C - Rickards Chemistry Laboratory - Rickards Invitational Div. C - 12-05-2020

Welcome to Rickards Chemistry Lab!

Below is a quick breakdown of the test you're about to take. This is a challenging exam and there is no penalty for guessing, so try not to get stuck on any one question. Best of luck!

Section Topic	Question Type	Question Count (75 Total)	Points Possible (200 Total)
Acids and Bases	Multiple Choice	15	15
Aqueous Solutions	Multiple Choice	15	15
Acids and Bases	Short Answer	5	25
Aqueous Solutions	Short Answer	5	25
Reactions	Short Answer	5	25
Trivia	Short Answer	10	20
Mystery Acid	Free Response	10	35
Solubility Puzzle	Free Response	8	30
Survey Questions	Multiple Choice	2	10

Acids and Bases - Multiple Choice

1. (1.00 pts) How many acidic protons does H_3PO_2 have?

- A) 0
- B) 1
- C) 2
- D) 3
- E) fOuR
- F) fiVe

2. (1.00 pts) 79.17 mL of 3.909 M HCl is mixed with 82.40 mL of 3.505 M NaOH. What is the pH of the resulting solution?

- A) 13.8722
- B) -0.2822
- C) 6.7950
- D) 6.8722
- E) 0.1278

3. (1.00 pts) In the following acid-base reaction, the acid reactant is _____ and the conjugate base product is _____.

$$B(OH)_3 + 2\,H_2O \rightleftharpoons [B(OH)_4]^- + H_3O^+$$

- A) H_2O; H_2O
- B) H_2O; H_3O^+
- C) H_2O; $[B(OH)_4]^-$
- D) $B(OH)_3$; H_2O
- E) $B(OH)_3$; H_3O^+
- F) $B(OH)_3$; $[B(OH)_4]^-$

4. (1.00 pts) Select all of the following choices that are conjugate acid-base pairs.

(Mark **ALL** correct answers)

- A) H_2SO_4; S^{6+}
- B) $HCOOH$; $COOH^-$
- C) HBF_4; F^-
- D) HF; F^-
- E) H_3O^+; H_2O
- F) H_2CrO_4; $HCrO_4{}^-$

5. (1.00 pts) Which of the following is not true of the autoionization of water?

- A) It is endothermic
- B) Its rate is limited by the speed of molecular diffusion
- C) It causes pure water to be acidic at high temperatures
- D) Its equilibrium constant, K_w, equals $[H_3O^+][OH^-]$
- E) It is thermodynamically unfavorable at room temperature

6. (1.00 pts)
Consider a solution, Solution A, with $pH = 1.00$ and another solution, Solution B, with $pH = 2.50$. Given that both solutions are at room temperature, select all of the following statements that are true.

(Mark **ALL** correct answers)

- A) $\frac{[H^+]_A}{[H^+]_B} = 10^{1.50}$
- B) $\frac{[OH^-]_A}{[OH^-]_B} = 10^{-1.50}$
- C) $[H^+]_A = 10^{-1.00}$
- D) $[H^+]_B = 10^{-2.50}$
- E) $pOH_A < pOH_B$
- F) None of the above are true

7. (1.00 pts) Given that the pK_b for ammonia is 1.8×10^-5, calculate the pH of a 0.57 M solution of ammonium chloride?

- A) 7.00
- B) 11.22
- C) 2.78
- D) 5.04

E) 8.96

F) Cannot be determined from the given information

8. (1.00 pts) Which of the following is not a major species present in a 1×10^{-14} M solution of $KClO_4$?

A) K^+

B) ClO_4

C) Cl^-

D) HO^-

E) H^+

F) All of the above are major species

9. (1.00 pts) Which of the following compounds is not amphoteric?

A) $LiAlH_4$

B) H_2O

C) $HCO_3{}^{2-}$

D) $Al(OH)_3$

E) All of the above are amphoteric

10. (1.00 pts) Given that the pK_a of KHP is 5.4, which of the following indicators would be most appropriate in a titration of KHP with NaOH?

