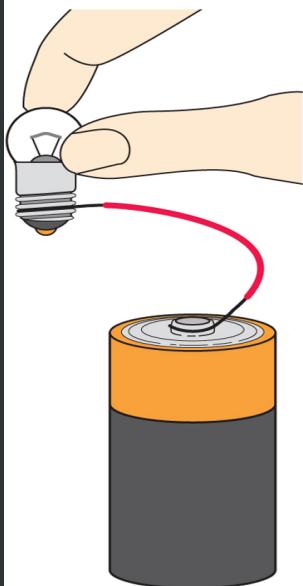
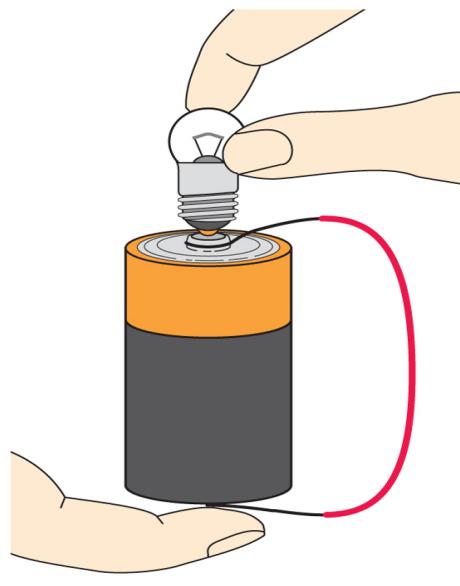


Chapter 13 - Electric Circuits

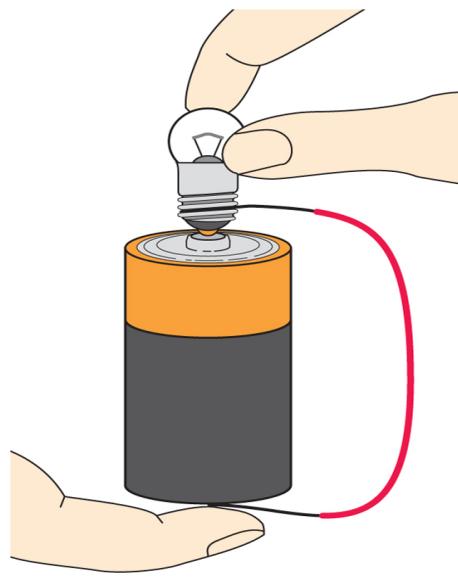
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(a)

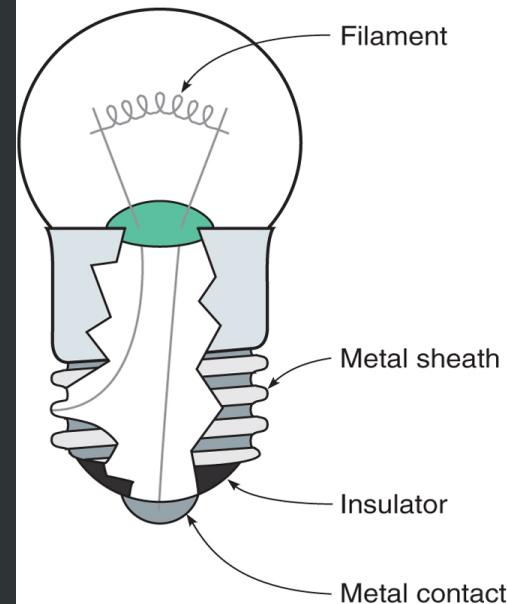


(b)

