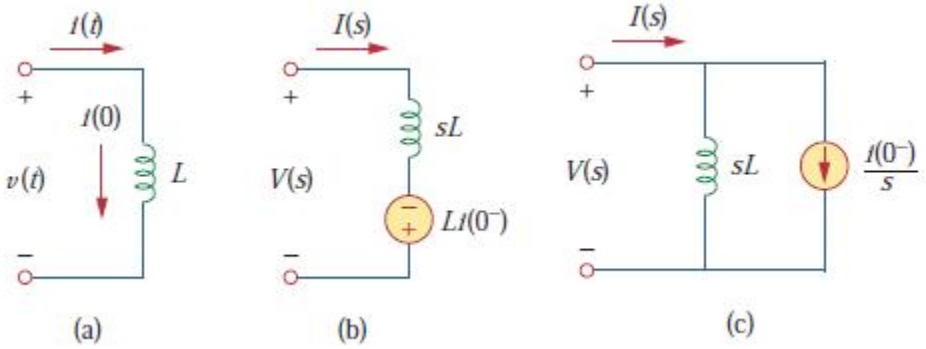
- ارتباط تبدیل لاپلاس ولتاژ و جریان المان‌ها
  - مقاومت

$$v(t) = R\,i(t)$$
$$V(s) = R\,I(s)$$
$$Z(s) = \frac{V(s)}{I(s)} = R$$

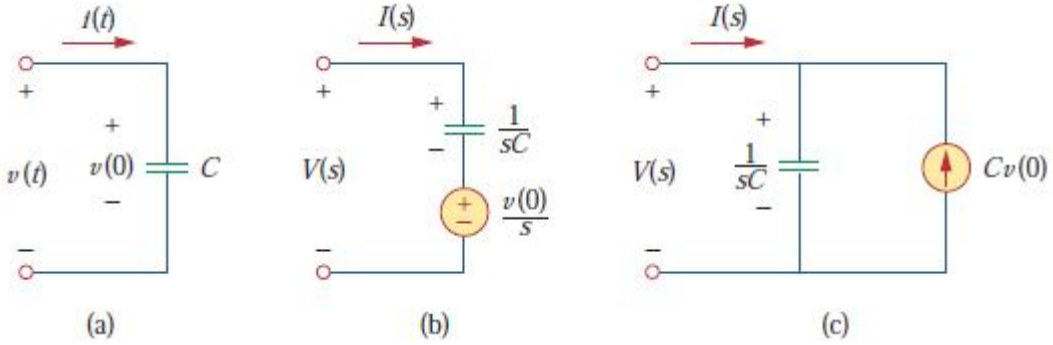
  - سلف

$$v(t) = L\,\frac{di(t)}{dt}$$
$$V(s) = L(s\,I(s) - i(0^-))$$
$$Z(s) = \frac{V(s)}{I(s)} = sL$$



  - خازن

$$i(t) = C\,\frac{dv(t)}{dt}$$
$$I(s) = C(s\,V(s) - v(0^-))$$
$$Z(s) = \frac{V(s)}{I(s)} = \frac{1}{sL}$$

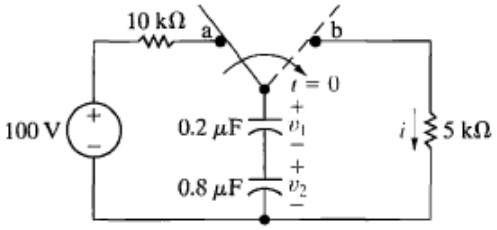


13.3 The switch in the circuit shown has been in position a for a long time. At $t = 0$, the switch is thrown to position b.

a) Find I, V_1, and V_2 as rational functions of s.

b) Find the time-domain expressions for i, v_1, and v_2.

Answer: (a) $I = 0.02/(s + 1250)$,
$V_1 = 80/(s + 1250)$,
$V_2 = 20/(s + 1250)$;
(b) $i = 20e^{-1250t}u(t)$ mA,
$v_1 = 80e^{-1250t}u(t)$ V,
$v_2 = 20e^{-1250t}u(t)$ V.



13.4 The energy stored in the circuit shown is zero at the time when the switch is closed.

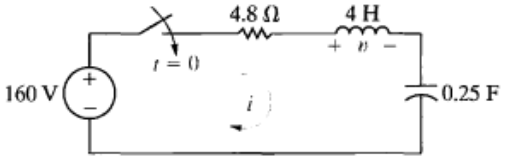
a) Find the s-domain expression for I.

b) Find the time-domain expression for i when $t > 0$.

c) Find the s-domain expression for V.

d) Find the time-domain expression for v when $t > 0$.

