2.2. a) $x(t) = 2\cos(200\pi t) + 5\sin(400\pi t)$

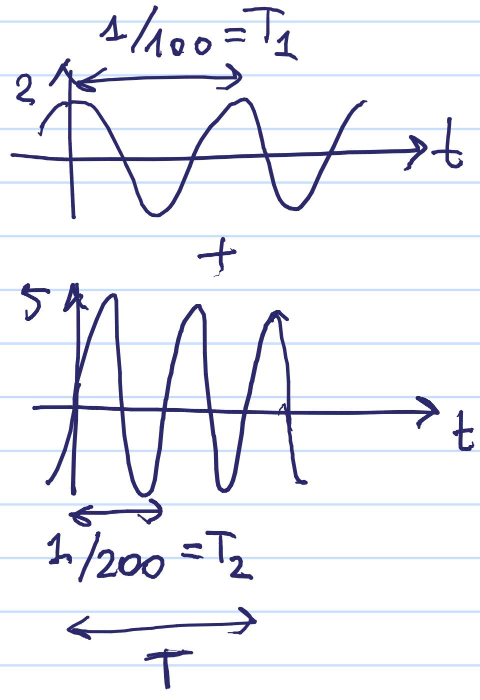
Period $T$ is the smallest value $T$ such that

$k_1 T_1 = k_2 T_2 = T$ for integers $k_1, k_2$

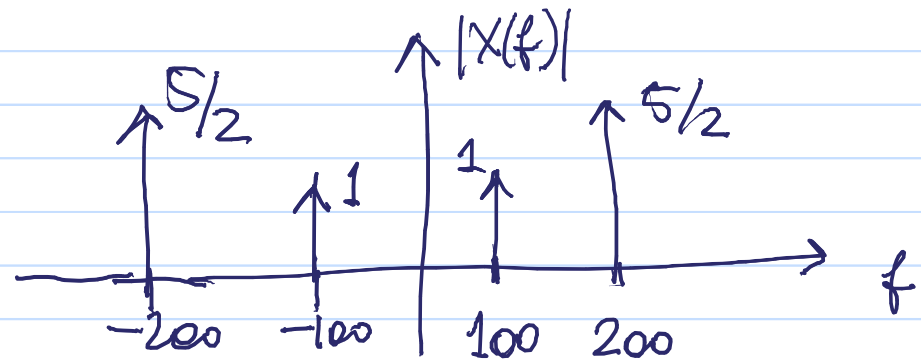
$\Rightarrow T = 1/100$, $k_1 = 1$, $k_2 = 2$

$$\Rightarrow \frac{1}{T_1} = \frac{1}{T} k_1 = \frac{1}{T}$$

$$\frac{1}{T_2} = \frac{1}{T} k_2 = \frac{2}{T}$$

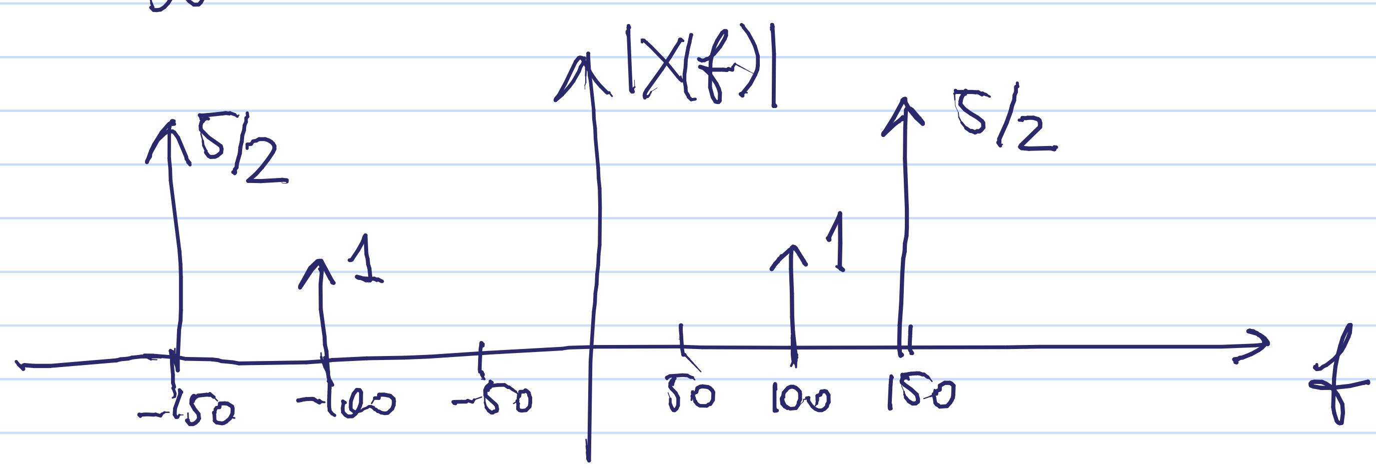



$$\Rightarrow \begin{cases} X_1 = 1 \\ X_{-1} = 1 \\ X_2 = -\frac{5}{2} j \\ X_{-2} = \frac{5}{2} j \\ X_n = 0 \text{ otherwise} \end{cases}$$




b) $T_1 = 1/100$, $T_2 = 1/150 \Rightarrow T = \frac{1}{50}$, $k_1 = 2$, $k_2 = 3$

