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Applied Science SC11

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Unit 11: Controlling Chemical Processes

Report on the Examination

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General Comments

Most candidates were well prepared.

Noticeably fewer candidates confused the terms 'reactant' and 'product'. Some still seem to incorrectly believe the word 'product' can be used in a general way like 'compound' or 'substance'.

The small number of questions which were less structured proved a challenge to the majority of candidates. Only a few candidates tried to ensure that the number of points they made were equal or greater than the mark allocation for that section. Candidates must carefully plan and structure their answers to such questions.

A worryingly significant proportion of candidates misunderstand the term 'activation energy'. Some seem to think it is identical to kinetic energy, others realise it is an amount of energy that has to be attained but think that altering conditions such as temperature, pressure and surface area will alter the activation energy for a particular reaction.

Unfortunately, mathematical skills again caused difficulties. Rearranging equations continue to be problematic for all but a few candidates. Reacting masses calculations also need to be practised a great deal. Enthalpy change calculations again proved to be the area where candidates achieved the most mathematical success.

Question 1

(a)(i) This was answered well, although some candidates could not distinguish between direct and indirect costs.

(a)(ii) Few candidates could give a definition here. Most resorted to examples which gained no credit. Some incorrectly defined a direct cost.

(b)(i) Generally well answered although some simply stated that a batch process is stop/start, which is insufficient.

(b)(ii) Whilst most candidates realised their answer should not be related to cost, many restated the same point and so only gained one mark out of the two.

(c)(i) It was extremely worrying to note that less than 50% of candidates seemed aware of the scientific meaning of 'reduced'. Of the candidates who realised oxygen or electrons needed to be discussed, several confused oxidation and reduction and so gave an incorrect answer.

(c)(ii) Extremely well answered.

(c)(iii) Reacting masses calculation again proved a challenge to most but it was reassuring that the majority recognised there was a ratio of 1:2 to be accounted for.

(d)(i) Only a few correct answers seen. Most candidates thought that this decomposition was a redox reaction.

(d)(ii) Only a few correct answers seen. Most were again unable to calculate oxidation states.

(d)(iii) Generally well answered.

Question 2

(a) Many correct answers seen. Unfortunately a significant number failed to state 'at same rate' and so only scored one mark.

(b)(i) Well answered, although some used incorrect formulae and some inverted the expression.

(b)(ii) Very few correct answers seen.

(c)(i) A large number of candidates could correctly state Le Chatelier's principle. Far fewer could use the principle to determine the effect on yield and explain it. Some clearly did not know that a negative enthalpy change indicated an exothermic reaction.

(c)(ii) Although many correct answers were seen, it was worrying to note that some candidates thought pressure affected the energy of the particles. Others attempted to answer in terms of collision frequency and others discussed temperature exclusively.

(d)(i) Whilst many were able to state the reaction rate was altered, most did not score the second mark as they thought the catalyst did not change at all throughout the reaction.

(d)(ii) A significant proportion of candidates knew that a catalyst would have no effect on equilibrium yield. A much smaller number could explain why. Some candidates incorrectly stated that the catalyst gave the particles greater energy, and several tried to use Le Chatelier's principle to incorrectly justify an increase or a decrease in yield.

Question 3

(a) Whilst many identified a correct precaution for ethyne, most did not give an appropriate precaution for chloroethene as it is produced as a gas. Generic statements such as 'wear protective clothing' will not score. Specific precautions are required.

(b) Well answered. Some candidates failed to label the y axis at all and many seemed unaware it represented energy. Only a few candidates transposed the terms reactant and product.

(c) Generally well answered. Many failed to include all the bonds in their additions. The largest number of errors came in the subtraction. Many transposed the two factors.

(d) A significant proportion tried to define mean bond enthalpy but many correct answers were seen. Only occasionally was 'energy required' stated rather than 'energy released'.

(e) A good number of correct answers seen. Far more candidates than in the past drew Hess's cycles to help their calculations and this contributed significantly to their success. Unfortunately, some failed to realise that the question used enthalpies of combustion rather than enthalpies of formation and so incorrectly used $\Sigma\Delta H_f$(products) - $\Sigma\Delta H_f$(reactants).

Only a few recognised that a final division by 4 was required as the answer was to be for one mole of chloroethene.

Question 4

(a)(i) Many incorrect pieces of apparatus listed here, such as bunsen burner, calorimeter, and top pan balance. Most candidates scored well.

(a)(ii) Many answers incorrectly referred to measuring mass and temperature rise. Of those that discussed a titration most answers were unspecific and so gained little or no credit. In experimental design questions, candidates must specify reasonable quantities whether that be time interval, volume, or concentration. Worryingly, most thought universal indicator was the indicator of choice for a titration. Many were under the false belief that if a generic 'indicator' (most were unable to name phenolphthalein) was used a permanent pink colouration would be achieved once sodium hydroxide had been neutralised. Several candidates made no attempt to describe an experiment but instead described drawing graphs, doing calculations or simply described setting up the burette, etc.

(a)(iii) Most answers showed a good understanding of what was happening but often answers were again unspecific, such as 'to get accurate results' and so did not score.

(a)(iv) Only a few candidates answered correctly. Many discussed cleaning of the equipment which was not asked about.

(a)(v) Well answered.

(b) Many good answers were seen. However, a significant proportion of candidates incorrectly stated that temperature altered the activation energy, and others seemed to believe, mistakenly, that temperature would alter the reaction pathway or surface area of any solid involved. Other wrong answers discussed that an increase in temperature would increase the number of particles present and would cause them to be closer together.

Most candidates only made 3 valid chemical points and so could only score a maximum of 3. Candidates must look closely at the mark allocation for each section.

Question 5

(a) Although some candidates simply said rate means speed (this was insufficient to gain credit) most gave a complete answer.

(b)(i) Mostly well answered, but several candidates gave unspecific answers like 'decrease' or 'slow' and so did not score.

(b)(ii) Many incorrect answers were seen.

(b)(iii) Whilst some excellent answers were seen the majority of candidates were unsuccessful here. It seems a good number are unfamiliar with the format of a rate equation.

(c) Both concentration and rate must be discussed to score.

(d)(i) A surprisingly large number of candidates were unable to calculate concentration. Only a few correct answers seen.

(d)(ii) The rearrangement of the equation proved too challenging for most.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.