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Examiners' Report January 2009

GCE

GCE O Level Chemistry (7081)

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7081/01 Chemistry Paper 1

General Comments

The paper provided the opportunity for candidates to demonstrate a knowledge of a wide range of factual material as well as an understanding of practical techniques and theoretical principles. Formulae should be clearly written if marks are to be gained; there were situations where it was almost impossible to decipher altered sub-scripts and super-scripts. Incorrect answers should be crossed out and carefully re-written. Although there were many excellent scripts, there seemed to be more scripts than usual where questions were not attempted; this was particularly so in the organic sections.

Question 1

This question was often well answered, the commonest mistakes being an incorrect oxidation state for iron(II) nitrate and writing Cr^{2+} instead of Cr^{3+}. Note that it is unnecessary to name aluminium sulphate as aluminium tetraoxosulphate(VI); if this name is written, then the oxidation state must be present and correct.

Question 2

Parts (e) and (f) often attracted the answer 10 but the remaining parts were well answered. Some candidates answered (a) and (b) using the s,p,d notation for electron configuration; this is not required at this level.

Question 3

Some candidates always have difficulty assigning colours to compounds and this was so in this question. Note that in (f), the colour blue needs to be accompanied by 'dark' or 'deep'.

Question 4

This question was well answered except for part (f).

Question 5

The calculation in (a) was well done but a few candidates tried to use atomic numbers to calculate the mole ratio. The diagram for the electron arrangement in PCl_3 was often correct but some missed the lone pair on phosphorus. The answers to (c) were variable; note that hydrochloric acid is not a product under anhydrous conditions.

Question 6

Part (a) was usually well answered. In (b)(i), electrons were sometimes included. In (b)(ii), it was necessary to mention that there is the same electron configuration or the same number of electrons in the outer shell. It is appreciated that they will also have the same number of protons but so do the atom and one of its ions; it is the electrons that are involved in chemical reactions.

Question 7

This question caused problems for most candidates. In (b), many correct answers were seen for the spacing and movement of the particles in steam, but few candidates stated that water molecules are close together and that they can move only a short distance before colliding or that they slide past each other. Statements such as 'they exchange partners' are meaningless. Many answers stated that the particles in water are 'closer together than in steam' which is not the same as 'they are close together'. In (c), a statement that molecules have to be completely separated in order to form steam or that intermolecular forces need to be completely overcome was expected. Likewise for ice to water, it was necessary to state that particles only need to be loosened or that intermolecular forces have to be partially overcome.

Question 8

Some candidates did not realise that the reactions of rubidium would be much more violent than those of sodium (or potassium). What was required was a reference to the violent nature of the reaction and one other likely observation. A lot of attempted equations had rubidium oxide as a suggested product but there were many correct answers. There is no excuse for writing the incorrect symbol for rubidium as it is given in the Periodic Table on the back of the paper.

Question 9

This topic is usually well known and there were many good answers. In (a)(ii), the water is boiled to remove dissolved oxygen/air and the oil is there to prevent re-entry of air; some appeared to think that the oil coated the nail. In (b), the statement that 'zinc rusts' was common and is incorrect. Many thought that a block of aluminium would prevent rusting of the hull but this is unlikely to be successful because of the protective layer of oxide formed on the surface of the aluminium; magnesium was the expected answer.

Question 10

This question produced many good answers. The main errors were in (iii) where the use of a gas-tight or air-tight container was often suggested (ignoring the fact that carbon dioxide has to escape) and in (vi) where the attempted equation involved water as a product. Part (b) was an invitation to invoke cost which was ignored; few scored two marks.

Question 11

Some candidates appeared to know very little organic chemistry. There were, however, many correct structures and names for the ester although some got the 'eth-' and 'meth-' mixed up. Completing the polymer chain was beyond many candidates but part (ii) was satisfactory.

Question 12

This question was well answered.

