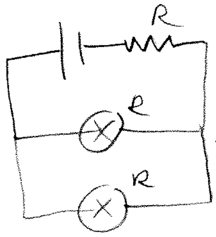
(29) (a) - bulbs are in parallel and therefore have the same voltage drop across them, $\mathcal{E}$

- bulbs are identical and so they pull the same current

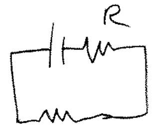
$\therefore$ the brightness will be the <u>same</u>

(b)

(1)

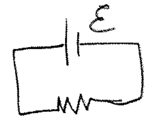


$I = \frac{\mathcal{E}}{3R}$ →



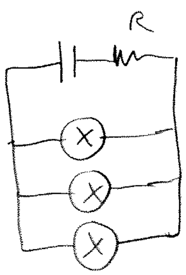
$R/2$ $\quad V = \frac{2\mathcal{E}}{3R}\left(\frac{R}{2}\right) = \frac{\mathcal{E}}{3}$

→

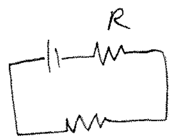


$\frac{3R}{2}$ $\quad I = \frac{2\mathcal{E}}{3R}$

(2)



$I = \frac{\mathcal{E}}{4R}$ →



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

→

$\frac{4R}{3}$ $\quad I = \frac{3\mathcal{E}}{4R}$

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

(30) $V_D = 8\,V$ $\qquad V_R = 12V - 8V = 4V$

$I_D = 2\,A$ $\qquad I_R = 2A$ (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) $R_{eq} = \left(\frac{1}{2R} + \frac{1}{R}\right)^{-1} = \frac{3R}{2}$ $\quad$ 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

<u>12 V</u>

(33) same reasoning as 32

<u>6 V</u>

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

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

8 V across battery

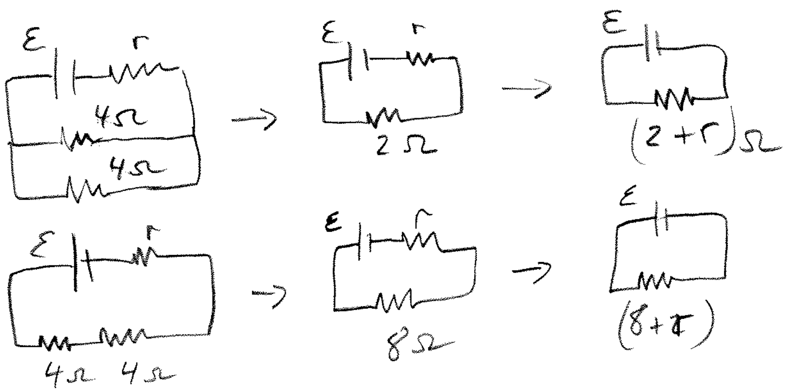
$\therefore\ \mathcal{E} = 8\text{V} + 3.84\text{V} = \underline{12\text{ V}}$

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

from graph $0.8\text{A} \rightarrow 1.6\text{ V}$

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

(36)



$\mathcal{E} = I(2+r) = 3(2+r)$

$\mathcal{E} = I(8+r) = 1.4(8+r)$

(b)

$3(2+r) = 1.4(8+r)$

$6 + 3r = 11.2 + 1.4r$

$1.6r = 5.2$

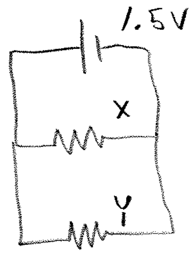
$r = \underline{3.25\ \Omega}$

(a) $\mathcal{E} = 3(2+r)$

$= 3(2 + 3.25)$

$= \underline{16\text{ V}}$

(37) (a)



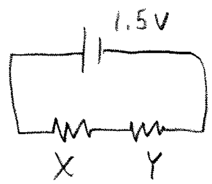
from graph (1.5V)

$I_x = 2.67\,A$

$I_y = 1.53\,A$

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

(b)



$V_x + V_y = 1.5\,V$

$I_x = I_y$

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

$I = 1.1\,A \qquad (V_x = 0.6V,\ V_y = 1.0V)$

(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) $\underline{39\,\Omega}$ (from graph)

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

$I = \dfrac{V}{R} = \dfrac{9.0\,V}{R_{NTC} + 25}$

Voltmeter is measuring voltage drop across R_{NTC}

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

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

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

(40) (a) 4.0 V

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

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

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

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

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

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

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

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

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

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

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

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