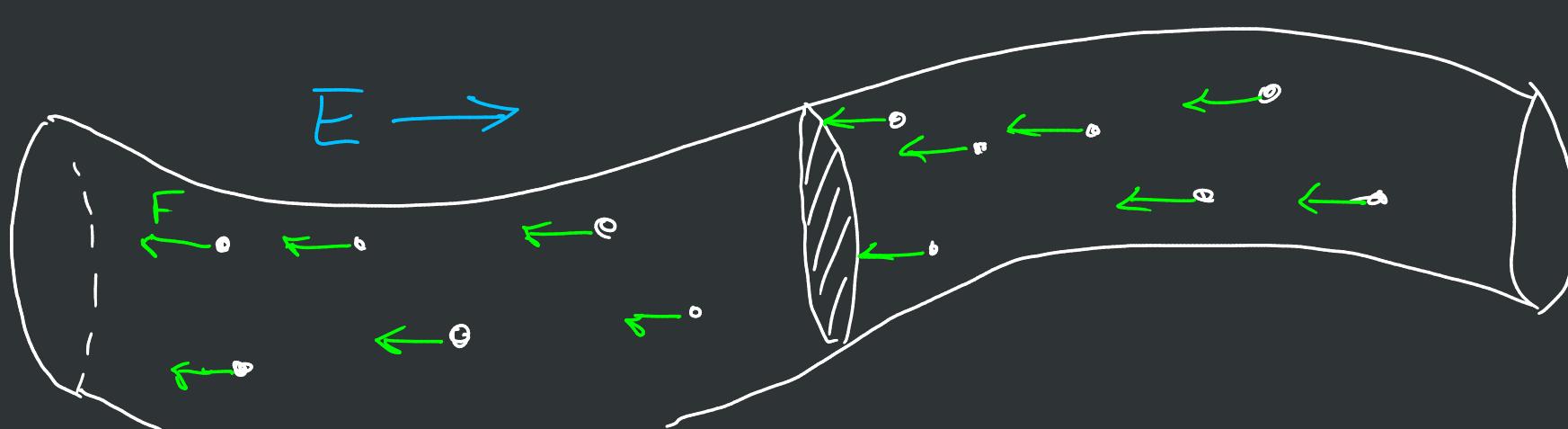


(c)

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Current - measure of the flow of charges through a cross section of wire



Current, I

Current = # of Coulombs of charge that pass a point
second

$$I = \frac{\Delta q}{t} \quad \left[\frac{C}{s} \right] \rightarrow [Ampere]$$

[Amp]
[A]

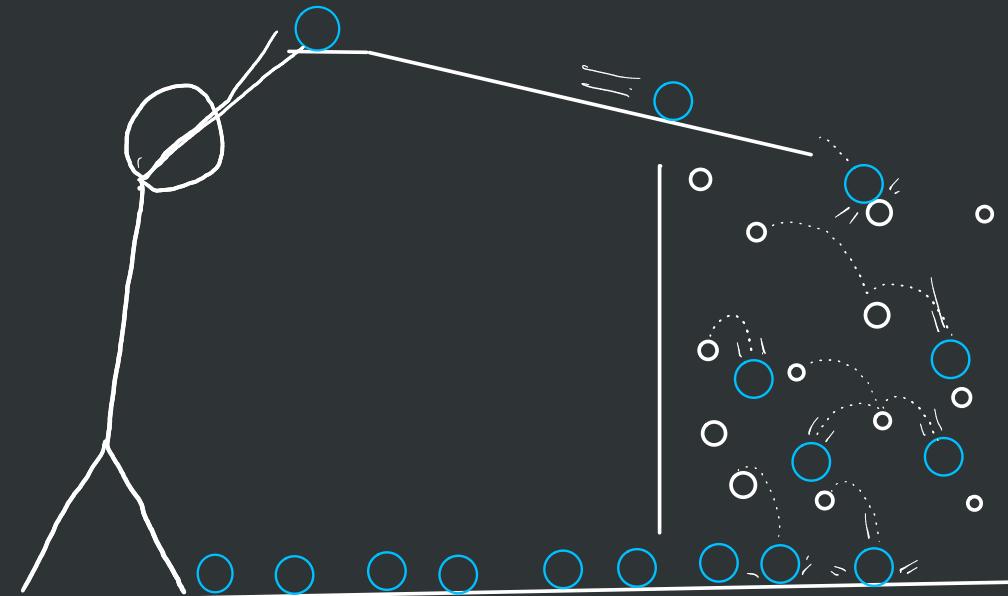
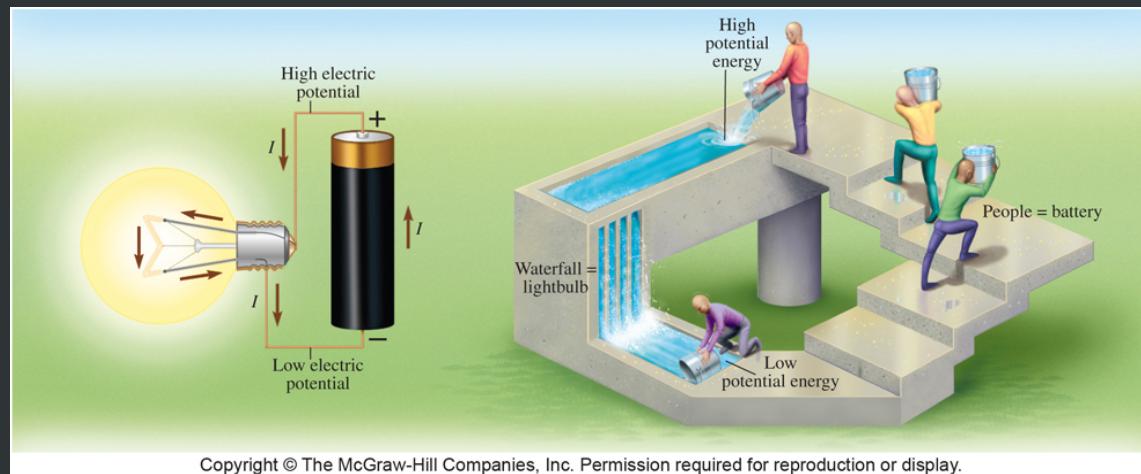
Ohm's Law

