EE 1100 Basic Electrical Engg - HW 2

August 25, 2010

1. Find the steady state inductor current i_L in the circuit shown in Fig P1.1.

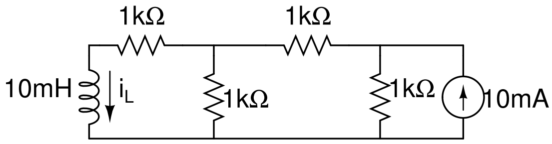

Fig P1.1

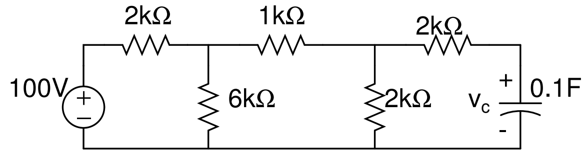

Fig P2.1

2. Find the steady state capacitor voltage v_C in the circuit shown in Fig P2.1.

3. Find v_{in}, i_1 and i_2 in the circuit shown in Fig P3.1 under DC steady state conditions with $i_{in} = 2$ A. Then calculate the total stored energy when $L = 5$ mH and $C = 25$ μF.

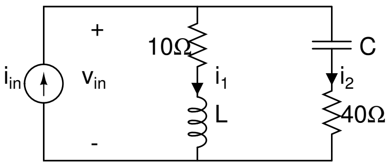

Fig P3.1

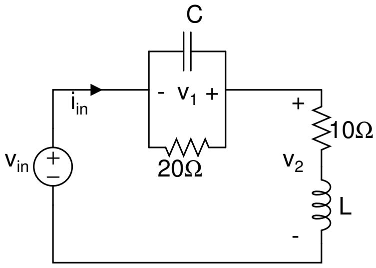

Fig P4.1

4. Find i_{in}, v_1 and v_2 in the circuit shown in Fig P4.1 under DC steady state conditions with $V_{in} = 15$ V. If $L = 16$ mH and the total stored energy is 5 mJ, then what is the value of C?

5. The current in the 4 mH inductor in Fig P5.1 is known to be 2.5 A for $t \leq 0$. The inductor voltage for $t \geq 0^+$ is given by the expression

$$v_L(t) = 30e^{-3t} \text{ mV}, \quad 0^+ \leq t < \infty$$

   (a) Find the power in milliwatts at the terminals of the inductor when $t = 1/3$ s.

   (b) Find the energy in millijoules stored in the inductor at $t = 1/3$ s.

   (c) Find the maximum energy in millijoules stored in the inductor and the time in milliseconds when it occurs.

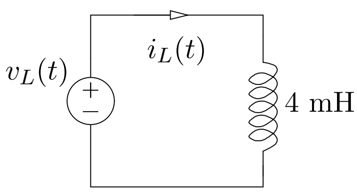

Fig P5.1

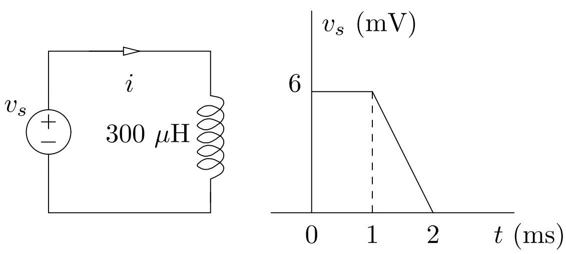

Fig P6.1

6. The voltage at the terminals of the 300 μH inductor is as shown in Fig P6.1. The inductor current is known to be zero for $t \leq 0$.

(a) Derive the expressions for i for $t \geq 0$.

(b) Sketch i versus t for $0 \leq t < \infty$.

7. The voltage across the terminals of a 0.4 μF capacitor is

$$v = \begin{cases} 25 \text{ V}, & t \leq 0 \\ A_1 t e^{-1500t} + A_2 e^{-1500t} \text{ V}, & t > 0 \end{cases}$$

The initial current in the capacitor is 90 mA.

(a) What is the initial energy stored in the capacitor?

(b) Evaluate the coefficients A_1 and A_2.

(c) Derive an expression for the capacitor current.

8. The initial voltage on the 0.2 μF capacitor shown in Figure P8.1 is -60.6 V. The capacitor current has the waveform shown in the figure.

