① Text, 10-16(b)

$$\mathcal{F}^{-1}\{ 2\,\mathrm{tri}(f/2)\, e^{-j6\pi f}$$

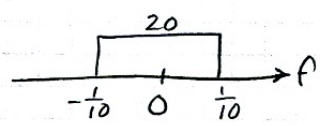
Freq domain		time domain
$2\,\mathrm{tri}(f)$		$2\,\mathrm{sinc}^2(t)$
$2\,\mathrm{tri}(f/2)$	Freq Scaling $a=\frac{1}{2}$	$2(2\,\mathrm{sinc}^2(2t)) = 4\,\mathrm{sinc}^2(2t)$
$2\,\mathrm{tri}(f/2)e^{-j2\pi 3f}$	time shifting $t_0=3$	$\boxed{4\,\mathrm{sinc}^2(2(t-3))}$

② Text, 10-17(a)

$$x(t) = 4\,\mathrm{sinc}(t/5) \xleftrightarrow[\text{time scale } a=1/5]{} 4\,\frac{1}{|1/5|}\,\mathrm{rect}(5t)$$

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

$X(f)$:



$$E = \int_{-\infty}^{\infty} |x(t)|^2 dt = \int_{-\infty}^{\infty} |X(f)|^2 df = \int_{-\frac{1}{10}}^{\frac{1}{10}} 20^2\, dt = 400t\Big|_{-1/10}^{1/10}$$

$$= 400\left(\frac{2}{10}\right) = \boxed{80}$$

(2) Text,

(3) Text, 10-44(b) E,

$E: \; 0.375 \, \mathrm{rect}(f/8) \, e^{j\pi f/4}$

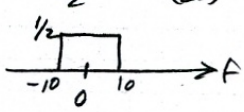
frequency domain	property	time domain
$0.375 \, \mathrm{rect}(f)$		$0.375 \, \mathrm{sinc}(t)$
$0.375 \, \mathrm{rect}(f/8)$	frequency scale $a = 1/8$	$0.375 \frac{1}{\lvert 1/8 \rvert} \mathrm{sinc}(t/1/8)$
$0.375 \, \mathrm{rect}(f/8) e^{j2\pi f \, 7/8}$	time shifting $t_0 = 7/8$	$= 3 \, \mathrm{sinc}(8t)$ $3 \, \mathrm{sinc}(8(t - 7/8))$ $= \boxed{3 \, \mathrm{sinc}(8t - 7)}$

(4) Text, 10-48

$x_1(t) = 10 \, \mathrm{sinc}(20t)$

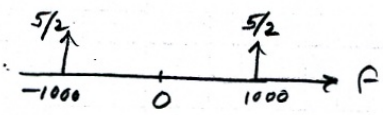
$X_1(f) = 10 \frac{1}{\lvert 20 \rvert} \mathrm{rect}\left(\frac{f}{20}\right)$

$= \frac{1}{2} \mathrm{rect}\left(\frac{f}{20}\right)$



$x_2(t) = 5\cos(2\pi 1000 t)$

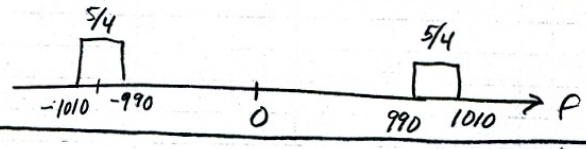
$X_2(f) = 5/2 \, \delta(f - 1000) + 5/2 \, \delta(f + 1000)$



$y(t) = x_1(t) \, x_2(t) \quad \longleftrightarrow \quad X_1(f) * X_2(f) = Y(f)$

$Y(f) = \frac{1}{2} \mathrm{rect}\left(\frac{f}{20}\right) * \left[\frac{5}{2}\delta(f - 1000) + \frac{5}{2}\delta(f + 1000)\right]$

$Y(f)$



A mixer is used in communications to shift the frequency content of a signal up or down.