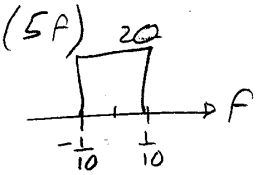
EE322 PS29 Solns

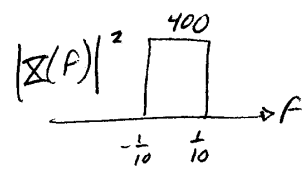
① Text 10-17a

$$X(f) = 20\,\mathrm{rect}(5f)$$

$$x(t) = 4\,\mathrm{sinc}(t/5) \longleftrightarrow 4\,\frac{1}{|\frac{1}{5}|}\,\mathrm{rect}(5f)$$



$$E_x = \int_{-\infty}^{\infty} |x(t)|^2\,dt = \int_{-\infty}^{\infty} |X(f)|^2\,df$$

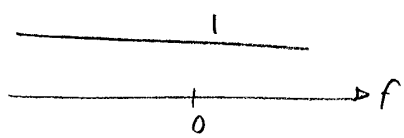


$$= \int_{-1/10}^{1/10} 400\,df = \boxed{80}$$

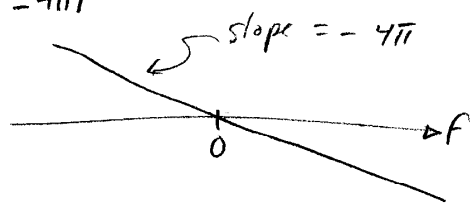
② Text 10-21a

$$x(t) = \delta(t-2) \longleftrightarrow X(f) = 1 \cdot e^{-j4\pi f}$$

$|X(f)|$



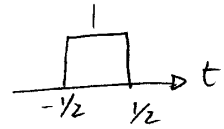
$\angle X(f) = -4\pi f$



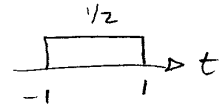
(3) Text 10-30 c

$$X(f) = \text{sinc}(f)\,\text{sinc}(2f)$$

$$\text{sinc}(f) \longleftrightarrow \text{rect}(t)$$

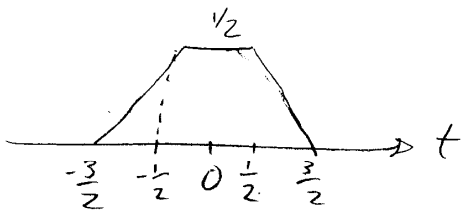


$$\text{sinc}(2f) \longleftrightarrow \tfrac{1}{2}\,\text{rect}\left(\tfrac{t}{2}\right)$$



$$x(t) = \text{rect}(t) * \tfrac{1}{2}\,\text{rect}(t/2)$$

Convolve 2 rectangles of different time width.
This will result in a trapezoid:



(4) Text 10-48

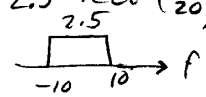
$$y(t) = \underbrace{10\,\text{sinc}(20t)}_{\text{let this} = x(t)}\; 5\cos(2\pi 1000 t)$$

$$= x(t)\cos(2\pi 1000 t)$$

$$x(t) = 50\,\text{sinc}(20t)$$

$$\text{so } X(f) = 50\,\frac{1}{|20|}\,\text{rect}\left(\frac{f}{20}\right)$$

$$= 2.5\,\text{rect}\left(\frac{f}{20}\right)$$

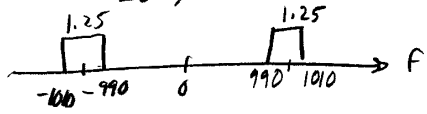


use modulation property

$$Y(f) = \tfrac{1}{2}X(f-1000) + \tfrac{1}{2}X(f+1000)$$

$$= \tfrac{1}{2}(2.5)\,\text{rect}\left(\frac{f-1000}{20}\right) + \tfrac{1}{2}(2.5)\,\text{rect}\left(\frac{f+1000}{20}\right)$$

$Y(f)$



A mixer is used to shift the frequency spectrum.