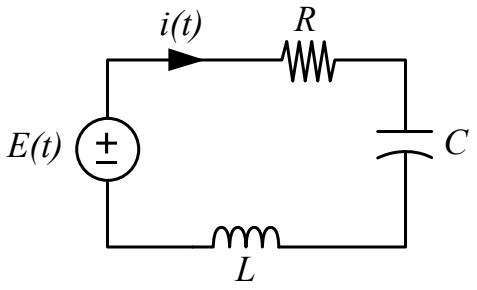

Component	Description	Unit of Measure
$q(t)$	Flow of charge	coulombs (C = A $\cdot$ sec)
$i(t) = q'(t)$	Current	amperes (A)
Resistors, R	Resists flow of charge. Used to control flow. $\Delta V_R = iR$	ohms (Ω = V/A)
Capacitors, C	Stores charge and opposes passage of current. Used to store voltage. $\Delta V_C = \frac{1}{C}q$	farads (F = A $\cdot$ sec/V)
Inductors, L	Opposes charge in current flowing through it. Used to store current. $\Delta V_L = L\frac{di}{dt}$	henrys (H = $\Omega \cdot$ sec)
Electromotive force, $E(t)$	Source of voltage	volts (V)

Kirchhoff's Second Law
As a consequence of the law of conservation of energy, the sum of the voltage drops around a closed circuit is zero.

$$\Delta V_L + \Delta V_R + \Delta V_C - E(t) = 0$$

$$\implies L\frac{di}{dt} + Ri + \frac{1}{C}q = E(t)$$

1. Find an equation for the current, $i(t)$ for $t > 0$ in a circuit with resistance of 7 ohms, inductance of 5 henrys and no capacitors (an RL circuit) and an electromotive force of 70 V. Assume that the current at $t = 0$ is 2 amperes.

2. An RC circuit has a resistance of $5\,\Omega$, a capacitance of $\frac{1}{50}\,\mathrm{F}$, and an electromotive force of $100\,\mathrm{V}$. If the capacitor is uncharged initially, determine the current in the circuit for $t > 0$.

3. Find the current of an RL circuit with $E(t) = 10\sin 4t$, $R = 2\,\Omega$, $L = \frac{2}{3}\,\mathrm{H}$, and there is no current flowing initially.

4. Determine the current flowing in an RC circuit if $\mathrm{R} = 2\,\Omega$, $\mathrm{C} = 15\,\mathrm{F}$, the capacitor is initially uncharged and the driving EMF is given by $E(t) = Ae^{-kt}$, where A and k are constants.

1. $i(t) = 10 - 8e^{-7t/5}$

2. $i(t) = 20e^{-10t}$

3. $i(t) = \frac{3}{5}(3\sin 4t - 4\cos 4t) + \frac{12}{5}e^{-3t}$

4. $i(t) = \dfrac{15A}{1-30k}\left(\dfrac{1}{30}e^{-t/30} - ke^{-kt}\right)$