1. **C.** $X_0 = (16+8+12+4) = 40$. $X_1 = (16 - j8 - 12 + j4) = 4 - 4j$.
   $X_2 = (16-8+12-4) = 16$. $X_3 = (16 + j8 - 12 - j4) = 4 + 4j$.

2. **B.** $\frac{1}{4}\sin(\frac{3\pi}{4}n) \to$ components at k=3 and 8-3=5$\to \{0,0,0,-j,0,j,0,0\}$.

3. **C.** Notch filter with $h[1] = -1 = -2\cos\omega_0 \to \omega = \pm\pi/3$.

4. **E.** $H(e^{j\pi/2})$=1+$0.5e^{j\pi/2}$+$1e^{j\pi}$=1+0.5j–1=$0.5e^{j\pi/2}$. y[n]=$0.5\cos(\frac{\pi}{2}n+\frac{\pi}{2})$ =$-0.5\sin(\frac{\pi}{2}n)$.

5. **D.** $H(e^{j\omega})$=$\frac{1+e^{-j\omega}}{1-e^{-j\omega}} \to H(e^{j\pi})$=0 and $H(e^{j\pi/2})$= $\frac{1-j}{1+j}$=$\frac{\sqrt{2}e^{-j\pi/4}}{\sqrt{2}e^{j\pi/4}}$=$e^{-j\pi/2} \to h[n]$=$\sin(\frac{\pi}{2}n)$.

6. **C.** Notch filter with $h[1] = -2\cos(2\pi\frac{60}{240}) = 0$.

7. **B.** $H(e^{j\omega}) = \frac{4+3e^{-j\omega}}{1+2e^{-j2\omega}} \to H(z) = \frac{4+3z^{-1}}{1+2z^{-2}} = \frac{Y(z)}{X(z)} \to Y(z)(1+2z^{-2}) = X(z)(4+3z^{-1})$.

8. **D.** Need zeros at $e^{\pm j\pi/2} = \pm j$ and $e^{j\pi} = -1$. Only (d) works.

9. **B.** $H(z) = \frac{1-z^{-1}}{1+z^{-1}} \to H(e^{j\omega}) = \frac{1-e^{-j\omega}}{1+e^{-j\omega}} = \frac{e^{j\omega/2}-e^{-j\omega/2}}{e^{j\omega/2}+e^{-j\omega/2}} = \frac{2j\sin(\omega/2)}{2\cos(\omega/2)} = j\tan(\omega/2)$.

10. **B.** Need linear phase. Only a=1 works: $H(e^{j\omega}) = \frac{e^{-j\omega}}{1+3e^{-j\omega}+1e^{-j2\omega}} = \frac{1}{3+2\cos(\omega)} > 0$.

11. **E.** X_0=1+1–1–1=0 and X_2=1–1+(–1)–(–1)=0. So has to be (e).

12. **C.** All others periodic with period=2π. (b),(e) (not (d))$\to x[n]$ pure imaginary.

13. **E.** $\{6\cdot3+9\cdot8+3\cdot1, 6\cdot1+9\cdot3+3\cdot8, 6\cdot8+9\cdot1+3\cdot3\}$=$\{93,57,66\}$.

14. **C.** $H(e^{j\omega})$=1+$e^{-j2\omega} \to H(e^{j\pi/4})$=$1$+$e^{-j\pi/2}$=1–j and $H(e^{j\pi/2})$=1+$e^{-j\pi}$=1–1=0.
    $\sqrt{2}\cos(\frac{\pi}{4}n - \frac{\pi}{4}) \to \sqrt{2}e^{-j\pi/4}$=1–j$\to x[n]$=$\cos(\frac{\pi}{4}n)$+$A\cos(\frac{\pi}{2}n+B)$ for any A & B.

15. **B.** $H(\omega=0) = H(z=1) = \frac{7+6-1}{5+3+1} = \frac{12}{9}$. $H(\omega=\frac{\pi}{2}) = H(z=j) = \frac{-7+6j-1}{-5+3j+1} = 2$.
    $H(\omega=\pi) = H(z=-1) = \frac{7-6-1}{5-3+1} = 0$. $y[n] = \frac{12}{9}(9) + 2(2)\cos(\frac{\pi}{2}n)$.

16. $x[n]$ has period=8 and real-valued $\to x[n]$ has the discrete-time Fourier series (DFTS)
    $x[n] = x_0 + x_1e^{j\frac{\pi}{4}n} + x_2e^{j\frac{\pi}{2}n} + x_3e^{j\frac{3\pi}{4}n} + x_4e^{j\pi n} + x_1^*e^{-j\frac{\pi}{4}n} + x_2^*e^{-j\frac{\pi}{2}n} + x_3^*e^{-j\frac{3\pi}{4}n}$.
    $H(z) = 1 + z^{-1} + \ldots + z^{-7} = (z^7 + z^6 + \ldots + z + 1)/z^7 \to$ zeros at $e^{j\frac{\pi}{4}k}, k = 0,1\ldots7$.
    This eliminates all Fourier components except DC, and mean=1$\to y[n] = 8$.

17. Peaks at $\omega = \{\pm\frac{\pi}{4}, \pm\frac{3\pi}{4}\}$. Dips to zero at $\omega = \{0, \pi, \pm\frac{\pi}{2}\}$. Plot is for |poles|=0.9.

SCORES	100	95	90	85	80	75	70	65	60	55	< 55	Total	Mean
#ugrad	6	7	5	6	3	7	5	3	3	1	1	47	81.2
#grad	1	0	0	1	1	1	0	1	0	0	0	5	81.0

GRADING: On #16, full credit for y[n]=1, not 8. On #17, I was pretty lenient.