10 20(a) $y[n-1]+2y[n]=x[n]$

$$z^{-1}+2=0 \qquad z=-\frac{1}{2}$$

$$\therefore\ y[n]=A(-\frac{1}{2})^{n}$$

代入 $y[-1]=A(-\frac{1}{2})^{-1}=-2A=2$

$\therefore\ A=1$ $\therefore\ y_{zi}[n]=-(-\frac{1}{2})^{n}$

(b). $x[n]=(\frac{1}{4})^{n}u[n]\overset{z}{\longleftrightarrow}\frac{1}{1-\frac{1}{4}z^{-1}}$

z变换 $z^{-1}Y(z)+y[-1]+2Y(z)=X(z)$

$$(z^{-1}+2)Y(z)=X(z)-2$$

$$Y(z)=\frac{\frac{1}{1-\frac{1}{4}z^{-1}}}{z^{-1}+2}-\frac{2}{z^{-1}+2}$$

$$=\frac{1}{2}\frac{1}{(1-\frac{1}{4}z^{-1})(1+\frac{1}{2}z^{-1})}$$

$$=\frac{1}{2}\left(\frac{\frac{1}{3}}{1-\frac{1}{4}z^{-1}}+\frac{\frac{2}{3}}{1+\frac{1}{2}z^{-1}}\right)$$

$$y_{zs}=\frac{1}{6}(\frac{1}{4})^{n}u[n]+\frac{1}{3}(-\frac{1}{2})^{n}u[n]$$

(c) $y[n]=y_{zi}[n]+y_{zs}[n]$

$$=\frac{1}{6}(\frac{1}{4})^{n}u[n]-\frac{2}{3}(-\frac{1}{2})^{n}u[n]$$

10 27 $X(z) = \dfrac{3z^{-10}+z^{-7}-5z^{-2}+4z^{-1}+1}{z^{-10}-5z^{-7}+z^{-3}}$

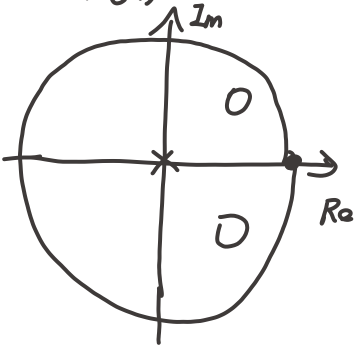
长陈法,

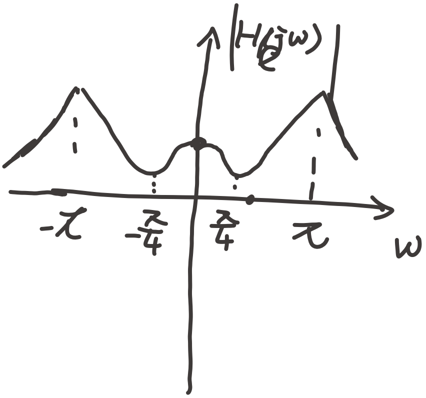
$$\begin{array}{r l}
 & z^{3}+4z^{2}-5z+0+5z^{-1}+20z^{-2}\cdots \\
z^{-3}-5z^{-7}+z^{-10} \big) & 1+4z^{-1}-5z^{-2}+z^{-7}+3z^{-10} \\
 & 1-5z^{-4}+z^{-7} \\ \hline
 & 4z^{-1}-5z^{-2}+5z^{-4}+3z^{-10} \\
 & 4z^{-1}-20z^{-5}+4z^{-8} \\ \hline
 & -5z^{-2}+5z^{-4}+20z^{-5}-4z^{-8}+3z^{-10} \\
 & -5z^{-2}+25z^{-6}-5z^{-9} \\ \hline
 & 5z^{-4}+20z^{-5}-25z^{-6}-4z^{-8}-5z^{-9}+3z^{-10} \\
 & 5z^{-4}-5z^{-8}+5z^{-11} \\ \hline
\end{array}$$

