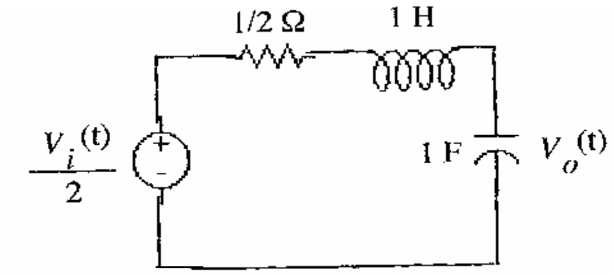
16.

a. Writing the node equations, $\frac{V_o - V_i}{s} + \frac{V_o}{s} + V_o = 0$. Solve for $\frac{V_o}{V_i} = \frac{1}{s+2}$.

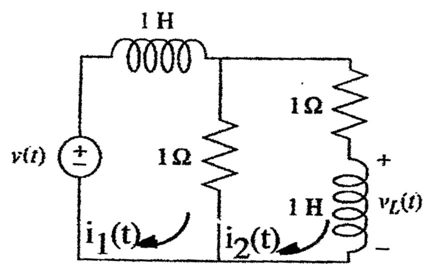
b. Thevenizing,



Using voltage division, $V_o(s) = \frac{V_i(s)}{2} \frac{\frac{1}{s}}{\frac{1}{2} + s + \frac{1}{s}}$. Thus, $\frac{V_o(s)}{V_i(s)} = \frac{1}{2s^2 + s + 2}$

17.

a.



Writing mesh equations

$$(s+1)I_1(s) – I_2(s) = V_i(s)$$

$$-I_1(s) + (s+2)I_2(s) = 0$$

But, $I_1(s) = (s+2)I_2(s)$. Substituting this in the first equation yields,

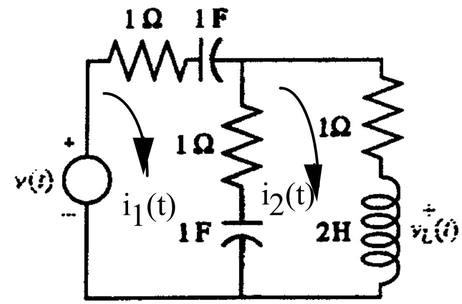
$$(s+1)(s+2)I_2(s) – I_2(s) = V_i(s)$$

or

$$I_2(s)/V_i(s) = 1/(s^2 + 3s + 1)$$

But, $V_L(s) = sI_2(s)$. Therefore, $V_L(s)/V_i(s) = s/(s^2 + 3s + 1)$.

b.



$$\left(2+\frac{2}{s}\right)I_1(s)-\left(1+\frac{1}{s}\right)I_2(s)=V(s)$$

$$-\left(1+\frac{1}{s}\right)I_1(s)+\left(2+\frac{1}{s}+2s\right)I_2(s)=0$$

Solving for $I_2(s)$:

$$I_2(s)=\frac{\begin{vmatrix}\frac{2(s+1)}{s} & V(s)\\ -\frac{s+1}{s} & 0\end{vmatrix}}{\begin{vmatrix}\frac{2(s+1)}{s} & -\frac{s+1}{s}\\ -\frac{s+1}{s} & \frac{2s^2+2s+1}{s}\end{vmatrix}}=\frac{V(s)s}{4s^2+3s+1}$$

Therefore, $\dfrac{V_L(s)}{V(s)}=2s\dfrac{I_2(s)}{V(s)}=\dfrac{2s^2}{4s^2+3s+1}$

23.

Writing the equations of motion, where $x_2(t)$ is the displacement of the right member of springr,

$$(s^2+s+1)X_1(s) \ -X_2(s) = 0$$

$$-X_1(s) + X_2(s) = F(s)$$

Adding the equations,

$$(s^2+s)X_1(s) \ = F(s)$$

From which, $\dfrac{X_1(s)}{F(s)} = \dfrac{1}{s(s+1)}$.

26.

$$(s^2+3s+2)X_1(s)-(s+1)X_2(s)=0$$

$$-(s+1)X_1(s)+(s^2+2s+1)X_2(s)=F(s)$$

Solving for $X_1(s)$; $X_1 = \dfrac{\left|\begin{pmatrix} 0 & -[s+1] \\ F & s^2+2s+1 \end{pmatrix}\right|}{\left|\begin{pmatrix} s^2+3s+2 & -[s+1] \\ -[s+1] & s^2+2s+1 \end{pmatrix}\right|} = \dfrac{F(s)}{s^3+4s^2+4s+1}$. Thus, $\dfrac{X_1}{F(s)} = \dfrac{1}{s^3+4s^2+4s+1}$

27.