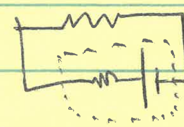
Ch10 solutions

22) a) $I = V/R_{eq} = 12/0.06 = \boxed{200\,A}$

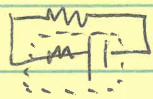


b) Since $R_{internal} = 0.01\Omega$, then voltage "wasted" within battery is $IR_{internal} = 2.0V \Rightarrow \Delta V_{motor} = \boxed{10.0V}$

c) $P = \Delta V^2/R_{motor} = 10^2/0.05 = \boxed{2000\,W}$

d) $I = 12/0.15 = \boxed{80A}$ $\quad \Delta V_{motor} = 12V - 80 \cdot 0.1 = \boxed{4V}$ $\quad P = 4^2/0.05 = \boxed{320\,W}$

24) a)



b) $I = \frac{20,000}{12,000} = \boxed{1.67A}$

c) $P = I^2R = (1.67)^2(10,000) = \boxed{2.78\,kW}$

d) $I_{th} < 10^{-3} \Rightarrow R > V/I_{th} = \boxed{20M\Omega}$

e) From solutions manual: "With low current, the power supply is still effective as power loss is low due to internal resistance."

28) a) $I = P/V \Rightarrow I_{toaster} = \boxed{15A}$ $\quad I_{speaker} = \boxed{11.7A}$ $\quad I_{lamp} = \boxed{0.63A}$

b) $I_{total} = I_{toaster} + I_{speaker} + I_{lamp} > 15A$ $\boxed{\text{yes}}$

33) a) $\Delta V_1 = 15 \cdot 0.8 = 12V$ $\quad \Delta V_2 = \Delta V_3 = 120 - 12 = 108V$

$\Rightarrow P_{bulb} = V_2^2/R_2$ where $R_2 = 120^2/75 = 192\Omega$

$= 108^2/192 = \boxed{60.75\,W}$

b) $R_{eq} = 120V/15A = 8\Omega$

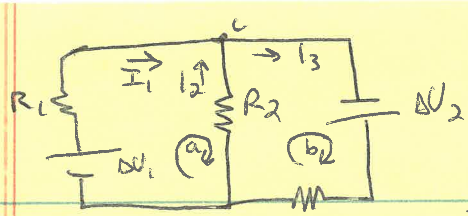
also, $R_{eq} = R_1 + \left(\frac{1}{R_2} + \frac{1}{R_3}\right)^{-1} \Rightarrow R_3 = \left[(R_{eq} - R_1)^{-1} - \frac{1}{R_2}\right]^{-1} = 7.48\Omega$

$\Rightarrow P_3 = 108^2/7.48 = \boxed{1559\,W}$

36) a) $I = \frac{24V - 12V}{60 \cdot 10^3\Omega} = 0.2mA \Rightarrow$ $\boxed{\Delta V_1 = I_1R_1 = 2.00V \quad \Delta V_2 = 4.00V \quad \Delta V_3 = 2.00V \quad \Delta V_4 = 2.00V \quad \Delta V_5 = 2.00V}$

b) battery 2 powers the circuit $\Rightarrow P_{in} = I\Delta V_2 = \boxed{4.8mW}$

$P_{out} = I\Delta V_1 + I^2(R_1 + R_2 + R_3 + R_4 + R_5) = \boxed{4.8mW}$



38) a) $\Delta V_1 - I_1 R_1 + I_2 R_2 = 0$ b) $-I_2 R_2 + \Delta V_2 - I_3 R_3 = 0$

c) $I_1 + I_2 = I_3$

c) $I_2 = I_3 - I_1$ (4)

(4) into (b): $-I_3 R_2 + I_1 R_2 + \Delta V_2 - I_3 R_3 = 0$ (5)

$\Rightarrow I_3 = (I_1 R_2 + \Delta V_2)/(R_2 + R_3) = \frac{12+21}{6+5} = \boxed{3A}$ (6)

(6) into (4): $I_2 = 3 - 2 = \boxed{1A}$ (7)

(7) into (a): $\Delta V_1 = I_1 R_1 - I_2 R_2 = 24 - 6 = \boxed{18V}$

50) $V_f = V_i (1 - e^{-\Delta t/RC}) \Rightarrow 0.632 = 1 - e^{-\Delta t/RC}$

$\Rightarrow R = -\Delta t / C \ln(0.368) = \frac{-60/72}{25 \cdot 10^{-9} \ln(0.368)} = \boxed{3.33 \cdot 10^7 \Omega}$

52) $R_a = 125\,k\Omega$ $R_b = 20\,k\Omega$ $C_a = 9.50\,\mu F$ $C_b = 1.5789\,\mu F$

$\Rightarrow R_a C_a = \boxed{1.188\,s}$ $R_a C_b = \boxed{0.197\,s}$ $R_b C_a = \boxed{0.19\,s}$ $R_b C_b = \boxed{0.0316\,s}$

56) $V(t) = V_f (1 - e^{-t/RC}) \Rightarrow 0.9 = 1 - e^{-t/RC} \Rightarrow t = -RC \ln 0.1 = \boxed{17.3\,ms}$

62) Section 10.6 of OpenStax textbook indicates $< 1\,mA$ for no sensation

$\Rightarrow R > V/I_{th} = \boxed{1.2 \cdot 10^5 \Omega}$