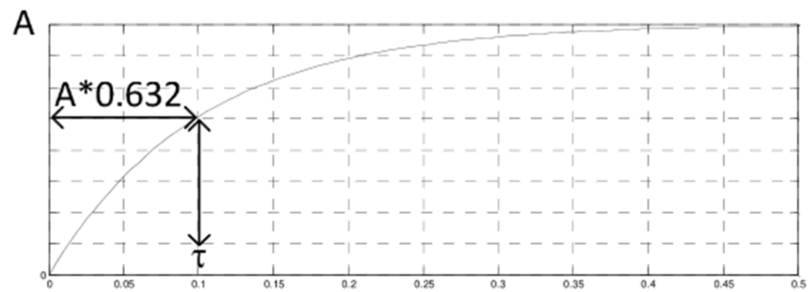
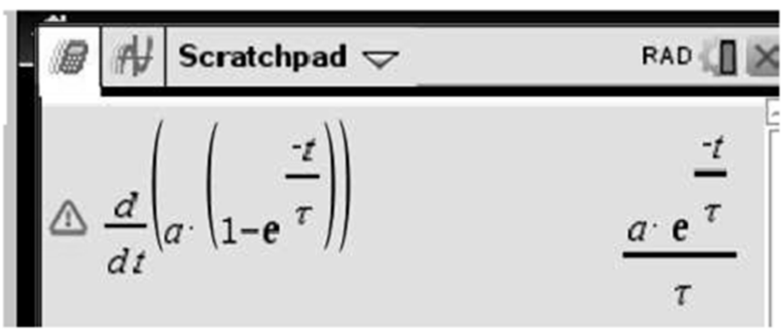


$$v(t) = A\left(1 - e^{\frac{-t}{\tau}}\right)$$

$$\frac{d}{dt}\left[A\left(1 - e^{\frac{-t}{\tau}}\right)\right] = \frac{A}{\tau}e^{\frac{-t}{\tau}}$$

$$\int_0^t \left[A\left(1 - e^{\frac{-t}{\tau}}\right)\right]dt = A\left[t - \tau\left(1 - e^{\frac{-t}{\tau}}\right)\right]$$

Figure 3-6 Exponential rise with amplitude (A), and time constant (τ) defined



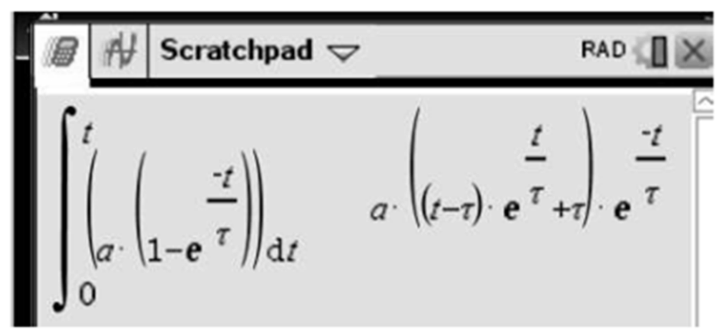


Figure 3-7 TI-Nspire derivative and integral of an exponential rise

$$v(t) = Ae^{\frac{-t}{\tau}}$$

$$\frac{d}{dt}\left(Ae^{\frac{-t}{\tau}}\right) = \frac{-A}{\tau}e^{\frac{-t}{\tau}}$$

$$\int_0^t \left(Ae^{\frac{-t}{\tau}}\right)dt = A\tau\left(1 - e^{\frac{-t}{\tau}}\right)$$

