A-LEVEL
CHEMISTRY

7405/1 Inorganic and Physical Chemistry
Report on the Examination

7405/1
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Question 1

Although many students gave the correct definition in 01.1, several answers did not refer to an atom or ion and many answers gave the definition of a transition metal instead of a transition metal complex.

In 01.2, the name of the shape was often not known even if the diagram was correct; common errors included diagrams with no lone pairs.

Only the most able students could give the correct explanation in 01.3; many students referred to the oxidation state of $Cr(PF_3)_6$ or the PF_3 molecule.

In 01.4, the oxidation state was given correctly by 49% of students; the most common incorrect answer was +2.

Many students gave the correct answer in 01.5; common errors were hydrogen bonds and dative covalent bonds.

Many students gained partial marks in 01.6. There were several errors seen in students' answers, eg Cl_2 as a ligand, omitting the charge on the ion, drawing two cis- or two trans-isomers, and attempts at drawing optical isomers.

Students found 01.7 challenging; the correct equation was given by only 14% of students.

Question 2

The majority of students could state the purpose of the salt bridge in 02.1 but the identity of the ionic compound was not answered quite as well; several students thought that electrons flowed through the salt bridge and many students did not realise that the ionic compound should be soluble and not react with the acid or magnesium ions or chloride ions.

There were many correct answers in 02.2 although a few had confused this with rates of reaction.

Few students gave the correct answer in 02.3.

Question 02.4 proved challenging; the equation given by most students was for the reverse reaction.

Question 3

The equation in 03.1 was well known.

The equation in 03.2 was less well known; some students gave H_2SO_4 as the product.

Many students found 03.3 difficult and did not draw the displayed formula of the anion.

In 03.4 several students did not give the correct equation; the most common errors were to form magnesium hydroxide and hydrogen or to give the observation as fizzing or a white precipitate.
If students knew the formula of the product in 03.5 they invariably gave a correct equation; many students did not know the formula of magnesium phosphate and therefore could not give a balanced equation.

Question 4

Questions 04.1 and 04.2 were well answered.

In 04.3, 47% of students gained all the marks; errors included using square brackets in the expression for K_p and not rearranging the expression correctly to calculate total pressure.

Most students gained at least one of the marks in 04.4; many students did not realise that changing the pressure does not change K_p. Only a change in temperature affects the value of K_p.

In 04.5, many students gave correct answers; several students gave answers referring to rates.

Question 5

Many students answered 05.1 well; errors included omitting 2 × –364 and forgetting to reverse the sign of one of the values given in the table.

Answers to 05.2 were generally good.

Students found 05.3 challenging with only 12% gaining all the marks. Many students knew that fluoride ions are smaller than chloride ions but failed to gain the mark because of confusion between atoms and ions (eg stating that "fluoride has a smaller atomic radius than chloride"). For the second mark several students referred to the attraction of F^- to $O^{\delta-}$ or H^+ instead of $H^{\delta+}$.

Answers to 05.4 were generally good; some students missed electrons or state symbols or put Cl_2 in the top equation rather than 2 Cl.

Common errors in 05.5 included missing one or both of the factors of 2 for the atomisation and the electron affinity of chlorine. A substantial number of students had problems evaluating the combination of positive and negative values.

Answers to 05.6 were often vague and did not address the greater attraction between the electron removed and the more positive, smaller ion.

There were some very good answers to 05.7 and 28% of students gave level 3 answers; many students began their answer by stating that the experimental values were all higher than the theoretical values and that the calcium chloride value was the highest for both the experimental and theoretical data. They then went on to explain incorrectly that this was because of covalent character in calcium chloride and that the greater difference for silver chloride was because it had more covalent character. Students who discussed the relative values for the three chlorides often lost credit because they confused atoms and molecules (eg calcium atoms are smaller than potassium atoms or calcium chloride molecules have stronger ionic bonds).

Question 6

Answers to 06.1 were generally good; a common error was omitting to convert the volume from cm^3 to dm^3.

