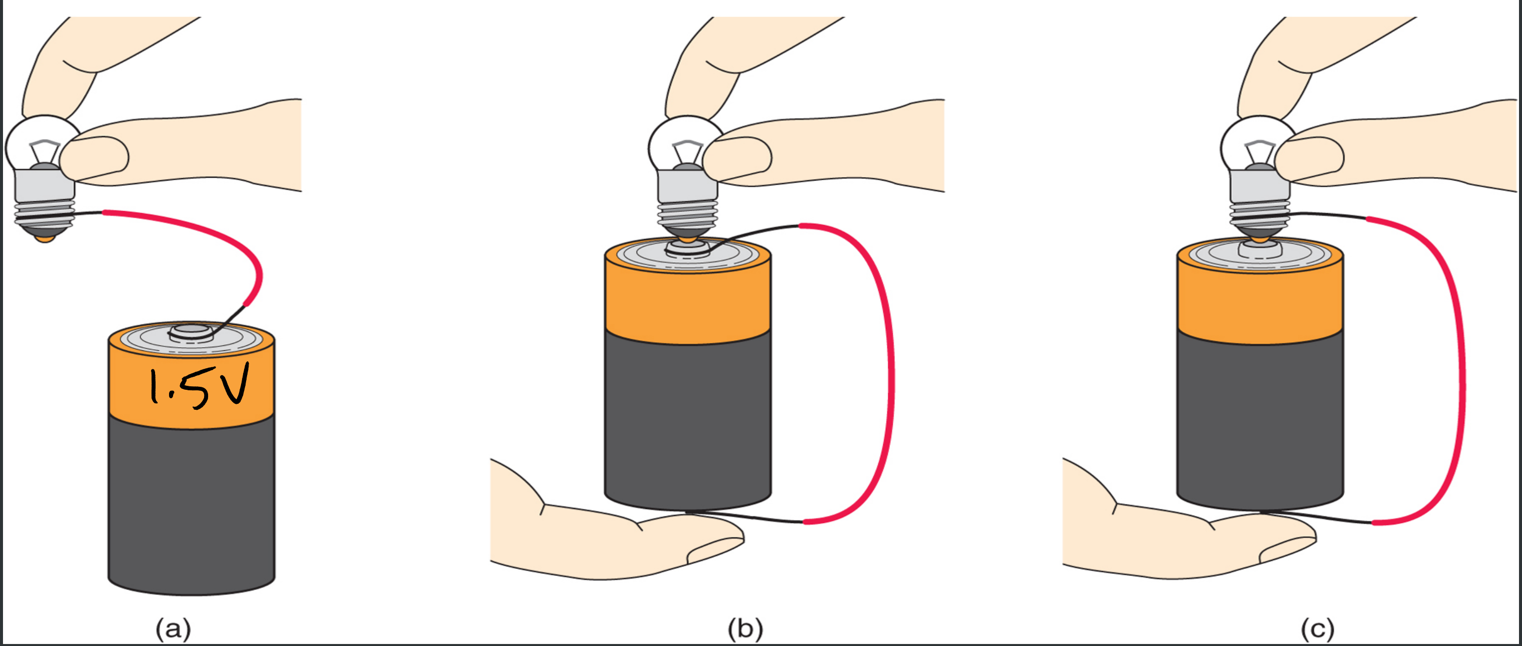
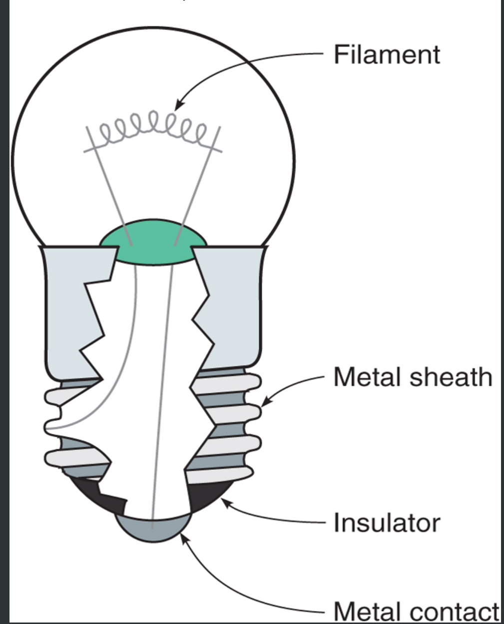
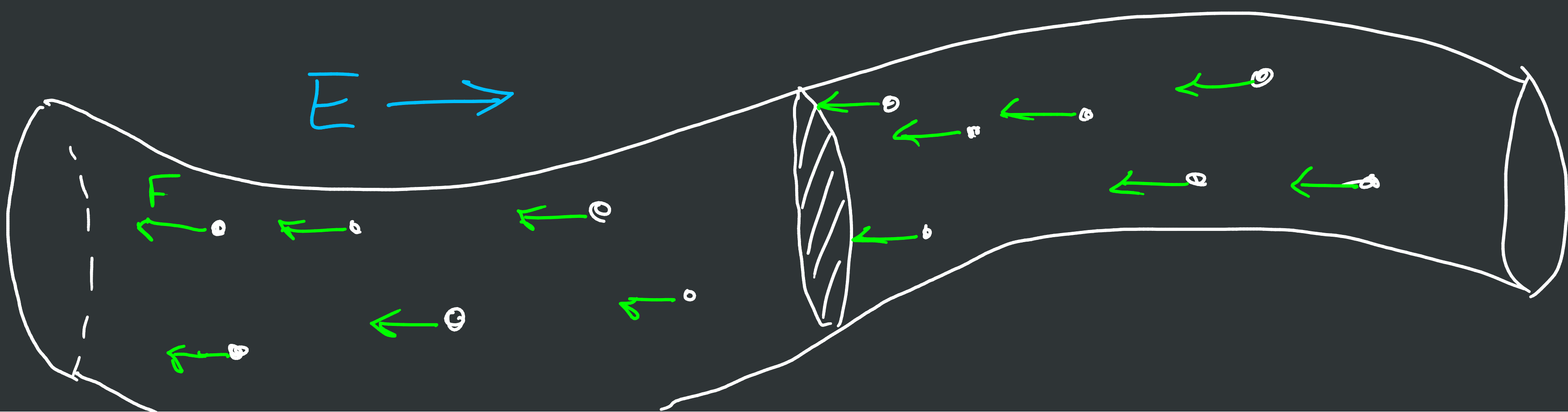




