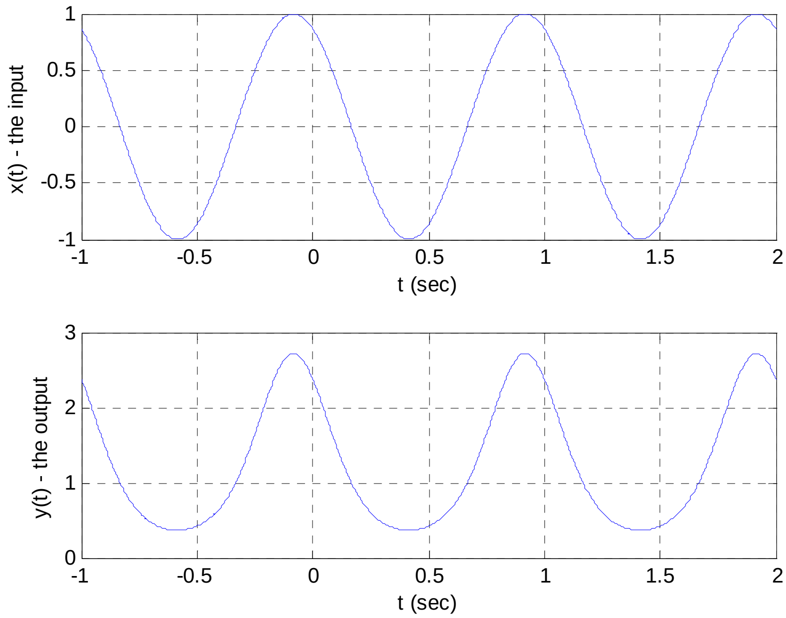
Practice Quiz 4

(no calculators allowed)

1) Consider an unknown system. When the input to the system is $x(t) = 2\cos(2t)$ the output of the system is $y(t) = 2\cos(2t) + \cos(4t)$. Is the system **linear**?

a) Yes b) No c) Can't tell, not enough information

2) Consider the following input/output pair for an unknown system.



Which of the following is true:

a) The system is linear
b) The system is not linear
c) It is not possible to determine if the system is linear based on the information given.

3) The **impulse response** for the LTI system $y(t) = \frac{1}{2}[x(t) - x(t-1)]$ is

a) $h(t) = \frac{1}{2}[u(t) - u(t-1)]$ b) $h(t) = \frac{1}{2}[\delta(t) - \delta(t-1)]$ c) neither of these

4) The **impulse response** for the LTI system $y(t) = \int_{-\infty}^{t+1} e^{-(t-\lambda)} x(\lambda) d\lambda$ is

a) $h(t) = e^{-t}u(t)$ b) $h(t) = e^{-t}u(t+1)$ c) $h(t) = e^{-t}\delta(t)$ d) none of these

5) The **impulse response** for the LTI system $y(t) = 2x(t) + \int_{-\infty}^{t-2} e^{-(t-\lambda)} x(\lambda+3)d\lambda$ is

a) $h(t) = 2u(t) + e^{-(t+3)}u(t+1)$ b) $h(t) = 2\delta(t) + e^{-(t+3)}u(t+1)$
c) $h(t) = 2\delta(t) + e^{-(t+3)}u(t)$ d) $h(t) = 2\delta(t) + e^{-(t+3)}u(t-2)$
e) $h(t) = 2\delta(t) + e^{-(t+3)}u(t+3)$ f) none of these

6) The **impulse response** for the LTI system $\dot{y}(t) + y(t) = x(t-1)$ is

a) $h(t) = e^{t}u(t)$ b) $h(t) = e^{-t}u(t)$ c) $h(t) = e^{-(t-1)}u(t)$
d) $h(t) = e^{-(t-1)}u(t-1)$ e) $h(t) = e^{(t-1)}u(t-1)$ f) none of these

7) The **impulse response** for the LTI system $\dot{y}(t) - 2y(t) = 3x(t+1)$ is

a) $h(t) = 3e^{2(t+1)}u(t+1)$ b) $h(t) = 3e^{-2(t+1)}u(t+1)$ c) $h(t) = 3e^{-2(t+1)}u(t-1)$
d) $h(t) = 3e^{-2(t+1)}u(t)$ e) $h(t) = 3e^{2(t+1)}u(t)$ f) none of these