A) Methyl red, $pK_a = 4.95$

B) Phenol red, $pK_a = 7.9$

C) Phenolpthalein, $pK_a = 9.4$

D) Alizarin Yellow, $pK_a = 11.2$

E) Cannot be determined from the given information

11. (1.00 pts) Which of the following salts forms the most basic solution in water?

A) $NaHF_2$

B) $Ca(H_2PO_4)_2$

C) Na_2S

D) $(NH_4)HCO_3$

E) H_2SO_4

12. (1.00 pts) Which of the following is the strongest base?

A) LiOH

B) NaOH

C) KOH

D) RbOH

E) All of these bases are the same strength

13. (1.00 pts) Which of the following is the strongest acid?

A) HCl
B) $HClO$
C) $HClO_2$
D) $HClO_3$
E) $HClO_4$

14. (1.00 pts) Which of the following is the strongest acid?

A) HF
B) HCl
C) HBr
D) HI

15. (1.00 pts) Which of the following is the strongest acid?

A) $HOOC-CH(NH_3^+)-(CH_2)_2-COOH$
B) $HOOC-CH(NH_3^+)-(CH_2)_2-COOH$
C) $^-OOC-CH(NH_3^+)-(CH_2)_2-COO^-$
D) $^-OOC-CH(NH_2)-(CH_2)_2-COO^-$
E) Cannot be determined from the given information

Aqueous Solutions - Multiple Choice

16. (1.00 pts) Which of the following ions is colorless in aqueous solution?

A) $CuCl_4^{2-}$
B) $Cr_2O_7^{2-}$
C) Ti^{3+}
D) Zn^{2+}
E) None of the above

17. (1.00 pts) Select all of the following ions that would form a green aqueous solution.

(Mark **ALL** correct answers)
A) Ni^{2+}
B) Co^{2+}
C) Ag^+
D) Li^+
E) Ti^{3+}

- [x] F) Fe^{2+}

18. (1.00 pts) Select all of the following that would give a yellow flame test.

(Mark **ALL** correct answers)

- [ ] A) Cs
- [ ] B) Li
- [ ] C) K
- [ ] D) Mg
- [ ] E) Ca
- [x] F) Cu

19. (1.00 pts) Lead(II) nitrate solution is added to a saturated solution of sodium sulfate. Which of the following best describes what happens as a result?

- ○ A) The amount of sodium sulfate in solution increases
- ◉ B) The amount of sodium sulfate in solution decreases
- ○ C) The amount of sodium sulfate in solution stays the same
- ○ D) The amount of sodium cation in solution increases
- ○ E) The amount of sodium cation in solution decreases
- ○ F) Cannot be determined from the given information

20. (1.00 pts) Select the choice that best describes the role of Na^+ in the following equation:

$$Na_2S + 2\,HCl \longrightarrow H_2S + 2\,NaCl$$

- ○ A) Catalyst
- ○ B) Intermediate
- ○ C) Conjugate base
- ◉ D) Spectator ion
- ○ E) Oxidizer

21. (1.00 pts) Which of the following metals in aqueous solution is the highest on the activity series?

- ◉ A) Ba
- ○ B) Al
- ○ C) Cu
- ○ D) Pt
- ○ E) Pb

22. (1.00 pts) What mass of lead nitrate should you weigh out when preparing 64.13 mL of 3.535 M solution of lead nitrate?

- ○ A) 150.2 g
- ◉ B) 75.08 g

C) 0.1502 g

D) 0.07508 g

E) Cannot be determined from the given information

23. (1.00 pts) 28.43 mL of a 9.813 M stock solution of NaOH is diluted to 100 mL. What is the concentration of Na^+ in the resulting solution?

A) 9.813 M

B) 0.009813 M

C) 2.790 M

D) 0.002790 M

E) Cannot be determined from the given information

24. (1.00 pts) Select all of the following that would be soluble in diethyl ether solvent.

(Mark **ALL** correct answers)

A) Pentane

B) Sodium sulfate

C) Carbon tetrachloride

D) Methanol

E) Hydrochloric acid

25. (1.00 pts) As temperature increases, the solubility of solid solutes in a liquid solvent _____, while the solubility of gaseous solutes in liquid solvent _____.

