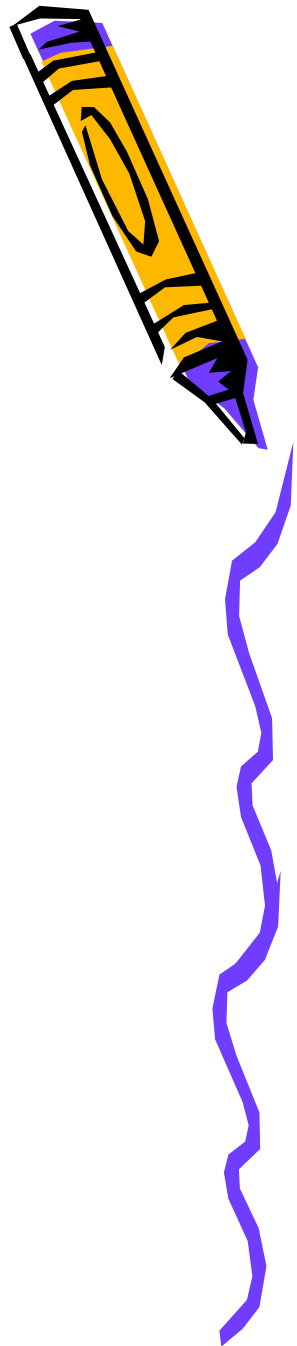# Signals And Systems

Transformations of CT Functions

Let a CT function be defined by
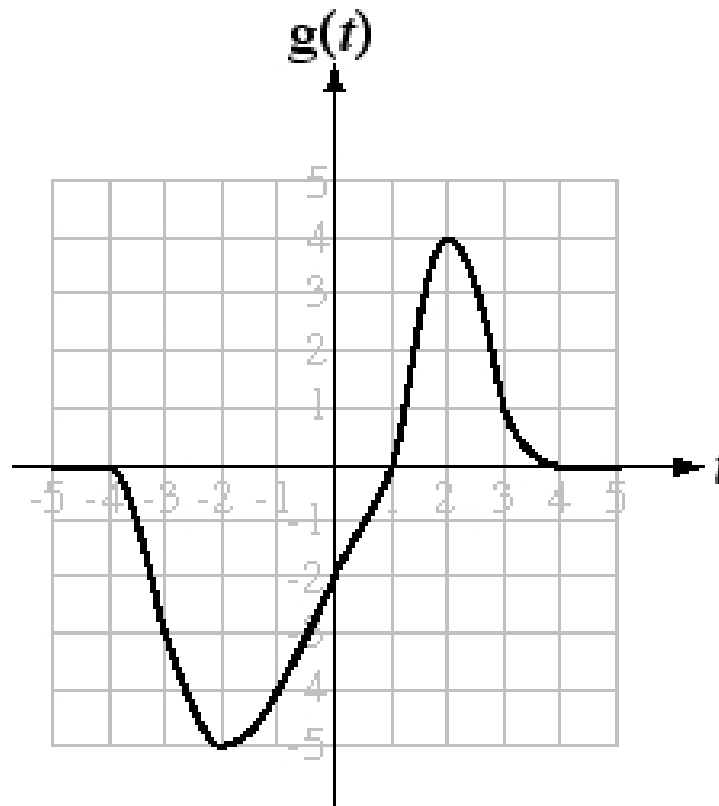
