① Text 15-12a

$$x'(t) + 10x(t) = u(t), \quad x(0^-) = 1$$

$$sX(s) - x(0^-) + 10X(s) = \frac{1}{s}$$

$$X(s)\,[s + 10] = 1 + \frac{1}{s} = \frac{s+1}{s}$$

$$X(s) = \frac{s+1}{s(s+10)} = \frac{A}{s} + \frac{B}{s+10}$$

$$A = \left.\frac{s+1}{\cancel{s}(s+10)}\cdot\cancel{s}\right|_{s=0} = \frac{+1}{10} = +.1$$

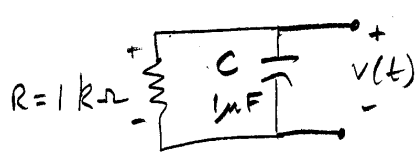
$$B = \left.\frac{s+1}{s\cancel{(s+10)}}\cancel{(s+10)}\right|_{s=-10} = \frac{-9}{-10} = 0.9$$

$$X(s) = \frac{-.1}{s} + \frac{1.1}{s+10} \Rightarrow \boxed{x(t) = 0.1\,u(t) + 0.9e^{-10t}u(t)}$$

note: $x(0) = .1\,u(0) + .9e^{-10\cdot 0}u(0)$
$= 1$ ✓

② Text 15-13b

$v(0^-) = 10, \quad v(t) = \text{output}$



$$\underbrace{C\frac{dv(t)}{dt}}_{\text{current thru Cap}} + \underbrace{\frac{v(t)}{R}}_{\text{current thru R}} = 0$$

$$C\left[sV(s) - v(0^-)\right] + \frac{V(s)}{R} = 0$$

$$V(s)\left[sC + \frac{1}{R}\right] = v(0^-)C$$

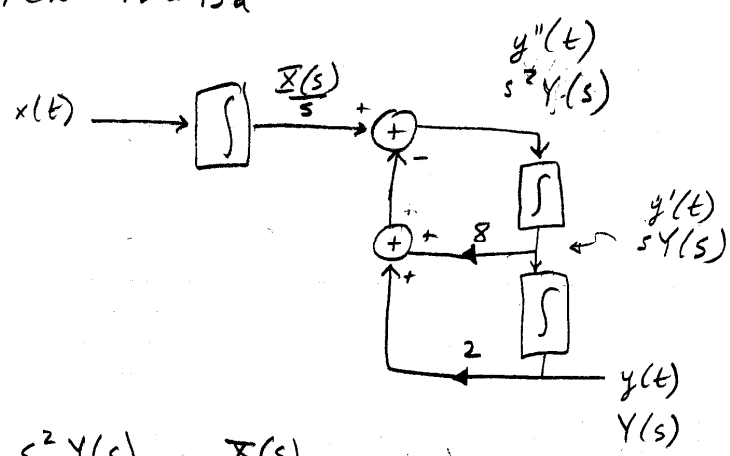
$$V(s) = \frac{v(0^-)\ C}{sC + \frac{1}{R}}$$

$$V(s) = \frac{v(0^-)\ C}{\left(sC + \frac{1}{R}\right)} \frac{\left(\frac{1}{C}\right)}{\left(\frac{1}{C}\right)} = \frac{v(0^-)}{s + \frac{1}{RC}} = \frac{10}{s + 1000}$$

$$\boxed{v(t) = 10 e^{-1000t} u(t)}$$

note: $v(0) = 10 e^{-1000(0)} u(0) = 10$ ✓

(3) Text 15-15a



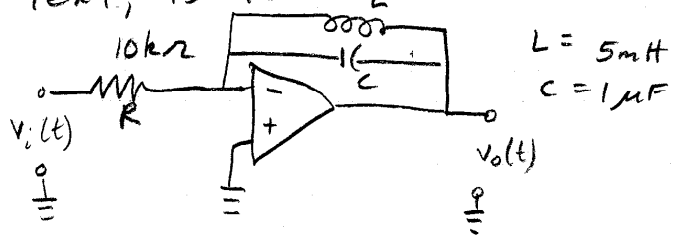
$$s^2 Y(s) = \frac{X(s)}{s} - 8sY(s) - 2Y(s)$$

$$Y(s)\left[s^2 + 8s + 2\right] = \frac{X(s)}{s}$$

$$\boxed{H(s) = \frac{Y(s)}{X(s)} = \frac{1}{s(s^2 + 8s + 2)}}$$

TOPS 35500

(4) Text, 15-40b



$L = 5mH$
$C = 1\mu F$

Inverting Amp

$$H(s) = -\frac{Z_o(s)}{Z_i(s)} \qquad Z_i(s) = R = 10000$$

$$Z_o(s) = \frac{sL\left(\frac{1}{sC}\right)\left(\frac{s}{L}\right)}{\left(sL + \frac{1}{sC}\right)\left(\frac{s}{L}\right)} = \frac{\frac{s}{C}}{s^2 + \frac{1}{LC}}$$

$$H(s) = \frac{-\frac{s/C}{s^2 + \frac{1}{LC}}}{R} = -\frac{1}{RC}\,\frac{s}{s^2 + \frac{1}{LC}}$$

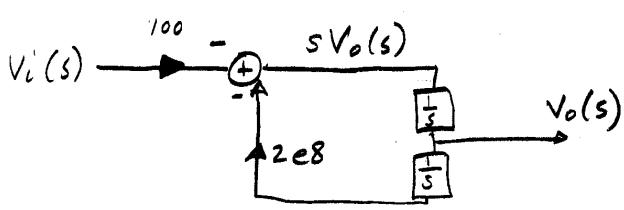
$$\boxed{H(s) = \frac{-100\,s}{s^2 + 2e8}}$$

$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{-100s}{s^2 + 2e8}$$

$$-100s\,V_i(s) = s^2 V_o(s) + 2e8\,V_o(s)$$

$$-100\,V_i(s) = s\,V_o(s) + \frac{1}{s}\,2e8\,V_o(s)$$

$$-100V_i(s) - \frac{2e8}{s}V_o(s) = s\,V_o(s)$$



TOPS 35500