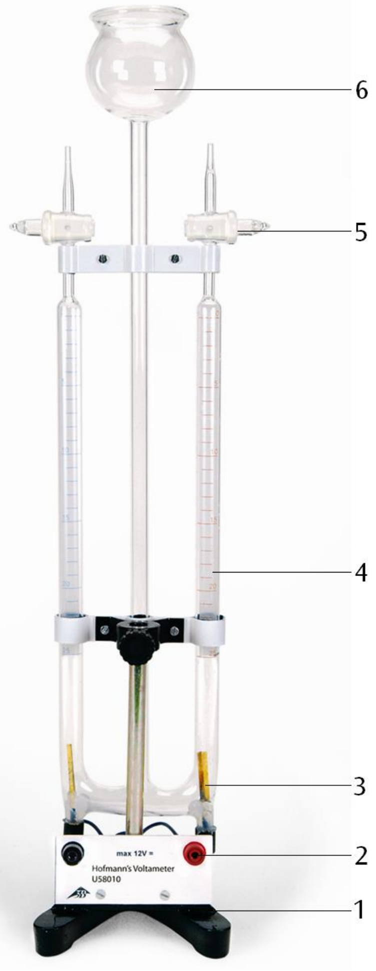
3B SCIENTIFIC® PHYSICS

Hofmann's Voltameter, S 1003507

Instruction Sheet

11/15 ALF



1 Stand base with rod
2 Sockets
3 Gold leaf electrodes
4 Gas collection tube
5 Stop cock
6 Water reservoir

1. Safety instructions

The apparatus is made of glass. There is a risk of breakage and resulting injury.

- Handle the apparatus with care when carrying it and make sure it is stable on the desk.
- Do not subject the glass components to mechanical stress.

Hydrogen and oxygen form an explosive mixture.

- Never re-combine the gases in a test tube.

Since the conductivity of distilled water is too low electrolysis is carried out using dilute sulphuric acid (c = 1 mol/l approx.). Students should always be informed of the dangers of the chemicals needed for the experiment.

- Carefully add the sulphuric acid to the water while stirring. Never do this the other way round.
- Wear protective goggles when mixing the solution and when releasing the gases.

Caution! Any acid that escapes can cause irreparable stains and holes in clothing.

2. Description

Hofmann's voltameter is used for the electrolysis of water (converting electrical energy into chemical energy), quantitative determination of the resulting gases and confirmation of Faraday's laws.

The apparatus consists of three vertical glass tubes connected to each other at the bottom. Taps at the top ends of the outside tubes are closed whilst the inner cylinder is open at the top to allow the addition of water via a reservoir. Gold sheet electrodes are fitted to the lower ends of the outside tubes and connected to a low voltage DC power supply unit. The proportion of hydrogen and oxygen produced by electrolysis from the water can be read from the graduations on the side tubes.

By opening the taps at the top of the tubes, gases can be collected for analysis. Carbon electrodes (1003508) are also available for analysis of solutions where gold is unsuitable.

3. Technical data

Dimensions:	approx. 580 x 150 mm²
Stand base, A-shaped:	115 mm leg length
Operating voltage:	4 - 12 V DC

4. Additionally required equipment

1 DC Power Supply 0 - 20 V, 0 - 5 A @ 230 V	1003312
or	
1 DC Power Supply 0 - 20 V, 0 - 5 A @ 115 V	1003311
1 Mechanical Stopwatch, 30 min	1003368
1 Digital Pocket Thermometer	1002803
and	
1 K-Type NiCr-Ni Immersion Sensor	1002804
1 Barometer	1010232
Distilled water	
Sulphuric acid (*c* = 1 mol/l approx.)	

5. Example experiments

5.1 Investigation of the conductivity and composition of water

- Pour distilled water into the water reservoir with both stopcocks open until both tubes are full. Then close the stopcocks.
- Turn on the power supply and observe the electrodes.

There is no perceptible reaction at the electrodes.

- Turn the power supply off again.
- Add a few drops of dilute sulphuric acid.
- After waiting for about 5 minutes, switch on the power supply again.

Gas bubbles should rise from both electrodes.

- When the gas collection tube at the negative pole (cathode) is half filled with gas, turn off the power supply.
- Release the gases through the stopcocks and collect them in upturned test tubes.
- Demonstrate the presence of hydrogen by the pop test and the presence of oxygen using a glowing splint.

5.2 Determining the Faraday constant

- Pour distilled water into the water reservoir with both stopcocks open until both tubes are full. Then close the stopcocks.
- Add a few drops of dilute sulphuric acid.
- Turn on the power supply and set the current so that approximately 1 A flows. Check to see that gas is being emitted into both tubes.
- Turn the power supply off again, open the stopcocks and release the gas.
- Close the stopcocks. Turn on the power supply and take the time with a stopwatch.
- When the glass collection tube at the negative pole (cathode) is nearly full, turn off the power supply and the stopwatch together and record the time.
- Determine the volume of the hydrogen.
- Measure the air pressure and water temperature in the reservoir.

For a known current I (A), time t (s), air pressure p (Nm^{-2}), temperature T (K), volume of gas V_{H_2} (m^3) and universal gas constant R (8.3 J mol^{-1} K^{-1}) the Faraday constant F is given by:

$$F = \frac{I \cdot t \cdot R \cdot T}{2 \cdot p \cdot V} \approx 10^5 C/mol.$$