(a) How much energy, in microjoules, is stored in the capacitor at $t = 250\ \mu s$?

(b) Repeat (a) for $t = \infty$.

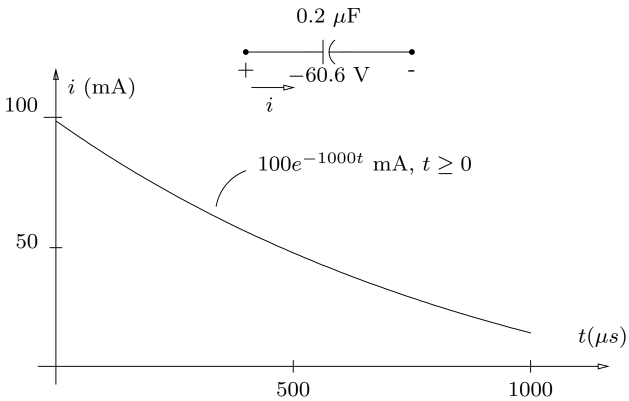

Figure P8.1

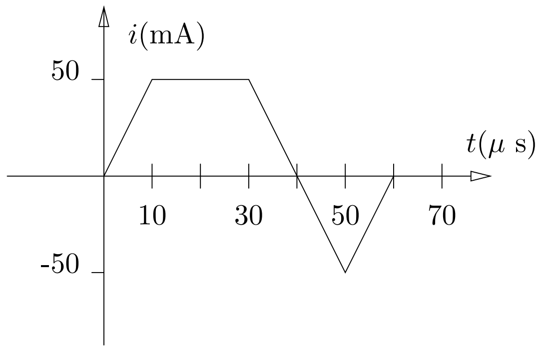

Figure P9.1

9. The current pulse shown in figure P9.1 is applied to a 0.25 μF capacitor. The initial voltage on the capacitor is zero.

(a) Find the charge on the capacitor at $t = 30\ \mu$s.

(b) Find the voltage on the capacitor at $t = 50\ \mu$s.

(c) How much energy is stored in the capacitor by the current pulse?

10. Assuming that the initial energy stored in the inductors of figure P10.1 is zero, determine the equivalent inductance with respect to the terminals a-b.

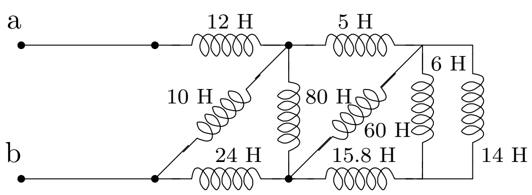

Fig P10.1

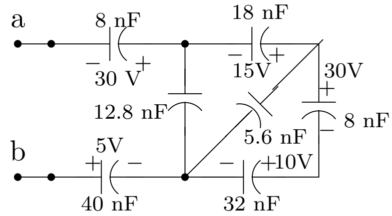

Fig P11.1

11. Find the equivalent capacitance with respect to the terminals a-b for the circuit shown in figure P11.1.

12. A sinusoidal current is zero at $t = 200\ \mu$s and increasing at a rate of $5 \times 10^5\pi$ A/s. The maximum amplitude of the current is 50 A.
    (a) What is the frequency of i in radians per second?
    (b) What is the expression for i?

13. Consider the sinusoidal voltage $v(t) = 170\cos(120\pi t - 60^0)$ V.
    (a) What is the maximum amplitude of the voltage? What is the frequency in Hertz? In radians per second?
    (b) What is the phase angle in radians? In degress? What is the period in millisecond?
    (c) What is the first time after $t = 0$ that $v = 170$ V?
    (d) The sinusoidal function is shifted 125/18 ms to the left along the time axis. What is the expression for $v(t)$?
    (e) What is the minimum number of milliseconds that the function must be shifted to the right if the expresion for $v(t)$ is $170\sin 120\pi t$ V?
    (f) What is the minimum number of milliseconds that the function must be shifted to the left if the expresion for $v(t)$ is $170\cos 120\pi t$ V?