Current - measure of the flow of charges through a cross section of wire



current, I

$$\underline{\text{current}} = \frac{\text{\# of Coulombs of charge that pass a point}}{\text{second}}$$

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

$[\text{Amp}]$

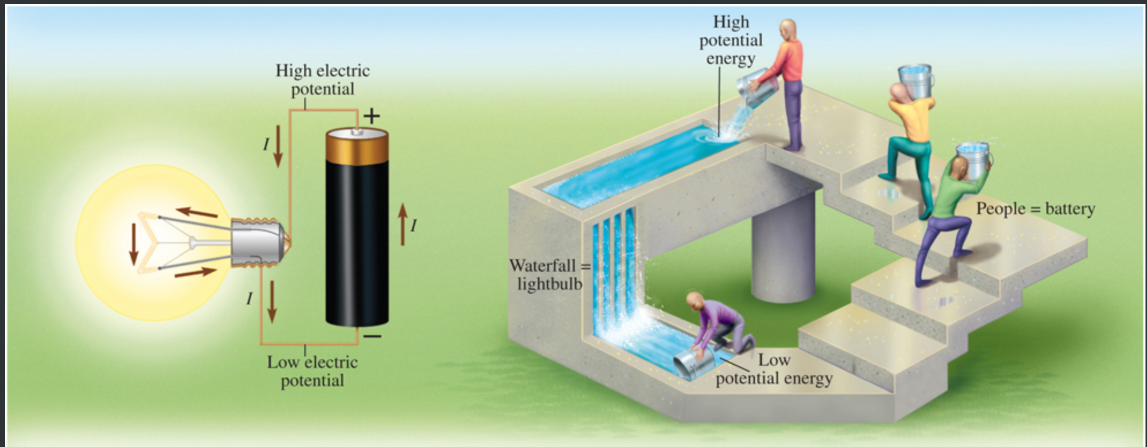
$[A]$

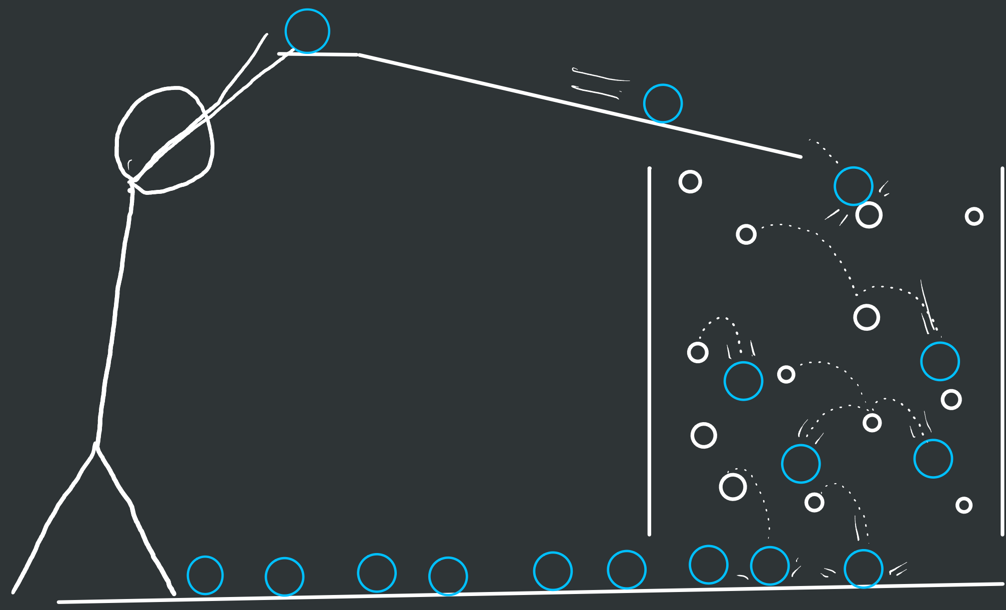
$V = I \cdot R$

Ohm's Law

$$\text{Resistance} = \frac{\text{Voltage}}{\text{Current}} \longrightarrow \boxed{R = \frac{V}{I}} \qquad \left[\frac{\text{Volt}}{\text{Amp}}\right] = [\text{Ohm}] = [\Omega]$$

↳ <u>resistance</u> → restriction to the flow of charges.





→ 12 Volt battery

→ Resistance → $\underline{80\,\Omega}$

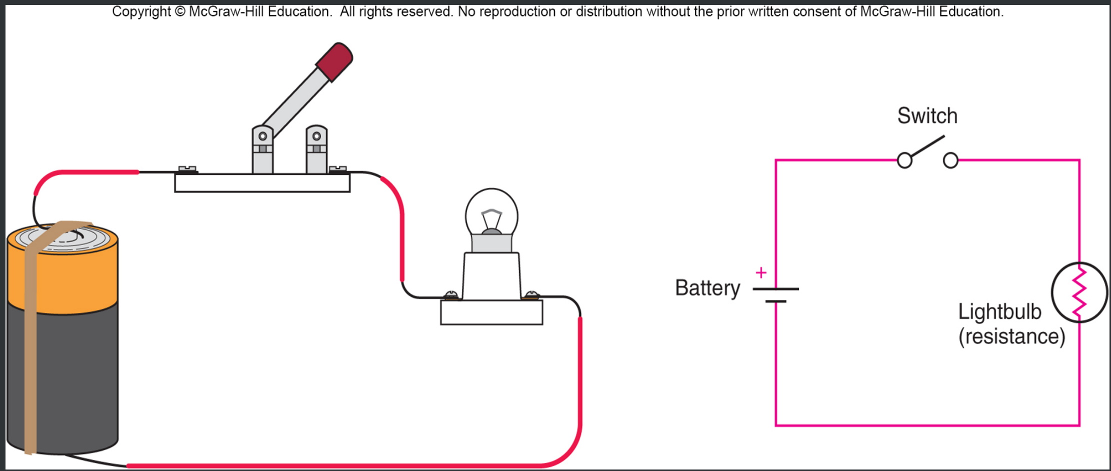
→ Current = ?

$$I = \frac{V}{R} = \frac{12\,V}{80\,\Omega} = 0.15\,A$$

positive terminal (high potential)