A) Usually increases; Always decreases

B) Usually increases; Usually increases

C) Usually increases; Usually decreases

D) Always increases; Always decreases

E) Always increases; Always increases

F) Always increases; Usually increases

26. (1.00 pts) Solution A and Solution B are mixed to form an ideal mixture, Solution C. Select all of the following choices that are true of ideal solutions.

(Mark **ALL** correct answers)

A) The Gibbs free energy of mixing is zero

B) The entropy of mixing is zero

C) The enthalpy of mixing is zero

D) The vapor pressure of Solution C obeys Raoult's and Henry's law

E) The activity coefficients of all components of Solution C equal one

F) The volume of Solution C equals the sum of the volumes of Solutions A and B

27. (1.00 pts) The dissolution of which of the following compounds in water is most endothermic?

A) NH_4NO_3

B) $NaOH$

C) $CaCl_2$

D) $KClO_3$

E) $NaCl$

28. (1.00 pts) Given the following compounds and their corresponding K_{sp} values, identify the least soluble compound.

A) $Al(OH)_3$, $K_{sp} = 1.8 \times 10^{-5}$

B) $BaCO_3$, $K_{sp} = 5.1 \times 10^{-9}$

C) $Cu_3(AsO_4)_2$, $K_{sp} = 7.6 \times 10^{-36}$

D) $Pb(N_3)_2$, $K_{sp} = 2.5 \times 10^{-9}$

E) Cannot be determined from the given information

29. (1.00 pts)
A seawater solution is titrated with silver nitrate in the presence of potassium chromate to determine the chloride concentration in the solution. The endpoint of the titration is indicated by the formatio of a red precipitate. Which of the following is the chemical formula of this precipitate?

A) $AgNO_3$

B) K_2CrO_4

C) KCl

D) Ag_2CrO_4

E) None of the above

30. (1.00 pts) Which of the following is least soluble in aqueous solution at 298 K?

A) LiI

B) Na_2CO_3

C) $NaOH$

D) Cs_2CO_3

E) KNO_3

Acids and Bases - Short Answer

For questions 31-35, provide an explanation for the given observations relating to acids and bases.

31. (5.00 pts) *trans*-Butenedioic acid has $pK_{a1} = 3.03$ and $pK_{a2} = 4.44$, while *cis*-Butenedioic acid has $pK_{a1} = 1.90$ and $pK_{a2} = 6.07$.

Expected Answer: In maleic acid, losing one proton allows for favorable intramolecular hydrogen bonding between the carboxyl and carboxylate. +3 implication that HA- is more stable for maleic than fumaric +2 specifically more stable due to H-bonding IF NONE OF ABOVE +0.5 resonance argument +0.5 mention of polar vs nonpolar

32. (5.00 pts) Hypoiodous acid rapidly disproportionates in aqueous solution at pH 0, but not if the solution contains hydrochloric acid. (Hint: You should address both reactions in your answer.)

Expected Answer: Aqueous: HOI -> HIO3 and I2 HCl solution: HOI reacts with HCl to form [ICl2]-, which doesn't disproportionate (only goes to I2). +1 [1 per product] correctly identify that HOI disproportionates into HIO3 and I2 in aqueous solution +1 Mention that HOI reacts with HCl +1 Identify that this reaction forms [ICl2]- +1 Some mention of thermodynamics or stability or reduction potentials literally anywhere +1 Identify that [ICl2]- goes directly to I2. +1 Identify that [ICl2]- specifically does not go to [IO3]-

33. (5.00 pts) The pK_a of CH_3COOH is 4.75, while the pK_a of CF_3COOH is 0.23.

Expected Answer: Inductive effects from more electronegative fluorine stabilize the conjugate base of TFA more than acetic acid. +3.5 Mention induction/inductive effects +2 Some reasonable explanation along the lines of induction but without naming it +1.5 Make a comparison of the conjugate base stability

34. (5.00 pts) The pK_a of H_2S is 7.00 while the pK_a of H_2O is 14.00.

