

SI Chemistry - Full Discipline Demo

Digital Qualitative Analysis - Beyond Labz

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

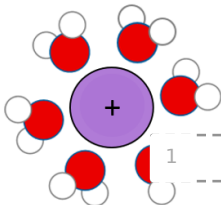
Test Your Knowledge

Label each image with the best descriptive term.

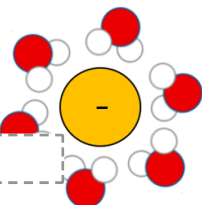
⚡ Anion

⚡ Cation

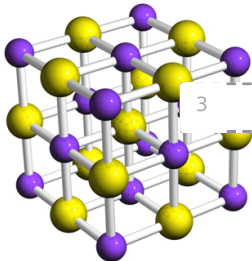
⚡ Ionic compound



1



2



3

Correct answers:

1 Cation 2 Anion 3 Ionic compound

Fill in the blank with the best term to complete the sentence.

⚡ Anion

⚡ Cation

⚡ Emission spectra

⚡ Hydration

⚡ Ion

⚡ Ionic bonds

⚡ Precipitate

Many compounds dissolve into water in a process called

1

A nonmetal that gains an electron will typically form a(n)

2

with a

negative charge.

3

are typically comprised of strong electrostatic attractions in a lattice structure.

When an atom loses electrons, it forms a positively-charged particle called a(n)

4

5

is the term used for any charged particle.

When exposed to radiation, elements emit a(n)

6

due to electrons

going into excited states and radiating light of specific wavelengths.

Particles that become insoluble and fall out of solution are part of the

7

Correct answers:

1 Hydration 2 Anion 3 Ionic bonds 4 Cation 5 Ion

6 Emission spectra 7 Precipitate

Arrange the following species to represent the pattern of a double-replacement reaction:

⚡ A
⚡ B
⚡ C
⚡ D

AB + CD

1
2
+
3
4
→

Correct answers:

1 A 2 D 3 C 4 B

Put the steps for running a centrifugation in the correct order.

≡ Separated samples are removed.

1

Correct answer: Sample is placed in a holder in centrifuge.

≡ Centrifuge lid is closed and locked.

2

Correct answer: Blank vial of the same mass is placed opposite of the sample.

≡ Settings for the centrifuge are specified.

3

Correct answer: Centrifuge lid is closed and locked.

≡ Centrifuge spins at high velocity.

4

Correct answer: Settings for the centrifuge are specified.

≡ Blank vial of the same mass is placed opposite of the sample.

5

Correct answer: Centrifuge spins at high velocity.

≡ Sample is placed in a holder in centrifuge.

6

Correct answer: Separated samples are removed.

Exploration

Most nonmetals form negatively charged ions called ____.

- ☐ hydration
- ☐ ionic bonds
- ☐ cations
- ☒ anions

✓

All elements create a unique emission spectrum when exposed to a flame or radiation.

- ☒ True
- ☐ False

✓

A double replacement reaction occurs when ____.

- ☐ two anions form an ionic bond and create new compounds
- ☐ the reactants, a salt and a solid, share ions
- ☒ the anions and cations of ionic compounds switch places
- ☐ hydration replaces two cations

✓

In an ionic reaction, spectator ions are not involved in the production of a precipitate.

- ☒ True
- ☐ False

✓

It is important to balance a centrifuge by placing an equal-mass blank opposite the sample because ____.

- ☒ an unbalanced centrifuge may break ✓
- ☐ the blank also needs to be centrifuged
- ☐ without a blank the heavier particles cannot settle
- ☐ All of the above

Exercise 1

Explain what occurs when certain metallic cations are exposed to a hot flame.

Student answers will vary.

Ex: The flame will change color. The metallic cations go into an excited state and their electrons radiate a specific emission spectrum, which our eyes see as colored light.

What is the identity of a cation solution that burns in a flame test with a mix of red and yellow, but viewed through a cobalt filter the flame is red?

Strontium

The frequency of light increases from violet to blue, green, yellow, orange, and red. Arrange the following cations from shortest to longest wavelength of light emitted in a flame test: copper, calcium, potassium, sodium.

