

HW #5 Solutions E245B 10/11/01

Problem 5.1

A $12\mu\text{F}$ capacitor has an accumulated charge of $480\mu\text{C}$. Determine the voltage across the capacitor after 4 s.

Suggested Solution

$$v(t_2) - v(t_1) = \frac{1}{C} \int_{t_1}^{t_2} i(t) dt \quad C = 100\mu\text{F} \quad i(t) = 1\text{mA} = I$$

$$v(t_1) = 0. \quad \text{so,} \quad v(t_2) = \frac{1}{C}(t_2 - t_1) \quad \text{where} \quad t_2 - t_1 = 4\text{sec}$$

$$v(t_2) = 40\text{V}$$

Problem 5.16

Draw the waveform for the current in a $12\text{-}\mu\text{F}$ capacitor when the capacitor voltage is as described in Figure 5.16

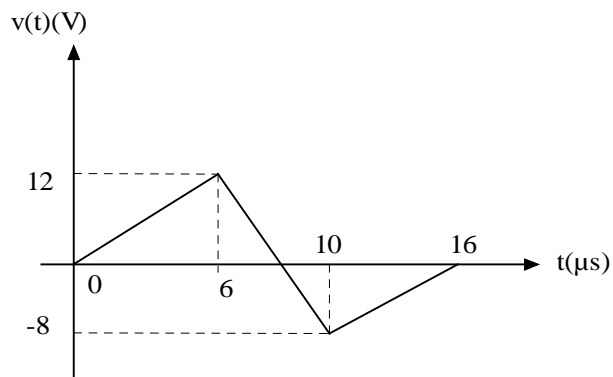
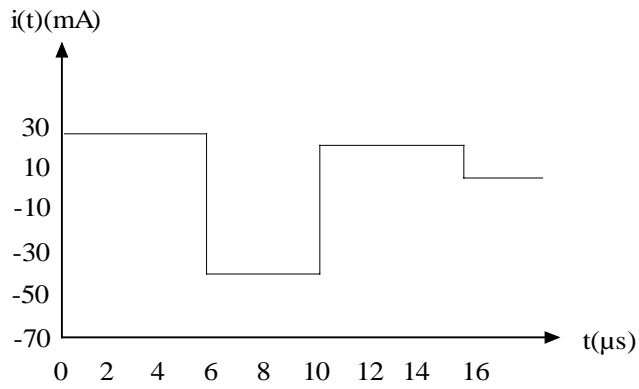
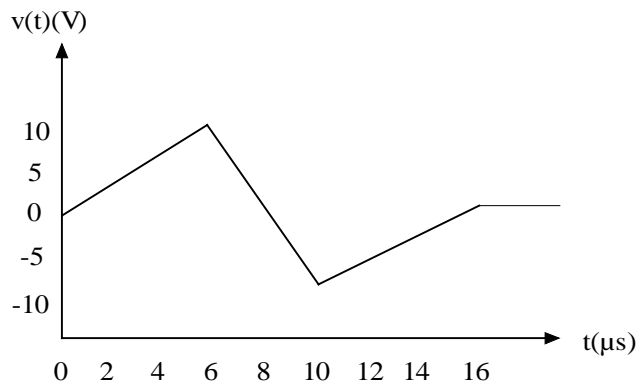


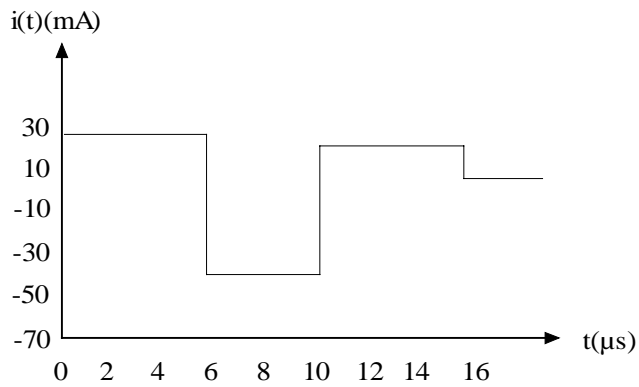
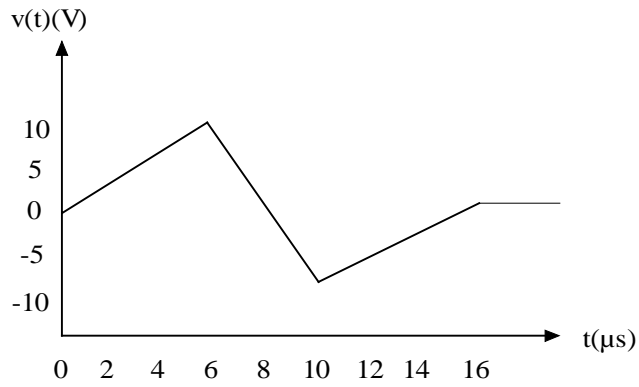
Figure P5.16

Suggested Solution

$$C = 12\mu F \quad i(t) = C \frac{dv}{dt}$$

Time (μs)	$\frac{dv}{dt}$ (V/ μs)	$i(t)$ (A)
$0 \leq t$	2	24
$6 \leq t \leq 10$	-5	-60
$10 \leq t \leq 16$	1.33	16
$t > 16$	0	0





Problem 5.31

Draw the waveform for the voltage across a 10-mH inductor when the inductor current is given by the waveform shown in Figure P5.31

