AP® Chemistry
2000 Scoring Commentary

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Question 1

Sample A - Score 10

This response earned a full score of 10 points. The student clearly describes (both written and mathematically) how $[H_2]$ and $[H_2S]$ are calculated, and the calculations are correct to three significant figures. Substitution of these values into the K_c expression gives the correct numerical value. With the number of moles of S_2 given, there is no dependence on previous parts of this question to determine the partial pressure of S_2. Both the reciprocal and the square root of the original K_c are indicated.

Sample B - Score 8

This response earned a total of 8 points. Parts (a) and (b) are correct and earn the full 4 points for those parts. In part (c), the number of moles of S_2, not $[S_2]$, is used so only 1 of the 2 points is earned. In part (e), 1 point is earned for writing the K_c for the reaction as written, but the substitutions are incorrect.

Sample C - Score 5

This response earned 5 points. The K_c expression is correct, so the first point is earned. Note that in the table in part (b) of the response the original value for $[H_2S]$ is 0.8 M, not the correct value of 0.080 M. This results in part (b) earning only 2 out of 3 points because of a mathematical error. In part (c), the numerical value of K_c is not correct but is calculated correctly based on the concentrations from part (b): there is no further penalty for the error in part (b). Part (d) earned 0 points. Part (e) recognized that a reciprocal (at a minimum) was required; however the substitutions were not correct so 0 points were earned.

Question 2

Sample A - Score 10

This response earned a perfect score of 10 points. In part (b) (iii), 2 points were given for the correct voltage. The reactions are also shown.

Sample B - Score 7

This was a good paper and earned a score of 7 points. In part (b) (i), the n value was wrong, and the second point was not earned because of an error in significant figures and a missing unit. The point was awarded in part (b) (ii) because the answer calculated was consistent with part (b) (i). In part (c), only 1 point was earned because the ratio of moles of electrons to moles of copper was incorrect.

Question 2 (cont.)

Sample C - Score 4

This was an average response, and earned 4 points. Part (b) (i) earned only 1 point because no unit was expressed. No credit was earned in part (b) (ii) or part (b) (iii).

Question 3

Sample A - Score 10

This response earned a full score of 10 points. Note that the calculations are clearly shown.

Sample B - Score 7

This response earned a total of 7 points. Part (a) only earned 1 of 2 points because the molar mass was incorrect. Part (b) earned all 3 points because, even though the calculated values were incorrect, they were consistent with the molar mass calculated in part (a). Part (c) (iii) earned 0 points because the student did not account for the dilution of the sample: this was a common error. Part (c) (iv) earned 0 points because the amount of anhydrous $BeC_2O_4(s)$ calculated was not consistent with the data or earlier calculations.

Sample C - Score 4

This response earned 4 points. No credit was earned for (b) (i). Part (b) (ii) earned 1 point for calculations showing the correct number of moles of $H_2O(g)$ released, even though the number was not explicitly stated. The second point for (b) (ii) was not earned because the volume of $H_2O(g)$ was not determined for the pressure and temperature conditions specified. Part (c) (ii) earned 1 point for the correct determination of moles of MnO_4- based on volumetric data. No credit was earned for moles of $C_2O_4^{2-}$.

Question 4

Sample A - Score 15

This response had no errors and earned a perfect score of 15 points.

Sample B - Score 11

This response received 1 reactant point and 1 product point in part (a), and no points in part (d). The overall score was 11 points.

Sample C - Score 8

This response received 1 reactant point and 1 product point in part (a). Part (c) received no points, part (f) received 1 product point, part (g) received all 3 points, and part (e) received 1 reactant point and 1 product point. Parts (a) and (e) were very typical responses for students choosing these parts. The overall score for this response was 8 points.

Question 5

Sample A - Score 10

This was a nice paper, and earned all 10 points available. The student was concise in all parts.

Sample B - Score 8

This response earned a total of 8 points. Part (a) earned 2 points. The student clearly showed the freezing point change in the second graph. Part (b) earned all available points and was very clear. No points were earned in part (c) because the student incorrectly comes to the conclusion that the molar mass increases. Part (d) earned full credit.

Sample C - Score 6

This response earned 6 points. No credit was earned for part (a): although the first graph does plateau at 10°C, the question clearly states to go to 0°C. Part (b) earned full credit: part (b) (ii) had a nice explanation. In part (c), 1 point was earned for choosing that the molar mass would be too small, but no point was earned for the explanation. No credit was earned for part (d).

Question 6

Sample A - Score 10

This response earned the full score of 10 points. Part (b) is excellent: it addresses both the number and the complexity of the molecules. The information from part (b) is used in part (c). Part (d) is thoroughly worked out and clearly concluded. Part (e) has a full analysis of all options, and appropriate conclusions.

Sample B - Score 8

This response earned 8 points. Parts (a) and (b) were clear and correct. No credit was earned for part (c). Part (d) earned all 3 points: it has a good description, and is about the minimum required to earn 3 points for this part. Both points were earned in part (e). It refers to the result in (d) and is correct for an elementary step.

Sample C - Score 5

This response earned 5 points. Part (a) earned 0 points. Part (b) earned 1 point for "tend towards zero" but the explanation is incorrect. Part (c) earned both points because the explanation and conclusion are consistent with (a) and (b). Part (d) shows the common error of comparing experiments 2 and 3 but not noticing that the concentration of both reactants changed. However, the rate law that was written was consistent with the conclusion, so 2 of the 3 points available were earned in part (d). Part (e) did not earn any points since the conclusion was not consistent with the rate law in (d).

Question 7

Sample A - Score 8

This response earned a perfect score of 8 points.

Sample B - Score 6

This response earned a total score of 6 points. Like most of the responses for this question, full credit was earned in parts (a) and (b). Part (c) (i) earned 0 points. The rationale of stability of half-filled sublevels does not answer the question asked: this is another common approach that was erroneous. Part (d) earned 1 out of 2 points. This response contains the common misconception that the presence of a lone pair of electrons causes polarity.

Question 7 (cont.)

Sample C - Score 4

This response earned 4 points. Part (a) earned 1 point because the same atomic number was accepted as meaning the same number of protons. The number of neutrons was not mentioned. Both points were earned for part (b). No credit was earned in part (c) for stating the ionization energy trends in the periodic table: the student did not specifically address the question and situation presented. This was a very common error. In part (d), the sketch of the molecular 3D structure was omitted, and there was no mention of a valid reason for polarity. "Nonsymmetrical" is insufficient to explain the polarity of this molecule.

Question 8

Sample A - Score 8

This response earned the full score of 8 points. Part (d) has a good, simple explanation.

Sample B - Score 5

This response earned 5 points. Part (b) only earned 2 out of 3 points because the number of mL of HCl at the equivalence point was too low. Part (d) shows a common error.

Sample C - Score 4

This response earned 4 points. Part (b) earned 1 of the 3 points available for having the initial pH at more than 7. Part (c) earned full credit because the indicator chosen corresponds to the mark made on the curve, and the answer is justified for the curve given. Part (d) earned no credit, and shows a common misconception.