Constructing a galvanic cell

Written by: Dianne Turner **Commenced on:** 22 Apr 2024 **Expires:** 22 Jul 2025

Classes for which experiment is required

Teacher: Ian D Sonter **Year Group:** 12 Chemistry

Items to be prepared by laboratory technician

1M Copper sulphate
1M Ferric chloride
1M Zinc nitrate
1M Aluminum nitrate
1M Potassium nitrate
100ml beaker
Copper strip
Iron nail
Zinc strip
Aluminum strip
Filter paper
alligator clip with lead
tweezers plastic
Voltmeter
Wash bottle RO Water
lab coat
safety glasses
disposable gloves

Procedure or reference, including variations

Oxford Chemistry units 3 and 4
MP 7.1

Equipment to be used

alligator clip with lead

Potential hazards
Clip may cause pain and injury if applied to skin.

glass beaker, 200 mL or less

Potential hazards
Breakage of beaker. Cuts from chipped rims.

Standard handling procedures
Inspect and discard any chipped or cracked beakers, no matter how small the damage. Sweep up broken glass with brush and dustpan; do not use fingers.

metal tweezers

Potential hazards
Can be used as a weapon if long and sharply pointed.

disposable plastic gloves

Potential hazards
ALLERGY ALERT. May easily be punctured, allowing entry of liquid. Latex gloves may cause an allergic reaction to some people; check for latex allergies before use. Check for talc allergies, if gloves are powdered with talc. Organic solvents may damage gloves.

Standard handling procedures
Take care not to puncture. Check for punctures before use. Use a type of glove that is suitable for the chemicals to be used.

lab coat

Potential hazards
Flammable. Sleeves may catch on objects and knock them over.

Standard handling procedures
Clean regularly. Keep clear of naked flames.

safety glasses

Potential hazards
May transfer pathogens from one user to the next, e.g. eye infections, flu or coronavirus, which may enter the

Standard handling procedures
Each student should preferably have own safety glasses. If safety glasses are shared, they should be disinfected

body through the conjunctiva. Scratched or dirty glasses may hinder vision, causing headaches during prolonged use.

between use. Safety goggles may be stored in a tank of detergent solution and removed as needed, rinsed and dried before use. Avoid scratching lenses during storage. Check and, if necessary, clean glasses before each use. Ensure that the safety glasses fit the shape of the face and provide protection around the edges, especially at the bottom (against upward splashes of liquid).

spatula

Potential hazards
Properties depend on spatula material. A nickel spatula may cause an allergic skin reaction, especially if used repeatedly.

Standard handling procedures
People with nickel allergy should wear gloves if using a nickel spatula.

DC voltmeter

Potential hazards
Breakage of glass.

Standard handling procedures
Sweep up broken glass with brush and dustpan; do not use fingers.

wash bottle

Potential hazards
May be used to spray others.

Standard handling procedures
Preferably use distilled water. Change water regularly to avoid microbial growth.

filter paper

Potential hazards
Flammable. Used filter paper may contain harmful residues.

Standard handling procedures
After use, dispose of residue and filter paper appropriately.

Chemicals to be used

aluminium, pieces **Al**

Class: 9 PG: III Users: K-12 Training: 1-6 UN: 3077 CAS: 7429-90-5

GHS data: Not classified as a hazardous chemical.

Potential hazards
Not toxic. Sharp points and edges may cause injury to skin and eyes.

Disposal
May be placed in the garbage.

copper, sheet **Cu**

Class: nc PG: none Users: K-12 Training: 1-6 CAS: 7440-50-8

GHS data: Not classified as a hazardous chemical.

Potential hazards
Not toxic.

Disposal
<1 kg/day may be placed in the garbage. Larger quantities should be retained for collection by a waste service or metal recycler.

copper(II) sulfate >0.94 M (>15% wt/wt) **$CuSO_{4(aq)}$**

Class: nc PG: none Users: K-12 Training: 1-6 CAS: 7758-99-8

GHS data:

WARNING

Harmful if swallowed
Causes serious eye irritation
Causes skin irritation
Very toxic to aquatic life with long lasting effects

Potential hazards
Toxic. Irritates skin and eyes. Not recommended for use by K-2 students; teacher demonstration only. Careful teacher supervision required with students in Years 3-6.

Standard handling procedures
Solubility ~200 g/L at 20°C.

Disposal
<5 mL/day may be poured down the drain. Larger quantities should be placed in a Copper waste container.

iron, nails **Fe**

CAS: 7439-89-6

Class: nc PG: none Users: K-12 Training: 1-6

GHS data: Not classified as a hazardous chemical.

Potential hazards
Not toxic. Usually mild steel. Sharp edges and points may cause injury.

Standard handling procedures
Store in a dry location to prevent rusting of iron surfaces.

Disposal
May be placed in the garbage.

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iron(III) chloride >0.93 M (>15% wt/wt) (ferric chloride) **$FeCl_{3(aq)}$**

UN: 2582 CAS: 10025-77-1

Class: 8 PG: III Users: 7-12 Training: 1,2,5

GHS data:

DANGER

May be corrosive to metals
Harmful if swallowed
Causes skin irritation
Causes serious eye damage

Potential hazards
CORROSIVE TO SKIN, EYES AND LUNGS.

