5.34) $|X(e^{0.12j})| = 100$ (signal 1) $\quad |H(e^{0.12j})| = 1.8 \quad \tau(0.12) = 40$

$|X(e^{0.3j})| = 40$ (signal 2) $\quad |H(e^{0.3j})| = 1.7 \quad \tau(0.3) = 80$

$|X(e^{0.5j})| = 40$ (signal 3) $\quad |H(e^{0.5j})| = 0 \quad 3^{rd}$ signal removed by filter

$100(1.8) = 180$ (+ 40 sample delay)

$40(1.7) = 68$ (+ 80 sample delay)

$\boxed{\text{The output plot that best fits these calculations is } y_2[n] \text{ because the output of the first signal has more samples than the second one but the delay is less.}}$

5.46) a) $H(e^{j\omega}) = H_1(e^{j\omega})\,H_2(e^{j\omega})$

$$= \left(A_1(e^{j\omega})e^{-j\omega M_1/2}\right)\left(jA_2(e^{j\omega})e^{-j\omega M_2/2}\right)$$

$$= \boxed{jA_1(e^{j\omega})\,A_2(e^{j\omega})\,e^{-j\omega\left(\frac{M_1+M_2}{2}\right)}}$$

b) The length of the impulse response of the overall system is M_1+M_2+1.

c) The overall delay of the system is $\frac{M_1+M_2}{2}$

d) This is a type 4 generalized linear-phase system because $H(e^{j\omega}) = je^{-j\omega(M/2)}\,H_R(\omega)$ where $H_R(\omega) = A_1(e^{j\omega})A_2(e^{j\omega})$ and $M = M_1 + M_2$, which is an odd value.

5.47) a) $H(z) = (1-az^{-1})(1-e^{j\frac{\pi}{2}}z^{-1})(1-bz^{-1})(1-0.5z^{-1})(1-cz^{-1})$

$\boxed{H(z) \text{ is fifth-degree, so it has a length of 6 samples.}}$

b) $H(e^{j\omega}) = 0$ @ $\omega = 0 \rightarrow H(z) = 0$ at $z = 1$

System is either type 3 or type 4

If $H(-1) = 0$, type 3. Otherwise, type 4.

Given
$H(1) = (1-a)(1-j)(1-b)(0.5)(1-c) = 0$, then

Assuming
$H(-1) = (1+a)(1+j)(1+b)(1.5)(1+c) = 0$

a, b, & C don't have the same values when $z=1$ and $z=-1$.

$\boxed{\text{This means that this is a type 4 system.}}$

c) The group delay is $\frac{5}{2}$ samples.

d) If z_i is a zero, then z_i^*, $\frac{1}{z_i}$, and/or $\frac{1}{z_i^*}$ should be zeros

$$z_1 = e^{j\frac{\pi}{2}} \longrightarrow z_1^* = e^{-j\frac{\pi}{2}} = a$$

$$z_2 = 0.5 \longrightarrow \frac{1}{z_1} = 2 = b$$

$$z_3 = 1 = c$$

$$\boxed{a = e^{-j\frac{\pi}{2}}} \quad \boxed{b = 2} \quad \boxed{c = 1}$$

e) $$H(z) = \left(1 - e^{-j\frac{\pi}{2}} z^{-1}\right)\left(1 - e^{j\frac{\pi}{2}} z^{-1}\right)\left(1 - 2z^{-1}\right)\left(1 - 0.5z^{-1}\right)\left(1 - z^{-1}\right)$$

$$= \left(1 + z^{-2}\right)\left(1 - 2z^{-1}\right)\left(1 - 0.5z^{-1}\right)\left(1 - z^{-1}\right)$$

$$= 1 - \frac{7}{2}z^{-1} + \frac{9}{2}z^{-2} - \frac{9}{2}z^{-3} + \frac{7}{2}z^{-4} - z^{-5}$$

$$\boxed{h[n] = \delta[n] - \frac{7}{2}\delta[n-1] + \frac{9}{2}\delta[n-2] - \frac{9}{2}\delta[n-3] + \frac{7}{2}\delta[n-4] - \delta[n-5]}$$