tutorial #3 [electric circuits] .quiz

1) Alessandro Volta connects his car's $E = 12$ V battery to two same parallel $R = 2\ \Omega$ coils immersed in the water. The wires that he connects the battery has $r = 0.5\ \Omega$ resistance. He wants to make some tea so he need $m = 0.3$ kg water. The water is initially in temperature $T_i = 20°$.

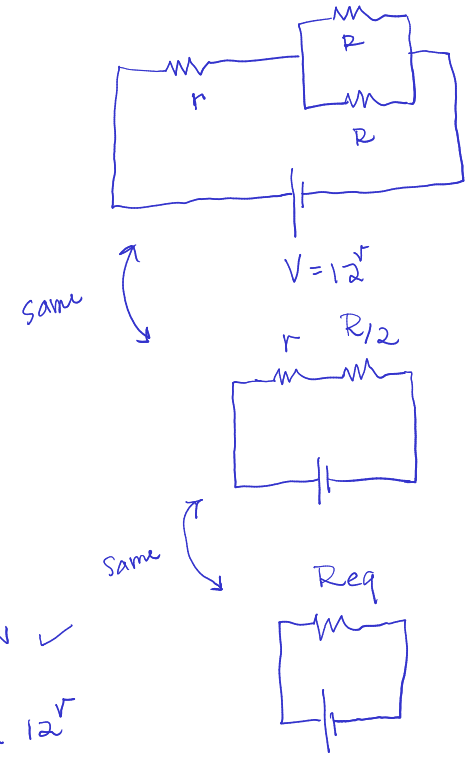
a) Find the equivalence resistance of the whole circuit, r in series with two parallel R's.
b) Find the current passing through the battery.
c) Find the power being supplied by the battery.
d) The equivalence of two parallel R's is $R/2$. Calculate the power that is delivered to the coils.
e) Find the amount of energy needed to get water to boiling point.
f) Using last two parts, how long it takes to boil the water?

a) from battery's point of view

$R_{eq} = r + R/2 = 1.5\ \Omega$

b) $V = R_{eq} I \Rightarrow I = \frac{12\ V}{1.5\ \Omega} = 8\ A$

c) $P_{tot} = VI = 12\ V \times 8\ A = 96\ W$



d) We know the current passing through $\frac{R}{2}$, the same $I = 8\ A$.

so $P = \frac{R}{2} I^2 = 1.0\ \Omega \cdot 64\ A^2 = 64\ W$ ✓

or the voltage across $\frac{R}{2}$ is $\frac{R}{2} I = 8\ V < 12\ V$

so $P = \frac{(8\ V)^2}{1.0\ \Omega} = 64\ W$ ✓

e) $\text{energy} = mc\Delta T = (0.3\ kg)(4200\ J/kg°C)(100°C - 20°C) = 1.0 \times 10^5\ J$

f) $\Delta t = \frac{\text{energy}}{P} = \frac{1.0 \times 10^5\ J}{64\ W} = 1.6 \times 10^3\ \text{sec} \sim 27\ \text{min}.$