

Year 12 ATAR Chemistry

Lab Validation Test

**Factors affecting the corrosion of iron**

2017

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Teacher:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Time permitted for completion of the test: 30 minutes.

Marks

**Marks:**  **/15**

**Background**

Corrosion is the process by which metals are converted to oxides or other compounds. This causes the metals to gradually deteriorate as illustrated by the rusting of iron and steel and the corrosion of aluminium fittings in salty ocean environments. Corrosion is an expensive problem in our society and quite extensive industries have developed that specialise in minimising the corrosion of metal structures.

In this experiment you will investigate the corrosion of iron and various factors that can accelerate or inhibit the rate of this process. In the rusting process iron is oxidised initially to iron (II) and then to iron (III). This combines with the hydroxide ion, which is formed in the reduction of oxygen, to produce hydrated iron(III)oxide or rust (Fe2O3.H2O). This can be represented by the equations:

Fe (s) Fe2+ (aq) + 2e- Fe3+ (aq) + 3e-

O2 (g) + 2H2O (l) + 4e- 4OH- (aq)

Fe3+ (aq) + 6 OH- (aq)  Fe2O3.H2O (s) + 2H2O (l)

**Equipment required**

6 Test tubes Bunsen, tripod and gauze mat

Distilled water Phenolphthalein 10 clean iron nails Sodium hydroxide solution

Vaseline Sodium dichromate solution

Sodium chloride solution Hydrochloric acid

Potassium hexacyanoferrate solution [K3Fe(CN)6]

**Procedure A: rusting of iron in various aqueous solutions**

* Place a clean, bright nail in each of 5 test tubes and partly fill the test tubes with one of the following reagents so that the nail is just covered by the solution: 0.1 molL-1 HCl, 0.1 molL-1 NaOH, 0.1 molL-1 NaCl, 0.1 molL-1 Na2Cr2O7 and distilled water.
* Fill a sixth test tube with distilled water to a depth that will completely cover a nail. Boil the water vigorously for about 3 minutes. While the water is still hot drop in a clean nail and add about 1mL of Vaseline to cover the surface of the water.
* Allow the nails to stand in the solution for approximately 24 hours. Then observe the nails and solutions carefully and record any evidence of rusting.
* To those solutions in which there is no evidence of rusting, add 2 drops of 0.1 molL-1 K3Fe(CN)6 solution. The formation of a blue precipitate is indicative of the presence of iron (II) ions.

**Procedure B: Rusting of iron in contact with other metals**

* You will be shown 2 petri dishes containing agar jelly mixed with phenolphthalein and K3Fe(CN)6. Four clean nails have been placed in to the petri dishes as shown below:



* Examine the nails then **colour and label** the diagram above to show what you observed.

[3]

**Processing of results and questions**

1. Fill out the results table below for part A:

|  |  |  |  |
| --- | --- | --- | --- |
| Test tube  number | Contents of test tube | Corrosion present Y/N | Ranking (1 = most corrosion, 6 = least corrosion) |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |
| 6 |  |  |  |

[3]

1. Why was the water boiled and Vaseline added to one of the test tubes?

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[1]

1. What substances must be present for rusting to occur?

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[1]

1. Explain the evidence from your experiment that supports the answer to 3.

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[2]

1. Name a substance in this experiment that might be used as a rust inhibitor.

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[1]

1. What is the purpose of both the phenolphthalein and the Potassium hexacyanoferrate (III) solution used in part B,

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[2]

1. For the iron nail wrapped in copper explain why the nail corroded readily.

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[1]

1. For the iron nail wrapped in zinc explain why the nail did not corrode.

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