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

$$\rightarrow V = I \cdot R \rightarrow R = \frac{V}{I}$$
$$\left[\frac{Volts}{Amp} \right] \rightarrow [Ohm]$$

A
[Ω]

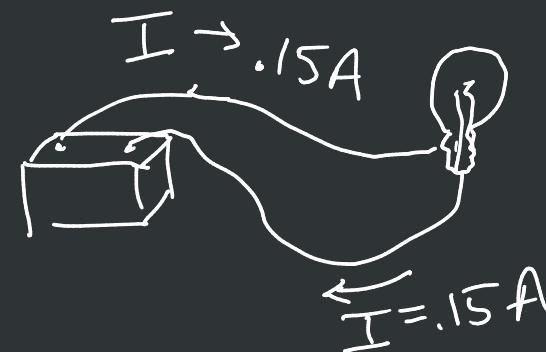
resistance → restriction to the flow of charges.



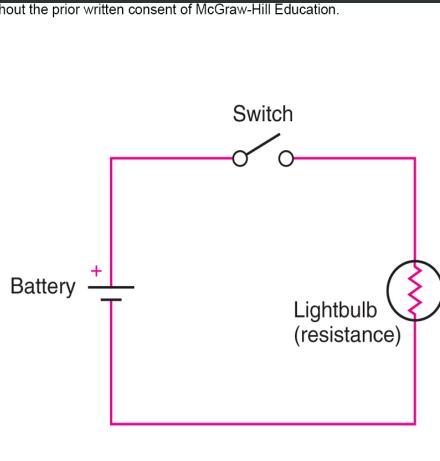
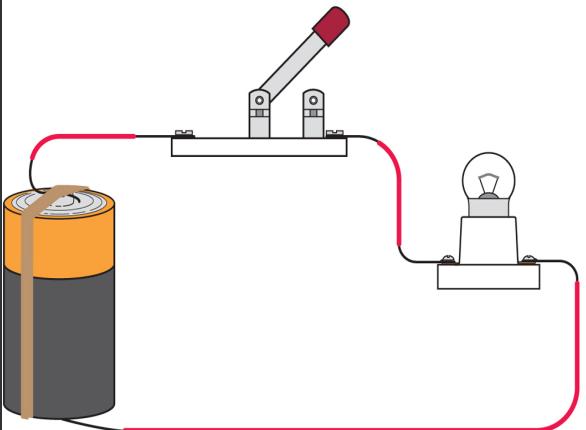
→ 12 Volt battery

→ Resistance $\rightarrow 80\Omega$

→ Current = ?