0 / 10000 Word Limit

Date Table 1: Cation Flame Tests
(SAMPLE ANSWER BELOW)

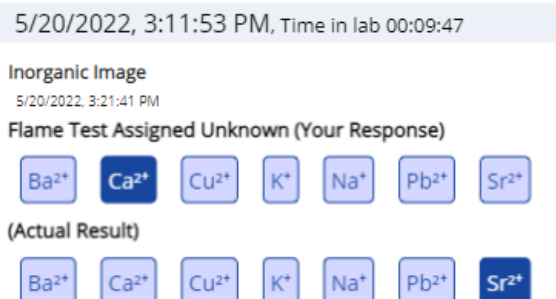
Cation	Flame test	Cobalt filter flame test
None (H ₂ O)	blue/unchanged	blue/unchanged
Potassium	pink/red	pink/red
Sodium	yellow	blue/unchanged
Lead	white/gray	blue/unchanged
Copper	green/turquoise	blue/unchanged
Barium	light green	some red/mostly unchanged/blue
Strontium	red&yellow/orange	red
Calcium	red&yellow/orange	blue/unchanged

Data Table 2: Practice with Unknowns
(SAMPLE ANSWER BELOW)

Practice unknown	Flame test	Cobalt filter flame test	Cation identity
1	Student answers will vary; grade on completion		
2			
3			
4			
5			
6			

Image 1: Unknown Flame Test Results
(SAMPLE ANSWER BELOW)

Student answers will vary. If correct, the highlighted cation that the student selected on the upper line of cations will match the cation highlighted on the lower line as the correct answer. Note that the date/time stamp should be included in the image to verify that your student is not cheating. The below image is an example of an INCORRECT student answer:



The below image is an example of a COREECT student answer:

9/14/2022, 11:04:47 AM, Time in lab 00:05:41

Inorganic Image

9/14/2022, 11:10:28 AM

Flame Test Assigned Unknown (Your Response)



(Actual Result)



Exercise 2

How were the identities of the cations in the Unknown test tube confirmed? Explain your process using terms from the associated Flowcharts.

Student answers will vary but should walk through each flowchart and explain how they separated and confirmed each cation. At least 5 cations should be identified.

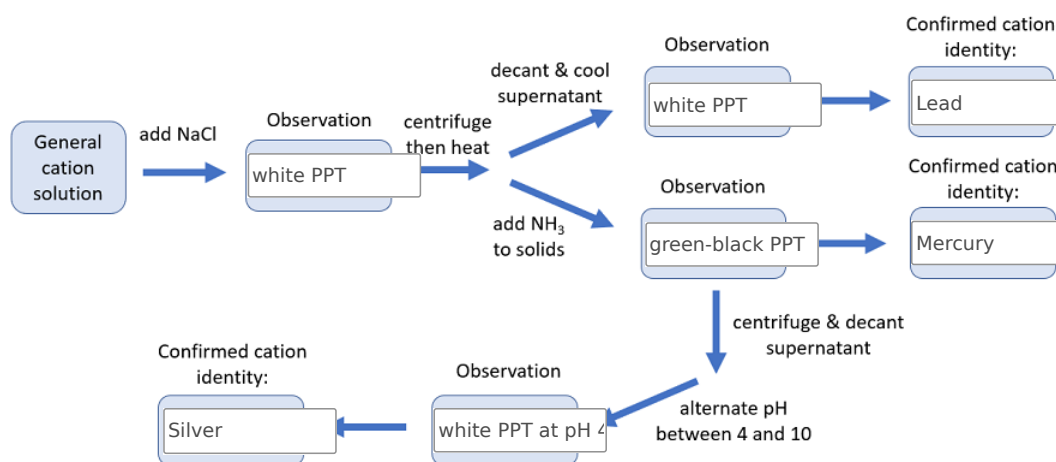
If a solution was suspected to contain both mercury and iron, how could their presence be confirmed? Use terms and procedures from the associated Flowcharts.

The solution should be precipitated with NaCl, which would produce a white precipitate. The supernatant should be removed. The solid can then be precipitated again with NH₃, which would produce a black precipitate. This confirms the presence of mercury. The supernatant from the NaCl step above should then be precipitated with NaOH, and to the solid NH₃ would be added. If the addition of HNO₃ and Na₂CO₃ produce a red-brown or black precipitate, the presence of iron is confirmed.

