Use of iron III nitrate and zinc nitrate

Posted by Anonymous on Thu, 2015-09-24 10:14

Use of iron III nitrate and zinc nitrate: Is it still okay to use iron III nitrate and zinc nitrate, as they are not listed on the Recommended List of Chemicals for Schools. We currently make up 0.5 M solutions of each to use in Year 11 & 12 Chemistry to look at half cells and the electrochemical series. Should we continue to use them and/or are there recommended alternatives?

Voting:

No votes yet

Year Level:
Senior Secondary
Laboratory Technicians:
Laboratory Technicians

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Use of Iron III Nitrate and Zinc Nitrate

Submitted by sat on 14 January 2016

Answer reviewed 26 February 2023

Half-cell reactions

Both these chemicals are on the List of recommended chemicals for science in Australian schools 2021 therefore you can continue to use these chemicals. We suggest using iron (II) sulfate, rather than iron (III) nitrate, in an Fe/Fe^{2+} half-cell (or using a mixture of iron (II) sulfate and iron (III) sulfate, if you are preparing an Fe^{2+}/Fe^{3+} half-cell).

Concentrations of 0.5 M achieve a better voltmeter reading than 0.1 M solutions. Aqueous solutions of nitrates are usually used in half-cells as the nitrate ions will not interfere with the electrochemical reaction by being oxidised or reduced and will not form any precipitates.

A half-cell consists of an electrode partially immersed in an aqueous solution. A potential difference is developed between the positively charged solution and the negatively charged electrode when connected to a standard hydrogen electrode. A number of different half-cells can be used.

Typical half-cells

- Copper metal in an aqueous solution of copper (II) nitrate
- Zinc metal in an aqueous solution of zinc (II) nitrate
- Magnesium metal in an aqueous solution of magnesium nitrate
- Aluminium metal in an aqueous solution of aluminium nitrate

Note: Aqueous solutions of the metal sulfates can also be used for the copper, zinc, magnesium and aluminium half-cell.

- Iron metal in an aqueous solution of iron (II) sulfate
- Lead metal in an aqueous solution of lead (II) nitrate

Note: Before using lead or its compounds, a risk assessment should be prepared taking into consideration its toxicity, level of student competence, concentration and quantities used and disposal.

Science ASSIST recommendations

- Consult SDSs before using any chemicals.
- Safety glasses and lab coats should be worn throughout the laboratory activity.
- Follow general laboratory hygiene rules, such as washing hands before leaving the laboratory.
- All used solutions should be collected in a heavy metal wastes container.
- Metal strips can be cleaned and reused.

Additional information

An electrochemical cell comprises of two half-cells joined by a salt bridge. In one half-cell, oxidation of a metal electrode occurs, while in the other half-cell there is the reduction of metal ions in solution. The half-cell with the most negative electrode potential forms the negative terminal (anode). Oxidation occurs at the anode. Reduction occurs at the positive terminal (cathode). The salt bridge usually contains a saturated solution of sodium or potassium nitrate or chloride. The salt bridge allows the flow of ions from one half-cell to another without the mixing of the two solutions. The salt bridge also maintains electrical neutrality of the solutions in the two half–cells and completes the electrical circuit.

Consider the electrochemical cell consisting of the 2 half-cells expressed in the following half equations:

$Cu^{2+}_{(aq)} + 2e^- \rightleftharpoons Cu_{(s)}$ $E^0 = +0.34$ V (strip of copper partially immersed in aqueous solution of copper (II) nitrate)

$Zn^{2+}_{(aq)} + 2e^- \rightleftharpoons Zn_{(s)}$ $E^0 = -0.76$ V (strip of zinc partially immersed in aqueous solution of zinc (II) nitrate)

Copper (II) ions have a higher standard electrode potential value and are a stronger oxidant than zinc ions. At the zinc anode, Zn^{2+} ions are released into the solution of the half-cell while at the copper cathode, Cu^{2+} ions are reduced to metallic copper.

The overall equation is:

$Zn_{(s)} + Cu^{2+}_{(aq)}$? $Zn^{2+}_{(aq)} + Cu_{(s)}$

References

Chem Supply website, (2020). *Iron (III) nitrate*, Safety Data Sheet. Search https://www.chemsupply.com.au/ to source the latest Safety Data Sheet via the product information page.

Chem-Supply. (2021). *Zinc nitrate*, Safety Data Sheet. Search https://www.chemsupply.com.au/ to source the latest Safety Data Sheet via the product information page.

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