

1. Which system is linear?

☐ $y(t) = 3x(t - 2)$

☐ $y(t) = x(t)^2$

☐ $y(t) = x(t) + 1$

☐ $y(t) = |x(t)|$

2. Convolution with $h(t)$ gives the output of any system, linear or not.

☐ True ☐ False

3. $X(0)$, the Fourier transform at zero frequency, equals the total area under $x(t)$.

☐ True ☐ False

4. Sampling at f_s places copies of the signal's spectrum at every multiple of f_s .

☐ True ☐ False

5. $H(s) = (s + 3)/((s + 1)(s + 5))$. Where are the poles and zero?

☐ Poles at -3 ; zeros at -1 and -5

☐ Poles at 1 and 5 ; zero at 3

☐ Poles at -1 and -5 ; zero at -3

☐ Poles at -1 , -3 and -5

6. $y[n] = 0.5y[n-1] + x[n]$, starting at rest. What is the impulse response $h[n]$?

☐ 0.5^n for $n \geq 0$

☐ 1 for $n \geq 0$

☐ 0.5 at $n = 1$ only

☐ 2^n for $n \geq 0$

7. In the z -domain, delaying a signal by one sample multiplies its transform by z^{-1} .

☐ True ☐ False

8. The system $y = 2x + 5$ is linear.

☐ True ☐ False

9. A unit step into $h(t) = e^{-t}u(t)$ gives, for $t \geq 0$,

☐ e^{-t}

☐ $1 - e^{-t}$

☐ $1 + e^{-t}$

10. An input with spectrum $X(\omega)$ passes through a system with frequency response $H(\omega)$. The output spectrum is

☐ $X(\omega) \cdot H(\omega)$

☐ $X(\omega) + H(\omega)$

☐ $X(\omega)/H(\omega)$

☐ $X(\omega) * H(\omega)$, a convolution

1. **$y(t) = 3x(t - 2)$**

A scaled delay obeys superposition and scaling. Squaring and the absolute value fail scaling; adding 1 gives a non-zero output for zero input.

2. **False**

The derivation uses linearity (to add the responses) and time invariance (to shift one h). Without both, one impulse response does not describe the system.

3. **True**

Put $\omega = 0$: $e^0 = 1$, so $X(0) = \int x(t) dt$. For a pulse that is $A\tau$.

4. **True**

Multiplying by an impulse train in time convolves the spectrum with an impulse train in frequency, which copies it to each kf_s .

5. **Poles at -1 and -5 ; zero at -3**

Poles make the denominator zero ($s = -1, -5$); the zero makes the numerator zero ($s = -3$).

6. **0.5^n for $n \geq 0$**

An impulse gives $y[0] = 1$, then each sample halves: $1, 0.5, 0.25, \dots = 0.5^n$.

7. **True**

Each term $x[n-1]z^{-n}$ re-indexes to $z^{-1}x[m]z^{-m}$. That is why difference equations become algebra in z .

8. **False**

Zero input gives 5, but a linear system must map zero to zero. Its graph is a straight line, but "linear" here means superposition.

9. **$1 - e^{-t}$**

$\int_0^t e^{-(t-\tau)} d\tau = 1 - e^{-t}$. It starts at 0 and settles at the DC gain 1.

10. **$X(\omega) \cdot H(\omega)$**

Convolution in time is multiplication in frequency. That single property is why filters are designed in the frequency domain.