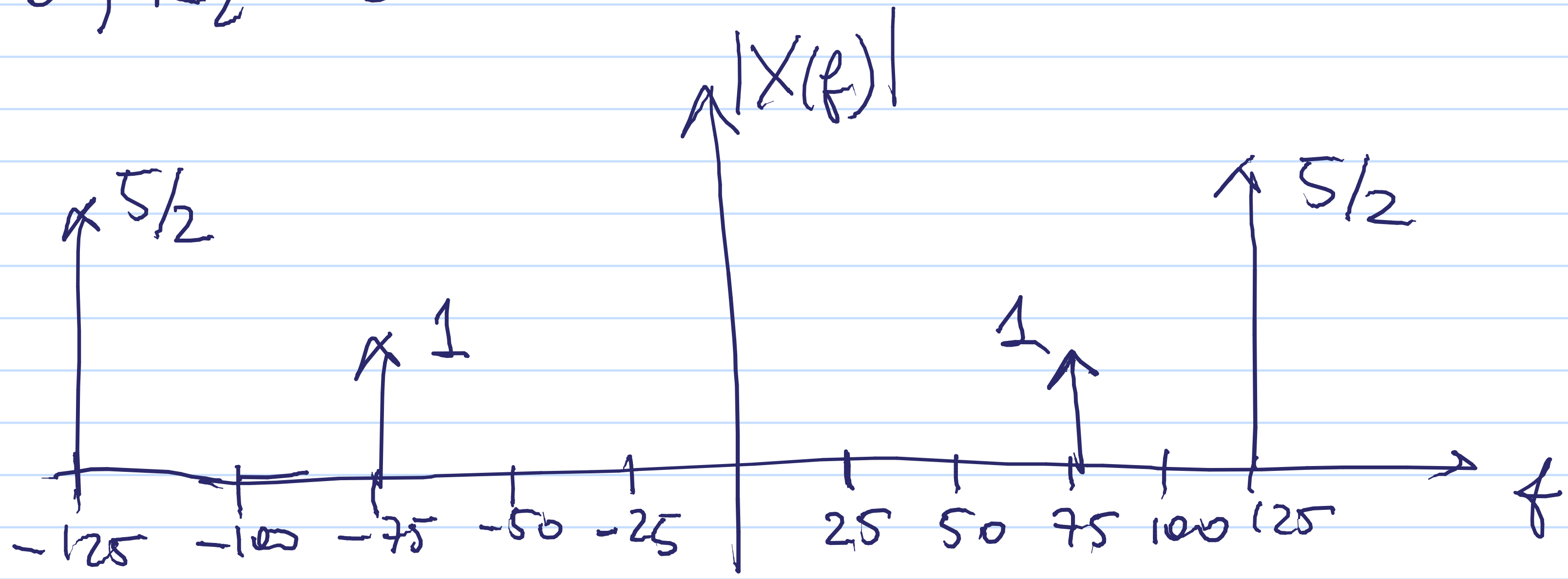
$$\begin{cases} X_2 = 1 \\ X_{-2} = 1 \\ X_3 = -5/2\, j \\ X_{-3} = 5/2\, j \\ X_n = 0 \text{ otherwise} \end{cases}$$



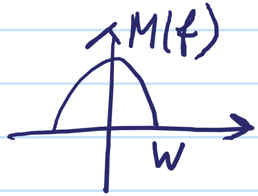

c) $T_1 = 1/75$, $T_2 = 1/125$

$\Rightarrow T = \frac{1}{25}$, $k_1 = 3$, $k_2 = 5$

$$\begin{cases} X_3 = 1 \\ X_{-3} = 1 \\ X_5 = -\frac{5}{2} j \\ X_{-5} = \frac{5}{2} j \end{cases}$$

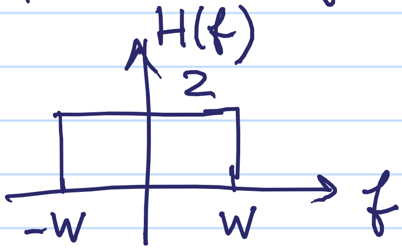


2.3. a. $y_1(t) = m(t)\cos(2\pi f_c t)\cos(2\pi f_c t)$




$$= \frac{1}{2}m(t) + \frac{1}{2}m(t)\cos(2\pi f_c t)$$

A low-pass filter with bandwidth equal to the bandwidth of m(t) and gain 2 is able to recover m(t)




b. $y_2(t) = m(t)\cos(2\pi f_c t)\sin(2\pi f_c t)$

$$= \frac{1}{2}m(t)\sin(4\pi f_c t)$$

Not useful to recover m(t)

c. and d. are similar.