Department of Electrical & Computer Engineering
University of California, Santa Barbara

Homework #5

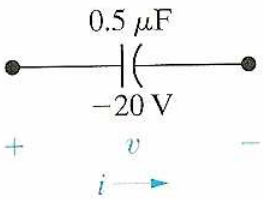
Due Date: May 16, 2008 (by 5:00 pm)

1. The current in a 50 H inductor is known to be

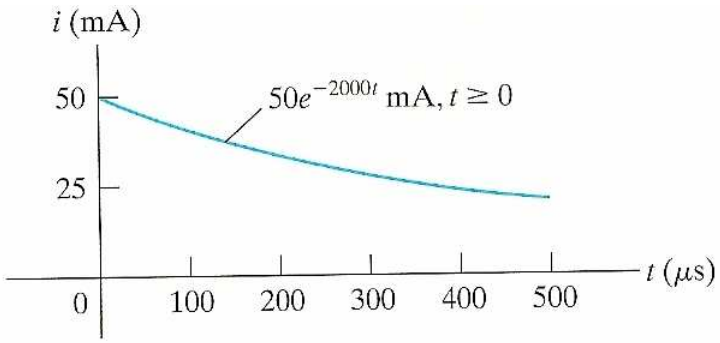
$$i_L = 18te^{-10t}\ \text{A} \quad \text{for } t \geq 0.$$

(a) Find the voltage across the inductor for t>0. (Assume the passive sign convention.)
(b) Find the power at the terminals of the inductor at t = 200 ms.
(c) Is the inductor absorbing or delivering power at 200 ms ?
(d) Find the energy stored in inductor at 200 ms.
(e) Find the max. energy stored in inductor and the time it occurs.

2. The initial voltage on the 0.5 μ F capacitor shown in figure (a) below is -20 V. The capacitor has a waveform is shown in Fig (b)
(a) How much energy, in microjoules, is stored in the capacitor at t = 500 μs
(b) Repeat (a) for t = ∞.

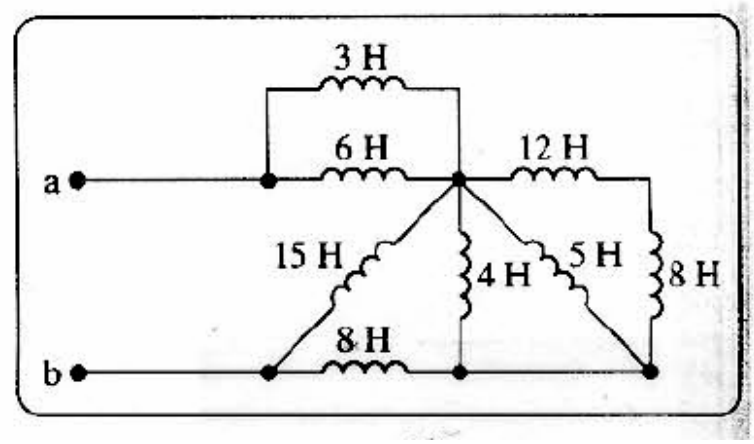


(a)

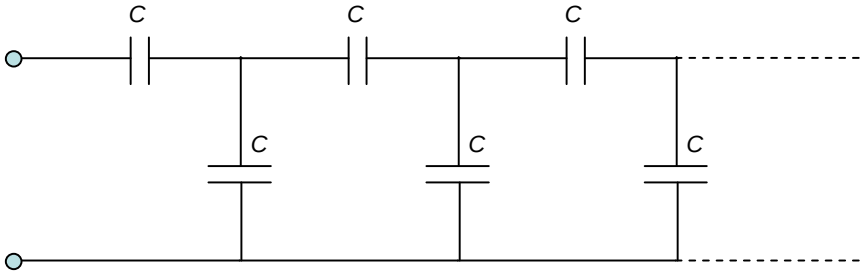


(b)

3. Assume that the initial energy stored in the inductors of fig. below is zero. Find the equivalent inductance with respect to the terminals a,b.