$\therefore X(z) = z^{3}+4z^{2}-5z+0+5z^{-1}+20z^{-2}+\cdots$

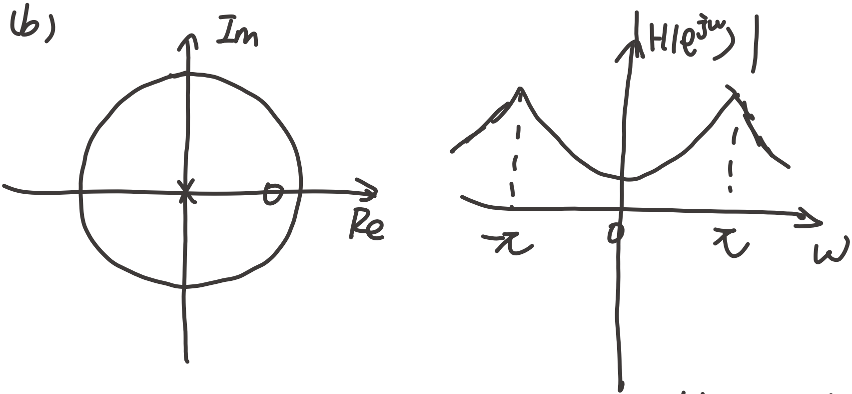
$x[n] = \delta[n+3]+4\delta[n+2]-5\delta[n+1]+5\delta[n-1]$
$+20\delta[n-2]$

10.29 (a)

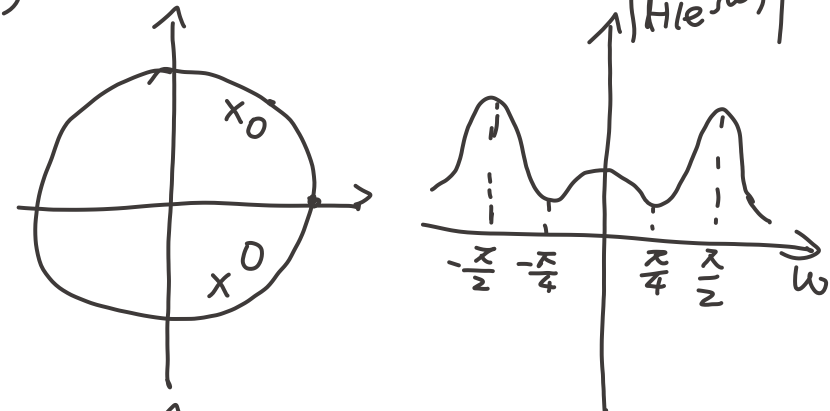




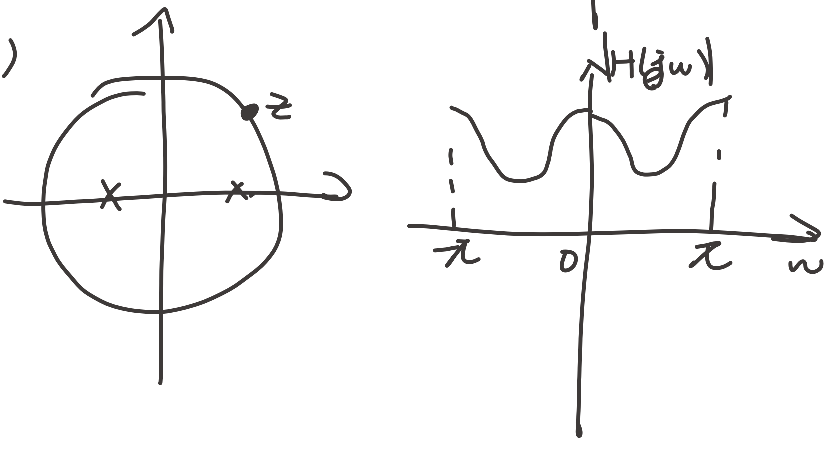
(b)



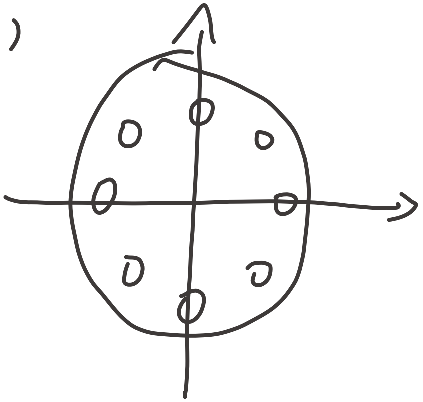
(c)