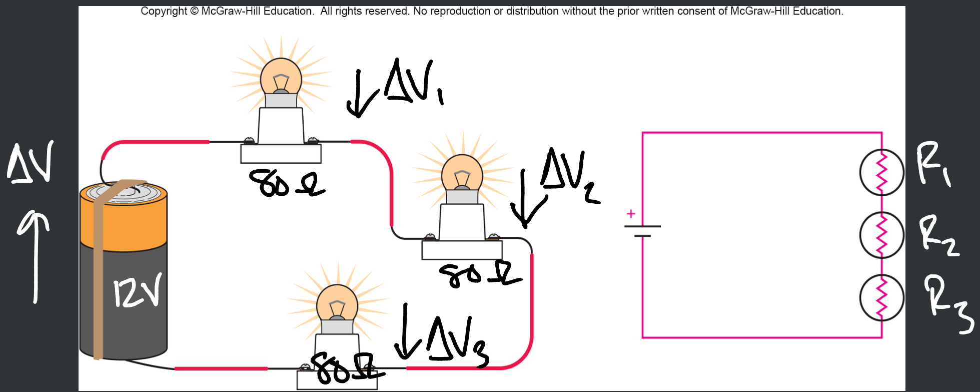
negative terminal (0 potential)

conventional current, I, flows from ⊕ to ⊖ terminals



lightbulbs

Resistors in Series



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

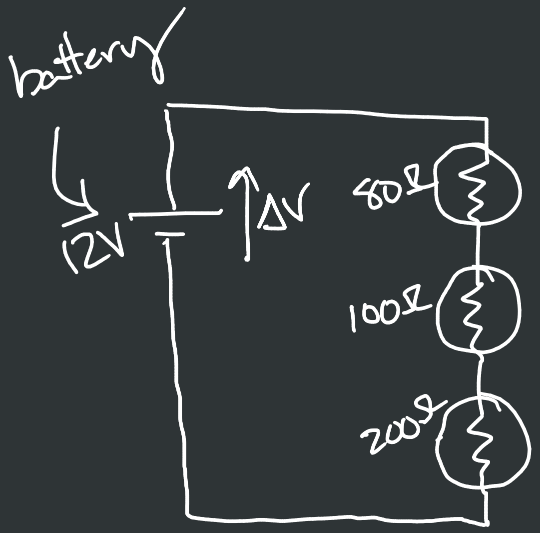
add up to find the equivalent resistance