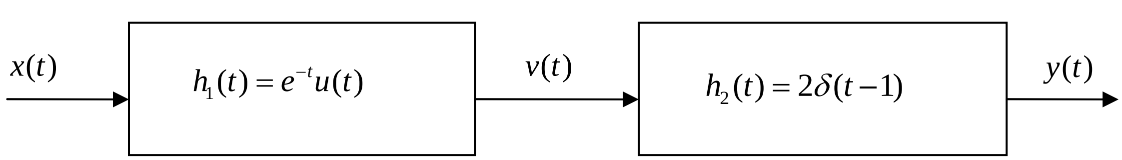
8) The **unit step response** of a system with impulse response $h(t) = e^{-(t-1)}u(t-1)$ is

a) $y(t) = [1-e^{-(t-1)}]\,u(t-1)$ b) $y(t) = [1-e^{-(t-1)}]\,u(t)$ c) $y(t) = [1-e^{(t-1)}]\,u(t)$
d) $y(t) = [1-e^{(t-1)}]\,u(t-1)$ e) none of these

9) If the unit step response of a system is $y(t) = A(1-e^{-t/\tau})\,u(t)$, the **impulse response** of the system is

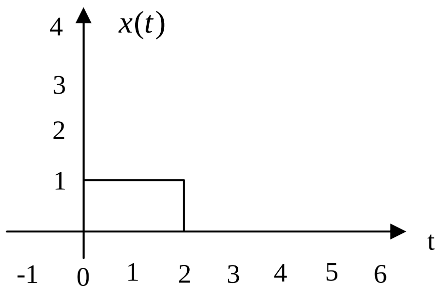
a) $h(t) = \frac{A}{\tau}e^{-t/\tau}\delta(t)$ b) $h(t) = \frac{A}{\tau}e^{-t/\tau}u(t)$ c) $h(t) = \frac{A}{\tau}e^{-t/\tau}$ d) $h(t) = A\tau e^{-t/\tau}u(t)$

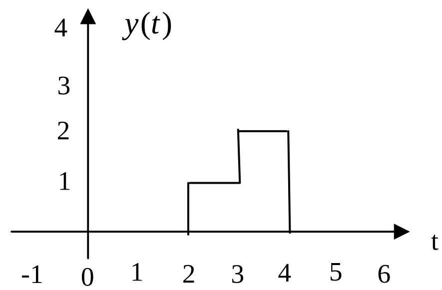
10) The **impulse response** of the system



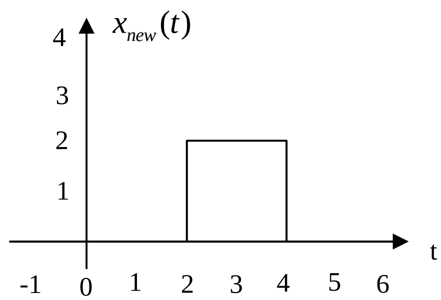
is
a) $h(t) = 2e^{-t}u(t)$ b) $h(t) = 2e^{-t}\delta(t-1)$ c) $h(t) = 2e^{-(t-1)}u(t-1)$ d) $h(t) = 2e^{-(t-1)}u(t)$

11) Assume we know a system is a linear time invariant (LTI) system. We also know the following input $x(t)$ – output $y(t)$ pair:



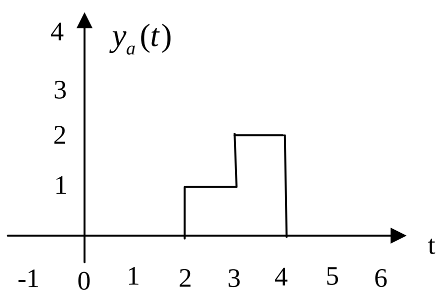


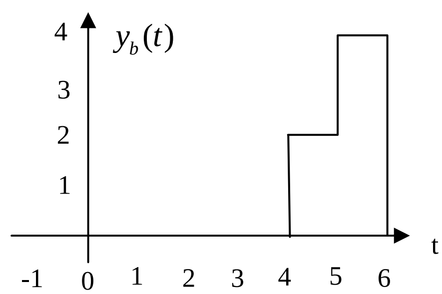
If the input to the system is now $x_{new}(t)$

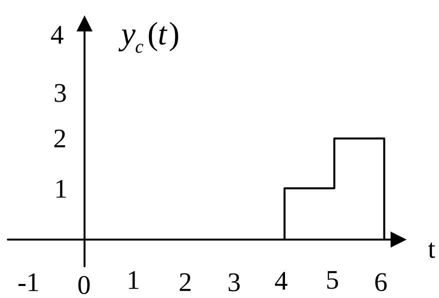


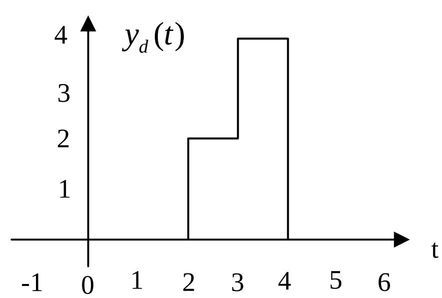
Which of the following best represents the output of the system?

