

Mon Feb 26

Quiz Wednesday

- Review Today

- LRC-Series Circuit

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LRC-Series Circuit

Find the charge on

Capacitor on LRC-series

circuit,

$$L = 0.05 \text{ Henry}$$

$$R = 1 \text{ ohm}$$

$$C = 0.04 \text{ Farads}$$

$$E(t) = 0 \text{ Volts}$$

$$q(0) = 7 \text{ Coulombs}$$

$$I(0) = 0 \text{ amperes}$$

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$$q'(0) = 0$$

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$$Lq'' + Rq' + \frac{q}{C} = E(t)$$

$$.05q'' + q' + \frac{q}{0.04} = 0$$

$$\frac{1}{20}q'' + q' + \frac{q}{0.04} = 0$$

$$q'' + 20q' + 500q = 0$$

Q: How to solve?

$$r^2 + 20r + 500 = 0$$

$$r = \frac{-20 \pm \sqrt{400 - 4(1)(500)}}{2}$$

$$r = \frac{-20 \pm \sqrt{400 - 4(500)}}{2}$$

$$r = \frac{-20 \pm \sqrt{400 - 2000}}{2}$$

$$r = \frac{-20 \pm \sqrt{-1600}}{2}$$

$$r = \frac{-20 \pm 40i}{2}$$

$$r = -10 \pm 20i$$

Solution to LRC-series

$$q(t) = e^{-10t} (C_1 \cos(20t) + C_2 \sin(20t))$$

a) Find the charge  
at time  $t = 0.02$ .

$$q(0.02) = e^{-10(0.02)} (C_1)$$

Constant solution yet

$$t=0 \rightarrow q=7$$

$$7 = e^0 (C_1 \cos(20(0)) + C_2 \sin(20(0)))$$

$$7 = e^0 (C_1 + 0)$$

$$\boxed{7 = C_1}$$

$$q(t) = e^{-10t} (C_1 \cos(20t) + C_2 \sin(20t))$$

$$q'(t) = -20 e^{-10t} (C_1 \sin(20t) - C_2 \cos(20t))$$

$$0 = -10 C_1 + 20 C_2$$

$$0 = -70 + 20 C_2$$

$$C_2 = \frac{7}{2}$$

$$q(t) = e^{-10t} \left( 7 \cos(20t) + \frac{7}{2} \sin(20t) \right)$$

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$$q(0.02)$$

$$t = 0.02 \text{ s}$$

$$e^{-.2} \left( 7 \cos(0.4) + \frac{7}{2} \sin(0.4) \right)$$

B) Determine the first time the charge = 0.

$$q(t) = 0$$

$$0 = e^{-10t} \left( 7 \cos(20t) + \frac{7}{2} \sin(20t) \right)$$

$$0 = \left( 7 \cos(20t) + \frac{7}{2} \sin(20t) \right)$$

$$0 = \frac{\left( 7 \cos(20t) + \frac{7}{2} \sin(20t) \right)}{\cos(20t)}$$

$$0 = 7 + \frac{7}{2} \tan(20t)$$

$$\frac{7}{2} \tan(20t) = -7$$

$$t = .1017$$