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

$$I_{R_E} = \frac{V}{R_E}$$ ← Ohm's Law

↳ $R_E = 240\,\Omega = 80 + 80 + 80$

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



$\downarrow \Delta V_1 = R_1 \cdot I$

$R_E = 80 + 100 + 200 = 380\,\Omega$

$$I = \frac{\Delta V_b}{R_E} = \frac{12V}{380\,\Omega} = .0316\,A$$

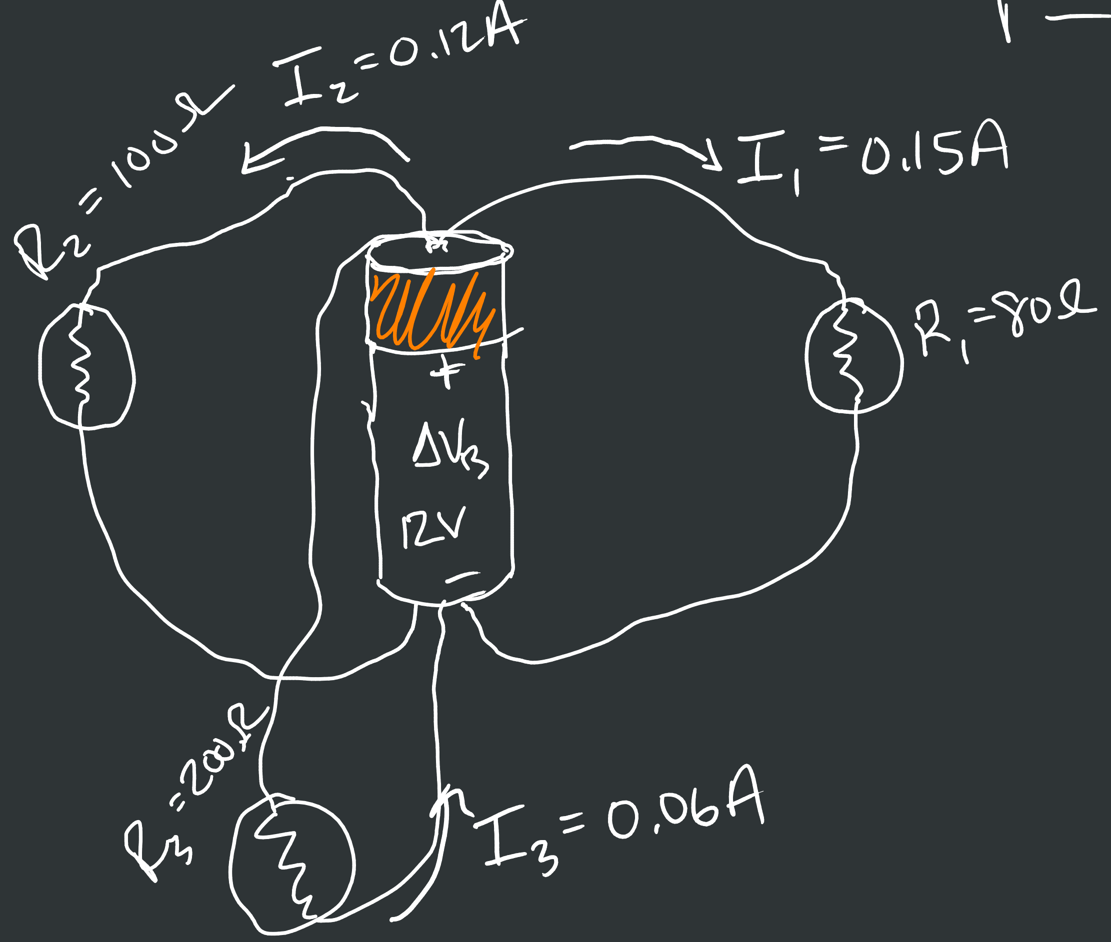
potential drop $= \Delta V_1 = I \cdot R_1 = 80\,\Omega \cdot .0316\,A$

$= 2.563\,V$

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

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

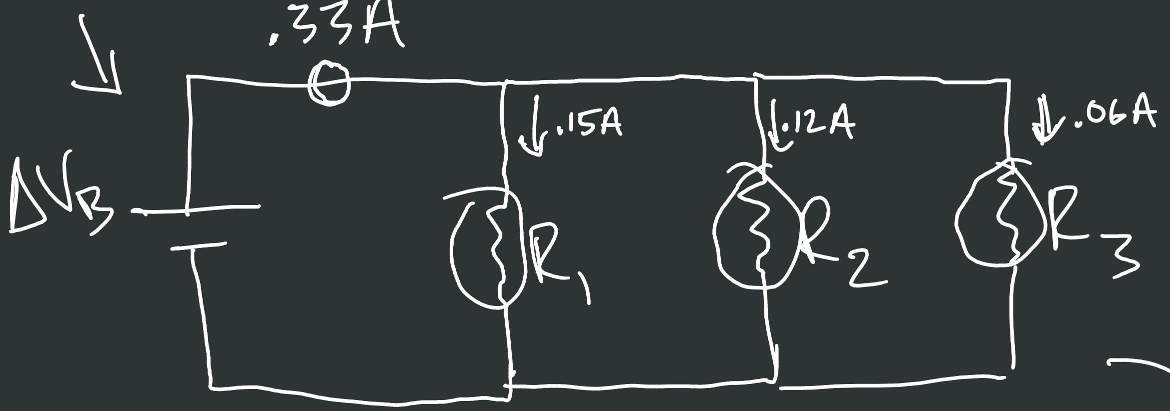
Resistors in parallel → each device has it own connection to the power source.