Answer: (a) $I = 40/(s^2 + 1.2s + 1)$;
(b) $i = (50e^{-0.6t} \sin 0.8t)u(t)$ A;
(c) $V = 160s/(s^2 + 1.2s + 1)$;
(d) $v = [200e^{-0.6t} \cos(0.8t + 36.87°)]u(t)$ V.



Practice Problem 16.1

Determine $v_o(t)$ in the circuit of Fig. 16.6, assuming zero initial conditions.

Answer: $20(1 - e^{-2t} - 2te^{-2t})u(t)$ V.

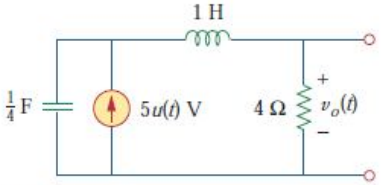


Figure 16.6
For Practice Prob. 16.1.

Practice Problem 16.2

Find $v_o(t)$ in the circuit shown in Fig. 16.9. Note that, since the voltage input is multiplied by $u(t)$, the voltage source is a short for all $t < 0$ and $i_L(0) = 0$.

Answer: $(24e^{-2t} - 4e^{-t/3})u(t)$ V.

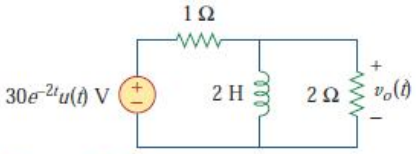


Figure 16.9
For Practice Prob. 16.2.

Practice Problem 16.3

The switch in Fig. 16.11 has been in position b for a long time. It is moved to position a at $t = 0$. Determine $v(t)$ for $t > 0$.

Answer: $v(t) = (V_o - I_oR)e^{-t/\tau} + I_oR$, $t > 0$, where $\tau = RC$.

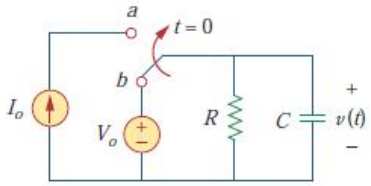


Figure 16.11
For Practice Prob. 16.3.

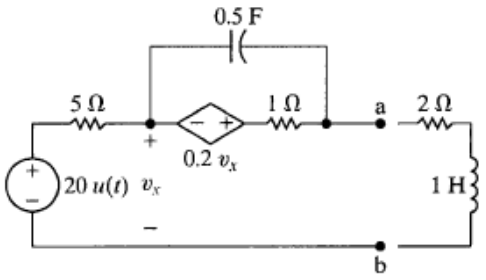
13.6 The initial charge on the capacitor in the circuit shown is zero.

a) Find the *s*-domain Thévenin equivalent circuit with respect to terminals a and b.

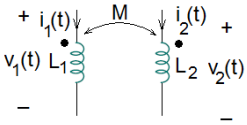
b) Find the *s*-domain expression for the current that the circuit delivers to a load consisting of a 1 H inductor in series with a 2 Ω resistor.

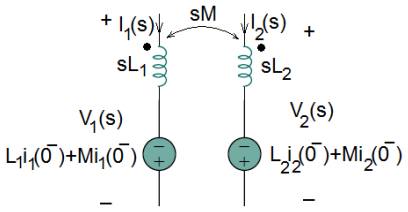
Answer: (a) $V_{Th} = V_{ab} = [20(s + 2.4)]/[s(s + 2)]$, $Z_{Th} = 5(s + 2.8)/(s + 2)$;

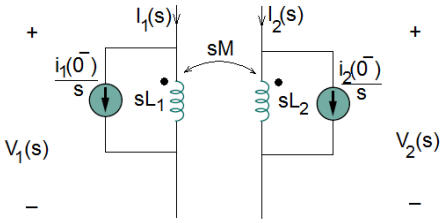
(b) $I_{ab} = [20(s + 2.4)]/[s(s + 3)(s + 6)]$.



مدار تزویج







- تابع انتقال

The transfer function $H(s)$ is the ratio of the output response $Y(s)$ to the input excitation $X(s)$, assuming all initial conditions are zero.

$$H(s) = \frac{Y(s)}{X(s)}$$

$$H(s) = \text{Voltage gain} = \frac{V_o(s)}{V_i(s)}$$

$$H(s) = \text{Current gain} = \frac{I_o(s)}{I_i(s)}$$

$$H(s) = \text{Impedance} = \frac{V(s)}{I(s)}$$

$$H(s) = \text{Admittance} = \frac{I(s)}{V(s)}$$

- اگر $x(t)=\delta(t)$ آنگاه $Y(s)=H(s)$. بنابراین:

$$Y(s) = H(s) \qquad \text{or} \qquad y(t) = h(t)$$

$$h(t) = \mathcal{L}^{-1}[H(s)]$$