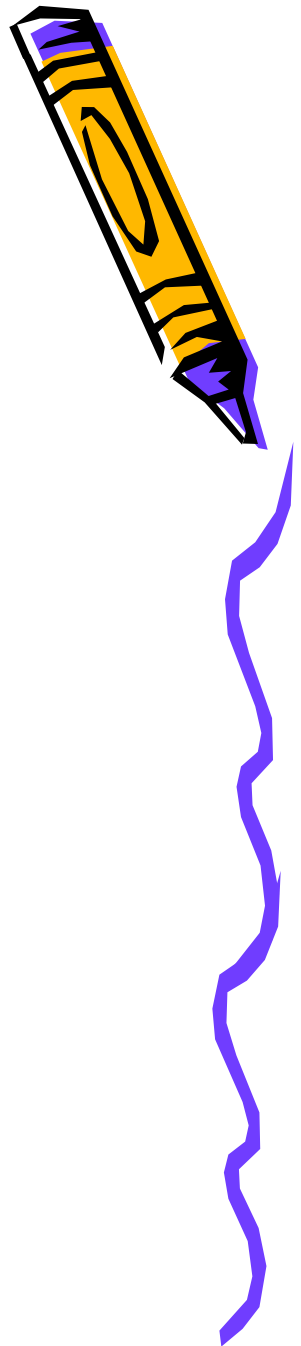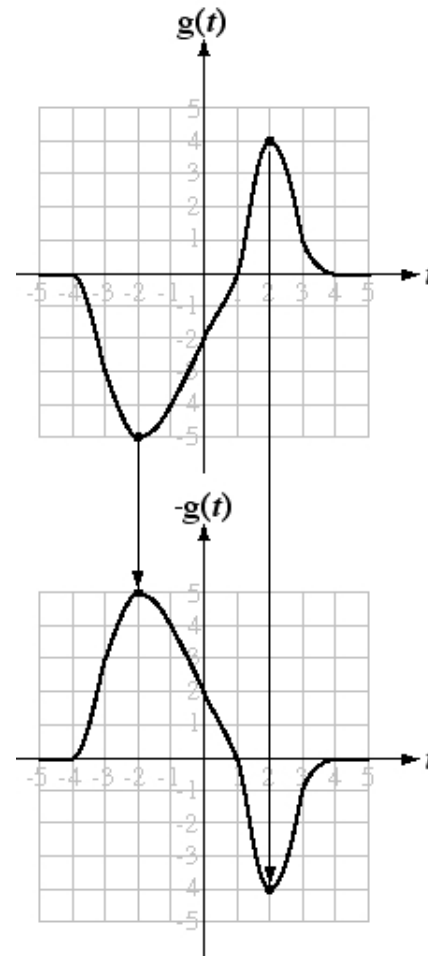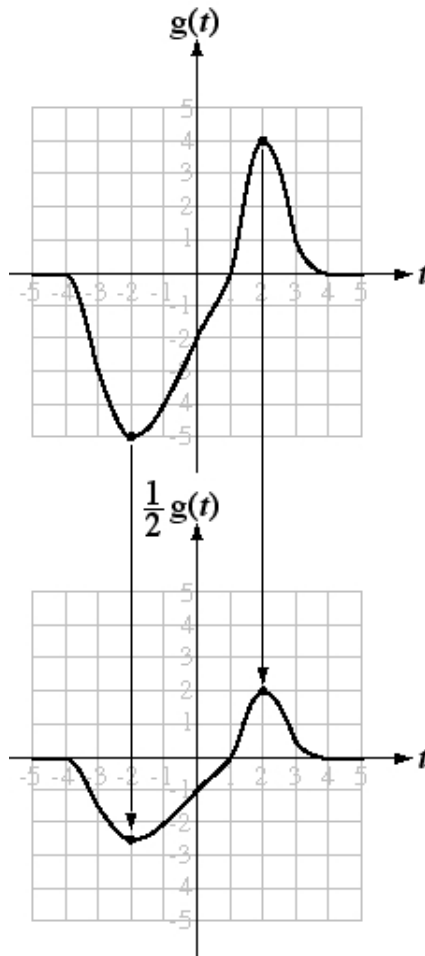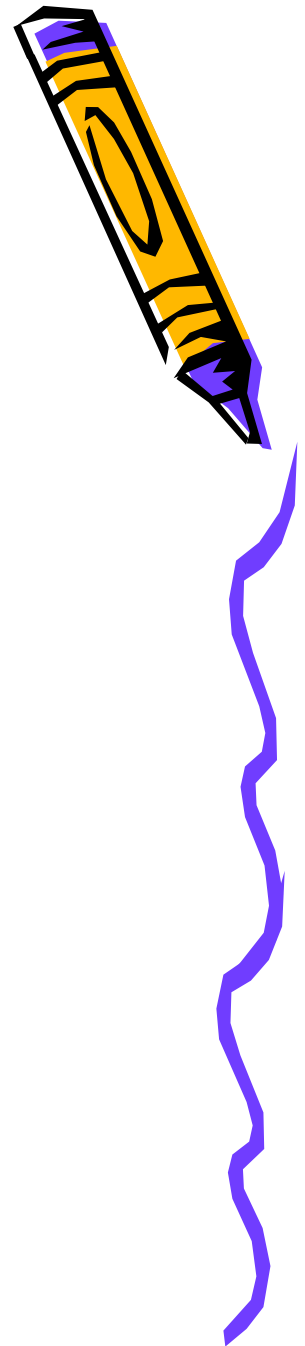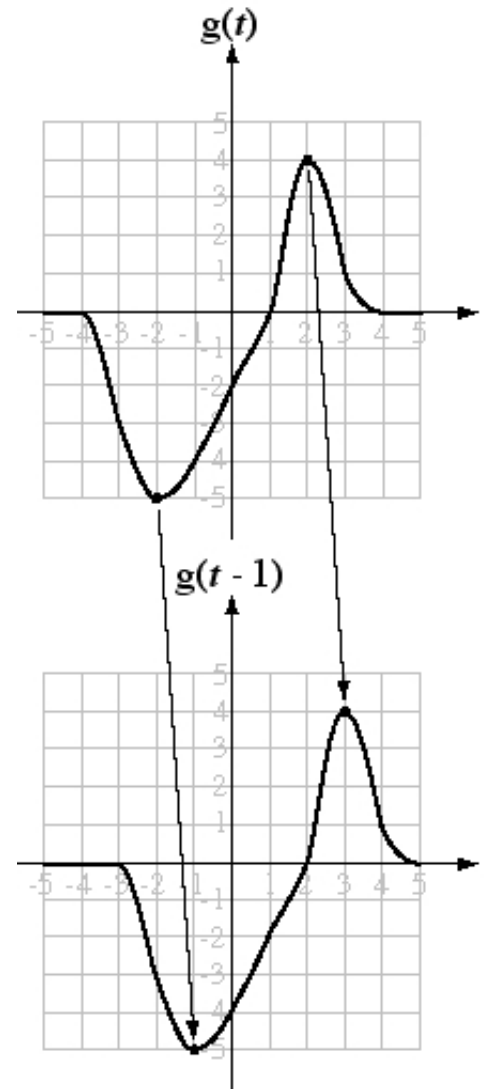

