Homework #5
Due Th. 10/18

You may use Matlab to generate plots.

1. (Hambley P4.7)

   Given an initially charged capacitance that begins to discharge through a resistance at $t = 0$,

   (a) What percentage of the initial voltage remains at two time constants?

   (b) What percentage of initial stored energy remains?

2. (Hambley P4.9)

   In physics, the half-life is often used to characterize exponential decay of physical quantities such as radioactive substances. The half-life is the time required for the quantity to decay to half of its initial value. The time constant for the voltage on a capacitance discharging through a resistance is $\tau = RC$. Find an expression for the half0life of the voltage in terms of RC.

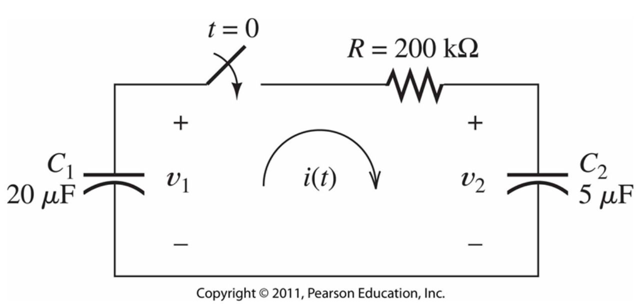

Figure P4.18

3. (Hambley P4.18)

   Consider the circuit shown in Fig. P4.18. Prior to $t = 0, v_1 = 100\,\mathrm{V}, \mathrm{and} v_2 = 0$.

   (a) Immediately after the switch is closed, what is the value of the current [i.e., what is the value of $i(0^+)$]?

   (b) Write the circuit equations needed to obtain the differential equation relating current?

   (c) What is the value of the time constant in this circuit?

   (d) Find and expression for the current as a function of time.

   (e) Find the value that v_2 approaches as t becomes very large.

4. (Hambley P4.20)

   Explain why we replace capacitances with open circuits and inductances with short circuits in dc steady-state analysis.

5. (Hambley P4.24)

   The circuit shown in Fig. P4.24 has been setup for a long time prior to $t = 0$ with the switch closed. Find the value of v_C prior to $t = 0$. Find the steady-state value of v_C after the switch has been opened for a long time.

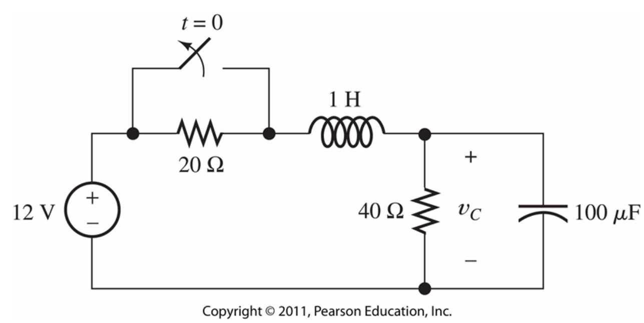

Figure P4.24

6. (Hambley P4.27)

   The circuit of Fig. P4.27 has been connected for a very long time. Determine the values of v_C and i_R.

7. (Hambley P4.28)
Consider the circuit of Fig. P4.28 in which the switch has been closed for a long time prior to $t = 0$.
   (a) Determine the values of $v_C(t)$ before $t = 0$ and a long time after $t = 0$.
   (b) Also determine the time constant after the switch opens and an expression for $v_C(t)$.
   (c) Sketch $v_C(t)$ to scale versus time for $-0.2 \leq t \leq 0.5\,\text{s}$

8. (Hambley P4.42)
The switch shown in Fig. P4.42 has been closed for a long time prior to $t = 0$, then it open at $t = 0$ and closes again at $t = 1\,\text{s}$. Find $i_L(t)$ for all t.

9. (Hambley P4.43)
Determine expressions for and sketch $v_R(t)$ to scale versus time for the circuit of Fig. P4.43. The circuit is operating in steady state with the switch closed prior to $t = 0$. Consider the time interval $-1 \leq t \leq 5\,\text{ms}$.

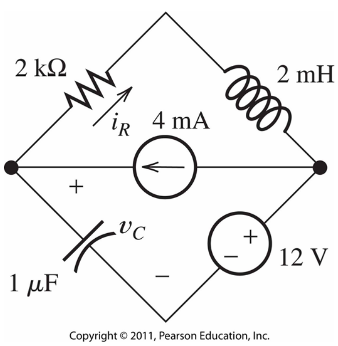

Figure P4.27

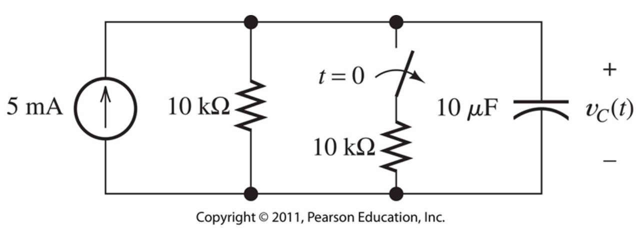

Figure P4.28

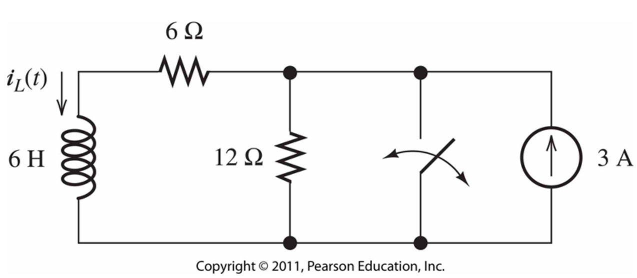

Figure P4.42

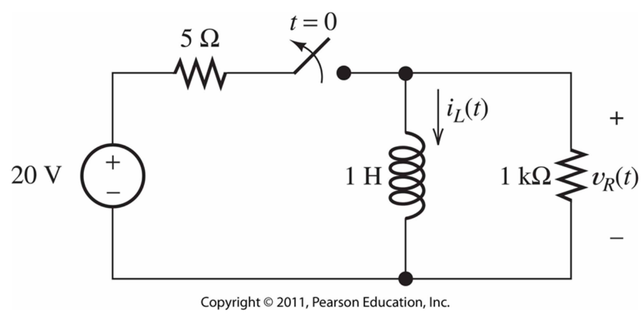

Figure P4.43