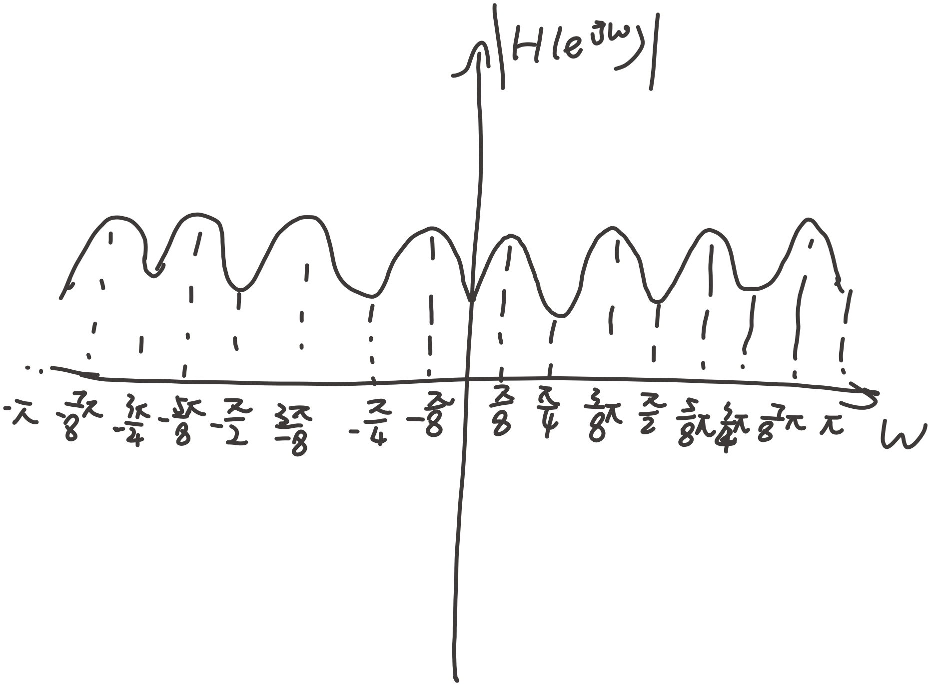


(d)



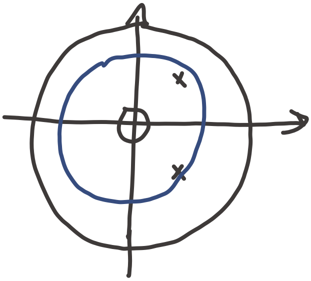
(e)





10 31 · $x[n]$实序列 由共轭对称

$z_1 = \frac{1}{2}e^{j\pi/3}$ $z_2 = \frac{1}{2}e^{j(-\frac{\pi}{3})}$



零点2个 共轭对称

由右边序列.

∴ ROC: $|z| > \frac{1}{2}$

设 $H(z) = \frac{Az^2}{(z-\frac{1}{2}e^{j\pi/3})(z-\frac{1}{2}e^{-j\pi/3})}$

令 $z=1$ · $H(1) = \frac{A}{(1-\frac{1}{2}e^{j\pi/3})(1-\frac{1}{2}e^{-j\pi/3})} = \frac{8}{3}$

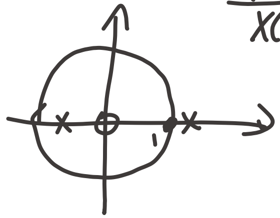
∴ $\frac{A}{1-\frac{1}{4}-\frac{1}{2}(\frac{1}{2})}$ $A = \frac{10}{3}$

10 34 (a) $y[n]-y[n-1]-y[n-2] = x[n-1]$

$Y(z) - z^{-1}Y(z) - z^{-2}Y(z) = z^{-1}X(z)$

∴ $Y(z)(1-z^{-1}-z^{-2}) = z^{-1}X(z)$

$\frac{Y(z)}{X(z)} = H(z) = \frac{z^{-1}}{1-z^{-1}-z^{-2}} = \frac{z}{z^2-z-1}$



ROC: $|z| > \frac{1+\sqrt{5}}{2}$

(b) $H(z) = \frac{z}{(z-\frac{1+\sqrt5}{2})(z-\frac{1-\sqrt5}{2})}$

$\frac{H(z)}{z} = \frac{1}{(z-\frac{1+\sqrt5}{2})(z-\frac{1-\sqrt5}{2})} = \frac{1}{\sqrt5}\left(\frac{-1}{z-\frac{1-\sqrt5}{2}} + \frac{1}{z-\frac{1+\sqrt5}{2}}\right)$

