

Score:

Name:

Solution

Period (circle one): 1 2 3 4 5 6

Team (circle one): a b c d e f

SM286 – Quiz 11 – Section 5.1.4 LCR Circuits

- Find the charge (q) and current (i) LCR circuit with a 4 ohm resistor, 6 henry inductor, and 2 farad capacitor attached to a constant 9 volt battery.
 - How would you characterize the damping of the circuit?
 - Find $q(\infty)$ and $i(\infty)$

$$Lq'' + Rq' + \frac{1}{C}q = V \Rightarrow 6q'' + 4q' + \frac{1}{2}q = 9 \Rightarrow (6D^2 + 4D + \frac{1}{2})q = 9$$

$$\textcircled{1} \quad D = \frac{-4 \pm (16 - 4(6)(\frac{1}{2}))^{1/2}}{12} = \frac{-4 \pm 2}{12} = \frac{-2}{12}, \frac{-6}{12} \Rightarrow \frac{-1}{6}, \frac{-1}{2}$$

$$\Rightarrow q_H = c_1 e^{-1/6 t} + c_2 e^{-1/2 t}$$

$$\textcircled{2} \quad q_P = A \quad \textcircled{3} \Rightarrow q'_P = 0, q''_P = 0 \quad \textcircled{4} \Rightarrow \frac{1}{2}A = 9 \Rightarrow A = 18$$

$$\textcircled{5} \quad \boxed{q = c_1 e^{-1/6 t} + c_2 e^{-1/2 t} + 18} \Rightarrow i = \frac{dq}{dt} = -\frac{1}{6}c_1 e^{-1/6 t} - \frac{1}{2}c_2 e^{-1/2 t}$$

↑ "overdamped"

$$q(\infty) = 18 \text{ coulomb}$$

$$i(\infty) = 0 \text{ amps}$$