

## Exercises "Electronic Materials"

#1

### Exercise 1: Conducting Wire

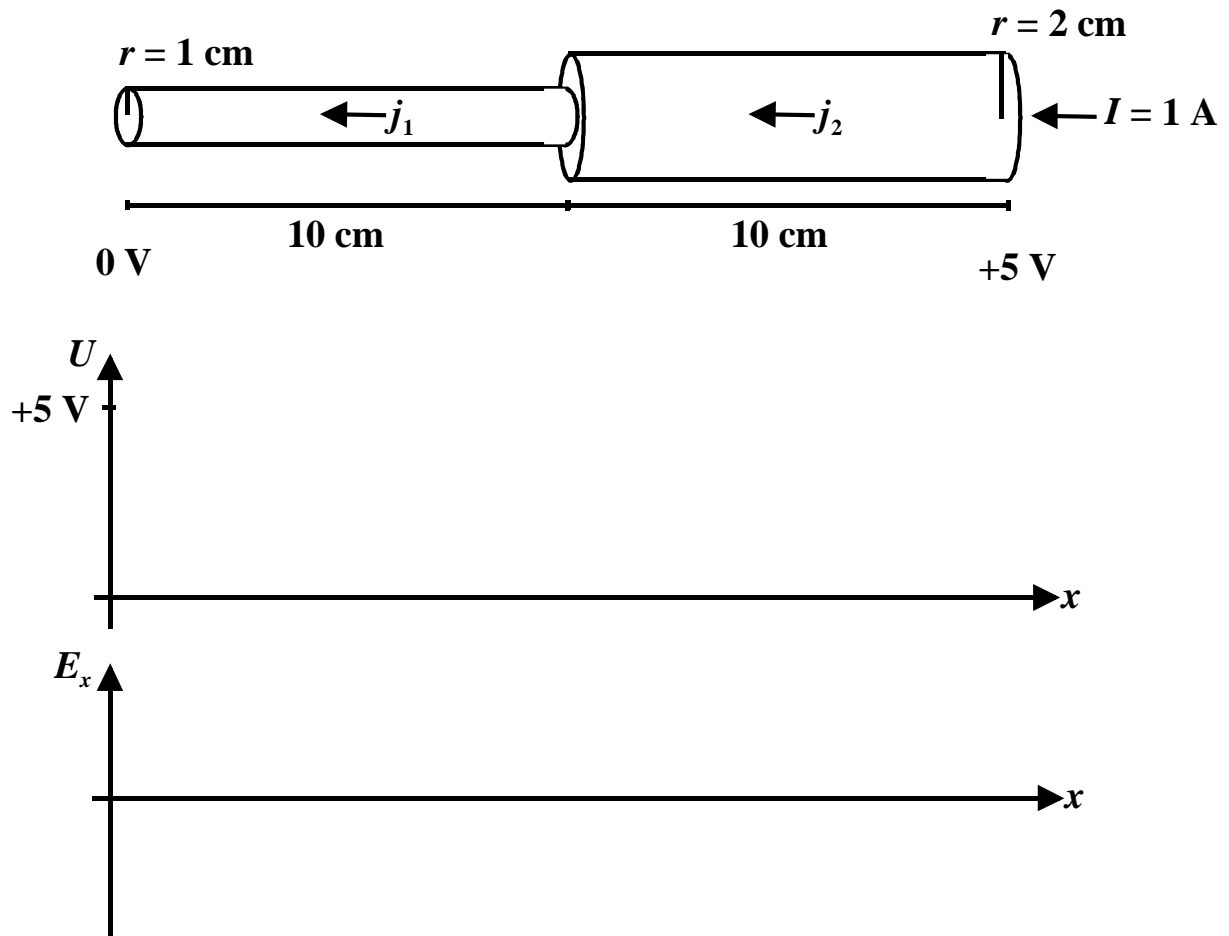


Fig. 1

Through a cylindrical workpiece of a homogeneous material with a geometry as shown in Fig. 1 a current of  $1 \text{ A}$  is flowing, if a voltage of  $5 \text{ V}$  is applied.

a) Define the variables in the following equations:  $R = \frac{\rho l}{A}$ ,  $\vec{j} = \sigma \vec{E}$  and  $\vec{E} = -\vec{\nabla} U$ , and discuss these formulas shortly.

b) Prove that the ratio of current densities in the thin and thick conductor part equals

$$\frac{j_1}{j_2} = 4. \quad (1)$$

- c) Calculate the electrical field strength in the thin and the thick part of the conductor.
- d) Draw the electrical field and the voltage loss into the coordinate system given above. The x-axis shall correspond to the length scale of the conductor drawn above. The scale for the voltage loss is defined by the dash at 5 V.
- e) In which direction are the electrons flowing in the circuit above?
- f) Estimate the conductivity of the material regarded here. Is this a good or a bad conductor?
- g) Which material parameter determines the conductivity of a solid state material?
- h) With increasing temperature the resistance of the workpiece shown above decreases nearly exponentially. What class of material does it belong to?
- i) In a Hall measurement the material shows a positive Hall constant. What conclusion can you draw from that?
- j) Can the contacting of the workpiece with a metal on the left and right side be a problem? Please explain your answer!