Question 13

This question often scored high marks if part (a) was correct. Sometimes the evolution of carbon dioxide was not clearly stated as the reason for the loss in mass and the type of chemical change was said to be reduction. The equations were often correct but slips in balancing lost some marks.

Question 14

It was fairly obvious from some of the answers that a considerable number of candidates had little or no experience of doing titrations and processing the results. The names of the apparatus were usually correct and methyl orange or phenolphthalein was chosen as indicator by many; universal indicator or litmus are not acceptable. In this titration, the end-point would be when phenolphthalein just turns colourless (and not faint pink). The reason for repeating the titration is to achieve accuracy; just taking an average (without eliminating erroneous results first) does not achieve an accurate value for the end-point.
When completing the table, numerous candidates added the values to get the volume of acid added and some wrote down figures that did not relate to anything in the table. In (e), the transferred error principle was applied so further marks could be scored. The calculation was well done by the more able candidates; the main error was to use 0.200 x 0.025 instead of 0.200 x 0.028 when calculating the moles of hydrochloric acid.

7081/02 Chemistry Paper 2

General Comments

All questions were accessible to all candidates, with every mark on the paper being scored. There was a very wide range of marks. As previously stated, the standard of calculation work remains good, but practical observations and balancing of equations need improving. Question 8 attracted many weaker candidates who showed a lack of understanding of both chemical principles and of practical work.

Section A

Question 1

This question had a very mixed response. In part (a), most candidates knew that hydrogen was prepared by adding a suitable acid to a suitable metal, but the absence of 'concentrated' and 'anhydrous' before sulphuric acid and calcium chloride respectively lost the drying agent mark. Many candidates, having dried the gas, then proceeded to collect it over water!
In part (b), most candidates scored marks on parts (ii) and (iii), but there was much evidence of monatomic hydrogen and oxygen in the equation.
In part (c), as part (b), it was very disappointing to see the use of monatomic hydrogen and chlorine and failure to balance the equation. Despite being told to name the gas formed, hydrochloric acid was a very popular incorrect response.

Question 2

Candidates should read the question. The only available chemicals and apparatus listed were often ignored. There was only one correct answer to each part, i.e. the use of barium chloride in (a), sodium hydroxide in (b) and heat followed by passage of any gas formed through lime water in (c).

Question 3

There was a disappointing response to part (a). The fractions obtained from fractional distillations are mixtures of hydrocarbons and not individual compounds. Candidates should give a complete use of a fraction, i.e. petrol is used as a fuel for cars and not simply petrol is a fuel.
The importance of the cracking process was required in (b), and not simply a statement of the breakdown of long chained alkanes to shorter chain alkanes and alkenes. A simple statement such as cracking gives high-value products was all that was required.
The structure of the polymer in (b) and the isomers in (c) were generally well known.

Question 4

There was a disappointing response to the observations made in each part of this question. Iodine is formed in solution in (a) and does not appear as a gas. A black solid is formed in (b) and a cream precipitate in (c). Only the names of the halogen-containing products were required and any extra product was treated as a contradiction. There was some very disappointing equation work.

Question 5

In part (a), despite being given the equation to enable candidates to calculate the energy change, the error of using the total mass of reactants was frequently seen.
In part (b), only the better candidates knew that the moles of copper(II) sulphate were obtained by multiplying the volume in dm^3 by the concentration and that the energy change per mole by dividing the answer to (i) by the moles in (ii). Errors carried forward were rewarded by the examiners. In part (iii), candidates had to recognise that the reaction was exothermic (there was a rise in temperature) and put a negative sign in front of their answer to part (ii).
Candidates struggled with the ionic equation and explanation in part (b). The correct equation was $Fe(s) + Cu^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cu(s)$. This clearly shows that Fe loses electrons and is oxidised and the Cu^{2+}ion (and not Cu) gains electrons and is reduced.

Section B

There were many excellent responses to the three most popular questions 6, 7 and 9. Question 8 attracted many weaker students who wrote at length without stating valid arguments to support the explanations.

