Practice Test: DC Circuits

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, suggest a simple circuit that automatically fades out a light bulb after activating a switch. Can you expect an exponentially decaying current for your circuit? Why?
2. Tick the correct statements.

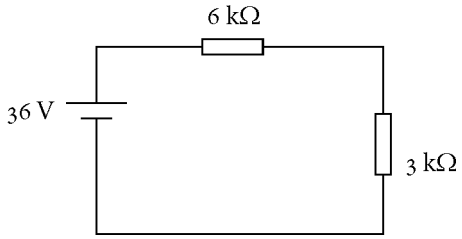
   ☐ In an RC circuit with half life 2.3 ms the capacitor is fully charged after 4.6 ms.

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

   ☐ When discharging a capacitor, the electric power decreases half as fast as the current.

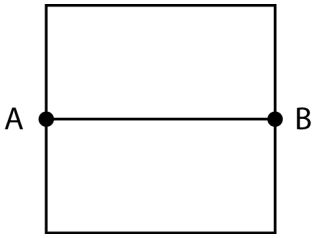
   ☐ In a parallel circuit the voltage is split in the reciprocal ratio of the resistances.

3. Calculate the electric power dissipated in the 3 kΩ resistor.



4. A current divider connected to 12 V splits the current in the ratio 2 : 1. The total current is 6 mA. Calculate the two resistance values.

5. The figure below is made from a constantan wire. The straight wire connecting points A and B has a resistance of 12 Ω. Calculate the total resistance between A and B.



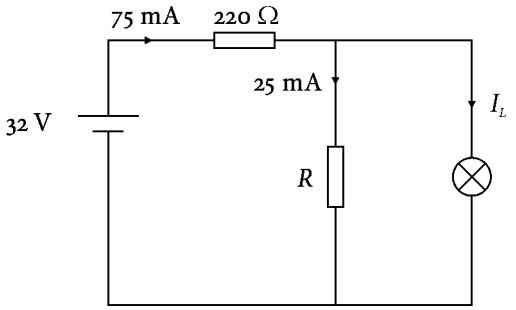
Numerical Solutions: 2. ☐ ☑ ☐ ☐; 3. 48 mW; 4. 3 kΩ, 6 kΩ; 5. 6 Ω

Part B: Problems

Remarks:

- Write your 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. Two resistors and a light bulb are connected to a battery as described by the circuit diagram below.



   a) Calculate the total power dissipated in the circuit.

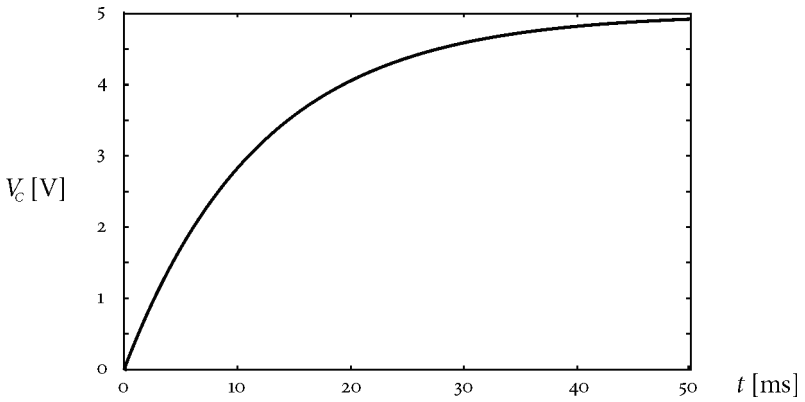
   b) Determine the current I_L flowing through the light bulb and the resistance R.

   Calculate the light bulb's resistance and the power dissipated in it.

   c) The applied voltage is increased. How does this affect the current through the resistor R? Give a qualitative explanation for your answer.

2. A capacitor is charged through a 2.2 kΩ resistor on a voltage of 5.0 V.

   The charging process is investigated with an oscilloscope. The result is displayed in the following voltage vs. time graph.



   a) Determine the half life from the diagram.

   Check whether it is sensible to assume an exponential voltage.

   b) Calculate the circuit's capacitance from the measured half life.

   c) Draw the current vs. time diagram for this circuit. Label the axes with the correct values.

Numerical Solutions: 1. 2.4 W, 50 mA, 620 Ω, 310 Ω, 0.78 W, current increases; 2. 8 ms, 5.2 μF