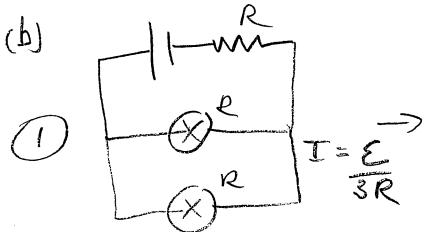
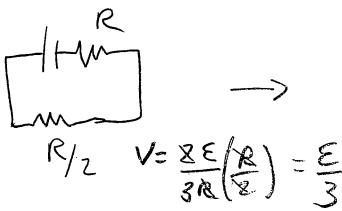


- (29) (a) - bulbs are in parallel and therefore have the same voltage drop across them, \mathcal{E}
 - bulbs are identical and so they pull the same current
 ∴ the brightness will be the same

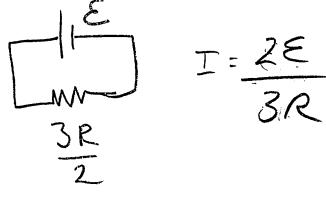
(b)

① 

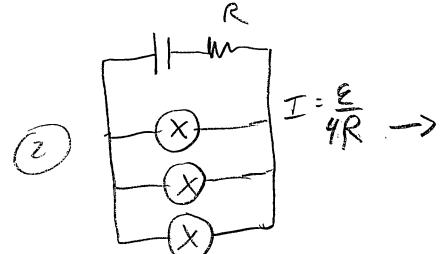
$$I = \frac{\mathcal{E}}{3R} \rightarrow$$



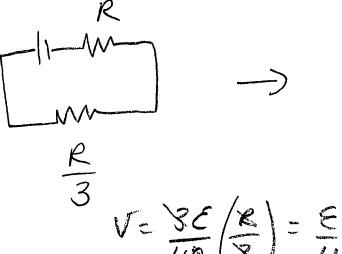
$$V = \frac{8\mathcal{E}}{3R} \left(\frac{R}{2} \right) = \frac{\mathcal{E}}{3}$$



$$I = \frac{2\mathcal{E}}{3R}$$

② 

$$I = \frac{\mathcal{E}}{4R} \rightarrow$$



$$V = \frac{8\mathcal{E}}{4R} \left(\frac{R}{3} \right) = \frac{\mathcal{E}}{4}$$

$$\frac{P_1}{P_2} = \frac{I_1^2 R_1}{I_2^2 R_2} = \frac{\left(\frac{\mathcal{E}}{3R}\right)^2 R}{\left(\frac{\mathcal{E}}{4R}\right)^2 R} = \frac{\frac{1}{9}}{\frac{1}{16}} = \frac{16}{9} \text{ times brighter}$$

(30) $V_D = 8V$ $V_R = 12V - 8V = 4V$
 $I_D = 2A$ $I_R = 2A$ (resistors are in series)

$$R = \frac{V}{I} = \frac{4V}{2A} = \underline{2\Omega}$$

- (31) (a) P (only one device in the circuit)
 (b) $2P$ (two devices in parallel - same \mathcal{E} , same I - so both dissipate P)
 (c) $\frac{P}{2}$ (two devices in series)
 (d) $R_{eq} = \left(\frac{1}{2R} + \frac{1}{R} \right)^{-1} = \frac{2R}{3}$ so power dissipated would be $\frac{3}{2}P$

- (32) an ideal voltmeter has $R = \infty \Omega$
 so all of voltage would be dropped across the voltmeter

$$\underline{12V}$$

- (33) same reasoning as 32

$$\underline{6V}$$

(34) (a) Internal resistance = slope $= -\frac{\Delta V}{\Delta I} = -\frac{(2.4 - 8)}{(18 - 3.2)} = \underline{1.2 \Omega}$

(b) $V = Ir = (3.2A)(1.2\Omega) = 3.84V$ across the internal resistor.

