Problem 2.26

(a) Consider a rectangular pulse $g(t)$ of duration T and amplitude $1/T$, centered at $t = 0$, as shown in Fig. 1:

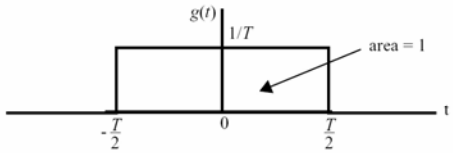


Figure 1

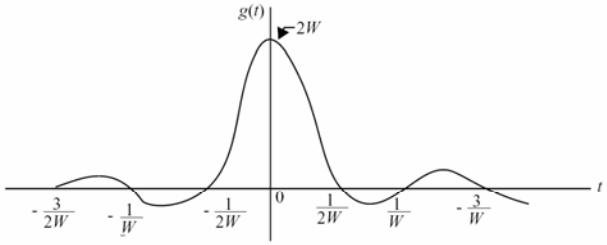
The Fourier transform of $g(t)$ is

$$G(f) = \frac{\sin(\pi fT)}{\pi fT}$$

As the duration T approaches zero, $g(t)$ approaches a delta function, and so we find that in the limit:

$$\lim_{T \to 0} G(f) = \lim_{T \to 0} \frac{\sin(\pi fT)}{\pi fT} = 1$$

(b) Consider next the sinc pulse $2W\,\mathrm{sinc}(2Wt)$ of unit area, as shown in Fig. 2:



The Fourier transform of $g(t)$ is

$$G(f) = \mathrm{rect}\left(\frac{f}{2W}\right)$$

which has unit amplitude and width $2W$, centered at $f = 0$. As W approaches infinity, $g(t)$ approaches a delta funct6ion, and the corresponding Fourier transform becomes equal to unity for all f.