EECE 290, Problem solving

Session 6

LT for circuits

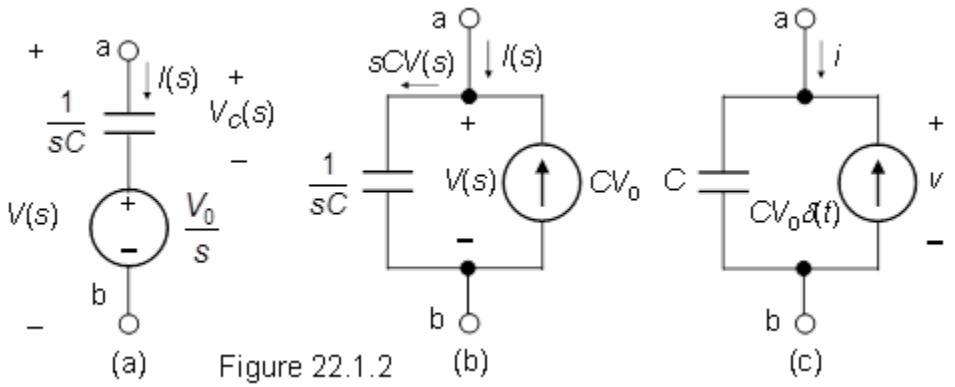


Figure 22.1.2

- Convert circuit with initial conditions to s-domain.
- Apply circuit analysis.
- Apply ILT to result

(in s domain) to get expression in time domain.

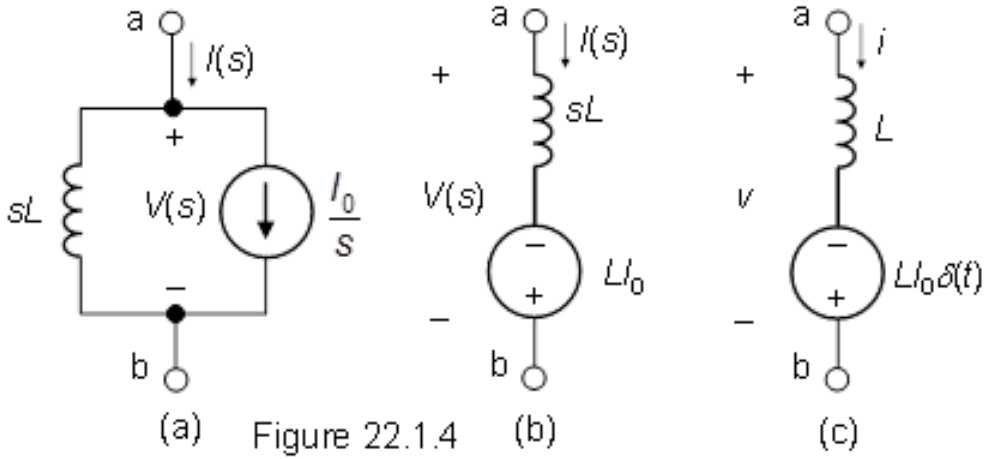
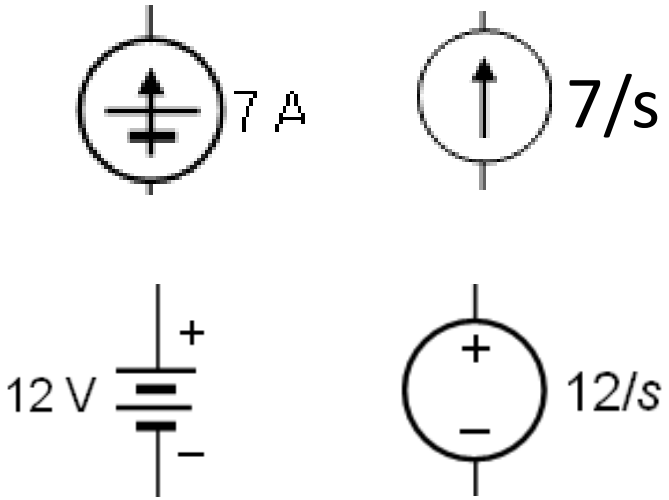
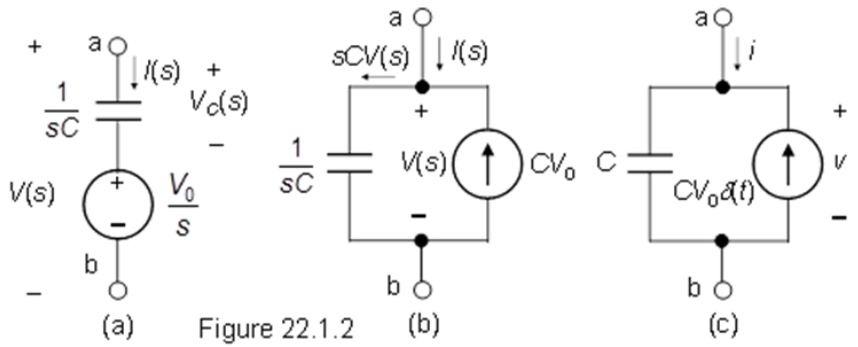


