HOMEWORK 6 SOLUTIONS

1. (26.16) a) $R_{60W} = \frac{V^2}{P} = \frac{(120V)^2}{60W} = 240\,\Omega$

$$R_{200W} = \frac{V^2}{P} = \frac{(120V)^2}{200W} = 72\,\Omega$$

$$\Rightarrow I_{60W} = I_{200W} = \frac{\mathcal{E}}{R} = \frac{240V}{(240\Omega + 72\Omega)} = 0.769A$$

b) $P_{60W} = I^2R = (0.769A)^2(240\Omega)$
$= 142W$

$$P_{200W} = I^2R = (0.769A)^2(72\Omega) = 42.6W$$

c) The 60W bulb burns out quickly because the power it delivers (142W) is 2.4 times its rated value.

2. (26.22) From the circuit in Fig. 26.42, we use Kirchhoff's Rules to find the currents, I_1 to the left through the 10V battery, I_2 to the right through the 10Ω resistor:

Upper loop: $10.0V - (2.0\Omega + 3.0\Omega)I_1 - (1.0\Omega + 4.0\Omega)I_2 - 5V = 0$
$\Rightarrow I_1 + I_2 = 1.00A$

Lower loop: $5.0V + (1.0\Omega + 4.0\Omega)I_2 - (10.0\Omega)I_3 = 0$
$\Rightarrow I_2 - 2I_3 = -1.0A$

Along with $I_1 = I_2 + I_3$, we can solve for the three currents and find: $I_1 = 0.8A$, $I_2 = 0.2A$, $I_3 = 0.6A$

b) $V_{ab} = -(0.2A)(4.0\,\Omega) - (0.8A)(3.0\,\Omega) = -3.2V$

3. (26.25) The total power dissipated in the four resistors of Fig. 26.10a is given by the sum of:

$$P_2 = I^2R_2 = (0.5A)^2(2\,\Omega) = 0.5W,$$

$$P_3 = I^2R_3 = (0.5A)^2(3\,\Omega) = 0.75W$$

$$P_4 = I^2R_4 = (0.5A)^2(4\,\Omega) = 1W$$

$$P_7 = I^2R_7 = (0.5A)^2(7\,\Omega) = 1.8W$$

$$\Rightarrow P_{total} = P_2 + P_3 + P_4 + P_7 = 4W$$

4. (26.37) a) $i = \mathcal{E}/RC = 1.12\times10^{-4}A$

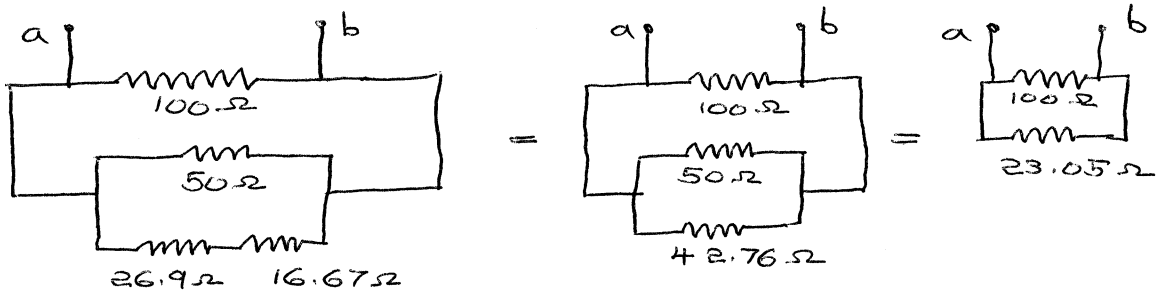
b) $\tau = RC = 5.82\times10^{-4}s$

5. (26.55) Circuit (a)

The $75\,\Omega$ and $40\,\Omega$ resistors are in parallel and have equivalent resistance $26.09\,\Omega$

The $25\,\Omega$ and $50\,\Omega$ resistors are in parallel and have equivalent resistance $16.67\,\Omega$

The network is equivalent to:

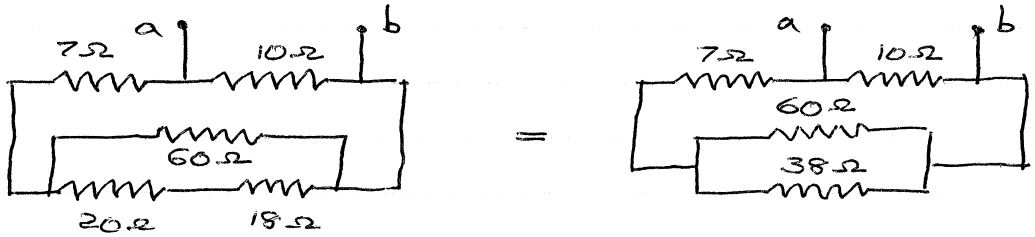


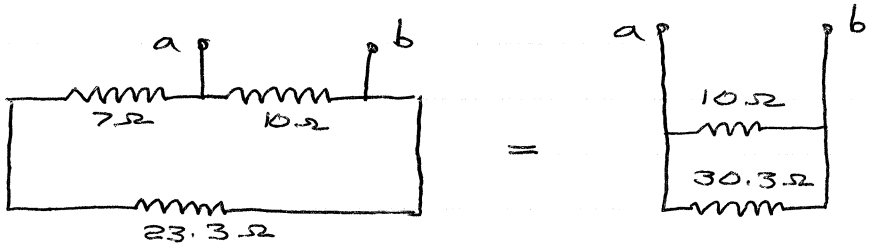
$$\frac{1}{R_{eq}} = \frac{1}{100\,\Omega} + \frac{1}{23.05\,\Omega} \quad \text{so} \quad R_{eq} = 18.7\,\Omega$$

Circuit (b)

The 30.0 Ω and 45.0 Ω resistors are in parallel and have equivalent resistance 18.0 Ω

The network is equivalent to:





$$\frac{1}{R_{eq}} = \frac{1}{10\,\Omega} + \frac{1}{30.3\,\Omega} \quad \text{so} \quad R_{eq} = 7.5\,\Omega$$