$$I_1 = \frac{V}{R_1} = \frac{12V}{80\Omega} = 0.15A$$

$$I_2 = \frac{V}{R_2} = \frac{12V}{100\Omega} = 0.12A$$

$$I_3 = \frac{V}{R_3} = \frac{12V}{200\Omega} = 0.06A$$



For resistors in parallel

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

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

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

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

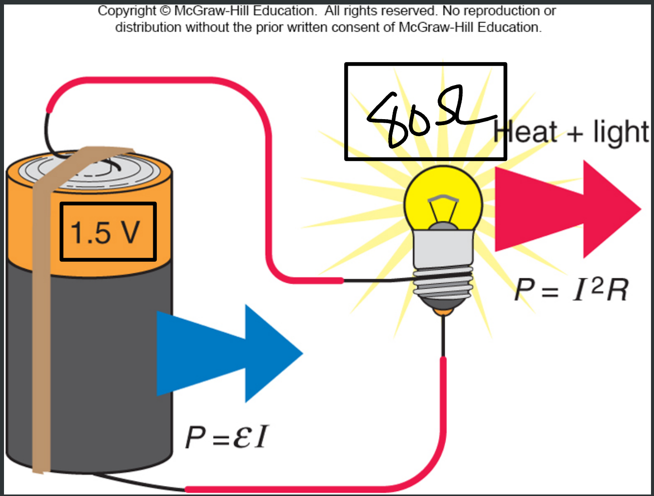
$$\boxed{R_E = 36.36\,\Omega}$$

$$I_b = \frac{12V}{36.36\,\Omega}$$

$$= 0.33A$$

$\boxed{\text{Power}}$ → rate at which work is done / energy changes

→ $\text{Power} = \dfrac{\text{Energy dissipated/used}}{\text{time it is on}}$ $\left[\dfrac{\text{Joule}}{\text{second}}\right]$ $\left[\dfrac{\text{Joule}}{\text{Coulomb}} \cdot \dfrac{\text{Coulomb}}{\text{second}}\right]$



[Watt] [horsepower]

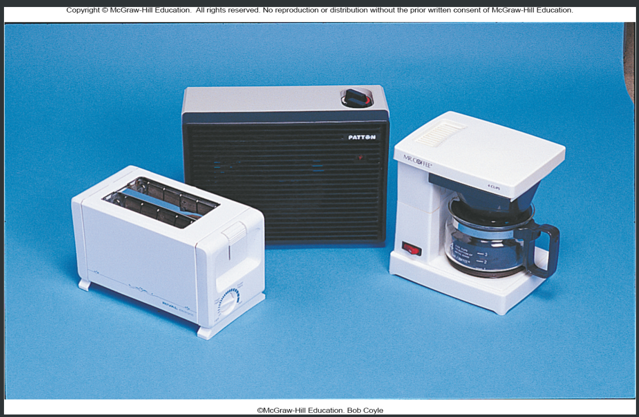
746 Watts = 1 horsepower

Power = Voltage · Current

→ $P = V \cdot I = \dfrac{V^2}{R}$

Ohm's → $R = \dfrac{V}{I} \Rightarrow I = \dfrac{V}{R}$

- $P = V \cdot I$
- (best) $P = \dfrac{V^2}{R}$
- $P = I^2 R$



$P = 100$ Watts

$V = 120$ Volts

$R = ?$

$I = ?$

$P = \dfrac{V^2}{R}$

$100\,W = \dfrac{(120V)^2}{R}$

$R = \dfrac{120^2}{100} = 144\,\Omega$

$P = V \cdot I$

$100W = 120V \cdot I$

$I = \dfrac{100W}{120V}$

$I = .83\,A$

Kilowatt-hours

$$\underbrace{1000\ \text{watt}}_{\text{power}} \cdot \underbrace{\text{hours}}_{\text{time}}$$