Figure 22.1.4



A capacitance of .5 F has a initial voltage of 4 V. In the s-domain circuit this is modeled by a current source



A. of 4/s in parallel
B. of 4/s in series
C. of 8/s in parallel
D. of 8/s in series
E. of 2 in series
F. of 2 in parallel

An inductance of 2 H has an initial current of 4 A. In the s-domain circuit this is modeled by a current source

A. of 4/s in parallel
B. of 4/s in series
C. of 2/s in parallel
D. of 2/s in series
E. of 8 in series
F. of 8 in parallel

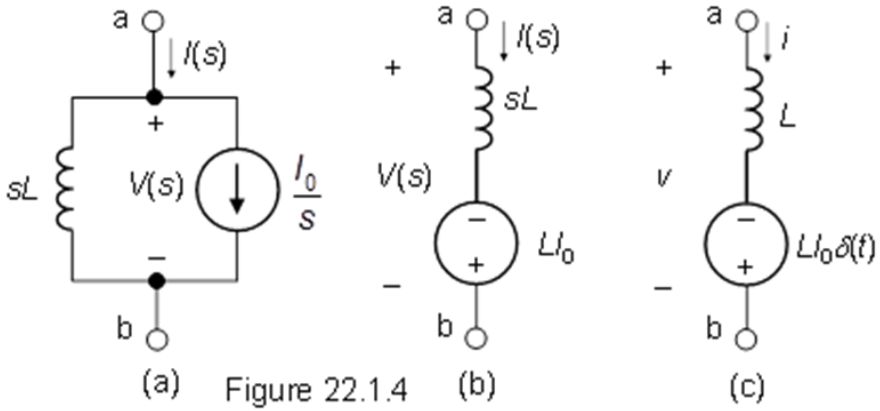


Figure 22.1.4

An inductance of 2 H has an initial current of 4 A. In the s-domain circuit this is modeled by a voltage source

A. of 4/s in parallel
B. of 4/s in series
C. of 2/s in parallel
D. of 2/s in series
E. of 8 in series
F. of 8 in parallel

