1a. x[n] real & even→ x_k real & even. $x_k=\frac{1}{6}\sum_{n=0}^{5} x[n]e^{-j2\pi nk/6}=\frac{1}{6}\sum_{n=0}^{3} 2\cos(2\pi nk/6)$.
$x_0=\frac{1}{6}(18+12+6+0+6+12)=9$. $x_1=\frac{1}{6}(18+12(2)\cos(2\pi/6)+6(2)\cos(4\pi/6)=4$.
$x_3=\frac{1}{6}(18-12+6-0+6-12)=1$. $x_2=\frac{1}{6}(18+12(2)\cos(4\pi/6)+6(2)\cos(8\pi/6)=0$.
$x_k=\boxed{9,4,0,1,0,4}$. Check: `fft([18,12,6,0,6,12])/6` gives `9,4,0,1,0,4`.

1b,c. $\frac{1}{6}(18^2+12^2+6^2+0^2+6^2+12^2)=(9^2+4^2+0^2+1^2+0^2+4^2)=\boxed{114}$.

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2. $\cos(\frac{\pi k}{4})+\sin(\frac{3\pi k}{4})=\frac{1}{2}e^{j\frac{2\pi k}{8}}+\frac{j}{2}e^{j\frac{2\pi 3k}{8}}-\frac{j}{2}e^{-j\frac{2\pi 3k}{8}}+\frac{1}{2}e^{-j\frac{2\pi k}{8}}=\frac{1}{2}e^{j\frac{2\pi k}{8}}+\frac{j}{2}e^{j\frac{2\pi 3k}{8}}-\frac{j}{2}e^{j\frac{2\pi 5k}{8}}+\frac{1}{2}e^{j\frac{2\pi 7k}{8}}$.

2a. DTFS coefficients x_k have period 8=N→x[n] has period N=8.

2b. $x_{\text{EVEN}}[n]=\boxed{\{\underline{0},4,0,0,0,0,0,4\}}$. (2c) $x_{\text{ODD}}[n]=\boxed{\{\underline{0},0,0,4j,0,-4j,0,0\}}$.

2d. Average power$=\frac{2}{8}(0^2+4^2+0^2+|4j|^2)=2(1^2+(\sqrt{2})^2+(-1)^2+0^2)=\boxed{8}$.

3a. $e^{j2\omega}+e^{j\omega}+1+e^{-j\omega}+e^{-j2\omega}=\boxed{1+2\cos(\omega)+2\cos(2\omega)}$.

3b. $3e^{j\omega}+2+e^{-j\omega}=\boxed{2+4\cos(\omega)+2j\sin(\omega)}$.

4a. $\frac{e^{j\omega}}{e^{j\omega}-\frac{1}{2}}$=DTFT$\{(\frac{1}{2})^n u[n]\}$. $(\frac{1}{2})^3=\boxed{\frac{1}{8}}$.

4b. $2\cos(3\omega)=e^{j3\omega}+e^{-j3\omega}$=DTFT$\{1,0,0,\underline{0},0,0,1\}$. At n=3: $\boxed{1}$.

5a. $X(e^{j\pi})=1-4+3-2+5-7+(-45)-7+5-2+3-4+1=\boxed{-53}$.

5b. Since 45>2(1+4+3+2+5+7)=44, $\arg[X(e^{j\omega})]=\boxed{-\pi}$. (5c) 2πx[0]$=\boxed{-90\pi}$.

5d. $2\pi[(-45)^2+2(1^2+4^2+3^2+2^2+5^2+7^2)]=\boxed{4466\pi}$.

6a. It is actually "Matlab-Breakfast of Champions" *scrambled*. Hard to interpret it.

6b. Looking carefully, you can see that I $\boxed{\text{flipped the spectrum}}$.

6c. `Y=real(ifft(fftshift(fft(X))))` flips the spectrum back.

6d. Comparing `X` and `Y`, the latter is the former with every other value's sign changed.
This follows from the modulation property: DTFT$\{(-1)^n x[n]\}=X(e^{j(\omega+\pi)})$.