a) $y_a(t)$ b) $y_b(t)$ c) $y_c(t)$ d) $y_d(t)$

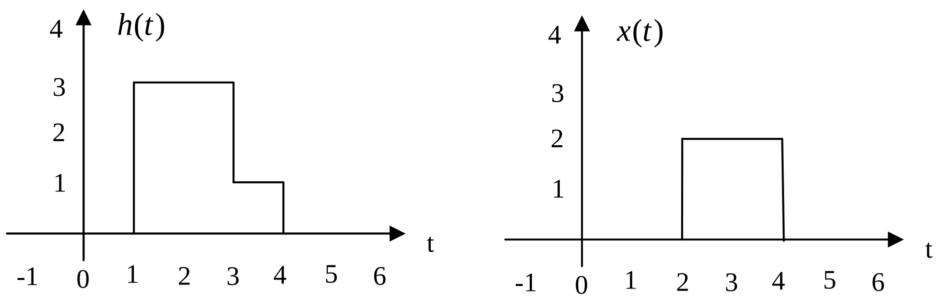








Problems **12 - 15** refer to the following linear time invariant (LTI) system, with impulse response $h(t)$ shown below on the left, and input $x(t)$ shown below on the right. The output of the system, $y(t)$, is the convolution of the impulse response with the input, $y(t) = h(t) * x(t)$.



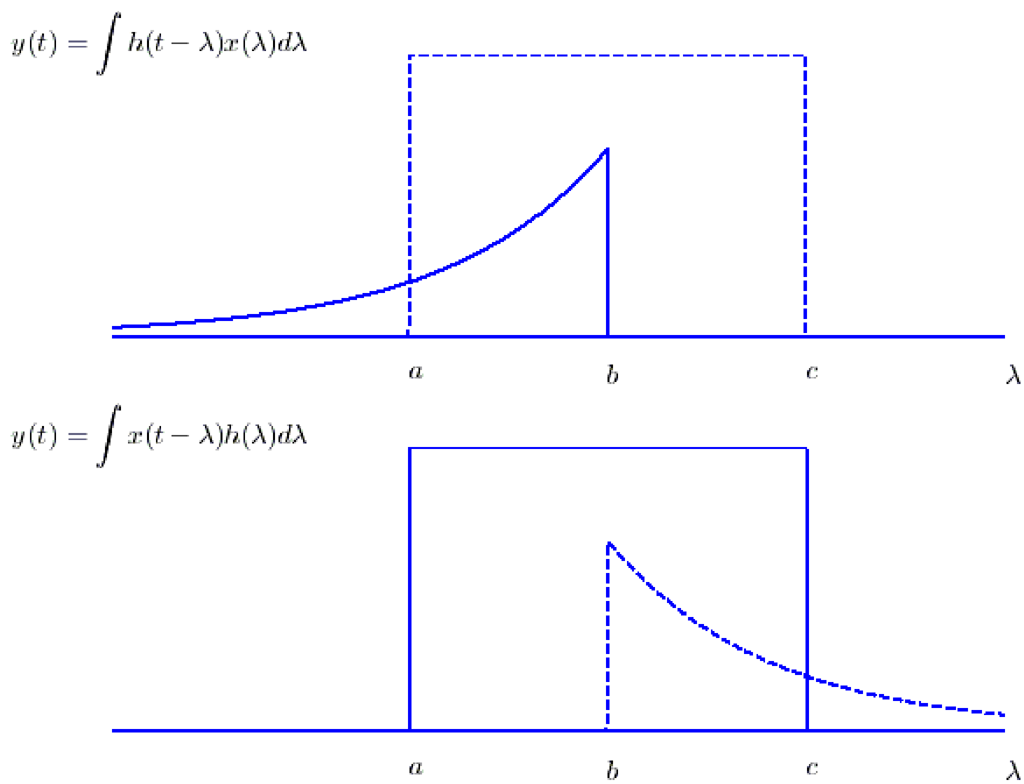
12) Is this LTI system causal? a) Yes b) No

13) The maximum value of $y(t)$ is a) 4 b) 5 c) 6 d) 12 e) 14

14) $y(t)$ is zero until what time? a) 0 b) 1 c) 2 d) 3 e) 4

15) $y(t)$ will return to zero at what time? a) 6 b) 7 c) 8 d) 9 e) 10

For problems **16- 21**, assume we are going to convolve the impulse response $h(t) = 2e^{-t/0.8}$u(t) with input x(t) = 3 rect$\left(\frac{t}{2}\right)$.



