ENGR 12 Assignment 7 SOLUTIONS

Part I. Drills -- 1 point each

1) An inductance of 2 mH has a current i = 5.0(1 – e^{-5000t}) A. Find the corresponding voltage.

v = L di/dt = $0.002 \frac{\partial(5.(1-e^{-5000t}))}{\partial t} = 50.e^{-5000t}$, V

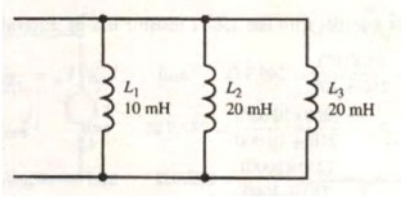
2) A 20uF capacitor has a voltage v = 50 sin(200t) V during the interval 0<t< 5π ms. Find the corresponding current

i = $20\times10^{-6} \frac{\partial(50\sin(200t))}{\partial t} = \frac{1}{5}\cos(200t)$ Amps

3) A 20uF capacitor has a current i = 50 sin(200t) A during the interval 0<t< 5 π ms, and an initial voltage of 0V. Find the corresponding voltage.

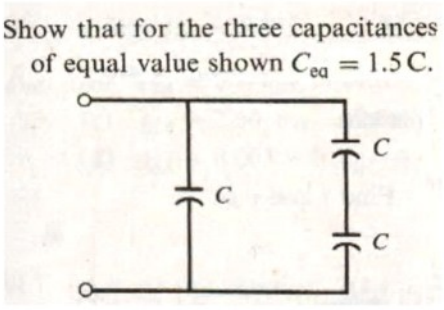
$$v = \frac{1}{20\text{x}10^{-6}}\int_0^t 50\sin(200x)\,dx = \left\langle \frac{1}{20\text{x}10^{-6}} \right\rangle \frac{1}{4}(1-\cos(200t)) = 12500(1-\cos(200t)) \text{ Volts}$$

4) Find the equivalent inductance of the 3 parallel connected inductors:



Leq = 10|| 20 || 20 = 10||10 = 5 mH

5)



Ceq = C + C*C/(C+C) = C + C^2/2C = C + C/2 = 1.5 C

6)

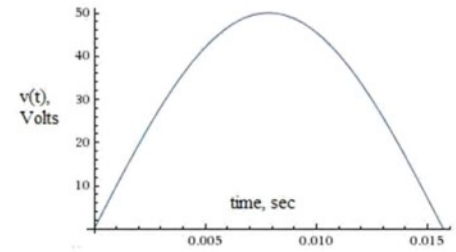
v = 50 sin(200t) V

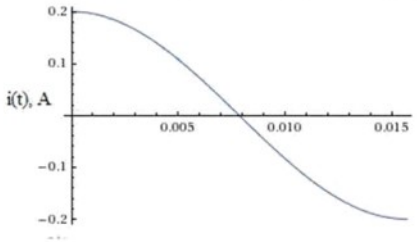
$i = \frac{1}{5}\cos(200\,t)$ Amps

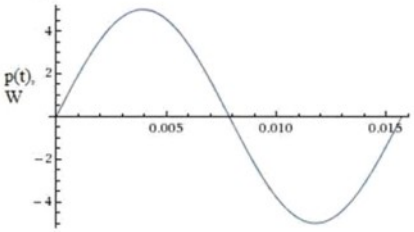
p = v*i = 10 sin(200t)cos(200t) = 5 sin(400t) Watts

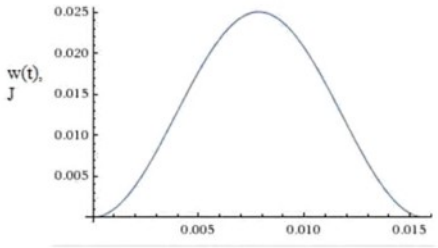
$w = Cv^2/2 = (20\times10^{-6})2500\sin^2(200t)/2, = .025\sin^2(200t)$ J

max energy = .025J









7)

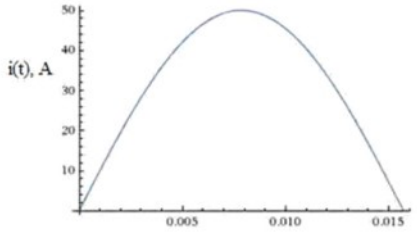
i = 50 sin(200t) A

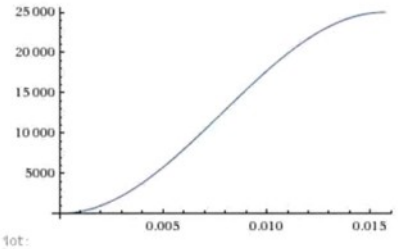
v = $12500\,(1-\cos(200\,t))$ Volts

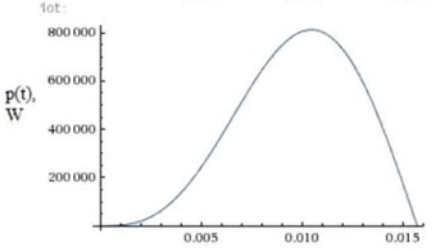
p = $625\,000\sin(200\,t)\,(1-\cos(200\,t))$, Watts

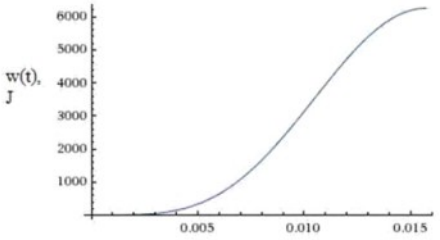
$w = Cv^2/2 = \frac{3125}{2}(1-\cos(200\,t))^2$, Joules

Max energy = 6250 J









8)

a) V=IR = 2.5mA *10kOhm = 25 V

b) V = L di/dt = .015*(-.005 A/1x10^{-6} s) = -75 V

c) To find V, integrate the triangle, the rectangle and the first half of the second triangle:

V(3 us) = 1/C * area under 1st triangle = (1/.3x10^{-9})*(.005*3x10^{-6})/2 = 25V
V(6 us) = V(3us) + 1/C* area under rectangle = 25 + (1/.3x10^{-9})*(.005*3x10^{-6}) = 75 V
V(6.5us) = 75 + 1/C* (3/4)* area under 2nd triangle = 75 + (1/.3x10^{-9})*0.75*(.005*1x10^{-6})/2 = 75 + 6.25 = **81.25 V**

The current after $t = 0$ in a single circuit element is as shown Find the voltage across the element at $t = 6.5\,\mu s$, if the element is (*a*) $10\,k\Omega$, (*b*) 15 mH, (*c*) 0.3 nF with $O(0) = 0$.