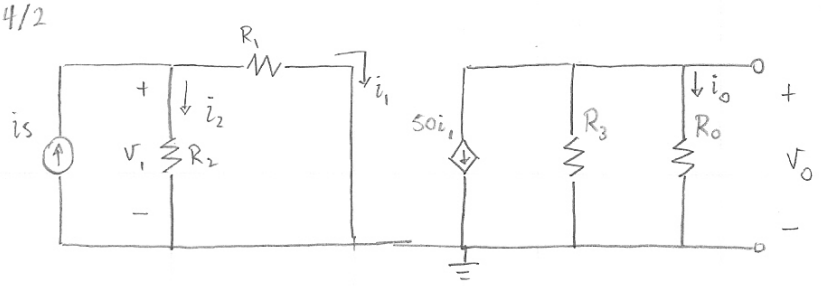
4/2, 14, 28, 31

9/17, 31

4/2



$R_1 = R_2 = 100\ \Omega$

$R_3 = R_o = 2\ k\Omega$

$$i_1 = i_s \frac{R_2}{R_1+R_2} = \frac{i_s}{2}$$

$$v_1 = i_2 R_2$$

$$= (i_s - i_1) R_2$$

$$= 50 i_s$$

$$i_o = (-50 i_1) \frac{R_3}{R_3+R_o}$$

$$= -25 i_1$$

$$= -\frac{25}{2} i_s$$

$$v_o = i_o R_o$$

$$= -\frac{25}{2} i_s R_o$$

$$= -500 v_1$$

$$\boxed{\begin{aligned} v_o/v_1 &= -500 \\ i_o/i_s &= -25/2 \end{aligned}}$$

If $i_s = 2\ mA$

$v_1 = 50\ i_s = .1\ V$

$P_s = i_s v_1 = .2\ mW$

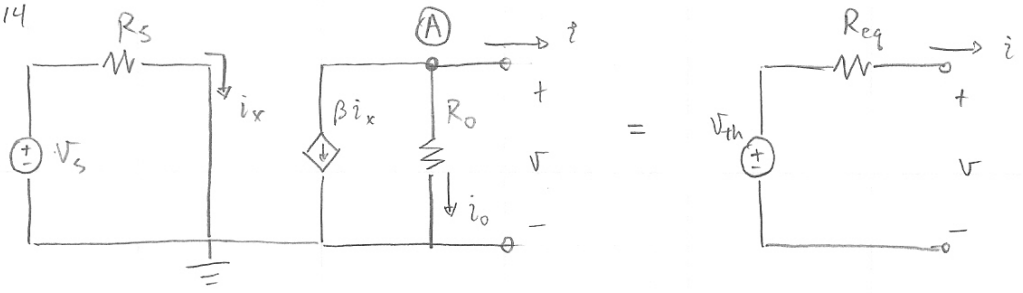
$v_o = -50\ V$

$i_o = -25\ mA$

$P_o = v_o i_o = 1.25\ W$

$$\boxed{\begin{aligned} P_s &= .2\ mW \\ P_o &= 1.25\ W \end{aligned}}$$

4/14



$$i_x = \frac{V_s}{R_s}$$

OC test $i = 0$

$\Rightarrow v = V_{th}$

$$v = i_o R_o$$

$$= -\beta i_x R_o$$

$$= -\frac{\beta V_s R_o}{R_s}$$

SC test $v = 0$

$$i = \frac{V_{th}}{R_{eq}}$$

$$\Rightarrow R_{eq} = V_{th}/i$$

$$i = -i_o - \beta i_x$$

$$= -\beta i_x$$

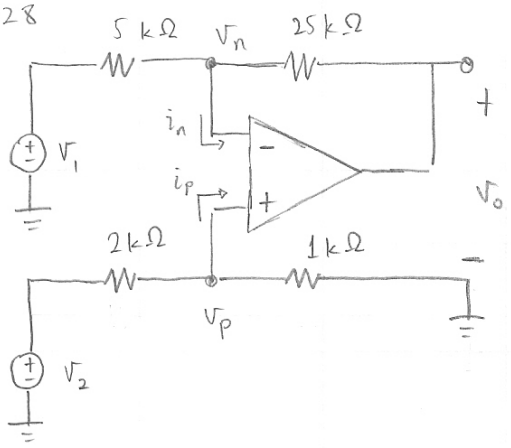
$$R_{eq} = \frac{V_{th}}{-\beta i_x}$$

$$= -\frac{\beta i_x R_o}{-\beta i_x}$$

$$= R_o \quad \text{(not surprisingly)}$$

$$\boxed{V_{th} = -\beta V_s \frac{R_o}{R_s}, \quad R_{eq} = R_o}$$

4/28



(1) $v_p = v_n$, (2) $i_p = i_n = 0$

2 $\Rightarrow$ $\frac{v_2}{2+1} = \frac{v_p}{1}$

$\Rightarrow v_p = \frac{v_2}{3}$

1 $\Rightarrow$ $v_n = \frac{v_2}{3}$

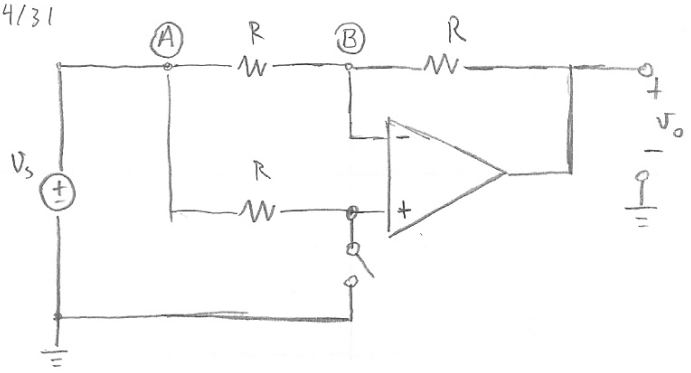
$\frac{1}{5}(v_1 - v_n) = \frac{1}{25}(v_n - v_o)$

$5v_1 - 5v_n = v_n - v_o$

$5v_1 - \frac{5}{3}v_2 = \frac{v_2}{3} - v_o$

$\boxed{v_o = 2v_2 - 5v_1}$

4/31



Switch open

$V_n = V_p$, $i_p = i_n = 0$

$\Rightarrow V_A = V_B = V_s$

$$\frac{V_B - V_o}{R} = 0$$

$$V_B - V_o = 0$$

$$\Rightarrow \boxed{V_s = V_o}$$

Switch closed

$\Rightarrow V_p = V_n = V_B = 0$

