



Evaluate Loop1 Using KVL:

$$\frac{dV_s}{dt} + R \frac{di_1(t)}{dt} + \frac{1}{C} [i_1(t) - i_2(t)] = 0$$

Evaluate Loop 2 Using KVL:

$$2R \frac{di_2(t)}{dt} + \frac{1}{C} [i_2(t) - i_1(t)] + \frac{1}{C} i_2(t) = 0$$

$$\rightarrow 2RC \frac{di_2(t)}{dt} + 2i_2(t) - i_1(t) = 0$$

Solving Loop 1 for $i_2(t)$ and noting that $\frac{dV_s}{dt} = 0$, we find:

$$i_2(t) = RC \frac{di_1(t)}{dt} + i_1(t)$$

Also noting that:

$$\frac{di_2(t)}{dt} = RC \frac{d^2 i_1(t)}{dt^2} + \frac{di_1(t)}{dt}$$

We find:

$$2RC \left[RC \frac{d^2 i_1(t)}{dt^2} + \frac{di_1(t)}{dt} \right] + 2 \left[RC \frac{di_1(t)}{dt} + i_1(t) \right] - i_1(t) = 0$$

Which reduces to:

$$2R^2 C^2 \frac{d^2 i_1(t)}{dt^2} + 4RC \frac{di_1(t)}{dt} + i_1(t) = 0$$