... 1.27. (4)

g) $y(t) = \frac{dx(t)}{dt} = \lim_{h\to 0} \frac{x(t+h)-x(t)}{h}$

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

2) $x'(t) = x(t+k) \Rightarrow y'(t) = \frac{\partial x'(t)}{\partial t} = \lim_{h\to 0} \frac{x'(t+h)-x'(t)}{h} = \lim_{h\to 0} \frac{x(t+k+h)-x(t+k)}{h}$

$y(t+k) = \lim_{h\to 0} \frac{x(t+k+h)-x(t+h)}{h} = y'(t) \Rightarrow$ $\boxed{\text{time invariant}}$

3) $x'(t) = \alpha x_1(t) + \beta x_2(t) \Rightarrow y'(t) = \frac{dx'(t)}{dt} = \frac{d}{dt}(\alpha x_1(t) + \beta x_2(t)) = \alpha \frac{d x_1(t)}{dt} + \beta \frac{dx_2(t)}{dt}$

$\alpha y_1(t) + \beta y_2(t) = \alpha \frac{dx_1(t)}{dt} + \beta \frac{dx_2(t)}{dt} = y'(t) \Rightarrow$ $\boxed{\text{Linear}}$

4) $\exists y(t) \Leftrightarrow \exists \lim_{h\to 0} \frac{x(t+h)-x(t)}{h} \Leftrightarrow \lim_{h\to 0^-} \frac{x(t+h)-x(t)}{h} = \lim_{h\to 0^+} \frac{x(t+h)-x(t)}{h} = y(t) \Rightarrow$

$y(t) = \lim_{h\to 0^-} \frac{x(t+h)-x(t)}{h}$, ~~where~~

$y(t_0)$ depends on $x(t_0+h) - x(t_0)$, where $t_0+h \not> t$, $t_0 \not> t_0 \Rightarrow$ $\boxed{\text{causal}}$

5) ~~Let $x(t) = \frac{|t|}{dt} \leq 1 \quad \forall t$~~

~~$\frac{dx(t)}{dt} = \frac{dx(t)}{dt} = \lim_{h\to 0} \frac{x(0+h)-x(0)}{h} = \frac{|h|}{h} - \frac{|0|}{0}$~~

Let $x(t) = \begin{cases} \sqrt[3]{t} & |t| \leq 1 \\ 0 & \text{otherwise} \end{cases} \Rightarrow x(t) \leq 1 \quad \forall t \in \mathbb{R}$

$x(0) = \sqrt[3]{0}$

$y(0) = \frac{dx}{dt}(0) = \lim_{h\to 0} \frac{x(0+h)-x(0)}{h} = \lim_{h\to 0} \frac{\sqrt[3]{h} - 0}{h} = \lim_{h\to 0} \frac{1}{\sqrt[3]{h^2}} = +\infty \not\leq B \quad \forall B \in \mathbb{R} \Rightarrow$

$\Rightarrow$ $\boxed{\text{not stable}}$