PQ 4 Electricity

Q and A

Q1

Household current in a circuit cannot generally exceed 15 A for safety reasons. What is the maximum amount of charge that could flow through this circuit in a house during the course of a 24.0-h day?

Solution: Because the unit ampere means coulombs per second, 24.0 h must be converted in 86,400 s.

Given: $I = 15$ A
$\Delta t = 86{,}400$ s

Unknown: $\Delta q = ?$
Original equation: $I = \dfrac{\Delta q}{\Delta t}$

Solve: $\Delta q = I\Delta t = (15\text{ A})(86{,}400\text{ s}) = \mathbf{1.3 \times 10^6\ C}$

Q2

What is the resistance of the heating element in a car lock de-icer that contains a 1.5-V battery supplying a current of 0.5 A to the circuit?

Given: $V = 1.5\ \text{V}$
$I = 0.5\ \text{A}$

Unknown: $R = ?$
Original equation: $V = IR$

Solve: $R = \dfrac{V}{I} = \dfrac{1.5\ \text{V}}{0.5\ \text{A}} = \mathbf{3\ \Omega}$

Q3

Arthur is going trick-or-treating for Halloween so he puts new batteries in his flashlight before leaving the house. Until the batteries die, it draws 0.500 A of current, allowing a total of 5400. C of charge to flow through the circuit. How long will Arthur be able to use the flashlight before the batteries' energy is depleted?

$\Delta t = \Delta q / I = (5400.\ \text{C})/(0.500\ \text{A}) =$ **10,800 s**

Q4

Fabian's car radio will run from the 12-V car battery that produces a current of 0.20 A even when the car is turned off. The car battery will no longer operate when it has lost 1.2×10^6 J of energy. If Fabian gets out of the car and leaves the radio on by mistake, how long will it take for the car battery to go completely dead (that is, lose all energy)?

$\Delta q = W/V = (1.2 \times 10^6 \text{ J})/(12 \text{ V}) = 1.0 \times 10^5 \text{ C}$
$\Delta t = \Delta q/I = (1.0 \times 10^5 \text{ C})/(0.20 \text{ A}) = 5.0 \times 10^5 \text{ s}$ or **139 h**

Q5

While cooking dinner, Dinah's oven uses a 220.-V line and draws 8.00 A of current when heated to its maximum temperature. What is the resistance of the oven when it is fully heated?

$R = V/I = (220.\ \text{V})/(8.00\ \text{A}) = \mathbf{27.5\ \Omega}$

Q6

Justine's hair dryer has a resistance of 9.00 Ω when first turned on. a) How much current does the hair dryer draw from the 110.-V line in Justine's house?

a) $I = V/R = (110.\ \text{V})/(9.00\ \Omega) = \mathbf{12.2\ A}$

Q7

Camille takes her pocket calculator out of her bookbag as she gets ready to do her physics homework. In the calculator, a 0.160-C charge encounters 19.0 Ω of resistance every 2.00 seconds. What is the potential difference of the battery?

$I = \Delta q / \Delta t = (0.160\ \text{C})/(2.00\ \text{s}) = 0.0800\ \text{A}$
$V = IR = (0.0800\ \text{A})(19.0\ \Omega) = \mathbf{1.52\ V}$