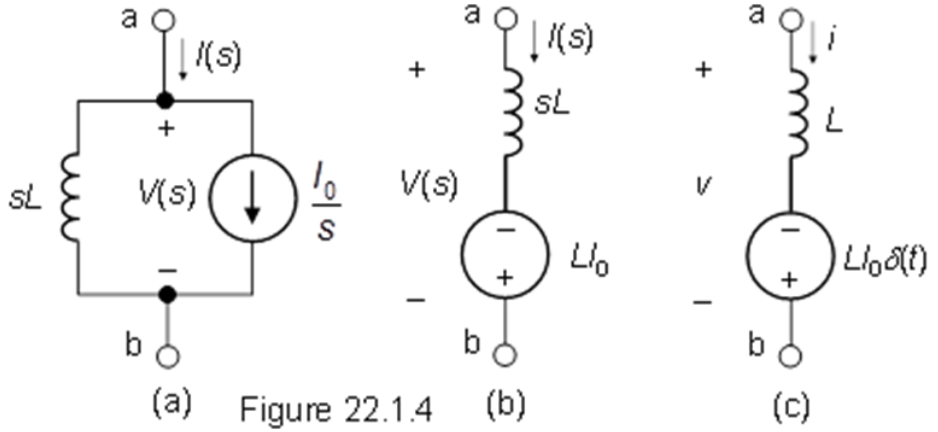
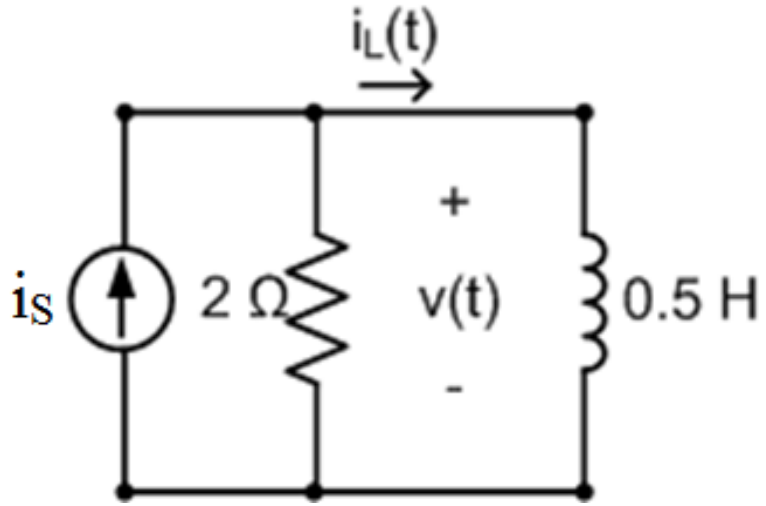


Figure 22.1.4

Transfer functions

- Ratio of output quantity (V or I) to input quantity (V or I source) in s-domain: H(s)
- If input is G(s), then output is F(s)=H(s)G(s) (multiplication)
- ILT of H(s) is impulse response h(t).
- If the input is g(t), then the output is f(t)=h(t)*g(t) (convolution).

$I_L(s)/I_S(s)$= ?



A. 1/(s+4)

B. 2/(s+4)

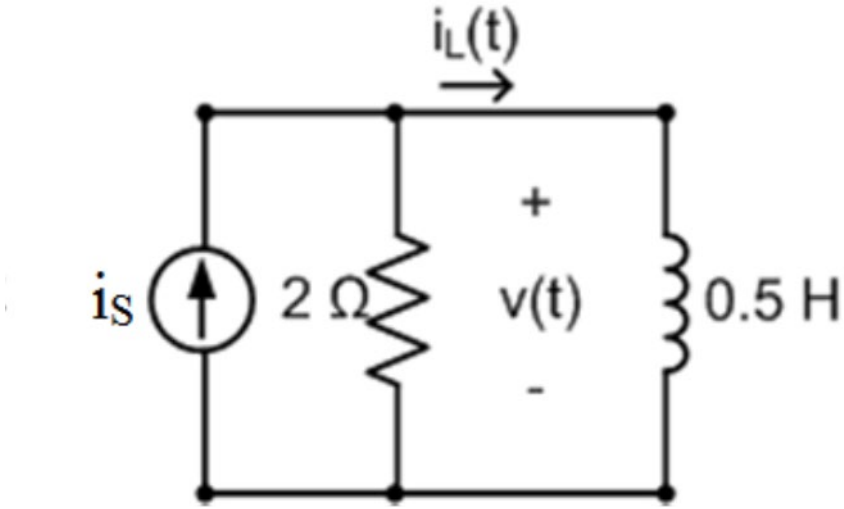
C. 12

D. 6

E. 4/(s+4)

$I_L(s)/I_S(s)=4/(s+4)$

$i_S(t)=2\delta(t)$, $i_L(t)=$?



