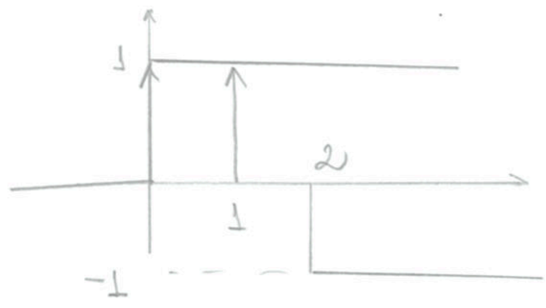
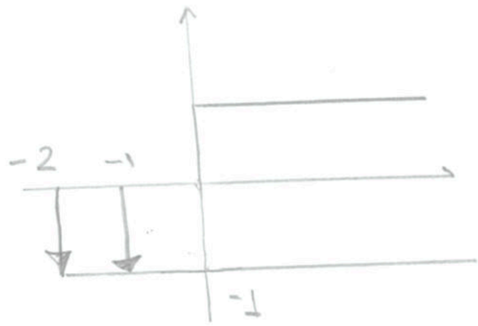
Resolução PR1 - 2017:

1)

$$x(n) = \underbrace{(u[n] - u[n-2])}_{(\delta[n]+\delta[n-1])} * \underbrace{(u[n] - u[n+2])}_{(-\delta[n+2]-\delta[n+1])}$$

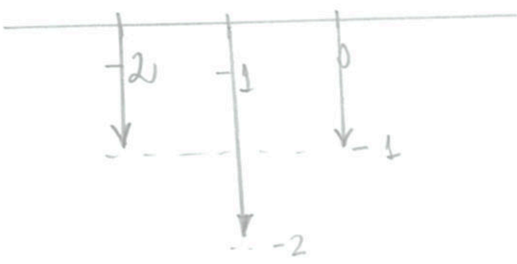




$$x(n) = (\delta[n] + \delta[n-1]) * (-\delta[n+2] - \delta[n+1])$$

$$x(n) = -\delta[n+2] - \delta[n+1] - \delta[n+1] - \delta[n]$$

$$\boxed{x(n) = -\delta[n+2] - 2\delta[n+1] - \delta[n]}$$



2)

$$y[n] = \max_{k \in (n-1,\, n,\, n+1)} |x[k]|$$

a) linear?

$$y[n] = |a x_1[k] + b x_2[k]| \neq a|x_1[k]| + b|x_2[k]| \quad \therefore \text{não linear}$$

b) $x[n-1], x[n], x[n+1]$

Se $n=0 \rightarrow x[-1], x[0], x[1]$

Não causal

③

a) $h[n] = 5(2)^{-n}u[n] \longrightarrow H(z) = 5\dfrac{z}{z-1/2}$

$$\boxed{H(z) = \frac{10z}{2z-1}}$$

b) $x[n] = 20 = 20\,\underset{z}{1}^n$

$$y_f[n] = 20\,H(1) = 20 \cdot 10 = \boxed{200}$$

④ $X(z) = \dfrac{5z^2}{(4z-1)}$ $\quad |z| > 1/4$

a) $x[0] = \lim\limits_{z\to\infty} X(z) = \lim\limits_{z\to\infty} \dfrac{5z^2}{16z^2-8z+1} = \dfrac{5}{16}$

$$\boxed{x[0] = 5/16}$$

b) $\sum k\,x[k] = \left(-z\dfrac{d}{dz}\right)X(z)\Big|_{z=1} = -z\left(\dfrac{10z(16z^2-8z+1) - 5z^2(32z-8)}{(16z^2-8z+1)^2}\right)$

$$\sum k x[k] = -1 \cdot \frac{(10(9) - 5(24))}{(9)^2} = -\frac{(90-120)}{81}$$

$$= \frac{30}{81} = \boxed{\frac{10}{27}}$$

5 a) $y[n] = \sum e^{n-k} x(k) u[n-k]$

$$\boxed{h[n] = e^n u[n]}$$

b) BIBO = ?

