Problem 1

a) Solution #1

\[ V_x = \frac{V_1}{3} + \frac{2}{3} V_2 \]

many other solutions are possible.
Prob 1 Part B

Solution 1

Solution 2

There are many other possible solutions
Problem 2

Break the CKT into two parts

\[
V_x = \frac{V_1 \frac{R}{R+R_1R}}{R+R_1R} + \frac{V_2 \frac{R}{R+R_1R}}{R+R_1R}
\]

\[
= \frac{V_1 \frac{R}{R+R_2}}{R+R_2} + \frac{V_2 \frac{R}{R+R_2}}{R+R_2}
\]

\[
= \frac{V_1 + V_2}{3}
\]

Find \( V_0 \) due to \( V_x \), then
Find \( V_0 \) due to \( V_3 \)
To find $V_0$ due to $V_x$, set $V_3 = 0 = \text{short } V_3$

$V_x \rightarrow \text{non-inverting Amp, } \frac{V_0}{V_x} = +3$

$\text{So } V_0 \big|_{V_x} = +3V_x = 3\left(\frac{V_1 + V_2}{3}\right) = V_1 + V_2$

Next, find $V_0$ due to $V_3$. Set $V_x = 0$

$V_3 \rightarrow \text{inverting Amp, } \frac{V_0}{V_3} = -2 \Rightarrow V_0 = -2V_3$

$\text{So } V_0 = V_0 \big|_{V_x} + V_0 \big|_{V_3} = \frac{V_1 + V_2 - 2V_3}{-2}$
Problem 3

Rectifier

Buffer

$V_1(t)$

Subtractor

$V_0 = V_1 - V_2$

Inverting Amp

$\text{Gain} = -1$

$V_3(t) = -V_{in}(t)$
Problem 3 plots
Problem 4

\[ V_4 = V_5 - V_3 \]
\[ V_3 = V_2 \]
\[ V_2 = -5V \left( \frac{1}{2} \right) = -2.5V \]
\[ V_1 = -5V \left( \frac{-R}{R} \right) = +5V \]
\[ V_5 = V_6 + V_1 \]
\[ V_6 = 2V_7 \]
\[ V_7 = 2.5V \]

\[ V_6 = 2V_7 = 5V \]
\[ V_5 = V_6 + V_1 = 5V + 5V = 10V \]
\[ V_3 = V_2 = -2.5V \]
\[ V_4 = V_5 - V_3 = 10V - (-2.5V) = 12.5V \]