

Department of Electrical Engineering and Computer Science
ENGR 210. Introduction to Circuits and Instruments (4)

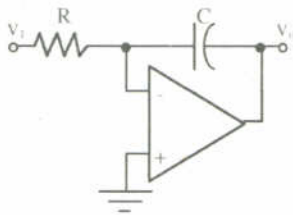
Quiz No. 10

4/1/05

PUT ANSWERS IN THE SPACE PROVIDED AND, IF APPROPRIATE, SHOW YOUR WORK. BE SURE TO STATE ANY ASSUMPTIONS

Problem 1 OP AMP integrator/differentiator (10 points)

A 10 volt dc voltage is applied to an op amp integrator with $R=50k\Omega$, $C=100\mu\text{f}$ at $t=0$. How long will it take for the op amp to saturate if the saturation voltages are +12 volts and -12 volts. Assume that the initial capacitor voltage was zero.



③

equation

$$V_o = -\frac{1}{RC} \int_0^t V_i + \cancel{V_o(0)} dt$$

$$V_o = -\frac{1}{(50k\Omega)(100\mu\text{F})} \int_0^t 10V dt$$

$$V_o = -\frac{1}{5\text{sec}} (10V)t$$

④

math

$$V_o = -2V/\text{sec}(t)$$

$$-12V = -2V/\text{sec}(t)$$

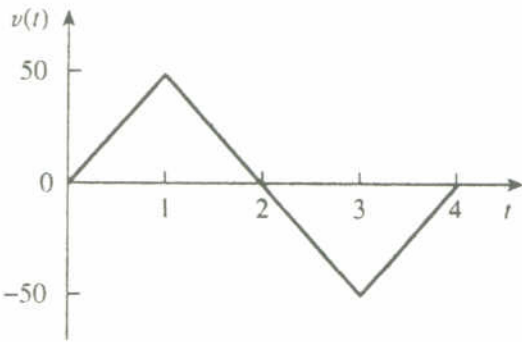
④

answer

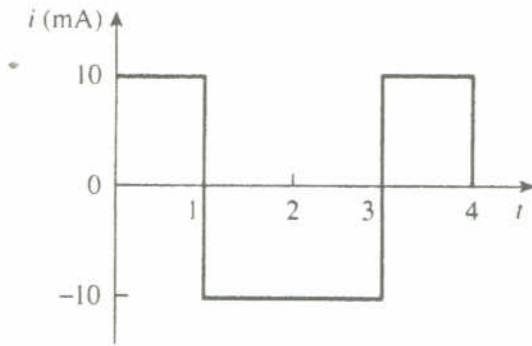
$$t = 6\text{ sec}$$

Problem 2 Inductance/Capacitance Characteristics (10 points)

The figure below shows the current through and the voltage across an unknown energy storage element.



NOTE: The voltage (y-axis) is volts.



part B (hard way)

$$W = \frac{1}{2} CV^2$$

$$I = C \frac{d}{dt} v(t)$$

③ work

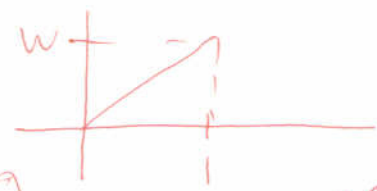
$$10 \text{ mA} = C \cdot 50 \text{ V/sec}$$

$$0.2 \text{ mF} = C$$

$$W = \frac{1}{2} (0.2 \text{ mF}) (50 \text{ V})^2$$

$$W = 250 \text{ mJ}$$

② answer



(a) What is the element (inductor or capacitor?) and its numerical value?

Capacitor = 0.2 mF

(b) If the energy stored in the element at t=0 is zero, how much energy is stored in the element at t=1 second.

t = 1 sec

$$W(1) = \int_0^1 p(t) dt + W(0)$$

$$W(1) = \frac{1}{2} (500 \text{ mW}) (1 \text{ sec})$$

$$W(1) = 250 \text{ mJ}$$

③ work

② answer

③ answer

② answer