A. 12 A

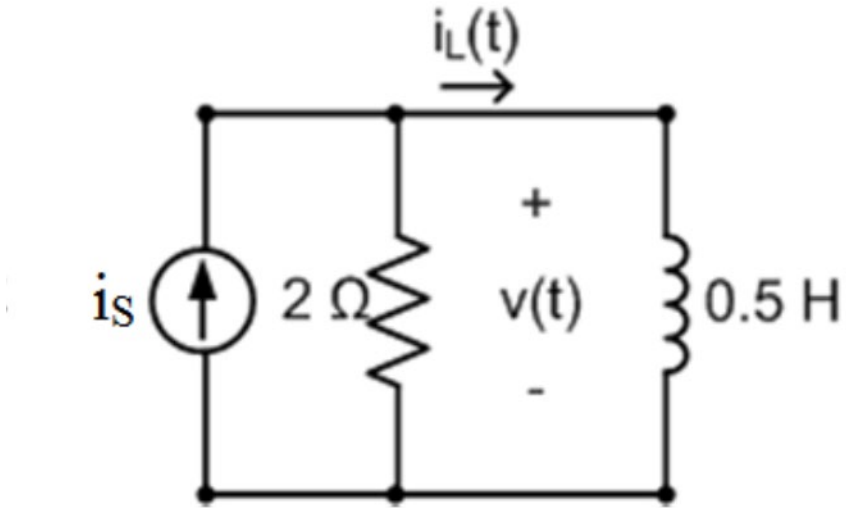
B. 6 A

C. $8\,e^{-4t}$ A

D. e^{-4t} A

E. $4\,e^{-4t}$ A

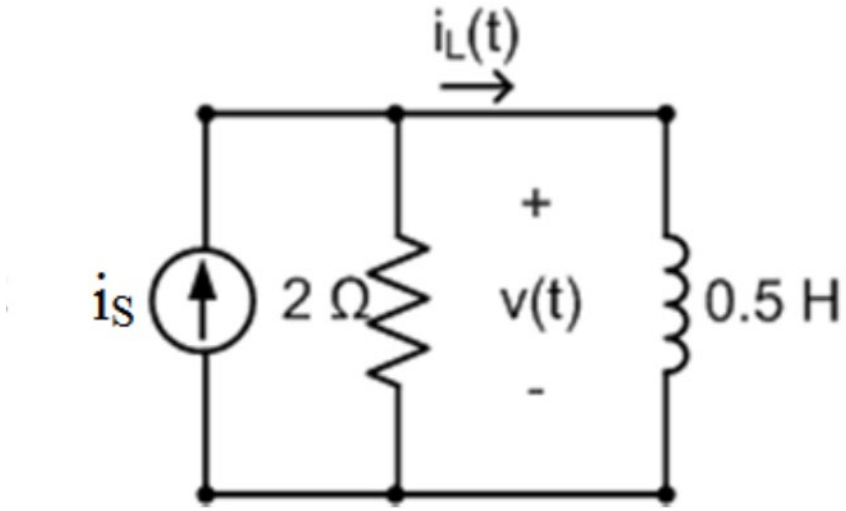
$V(s)/I_S(s)= ?$



A. -24/(s+4)
B. 4
C. 2s/(s+4)
D. 6
E. s/(s+4)

$V(s)/I_S(s)=2s/(s+4)$

$i_S(t)=2\delta(t)$, $v(t)=$?



