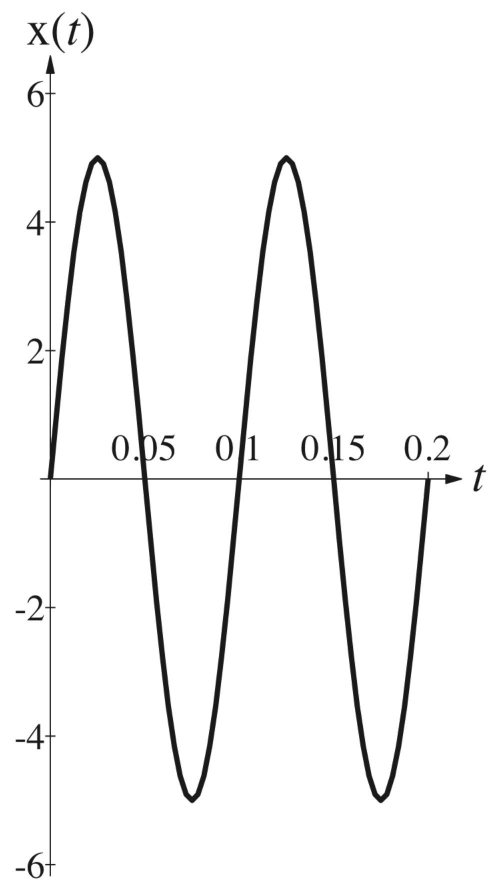
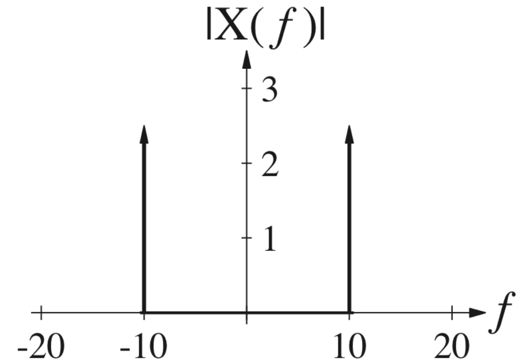
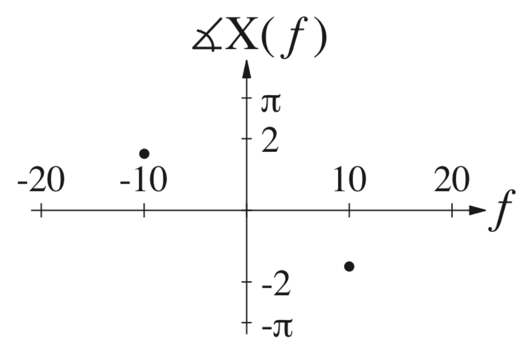
Original Continuous-Time Signal

$$\mathrm{x}(t) = 5\sin(20\pi t) \xleftrightarrow{\mathscr{F}} (j5/2)\left[\delta(f+10) - \delta(f-10)\right]$$







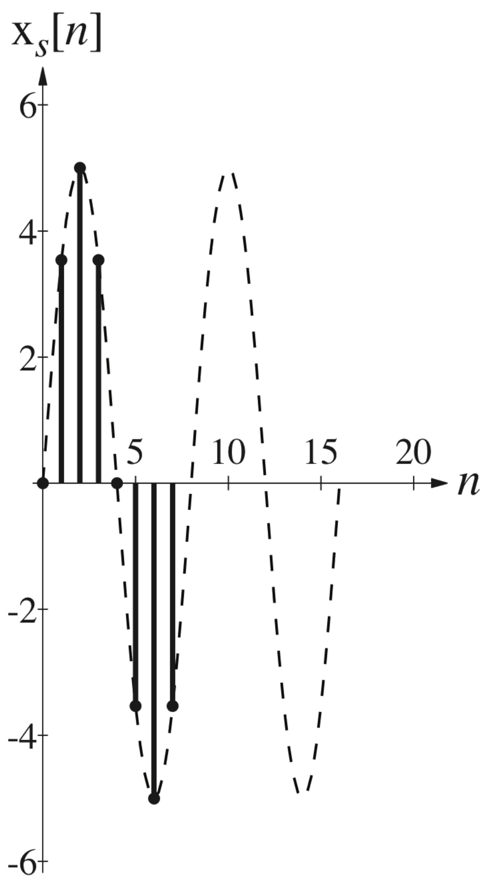
Sample at 80 Hz ($f_s = 80$) $\Rightarrow T_s = 1/80$

