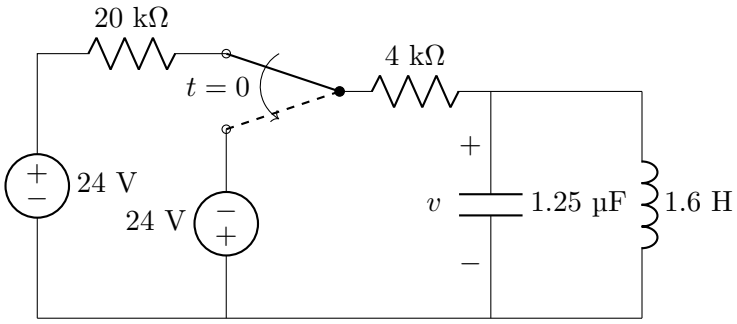
ECE 2260 hw05

1. RLC circuits

For the following circuit, find $v(t)$ for $t \geq 0$.



2. Critical Damping in Series RLC

In the circuit in Fig. 1 the switch closes at $t = 0$. The resistor is adjusted for critical damping. The initial capacitor voltage is 15 V, and the initial inductor current is 6 mA.

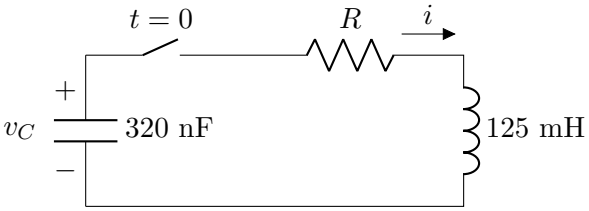


Figure 1: The circuit for problem.

a) Find the numerical value of R.

b) Find the numerical values of i and $i'(t)$ immediately after the switch is closed.

c) Find $v_C(t)$ for $t \geq 0$.

3. Step Response of a Series RLC Circuit

The circuit shown in Fig. 2 has been in operation for a long time. At $t = 0$, the source voltage suddenly drops to 150 V. Find $v_o(t)$ for $t \geq 0$.

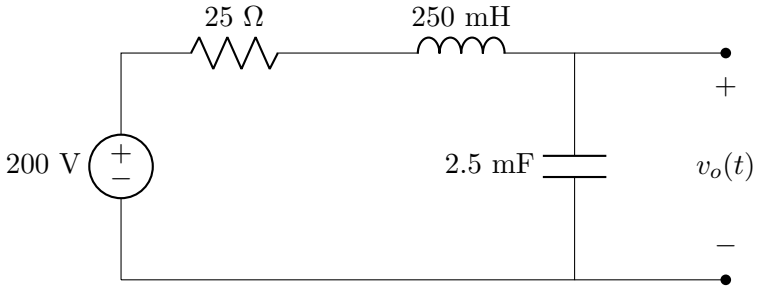


Figure 2: The circuit for problem.

4. Multiple Switches in RLC

The two switches in the circuit seen in Fig. 3 operate synchronously. When switch 1 is in position a, switch 2 is closed. When switch 1 is in position b, switch 2 is open. Switch 1 has been in position a for a long time. At $t = 0$, it moves instantaneously to position b. Find $v_c(t)$.

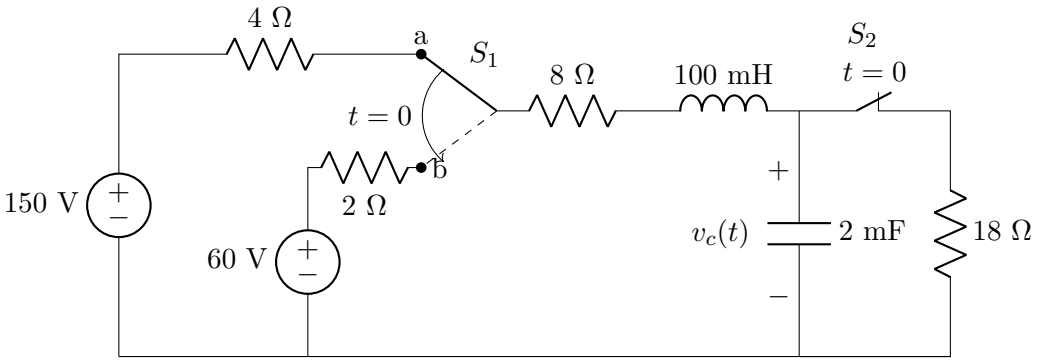


Figure 3: The circuit for problem.

