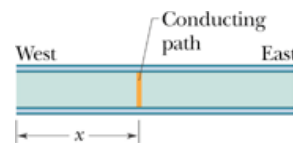


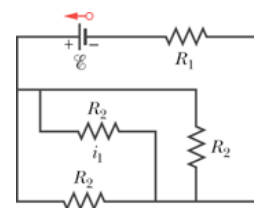
Chapter 28 – Problem Day

5. A car battery with a 12 V emf and an internal resistance of $0.040\ \Omega$ is being charged with a current of 50 A. What are (a) the potential difference V across the terminals, (b) the rate P_r of energy dissipation inside the battery, and (c) the rate P_{emf} of energy conversion to chemical form? When the battery is used to supply 50 A to the starter motor, what are (d) V and (e) P_r ?

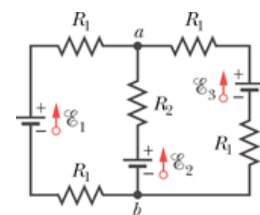
15. A 10-km-long underground cable extends east to west and consists of two parallel wires, each of which has resistance $13\ \Omega/\text{km}$. An electrical short develops at distance x from the west end when a conducting path of resistance R connects the wires. The resistance of the wires and the short is then $100\ \Omega$ when measured from the east end and $200\ \Omega$ when measured from the west end. What are (a) x and (b) R ?



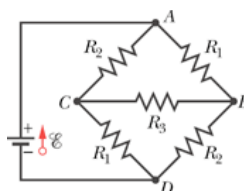
17. In the figure, $R_1 = 6\ \Omega$ and $R_2 = 18\ \Omega$, and the ideal battery has emf $\varepsilon = 12\ \text{V}$. What are the (a) size and (b) direction (left or right) of current i_1 ? (c) How much energy is dissipated by all four resistors in 1 min?



37. In the figure, the resistances are $R_1 = 1\ \Omega$ and $R_2 = 2\ \Omega$, and the ideal batteries have emfs $\varepsilon_1 = 2\ \text{V}$ and $\varepsilon_2 = \varepsilon_3 = 4\ \text{V}$. What are the (a) size and direction (up or down) of the current in battery 1, the (b) size and direction of the current in battery 2, and the (c) size and direction of the current in battery 3? (d) What is the potential difference $V_a - V_b$?



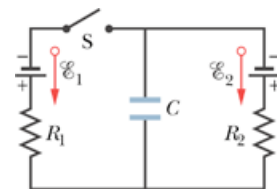
39. In the figure, $\varepsilon = 12\ \text{V}$, $R_1 = 2000\ \Omega$, $R_2 = 3000\ \Omega$, and $R_3 = 4000\ \Omega$. What are the potential differences (a) $V_A - V_B$, (b) $V_B - V_C$, (c) $V_C - V_D$, and (d) $V_A - V_C$?



59. A $15\ \text{k}\Omega$ resistor and a capacitor are connected in series, and then a 12 V potential difference is suddenly applied across them. The potential difference across the capacitor rises to 5 V in $1.3\ \mu\text{s}$. (a) Calculate the time constant of the circuit. (b) Find the capacitance of the capacitor.

61. Switch S in the figure is closed at time $t = 0$, to begin charging an initially uncharged capacitor of capacitance $C = 15\ \mu\text{F}$ through a resistor of resistance $R = 20\ \Omega$. At what time is the potential across the capacitor equal to that across the resistor?

89. The circuit shows a capacitor, two ideal batteries, two resistors, and a switch S. Initially S has been open for a long time. If it is then closed for a long time, what is the change in the charge on the capacitor? Assume $C = 10\ \mu\text{F}$, $\varepsilon_1 = 1\ \text{V}$, $\varepsilon_2 = 3\ \text{V}$, $R_1 = 0.2\ \Omega$ and $R_2 = 0.4\ \Omega$.



Chapter 28 – Problem Day Answers

- 5a) 14 V
- 5b) 100 W
- 5c) 600 W
- 5d) 10 V
- 5e) 100 W

- 15a) 6.9 km
- 15b) 20 Ω

- 17a) 0.333 A
- 17b) right
- 17c) 720 J

- 37a) 0.67 A, down
- 37b) 0.33 A, up
- 37c) 0.33 A, up
- 37d) 3.3 V

- 39a) 5.25 V
- 39b) 1.50 V
- 39c) 5.25 V
- 39d) 6.75 V

- 59a) 2.41 μs
- 59b) 161 pF

- 61) 0.208 ms

- 89) $-13 \mu\text{C}$