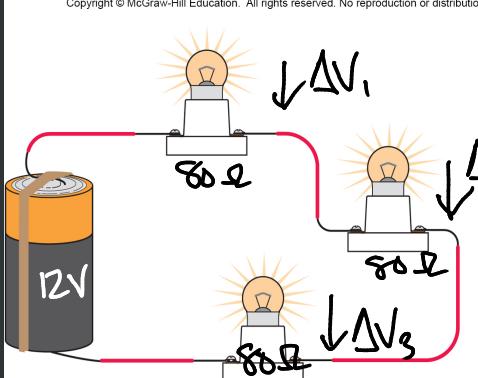


$$I = \frac{V}{R} = \frac{12 V}{80 \Omega} = .15 A$$



lightbulbs

Resistors in Series



$$\Delta V_{\text{battery}} - \Delta V_1 - \Delta V_2 - \Delta V_3 = 0$$

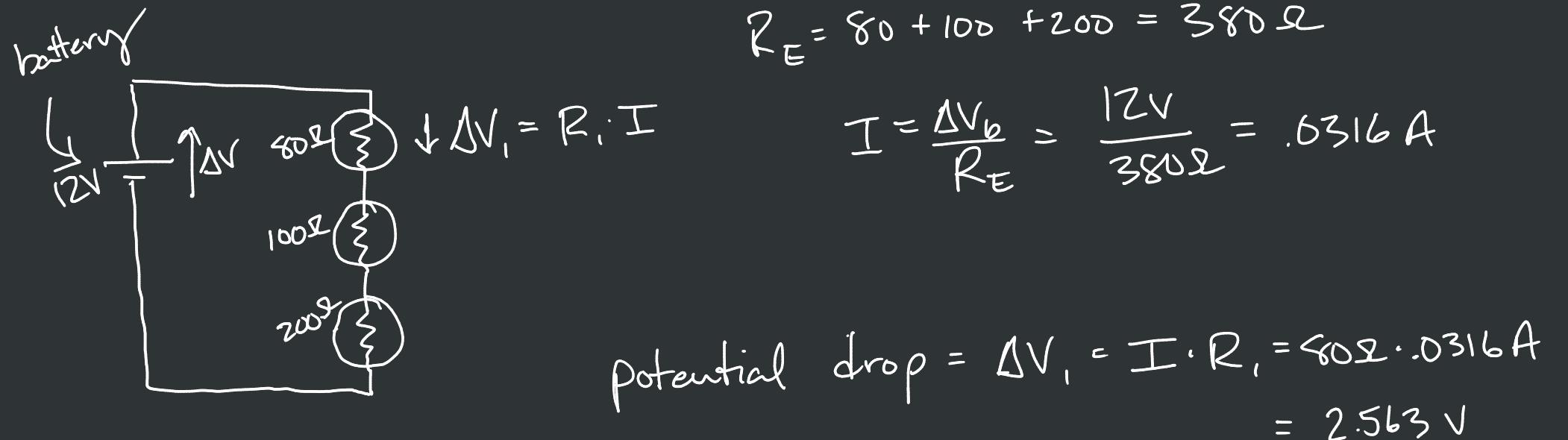
} add up to find the equivalent resistance

$$R_E = R_1 + R_2 + R_3 + \dots$$

$$\hookrightarrow R_E = 240\Omega = 80 + 80 + 80$$

$$I = \frac{12V}{240\Omega} = .05A$$

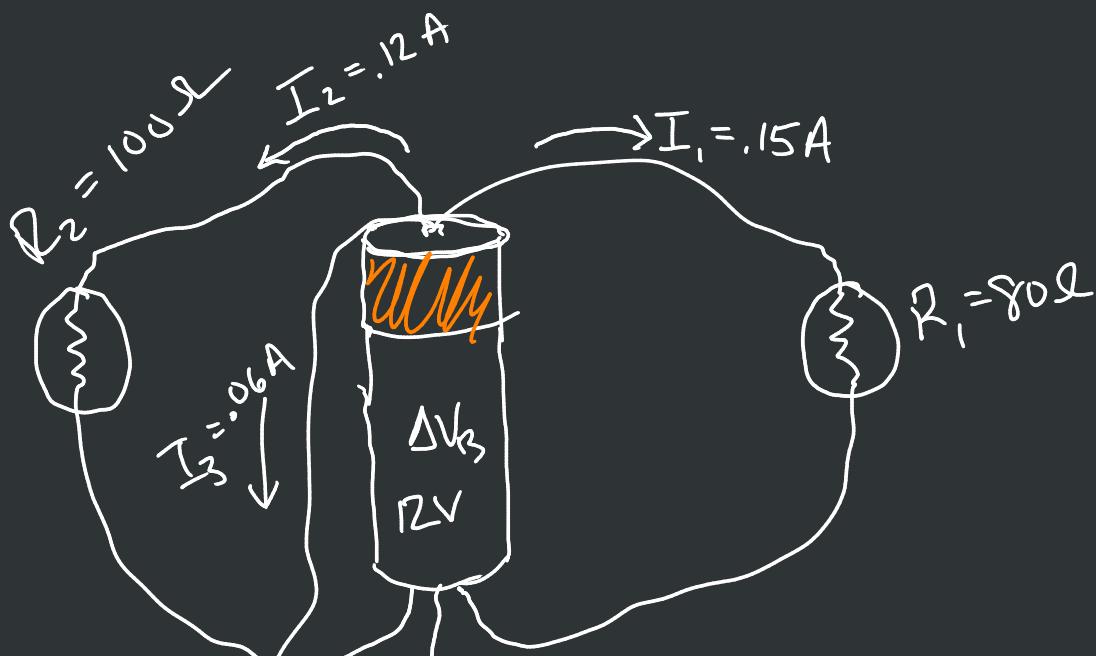
$$I_{R_E} = \frac{V}{R_E} \quad \leftarrow \text{Ohm's Law}$$



