(4.2) a)

$$\delta(t-t_o) = \begin{cases} \infty & , \quad t = t_o \\ 0 & , \quad t \neq t_o \end{cases}$$

(b)

$$\delta(x - x_o) = \begin{cases} 1 & , \quad x = x_o \\ 0 & , \quad x \neq x_o \end{cases}$$

(c)
$$\delta(a-t) = \delta(-(t-a))$$

$$\delta(t-a) \neq \delta(-(t-a))$$
These two functions will always be mirrored across $x = 0$. $\delta(t-a)$ has an impulse at $t = a$, $\delta(a-t)$ has an impulse at $t = -a$

(4.3) $\rightarrow$ Repeat with $f(t) = A$ for $0 \leq t \leq T$

(a)
$$f(t-t_o) = \begin{cases} A & , \quad t_o \leq t < T + t_o \\ 0 & ; \quad else \end{cases}$$

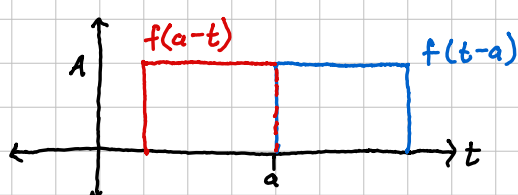(b)
$$f(x-x_o) = \begin{cases} A & , \quad x_o \leq x < T + x_o \\ 0 & ; \quad else \end{cases}$$

(c)
$$f(a-t) = f(-(t-a)) = \begin{cases} A & \quad a \geq t > a-T \\ 0 & \quad else \end{cases}$$

$$f(t-a) = \begin{cases} A & \quad a \leq t < T+a \\ 0 & \quad else \end{cases}$$

$$a \geq t > a-T$$
$$a-T \leq t \leq a$$

These two functions are mirrored across the line $x = a$.

$$0 \leq a - t < T$$
$$-a \leq -t < T - a$$
$$a \geq t > a - T$$
$$a - T < t \leq a$$

(4.11)
$$\mathcal{F}\{(f * h)(t)\} =$$

$$\int_{-\infty}^{\infty} (f*h)(t) \, e^{-j2\pi\mu t} \, dt =$$

$$\int_{-\infty}^{\infty} \left[\int_{-\infty}^{\infty} f(\tau) h(t-\tau) \, d\tau\right] e^{-j2\pi\mu t} \, dt =$$

$$\int_{-\infty}^{\infty} f(\tau) \left[\int_{-\infty}^{\infty} h(t-\tau) \, e^{-j2\pi\mu t} dt\right] d\tau =$$

$$\int_{-\infty}^{\infty} f(\tau) \, H(\mu) \, e^{-j2\pi\mu\tau} \, d\tau =$$

$$H(\mu) \int_{-\infty}^{\infty} f(\tau) e^{-j2\pi\mu\tau} d\tau =$$

$$H(\mu) \, F(\mu) =$$

$$(F \cdot H)(\mu)$$

$$\mathcal{F}^{-1}\{(F * H)(\mu)\} =$$

$$\int_{-\infty}^{\infty} (F*H)(\mu) \, e^{j2\pi\mu t} \, d\mu =$$

$$\int_{-\infty}^{\infty} \left[\int_{-\infty}^{\infty} F(\nu) H(\mu-\nu) d\nu\right] e^{j2\pi\mu t} \, d\mu =$$

$$\int_{-\infty}^{\infty} F(\nu) \left[\int_{-\infty}^{\infty} H(\mu-\nu) e^{j2\pi\mu t} \, d\nu\right] d\mu =$$

$$\int_{-\infty}^{\infty} F(\nu) \, h(t) \, e^{j2\pi\nu t} \, d\mu =$$

$$h(t) \int_{-\infty}^{\infty} F(\nu) e^{j2\pi\nu t} d\mu =$$

$$h(t) \, f(t) =$$

$$(f \cdot h)(t)$$