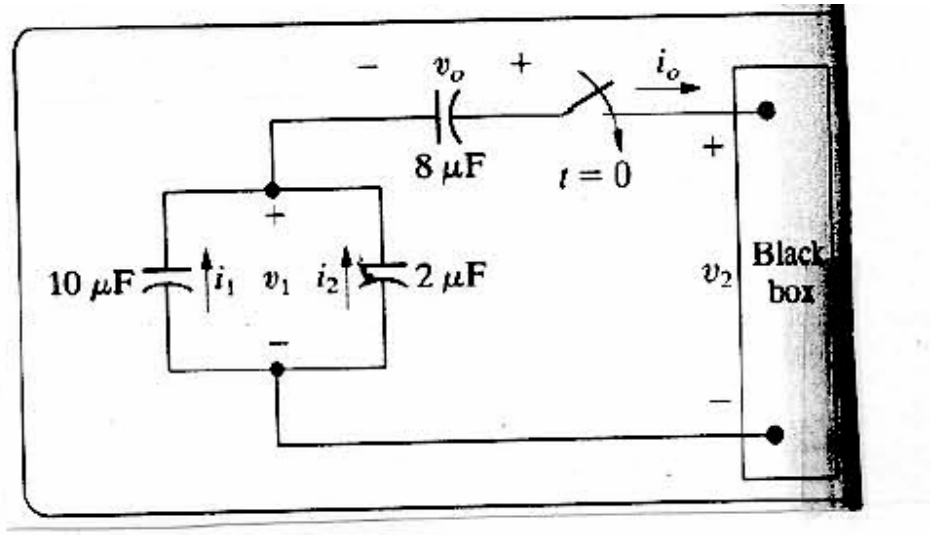
4. Find the capacitance of an infinite circuit formed by the repetition of the same link consisting of two identical capacitors, each with capacitance C (see figure below)



5. The three capacitor in fig below are connected across a black box at t = 0. Assuming current i_0 for t>0 is known to be

$$i_o = 1.92e^{-20t}\ \text{mA}.$$

If $v_0(0)$ = -5 V and $v_1(0)$ = 25 V, find the following for t≥0 ; (a) v_2 (t) (b) $v_0(t)$ (c)$v_1(t)$ (d) $i_1(t)$ (e) $i_2(t)$

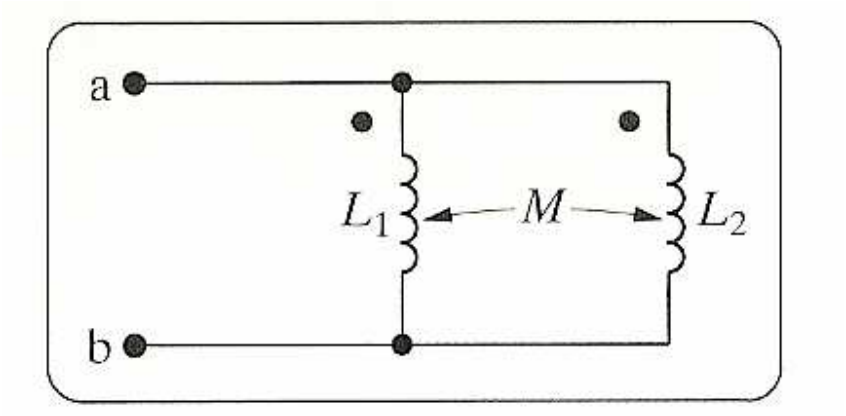


6. (a) Show that the two magnetically coupled coils in fig below can be replaced by a single coil having an inductance of

$$L_{ab} = \frac{L_1 L_2 - M^2}{L_1 + L_2 - 2M}$$

(Hint : Let i_1 and i_2 be clockwise mesh current in the left and right "windows" of fig. respectively. Sum the voltages around the two meshes. In mesh 1 let the v_{ab} be the unspecified applied voltage. Solve for di1/dt as function of v_{ab}.)
(b) Show that if the magnetic polarity of coil 2 is revered, then

$$L_{ab} = \frac{L_1 L_2 - M^2}{L_1 + L_2 + 2M}$$



7. A capacitor of capacitance C1 = 1.0 mF charged up to a voltage V = 110 V is connected in parallel to the terminals of a circuit consisting of two uncharged capacitors connected in series and possessing the capacitances C2 = 2.0 mF and C3 = 3.0 mF. What charge will flow through the connecting wires?

8. Some lamps made to turn on or off when the base is touched. Fig. below shows a circuit model of such a lamp. Calculate the change in the voltage v(t) when a person touches the lamp. Assume all capacitors are initially discharged.