* 1. If the output is observed to be *y (n)= δ (n)+ δ (n − 1)*, then what is the input?

**Problem 5.24**: Digital Filtering

A digital flter has an input-output relationship expressed by the diference equation



1. Plot the magnitude and phase of this flter's transfer function.
2. What is this flter's output when



**Problem 5.25:** Detective Work

The signal *x (n)* equals δ *(n)* − δ *(n − 1).*

1. Find the length-8 DFT (discrete Fourier transform) of this signal.
2. You are told that when *x (n)* served as the input to a linear FIR (fnite impulse response) flter, the output was *y (n)= δ (n) −δ (n − 1) + 2δ (n − 2)* . Is this statement true? If so, indicate why and fnd the system's unit sample response; if not, show why not.

###### Problem 5.26:

A discrete-time, shift invariant, linear system produces an output *y (n)= {1, −1, 0, 0,... }*

when its input *x (n)* equals a unit sample.

1. Find the diference equation governing the system.
2. Find the output when *x (n) = cos (2πf0n).*
3. How would you describe this system's function?

**Problem 5.27**: Time Reversal has Uses

A discrete-time system has transfer function *H*(e*j2πf*) . A signal *x (n)* is passed through this system to yield the signal *w (n)*. The time-reversed signal w (−n) is then passed through the system to yield the time-reversed output y *(-n)*. What is the transfer function between *x (n)* and y *(n)*?

**Problem 5.28:** Removing "Hum"

The slang word "hum" represents power line waveforms that creep into signals because of poor circuit construction. Usually, the 60 Hz signal (and its harmonics) are added to the desired signal. What we seek are flters that can remove hum. In this problem, the signal and the accompanying hum have been sampled; we want to design a **digital** flter for hum removal.

1. Find flter coefcients for the length-3 FIR flter that can remove a sinusoid having

**digital** frequency *f*0 from its input.

1. Assuming the sampling rate is *f*s to what analog frequency does *f*0 correspond?
2. A more general approach is to design a flter having a frequency response

**magnitude** proportional to