$$\Delta V_2 = I R_2 = 3.16 V$$

$$\Delta V_3 = I R_3 = 6.32 V$$

Resistors in Parallel



$$I_1 = \frac{12V}{80\Omega} = .15A$$

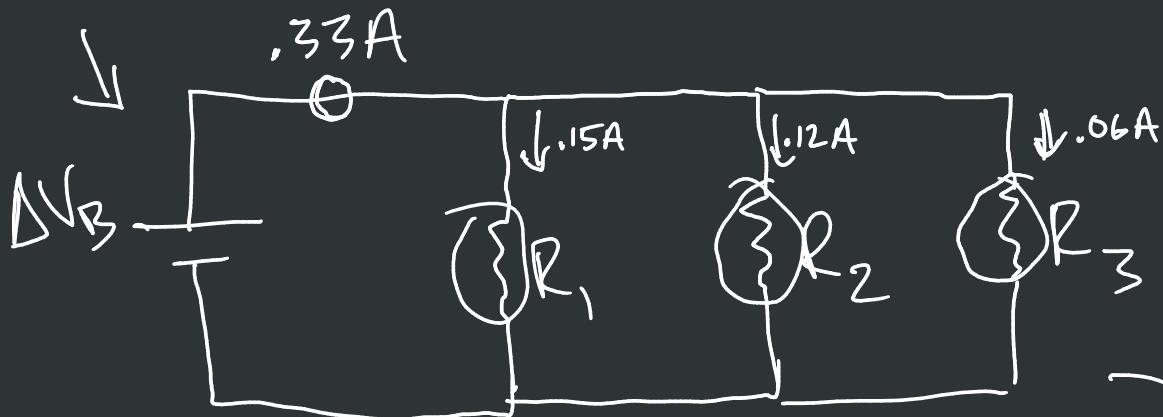
$$I_2 = \frac{12V}{100\Omega} = .12A$$

$$I_3 = \frac{12V}{200\Omega} = .06A$$

$$I_b = .15A + .12A + .06A$$

$$I_b = .33A$$

↳ current supplied by the battery



For resistors in parallel

$$R_E = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots}$$

$$\Rightarrow R_E = \frac{1}{\frac{1}{80} + \frac{1}{100} + \frac{1}{200}}$$

$$= \frac{1}{.0125 + .01 + .005}$$

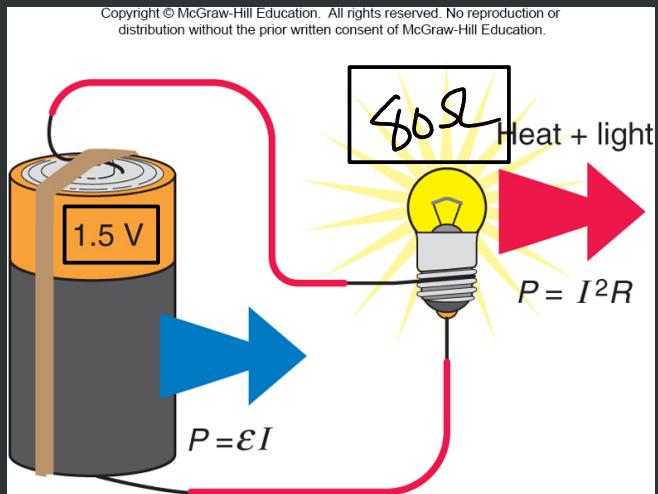
$$= \frac{1}{.0275}$$

$$I_b = \frac{12V}{36.36\Omega} \quad \leftarrow \boxed{R_E = 36.36\Omega}$$

$$= 0.33A$$

Power → rate at which work is done/energy changes $\rightarrow P = \frac{\Delta E}{t}$

→ Power = $\frac{\text{Energy dissipated/used}}{\text{time it is on}}$ $\left[\frac{J}{s} \right]$ $[VA]$ $[Watt]$



$$\text{Power} = \underline{\text{Voltage}} \times \text{Current} \rightarrow P = VI$$

$$I = \frac{V}{R} = \frac{1.5V}{80\Omega} = 0.018 A$$

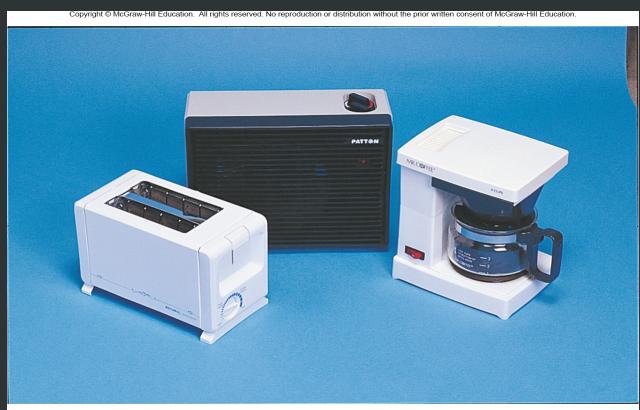
$$\text{Power dissipated} = 1.5V \cdot 0.018A = .028 \text{ Watts}$$