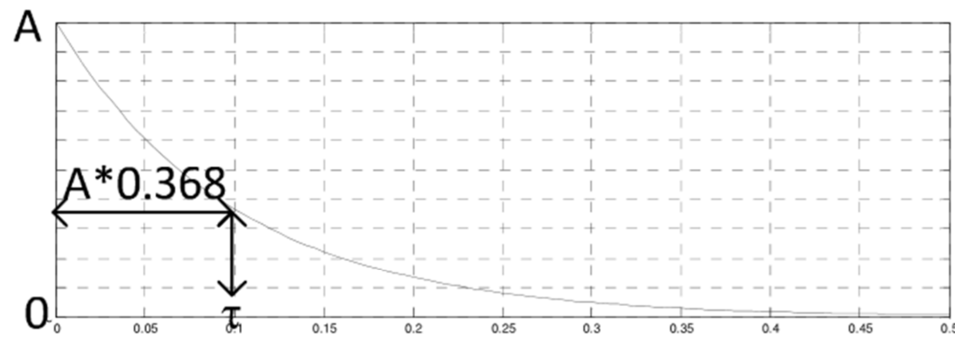


Figure 3-8 Exponential fall with amplitude (A), and time constant (τ) defined

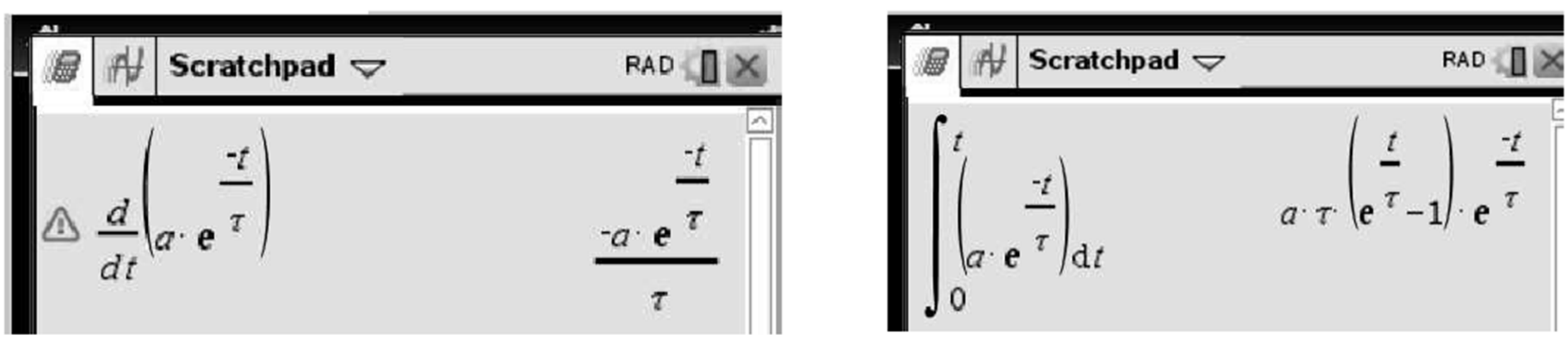


Figure 3-9 TI-Nspire derivative and integral of an exponential fall or spike

Ohm's Law for Capacitors

Resistors

$$i = \frac{v}{R}$$

$$i = \frac{dQ}{dt}$$

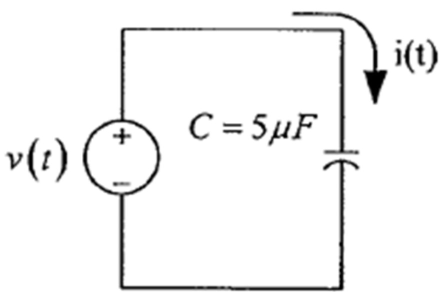
$$C = \frac{Q}{V}$$

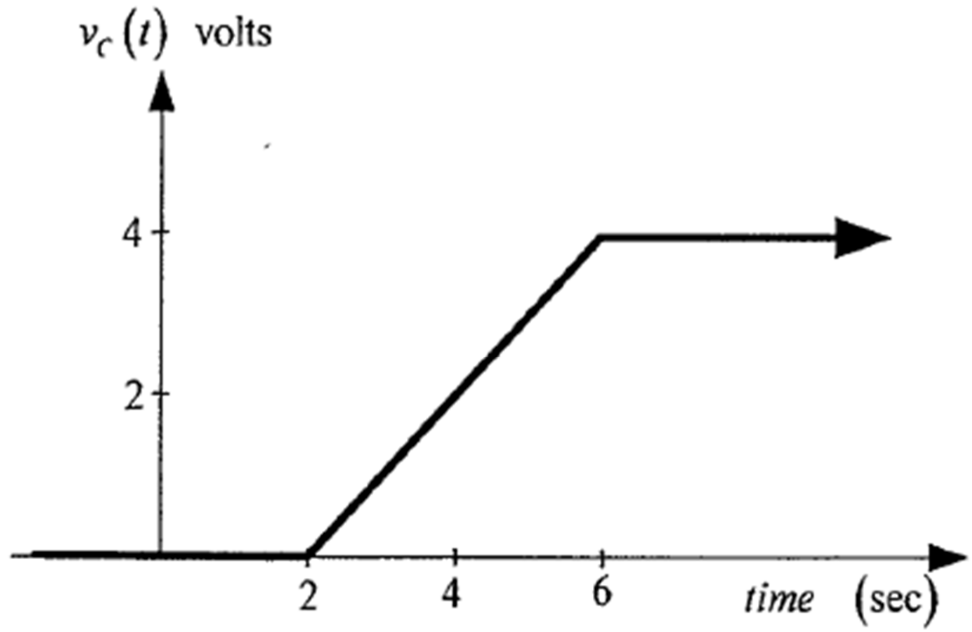
$$V = \frac{Q}{C}$$

$$\frac{dV}{dt} = \frac{1}{C}\frac{dQ}{dt}$$

$$\frac{dV}{dt} = \frac{1}{C}i$$

$$i = C * dv/dt$$





$$i = C * dv/dt$$

The voltage across a 5 μF capacitor is given by the following equation:

$$v(t) = 4(1 - e^{-10t}) \quad for\, t > 0$$

Determine an expression for the current $i(t)$.