$H(z) = \frac{1}{\sqrt5}\left(\frac{-z}{z-\frac{1-\sqrt5}{2}} + \frac{z}{z-\frac{1+\sqrt5}{2}}\right)$

∴ $h[n] = -\frac{1}{\sqrt5}\left(\frac{1-\sqrt5}{2}\right)^n u[n] + \frac{1}{\sqrt5}\left(\frac{1+\sqrt5}{2}\right)^n u[n]$

(C) ROC 未包含 $|z|=1$ 是不稳定的

要求稳定 则可选一个双边信号

ROC: $\frac{-1+\sqrt5}{2} < |z| < \frac{1+\sqrt5}{2}$ 其中 $\frac{1}{\sqrt5}\left(\frac{1+\sqrt5}{2}\right)^n u[-n-1]$ 为左信号

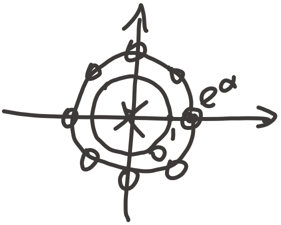
∴ $h[n] = -\frac{1}{\sqrt5}\left(\frac{1-\sqrt5}{2}\right)^n u[n] - \frac{1}{\sqrt5}\left(\frac{1+\sqrt5}{2}\right)^n u[-n-1]$

10.46 (a) z变换 $X(z) = S(z) - e^{8\alpha} z^{-8} S(z)$

$X(z) = S(z)(1-e^{8\alpha}z^{-8})$

$H_1(z) = \frac{X(z)}{S(z)} = 1 - e^{8\alpha}z^{-8} = 1 - \frac{e^{8\alpha}}{z^8}$

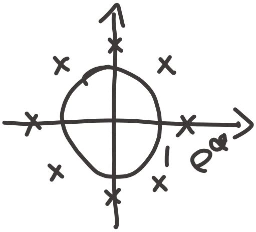
$= \frac{z^8 - e^{8\alpha}}{z^8}$ 零点 8个



ROC: $|z|>0$ 为 $z = e^{\alpha} e^{j\frac{\pi}{4}k}$

$(k = 0.1.2..)$

(b) $H_2(z) = \frac{Y(z)}{X(z)} = \frac{S(z)}{X(z)} = H_1^{-1}(z) = \frac{z^8}{z^8 - e^{8\alpha}}.$



极点：$z = e^{\alpha} e^{j\frac{\pi}{4}k}$ $(k=0\ 1,2\cdots)$

零点. $z=0$

① 当 $|z|>e^{\alpha}$ 因果但不稳定

② 当 $0<|z|<e^{\alpha}$，稳定而非因果

(c) ① 因果情况 $H_2(z) = \frac{1}{1-e^{8\alpha}z^{-8}}$

$= \sum_{n=0}^{+\infty} e^{8\alpha n} z^{-8n}$

$h_2[n] = e^{8\alpha\frac{n}{8}} = e^{\alpha n}$ $\quad n=0, 8, 16\cdots)$

$h_2[n]=0$ 其他

② 非因果 $H_2(z) = \sum_{k=1}^{+\infty} (e^{-8\alpha}z^{8})^{k} = \sum_{k=1}^{+\infty} e^{-8\alpha(k-1)} z^{8(k-1)}$

∴ $h_2[n] = e^{-\alpha|n|}$ $(n=0.-8.-16\ \cdot)$

$h_2[n]=0$ (其他)

10.48 (a) → (b)：相当于旋转180° 放缩极点 $\frac{2}{3}$.

$h_2[n] = A(\frac{2}{3}e^{j\pi})^n u[n].\ h_1[n]$

$= A(-\frac{2}{3})^n u[n]\ h_1[n]$

∵ $\sum_{0}^{+\infty} |g[k]| = 3$ ∴ $A \frac{1}{1+\frac{2}{3}} = 3$

∴ $A=5$