

ACDB 4011: COLOUR CHEMISTRY

Risk Assessment

Before starting the experiment, you need to carry out a safety check. Please note down additional health and safety information from the presentation here:

OK

No eating or drinking or chewing. Tie long hair back. Cover impressive beards. Fully covering clothing and shoes. Keep transferable items away from experiment. Bunsen burner on orange flame when not in use. Bags at the back of the room. Wear PPE. If there's a spillage tell Mark/Ewa. Label beakers

POTENTIAL HAZARD:

Chemical	Hazards
Hydrochloric acid solution (1 M HCl)	 Causes severe skin burns and eye damage.  Harmful if swallowed.
Barium chloride (BaCl_2)	 Acute toxicity (oral, dermal, inhalation), category 3.  Irritant.
Calcium chloride (CaCl_2)	 Causes serious eye irritation.
Lithium chloride (LiCl)	 Causes serious eye irritation. Harmful if swallowed. Causes skin irritation.
Strontium chloride (SrCl_2)	 Serious eye damage.
Strontium nitrate ($\text{Sr}(\text{NO}_3)_2$)	 May intensify fire; oxidiser  Harmful if swallowed. Causes serious eye irritation. Can cause respiratory irritation
Potassium chloride (KCl)	 Causes serious eye irritation.
Potassium nitrate (KNO_3)	 May intensify fire; oxidiser

Lab Quiz

- The hazard(s) associated with the chemicals used in this experiment are:

Corrosive = for this experiment but ^{many} others
 Irritant } hazards exist
 Toxic }
 Harmful } to eyes, skin, respiratory system
 Oxidiser

OK

- Where would I find the hazard information for a chemical? (2 answers)

MSDS - chemicals use, its make up, disposal, cleanup, reactions
 COSHH - basic guidelines on storage, use, for example disposal + hazards

OK

- If there is a fire, what are my (your) responsibilities?

Stop working. Turn off bunsen burner if using
 Leave experiment safe, if practical to do so.
 Follow instructions and leave the lab + building calmly. Meet at the fire assembly point

OK

- Why must glassware be labelled (2 reasons):

To avoid unintended reactions and contamination
 So the contents are known to all users.

OK

- Name 5 mandatory requirements for clothing and hair in the lab:

Sensible clothing + shoes - no bare skin, no open shoes
 Hair tied back

Gloves, Lab coat + goggles minimum ppe
 Long beards covered
 Additional PPE as required

OK

- What is the procedure for disposal of reacted acidic reagents?

Waste acid goes in waste acid jar, chemicals will be collected by a waste company one week after experiment has ended.
 - reacted acidic reagents should still be treated as a waste acid + disposed of according to regulations

OK

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STUDENT NUMBER & NAME: Natale Coplin 2113351

PROCEDURE

Put on the lab coat, safety goggles, and gloves. Make sure that long hair is tied.

In this experiment you will:

1. Identify metal ions in **X** unknown salt samples by observing the colour each of them gives to the flame.
2. Evaluate the effect of chloride ions on the intensity and duration of the colour.

IMPORTANT: Record all your observations, calculations, and conclusions in the data sheets at the end of this script.

Lab tools and supplies:

- Bunsen burner
- Heat-resistant mat
- Metal rod
- Unknown metal salts labeled A-Y
- Beaker with 1 M HCL
- Beaker to be filled with tap water

Procedure:

1. Set up a Bunsen burner on the surface of the heat-resistant mat.
2. Fill up a large beaker with tap water.
3. Light the Bunsen burner and open the air vent to obtain a non-luminous flame with two blue cones. Make sure that when the Bunsen burner is not in use the safety yellow flame is on.
4. To clean the wire, dip it into the beaker of 1M HCl and heat the wire in the hottest part of the flame. This step is usually repeated several times until no colour is shown. If the colour of the flame does change there is an impurity on the wire. Dip it again in the acid and return it to the flame.

