AP® Chemistry
2001 Scoring Commentary

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Question 1

Sample 1A (Score 10)

This response earned a perfect score of 10 points.

Sample 1B (Score 9)

This response earned a total of 9 points. The calculations were done correctly, but in part (b) (iii) the student misinterpreted the results of the calculations and drew an incorrect conclusion about which compound would precipitate first. This was a common error.

Sample 1C (Score 6)

This response earned a total of 6 points. The student correctly calculated the number of moles of ions present in part (b) (i), but did not then use these values to calculate Q or to make a prediction about whether or not a precipitate would form. Therefore, the student earned only 1 out of the 3 points available in part (b) (i). In part (b) (iii), the student did not recognize the need to calculate $[Cl^-]$ for both solutions and, from these, to predict which compound would precipitate first.

Question 2

Sample 2A (Score 10)

This response earned a perfect score of 10 points. Note that the correct units are used in all parts of the problem, and that the setups are very clear.

Sample 2B (Score 7)

This response earned a total of 7 points. The student lost one point because the units in part (a) should be kJ, not kJ/mol. The student earned 1 point for the explanation involving ΔH in (b) (ii). The student only earned 1 of the 2 points available in part (d) because each NO_2 molecule has 2 N-O bonds, not one.

Sample 2C (Score 5)

This response earned 5 points. The student used a calorimetry equation, $q = mc\Delta T$, in part (a) and a K_{eq} expression in part (b) (i), and did not receive any credit for either part. The student earned only 1 of the 2 points available for part (d) because the signs of the bond energies were incorrect and because a total of two bonds were used for the two NO_2 molecules instead of four bonds.

Question 3

Sample 3A (Score 10)

This response earned a total of 10 points. All parts were correct, justified, and the work was neatly done.

Sample 3B (Score 8)

This response earned 8 out of 10 points. In part (b), the student incorrectly determined the number of moles of CO_2 by dividing the given volume by 22.4 L/mol, a common error. Since the student obtained a mass of CO_2 consistent with this incorrect number of moles, the student only lost 1 of the 2 points for the carbon calculation. The student earned credit for the number of grams of oxygen since this value was consistent with the correct number of grams of hydrogen and the incorrect number of grams of carbon already given. The student did not earn credit for (d) (i), since the pH at the equivalence point was incorrectly used as the pK_a of the acid.

Sample 3C (Score 6)

This response earned 6 out of 10 possible points. In part (b), the student incorrectly determined the mass of hydrogen in the original sample by determining the mass of hydrogen in the water formed. The student incorrectly determined the moles of CO_2 formed by dividing the given volume by 22.4 L/mol. The student then obtained a mass of carbon consistent with the number of moles of CO_2, earning 1 of 2 possible points for the carbon calculation. The student neglected to obtain a value for the mass of oxygen in the original sample. The student did not receive any credit for part (d) (ii).

Question 4

Sample 4A (Score 15)

This response earned a perfect score of 15 points. All reactants and products have been identified with correct charges (although the zero on Cu^0 and Ag^0 is not required). No spectator ions or extraneous species are shown.

Sample 4B (Score 13)

This response earned 13 out of 15 points. Reactions (h), (c), and (g) are correct. Reaction (a) has the correct reactants and one correct product (the hydrogen ion); the sulfate ion was a common incorrect product given for reaction (a). Reaction (f) has the correct reactants and one correct product (the chloride ion); writing Br instead of Br_2 was a common error.

Sample 4C (Score 11)

This response earned 11 out of 15 points. Reactions (f) and (g) are correct. The student did not earn the reactant point for reaction (c); when the student crossed out NO_3, he or she did not indicate the charge on the silver ion. This was a common error. The reactants in reaction (a) are correct, but the products are incorrect. The products in reaction (h) are correct but the formula for magnesium carbonate is incorrect.

Question 5

Sample 5A (Score 10)

This response earned a perfect score of 10 points.

Sample 5B (Score 8)

This response earned a total of 8 points. The student did not receive any credit for the size/mass explanation given in part (a). (This was a common incorrect explanation.) The student neglected to give the product of the oxidation in part (d), so did not earn the second point for that part.

Sample 5C (Score 6)

This response earned a total of 6 points. The student did not earn any credit for part (a). The argument that hydrogen bonding in C_2H_5OH would result in a high boiling point was common. The student only earned 1 point for part (c) because PbCl was given as the precipitate, not $PbCl_2$. The student neglected to give the product of the oxidation in part (d).

Question 6

Sample 6A (Score 10)

This response earned a perfect score of 10 points.

Sample 6B (Score 8)

This response earned a total of 8 points. In part (c), the student changed the concentration of a product and a reactant instead of both reactants, and earned only 1 out of 2 points. In part (d), there was no indication of the rate and concentration data to be substituted, so the student earned only 1 out of 2 points. In part (e), the student drew an appropriate graph, and so earned the full 2 points.

Sample 6C (Score 6)

This response earned a total of 6 points. In part (a), the student did not give the formula of another oxidant that could be used. In part (b) (ii), the student determined the concentration of I_3^- instead of the instantaneous rate of its formation. In part (d), the student provided an appropriate rate law but neglected to indicate the source of the values to be substituted into the equation in order to solve for *k*. In part (e), the graph is incorrect in that the final $[I_3^-]$ should have leveled off at 0.0020 *M*.

Question 7

Sample 7A (Score 8)

This response earned a perfect score of 8 points. The reasoning in parts (c) and (d) is very good.

Sample 7B (Score 6)

This response earned a total of 6 points. No points were earned for part (c) because the student did not use the data from the question.

Sample 7C (Score 5)

This response earned a total of 5 points. The student did not earn credit in part (a) for saying that $Zn(NO_3)_2$ was the anode. In part (c), no credit was earned for an explanation. In part (d), the explanation was not sufficient to earn credit: the student needed to explain how one could tell that the reaction was spontaneous (e.g., this is a voltaic cell, a galvanic cell, or a battery, and therefore the reaction is spontaneous *or* E°_{cell} is greater than 0 therefore the reaction is spontaneous).

Question 8

Sample 8A (Score 8)

This response earned a perfect score of 8 points.

Sample 8B (Score 6)

This response earned 6 points. No credit was earned for part (c) because the student did not identify the type of bonding in Si and did not discuss the intermolecular forces (London dispersion forces) in Cl_2.

Sample 8C (Score 4)

This response earned a total of 4 points. In part (b), the explanation using molar mass earned no credit. In part (c), no credit was earned for citing "molecular crystals" in relation to Si , but one point was earned for relating Cl_2 to dispersion forces. In part (d), 1 point was earned for mentioning that both compounds are ionic.