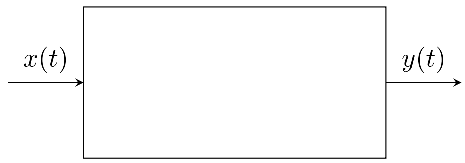
Consider the system as shown below:



The system is described by the equation

$$y(t) = x(e^{-t}).$$

The system is:

(A) non-linear and causal.

(B) linear and non-causal.

(C) non-linear and non-causal.

(D) linear and causal.

Solution:

Homogeneity Test:

For input $x_1(e^{-t})$, the output will be $y_1(t)$.

$$y_1(t) = x_1(e^{-t}) \tag{1}$$

Multiplying both sides by a scalar quantity 'a'

$$ay_1(t) = ax_1(e^{-t}) \tag{2}$$

For input $x_2(e^{-t})$, the output will be $y_2(t)$.

$$y_2(t) = x_2(e^{-t}) \tag{3}$$

Multiplying both sides by a scalar quantity 'b'

$$by_2(t) = bx_2(e^{-t}) \tag{4}$$

Adding the above equations we get:

$$ay_1(t) + by_2(t) = ax_1(e^{-t}) + bx_2(e^{-t}) \tag{5}$$

Let us assume that, for input $ax_1(e^{-t}) + bx_2(e^{-t})$, the output will be $y_3(t)$.

$$y_3(t) = ax_1(e^{-t}) + bx_2(e^{-t}) \tag{6}$$

But, $ay_1(t) + by_2(t) = ax_1(e^{-t}) + bx_2(e^{-t})$

Therefore;

$$y_3(t) = ay_1(t) + by_2(t) \tag{7}$$

The system satisfies homogeneity, as scaling the input scales the output.

Additivity Test:
From the given system;

$$y(t) = x(e^{-t}) \tag{8}$$

$$y(0) = x(e^{0}) \tag{9}$$

$$y(1) = x(e) = x(2.71) \tag{10}$$

So, the present value of output depends on the future value of input, indicating non-causality.

Therefore, the correct answer is: **(B) linear and non-causal**