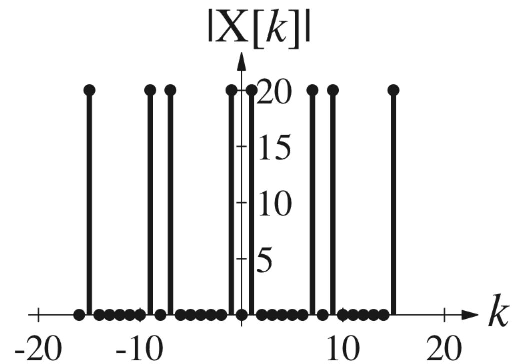
$$\mathrm{x}_s[n] = 5\sin(20\pi n T_s) = 5\sin(\pi n / 4)$$

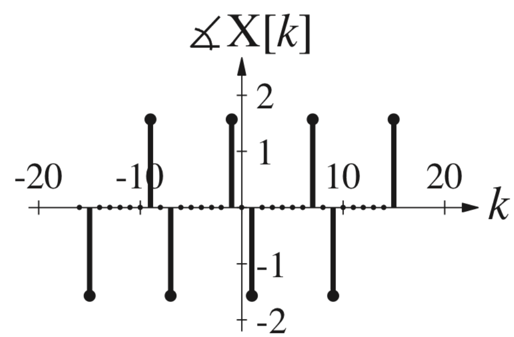
Use first 8 points (one period)

$$\mathrm{x}_{sw}[n] = \begin{cases} 5\sin(\pi n/4) & , \ 0 \le n < 8 \\ 0 & , \ \text{otherwise} \end{cases}$$

