2.20

(a)

Solution.

$$\int_{-\infty}^{\infty} u_0(t)\cos(t)\,\mathrm{d}t = \cos 0 = 1.$$

(b)

Solution.

$$\int_{0}^{5} \sin(2\pi t)\delta(t+3)\,\mathrm{d}t = 0.$$

(c)

Solution.

$$\int_{-5}^{5} u_1(1-\tau)\cos(2\pi\tau)\,\mathrm{d}\tau = \int_{-5}^{1} \cos(2\pi\tau)\,\mathrm{d}\tau = 0.$$

2.21

(a)

Solution.

$$y[n] = \sum_{k=-\infty}^{\infty} x[n]h[n] = \sum_{k=0}^{n} \alpha^k \beta^{n-k} = \frac{\alpha^{n+1}-\beta^{n+1}}{\alpha-\beta}.$$

2.22

(c)

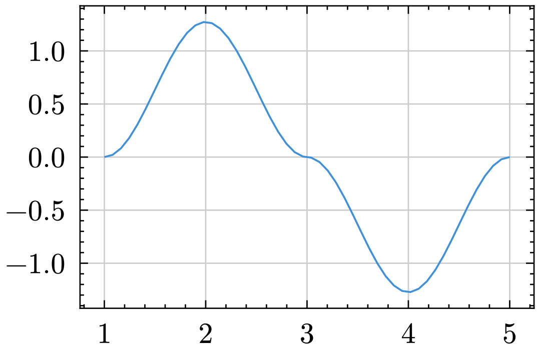
Solution. The desired convolution is

$$y(t) = \int_{-\infty}^{\infty} x(\tau)h(t-\tau)\,\mathrm{d}\tau = \int_{0}^{2} \sin(\pi\tau)h(t-\tau)\,\mathrm{d}\tau.$$

This gives us

$$y(t) = \begin{cases} 0, & t<1 \\ 2/\pi(1-\cos(\pi(t-1))), & 1<t<3 \\ 2/\pi(\cos(\pi(t-3))-1), & 3<t<5 \\ 0, & t>5 \end{cases}$$

as shown in the figure below.



2.28

(c)

Solution. Not causal because $h[n] = 2^n > 0$ for $n < 0$. Unstable because

$$\sum_{n=-\infty}^{\infty} h[n] = \sum_{n=0}^{\infty} 2^n = \infty.$$

2.29

(g)

Solution. Causal because $h(t) = 0$ for $t < 0$. Unstable because

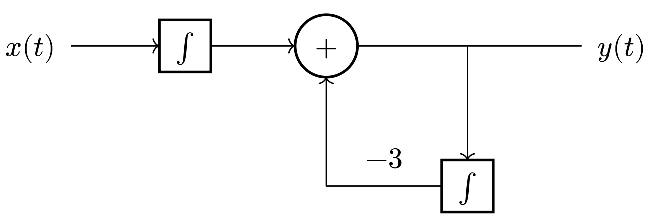
$$\int_{-\infty}^{\infty} |h(\tau)| \, \mathrm{d}\tau \geq \int_{100}^{\infty} \left(e^{\frac{x}{100}-1} - 1\right) \mathrm{d}\tau = \infty.$$

2.33

2.39

(b)

Solution. The block diagram is as shown in the figure below.



2.47

(b)

(d)

(f)