$$P = 100 \text{ Watts}$$

$$V = 120 \text{ Volts}$$

$$I = \frac{P}{V} = \frac{100W}{120V} = .83 A$$

$$R = ? \quad R = \frac{V}{I} = \frac{120V}{.83A} = 145 \Omega$$



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$$P = IV$$

$$V = IR$$

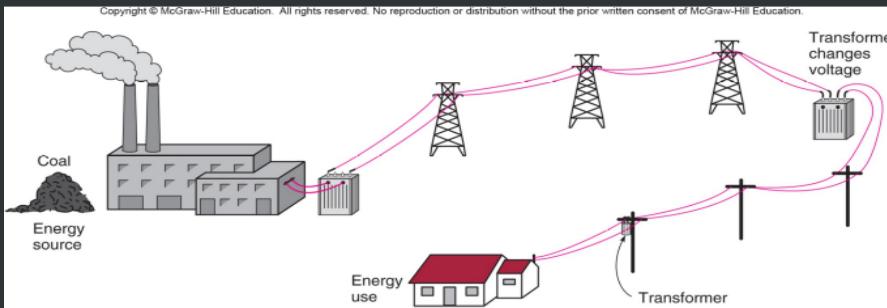
$$I = \frac{V}{R}$$

$$P = I(IR) = I^2 R$$

$$P = I^2 R$$

$$P = \left(\frac{V}{R}\right)V = \frac{V^2}{R}$$

Figure 13.16



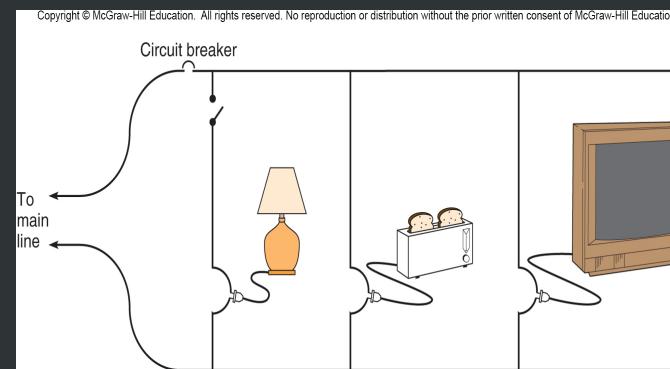
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table 13.2

Power and Current Ratings of Some Common Appliances

Appliance	Power (W)	Current (A)
stove	6000 (220 V)	27
clothes dryer	5400 (220 V)	25
water heater	4500 (220 V)	20
clothes washer	1200	10
dishwasher	1200	10
electric iron	1100	9
coffeemaker	1000	8
toaster	850	7
hair dryer	650	5
food processor	500	4
large fan	240	2
color television	100	0.8
small fan	50	0.4
personal computer	45	0.4
clock radio	12	0.1

These values vary, depending on the size and design of a particular appliance.