$$P = \frac{E}{t} \Rightarrow \text{Energy} = \text{power} \cdot \text{time}$$

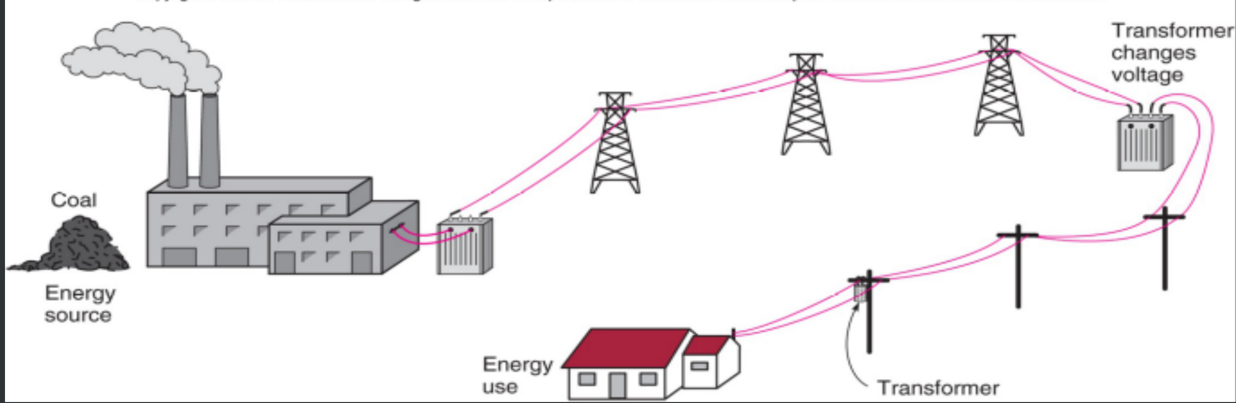
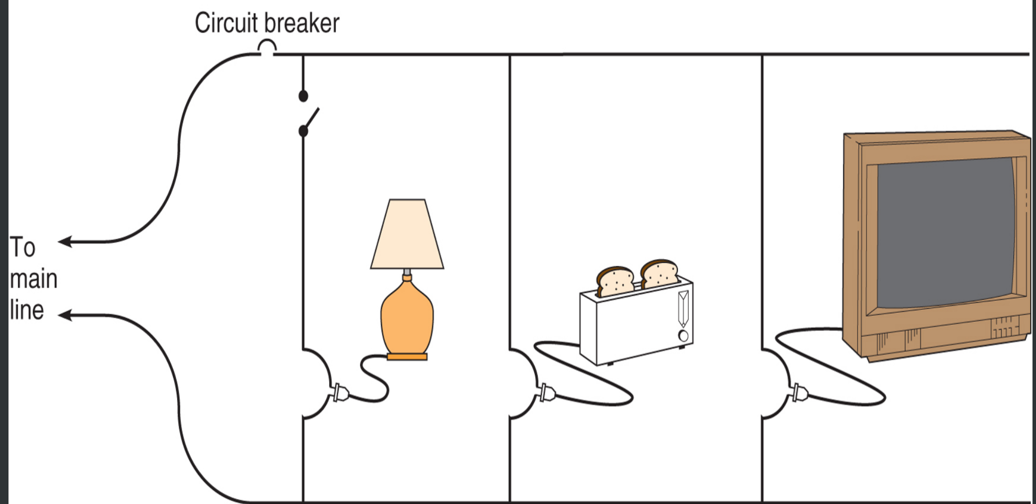


table 13.2

Power and Current Ratings of Some Common Appliances

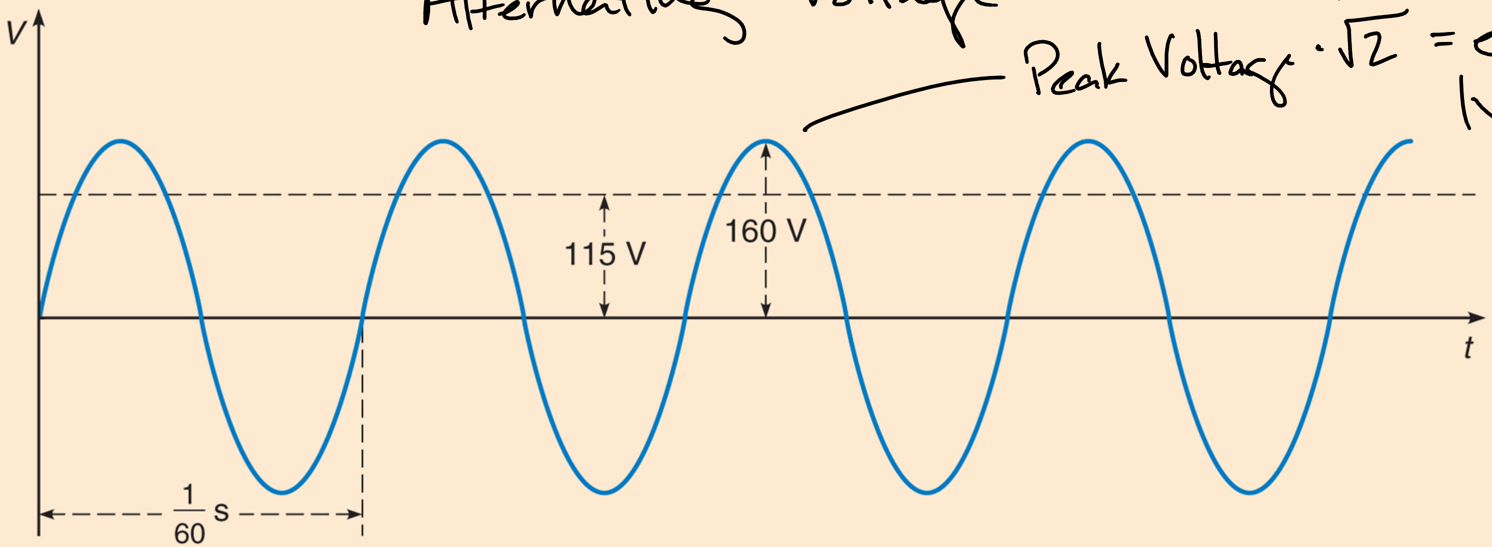
Appliance	Power (W)	Current (A)
stove	6000 (220 V)	27
clothes dryer	5400 (220 V)	25
water heater	4500 (220 V)	20
clothes washer	1200	10
dishwasher	1200	10
electric iron	1100	9
coffeemaker	1000	8
toaster	850	7
hair dryer	650	5
food processor	500	4
large fan	240	2
color television	100	0.8
small fan	50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

