Capacitors Inductors 004

Problem has been graded.

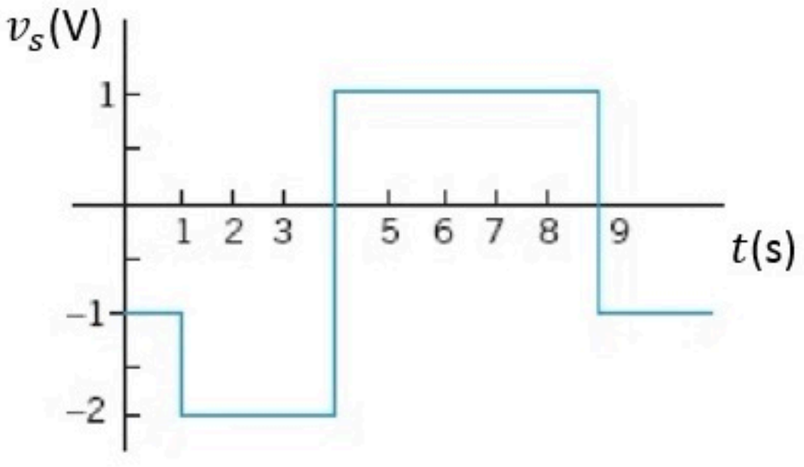
Find the current $i(t)$ in the circuit, when $i(0) = 1$ A and the voltage is as shown in the graph.

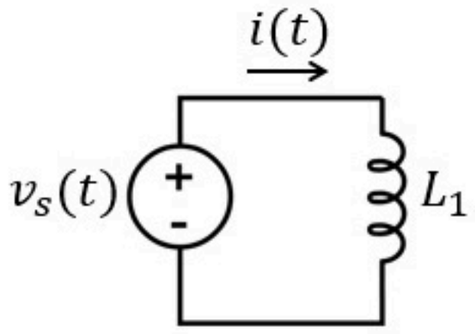
$i(t) = a_1 t + a_2$ for 0 s < t < 1 s

$i(t) = a_3 t + a_4$ for 1 s < t < 4 s

$i(t) = a_5 t + a_6$ for 4 s < t < 9 s

$i(t) = a_7 t + a_8$ for 9 s < t





Given Variables:

L1 : 0.2 H

Calculate the following:

a1 (A/s) :

-5 ✓

a2 (A) :

1 ✓

a3 (A/s) :

-10 ✓

a4 (A) :

6 ✓

a5 (A/s) :

5 ✓

a6 (A) :

-54 ✓

a7 (A/s) :

-5 ✓

a8 (A) :

36 ✓

Hint: Make sure your offsets of the line segments are correct

Find the current $i(t)$ in the circuit, when $i(0) = 1$ A and the voltage is as shown in the graph.

L1 = 0.1 H

ⓐ $i(t) = a_1 t + a_2$ for $0s < t < 1s$

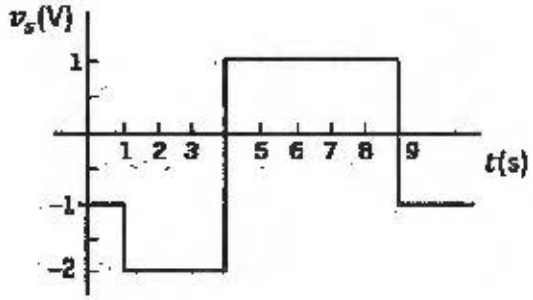
ⓑ $i(t) = a_3 t + a_4$ for $1s < t < 4s$

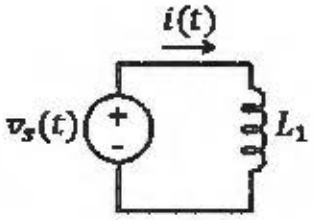
ⓒ $i(t) = a_5 t + a_6$ for $4s < t < 9s$

ⓓ $i(t) = a_7 t + a_8$ for $9s < t$

$$v_s = L \frac{di}{dt}$$

$$i(t) = i(t_0) + \frac{1}{L} \int_{t_0}^{t} v_s(u)\,du$$





ⓐ $t_0 = 0s$: $i(t) = 1 + \frac{1}{0.1} \int_0^t (-1)\,du = 1 - 10t$

$a_1 = -10$ A/s

$a_2 = 1$ A

at $t = 1s$: $i(1) = 1 - 10.1 = -9$ A

ⓑ $t_0 = 1s$ $i(t) = -9 + \frac{1}{0.1} \int_1^t (-2)\,du = -9 - 20(t-1) = 11 - 20t$

at $t = 4s$. $i(4) = 11 - 20.4 = -69$ A

$a_3 = -20$ A/s $a_4 = 11$ A

ⓒ $t_0 = 4s$. $i(t) = -69 + \frac{1}{0.1} \int_4^t 1\,du = -69 + 10(t-4) = -109 + 10t$

at $t = 9s$. $i(9) = -109 + 10 \cdot 9 = -19$ A

$a_5 = 10$ A/s $a_6 = -109$ A

ⓓ $t_0 = 9s$. $i(t) = -19 + \frac{1}{0.1} \int_9^t (-1)\,du = -19 - 10(t-9) = 71 - 10t$

$a_7 = -10$ A/s $a_8 = 71$ A