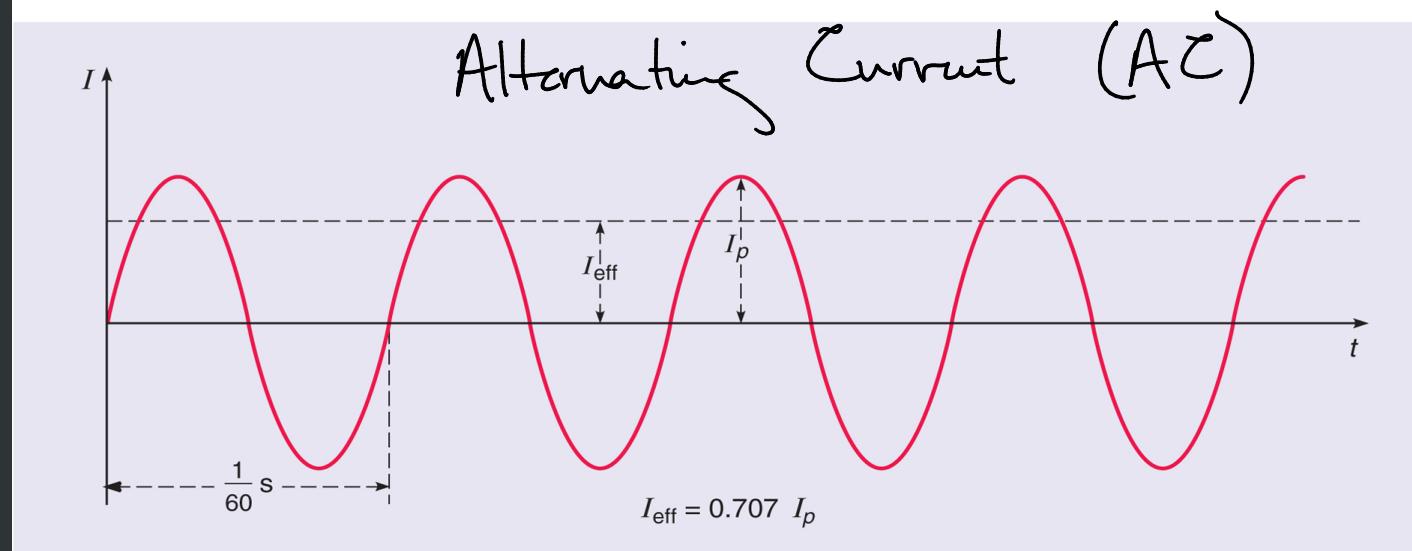
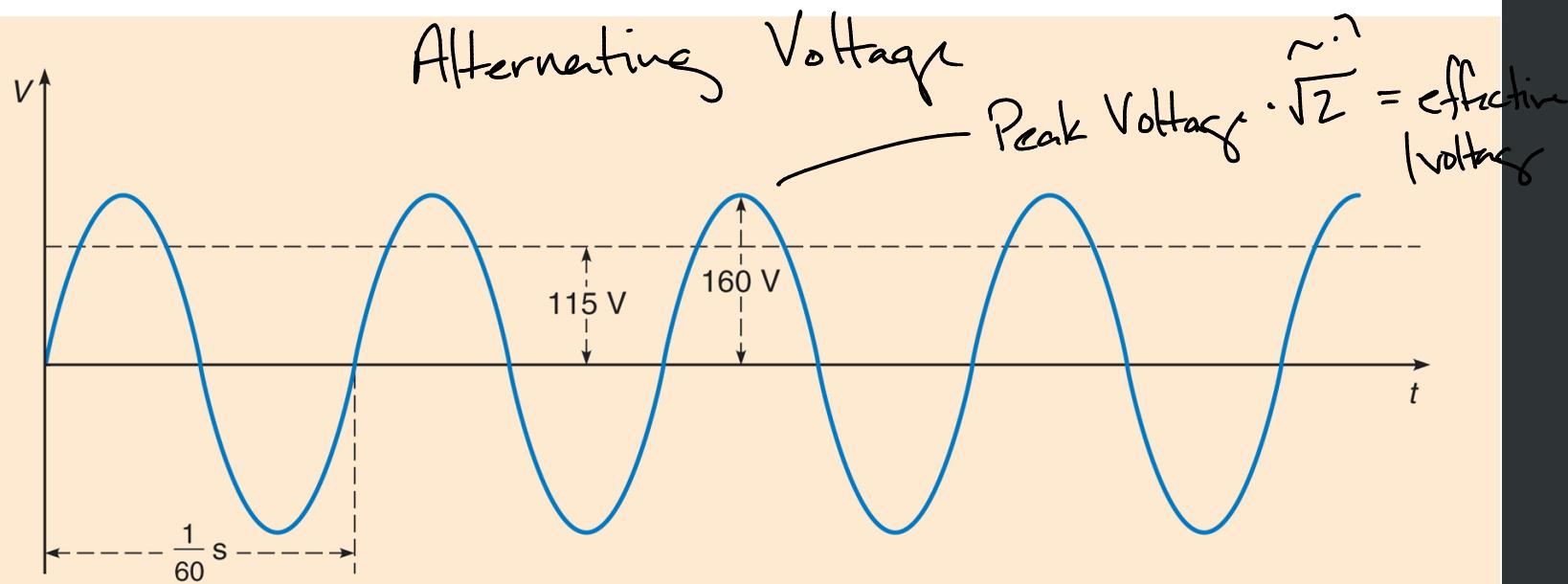
$$P = \frac{E}{t}$$