$$g(t) = 0 \ , \ |t| > 5$$

Transformations of CT Functions
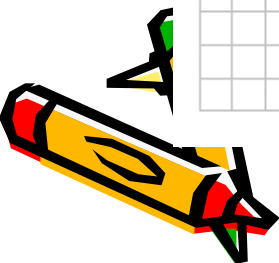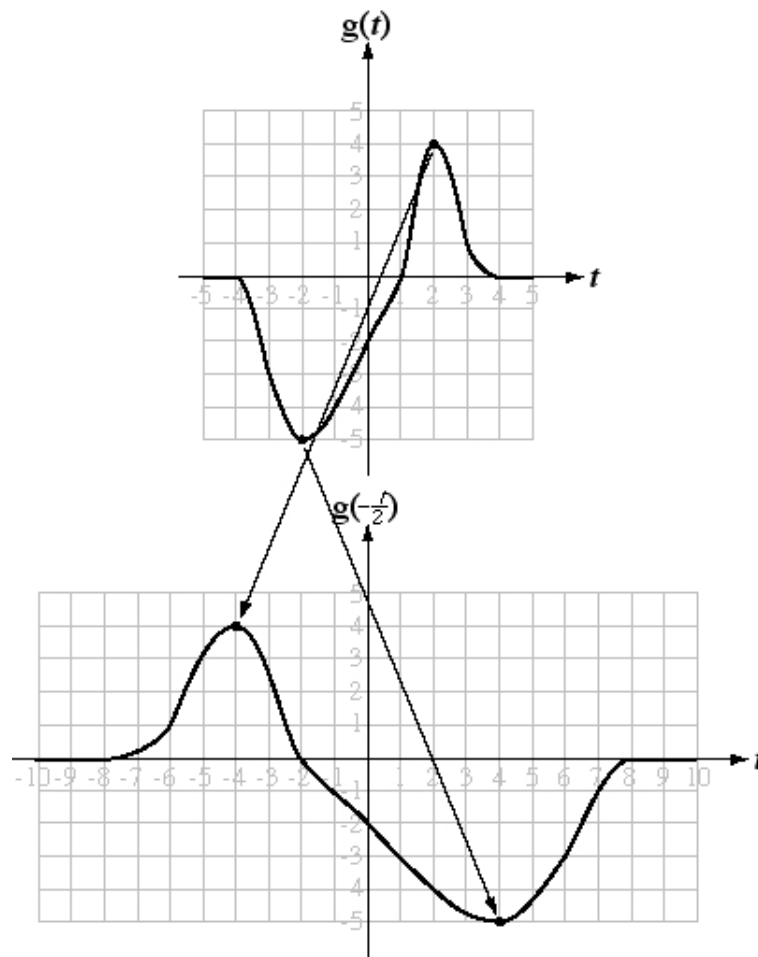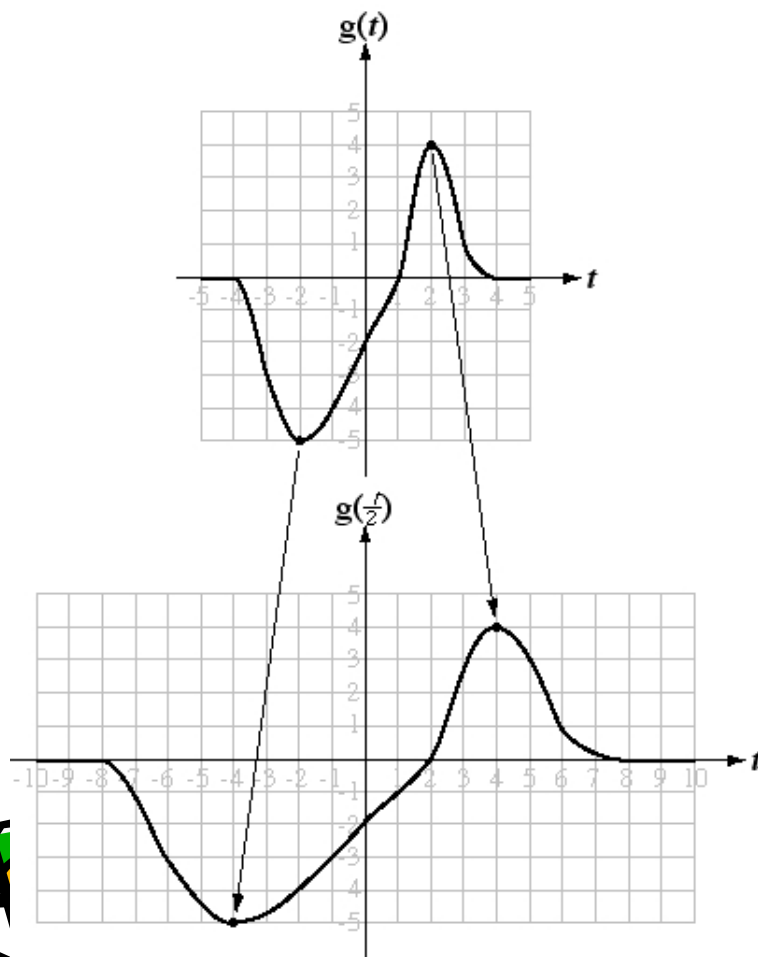
Amplitude Scaling, $g(t) \rightarrow A\,g(t)$