Expected Answer: +2 S is bigger than O +1 H-S bond is longer/weaker than H-O bond +0.5 Due to more diffuse orbitals +1 Larger means more able to stabilize negative charge +0.5 Due to reduced e- e- repulsions. IF NONE OF ABOVE +0.5 Electronegative argument +0.5 Solvation argument

35. (5.00 pts) In liquid ammonia solvent, acetic acid and nitric acid have the same acidity.

Expected Answer: Any of these (and maybe more) are fine: dropping leveling effect, solvent leveling, differentiating solvent, discrimination window +5 for a reasonably good explanation of any of the above, don't have to name it to get credit +3 for name dropping without explanation

Aqueous Solutions - Short Answer

For questions 36-40, provide an explanation for the given observations relating to aqueous solutions.

36. (5.00 pts)
Lithium fluoride and lithium carbonate are somewhat insoluble at room temperature, despite the fact that lithium is an alkali metal. Additionally, the solubility of lithium fluoride increases with temperature, while the solubility of lithium carbonate decreases with temperature. *(Hint: Consider the signs and relative magnitudes of the thermodynamic quantities that characterize the solvation of each salt.)*

Expected Answer: VARYING SOL W/ TEMP +1 identify that LiF has positive delS, Li2CO3 has negative delS +1 Mention that CO32- has lower solvation entropy than F- (-40 ish to -14 ish) +1 Some reasonable explanation as to why carbonate decreases entropy more (e.g. size, charge, etc.) +1 Mention that Li+ has positive solvation entropy +1 Li+ delS pos bc it's small Note: No credit for this part if they talk about enthalpy here ROOM TEMP INSOL +1 Enthalpy of the solvation reaction for both salts is pretty positive +1 delH is positive because of high lattice enthalpy +1 Lattice enthalpy is high because Li+ is smaller than other alkali metals Note: No credit if they talk about entropy here Also give points for these things, which demonstrate knowledge but are not applicable or valid: +1 Li+ is solvated very strongly +1 Talk about solvation steps (separate solvent, separate salt, put them together +1 Mention thermodynamics but or vaguely/incorrectly

37. (5.00 pts) Beryllium fluoride is highly soluble in water, despite being a covalent solid.

Expected Answer: +2 BeF2 forms something else in water +2 Makes an aquo complex +1 A tetraaquo complex IF NONE OF ABOVE +1 self consistent thermo, wrong but understandable +0.5 bad thermo

38. (5.00 pts) MgO is more soluble in $MgCl_2$ solution than in pure water.

Expected Answer: +5 A complex such as [MgOMg]2+ or its hydrate forms in MgCl2 IF NONE OF ABOVE +1 Self-consistent thermo. Wrong but understandable. +0.5 Bad thermo.

39. (5.00 pts)
Equal amounts of sodium chloride and potassium chloride in separate solutions both raise the boiling point of the solution by the same amount, despite the fact that they are different compounds.

Expected Answer: +4 boiling point elevation is a colligative property +1 NaCl and KCl have the same vant hoff factor

40. (5.00 pts) The solubility of sodium sulfate in aqueous solution increases up to 305 K, then decreases.

Expected Answer: +3 they are two different complexes +1 the first is a hydrate Na2SO4 * xH2O +1 the second is the anhydride Na2SO4 +1 give a bonus point if they know it's a decahydrate. (also place them under scrutiny for cheating because why would anyone remember that)

Reactions - Short Answer

For questions 41-45, provide balanced chemical equations for the given reactions.

States of matter may be omitted with no penalty. If no reaction occurs between the given reagents write “no reaction.” Don't worry too much about formatting--as long as the equation you enter is correct and unambiguous you'll get full points.

41. (5.00 pts) The reaction of acetic acid with ammonia.

Expected Answer: CH3COOH + NH3 <=> CH3COO- + NH4+ +1 for correct reactants +2 for correct products +1 for correctly balanced +1 for equilibrium arrow

42. (5.00 pts) Powdered Ag is added to concentrated HI solution.

Expected Answer: Ag + HI -> 1/2 H2 + AgI OR 2 Ag + 2 HI -> H2 + 2 AgI +1 for correct reactants +2 for correct products +1 for correctly balanced +1 for reaction arrow (gas evolution means this is irreversible)

43. (5.00 pts) The reaction of chlorine gas with concentrated sodium hydroxide.