= Energy

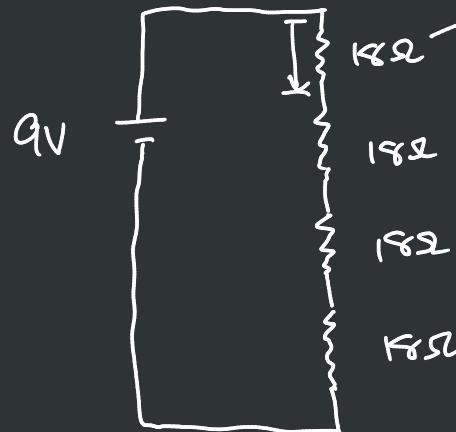
Kilowatt · hours
time

1000 watts
Power

→ Power · time



#5,b



$$V = IR = 0.125A \cdot 18\Omega = \underline{\underline{2.25V}}$$

$$R_E = 4 \cdot R = 72\Omega$$

$$V = I \cdot R_E$$

$$9V = I \cdot 72\Omega$$

$$I = \frac{9V}{72\Omega} = 0.125 A$$

#1

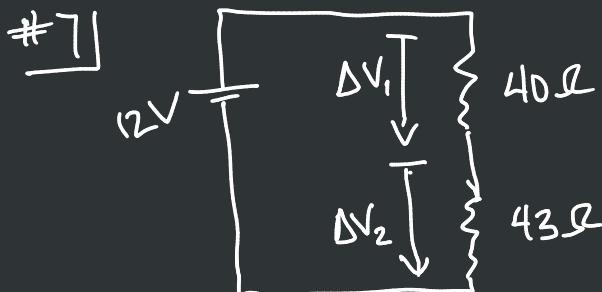
$$I = \frac{Q}{t}$$

↑ Current (A)
↓ C
↑ S

#2

$$Q = I \cdot t$$

$$= 34 \frac{C}{s} \cdot (120s) = 408 C$$



$$R_E = 40 + 43 = 83\Omega$$

$$\frac{12V}{83\Omega} = I = .145 A$$

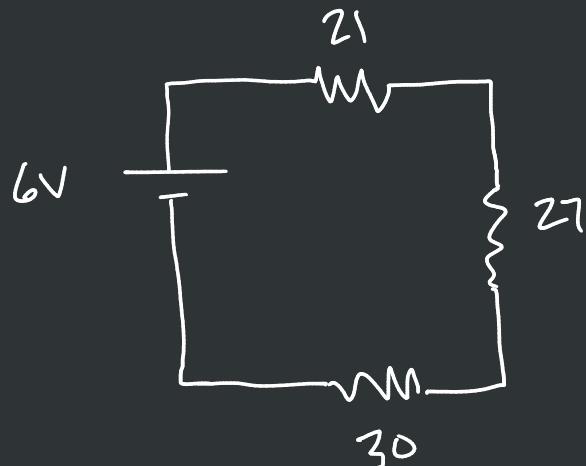
$$\Delta V_1 = I \cdot R = .145A \cdot 40\Omega$$

$$= 5.8 V$$

$$\Delta V_2 = .145A \cdot 43\Omega$$

$$= 6.2 V$$

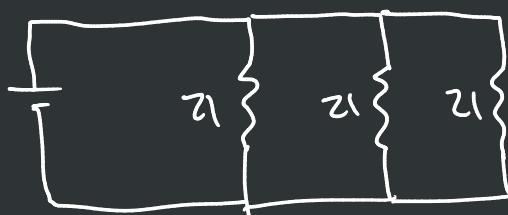
#8



$$R_E = 21 + 27 + 30 = 78 \Omega$$

$$\frac{V}{R} = \frac{6V}{78\Omega} = I = .0769 A$$

#10+11



$$R_E = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

$\underbrace{\hspace{1cm}}_{21\Omega}$

$$R_E = \frac{1}{\frac{1}{21} + \frac{1}{21} + \frac{1}{21}} = \frac{1}{.0476 + .0476 + .0476} = \frac{1}{.1428} = 7 \Omega$$

Current through R_1

$$\frac{10V}{21\Omega} = I = 0.48 A$$

$$R_E = 7 \Omega$$

13-14

$$P = I \cdot V$$

$$30W = I \cdot 80V$$

$$I = \frac{P}{V} = \frac{30W}{80V} = .375 A$$

$$\underline{V = I R}$$

$$80V = .375A \cdot R$$

$$R = \frac{V}{I} = \frac{80V}{.375A} = 213 \Omega$$

$$60W \rightarrow I = ?$$

$$60W = I \cdot 80V \quad \Leftarrow \text{brighter!}$$

$$I = \frac{60}{80} = \underline{\underline{.75A}}$$

$$80V = .75A \cdot R$$

$$\frac{80}{.75} = R = \underline{\underline{106.7 \Omega}}$$

lower R
than the 30W
bulb!