries that can be safely eaten by a toddler is 3×10^{-3}. When considering the number of significant figures to use in (c)(iii), we hoped that candidates would ensure that their final number did not exceed the safe limit. The correct numerical answer was 3571; as the numbers in the question were given to 2sf, this figure was often quoted as 3600, although eating this number of blueberries would have exceeded the safe limit. However, candidates were not penalized for making this error.

Molecules containing halogen atoms have more complicated molecular ions than is normally encountered at A-level and the next few parts of this question allowed us to explore this. In (f)(ii) and (g) candidates quoted the ratios in many different ways but all mathematically correct answers were credited. Candidates should remember that m/z values in mass spectra are based on isotopic masses rather than relative atomic masses, therefore in (g) m/z values should have been quoted as integers.

Even though ester chemistry is not encountered in all first year 6th form courses, we were impressed with the quality of the answers in (j). In all organic questions, we accepted structures drawn in any orientation but the number of carbon atoms had to be correct! Candidates should also be encouraged to think carefully about the connectivity of atoms within their organic structures. The synthesis parts of this question were designed to be the most challenging part of this paper; (k) was answered much better than (m) although the very best students did manage to deduce the correct structures for Y and Z – a very impressive achievement for students of this age.