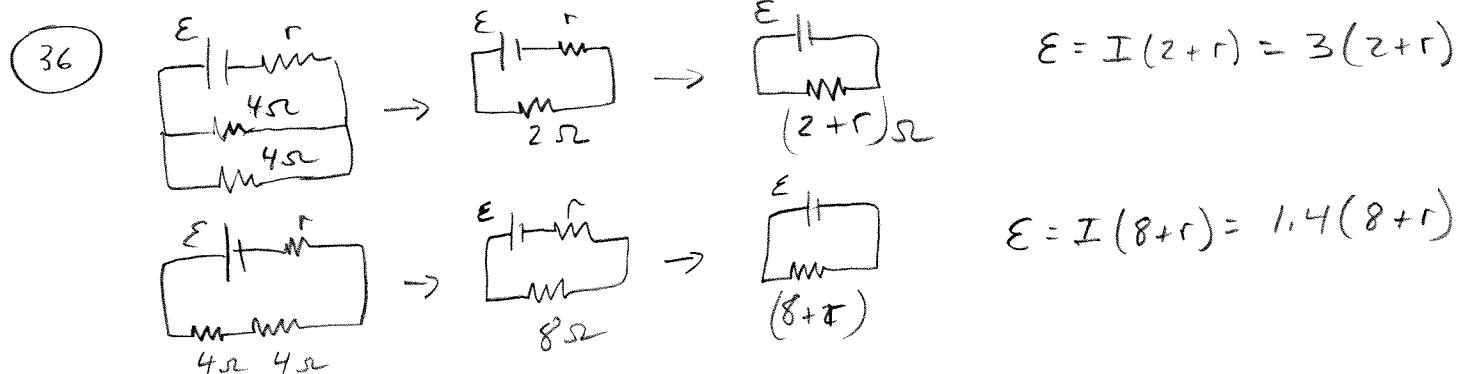
8V across battery

$$\therefore E = 8V + 3.84V = \underline{12V}$$

(35) $I_R = \frac{V}{R} = \frac{1.2V}{1.5\Omega} = 0.8A$

from graph $0.8A \rightarrow 1.6V$

$$\therefore \text{EMF} = 1.2V + 1.6V = \underline{2.8V}$$

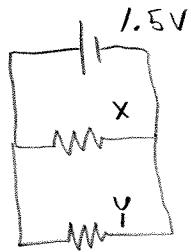


(b) $3(2+r) = 1.4(8+r)$
 $6 + 3r = 11.2 + 1.4r$
 $1.6r = 5.2$
 $r = \underline{3.25\Omega}$

(a) $E = 3(2+r)$
 $= 3(2+3.25)$
 $= \underline{16V}$

(37)

(a)



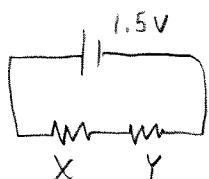
from graph (1.5V)

$$I_x = 2.67 \text{ A}$$

$$I_y = 1.53 \text{ A}$$

$$\text{Total Current} = I_x + I_y = 2.67 \text{ A} + 1.53 \text{ A} = \underline{\underline{4.2 \text{ A}}}$$

(b)



$$V_x + V_y = 1.5 \text{ V}$$

$$I_x = I_y$$

using the graph, find a current that gives two voltages that add to 1.5V

$$I = 1.1 \text{ A} \quad (V_x = 0.6 \text{ V}, V_y = 1.0 \text{ V})$$

(38)

- voltage will not change (parallel circuit)

- PTC R increases, so I decreases

- NTC R decreases, so I increases

A will be dimmer, B will be brighter

(39)

(a) 39 Ω (from graph)

$$(b) R_{\text{eq}} = R_{\text{NTC}} + 25$$

$$I = \frac{V}{R} = \frac{9.0 \text{ V}}{R_{\text{NTC}} + 25}$$

Voltmeter is measuring voltage drop across R_{NTC} .

$$V = IR = \frac{9.0 (R_{\text{NTC}})}{R_{\text{NTC}} + 25}$$

$$(c) V = \frac{9.0 (39 \Omega)}{39 \Omega + 25} = \underline{\underline{5.5 \text{ V}}}$$

(d) - Voltmeter reading can be calibrated for temperature.
- as temperature changes, the voltage will change.

(40) (a) 4.0V

$$(b) R = \frac{V}{I} = \frac{4V}{0.2A} = 20\Omega$$

$$(c) R_{eq} = \left(\frac{1}{60} + \frac{1}{20} \right)^{-1} = 15\Omega + 60\Omega = \underbrace{75\Omega}_{\text{Total } R}$$

$$I = \frac{V}{R} = \frac{8V}{75\Omega} = 0.107A$$

$$V = IR = (0.107A)(15\Omega) = \underline{1.6V}$$

$$(d) I = \frac{V}{R} = \frac{1.6V}{20\Omega} = \underline{0.08A}$$

(e) there is not enough current to light the bulb.

(41) (a) $R_{eq} = \left(\frac{1}{100\Omega} + \frac{1}{100\Omega} \right)^{-1} = 50\Omega + 100\Omega = 150\Omega$

$$I = \frac{V}{R} = \frac{6V}{150\Omega} = 0.04A$$

$$V = IR = (0.04A)(50\Omega) = \underline{2V}$$

$$(b) R_{eq} = \left(\frac{1}{110\Omega} + \frac{1}{100\Omega} \right)^{-1} = 52.38 + 100\Omega = 152.38\Omega$$

$$I = \frac{V}{R} = \frac{6V}{152.38} = 0.039A$$

$$V = IR = (0.039A)(52.38) = \underline{2.06V}$$