1a. YES is LTI. This is a constant-coefficient MA difference equation.
1b. NO not causal since \( y[n] \) depends on future inputs \( \{x[n+1], x[n+2], \ldots \} \)
1c. Read off impulse response \( h[n]=\{\ldots, -\frac{5}{2}, 1, 0, -1, \frac{1}{2}, -\frac{5}{2}, \ldots \} \)
1d. NOT BIBO stable since \( \sum |h[n]|=2(1+\frac{1}{2}+\frac{1}{3}+\ldots) \) diverges. Note \( \sum h[n]=0 \).
1e. \( x[n]=-(\neg)^n\text{sgn}[n]=\text{sgn}(h[-n]) \) makes \( y[0]=\sum |h[n]| \) which diverges.

2b. \( u[n]+2u[n-1]-3u[n-2]=\{1, 3\} \) since \( 1+2=3 \) (n=1) and \( 1+2-3=0 \) (n \geq 2).
2c. \( u[n]-u[n-3]=\{1, 1, 1\} \) so get \( \{3, 3+4, 3+4+5, 4+5, 5\}=[3, 7, 12, 9, 5] \)
2d. Convolution by delayed impulse delays signal so get \( \{0, 0, 2, 4, 8\} \)

3a. Suppose IS time-invariant. Then it is LTI. Write the 1st input in terms of the 2nd:
\( \{1, 2, 3\}=\delta[n]+2\delta[n-1]+3\delta[n-2] \). Then since the system is LTI:
\( \{1, 2, 3\}=\delta[n]+2\delta[n-1]+3\delta[n-2] \rightarrow \{1, 3\}+\{0, 2, 6\}+\{0, 3, 9\}=\{1, 5, 9, 9\} \)
But this contradicts \( \{1, 2, 3\} \rightarrow \{1, 4, 7, 6\} \). So the system is not time-invariant.
3b. \( \{1, 2, 3\} \ast \{h[0], h[1]\}=\{1, 4, 7, 6\} \) since durations of each sequence are \( 3+2-1=4 \).
\( 1h[0]=1; 2h[0]+1h[1]=4; 3h[0]+2h[1]=7; 3h[1]=6 \) are all satisfied by \( h[n]=\{1, 2\} \).
If there were no consistent solution, \( h[n] \) must have infinite duration.

4a. \( n=0: y[0]-y[-1]-y[-2]=x[0]-y[0]-0=1\) → \( y[0]=1 \).
\( n=1: y[1]-y[0]-y[-1]=x[1]-y[1]-1=0\) → \( y[1]=1 \).
\( n=2: y[2]-y[1]-y[0]=x[2]-y[2]-1=0\) → \( y[2]=2 \).
4b. \( Y=\text{filter([1, 1 -1 -1], [1 zeros(1,6)]);Y(1:7)} \) gives \( 1 \ 1 \ 2 \ 3 \ 5 \ 8 \ 13 \)

5a. The voice saying “Matlab–Breakfast of Champions” with high-frequency noise added.
5b. The spectrum (below left) has high-frequency noise in a band above 8000 Hertz.
5c. Most of the noise, but not all, has been eliminated. The voice is much clearer.
5d. The spectrum (below right) still has a much-smaller band of high-frequency noise.
The convolution with this small lowpass filter eliminated much (not all) of the noise.