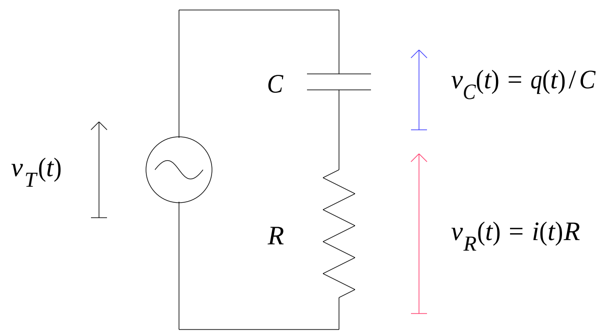
Conclusions concerning RC circuit



In all cases:

$$v_R(t) = RC\frac{dv_C(t)}{dt}$$

Sinusoidal driving:

$$v_T(t) = \mathcal{E}_m \sin\omega t \qquad \omega = 2\pi f$$

Slow changes: $\left(\text{low frequencies; } f \ll \frac{1}{2RC}\right)$

- **Voltage is mostly across capacitor** $(v_C(t) \approx v_T(t); \quad v_R(t) \ll v_T(t))$
- $v_C(t)$ ($\propto$ charge) lags $v_T(t)$ by a bit
- $v_R(t)$ ($\propto$ current) leads $v_T(t)$ by about $\frac{1}{4}$ period
- **Differentiation circuit:** $v_R(t) \approx RC\frac{dv_T(t)}{dt}$
  [holds for any slowly varying $v_T(t)$]

Fast changes: $\left(\text{high frequencies; } f \gg \frac{1}{2RC}\right)$

- **Voltage is mostly across resistor** $(v_R(t) \approx v_T(t); \quad v_C(t) \ll v_T(t))$
- $v_C(t)$ ($\propto$ charge) lags $v_T(t)$ by about $\frac{1}{4}$ period
- $v_R(t)$ ($\propto$ current) leads $v_T(t)$ by a bit
- **Integration circuit:** $v_T(t) \approx RC\frac{dv_C(t)}{dt} \Longrightarrow v_C(t) \approx \frac{1}{RC}\int v_T(t)\,dt$
  [holds for any rapidly varying $v_T(t)$]

At all frequencies, $v_R(t)$ leads $v_C(t)$ by exactly $\frac{1}{4}$ period