Transformations of CT Functions

Time shifting, $t \rightarrow t - t_0$

Transformations of CT Functions

Time scaling, $\quad t \to \dfrac{t}{a}$

Transformations of CT Functions

Multiple transformations, $\mathrm{g}(t) \rightarrow A\,\mathrm{g}\!\left(\dfrac{t - t_0}{a}\right)$

A multiple transformation can be done in steps

$$\mathrm{g}(t) \xrightarrow[\text{scaling, } A]{\text{amplitude}} A\,\mathrm{g}(t) \xrightarrow{t \to \frac{t}{a}} A\,\mathrm{g}\!\left(\dfrac{t}{a}\right) \xrightarrow{t \to t - t_0} A\,\mathrm{g}\!\left(\dfrac{t - t_0}{a}\right)$$

The sequence of the steps is significant

$$\mathrm{g}(t) \xrightarrow[\text{scaling, } A]{\text{amplitude}} A\,\mathrm{g}(t) \xrightarrow{t \to t - t_0} A\,\mathrm{g}(t - t_0) \xrightarrow{t \to \frac{t}{a}} A\,\mathrm{g}\!\left(\dfrac{t}{a} - t_0\right) \neq A\,\mathrm{g}\!\left(\dfrac{t - t_0}{a}\right)$$