Data Table 3: Observing the Chlorides
(SAMPLE ANSWER BELOW)

Cation	NaCl added	Heated	NH ₃ added	Acidified
Silver	white PPT	NR	PPT dissolved	low pH=PPT
Lead	white PPT	PPT dissolves	NR	NR
Mercury	white PPT	NR	black PPT	NR

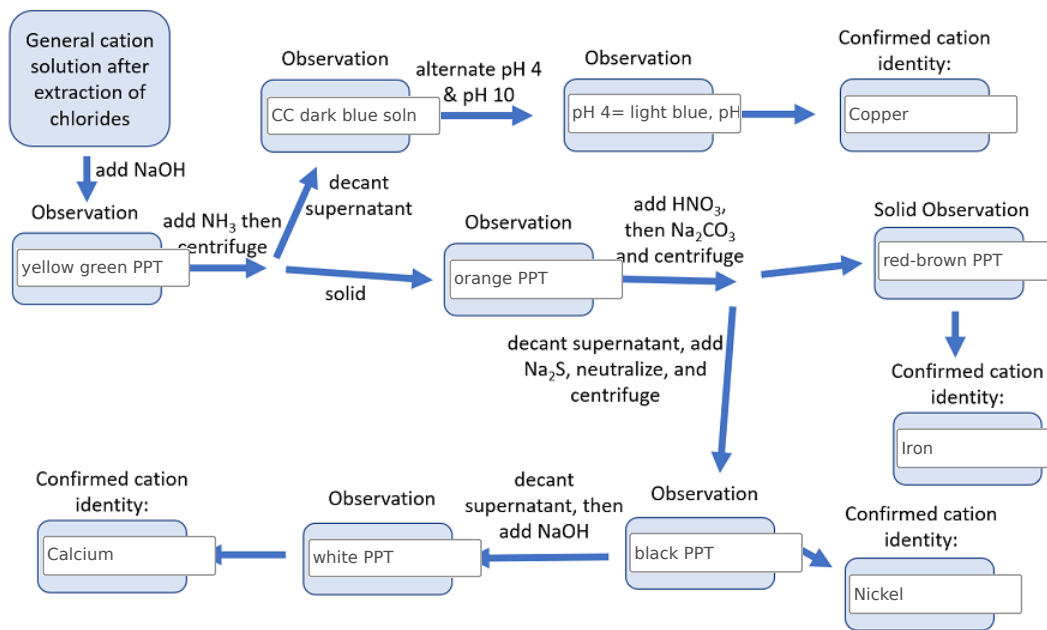
Flow Chart 1: The Chlorides
(SAMPLE ANSWER BELOW)



Data Table 4: Observing the Hydroxides
(SAMPLE ANSWER BELOW)

Cation	NaOH added	NH ₃ added	HNO ₃ /Na ₂ CO ₃ added	Na ₂ S and pH 7	NaOH added
Copper	blue PPT	CC dark blue soln	CC light then dark blue	black PPT	NR
Iron	red-brown PPT	NR	NR	black PPT	NR
Nickel	light turquoise PPT	NR	light green soln	black PPT	NR
Calcium	white PPT	NR	PPT dissolves	white PPT, then redissolves	white PPT

Flow Chart 2: The Hydroxides
(SAMPLE ANSWER BELOW)



Data Table 5: Observing the Carbonates
(SAMPLE ANSWER BELOW)

Cation	Na ₂ CO ₃ added	pH 7	Na ₂ SO ₄ added
Strontium	white PPT	NR	NR
Barium	white PPT	PPT dissolves	white PPT

Flow Chart 3: The Carbonates
(SAMPLE ANSWER BELOW)

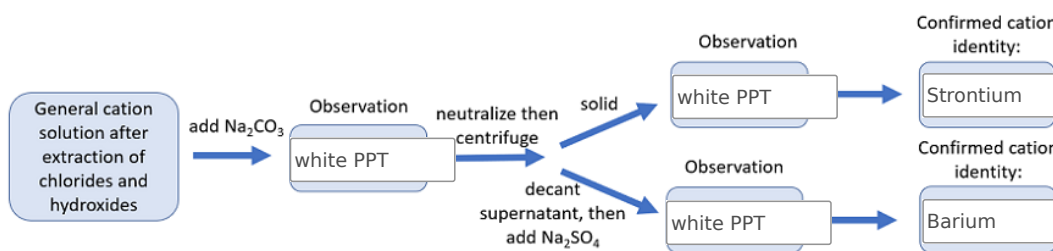


Image 2: Unknown Precipitation Tests Result
(SAMPLE ANSWER BELOW)