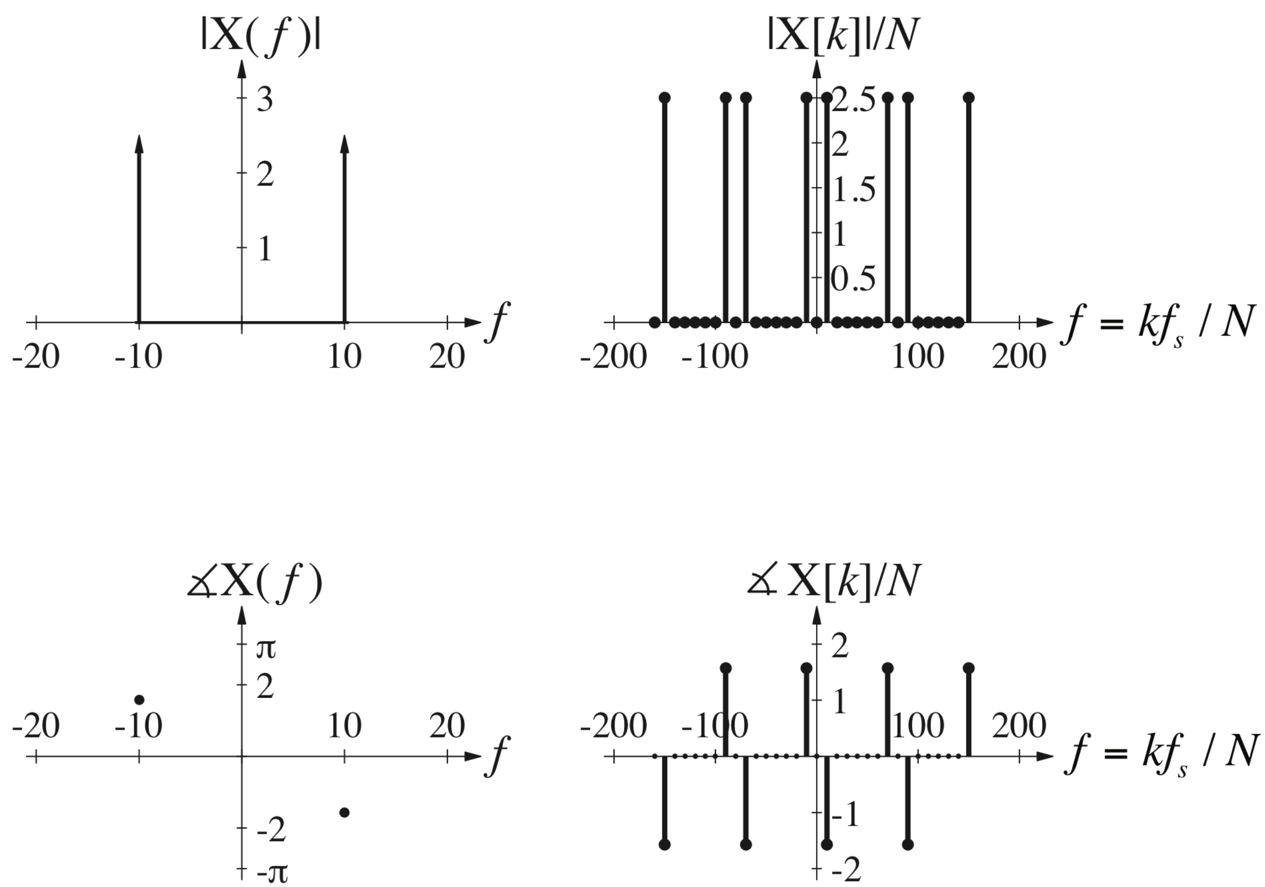
Compute the DFT $\mathrm{X}[k]$



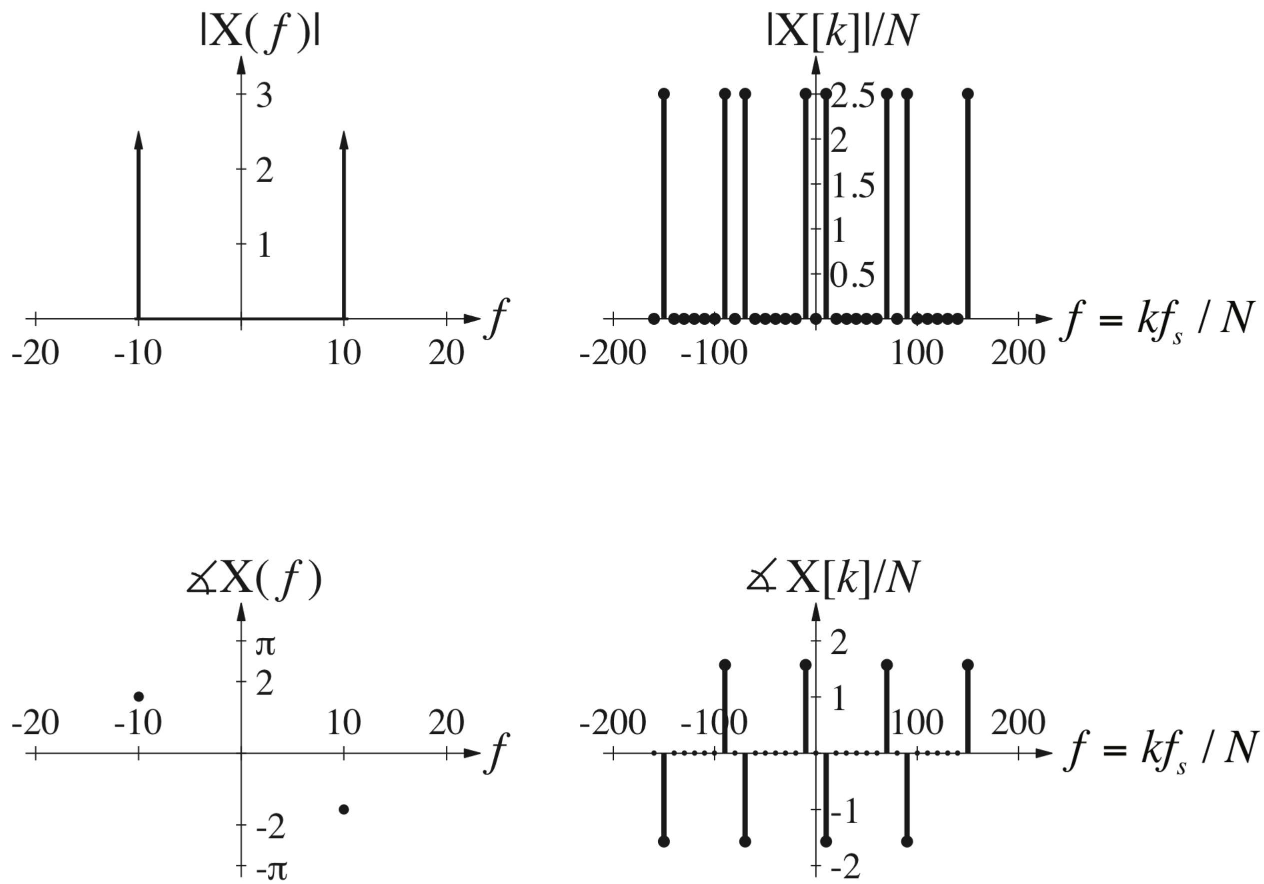