Transformations of CT Functions

Multiple transformations, $\mathrm{g}(t) \rightarrow A\,\mathrm{g}\!\left(\dfrac{t - t_0}{a}\right)$
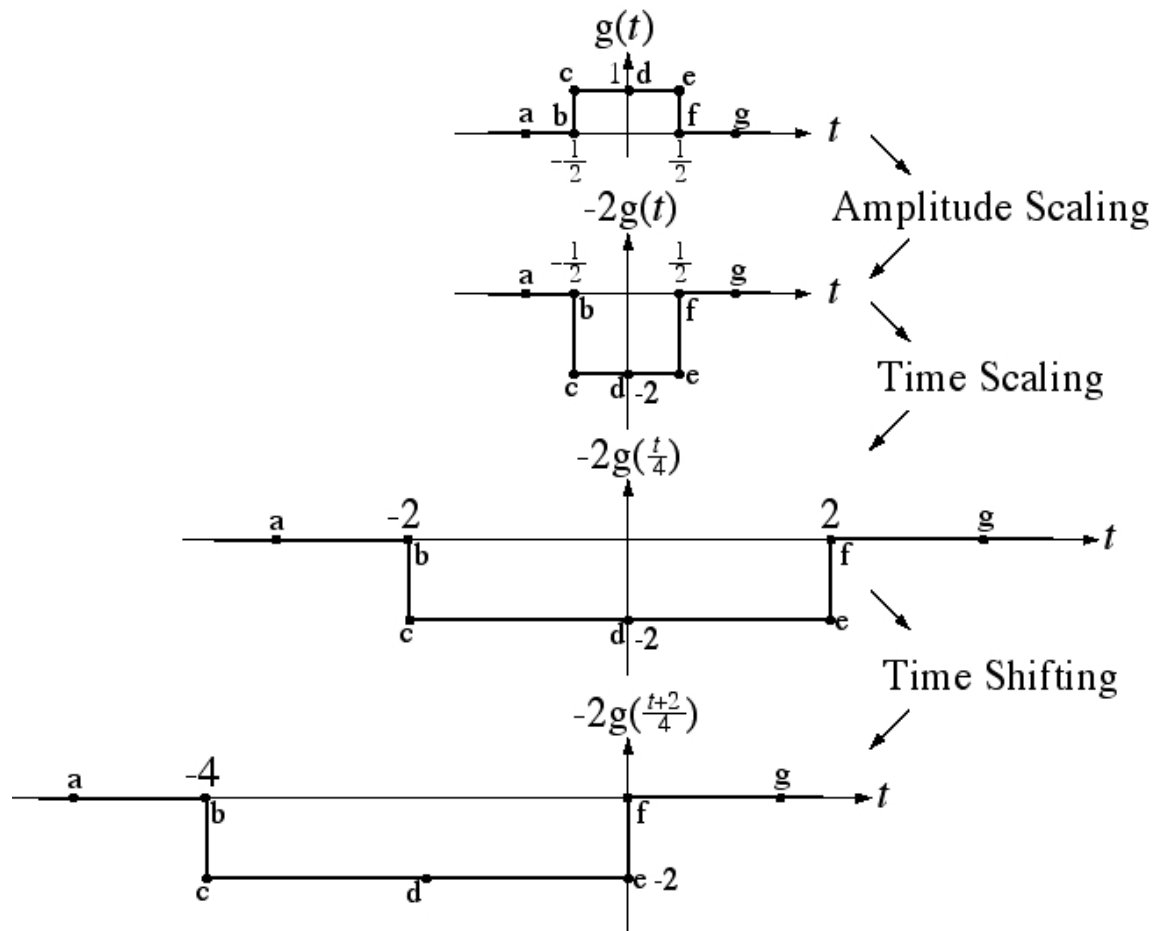
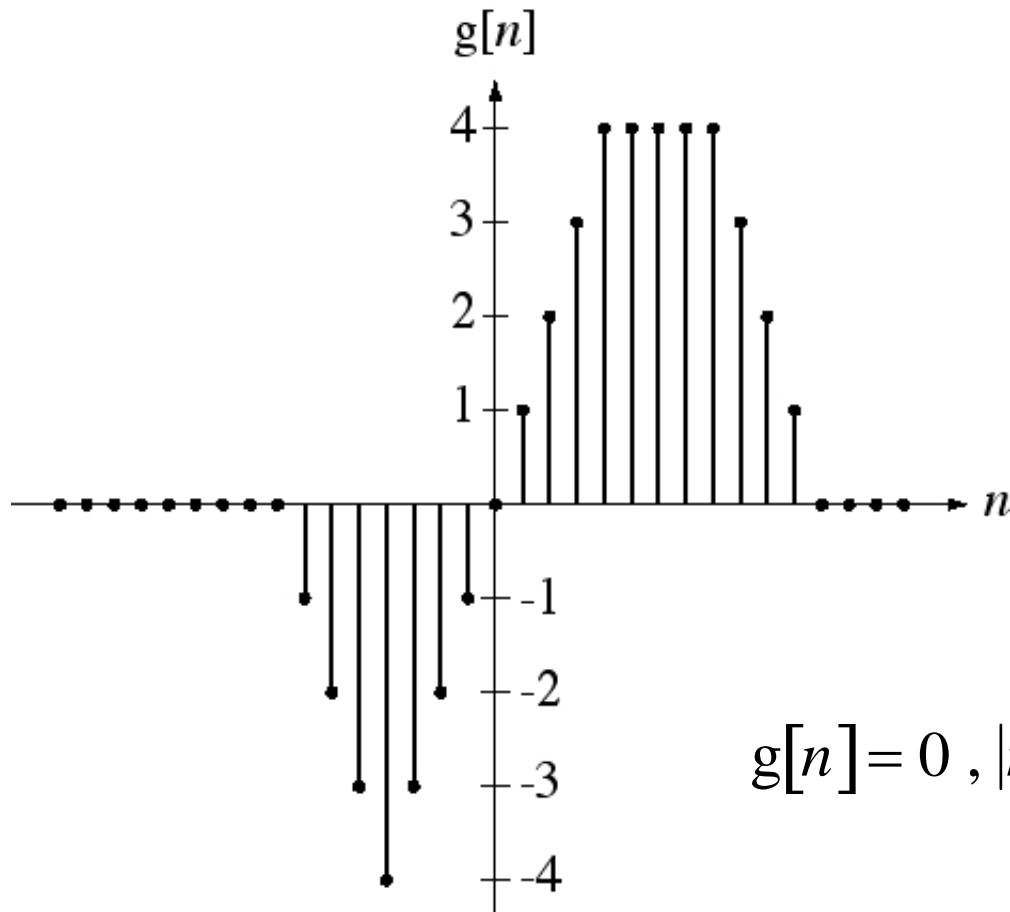# Transformations of CT Functions