$$i = C * dv/dt \qquad\qquad v = ?$$

$$v(t) = \frac{1}{C}\int_0^t i(t)dt + V_0$$

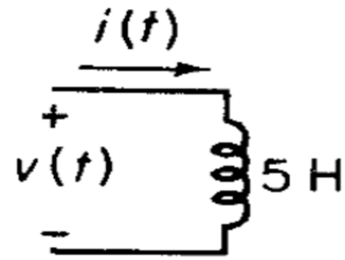
$$i(t) = (1.5)e^{-t/(1\times 10^{-4})}$$

V_0= -10V

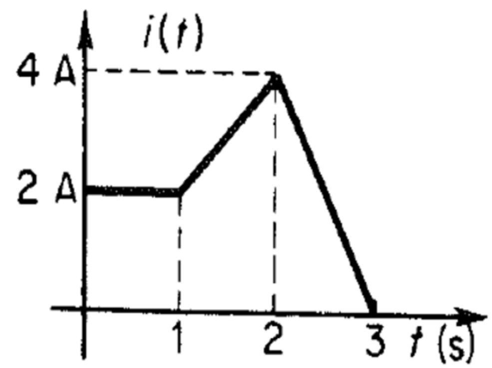
Inductor Analysis in the Time Domain

- $v = \mathrm{L}\ \mathrm{d}i\mathrm{d}t$
- i_{L} => v
  - Graphical
  - Calculus
- v_{L} => I
  - Graphical
  - Calculus
- Summary

$$v = L * di/dt$$



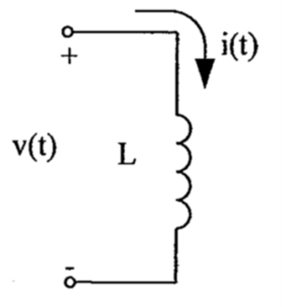
(a)

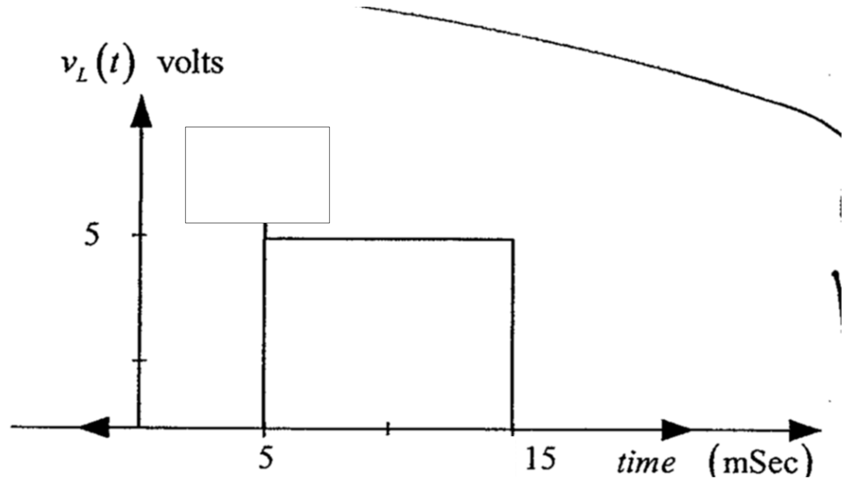


(b)

$$i(t) = \frac{1}{L}\int_0^t v(t)dt + I_0$$

Graphical





L = 100 mH

Example 3-6

Given a voltage ramp across an 80 mH inductor with:

$I_o = 0$ A (ramp starts at 0 and goes up)

$v_{max} = 5$ V

$f = 100$ Hz

determine the equation for the current through the inductor and plot it.

Summary – Circuit laws

UNKNOWN

$\Downarrow$	R	C	L
$i(t)$	$\frac{v(t)}{R}$	$C \cdot \frac{dv(t)}{dt}$	$\frac{1}{L}\int_0^t v(t)dt + I_o$
$v(t)$	$R \cdot i(t)$	$\frac{1}{C}\int_0^T i(t)dt + V_o$	$L \cdot \frac{di(t)}{dt}$