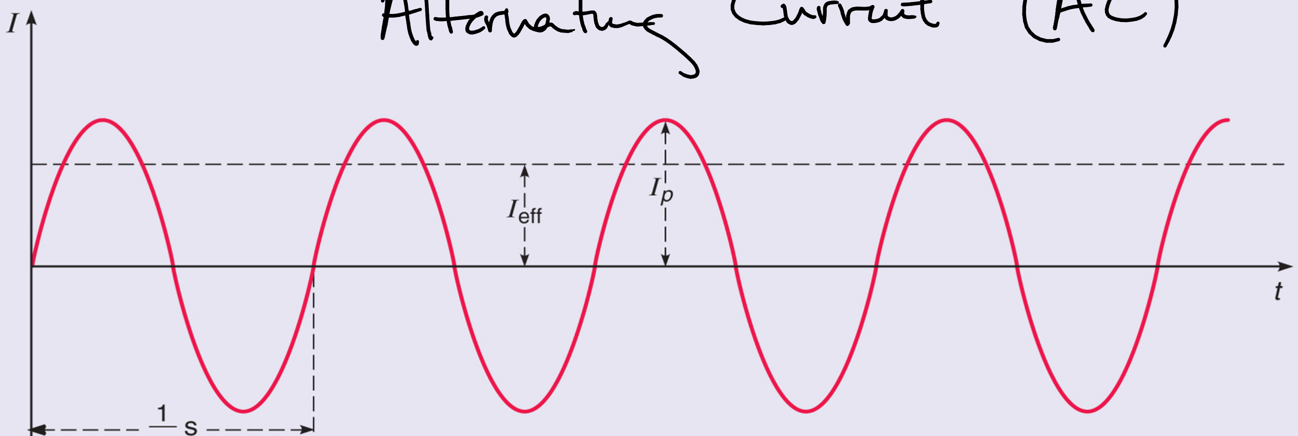


Alternating Voltage

Peak Voltage $\cdot \sqrt{2}$ ~.7 = effective voltage



Alternating Current (AC)



$I_{eff} = 0.707\ I_p$

1) $Q = 28C$ → passing through a resistor

amount that passes in 7 seconds

$I = ?$ $\quad I = \frac{Q}{t} = \frac{28C}{7s} = \underline{4 \text{ Amps}}$

2) A current of 4.5A flows for 3 minutes

How much charge passes?

$I = \frac{Q}{t} \implies Q = I \cdot t = 4.5A \cdot 180 \text{ seconds} = 810C$

$\underline{4.5 \text{ Amps}}$

3 min → 180 seconds

13-14

$P = I \cdot V$

$30W = I \cdot 80V$

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

$V = IR$

$80V = .375A \cdot R$

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

$60\,W \rightarrow I = ?$

$60W = I \cdot 80V$ ← brighter!

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

$80V = .75A \cdot R$

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

lower R than the 30W bulb!