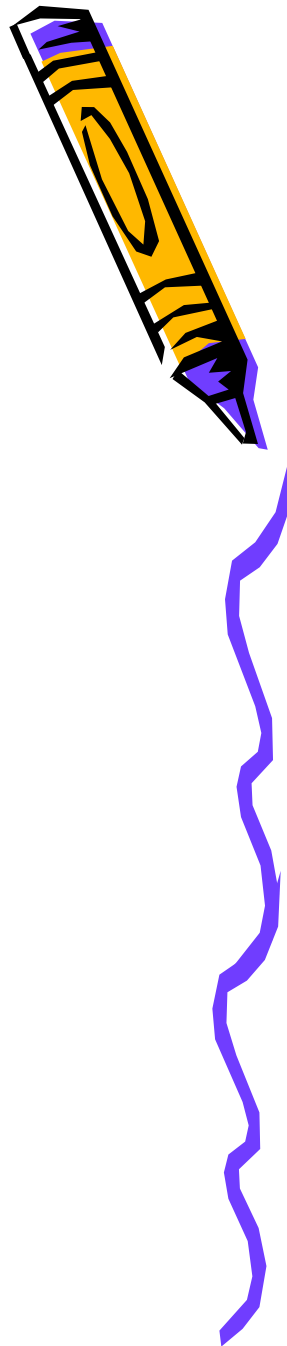Multiple transformations, $A\,g(bt - t_0)$
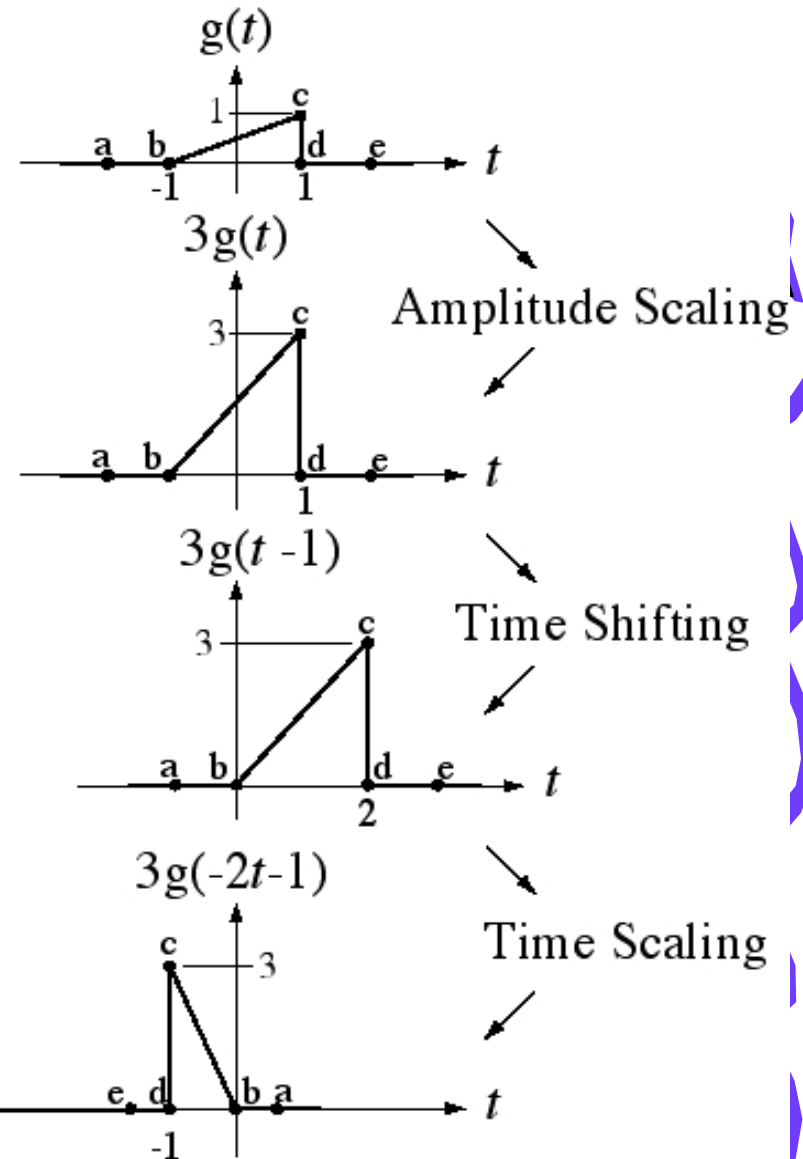
Transformation of DT Functions
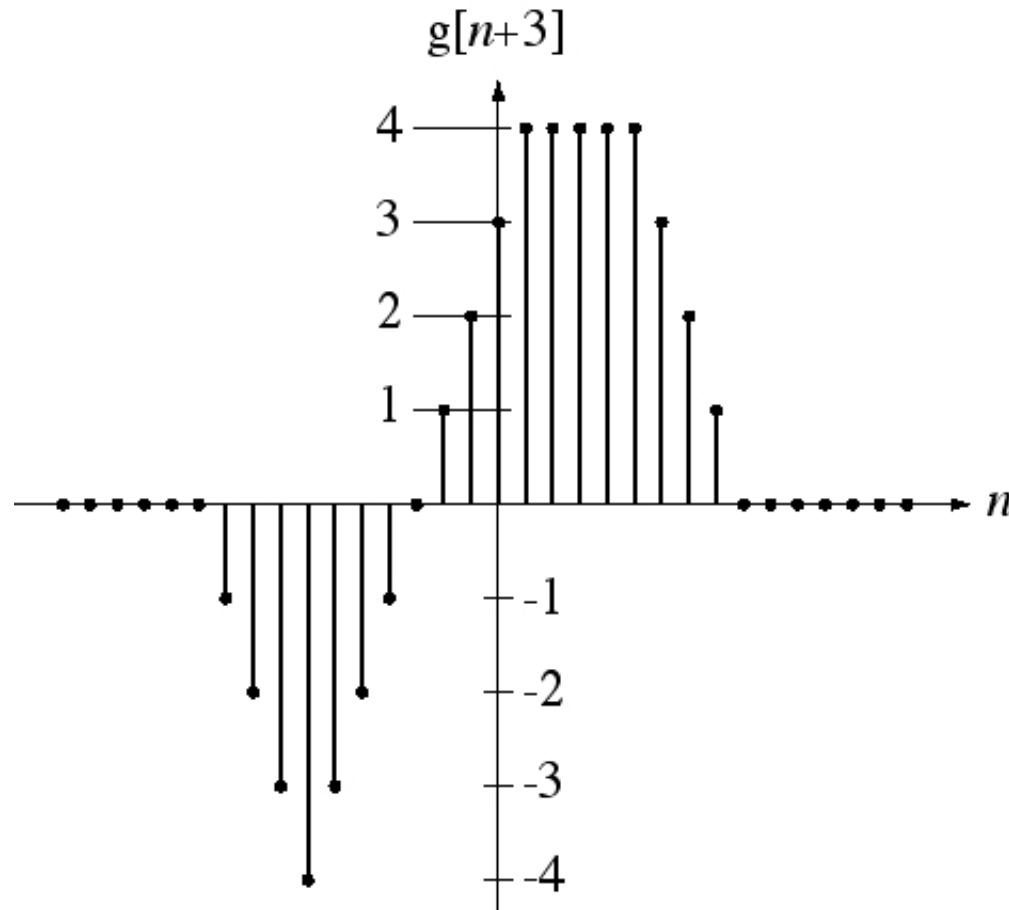
Let g[n] be defined by

