1. The Fourier transform of a function $f : \mathbb{R} \rightarrow \mathbb{R}$ is given by

$$\hat{f}(s) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} f(t) e^{-ist} \, dt.$$ 

Find the Fourier transform of the following functions

(a) $f(t) = 1$ for $|t| \leq \pi$ and $f(t) = 0$ for $|t| > \pi$.

(b) $f(t) = t$ for $|t| \leq 1$ and $f(t) = 0$ for $|t| > 1$.

2. As in section 3.5.1 in the text, find a vector $h$ so that the convolution $g \ast h$ computes the approximation of the derivative of $g$ given by the symmetric difference formula

$$g'(x_n) \approx \frac{g(x_{n+1}) - g(x_{n-1})}{2\Delta}$$

where $\Delta$ is the distance between the $x_i$. 