Physics Practice Test

Part A: Short Questions

Remarks:

- No aids (calculator, FoTa, formula sheet) allowed
- Always express numerical results as rounded decimal numbers (except in ratios)
- Derivation required for numerical results

1. On the reverse side of the sheet, draw the circuit diagram for a circuit with a battery, two identical light bulbs and a resistor, in which the first light bulb is brighter than the second one.
2. Which of the following statements are true?

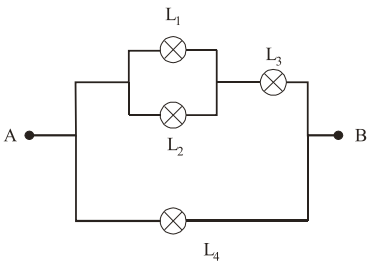
   ☐ The current through an NTC thermistor connected to a battery increases when temperature increases.

   ☐ In a parallel circuit the voltage is split in the reciprocal ratio of the resistances.

   ☐ The equivalent resistance of two resistors in parallel is always smaller than each resistor's resistance.

   ☐ When the potential difference across a resistor is doubled, the power is also doubled.

3. Four identical light bulbs (L_1 to L_4) are used in the circuit below. A voltage is applied between points A and B. Order the light bulbs in the order of increasing brightness. Give reasons for your answer.



4. Two parallel 220 Ω resistors and a 330 Ω resistor are connected in series to a battery with electromotive force 4.4 V. Calculate for one of the parallel resistors the potential difference across it, the current flowing through it and the dissipated power.

5. Two copper wires with the same volume differ in length by a factor of two. Calculate the ratio of their respective resistances.

Numerical Solutions: 2. ☑☐☑☐; 3. L_4, L_3, $L_1 = L_2$; 4. 1.1 V, 5 mA, 5.5 mW; 5. 8 : 1

Part B: Problems

Remarks:

- Write you solutions to the problems on the answer sheet. Start a new page for every problem.
- An algebraic solution and all values used in calculations are required to get the full mark.
- Results must be rounded to at most three significant figures.

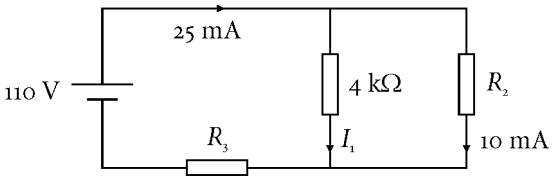
1. The heating of an old toaster consists of two identical iron wires. They each have a length of 15 m and a resistance of 48 Ω (at room temperature). At level 1 (only one wire connected to the voltage supply), the heating power on 230 V is measured to be 210 W.

   a) Calculate the heating wires' diameter.

   b) Calculate the heating wires' resistance and temperature while in operation.

   c) The toaster offers a "booster" level, which has a higher heating power. How are the wires connected in this case and what is the corresponding power?

2. Three resistors are connected to a dc voltage supply as described by the circuit diagram below.



   a) Calculate the total power dissipated by the circuit. What happens to the electric energy?

   b) Determine the missing quantities (I_1, R_2, R_3). No formal solutions are required.

   c) The branch of the circuit with the 4 kΩ resistor is interrupted. How does this affect the potential difference across R_3 and the current through R_2? Give qualitative (!) explanations for your answers.

Numerical Solutions: 1. 0.2 mm, 250 Ω, 705 °C, 420 W; 2. 2.75 W, 15 mA, 6 kΩ, 2 kΩ, $\Delta V_3 \downarrow$, $I_2 \uparrow$