$$\frac{V_A - V_B}{R} = \frac{V_B - V_o}{R}$$

$$V_s - 0 = 0 - V_o$$

$$\boxed{V_s = -V_o}$$

9/17 (a)

$$F_1(s) = \frac{2(s+5)}{s(s+10)}$$

$$= \frac{K_1}{s} + \frac{K_2}{s+10}$$

$$K_1 = \lim_{s\to 0} \frac{2(s+5)}{s(s+10)} \times s \quad \Rightarrow \quad K_1 = 1$$

$$K_2 = \lim_{s\to -10} \frac{2(s+5)}{s(s+10)} \times (s+10)$$

$$= \frac{2(-5)}{-10} \quad \Rightarrow \quad K_2 = 1$$

$$F_1(s) = \frac{1}{s} + \frac{1}{s+10}$$

$$\boxed{f_1(t) = u_t\,(1 + e^{-10t})}$$

9/17 (b)

$$F_2(s) = \frac{s^2}{(s+5)(s+10)}$$

$$\begin{array}{r} 1 \\ s^2+15s+50 \overline{)\, s^2} \\ \underline{-s^2-15s-50} \\ -15s-50 \end{array}$$

$$F_2(s) = 1 - \frac{15s+50}{(s+5)(s+10)}$$

$$= 1 - \left(\frac{K_1}{s+5} + \frac{K_2}{s+10}\right)$$

$$K_1 = \lim_{s\to -5} \frac{15s+50}{(s+5)(s+10)} (s+5) \Rightarrow \quad K_1 = -5$$

$$K_2 = \lim_{s\to -10} \frac{15s+50}{(s+5)(s+10)} (s+10) \Rightarrow \quad K_2 = 20$$

$$F_2(s) = 1 + \frac{5}{s+5} - \frac{20}{s+10}$$

$$\boxed{f_2(t) = \delta_t + u_t\,(5e^{-5t} - 20e^{-10t})}$$

9/31 (a)

$$50\dot{y}_t + 250 y_t = 0 \; ; \quad y_{0-} = 10$$

$$\Rightarrow 50(sy_s - y_{0-}) + 250 y_s = 0$$

$$(50s + 250) y_s = 500$$

$$y_s = \frac{500}{50(s+5)}$$

$$= \frac{10}{s+5}$$

$$\Rightarrow \boxed{y_t = 10 u_t e^{-5t}}$$

9/31 (b)

$$\dot{y}_t + 20 y_t = 40 u_t \; ; \quad y_{0-} = -10$$

$$\Rightarrow s y_s - y_{0-} + 20 y_s = 40\left(\frac{1}{s}\right)$$

$$(s+20) y_s + 10 = \frac{40}{s}$$

$$y_s = -\frac{10}{s+20} + \frac{40}{s(s+20)}$$

$$= -\frac{10}{s+20} + \frac{K_1}{s} + \frac{K_2}{s+20}$$

$$K_1 = \lim_{s \to 0} \frac{40}{s(s+20)} \times s \quad \Rightarrow \quad K_1 = 2$$

$$K_2 = \lim_{s \to -20} \frac{40}{s(s+20)} \times (s+20) \qquad K_2 = -2$$

$$y_s = -\frac{12}{s+20} + \frac{2}{s}$$

$$\Rightarrow \boxed{y_t = u_t \left(1 - 12 e^{-20t}\right)}$$