For problems **16-18**, assume we perform the convolution using the form $y(t) = \int h(t-\lambda)x(\lambda)d\lambda$, depicted in the top panel in the above figure.

16) The parameter *a* is equal to a) 0 b) 1 c) -1 d) t e) λ f) none of these

17) The parameter *b* is equal to a) 0 b) 1 c) -1 d) t e) λ f) none of these

18) The parameter *c* is equal to a) 0 b) 1 c) -1 d) t e) λ f) none of these

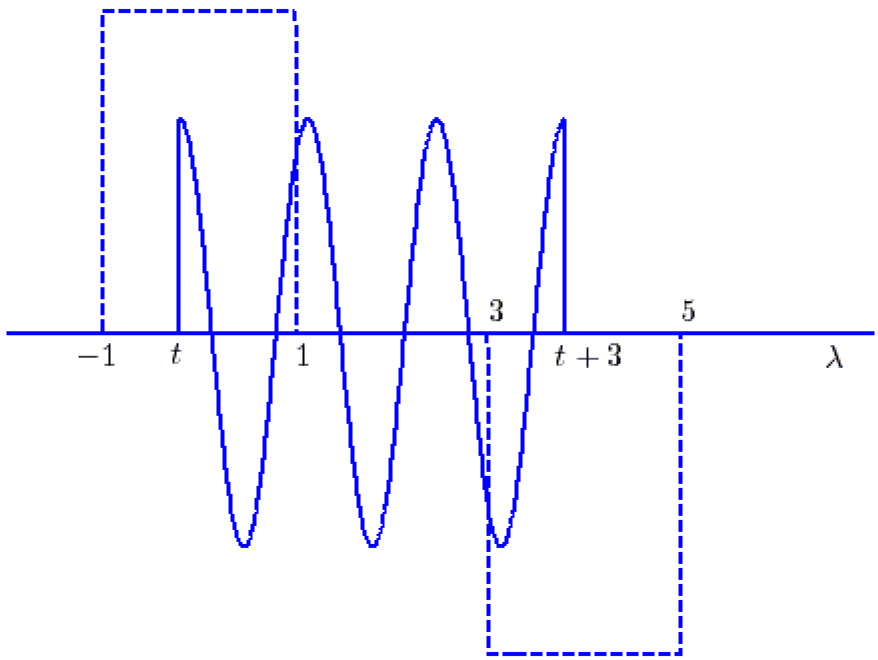
For problems **19-21**, assume we perform the convolution using the form $y(t) = \int h(\lambda)x(t-\lambda)d\lambda$, depicted in the bottom panel in the above figure.

19) The parameter *a* is equal to a) $t-1$ b) $t+1$ c) -1 d) 1 e) none of these

20) The parameter *b* is equal to a) $t-1$ b) $t+1$ c) -1 d) 1 e) none of these

21) The parameter *c* is equal to a) $t-1$ b) $t+1$ c) -1 d) 1 e) none of these

For problems **22-27**, assume we are convolving two functions, and at some point we have the configuration shown below:



The output at this time can be written as the sum of two integrals,

$$y(t)=\int_a^b x(\lambda)h(t-\lambda)d\lambda+\int_c^d x(\lambda)h(t-\lambda)d\lambda \backslash$$

22) The value of the parameter a is a) -1 b) 1 c) 3 d) 5 e) t f) $t+3$

23) The value of the parameter b is a) -1 b) 1 c) 3 d) 5 e) t f) $t+3$

24) The value of the parameter c is a) -1 b) 1 c) 3 d) 5 e) t f) $t+3$

25) The value of the parameter d is a) -1 b) 1 c) 3 d) 5 e) t f) $t+3$

26) This sketch is valid for

a) $-1<t<1$ b) $3<t<5$ c) $0<t<2$ d) $0<t<1$ e) none of these

27) Is this a causal system? a) yes b) no c) it is not possible to tell

<u>Answers:</u> 1-b, 2-b, 3-b, 4-b, 5-b, 6-d, 7-a, 8-a,
9-b, 10-c, 11-b, 12-a, 13-d, 14-d, 15-c
16- c, 17-d, 18-b, 19-a, 20-e, 21-b
22-e, 23-b, 24-c, 25-f, 26-d, 27-b