A. $2\delta(t)-8\ e^{-4t}$ V

B. 6 V

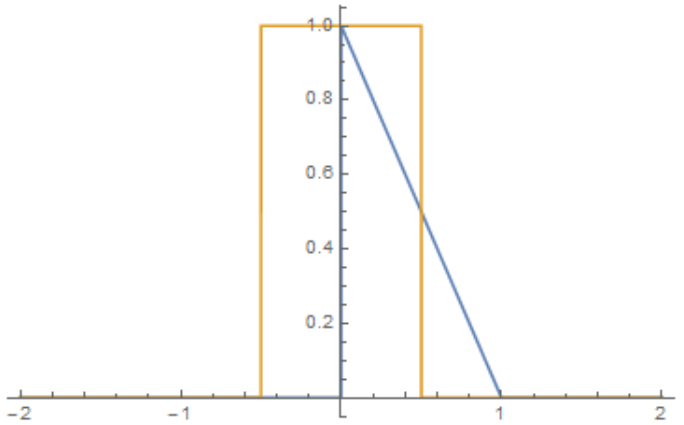
C. $\delta(t)-e^{-4t}$ V

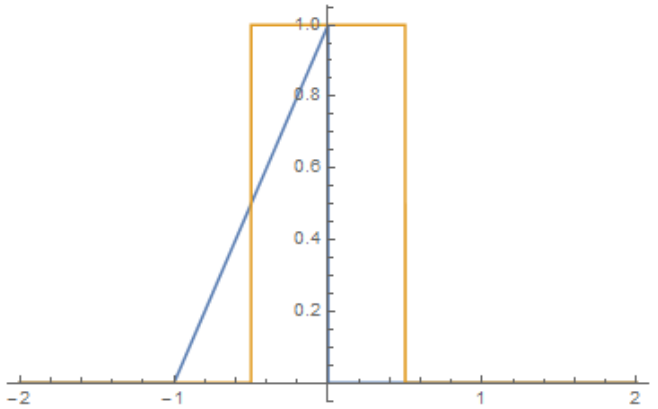
D. $8\ e^{-4t}$ V

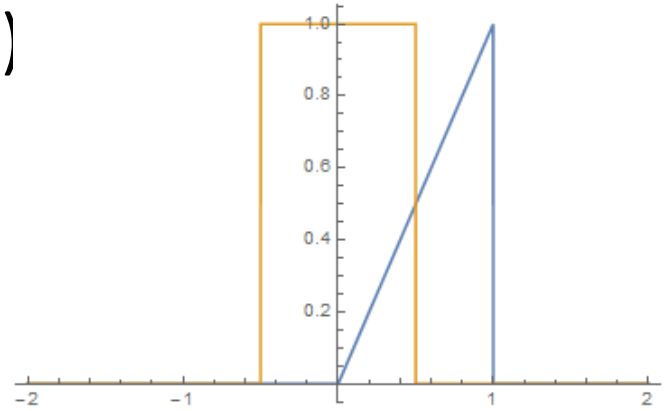
E. $4\delta(t)-16\ e^{-4t}$ V

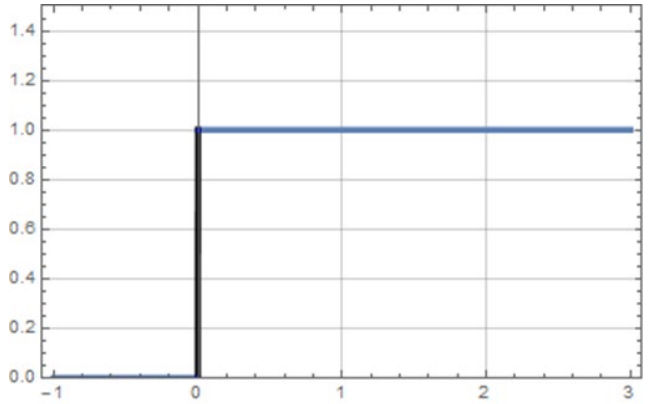
Convolution

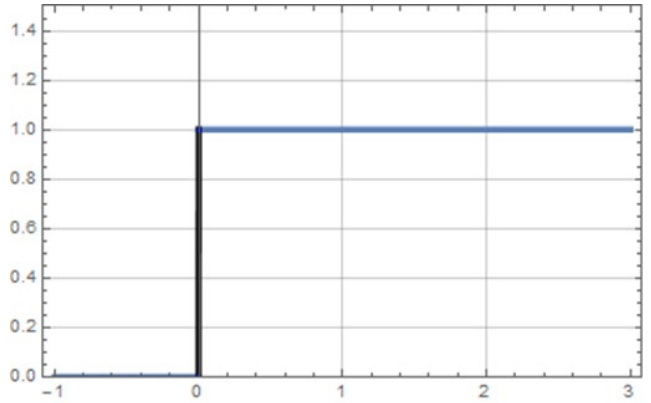
- Given g(t) and h(t)
- f=g*h= $\int_{-\infty}^{\infty} g(\lambda)\, h(t-\lambda)\, d\lambda$
- Properties
  - Commutative
  - Associative
  - Distributive
- (Staircase: use polynomials)







