How many kWh of energy does a 550 W toaster use in the morning if it is in operation for a total of 6.0 min? At a cost of 9.0 cents/kWh, estimate how much this would add to your monthly electric energy bill if you made toast four mornings per week.

Answer: 7.9 cents/month

GIVENS: $P = 550\ W$, $\Delta t = 6\ min$, $c :=$ RATE $= \$0.09/kWh$

"kWh" = "KILO-WATT HOUR"

POWER TIME

$$P = \frac{\Delta E}{\Delta t} = \frac{[J]}{[s]}$$

$$\Delta E = P \cdot \Delta t$$

$P = 0.550\ kW$, $\Delta t = 0.1\ h$

$$\Delta E = P\Delta t = (0.550\ kW)(0.1\ h) = 0.055\ kWh \text{ FOR 1 TIME}$$

$$\text{RATE} = \frac{[\$]}{[kWh]} \times [kWh]$$

$$\text{COST} = \text{RATE} \times \text{ENERGY} = \frac{\$0.09}{1\ kWh} \times 0.055\ kWh = \$0.00495$$

$$\frac{\$0.00495}{1\ \text{TIME}} \times \frac{4\ \text{TIME}}{1\ \text{WEEK}} \times \frac{4\ \text{WEEKS}}{1\ \text{MONTH}} = \frac{\$0.0792}{1\ \text{MONTH}} = 7.9\text{¢}/\text{MONTH}$$

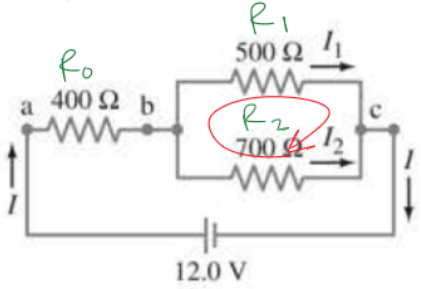
NOTE: This problem is pulled from your textbook in Example 26-5.

Consider the circuit shown in the diagram. The voltage of the battery and the resistance of each resistor are all given.

(a) Determine how much current is drawn from the battery. (i.e. Find the "total" current)

(b) Determine the current flowing through the 500 Ω resistor. ~ FIND I_1

Answer: (a) $I = 17\,\text{mA}$, (b) $I = 10\,\text{mA}$



NOTES:

- $V = IR$, OHM'S LAW
  - ↳ THIS EQN WOULD PERTAIN TO JUST 1 DEVICE (e.g. RESISTOR, BATTERY)
- $\Delta V = -V_1 - V_2 = 0$
- THE FLOW OF CURRENT MUST BE CONSERVED
- DEVICES IN PARALLEL HAVE THE SAME VOLTAGE
- DEVICES IN SERIES HAVE THE SAME CURRENT

(a) FINDING I_{TOTAL}

$$\frac{1}{R_{12}} = \frac{1}{R_1} + \frac{1}{R_2}$$

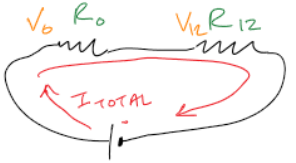
$$R_{12} = \left[\frac{1}{R_1} + \frac{1}{R_2}\right]^{-1}$$

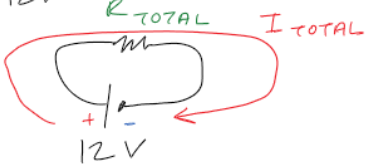
$$= \left[\frac{1}{500} + \frac{1}{700}\right]^{-1} = 291.67\,\Omega$$

$$R_{TOTAL} = R_0 + R_{12}$$

$$= 400 + 291.67 = 691.67\,\Omega$$

$$I_{TOTAL} = \frac{V_{TOTAL}}{R_{TOTAL}} = \frac{12\,V}{691.67\,\Omega} = 0.0173\,A = \boxed{17.3\,mA}$$





$V = IR \rightarrow I = \frac{V}{R}$

$V_0 = I_{TOTAL} R_0$

$$I_{TOTAL} = \frac{V_0}{R_0}$$

$V_{12} = V_1 = V_2$

$\Delta V = +12V - V_0 - V_{12} = 0$

$V_0 + V_{12} = 12V$

$V_0 + V_1 = 12V$

$I_0 R_0 + I_1 R_1 = 12V \rightarrow I_1 = \frac{12V - I_0 R_0}{R_1}$

$$= \frac{12 - (0.0173A)(400\,\Omega)}{(500)}$$

$\boxed{10\,mA}$

$$I_{TOTAL} = \frac{12V}{R_0 + R_1}$$

(b) Determine the current flowing through the 500 Ω resistor. ~ FIND I_1

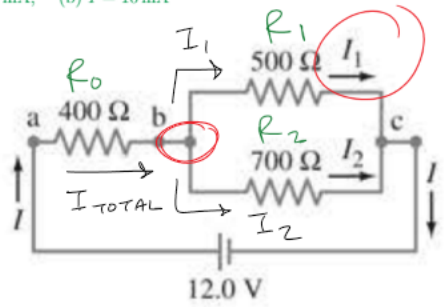
Answer: (a) $I = 17\,\text{mA}$, (b) $I = 10\,\text{mA}$

$V_1 = I_1 R_1$

(b) Determine the current flowing through the 500 Ω resistor.

Answer: (a) $I = 17\,\text{mA}$, (b) $I = 10\,\text{mA}$

~ FIND I_1 ?



$V_1 = I_1 R_1$

NOTES:

- $V = IR$, OHM'S LAW
  - THIS EQN WOULD PERTAIN TO JUST 1 DEVICE
    - e.g. RESISTOR, BATTERY
- THE FLOW OF CURRENT MUST BE CONSERVED
- DEVICES IN PARALLEL HAVE THE SAME VOLTAGE
- DEVICES IN SERIES HAVE THE SAME CURRENT

$V_1 = V_2$

$I_1 R_1 = I_2 R_2$ #1

2 UNKNOWNS: I_1 & I_2

$I_1 = \frac{R_2}{R_1} I_2$

$I_{TOTAL} = I_1 + I_2$ #2

$I_{TOTAL} = \frac{R_2}{R_1} I_2 + I_2 = \left[\frac{R_2}{R_1} + 1\right] I_2$

$I_2 = \frac{I_{TOTAL}}{R_2/R_1 + 1} = \frac{17.3\,\text{mA}}{700/500 + 1} = 7.21\,\text{mA}$

$I_1 = I_{TOTAL} - I_2 = 17.3\,\text{mA} - 7.21\,\text{mA} \approx 10\,\text{mA}$

10 mA