Expected Answer: 3 Cl2 + 6 OH- -> 5 Cl- + ClO3- + 3 H2O +1 for correct reactants +2 for correct products +1 for correctly balanced +1 for net ionic -3 for 2 OH- + Cl2 -> Cl- + OCl- H2O (cold/dilute rxn)

44. (5.00 pts) The oxidation of copper by dilute nitric acid.

Expected Answer: 3 Cu + 8 HNO3 -> 3 Cu2+ + 2 NO + 4 H2O + 6 NO3- +1 for correct reactants +2 for correct products +2 for correctly balanced

45. (5.00 pts) The addition of concentrated hydrochloric acid to a dilute cobalt(II) chloride solution.

Expected Answer: [Co(H2O)6]2+ + 4 Cl- <=> [CoCl4]2- + 6 H2O +1 for correct reactants +2 for correct products +1 for correctly balanced +1 for eq arrow -1 for not net ionic -1 for n hydrate

Trivia - Short Answer

46. (2.00 pts) What mechanism models proton jumping in water and explains the exceptionally high mobility of protons relate to other cations?

Expected Answer: Grotthuss mechanism

47. (2.00 pts) Which chemist introduced (the now obsolete but kind of useful sometimes maybe) hard-soft acid-base theory?

Expected Answer: Pearson

48. (2.00 pts) What solution, a mixture of sulfuric acid, hydrogen peroxide and water, is a strongly oxidizing solution used to clean organic matter off substrates.

Expected Answer: Pirahna solution

49. (2.00 pts) What set of twenty buffers were selected by its namesake in the 1970s based on their applicability for use in biochemical research?

Expected Answer: Good's buffers

50. (2.00 pts) Red cabbage juice can be used as a pH indicator due to the presence of what class of pigments, which are also found in other foods such as grapes and blueberries?

Expected Answer: Anthocyanins [generously accept flavonoids]

51. (2.00 pts) What is the name for the industrial process used to produce nitric acid?

Expected Answer: Ostwald process

52. (2.00 pts) What acid is the primary component of gastric acid?

Expected Answer: Hydrochloric acid

53. (2.00 pts) Nessler's reagent is used to detect the presence of _____, and consists of tetraiodomercury mixed with a solution of _____.

NH3 | KOH

54. (2.00 pts)
Water has a melting point of around 273 K and ethanol has a melting point of around 159 K. However, a mixture of these two substances with 93% ethanol by weight has a melting point of around 155 K. What is the term for this type of mixture?

Expected Answer: Eutectic

55. (2.00 pts) What base, also known as lye, is used in saponification reactions?

Expected Answer: NaOH

Mystery Acid

Questions 56-65 all refer to the same scenario.

During an AP Chemistry lab, Daniel completely combusts 1.343 g of a certain acid at STP in the presence of oxygen, yielding 0.4650 mL of H_2O and 0.8675 L of CO_2.

56. (3.00 pts) What is the empirical formula of this compound?

Expected Answer: C3H4O4

Daniel's lab partner, Patrick, weighs out a 5.94900 g sample of the same acid. He plans to dissolve this sample in exactly 100 mL of water, then titrate it with NaOH.

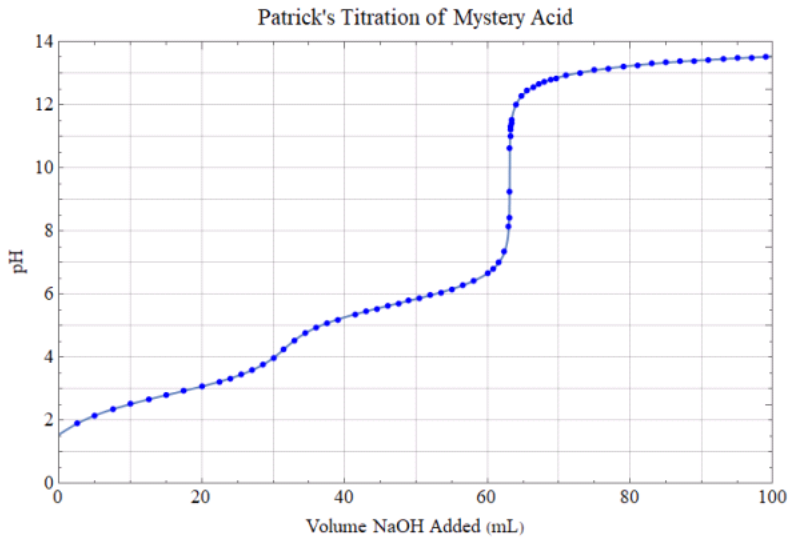
57. (2.00 pts) What piece of laboratory glassware should Patrick use to dissolve and prepare his acid solution?

