

## General instructions: Experimental Examination (20 points)

July 12, 2016

The experimental examination lasts for 5 hours and is worth a total of 20 points.

### Before the exam

- You must not open the envelopes containing the problems before the sound signal indicating the beginning of the competition.
- The beginning and end of the examination will be indicated by a sound signal. There will be announcements every hour indicating the elapsed time, as well as fifteen minutes before the end of the examination (before the final sound signal).

### During the exam

- Dedicated answer sheets are provided for writing your answers. Enter the observations into the appropriate tables, boxes or graphs in the corresponding answer sheet (marked A). For every problem, there are extra blank work sheets for carrying out detailed work (marked W). Be sure to always use the work sheets that belong to the problem you are currently working on (check the problem number in the header). If you have written something on any sheet which you do not want to be graded, cross it out. Only use to front side of every page.
- In your answers, try to be as concise as possible: use equations, logical operators and sketches to illustrate your thoughts whenever possible. Avoid the use of long sentences.
- Explicit error calculation is not required unless explicitly asked for. However, you are asked to give an appropriate number of significant digits when stating numbers. Also, you should decide on the appropriate number of data points or measurement repetitions unless specific instructions are given.
- You may often be able to solve later parts of a problem without having solved the previous ones.
- You are not allowed to leave your working place without permission. If you need any assistance (need to refill your drinking water bottle, broken calculator, need to visit a restroom, etc), please draw the attention of a team guide by putting one of the three flags into the holder attached to your cubicle ("Refill my water bottle, please", "I need to go to the toilet, please", or "I need help, please" in all other cases).

### At the end of the exam

- At the end of the examination you must stop writing immediately.
- For every problem, sort the corresponding sheets in the following order: cover sheet (C), questions (Q), answer sheets (A), work sheets (W).
- Put all the sheets belonging to one problem into the same envelope. Also put the general instructions (G) into the remaining separate envelope. Make sure your student code is visible in the viewing window of each envelope. Also hand in empty sheets. You are not allowed to take any sheets of paper out of the examination area.

- Put your writing equipment (2 ball point pens, 1 felt tip pen, 1 pencil, 1 pair of scissors, 1 ruler, 2 pairs of earplugs) as well as the provided calculator and your personal calculator (if applicable) back into the transparent zip bag.
- Wait at your table until your envelopes are collected. Once all envelopes are collected your guide will escort you out of the examination area. Take your writing equipment bag with you and hand it in at the exit. Also take your water bottle with you.

## Topics

<b>Experiment E-I:</b>	Electrical conductivity in two dimensions	10 marks
<b>Experiment E-II:</b>	Jumping beads - A model for phase transitions and instabilities	10 marks

Experiments E-I and E-II share some of the same equipment. Among others, the same power supply and signal generator are used for both experiments, but with different settings.

Attention: when unpacking the box, do not lift the loudspeaker assembly by the plastic cylinder attached to the membrane.

## Material used in both experiments

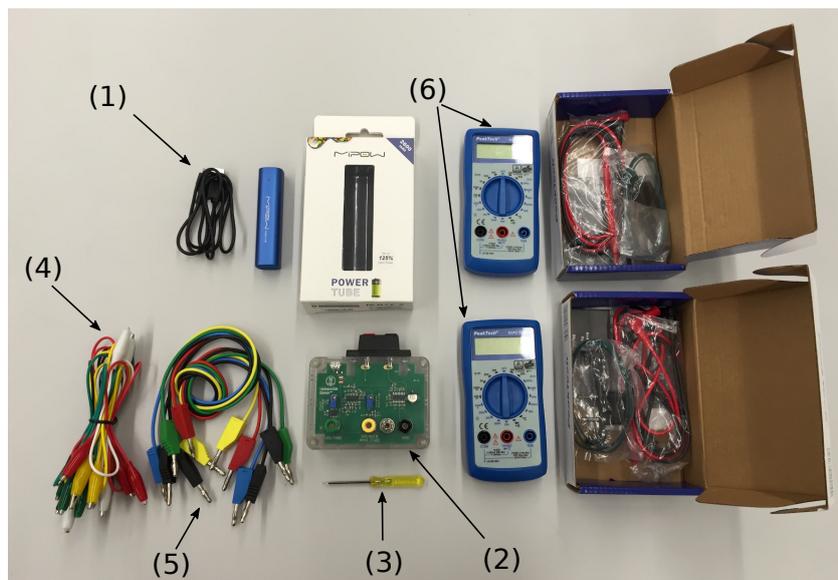


Figure 1: Common material for both experiments.

1. Battery pack with USB cable
2. Adjustable signal generator powered by the battery pack
3. Small screwdriver
4. Ten cables with crocodile clips
5. Six cables with 4 mm plugs
6. Two digital multimeters

You may also use any of the supplied stationary items to conduct the practical tasks.

## Signal generator

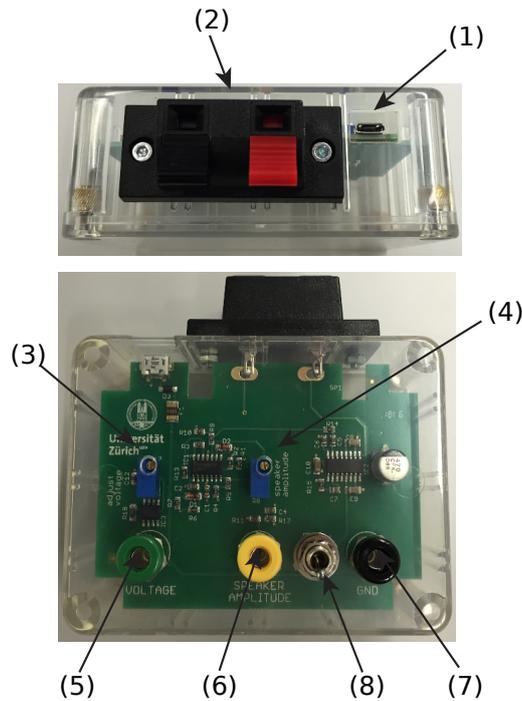


Figure 2.

1. USB connector for powering the signal generator
2. Loudspeaker terminals (only used in E-II)
3. Potentiometer for adjusting the constant voltage (only used in E-I)
4. Potentiometer for adjusting the speaker amplitude (only used in E-II)
5. DC voltage output socket (only used in E-I)
6. Monitor output socket for the loudspeaker drive amplitude (only used in E-II)
7. Common ground socket
8. Switch to turn the loudspeaker terminals and monitor output for the loudspeaker amplitude on / off

To power the signal generator, plug the battery pack using the USB cable to the USB connector of the signal generator (1).

Note that several turns of the potentiometer are required to go from one end of the range to the other. The potentiometers do not have mechanical stops at the end of their range.

## Digital multimeters

The digital multimeters can be used for current and voltage measurements. Always connect the two leads to the sockets labeled "VmAΩ" and "GND" and choose current/voltage and the measurement range

by means of the selector.