Question 6

In part (a), most candidates appreciated that the difference in boiling points enabled the two gases to be separated by the fractional distillation of liquid air. In part (ii), a lighted spill was used and not a glowing splint. Very few candidates knew that the spill would burn more brightly in oxygen and be extinguished in nitrogen. Carbon dioxide was the answer in part (iv), but many equations included hydrogen and not water as the other product of combustion.

In part (b) the diagram of the nitrogen molecule was generally well done, but only the better candidates realised that nitrogen’s inertness is due to the strength of the triple bond. Most candidates knew the temperature and pressure used in the Haber process and could identify the iron catalyst. Although candidates could relate the higher product yield to a low temperature due to the exothermic nature of the reaction, it was not appreciated that an increased temperature is used to compensate for the slow rate at low temperature. The calculation in (iii) was generally well done.

Question 7

Many candidates knew the names of the two allotropes of sulphur in part (i), but only the better candidates were aware that allotropes are different forms of an element in the same physical state. Parts (ii) and (iii) were generally well known, but many candidates were not aware that the sulphur trioxide is absorbed in 98% sulphuric acid to form oleum, which is then diluted by adding water. The health hazard associated with the mist of acid fumes or the highly exothermic nature of the reaction between sulphur trioxide and water was well known in part (iv).
There was an excellent response to the test for sulphur dioxide in part (b), but only the better candidates could write the equation for the formation of sodium sulphite in part (ii).
Part (c) was generally well done. Marks were lost by candidates not knowing that the sulphuric acid behaves primarily as a dehydrating agent (not drying agent) in the production of ethene and as a catalyst during the esterification reaction. The simple

equation, $C_2H_5OH \rightarrow C_2H_4 + H_2O$ was all that was required for the formation of ethene. Candidates failed to include water as a product in the formation of the ester. The structure and name of the ester was well known.

Question 8

Candidates generally tend to write at length when answering this type of question without giving the relevant principles.
In part (a)(i), the answer required was that metals conduct electricity by the movement of the delocalised electrons in both the solid and molten states, whilst it is only in the molten state of ionic compounds that the ions are mobile.
In part (ii), candidates should have compared the energy required to overcome the strong attraction between oppositely charged ions in an ionic compound to that required to overcome weak intermolecular forces between the molecules of covalent compounds.
In part (iii), the covalent hydrogen chloride remains as molecules in a non-polar solvent and only shows its acidic character in water due to the formation of hydrogen ions.
In part (iv), most candidates could relate the increased surface area of the particles to the increased frequency of collision and the higher rate of reaction when powdered calcium carbonate is used.

In part (b), candidates were expected to describe experiments and make a suitable observation to score the marks. A common error was to fail to mention any apparatus.
A simple experiment in part (i) would be to observe the effervescence obtained when the catalyst was added to hydrogen peroxide in a flask and compare it with the absence of effervescence when only hydrogen peroxide was in the flask.
In part (ii), candidates were expected to use the principle that the mass of the catalyst does not change during the reaction. The catalyst should have been weighed initially and then added to the peroxide in a flask. The solution should have been filtered when reaction was complete, the catalyst dried and then reweighed.

Question 9

Part (a), (b)(i) and (ii) were generally well done. Many candidates made the calculation in part (iii) more complicated than was necessary. The equation, $Cu^{2+} + 2e^{-} \rightarrow Cu$, from part (ii), shows that 2 faradays (2 moles of electrons) give 1 mole of Cu. Hence 200 faradays give 100 x relative atomic mass
In part (c), specific transition metal chemical properties include variable oxidation state, coloured ions or compounds, complex ions or catalytic activity. Examples using transition metals other than copper were not rewarded.
The observations and balanced equations in part (d) were well known only by the better candidates.

CHEMISTRY 7081 - GRADE BOUNDARIES

Grade	A	B	C	D	E
Lowest mark for award of grade	**72**	**57**	**42**	**37**	**25**

Note: Grade boundaries may vary from year to year and from subject to subject, depending on the demands of the question paper.

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