

Homework No. 06 (Fall 2025)

PHYS 203B-001: COLLEGE PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale

Due date: Tuesday, 2025 Oct 07, 12:30 PM, on D2L

Instructions

- You are encouraged to use any of the resources to complete this homework. However, the extent to which you depend on resources while doing this homework is a measure of how much extra work you need to put in to master the associated concepts. Solutions should be the last resource.
- Links to solutions are provided.
- Variations of homework problems and additional problems are available in [Lecture Notes](#). These serve as practice problems.
- Describe your thought process in detail and organize it clearly. Make sure your answer has units and right number of significant digits.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (under Assessments → Assignments). You can replace your PDF file as many times as you like, only the last file is graded. The deadline has an (undisclosed) buffer period, so do not hesitate to try submissions after the deadline.

Problems

1. **(10 points.)** Estimate the drift velocity of conduction electrons in a copper wire of radius 1.0 mm using

$$I = neAv_d. \quad (1)$$

Copper has one free electron per atom available for conduction. For reference copper wire has 9×10^{28} atoms/m³. Use $I = 1.0$ A. How much time (in hours) does it take for an individual electron to begin from the light switch and reach the bulb that is connected by a 2.0 m long copper wire?

Solution

2. **(10 points.)** Watt is the unit of power. Watt-hour is a unit of energy. How much is kWh (kilo Watt-hour) in Joules? The average cost of electricity in the United States, for residential users, is about 0.15 USD/kWh (15 cents per kiloWatt-hour). At this rate your electricity bill for a month came out to be 50.00 USD. How much electric energy (in Joules) did you use in the month?

Solution

3. (10 points.) Resistance is inversely proportional to the area of crosssection A and proportional to the length l , such that

$$R = \frac{\rho l}{A}, \quad (2)$$

where ρ is the resistivity of the material. A cylindrical copper rod has resistance R . It is reformed to thrice its original length with no change of volume. What is its new resistance in terms of the original resistance R ?

Solution

4. (10 points.) Figure 1 shows three resistors connected in parallel to a battery. The battery has a voltage of $V = 10.0 \text{ V}$, and the resistors have equal resistances of $R = 300.0 \Omega$.
- (a) Determine the equivalent resistance across the battery.
 - (b) Determine the voltage across each of the resistor.
 - (c) Determine the current passing through each resistor.
 - (d) Determine the power consumed by each resistor.

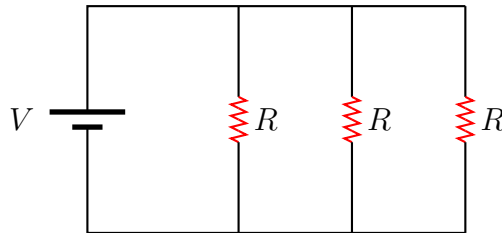


Figure 1: Problem 4

Solution

5. (10 points.) Figure 2 shows two resistors connected in series to a battery. The battery has a voltage of $V = 10.0 \text{ V}$, and the resistors have resistances $R_1 = 100.0 \Omega$ and $R_2 = 200.0 \Omega$.
- (a) Determine the equivalent resistance across the battery.
 - (b) Determine the voltage across each of the resistor.
 - (c) Determine the current passing through each resistor.
 - (d) Determine the power consumed by each resistor.
 - (e) Find the ratio P_1/P_2 of the powers of the resistors.
 - (f) If the resistors represented electric bulbs, which bulb would glow brighter?

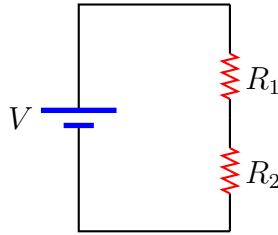


Figure 2: Problem 5

Solution

6. (10 points.) Figure 3 shows two resistors connected in parallel to a battery. The battery has a voltage of $V = 10.0 \text{ V}$, and the resistors have resistances $R_1 = 100.0 \Omega$ and $R_2 = 200.0 \Omega$.

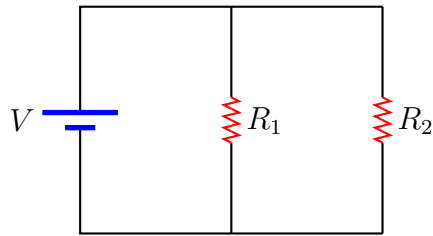


Figure 3: Problem 6

- Determine the equivalent resistance across the battery.
- Determine the voltage across each of the resistor.
- Determine the current passing through each resistor.
- Determine the power consumed by each resistor.
- Find the ratio P_1/P_2 of the powers of the resistors.
- If the resistors represented electric bulbs, which bulb would glow brighter?

Solution