...1.27. (2)

c) $y(t) = \int_{-\infty}^{2t} x(\tau)\,d\tau$

1) $y(t_0)$ depends on terms $x(\tau)$, where $\overset{\in(-\infty,2t]}{\tau}$ may be different from $t_0$ $\Rightarrow$ $\boxed{\text{not memoryless}}$

2) $\overset{x'(t)=x(t+k)}{\cancel{x(t+k)}} \Rightarrow y'(t) = \int_{-\infty}^{2t} x'(\tau)\,d\tau = \int_{-\infty}^{2t} x(\tau+k)\,d\tau = \left[\begin{array}{l}\tau' = \tau+k \\ \tau \to 2t \Rightarrow \tau' \to \tau+k \to 2t+k\end{array}\right] = \int_{-\infty}^{2t+k} x(\tau')\,d\tau'$

$y(t+k) = \int_{-\infty}^{2t+2k} x(\tau)\,d\tau \neq y'(t) \Rightarrow \boxed{\text{not time-invariant}}$

3) $x'(t) = \alpha x_1(t) + \beta x_2(t) \Rightarrow y'(t) = \int_{-\infty}^{2t} x'(\tau)\,d\tau = \int_{-\infty}^{2t} (\alpha x_1(\tau) + \beta x_2(\tau))\,d\tau = \alpha \int_{-\infty}^{2t} x_1(\tau)\,d\tau + \beta \int_{-\infty}^{2t} x_2(\tau)\,d\tau$

$\alpha y_1(t) + \beta y_2(t) = \alpha \int_{-\infty}^{2t} x_1(\tau)\,d\tau + \beta \int_{-\infty}^{2t} x_2(\tau)\,d\tau = y'(t) \Rightarrow \boxed{\text{linear}}$

4) $y(t)$ depends on terms $x(\tau)$, where $\tau \in (-\infty, 2t_0)$ may be greater than $t_0$ $\Rightarrow$ $\boxed{\text{not causal}}$

5) $|x(t)| \leq B \quad \forall t \in \mathbb{R}$ (let $x(t) = c \Rightarrow |y(0)| = \left|\int_{-\infty}^{0} c\,d\tau\right| = \left|[c\tau]_{-\infty}^{0}\right| = |-\infty| = \infty$)

$|y(t)| = \left|\int_{-\infty}^{2t} x(\tau)\,d\tau\right| \leq \left|\int_{-\infty}^{2t} B\,d\tau\right| = \infty \Rightarrow \boxed{\text{not stable}}$

d) $y(t) = \begin{cases} 0 & t < 0 \\ x(t) + x(t-2) & t \geq 0 \end{cases}$

1) $y(t_0)$ depends on terms $x(t_0-2)$, where $t_0 - 2 \neq t_0$ $\Rightarrow$ $\boxed{\text{not memoryless}}$

2) $x'(t) = x(t+k) \Rightarrow y'(t) = \begin{cases} 0 & t<0 \\ x'(t) + x'(t-2) & t \geq 0 \end{cases} = \begin{cases} 0 & t<0 \\ x(t+k) + x(t+k-2) & t \geq 0 \end{cases}$

$y(t+k) = \begin{cases} 0 & t<0 \\ x(t+k) + x(t+k-2) & t+k \geq 0 \end{cases} \neq y'(t) \Rightarrow \boxed{\text{not time-invariant}}$

3) $x'(t) = \alpha x_1(t) + \beta x_2(t) \Rightarrow y'(t) = \begin{cases} 0 & t<0 \\ x'(t) + x'(t-2) & t \geq 0 \end{cases} = \begin{cases} 0 & t<0 \\ \alpha x_1(t) + \beta x_2(t) + \alpha x_1(t-2) + \beta x_2(t-2) & t \geq 0 \end{cases}$ X

$\alpha y_1(t) + \beta y_2(t) = \alpha \begin{cases} 0 & t<0 \\ x_1(t) + x_1(t-2) & t \geq 0 \end{cases} + \beta \begin{cases} 0 & t<0 \\ x_2(t) + x_2(t-2) & t \geq 0 \end{cases} = \begin{cases} 0 & t<0 \\ \alpha x_1(t) + \alpha x_1(t-2) + \beta x_2(t) + \beta x_2(t-2) & t \geq 0 \end{cases} =$

$= y'(t) \Rightarrow \boxed{\text{linear}}$

4) $y(t_0)$ depends on $x(t_0)$ and $x(t_0-2)$, where $t_0 \ngtr t_0$ and $t_0 - 2 \ngtr t$ $\Rightarrow$ $\boxed{\text{causal}}$

5) $|x(t)| \leq B \Rightarrow |x(t) + x(t-2)| \leq 2B \quad \forall t \in \mathbb{R} \Rightarrow y(t) \leq 2B \quad \forall t \in \mathbb{R} \Rightarrow \boxed{\text{stable}}$