1. Which of the following pairs of tones is perceived as the louder tone (and by how many phons):
    1. 20 dB intensity level at 1000 Hz or 20 dB intensity level at 4000 Hz
    2. 40 dB intensity level at 250 Hz or 40 dB intensity level at 1000 Hz
    3. 50 dB intensity level at 500 Hz or 30 dB intensity level at 2000 Hz

2. By substitution, show that the set of equations:

$$u(x,t)=\left[u^{+}\left(t-x/c\right)-u^{-}\left(t+x/c\right)\right]$$

$$p(x,t)=\frac{\rho c}{A}\left[u^{+}\left(t-x/c\right)+u^{-}\left(t+x/c\right)\right]$$

   are solutions to the partial differential equations:

$$-\frac{\partial\rho}{\partial x}=\frac{\rho}{A}\frac{\partial u}{\partial t}$$

$$-\frac{\partial u}{\partial x}=\frac{A}{\rho c^{2}}\frac{\partial p}{\partial t}$$

3. Consider the calculation of short-time energy via the relation:

$$E_n=\sum_{m=-\infty}^{\infty}x^{2}[m]h[n-m]$$

Consider the use of a system with impulse response, h[n], of the form:

$$h[n]=[-\frac{a}{b-a}a^{n}+\frac{b}{b-a}b^{n}]u[n]$$

where a and b are distinct with |a| < 1 and |b| < 1

(a) Determine a difference equation implementation for the computation of short-time energy using the impulse response given above.

(b) What general property must h[n] have in order that it be possible to find a recursive implementation.