$$g[n] = 0 \ , \ |n| > 15$$

Transformation of DT Functions
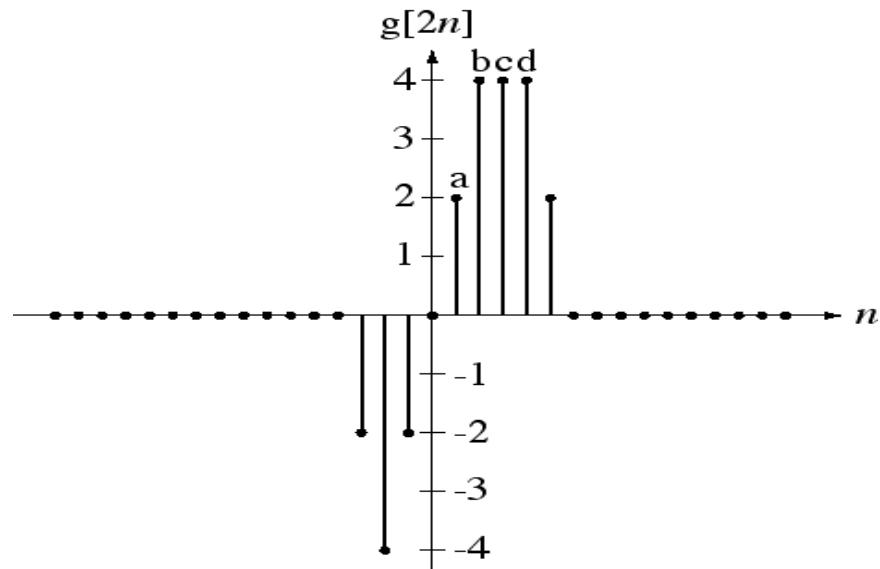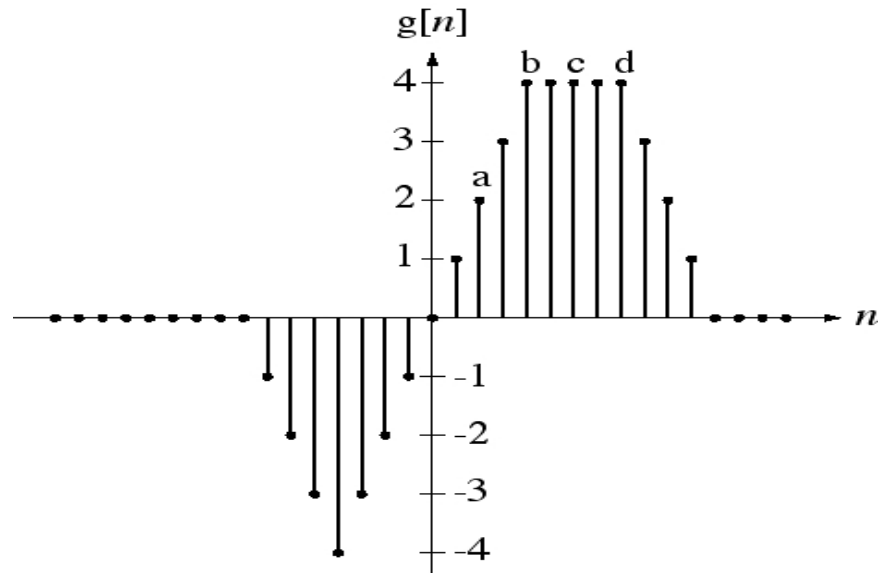
Time Shifting $n \rightarrow n + n_0$, n_0 an integer