Standard handling procedures
Solubility ~550 g/L at 20°C. Undergoes hydrolysis at low concentrations with precipitation of iron(III) hydroxide.

Disposal
<200 mL/day may be poured into 10 times the volume of water and poured down the drain in a stream of water.

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zinc, pieces **Zn**

CAS: 7440-66-6

Class: nc PG: none Users: K-12 Training: 1-6

GHS data:

WARNING

Very toxic to aquatic life with long lasting effects

Potential hazards
Not toxic to humans.

Disposal
May be placed in the garbage.

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zinc nitrate 0.79-1 M (15-20% wt/wt) **$Zn(NO_3)_{2(aq)}$**

CAS: 10196-18-6

Class: nc PG: none Users: 7-12 Training: 1-5

GHS data:

DANGER

Harmful if swallowed
Causes skin irritation
Causes serious eye irritation
Very toxic to aquatic life with long lasting effects

Potential hazards
Toxic. Irritates skin, eyes and lungs.

Disposal
<5 mL/day may be diluted with 10 times the volume of water and poured down the drain. Larger quantities should be placed in a Zinc waste container.

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potassium nitrate 0.1-1 M (1-10% wt/wt) **$KNO_{3(aq)}$**

CAS: 7757-79-1

Class: nc PG: none Users: 7-12 Training: 1-5

GHS data:

WARNING Causes mild skin irritation

Potential hazards
May irritate eyes and skin.

Disposal
<1 L/day may be poured down the drain in a stream of water.

aluminium nitrate >0.5 M (>10% wt/wt) **$Al(NO_3)_{3(aq)}$**

CAS: 13473-90-0

Class: nc PG: none Users: 7-12 Training: 1-5

GHS data:

WARNING

Causes skin irritation
Causes serious eye irritation

Potential hazards
Irritates skin and eyes, due to acidity as a result of reaction with water.

Disposal
<100 mL/day may be added slowly with stirring to 20 times the mass of water, then poured down the drain in a stream of water.

Knowledge

I have read and understood the potential hazards and standard handling procedures of all the equipment, chemicals and biological items, including living organisms.
I have read and understood the Safety Data Sheets for all hazardous chemicals used in the experiment.
I have copies of the Safety Data Sheets of all the hazardous chemicals available in or near the laboratory.

Risk assessment

I have considered the risks of:

fire or explosion	injuries from equipment	biohazards	waste disposal
chemicals in eyes	rotating equipment	injuries from animals	improper labelling/storage
inhalation of gas/dust	electrical shock	environmental impact	inappropriate behaviour
chemicals on skin	vibration or noise	intense light/lasers	communication issues
ingestion of chemicals	sharp objects	UV, IR, nuclear radiation	allergies
runaway reaction	falling or flying objects	pressure inside equipment	special needs
heat or cold	contamination of area	heavy lifting	ethical issues
breakage of equipment	exposure to pathogens	slipping, tripping, falling	other risks

For **outdoor activities**, consider wind, temperature, rain/hail/snow, UV, air quality, fire danger, pollen, bites/stings etc

Certification by Teacher

I have assessed the risks associated with performing this experiment in the classroom on the basis of likelihood and consequences using the School's risk matrix, according to International Organization for Standardization Standard ISO 31000:2018.

I consider the inherent level of risk (risk level without control measures) to be:

☐ Low risk ☐ Medium risk ☐ High risk ☐ Extreme risk

Where the risk level is "medium risk", "high risk" or "extreme risk", the following control measures will be employed:

Control measures (attach further pages as required):

☐ safety glasses ☐ gloves ☐ lab coat ☐ apron ☐ fume cupboard ☐ demonstration

With the specified control measures in place, I have found that all the risks are "low risk". Risks will therefore be managed by routine procedures in the classroom, in combination with the specified control measures.

Name: ..... **Signature:** ..... **Date:** .....

Certification by Laboratory Technician

I have assessed the risks associated with preparing the equipment, chemicals and and biological items, including living organisms, for this experiment and subsequently cleaning up after the experiment and disposing of wastes, on the basis of likelihood and consequences using the School's risk matrix, according to International Organization for Standardization Standard ISO 31000:2018.

I consider the inherent level of risk (risk level without control measures) to be:

Low risk Medium risk High risk Extreme risk

Risks will therefore be managed by routine procedures in the laboratory.

Electronic Signature: Dianne Turner **Date:** 22 Apr 2024

You have provided an electronic signature which is the equivalent of signing your name with a pen and as such will constitute a legally binding agreement between the relevant parties. We can give no warranty in respect to fraud or security breach resulting from the use of an electronic signature.

Approval by Authorized Person

(An authorized person, e.g. Head of Department, Laboratory Manager or Principal, is required to approve the experiment when the inherent level of risk in the classroom is "high" or "extreme")

I note that the inherent level of risk for this experiment is "high" or "extreme". As an authorized person, I approve this experiment, on the condition that the above control measures are put in place in the classroom.

Name: ..... **Signature:** ..... **Date:** .....

Monitoring and review

This risk assessment will be monitored using electronic review notes or hand-written notes on a printout. It will be reviewed within 15 months as part of the regular review process.