Q1:

a- (2 marks): the discrete system shown below has the discrete impulse response $h_i$ and discrete input $x_i$. Compute its output $y_i$.

$$h_i = \begin{cases} 
  i & i = 0, 1, 2 \\
  0 & \text{elsewhere}
\end{cases}$$

$$x_i = \begin{cases} 
  1 & i = 0, 1 \\
  0 & \text{elsewhere}
\end{cases}$$

b- (2 marks): consider the discrete system with the following difference equation:

$$y_i = 1.429 \cdot y_{i-1} - 0.571 \cdot y_{i-2} + 1.43 \cdot u_i$$

where $y_i$ is the output of the system and $u_i$ is its input. Assume that the input to the system is a discrete impulse ($u_i = \delta_i$). Determine the output when the discrete time goes to infinity: $\lim_{i \to \infty} y_i$.

Q2: Let $x_i = Z[X(Z)]$ be a Z-Transform pair,

a- (2 marks): for $X(Z) = \frac{10 \cdot Z + 5}{(Z-1)(Z-2)}$ use long division to obtain the first three terms of $x_i$,

b- (2 marks): for $X(Z) = \frac{10 \cdot Z}{(Z-1)(Z-2)}$ use long partial fraction to obtain a formula for $x_i$,

c- (2 marks): use the Z-Transform pairs:

$$y_i = 5 \cdot \delta_i + 6.25 - 6.25 \cdot (0.2)^i$$

$$Y(Z) = \frac{1}{Z^2 - 1.2Z + 0.2}$$

Find the inverse Z-Transform of: $Y(Z) = \frac{Z^2}{Z^2 - 1.2Z + 0.2}$

Q3: Consider the following simulation diagram with three delay registers (DR-1, DR-2, DR-3):

a- directly use the simulation diagram to write the discrete state space equations of the system shown above,

b- if the following numbers are initially stored in the delay registers: DR-1=1, DR-2=0, DR-3=1, and the input is zero ($U_n=0$), compute $Y_3$. 