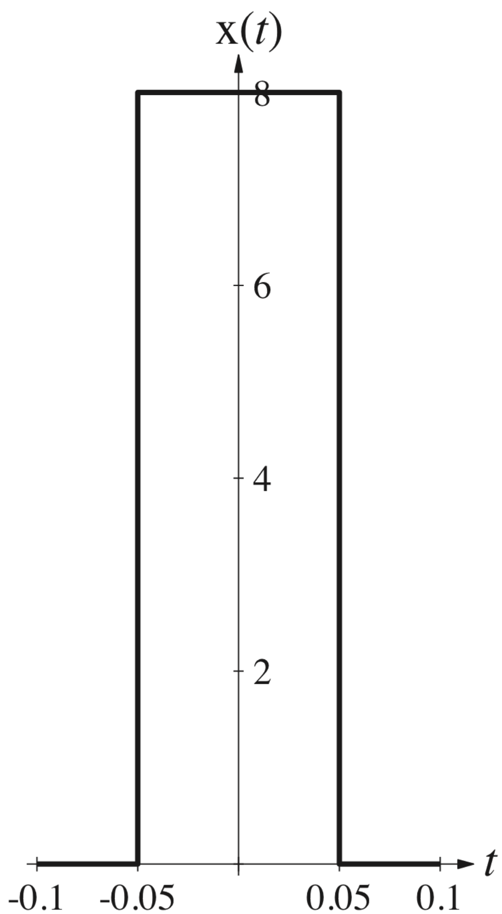
Scale the DFT by dividing by N. Graph versus frequency kf_s / N instead of harmonic number k.