5. When the wire is clean, dip it in the beaker with water and heat to remove any residue of HCl from the cleaning step.
6. Dip the wire in water and then use it to pick up a few grains of a metal salt **A**. Record your observation of the colour and approximate duration, intensity, etc. of the coloured flame in the table below.
7. Clean the wire in the 1 M HCl till no coloured flame is produced.
8. Repeat step 6 but this time using 1 M HCl instead of water to pick up a few grains of salt **A**. Try to use the same quantities of the solid sample as previously used in step 6. Record your observations as before.
9. Repeat steps 4-8 for all other unknown samples.

DATA SHEETS TO RECORD OBSERVATIONS AND RESULTS

Observations:

8p

unknown metal salt	flame colour		intensity		duration	
	H ₂ O	HCl	H ₂ O	HCl	H ₂ O	HCl
A	orange	orange	high	high	med	med
B	orange/ red *	lavender	high	low	med	med
C	yellow	orange/ red	high	high	long	long
D	red/ orange	red	high	high	long	short
E	Green/ Blue	Green/ blue	high	high	long	short
* the wire was not properly cleaned if for the same sample you observed different colours						

Analysis and Conclusions:

30p

Complete the table below. Based on the observed colour of the flame and Table 1, identify the metal ion in each unknown salt. Using the electromagnetic spectrum in Fig 2, estimate and report with the appropriate unit the wavelength for each observed colour:

Unknown metal salt	Identity of metal	Wavelength
A	Calcium	approx 630nm
B	Potassium	approx 410nm
C	Sodium	approx 580nm
D	Strontium	approx 700nm
E	Copper	approx 500nm

FINAL QUESTIONS

5p

1. Describe and explain the effect of the chloride ion, Cl^- , on the duration and intensity of the colour.

According to my results, little difference was noted. This may be due to user interpretation, which is a limiting factor of flame tests. The duration + intensity should have been increased with the use of HCl . This is due to HCl converting compounds/elements into their metal chlorides. Metal chlorides are more volatile than other salts.

$$c = 3.0 \times 10^8 \text{ m/s}$$

$$h = 6.63 \times 10^{-34} \text{ Js}$$

$$\Delta E = h \times \nu$$

$$c = \nu \times \lambda$$

2. Select three of the observed colours and calculate the energies of their photons.

30p

Colour 1: A - 630nm	Colour 2: B - 410 nm	Colour 3: C - 580nm
$\frac{3.0 \times 10^8}{630 \times 10^{-9}} = 4.76 \times 10^{14} \text{ Hz}$ $6.63 \times 10^{-34} \times 4.76 \times 10^{14}$ $= 3.159 \times 10^{-19} \text{ J}$	$\frac{3.0 \times 10^8}{410 \times 10^{-9}} = 7.317 \times 10^{14} \text{ Hz}$ $6.63 \times 10^{-34} \times 7.317 \times 10^{14}$ $= 4.851 \times 10^{-19} \text{ J}$	$\frac{3.0 \times 10^8}{580} = 5.172 \times 10^{14} \text{ Hz}$ $6.63 \times 10^{-34} \times 5.172 \times 10^{14}$ $= 3.429 \times 10^{-19} \text{ J}$

3. Do you think the flame test can be used to determine the identity of unknowns in a mixture? Why or why not?

10p

No, this would effectively be contamination leading to a mix of colours being observed. The observed intensity will not be ~~representative~~ representative of a single salt and could not be used as part of an identification process. Sample B in the results may highlight this. Without further tests it is unclear if the different colours

4. Colorful light emissions apply to everyday life. Where else, besides fireworks, have you observed colorful light emissions? Are these light emission applications related? ^{is accurate.}

Explain.

10p

High and low pressure sodium street lights
Glow sticks, countermeasure flares, tracers,
carbide lamps. Yes it is relatable. All are
using a specific wavelength and specific
metal salts to produce the desired effect
eg a tracer's specific colour and intensity and
getting to its target before running out

END