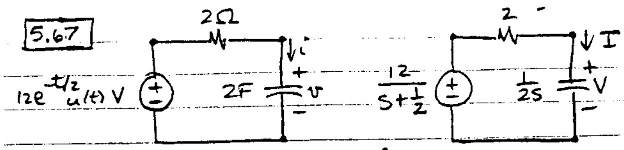
5.67



time domain   frequency domain

By voltage division,

$$V = \frac{\frac{1}{2s}}{2+\frac{1}{2s}}\,\frac{12}{s+\frac{1}{2}} = \frac{1}{4s+1}\,\frac{12}{s+\frac{1}{2}} = \frac{3}{(s+\frac{1}{4})(s+\frac{1}{2})}$$

$$V = \frac{3}{(s+\frac{1}{4})(s+\frac{1}{2})} = \frac{K_1}{s+\frac{1}{4}} + \frac{K_2}{s+\frac{1}{2}}$$

$$K_1 = \left.\frac{3}{s+\frac{1}{2}}\right|_{s=-\frac{1}{4}} = \frac{3}{-\frac{1}{4}+\frac{1}{2}} = 12 \qquad K_2 = \left.\frac{3}{s+\frac{1}{4}}\right|_{s=-\frac{1}{2}} = \frac{3}{-\frac{1}{2}+\frac{1}{4}} = -12$$

$$\therefore V = \frac{12}{s+\frac{1}{4}} - \frac{12}{s+\frac{1}{2}} \Rightarrow v(t) = 12e^{-t/4}u(t) - 12e^{-t/2}u(t)$$

$$v(t) = \underline{(12e^{-t/4} - 12e^{-t/2})\,u(t)\ \text{V}}$$

$$I = \frac{V}{1/2s} = 2sV = 2s\,\frac{3}{(s+\frac{1}{4})(s+\frac{1}{2})}$$

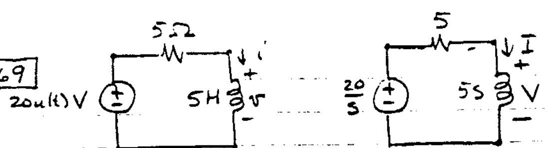
$$I = \frac{6s}{(s+\frac{1}{4})(s+\frac{1}{2})} = \frac{K_1}{s+\frac{1}{4}} + \frac{K_2}{s+\frac{1}{2}}$$

$$K_1 = \left.\frac{6s}{s+\frac{1}{2}}\right|_{s=-\frac{1}{4}} = \frac{6(-\frac{1}{4})}{-\frac{1}{4}+\frac{1}{2}} = -6 \qquad K_2 = \left.\frac{6s}{s+\frac{1}{4}}\right|_{s=-\frac{1}{2}} = \frac{6(-\frac{1}{2})}{-\frac{1}{2}+\frac{1}{4}} = 12$$

$$\therefore I = \frac{-6}{s+\frac{1}{4}} + \frac{12}{s+\frac{1}{2}} \Rightarrow i(t) = -6e^{-t/4}u(t) + 12e^{-t/2}u(t)$$

$$i(t) = \underline{(-6e^{-t/4} + 12e^{-t/2})\,u(t)\ \text{A}}$$

5.69



time domain   frequency domain

By KVL,

$$\frac{20}{s} = 5I + 5sI = (5s+5)I$$

$$\therefore I = \frac{20/s}{5s+5} = \frac{4}{s(s+1)} = \frac{K_1}{s} + \frac{K_2}{s+1}$$

$$K_1 = \left.\frac{4}{s+1}\right|_{s=0} = 4 \qquad K_2 = \left.\frac{4}{s}\right|_{s=-1} = -4$$

$$I = \frac{4}{s} - \frac{4}{s+1} \Rightarrow i(t) = 4u(t) - 4e^{-t}u(t)$$

$$i(t) = \underline{(4 - 4e^{-t})\,u(t)\ \text{A}}$$

$$V = 5sI = 5s\left(\frac{4}{s(s+1)}\right) = \frac{20}{s+1} \Rightarrow v(t) = \underline{20e^{-t}u(t)\ \text{V}}$$

5.110 $H(s) = \frac{s}{s+2}$

(a) $x(t) = u(t) \Rightarrow X(s) = \frac{1}{s}$

$$\therefore Y(s) = H(s)X(s) = \frac{s}{s+2}\cdot\frac{1}{s} = \frac{1}{s+2} \Rightarrow y(t) = \underline{e^{-2t}u(t)}$$