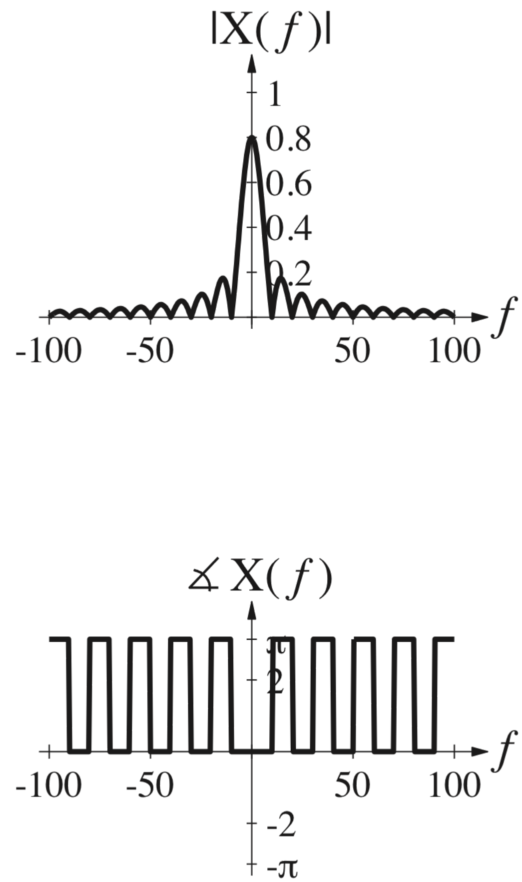


Compare the CTFT of the original signal to the (scaled) DFT of the samples. Notice that the base period ($-4 \le k < 4$ or $-40 \le kf_s / N < 40$) of the scaled DFT has the same two impulses at the same two frequencies as the original CTFT.



$$x(t) = 8\,\text{rect}(10t) \xleftrightarrow{\mathcal{F}} 0.8\,\text{sinc}(f/10)$$





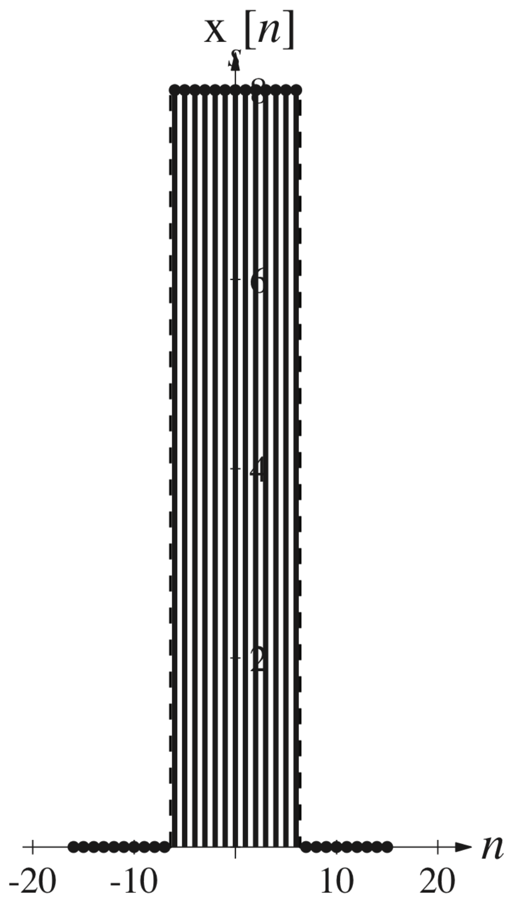
Sample at 80 Hz ($f_s = 80$) $\Rightarrow T_s = 1/80$

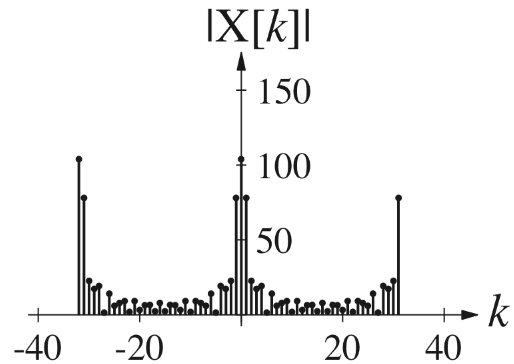
$$\mathrm{x}_s[n] = 8\,\mathrm{rect}(10nT_s) = 8\,\mathrm{rect}(n/8)$$