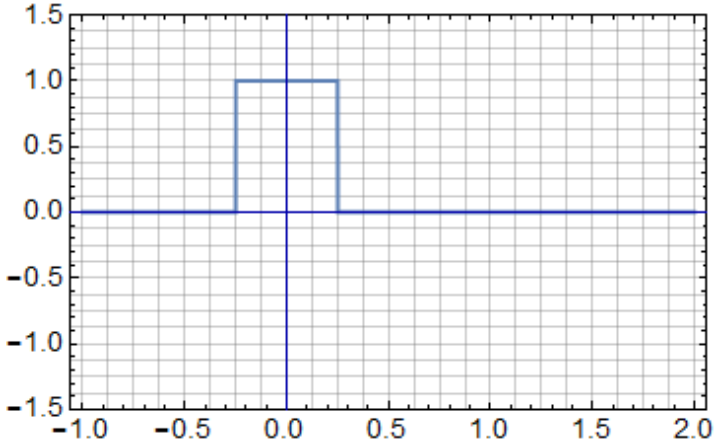




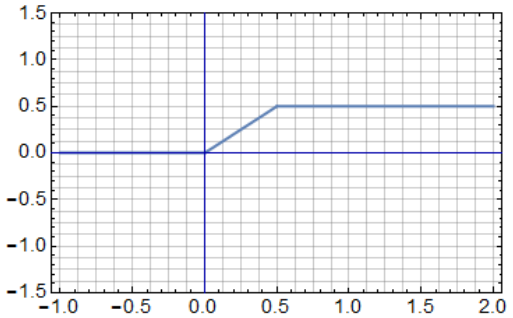
$u(t) * t\,u(t) = ?$

A. -1
B. 0
C. 1
D. t
E. t^2
F. $\frac{1}{2} t^2$

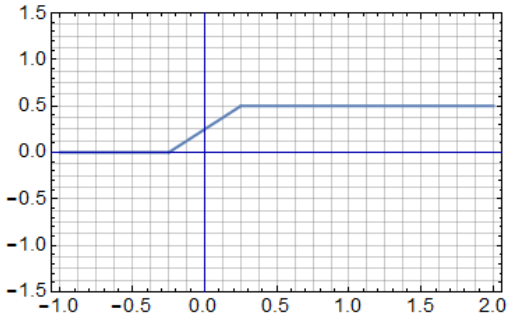
u(t)*


1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−1.0 −0.5 0.0 0.5 1.0 1.5 2.0

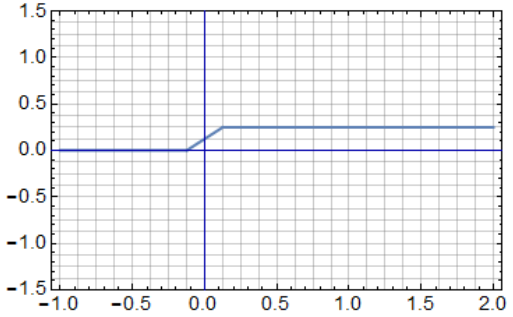
A.

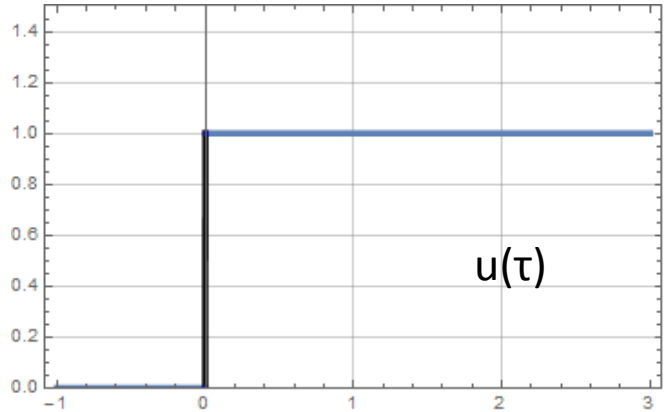

1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−1.0 −0.5 0.0 0.5 1.0 1.5 2.0

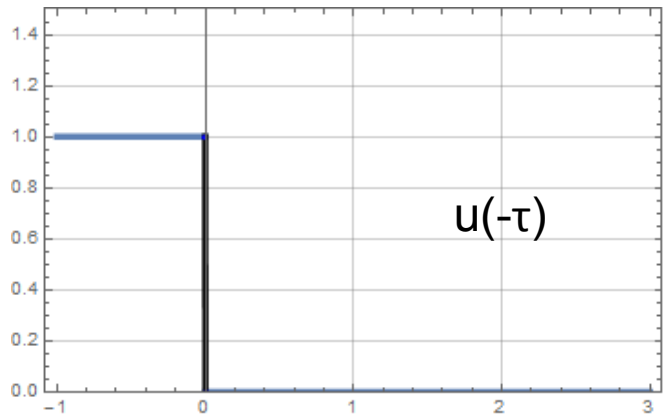
B.

