Answers to spring 2015 ap final.

1. B. 2. D. 3. A. 4. C. 5. B. 6 B. 7. B. 8. A. 9. A. 10. C. 11. B. 12. B. 13. D. 14. C

15. D. 16. D. 17. B. 18. B. 19. C. 20. D 21. A . 22. B. 23. C. 24.A. 25. D. 26. C. 27. B

28. C. 29. B. 30 . B. 31. B. 32. C. 33. B. 34. B. 35. A. 36. B. 37. A. 38. C. 39. B. 40. A.

41. C. 42. D. 43. B. 44. B. 45. D. 46. C. 47. A. 48. A. 49. A. 50 . C 51. D. 52. B.

53. D. 54. B. 55. B. 56. A. 57. B. 58. C. 59.A 60. A

Free response answers, and grading guide.

If you would like to help me calibrate the exam so that it can be used to predict AP scores in the future, please grade it according to the guidelines, even if you do not agree with them! (That is what we do when we grade the actual AP exams.) Then, when you receive the AP scores in July, send me a list of your students' scores, both on the AP exam and on this final exam. You should not include your students' names. Just two columns - final score, AP grade.

Thanks to those who take the time to do this.

Free response I. Total of 10 points. (do not deduct for sig fig errors) Work must be shown.

A. 0.050 M 1 point ( 20.0 x 0.10 = 40.0 x)

B. Log of 0.050 + 14 = 12.70. ( or pOH = 1.30 , so pH = 12.70 1 point. Do not give credit for a whole number pH like 13.

C. i. Since the base is a weak base, the equivalence point will be in the acid range. Phenolphthalein is a base range indicator, and will turn colorless too soon. ( 1 point)

ii. Less acid would be needed to reach the higher pH in phenolphthalein. That would lead to a smaller value for the molarity of the base. ( 1 point)

D. i. If the pH is 11.0, then [OH-] = 1.0 x 10-3 The Kb is the [OH-]2/ (0. 050 M - 1.00 x 10-3)

= 2. x 10-5 3 points total. Do NOT deduct if student fails to subtract the 0.0010 from the 0.050. Give full credit if student correctly uses an incorrect value from part A.

1 point for finding the correct [OH-]. 1 point for the correct calculation of Kb of 2. x 10-5

1 point for stating that the base could be ammonia. ( to one sig fig, the Kb is correct)

Give the point if the student simply says that the result is "close enough."

ii. At 10.0 mL, halfway to the equivalence point, OH- = Kb, OH- = 1.8 x 10-5 , and pH = 9.26

1 point for correct answer with work.

iii. The pH is 5.36. 2 points for correct answer with work.

1 point if the student either correctly calculates the Ka of NH4+ as 5.6 x10-10 or finds the molarity of the NH4+ as 0.033 molar, or both.

II. H+ + OH- ⭢ H2O ( 1 pt)

B. q = mcΔt, = 100 x 4.18 x 13.3 = 5560 joules. ( 2 points) Do not deduct for 5.56 kJ, but take off a point for 5.56 with no unit. Do NOT deduct for 5560 with no unit. (the unit is specified in the question) Give 1 point if the answer is wrong, but the student correctly multiplied by 100.

C. 5560 J (from part B) /0.100 mole = 55600 J, or 55.6 kJ, but since heat was produced, Δ H is negative, -55.6 kJ. 1 point for dividing by 0.10, 1 point for correct value with correct sign. (total 2 points) Full credit if an incorrect value from part B is used correctly.

D. + 55.6 kJ. 1 pt, no work needed. Award the point for any answer that is the same as the answer to part C but opposite in sign.

E. ΔGo = - RT LnK. K = 1.0 x 10-14 R = 8.31 J/mol K, T = 298 K,

ΔGo = +79.8 kJ/mol. ( 2 point) +79.8 with no unit is OK. +79800 is OK ONLY if it is in JOULES. 1 point for incorrect answer that includes BOTH the correct value of R and the correct value of K.