Transformation of DT Functions
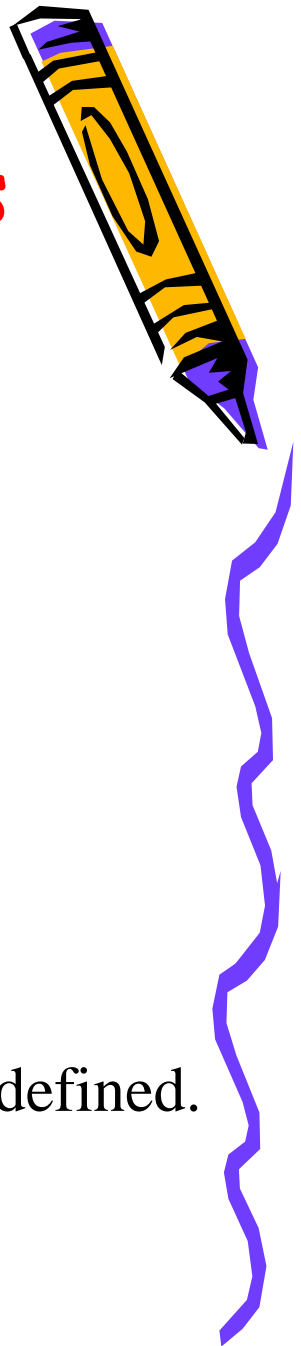
Time compression

$$n \rightarrow Kn$$

K an integer > 1

Transformation of DT Functions

Time expansion $\quad n \rightarrow \dfrac{n}{K} \quad , K > 1$

For all n such that n/K is an integer, $\text{g}\left[\dfrac{n}{K}\right]$ is defined.
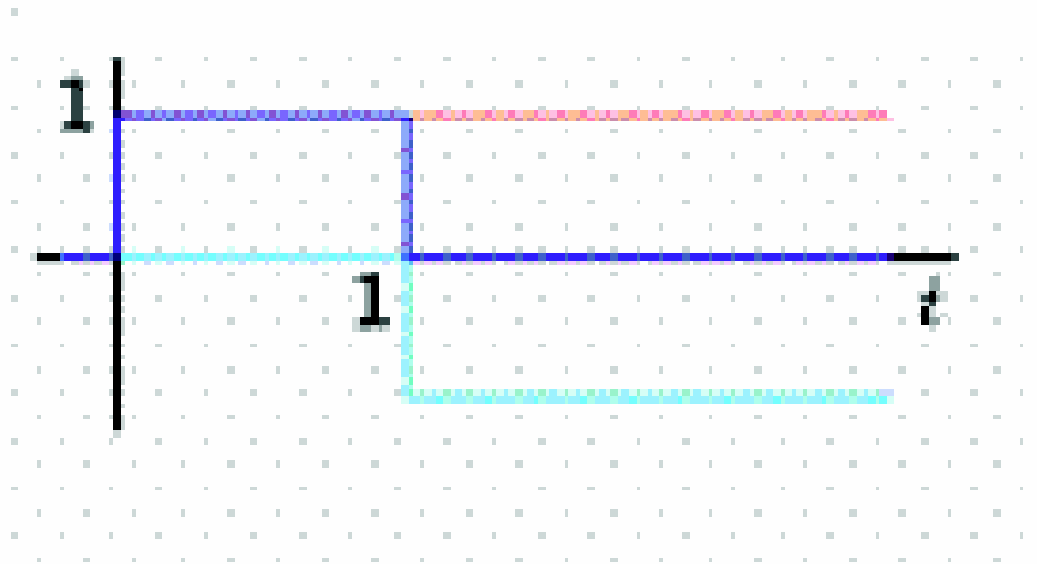
For all n such that n/K is not an integer, $\text{g}\left[\dfrac{n}{K}\right]$ is not defined.

Combination of signals

Unit steps and unit ramps can be combined to produce pulse signals.

$$u(t) - u(t-1)$$

Triangle signal using unit step and ramp signals

$$tu(t)-2(t-1)u(t-1)+(t-2)u(t-2)$$