CollegeBoard
Advanced Placement Program

AP® Chemistry
2004 Scoring Commentary

AP® CHEMISTRY
2004 SCORING COMMENTARY

Question 1

Sample: 1A
Score: 10

This response earns a perfect score of 10 points: 1 point for part (a), 2 points for part (b), 2 points for part (c), 1 point for part (d), 1 point for part (e), 2 points for part (f), and 1 point for part (g). The answers are very well written.

Sample: 1B
Score: 8

The point is not earned in part (a) because the charge of the anion is written outside the brackets. The point is not earned in part (g) because the response is not specific enough about how the ions are removed (many responses stated that ions evaporated).

Sample: 1C
Score: 6

Only 1 out of 2 points is earned in part (b) because $[Ag^+]$ is calculated by setting it equal to $4x^2$, not $2x$. No points are earned in part (c) or in part (g).

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Question 2

Sample: 2A
Score: 10

This response earns a perfect score of 10 points: 1 point for part (a)(i), 1 point for part (a)(ii), 2 points for part (b), 1 point for part (c), 2 points for part (d)(i), 1 point for part (d)(ii), and 2 points for part (e).

Sample: 2B
Score: 9

This paper illustrates how a student can answer incorrectly in one part of a question, but then earn points for using that value correctly in subsequent parts. The point is not earned in part (a)(ii) because the volume of $O_2(g)$ is calculated as if it were at standard conditions. The response to part (b) is consistent with the values calculated in parts (a)(i) and (a)(ii), and the stoichiometry is correct, so 2 points are earned in part (b). The answer to part (c) is consistent with $O_2(g)$ being the limiting reactant, so the point is earned in part (c).

Sample: 2C
Score: 6

In part (d)(i), 1 out of 2 points is earned for correct units. The point is not earned in part (d)(ii) because entropy is identified as the more responsible factor. No points are earned in part (e): simply reversing the reaction, changing the sign of the given $\Delta H°$, and dividing the value by 2 was a common incorrect method used in this part.

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Question 3

Sample: 3A
Score: 10

This response earns a perfect score of 10 points: 1 point for part (a), 2 points for part (b), 2 points for part (c), 2 points for part (d), 1 point for part (e)(i), and 2 points for part (e)(ii).

Sample: 3B
Score: 8

This response demonstrates two common errors: only 1 out of 2 points is earned in part (b) because incorrect units are used for the rate constant, and only 1 out of 2 points is earned in part (d) because there are no units for the half-life.

Sample: 3C
Score: 7

The point is not earned in part (e)(i) because the vertical axis is labeled ln[A] instead of ln k, a common error. No points are earned in part (e)(ii) because the answer does not say anything about the slope or how it is related to activation energy.

Question 4

Sample: 4A
Score: 15

This response earns a perfect score of 15 points. In each part, 1 point is earned for the correct reactant(s) and 2 points are earned for the correct product(s).

Sample: 4B
Score: 13

This response demonstrates two common errors. Only 2 points are earned in part (c) because nitrous acid is not represented in molecular form, and only 2 points are earned in part (d) because hydrogen iodide gas is not represented in molecular form. In both cases, 2 product points are earned because the products are consistent with the reactants.

Sample: 4C
Score: 9

No points are earned in part (f): there is an extra reactant, and the correct product is not given; the reaction is not treated as a complexation reaction. No points are earned in part (c). Nitrous acid is a weak acid and should be represented in molecular form, and the products are incorrect.

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Question 5

Sample: 5A
Score: 9

This well written response earns a perfect score of 9 points: 1 point for part (a)(i), 2 points for part (a)(ii), 2 points for part (b)(i), 1 point for part (b)(ii), 1 point for part (c)(i), 1 point for part (c)(ii), and 1 point for part (c)(iii).

Sample: 5B
Score: 7

The point is not earned in part (a)(i) because solution *Q* is identified as NaCl. In part (a)(ii), 1 out of 2 points is earned for a formula of a precipitate (AgCl) that is consistent with the response in part (a)(i). In part (b)(i), the 2 points are earned because identification of solution *R* as $Pb(NO_3)_2$ and solution *S* as K_2CO_3 is consistent with the evidence that solution *Q* (identified as NaCl in this response) will form a precipitate with solution *R* but not with solution *S*. The point is earned in part (b)(ii) because $PbCl_2$ would precipitate if the given solutions were mixed.

Sample: 5C
Score: 6

No points are earned in parts (c)(i), (c)(ii), and (c)(iii). The response only talks about a qualitative analysis scheme in general terms, and does not describe a procedure for these particular solutions. The response does not state the differences in what would be observed when specific solutions are mixed together.

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Question 6

Sample: 6A
Score: 10

This response earns a perfect score of 10 points: 2 points for part (a), 1 point for part (b), 1 point for part (c), 1 point for part (d), 1 point for part (e), 3 points for part (f)(i), and 1 point for part (f)(ii). In part (f)(ii), the explanation of the change in voltage is clear and logical.

Sample: 6B
Score: 8

The point is not earned in part (d) for the identification of aluminum as metal X. Note that full credit is earned in part (e) even though aluminum is used in the equation instead of iron, because this response is consistent with the incorrect answer given in part (c), and the stoichiometry is correct. Only 2 out of 3 points are earned in part (f)(i) because the Q term is incorrect. Full credit is earned in part (f)(ii) because the answer is consistent with the incorrect answer given in part (f)(ii).

Sample: 6C
Score: 7

This response contains three common errors. The point is not earned in part (c) because the standard reduction potential should be negative. Only 1 out of 3 points is earned in part (f)(i) because 0.74 V is used in the Nernst equation instead of 0.60 V, and the exponents are not included in the Q term.

Question 7

Sample: 7A
Score: 8

This response earns a perfect score of 8 points: 2 points for part (a), 2 points for part (b), 2 points for part (c), and 2 points for part (d).

Sample: 7B
Score: 6

Only 1 out of 2 points is earned in part (a) because the difference in the strength of the dispersion forces is attributed to molar mass, not size/polarizability of electron cloud (this was a common error). Only 1 out of 2 points is earned in part (d) because hydrogen bonding is not addressed.

Sample: 7C
Score: 5

Only 1 out of 2 points is earned in part (a) because the difference in the strength of the dispersion forces is attributed to molar mass. No credit is earned in part (b) because there is no mention of ionic species, and the difference in melting point is attributed to polarity of bonds.

Question 8

Sample: 8A
Score: 8

This response earns a perfect score of 8 points: 2 points for part (a), 1 point for part (b), 1 point for part (c), 1 point for part (d), 1 point for part (e)(i), 1 point for part (e)(ii), and 1 point for part (e)(iii).

Sample: 8B
Score: 6

The point is not earned in part (e)(i) because greater pressure (at the same temperature) does not result in greater kinetic energy. The point is not earned in part (e)(iii) because, although there are more CO(*g*) molecules, the response states that pressure is constant.

Sample: 8C
Score: 5

The point is not earned in part (c) because the wrong gas is chosen. The point is not earned in part (e)(i) because the kinetic energy is the same for both gases. In part (e)(iii), no point is earned because, although there are more CO(*g*) molecules, it is not because the CO(*g*) molecules are smaller than the CO_2(*g*) molecules.