(b) $x(t) = e^{-t}u(t) \Rightarrow X(s) = \frac{1}{s+1}$

$$\therefore Y(s) = H(s)X(s) = \frac{s}{s+2}\cdot\frac{1}{s+1} = \frac{s}{(s+1)(s+2)} = \frac{K_1}{s+1} + \frac{K_2}{s+2}$$

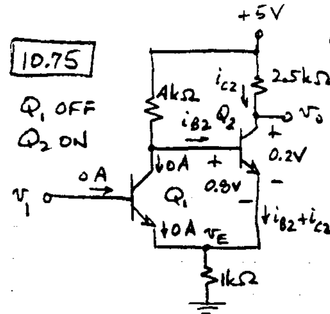
$$K_1 = \left.\frac{s}{s+2}\right|_{s=-1} = \frac{-1}{-1+2} = -1 \qquad K_2 = \left.\frac{s}{s+1}\right|_{s=-2} = \frac{-2}{-2+1} = 2$$

$$Y(s) = \frac{-1}{s+1} + \frac{2}{s+2} \Rightarrow y(t) = -e^{-t}u(t) + 2e^{-2t}u(t) = \underline{(-e^{-t} + 2e^{-2t})\,u(t)}$$

10.75

Q_1 OFF

Q_2 ON



(a) By KVL,

$$5 = 4k\,i_{B2} + 0.8 + 1k(i_{B2} + i_{C2})$$

$$4.2 = 5k\,i_{B2} + 1k\,i_{C2} \quad (A)$$

Also, by KVL,

$$5 = 2.5k\,i_{C2} + 0.2 + 1k(i_{B2} + i_{C2})$$

$$4.8 = 1k\,i_{B2} + 3.5k\,i_{C2}$$

$$14.7 = 17.5k\,i_{B2} + 3.5k\,i_{C2} \quad \times 3.5$$

$$-9.9 = -16.5k\,i_{B2}$$

$$\therefore i_{B2} = \frac{9.9}{16.5k} = \underline{0.6\,\text{mA}}$$

From Equation (A), $1k\,i_{C2} = 4.2 - 5k\,i_{B2} = 4.2 - 5k(0.6m) = 1.2$

$$\therefore i_{C2} = \frac{1.2}{1k} = \underline{1.2\,\text{mA}}$$

For Q_2 to indeed be ON, $h_{FE2} \geq \frac{i_{C2}}{i_{B2}} = \frac{1.2m}{0.6m} = \underline{\underline{2}}$

(b) Q_2 ON $\Rightarrow v_o$ is low.

By KVL, $v_o = 0.2 + 1k(i_{B2} + i_{C2}) = 0.2 + 1k(0.6m + 1.2m) = 0.2 + 1.8$

$v_o = \underline{2\,\text{V}}$ is the low voltage

(c) v_o will remain low as long as Q_1 is OFF ($v_{BE1} < 0.5$V)

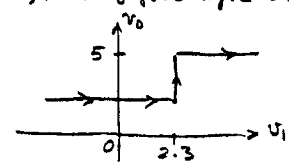
Thus, $v_{BE1} < 0.5$

$v_1 - v_E < 0.5$

$v_1 < 0.5 + v_E = 0.5 + 1k(i_{B2} + i_{C2}) = 0.5 + 1k(0.6m + 1.2m)$

$v_1 < 0.5 + 1k(1.8m) = 0.5 + 1.8 = \underline{\underline{2.3\,\text{V}}}$ is the upper threshold voltage

When $v_1 > 2.3$V, then v_o goes high (5V).

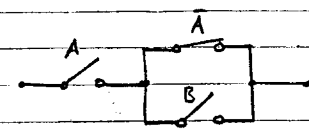


11.19

A	B	C	L = AB + AC
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Since this identical to Table 11.4, then $\underline{\underline{AB + AC = A(B+C)}}$

11.23



A	$\bar{A}$	B	$L = A(\bar{A}+B)$
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1

$\Rightarrow \underline{\underline{A(\bar{A}+B) = AB}}$

11.27 $F = (A+B)(\overline{AB})$

A	B	AB	$\overline{AB}$	A+B	$F = (A+B)(\overline{AB})$
0	0	0	1	0	0
0	1	0	1	1	1
1	0	0	1	1	1
1	1	1	0	1	0

This is the $\underline{\text{exclusive-OR operation}}$.