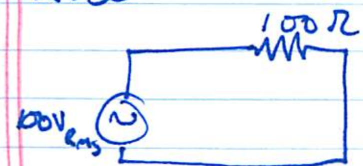
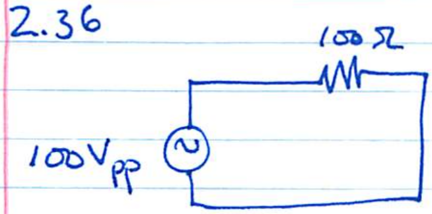
Electronics Hw #3

2.35



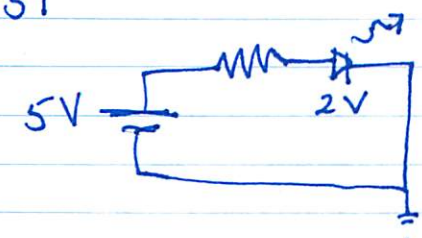
$$\langle P \rangle = i_{Rms} V_{Rms} = \frac{V_{Rms}^2}{R} = \frac{(100\,V)^2}{100\,\Omega}$$
$$= 100\,W$$

2.36



$$\text{The amplitude} = \frac{V_{pp}}{2} = 50V$$
$$V_{Rms} = \frac{\text{Amplitude}}{\sqrt{2}} = \frac{50V}{\sqrt{2}}$$
$$\langle P \rangle = V_{Rms}^2/R = \left(\frac{50V}{\sqrt{2}}\right)^2 \frac{1}{100\,\Omega} = 12.5W$$

2.39



By kirchhoffs loop rule

$$5V - iR - 2V = 0$$
$$R = \frac{3V}{i}$$

The desired current is at least $i = 10 \times 10^{-3} A$

and at most $i = 100 \times 10^{-3} A$

so $R = \frac{3V}{10^{-2}A} = 300\,\Omega$

and $R = \frac{3V}{10^{-1}A} = 30\,\Omega$

$$30\,\Omega < R < 300\,\Omega$$

the power disappated will depend on R

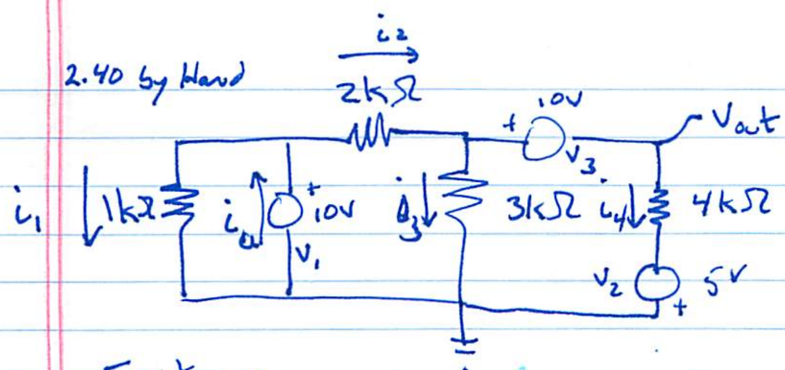
$$P = \frac{V^2}{R} = \frac{9V^2}{30\,\Omega} \text{ to } \frac{9V^2}{300\,\Omega}$$
$$= 0.3W \text{ to } 0.03W$$

so a ½ W resistor w/

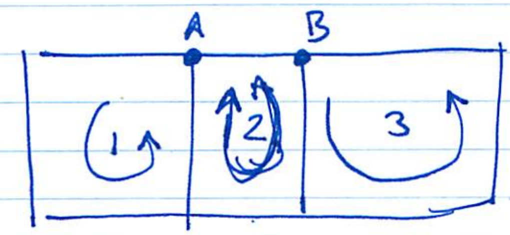
$30\,\Omega < R < 300\,\Omega$

would work.

2.40 by Hand



First we ~~Now to~~ assign current directions and then write loop and node equations



loop 1

$10V - i_1 1k\Omega = 0$

loop 2

$10V - 2k\Omega i_2 - 3k\Omega i_3 = 0$

loop 3

$10V - 3k\Omega i_3 - 5V + 4k\Omega i_4 = 0$

Node A

$i_a = i_1 + i_2$

Node B

$i_2 = i_3 + i_4$

from loop 1 $i_1 = 10mA$

Combining loop 2 and Node B

$10V - 2k\Omega(i_3 + i_4) - 3k\Omega i_3 = 0$

$10V - 5k\Omega i_3 - 2k\Omega i_4 = 0$

simplify ~~loop~~ loop 3

$5V - 3k\Omega i_3 + 4k\Omega i_4 = 0$

$25V - 13k\Omega i_3 + 0 = 0$

or $i_3 = \frac{25}{13} mA = 1.92 mA$

and from loop 3 $5V - \frac{75}{13} V = -4k\Omega i_4 \Rightarrow i_4 = 0.19 mA$ or $\frac{5}{26} mA$

Taking stock we want V_{out}, P_{V_1}, P_{V_2}, P_{V_3}

$$V_{out} = i_4 R_4 - 5V = 0.19\,mA \times 4k\Omega - 5V = -4.23V$$

To find Powers

$$P_{V_1} = i_a(V_1) = i_a\,10V$$

$$P_{V_2} = i_4(+V_2) = 0.19mA(+5V) = +0.96\,mW \quad \leftarrow \text{adds power}$$

$$P_3 = i_4(-V_3) = 0.19mA(-10V) = -1.9mW \quad \leftarrow \text{removes power}$$

all that remains is i_a which from Nodes A & B is

$$i_a = i_1 + i_3 + i_4 = 10\,mA + 1.92\,mA + 0.19\,mA$$
$$= 12.12\,mA$$

so

$$P_{V_1} = 121.2\,mW \quad \leftarrow \text{adds power}$$

Comparing this w/ LTspice (see HW3b.pdf)

$$V_{out} = -4.23V$$

$$P_{V_1} = -121.15\,mW$$
$$P_{V_2} = -0.96\,mW$$
$$P_{V_3} = 1.92\,mW$$

Note that LTspice reports disapated power so Negative power => power added to circuit.

2.46 Power in from wall $120V_{RMS}$ — Power out to lights 24_{RMS}

we need to step down the voltage

in → V_p, out → V_s:

$$\frac{V_p}{V_s} = \frac{n_p}{n_s}$$

$$\frac{120V}{24V} = 5 = \frac{n_p}{n_s}$$

we need 5x as many Primary loops as 2ndary.

2.47 Impedance matching delivers maximum power so if $Z_{out} = 8\Omega$ we need $Z_{in} = 8\Omega$ = impedance of speaker to choose.

2.48 separate wires can gap forming a loop ie. an inductor. This inductor can pick up high frequency interference, it acts like an antenna.