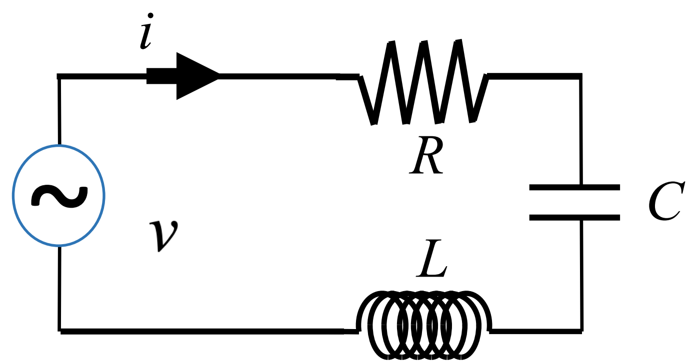
VP 10 RLC oscillation and transient behavior simulation

An RLC circuit, with $R = 30\ (\Omega)$, $L = 200\ (\text{mH})$, $C = 20\ (\mu\text{F})$. The driving voltage source is

$$v(t) = \begin{cases} 0 & \text{if } t < 0 \\ 36 \cdot \sin(2\pi f_d t) & \text{if } 0 \le t < 12T \\ 0 & \text{if } 12\text{T} \le t \end{cases}$$

where $f_d = 120\ (\text{Hz})$, $T = 1/f_d$.



(1) Solve this circuit numerically and plot the voltage $v(t)$, and current $i(t)$ as a function of t for $t = 0$ to $20T$ in *scene1* and the total energy $E(t)$ stored in the system in *scene2*.

(2) You will see a transient behavior of the current $i(t)$ before it reaches a steady-state oscillation around $t = 9T$. Find I, the amplitude of the oscillating current, and ϕ the phase constant of the oscillating current relative to the voltage source during the 9-th period. Compare them to the theoretical values.

(3) After the voltage is turned off at $t = 12T$, you will see both the current and the total energy decays. Find the time t such that the energy decays to 10% of the energy at the time the voltage is just turned off, i.e. $0.1E(t = 12T)$.

```
from vpython import*

fd = 120                # 120Hz
#(Your Parameters here)

t = 0
dt = 1.0/(fd * 5000)    # 5000 simulation points per cycle

scene1 = graph(align = 'left', xtitle='t', ytitle='i (A) blue, v (100V) red,', background=vector(0.2, 0.6, 0.2))
scene2 = graph(align = 'left', xtitle='t', ytitle='Energy (J)', background=vector(0.2, 0.6, 0.2))

i_t = gcurve(color=color.blue, graph = scene1)
v_t = gcurve(color=color.red, graph = scene1)
E_t = gcurve(color=color.red, graph = scene2)

#(Your program here)
```