Physics 102 Spring 2007: Suggested Problems # 6

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1. Problem 27-64. (**+5 pts**)

   a. +3 pts - Correct value for the current after applying Kirchhoff's rules for circuits.

   $$I = 0.3A.$$

   b. +1 pt - Correct power through the battery.

   $$P_V = V\,I = 1.8W.$$

   c. +1 pt - Correct power through the resistor.

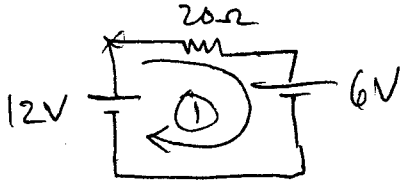
   $$P_R = V\,I = I^2\,R = 1.8W.$$

2. Problem 27-80 (**+5 pts**)

   a. +5 pts - Correct answer for the charge on the plates with *correct sign* ($Q_C = 5\mu C$ with top plate positive).

   b. +5 pts - Correct answer for the current through the 35-Ω resistor ($I_{35\Omega} = 0.1A$).

27-64



$$\Delta V = 0 = -20I - 6V + 12V = -20I + 6V$$

$$\Rightarrow I = \frac{6}{20} \text{ Amp}$$

(a) $\boxed{I = \frac{3}{10} \text{ Amp}}$

(b) Power through battery (6V)

$$P_{6V} = V_{6V} I = (6V)\left(\frac{3}{10} A\right) = \frac{18}{10} W = 1.8 W \quad //$$

(c) Power through resistor.

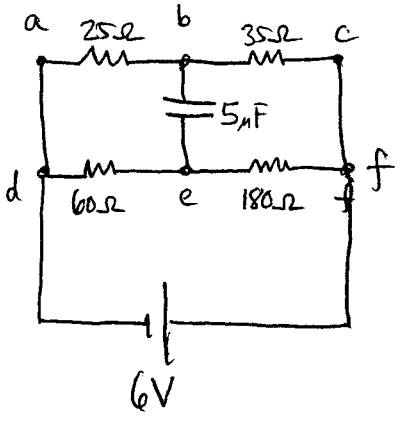
$$P_{20\Omega} = V_{20\Omega} I_{20\Omega} = I_{20\Omega}^2 (20\Omega) = \left(\frac{9 A^2}{100}\right)(20\Omega)$$

$$\boxed{P_{20\Omega} = \frac{9}{5} W = \frac{18}{10} W = 1.8 W}$$

Note: $P_{12V} = (12V)\left(\frac{3}{10} A\right) = \frac{36}{10} W = 3.6 W$

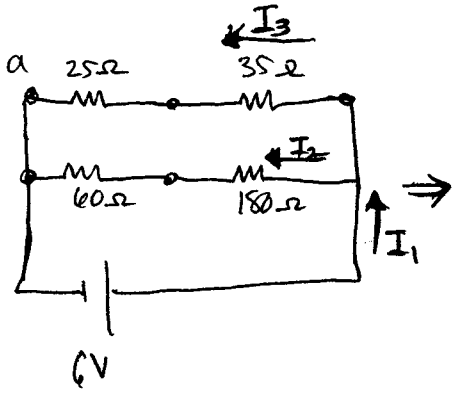
So $\boxed{P_{12V} = P_{6V} + P_{20\Omega}}$

27-80

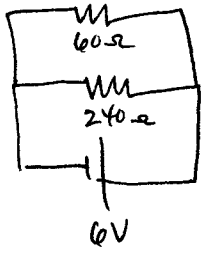


After a very long time the capacitor is fully charged so no current "flows" thru capacitor.

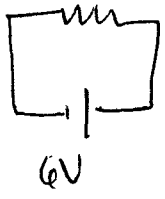
Redraw circuit



$I_4 = I_2 + I_3$



$\Rightarrow$



$\frac{1}{R_{eff}} = \frac{1}{60} + \frac{1}{240} = \frac{5}{240\Omega} \Rightarrow \frac{240}{5}\Omega = R_{eff}$

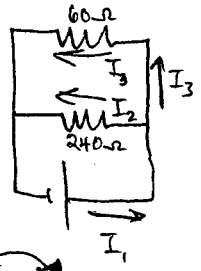
$R_{eff} = 48\Omega$ #

$\Rightarrow \boxed{I_T = \frac{6V}{48\Omega} = \frac{1}{8}A}$

27-80

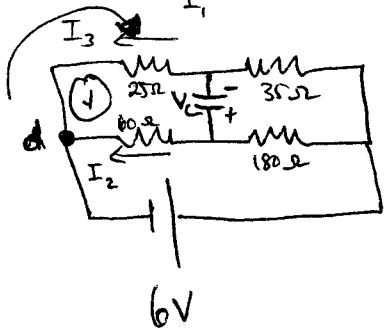
A current of $\frac{6V}{240\Omega} = 0.025\,A$ through 240Ω (effective resist)

A current of $\frac{6V}{60\Omega} = \frac{1}{10}A = 0.1\,A$ through 60Ω (effective resistor),



$\Rightarrow$ $I_1 = I_2 + I_3 = 0.125\,A$ ✓

$I_2 = 0.025A$ & $I_3 = 0.1A$



Applying Kirchhoff's Rules to loop labeled (1)

$\Delta V_{dd} = 0 = I_3(25\Omega) + V_c - I_2(60\Omega) -$

I have assumed top plate of capacitor is (-) w.r.t. bottom plate! so $V_b < V_e$ (in my assumption).

$\Rightarrow V_c = 60I_2 - 25I_3 = 60(0.025A) - 25(0.1A)$

$V_c = 1.5V - 2.5V = -1V$

$\Rightarrow V_b > V_e$ so my assumption was incorrect!

$\boxed{V_b - V_e = +1V}$ $\Rightarrow$ Top plate is (+).

(a) $\boxed{Q = (1V)(5\mu F) = 5\mu C}$

(b) Current through 35Ω resistor is $I_3 = 0.1\,A$ //