Expected Answer: 100 mL volumetric flask

58. (3.00 pts)
Patrick finds a bottle of stock NaOH solution labeled 1.75 M. However, instead of using this solution directly, he first standardizes the solution against KHP. Briefly explain the purpose of standardizin and state one reason why KHP was used in this procedure.

Expected Answer: +1.5 Determine exact concentration. +1.5 Any of the following: high purity, low reactivity/stable, low hygroscopicity, high equivalent weight, non-toxic, cheap, easy to get +0.5 for plausible/vague but not directly chemistry-related reasons, e.g. Daniel told him to, that's the only thing he could find, etc.

Following standardization, Patrick determines the concentration of the stock NaOH solution to be 1.81172 M. He then uses it to titrate his acid sample, yielding the following titration curve:



59. (4.00 pts)
Patrick's titration curve seems to fluctuate significantly from ~25-40 mL. Is there an equivalence point in this range? If so, explain why there is no sharp change in pH. If not, propose an explanation fo the observed fluctuations.

Expected Answer: +2 There is an equivalence point +2 It's because the pKa1 and pKa2 are close for this acid

60. (2.00 pts) What is the molar mass of this compound?

Expected Answer: Exact answer: 104.1 g/mol +2 full credit within +/- 0.2 of above -1 for wrong sf

61. (1.00 pts) What is the molecular formula of this compound?

Expected Answer: C3H4O4

62. (2.00 pts) Write the balanced chemical equation for the complete combustion of this compound.

Expected Answer: C3H4O4 + 2 O2 -> 2 H2O + 3 CO2 +0.25 right reactants +0.25 right products +1.5 right coefficients

63. (2.00 pts) Identify the compound that Daniel and Patrick used in the lab by giving its name or structural formula below.

Expected Answer: Malonic acid or (HOOC)-CH2-(COOH) and equivalents [all or nothing]

For questions 47-48, calculate the pH of the titration after the given volume of NaOH has been added.

You should use the exact numbers Patrick used in his titration, as well as the following exact pK_a values in your calculations: $\mathrm{pK}_{a1} = 2.83$, $\mathrm{pK}_{a2} = 5.69$. You will be scored based on how close your answer is to the exact theoretical value. As such, you may disregard significant figures in favor of accuracy with no penalty, if you'd like.

Note: Looking at Patrick's curve should get you a decent estimate, but it will not be particularly accurate as Patrick is not a great chemist. Additionally, in case you were considering doing so, you do not need to consider activity coefficients in your calculations as that is beyond the scope of this event.

64. (8.00 pts) 23.1704 mL

Expected Answer: Exact = 3.41452367 Points = 16/(1 + e

65. (8.00 pts) 63.5371 mL

Expected Answer: Exact = 11.67552325 Points = 16/(1 + e^100diff)

Solubility Puzzle

Questions 66-73 refer to the following scenario.

Daniel and Patrick are back at it again! This time, Daniel prepares numbered vials, each containing stock aqueous solutions of the following compounds: $AgNO_3$, CaI_2, HBr, KOH, K_2CO_3 and NH_4NO_3 (not necessarily in that order). Daniel then presents the vials to Patrick, challenging him to identify the solutions. Help Patrick identify which vial corresponds to which solution!

First, Patrick records the following observations about each solution:

- Solution 1: Colorless, neutral in pH (pH = 5), no odor.
- Solution 2: Colorless, neutral in pH (pH = 5), no odor.
- Solution 3: Colorless, strongly basic in pH (pH = 14), no odor.
- Solution 4: Colorless, strongly acidic in pH (pH = 0), slightly sour odor.
- Solution 5: Colorless, basic in pH (pH = 11), no odor.
- Solution 6: Colorless, neutral in pH (pH = 5), no odor.

