* A final example: Solving difference equation

$$6y[n] - 5y[n-1] + y[n-2] = 18x[n] - 8x[n-1]$$

Find $h[n]$

Ans:

* Important pairs of DTFT.

① $x[n] = \delta[n]$

Direct computation ↓ $X(e^{jw}) =$

② $X(e^{jw}) = \begin{cases} \delta(w) & \text{if } -\pi < w < \pi \\ \text{periodic with period } 2\pi. \end{cases}$

direct computation ↓ $x[n] =$

③ $x[n] = e^{jw_c n}$

↓ Inspection or by freq-shift property

$X(e^{jw}) =$

(3.1) $x[n] = \cos(\omega_c n)$

Inspection & periodicity

$X(e^{j\omega}) =$

Exercise

$x[n] = \sin(\omega_c \cdot n)$

(4) $x[n] = u[n+N_1] - u[n-(N_1+1)]$

direct computation

$X(e^{j\omega}) =$

{ periodic w. period 2π

⑤ $X(e^{jw}) = \begin{cases} U(w+W) - U(w-W) & \text{if } |w| < \pi \end{cases}$

direct computation ↓

$x[n] =$

⑥ $x[n] = \sum_{k=-\infty}^{\infty} \delta[n - kN]$

generalized DTFS ↓ $X(e^{jw}) =$

✕ Duality: See Sec 5.7

An important summary

CTFS
time

freq

DTFS
time

freq

CTFT
time

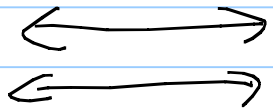
freq

DTFT
time

freq

Time

Freq



CTFS: $\begin{cases} a_k = \\ x(t) = \end{cases}$

DTFS: $\begin{cases} a_k = \\ x[n] = \end{cases}$

CTFT: $\begin{cases} X(j\omega) = \\ x(t) = \end{cases}$

DTFT: $\begin{cases} X(e^{j\omega}) = \\ x[n] = \end{cases}$