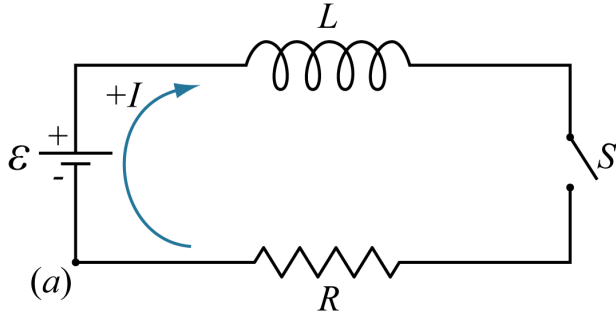


Inductor current vs. time in an LR series circuit



$$\Delta V_{\text{LOOP}} = 0$$

$$+\varepsilon - L \frac{dI}{dt} - IR = 0$$

Early times (just after closing "S")	Intermediate time t	Late times (long after closing "S")									
$+\varepsilon - L \frac{dI}{dt} - \underbrace{I}_0 R = 0$ <p>Inductor: $I_0 = 0, V_0 = \varepsilon$</p> <p>Resistor: $I_0 = 0, V_0 = 0$</p>	$+\varepsilon - L \frac{dI}{dt} - IR = 0$ $-L \frac{dI}{dt} = IR - \varepsilon$ $-\underbrace{\left(\frac{L}{R}\right)}_{\tau} \frac{dI}{dt} = I - \underbrace{\left(\frac{\varepsilon}{R}\right)}_{I_\infty}$ $-\tau \int_{I=I_i}^{I=I_f} \frac{1}{I - I_\infty} dI = \int_{t=t_i}^{t=t_f} dt$ $-\tau [\ln I - I_\infty]_{I=I_i}^{I=I_f} = t_f - t_i$ <p>Note: $I - I_\infty < 0$</p> $-\tau \ln\left(\frac{I_\infty - I_f}{I_\infty - I_i}\right) = t_f - t_i$ <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>Time</th> <th>Current</th> </tr> </thead> <tbody> <tr> <td>Initial</td> <td>$t_i = 0$</td> <td>$I_i = 0$</td> </tr> <tr> <td>Final</td> <td>$t_f = t$</td> <td>$I_f = I$</td> </tr> </tbody> </table> $I = \underbrace{\left(\frac{\varepsilon}{R}\right)}_{I_\infty} \left[1 - e^{-\frac{t}{\tau}}\right]$		Time	Current	Initial	$t_i = 0$	$I_i = 0$	Final	$t_f = t$	$I_f = I$	$+\varepsilon - L \frac{dI}{dt} - IR = 0$ <p>Inductor: $I_\infty = \frac{\varepsilon}{R}, V_\infty = 0$</p> <p>Resistor: $I_\infty = \frac{\varepsilon}{R}, V_\infty = \varepsilon$</p>
	Time	Current									
Initial	$t_i = 0$	$I_i = 0$									
Final	$t_f = t$	$I_f = I$									