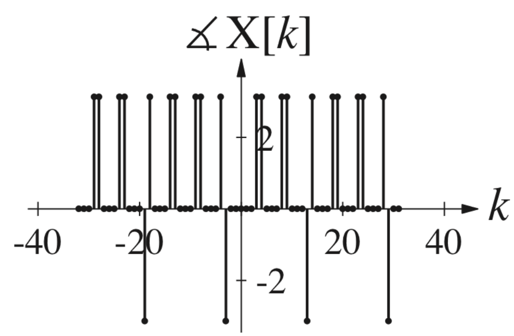
Use first 32 points from $-16 \le n < 16$

$$\mathrm{x}_{sw}[n] = \begin{cases} 5\sin(\pi n/4) & , \; 0 \le n < 8 \\ 0 & , \; \text{otherwise} \end{cases}$$

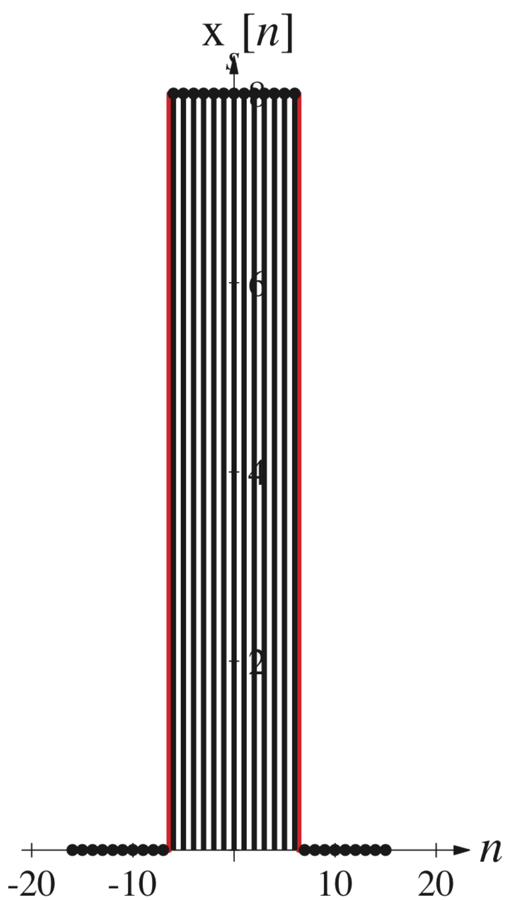
Compute the DFT $\mathrm{X}[k]$

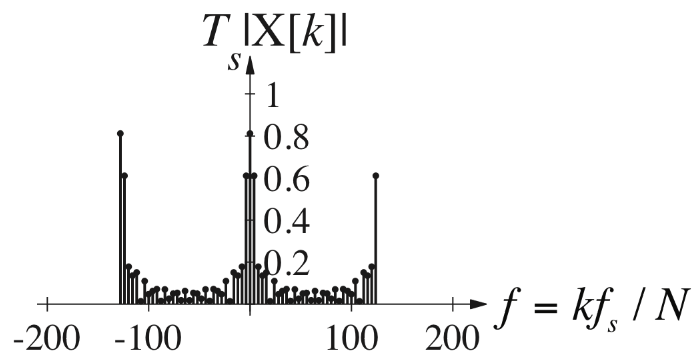


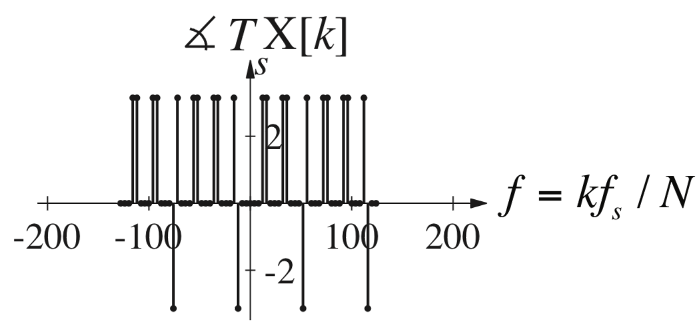




Scale the DFT by multiplying by T_s. Graph versus frequency kf_s / N instead of harmonic number k.







Compare the CTFT of the original signal to the (scaled) DFT of the samples. Notice that the base period ($-16 \le k < 16$ or $-40 \le kf_s / N < 40$) of the scaled DFT is now (approximately) a sampled version of the original CTFT.