Student answers will vary. If correct, the highlighted cation that the student selected on the upper line of cations will match the cation highlighted on the lower line as the correct answer. The below image is an example of an INCORRECT student answer:

5/20/2022, 4:33:08 PM, Time in lab 00:06:17

Inorganic Image

5/20/2022, 4:39:26 PM

Precipitation Test Assigned Unknown (Your Response)



(Actual Result)



The below image is an example of a CORRECT student answer:

9/14/2022, 11:27:36 AM, Time in lab 00:00:26

Inorganic Image

9/14/2022, 11:28:02 AM

Precipitation Test Assigned Unknown (Your Response)



(Actual Result)



Competency Review

When an element ____ one or more electrons, it becomes a negatively charged particle called a(n) ____.

- ☐ gains; anion
- ☐ gains; cation
- ☐ loses; anion
- ☐ loses; cation



A double-replacement reaction can generate products, including precipitates.

- ☐ True
- ☐ False

✓

In an ionic compound, the ____ is listed first, followed by the ____.

- ☐ salt; water
- ☐ water; salt
- ☐ cation; anion
- ☐ anion; cation

✓

In the compound NaCl, chlorine is the ____.

- ☐ anion
- ☐ cation
- ☐ spectator ion
- ☐ precipitate

✓

The purpose of a centrifuge is to ____.

- ☐ perform flame tests
- ☐ perform a series of reactions with known substances and compare these to reactions with the unknown
- ☐ separate higher-mass particles from a solution
- ☐ All of the above

✓

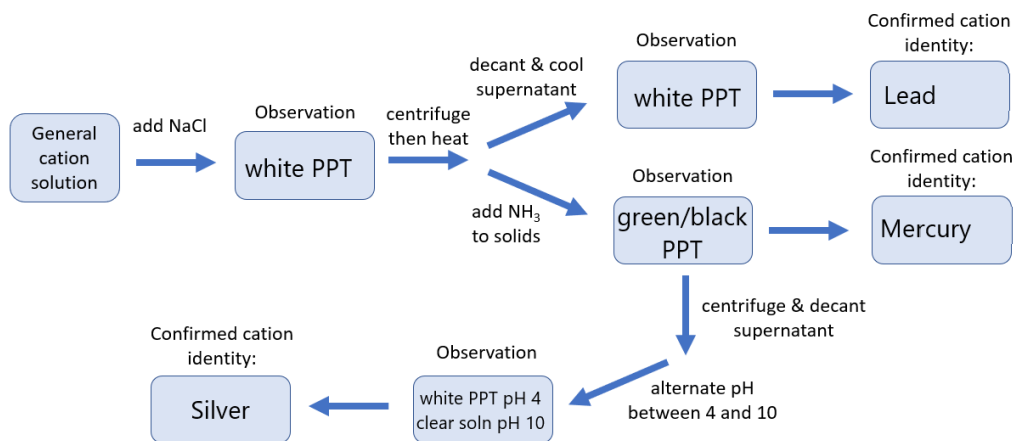
Practically, the cobalt-filter flame test is useful because it _____.

- ☐ identifies an ion by the color of its flame alone
- ☒ supplements unfiltered flame tests to differentiate between ions with similar flame test colors ✓
- ☐ can be used to identify multiple ions by color with the naked eye in the same test
- ☐ generates an emission spectrum that is the same as the unfiltered emission spectrum

To a solution containing multiple unknown ions, NaCl is added. The precipitate contains _____.

- ☒ the chlorides ✓
- ☐ the hydroxides
- ☐ the carbonates
- ☐ All of the above

A solution contains one type of unknown cation. The cation precipitates as a white solid with the chlorides, goes back into solution when heated, burns with a gray-white flame in a flame test, and burns with a blue or unchanged flame in a cobalt-filtered flame test. The unknown cation is _____.



- ☐ sodium
- ☐ mercury
- ☐ potassium
- ☒ lead ✓

Extension Questions

Assuming that there were no chlorides in solution, a researcher began the hydroxide separation by adding NaOH, but then received an indication that a chloride may have been present. Can anything be done to check if there are chlorides without starting over? (SAMPLE ANSWER BELOW)

Yes. Adding HNO_3 (or another strong acid) will drop the pH without adding more insoluble ions, which will cause any chlorides and hydroxides present to go back into solution. NaCl can then be added to precipitate out all chlorides, and the flowcharts to separate can be continued.