

ACDB 4011: COLOUR CHEMISTRY

Risk Assessment

95p

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

- ~~Do not~~ eat or drink - If not using, ~~burn~~ burner burners should be orange - Do not leave mobile phones, stationary books etc on desks during experiments - Bags, coats, hats to be placed out of the way at the back of the room - Alert Mark or Eva to any spills immediately

OK

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:
 - severe burns and eye damage - Harmful if swallowed
 - Acute toxicity - Irritant - Oxidising
 - Respiratory irritant - Toxic to aquatic life
- Where would I find the hazard information for a chemical? (2 answers)
 - Hazard data sheets / material safety data sheets
 - COSHH assessments
- If there is a fire, what are my (your) responsibilities?
 - Leave immediately via the nearest fire exit and wait at the fire assembly point (outside ID building near park). If I was to spot a fire, sound the fire alarm if not already sounded, then leave.
- Why must glassware be labelled (2 reasons):
 - to ensure contents are known e.g. HCl and water are both colourless liquids, but have very different hazards associated.
 - Ensure correct disposal route e.g. ensure Acidic reagent doesn't go down
- Name 5 mandatory requirements for clothing and hair in the lab: *Neutrine disposal route.*
 - lab coat
 - gloves
 - safety glasses
 - long hair tied up
 - No bare skin e.g. shorts or open-toed shoes
- What is the procedure for disposal of reacted acidic reagents?
 - Place in waste acid jar. Waste chemicals will be disposed of by specialist waste company 2 weeks after experiment has ended.

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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:

unknown metal salt	flame colour		intensity		duration	
	H ₂ O	HCl	H ₂ O	HCl	H ₂ O	HCl
A	Red orange	Red orange	Intense	more Intense	short	longer
B	lilac	lilac	weak	more Intense	long	shorter
C	orange	orange	medium	more Intense	very long	very long
D	Red	Red	Intense	more Intense	medium	medium
E	Blue green	Blue green	Intense	more Intense	long	slightly shorter.

10p

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Analysis and Conclusions:

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	Strontium	700 nm
B	Potassium	400 nm
C	calcium	600 nm
D	Strontium	700 nm
E	copper	470 nm

correct identification based on the observed colours, 30p

FINAL QUESTIONS

5p

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

The results show that the presence of the Cl^- increases the intensity of the colour. However, my ~~own~~ results show a varied effect on the duration of the colour and therefore cannot conclusively say whether the Cl^- increases or decreases the duration of the colour. Cl^- does not emit energy ^{in the visible spectrum} when electrons fall to lower energy levels, thus doesn't interfere with the light emitted by electrons in the metal ion, so appears more intense.

~~variable~~
~~Red is more reactive than the other metals and dissociate~~
~~more readily, releasing the electrons~~

30p

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

Colour 1: Cilac	Colour 2: Blue / Green	Colour 3: Red
$V = \frac{C}{\lambda} = \frac{3.0 \times 10^8}{400 \times 10^{-9}}$ $V = 7.5 \times 10^{14}$ $E = 6.63 \times 10^{-34} \times 7.5 \times 10^{14}$ $E = 4.97 \times 10^{-19} \text{ J}$	$E = 6.63 \times 10^{-34} \left(\frac{3.0 \times 10^8}{470 \times 10^{-9}} \right)$ $E = 4.23 \times 10^{-19} \text{ J}$	$E = 6.63 \times 10^{-34} \left(\frac{3.0 \times 10^8}{700 \times 10^{-9}} \right)$ $E = 2.84 \times 10^{-19} \text{ J}$

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

10p

Whilst it can give a rough indication of the metal present, I don't think it's useful in identifying the whole compound. Whilst the intensity was found to be increased, this method is very subjective and the results could vary depending on who's observing. Additionally, as it's a destructive test, small sample quantities would be used quickly, making it difficult to repeat multiple times.

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

10p

Explain.

In munitions manufacture, light emissions are used for tracer compositions for projectiles to enable troops to see the trajectory of a projectile during reduced visibility conditions. The most commonly used are red and green tracers, consisting of strontium and barium compounds respectively. These applications are related in that light emissions are caused when excited valence electrons drop back down energy levels, causing emissions of a specified wavelength of visible light.