Many students found the description in 06.2 challenging. Many students did not transfer the solution from the beaker to a volumetric flask and made the solution up to 250 cm^3 in the original beaker; some transferred the solution to a conical flask. Many students did not state that the beaker and stirring rod should be washed with distilled water and the washings transferred to the flask before making the solution up to the 250 cm^3 mark. Several students forgot to invert the flask to ensure thorough mixing.

Answers to 06.3 were good.

In 06.4, most students realised that acid could continue to drip into the burette, thus affecting the titre; some students thought the titre would increase, and some thought the stem of the funnel would alter the volume by displacing acid at the top of the burette.

In 06.5, 30% of students gained all the marks; common errors included using the wrong M_r of barium hydroxide, not calculating the amount in moles of barium hydroxide in 25 cm^3, not realising there was a 2:1 ratio and dividing by the wrong volume to calculate the concentration.

Answers to 06.6 were generally poor; many students added together the uncertainty in the pipette and the uncertainty in the burette and then divided by the total volume of both.

Question 7

Answers to 07.1 were good.

In 07.2, the correct equation was given by 35% of students; common errors included 6 waters on the LHS of the equation and missing the 2– charge on SO_4^{2-}.

Students generally found the explanation in 07.3 challenging; many students discussed the 3+ charge on the complex stating that the complex was polarising, with no reference to Al^{3+}. The second mark was not often gained.

Answers to 07.4 were quite good.

In 07.5, the observation was often correct but the equation was less well known.

A few students gave the correct answer in 07.6; $Al_2(SO_4)_3$ was a common incorrect answer.

In 07.7, the nitrogen atoms were generally correctly identified; common errors included circling both O species.

Question 07.8 discriminated very well. Most students could calculate the amount, in moles, of Zn^{2+} and $EDTA^{4-}$ and many then subtracted correctly to get M3; common errors in answers included not multiplying by 10, not dividing by 2 and not giving the answer as an integer. Some students incorrectly calculated the M_r of $Al_2(SO_4)_3$ even though this value was given in the question.

Question 8

The half-equation required in 08.1 was often missing the electrons.

In 08.2, the electrons were also often missing or on the wrong side of the equation.

Many students gained the mark in 08.3; the most common incorrect answer was 1.17 V.

Students found 08.4 challenging; many students thought that the cell was reversible and so could be recharged and others thought that hydrogen could be supplied from the air.

Question 08.5 proved difficult for students; many referred to the flammability of hydrogen without considering that methanol is flammable too.

Question 9

The majority of students gave a correct equation in 09.1; common errors included missing or incorrect state symbols, eg Sr(s).

In 09.2, 36% of students gained all of the marks. Common errors included rearranging the equation incorrectly, not converting cm to m, not converting kg to g, incorrect use of the Avogadro constant and not giving the mass number as an integer.

Question 09.3 was not well answered. Many students stated that a current was produced but did not mention the ion gaining an electron to produce the current, and many students did not state that the current was proportional to the abundance of the ion.

Answers to 09.4 were generally good; a small number of students did not use the 1:2 ratio of ^{86}Sr to ^{87}Sr and some did not give their answer to 1 decimal place.

In 09.5, many answers were insufficient and referred to the protein being denatured.

Question 10

Bromothymol blue was the most common incorrect answer in 10.1.

The expression in 10.2 was well known.

Answers to 10.3 were good, with 63% of students gaining all the marks. Common errors included not taking the square root or dividing by 0.1 (in M3 of the Mark Scheme) and not giving the answer to 2 decimal places.

29% of students gained all of the marks in 10.4. Many students did not identify that the reaction mixture was a buffer solution with an excess of a weak acid. These students did not subtract the amount, in moles, of sodium hydroxide from the amount of butanoic acid to determine the excess of the weak acid. Other errors included an attempt to use the weak acid approximation, $[H^+] = \sqrt{K_a \times [C_3H_7COOH]}$ to calculate pH.

Explanations in 10.5 were generally poor; many students did not state that this was a weak acid - weak base titration and answers rarely referred to the gradual pH change; common errors included reference to the indicator having a small pH range or a gradual colour change or the equivalence point being too short. Some students made reference to there being no steep section on the graph but with no explanation about the graph to which this statement referred.

Mark Ranges and Award of Grades

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