F. ΔS = (ΔH - ΔG)/T (55.6 - 79.8)/298 = -0.0812 kJ/mol K or - 81.2 J/mol K.

Accept either one, but the unit, J or kJ MUST appear. (Do not deduct if the mol or K is omitted from the unit) 1 point.

G. - 81.2 (from part F) = x - 69.9. x = -11.3 J/mol K. 2 points.

1 point for use of the expression ΔS = ( So products) - (So reactants\_) with an incorrect answer. Full credit of 2 points if incorrect values from part F are used correctly.

(total is 10 points.)

III. A. 3.0 mole. ( 1 point) No work needed)

B. i. 0.568 g/ 332g/mol = 1.71 x 10-3 mol (1 point) = 0.0890 grams. ( 1 point)

( 2 points total. 1 point either for correct moles, or for multiplying moles by atomic mass of chromium)

ii. 1.71 x 10-3 mol/ 0.025 L = 0.0684 Molar. ( 1 point)

iii. 0.00684 mol CrO42- x 1 Cr2O3/ 2 CrO42- x 152 g/mol = 0.520 g.

0.52/5.00 x 100 % = 10.4 % 3 points total.

1 point for the correct moles, ( the molarity found in ii times 0.10 L), 1 point for correctly using the ratio of 1 Cr2O3 for every 2 chromate ions. 1 point for correct answer.

C. i. 3.00 x 108m/s / 370 x 10-9m = 8.1 x 1014 s-1 ( 1 point)

D. ii 0.60/0.85 x 0.10 M = 0.071 molar. ( 1 point)

E. B ii had three sig figs, while Cii had only two, so Bii is likely to be more accurate.

(1 point) 10 points total.

IV. A. Trigonal bipyramid, linear, Trigonal bipyramid. 2 points if all correct. 1 point if two correct. Also, one point if student writes "linear" for all three. (student did molecular instead of electron geometry.)

B. 1 point for the correct Lewis dot structure, which must show 10 electrons around the iodine.

C. -1 1 point. ( total is 4 points)

V. A. - 44 kJ. 2 points. One point for + 44 kJ. One point if the set-up is correct, but a math error occurs.

B. -150 J/mol K. 1 point. No deduction for units UNLESS it says something other than joules. No deduction if unit is omitted. (work is needed)

C. 0.70 kJ/mol. (work must be shown. No deduction if incorrect values from parts A and/or B are used correctly ) 1 point.

4 points total.

VI. A. i 2 H2O2 → 2 H2O + O2 ( 1 point)

ii. Br2 is an intermediate (1 point)

B. i. The reaction must be first order, so step 1 must be rate determining.

1 point. The answer MUST mention first order.

ii. The rate constant = - the slope of the line. 1 point.

Award the point if the student says that the rate constant is found from the slope, even if he/she doesn't mention the sign. Do NOT give the point if the student says that the rate constant = the slope.

Total is 4 points.

VII. A. A correct diagram, showing the metal electrodes immersed in solutions, with a wire and a salt bridge gets 1 point. Labeling the Pt as the cathode gets 1 point.

B. Fe + 2 Fe3+ → 3 Fe2+ ( 1 point)

C. 1.21 volts ( 1 point)

Total is 4 points.

SCORING SHEET.

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Part 1 score \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (max. 60 )

Part II scoring. Do not round off fractional scores until the end.

Question I \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( max 10 )

Question II. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( max 10)

Question III. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( max 10 )

Question IV \_\_\_\_\_ \_\_\_\_\_\_\_\_ ( max 4)

Question V \_\_\_\_\_ \_\_\_\_\_\_\_\_ ( max 4)

Question VI \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( max 4)

Question VII \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( max 4 )

Part II total \_\_\_\_\_\_\_\_\_\_\_\_ multiply by 1.3 = \_\_\_\_\_\_\_\_\_\_\_ ( max 59.8, round to an interger)

Part I score + Part II. total = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( max 120 )