

ELECTRIC CURRENT, POWER AND RESISTANCE

Basic Problems

1. The label on a battery reads "1'300 mAh". It can run a Discman for 2.5 hours. What is the average current?
2. A current of 0.3 A flows through a light bulb connected to 6 V. What is the power consumed by the light bulb? What is the power emitted as light?
3. An immersion heater connected to 230 V produces 1'500 W of heat. Calculate the electric current.
4. The voltage across a light bulb is increased by 20 % leading to a current increase of 10 %. Calculate the percentage change of the dissipated power.
5. A notebook computer consumes some 20 W of electric power. What is the minimum area for a solar panel with 10 % efficiency to run the computer on a sunny day?
6. The resistance of a variable resistor connected to a battery is increased from 50 Ω to 70 Ω . How do the electric current and the dissipated power change?
7. A 15 Ω resistor has a maximum power rating of 0.5 W. What is the maximum voltage it can be connected to?
8. The current flowing through a resistor increases by 10 %. How does the dissipated power change?
9. A silver wire has a cross sectional area of 0.1 mm² and 2.2 Ω resistance. How long is the wire?
10. The resistances of two cylindrical wires differ by 40 %. What is the ratio of the two wires' diameters?
11. An iron wire is heated until its resistance has doubled. Calculate the necessary temperature increase.
12. At what temperature does the resistivity of copper have the value $2.0 \cdot 10^{-8} \Omega\text{m}$?

Additional Problems

13. Find out what your household's yearly consumption of electric energy is. Calculate the average electric current delivered by the electric power company.
14. An electric motor with 40 % efficiency has an electric power input of 6.5 W. It is used to lift an object with mass 350 g to a height of 3.4 m. How long does it take to do this task?
15. Use the characteristic of a light bulb measured in the physics lesson to answer the following questions:
 - a) What is the electric current at a voltage of 32 V?
 - b) What is the voltage when the electric current is 200 mA?
 - c) What is the voltage when the light bulb consumes 20 W of power?
16. An underground copper telephone cable (cross sectional area 0.50 mm²) is out of order: The two wires touch at some place. To find the exact position of the defect, the resistance between the ends of the wires is measured and found to have a value of 17.1 Ω . How far away is the defect?
17. A long copper wire with a negligibly thin insulation is stored as a roll with a mass of 10 kg. The resistance between the ends of the wire is 35 Ω . How long is the wire?
18. For a *thin film resistor* a cylindrical ceramic or glass carrier is covered with a thin conducting layer. The thickness of the layer is between 0.001 μm and 20 μm . Carbon, metals or metal oxides are typical conductors used for this type of resistors.

How thick is the layer for a carbon film resistor with a length of 1 cm, a diameter of 2 mm and a resistance of 10 k Ω ? How can the same resistor be realised with a thicker layer?
19. Calculate the resistance and the mass of a 6 km long copper cable with diameter 6 mm. What are the diameter and the mass of an aluminium cable with the same length and resistance? Which cable is less expensive?

HINT: Look up the prices for raw copper and aluminium in the economy section of a newspaper.

SOLUTIONS TO BASIC PROBLEMS: 1. 0.52 A; 2. 1.8 W / 90 mW; 3. 6.5 A; 4. +32 %; 5. 0.2 m²; 6. - 29 %; 7. 2.7 V; 8. + 21 %; 9. 14 m; 10. 1.29; 11. 200°C; 12. 65°C