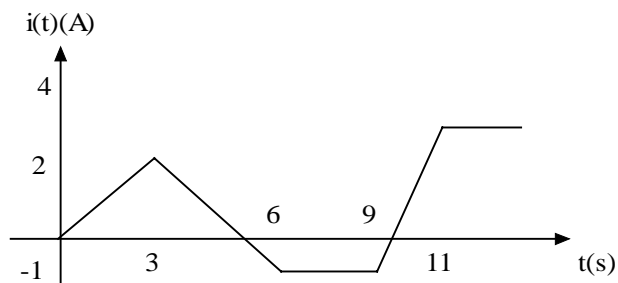


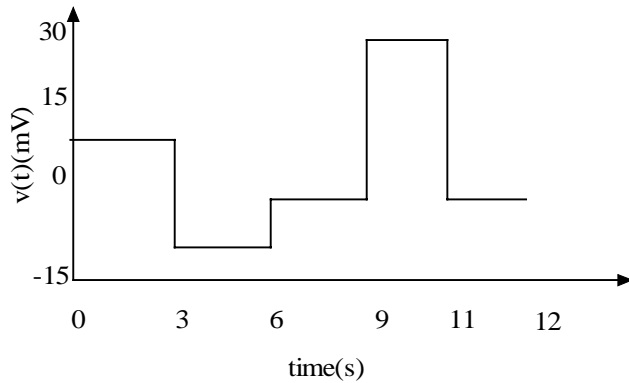
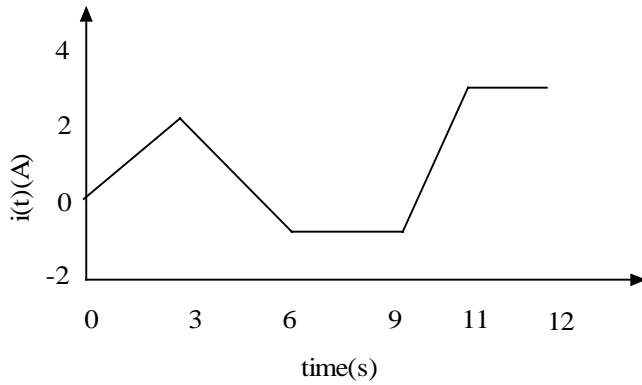
Figure P5.31

Suggested Solution

$$L = 10\text{mH}$$

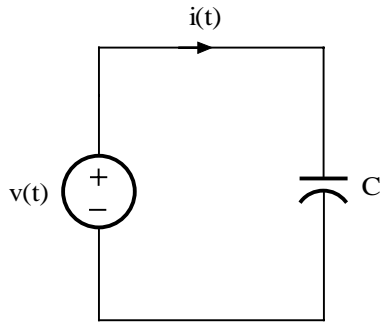
$$v(t) = L \frac{di}{dt}$$

Time(s)	$\frac{di}{dt}$ (A/s)	$v(t)$ (mV)
$0 \leq t \leq 3$	$2/3$	6.67
$3 \leq t \leq 6$	-1	-10
$6 \leq t \leq 9$	0	0
$9 \leq t \leq 11$	2.5	25
$t > 11$	0	0

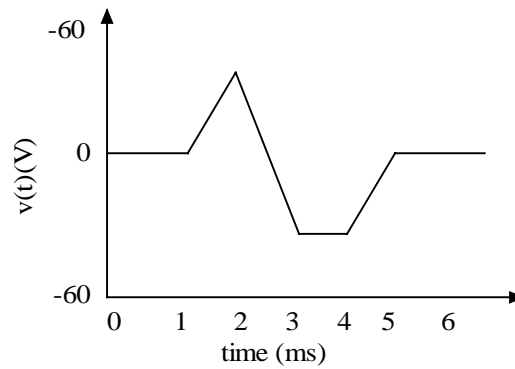


Problem 5.36

The capacitor in Figure P5.36a is 51 nF with a tolerance of 10%. Given the voltage waveform in Figure P5.36b graph the current $i(t)$ for the minimum and maximum capacitor values.



(a)



(b)

Figure P5.36

Suggested Solution

Maximum capacitor value = $1.1C = 56.1 \text{ nF}$

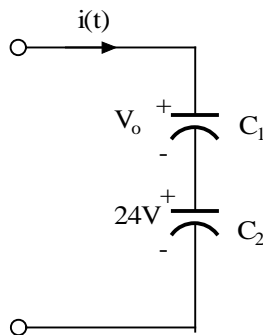
Minimum capacitor value = $0.9C = 45.9 \text{ nF}$

The capacitor voltage and current are related by the equation

$$i(t) = C \frac{dv(t)}{dt}$$

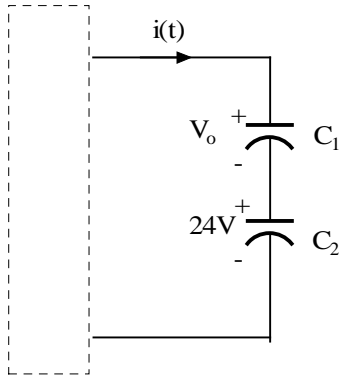
Problem 5.44

Two capacitors are connected in series as shown in Figure P5.44. Find V_o



$$C_1 = 12\mu\text{F} \quad C_2 = 6\mu\text{F}$$

Suggested Solution



$$C_1 = 12\mu\text{F} \quad C_2 = 6\mu\text{F}$$

$$vc = \frac{1}{C} \int i(t) dt$$

Since same current charged both caps,

$$C_1 V_o = C_2 (24)$$

$$V_o = 24(C_2 / C_1)$$

$$\boxed{V_o = 12V}$$