14. A 40 kHz sinusoidal voltage has zero phase angle and a maximum amplitude of 2.5 mV. When this voltage is applied across the terminals of a capacitor, the steady-state current has a maximum amplitude of 125.67 μA.
    (a) What is the frequency of the current in radians per second?
    (b) What is the phase angle of the current?
    (c) What is the capacitive reactance of the capacitor?
    (d) What is the capacitance of the capacitor in microfarads?
    (e) What is the impedance of the capacitor?

15. Find the steady-state expression for $i_g(t)$ in the circuit in Fig P15.1 if $v_g(t) = 750\cos 5000t$ mV.

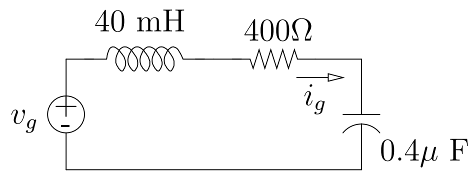

Figure P15.1

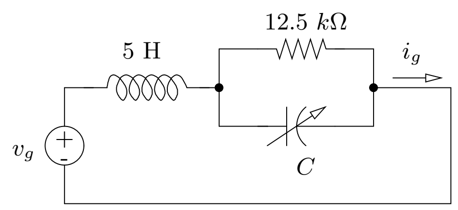

Figure P16.1

16. The circuit in figure P16.1 is operating in the sinusoidal steady-state. The capacitor is adjusted until the current i_g is in phase with the sinusoidal voltage v_g.
    (a) Specify the values of capacitance in microfarads if $v_g = 250\cos 1000t$ V.
    (b) Give the steady-state expression for i_g when C has the values found in (a).

17. The frequency of the sinusoidal voltage source in the circuit shown in Fig P17.1 is adjusted until the current i_o is in phase with v_g.
    (a) Find the frequency in Hz.
    (b) Find the steady state expression for i_o (at the frequency found in [a.]) if $v_g = 10\cos\omega t$.

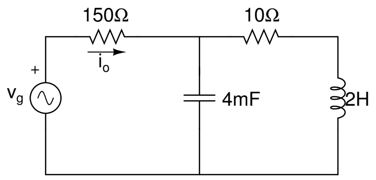

Figure P17.1

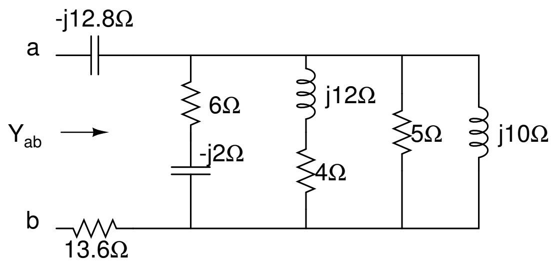

Figure P18.1

18. Find the admittance Y_{ab} in the circuit shown in Fig P18.1. Express Y_{ab} both in polar and rectangular form. Give the value of Y_{ab} in milliSiemens.

19. Find the steady state expression for $v_o(t)$ in the circuit shown in Fig P19.1 using superposition. $v_{g1} = 240\cos(4000t + 53.13^o)\ V$ and $v_{g2} = -96\sin 4000t\ V$.

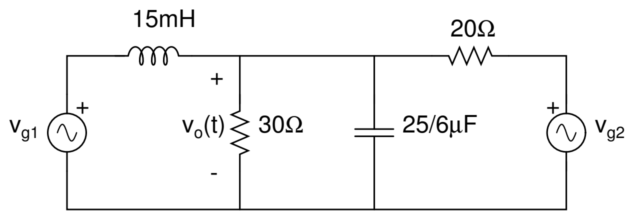

Fig P19.1

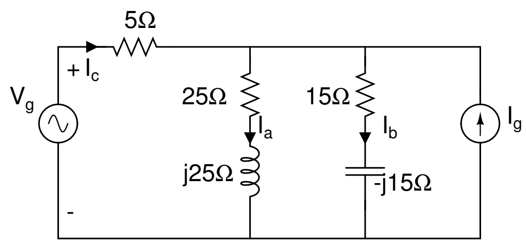

Fig P20.1

20. In the circuit shown in Fig P20.1, $I_g = 2\angle 45^o$ A. and the current I_b is $5\angle 45^o$ A.
    (a) Find I_a, I_c and V_g.
    (b) If $\omega = 800 rad/s$, write the expressions for $i_a(t)$, $i_c(t)$ and $v_g(t)$.

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