NÃO BIBO pq $\int e^n u[n] = +\infty$ diverge

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$$X(z) = \frac{z^2 + 8z}{\underbrace{(z+2)}_{>2}\underbrace{(z+4)}_{<4}} \qquad 2 < |z| < 4$$

$$\frac{X(z)}{z} = \frac{z+8}{(z+2)(z+4)} = \frac{A^{3}}{(z+2)} + \frac{B^{-2}}{(z+4)}$$

$$X(z) = \underbrace{\frac{3z}{(z+2)}}_{|z|>2} - \underbrace{\frac{2z}{(z+4)}}_{|z|<4}$$

$$\boxed{x[n] = 3(-2)^n u[n] + 2(-4) u[-n-1]}$$

(7) O teorema do valor final diz que só podemos ter um pólo sobre o círculo unitário. Assim,

$X(z)$ possui pólos $+1, \pm j$, ou seja 3 pólos sobre o círculo unitário

$\therefore$ NÃO EXISTE VALOR FINAL//

(8) $$\mathcal{G}\{z^x\} = \frac{2}{3-z} \qquad \mathcal{G}\{z^y\} = \frac{4}{5-z}$$

a) $$\mathcal{E}\{z^w\} = \mathcal{G}\{z^x\} \cdot \mathcal{G}\{z^y\} = \frac{8}{(3-z)(5-z)} \qquad |z|<3$$

$$\boxed{\mathcal{E}\{z^w\} = \frac{8}{z^2-8z+15}}$$

b) $$Pr\{w=1\} = p(1) = \frac{d}{dz}\mathcal{E}\{z^w\}\Big|_{z=0}$$

$$Pr\{w=1\} = \frac{-8(2z-8)}{(z^2-8z+15)^2}\Big|_{z=0} \longrightarrow \boxed{Pr\{w=1\} = \frac{64}{225}}$$

c) $$\mathcal{E}\{w\} = z\frac{d}{dz}\mathcal{E}\{z^w\}\Big|_{z=1} = \frac{z(-8(2z-8))}{(z^2-8z+15)^2}\Big|_{z=1}$$

$$\mathcal{E}\{w\} = \frac{-16+64}{64} \Rightarrow \boxed{\mathcal{E}\{w\} = 3/4}$$

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a) $x(n) = 2e^{\pi/2 j} + 3/2\left(e^{3\pi/5 jn}\, e^{\pi/4 j} + e^{-3\pi/5 jn}\, e^{-\pi/4 j}\right) + \frac{5}{2j}\left(e^{2\pi/5 jn} - e^{-2\pi/5 jn}\right)$

$$2\pi \cdot \frac{3}{\underbrace{2 \cdot 5}_{10}} \qquad 2\pi \cdot \frac{1}{\underbrace{5}_{5}}$$

$$N_1 \cdot 10 = N_2 \cdot 5 = 10$$

$$N_1 = 1 \quad N_2 = 2 \longrightarrow \boxed{N = 10}$$

b) $\boxed{C_0 = 2j}$

$$\frac{3}{2}\left(e^{\frac{2\pi}{10}(3)nj}\, e^{\pi/4 j} + e^{-\frac{2\pi}{10}(3)nj} \cdot e^{-\pi/4 j}\right) +$$

$$+ \frac{5}{2j}\left(e^{\frac{2\pi}{10}(2)nj} - e^{-\frac{2\pi}{10}(2)nj}\right)$$

$$\boxed{C_3 = \frac{3}{2} e^{\pi/4 j}}$$

$$\boxed{C_{-3} = C_7 = \frac{3}{2} e^{-\pi/4 j}} \qquad \boxed{C_2 = 5/2j}$$

$$\boxed{C_{-2} = C_8 = -\frac{5}{2j}}$$

Demais Nulos

c) $P_m = \sum |C_k|^2 = 4 + \frac{9}{4} + \frac{9}{4} + \frac{25}{4} + \frac{25}{4} = 4 + \frac{9}{2} + \frac{25}{2}$

$$P_m = \frac{8+9+25}{2} \longrightarrow \boxed{P_m = 21}$$

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$x[n] = \sum p[n-k5]$ $\qquad$ $p[n] = q[3-n]$

$q[n] = \delta[n-3] + \delta[n-4] + \delta[n-5]$

$q[n+3] = \delta[n] + \delta[n-1] + \delta[n-2]$

$q[-n+3] = \delta[n] + \delta[n+1] + \delta[n+2]$

$N = 5$

a)

$$c_k = \frac{1}{5} \cdot \sum x[n] e^{-jk\frac{2\pi}{N}n}$$

$$c_k = \frac{1}{5}\left(e^{-jk\frac{2\pi}{5}(-2)} + e^{-jk\frac{2\pi}{5}(-1)} + 1\right)$$

$$\boxed{c_k = 1/5\left(e^{4\pi k/5} + e^{2\pi k/5} + 1\right)}$$

b) $c_0 = 1/5\left(e^0 + e^0 + 1\right) \longrightarrow \boxed{c_0 = 3/5}$

c) $P_m = \frac{1}{N} \sum |x[n]|^2 = \frac{1}{5} \cdot (1+1+1) = \boxed{3/5}$