66. (3.00 pts) Explain why Patrick described Solutions 1, 2 and 6 as being neutral, despite the fact that the measured pH for each was 5.

Expected Answer: In practice, aqueous solutions are mildly acidic because water reacts with atmospheric CO2 to form carbonic acid. +3 mention carbonic acid or CO2 in any capacity +1 for technically plausible but not chemistry related answers, e.g. the probe is bork, patrick is stupid, etc.

67. (3.00 pts)
Upon closer inspection, the bottle in which Solution 4 is stored contains specks of a white precipitate. Propose a plausible identity for this precipitate and explain how it may have gotten there. (Hint: It may help to identify Solution 4 first.)

Expected Answer: Thrown out, because it was supposed to say Solution 5. Solution 5 is K2CO3, so the precipitate is probably CaCO3 or MgCO3. The solution was likely prepared using hard tap water, rather than pure distilled water. +1.5 Correctly identify the ppt (don't need both, just one is fine) +1.5 Correctly cite hard water as the source +0.5 for technically plausible but non-chemistry explanations (e.g. daniel accidentally dropped something in the solution) +0.5 for vaguely saying "the solution is impure" or whatever

Next, Patrick reacts each solution pairwise with one another, yielding the following results:

	1	2	3	4	5	6
1	-	-	-	-	-	-
2	No reaction	-	-	-	-	-
3	Bubbling; Ammonia odor	Dark brown precipitate	-	-	-	-
4	No reaction	Off-white precipitate	Solution warms	-	-	-
5	Slight ammonia odor	Light yellow precipitate	No reaction	Intense fizzing; gas is odorless	-	-
6	No reaction	Yellow precipitate	Cloudy white precipitate	No reaction	White precipitate	-

68. (4.00 pts) Give the identity of Solution 1.

- A) $AgNO_3$
- B) CaI_2
- C) HBr
- D) KOH
- E) K_2CO_3
- F) NH_4NO_3

69. (4.00 pts) Give the identity of Solution 2.

- A) $AgNO_3$
- B) CaI_2
- C) HBr
- D) KOH
- E) K_2CO_3
- F) NH_4NO_3

70. (4.00 pts) Give the identity of Solution 3.

- A) $AgNO_3$
- B) CaI_2
- C) HBr
- D) KOH
- E) K_2CO_3
- F) NH_4NO_3

71. (4.00 pts) Give the identity of Solution 4.

- A) $AgNO_3$
- B) CaI_2

- (●) C) HBr
- ( ) D) KOH
- ( ) E) K_2CO_3
- ( ) F) NH_4NO_3

72. (4.00 pts) Give the identity of Solution 5.

- ( ) A) $AgNO_3$
- ( ) B) CaI_2
- ( ) C) HBr
- ( ) D) KOH
- (●) E) K_2CO_3
- ( ) F) NH_4NO_3

73. (4.00 pts) Give the identity of Solution 6.

- ( ) A) $AgNO_3$
- (●) B) CaI_2
- ( ) C) HBr
- ( ) D) KOH
- ( ) E) K_2CO_3
- ( ) F) NH_4NO_3

Survey Questions

For questions 74-75, answer these two brief questions about your experience taking this exam. (You'll get points regardless of what you answer, as long as you pick something.)

74. (5.00 pts) How would you and your partner characterize the difficulty of this exam?

- ( ) A) Greatest imaginable level of challenging
- ( ) B) Extremely challenging
- ( ) C) Quite a bit challenging
- ( ) D) Moderately challenging
- ( ) E) Slightly challenging
- (●) F) Not at all challenging

75. (5.00 pts) As a result of our participation in this exam, my partner and I are _____ motivated to study chemistry, compared to before taking this exam.

- ( ) A) Far more
- ( ) B) Somewhat more
- (●) C) Equally as
- ( ) D) Somewhat less
- ( ) E) Far less

END OF EXAM

Great job getting here and good luck with your other events today!