5. Step Functions and Window Functions

Step functions can be used to define a *window function*. Thus $u(t+2) - u(t-3)$ defines a window 1 unit high and 5 units wide located on the time axis between -2 and 3.
A function $f(t)$ is defined as follows:

$$\begin{aligned} f(t) &= 0, && t \leq 0 \\ &= 5t, && 0 \leq t \leq 10 \text{ s} \\ &= -5t + 100, && 10\text{s} \leq t \leq 30 \text{ s} \\ &= -50, && 30\text{s} \leq t \leq 40 \text{ s} \\ &= 2.5t - 150, && 40\text{s} \leq t \leq 60 \text{ s} \\ &= 0, && 60\text{s} \leq t < \infty \end{aligned}$$

a) Sketch $f(t)$ over the interval $0\text{s} \leq t \leq 60$ s.

b) Use the concept of the window function to write an expression for $f(t)$.

6. Step Function Expressions

Use step functions to write the expression for each function shown in Fig. 4.

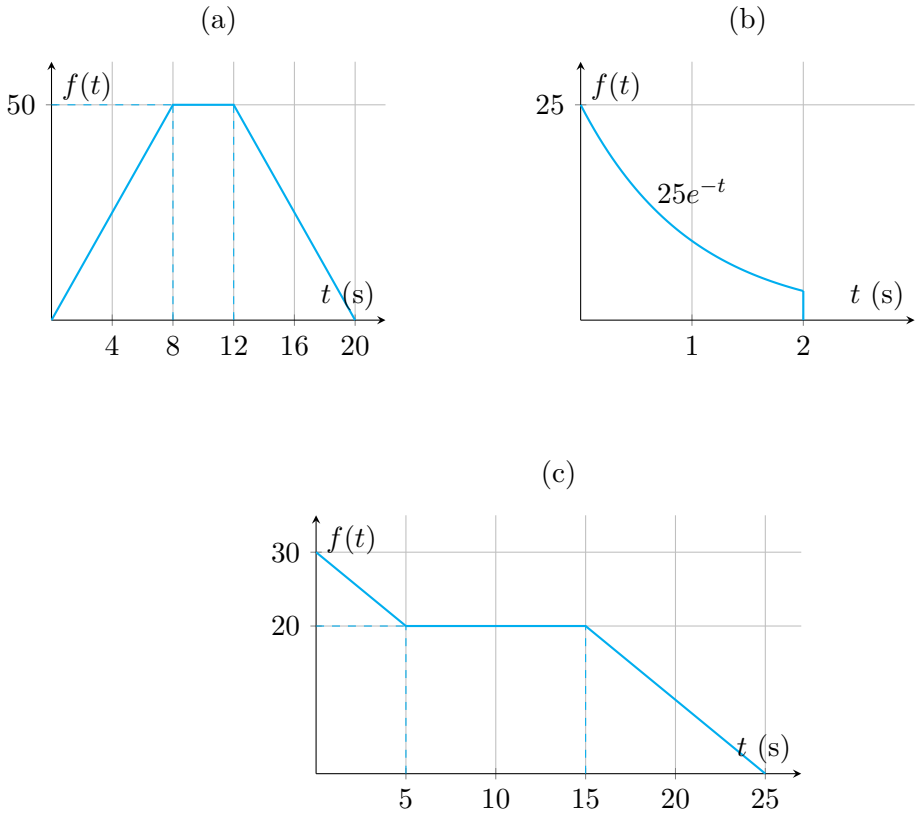


Figure 4: Functions for problem.

7. Integrals with Impulses

Evaluate the following integrals:

a) $I = \int_{-1}^{3} (t^3 + 2)[\delta(t) + 8\delta(t-1)]dt.$

b) $I = \int_{-2}^{2} t^2[\delta(t) + \delta(t+1.5) + \delta(t-3)]dt.$