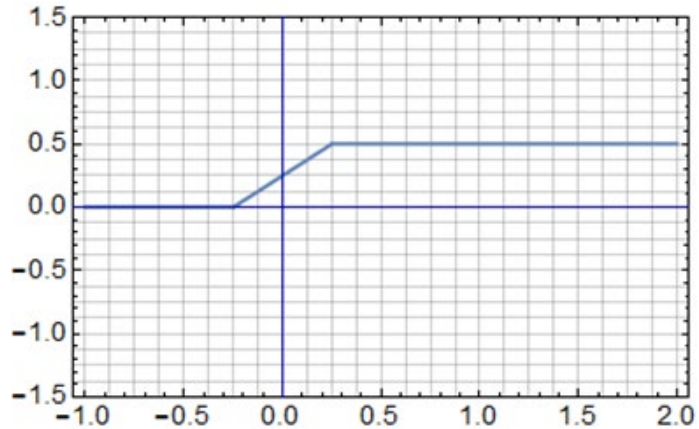

1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−1.0 −0.5 0.0 0.5 1.0 1.5 2.0

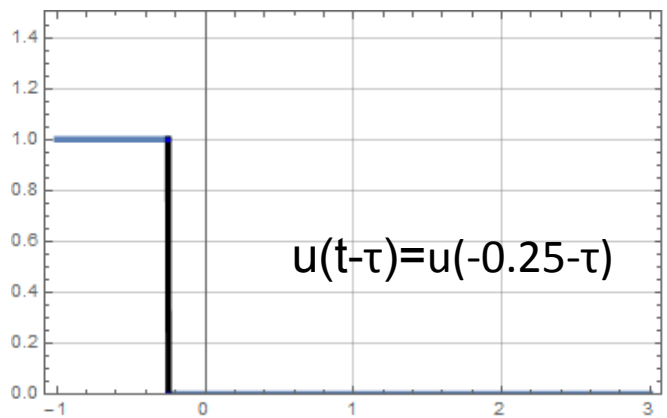
C.

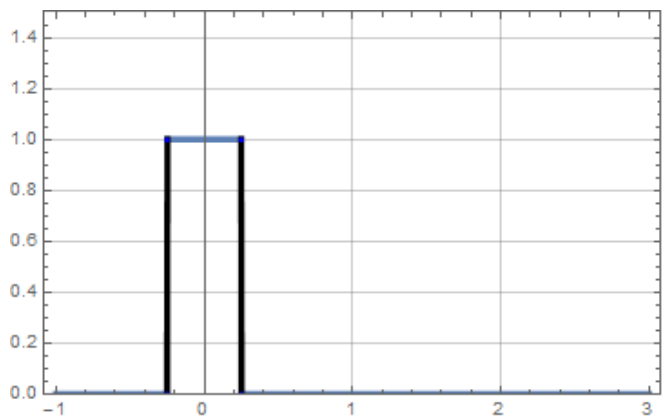

1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−1.0 −0.5 0.0 0.5 1.0 1.5 2.0

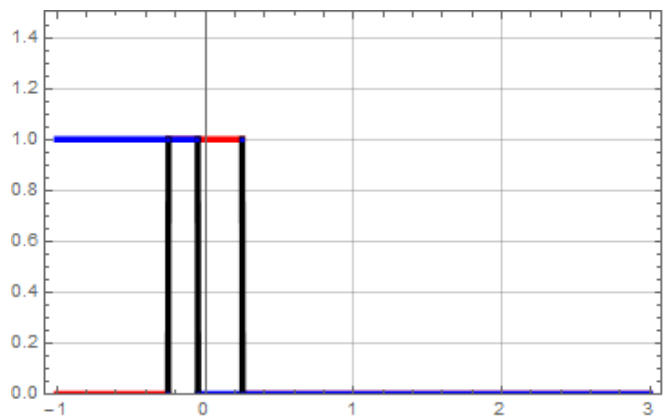

u(τ)


u(-τ)

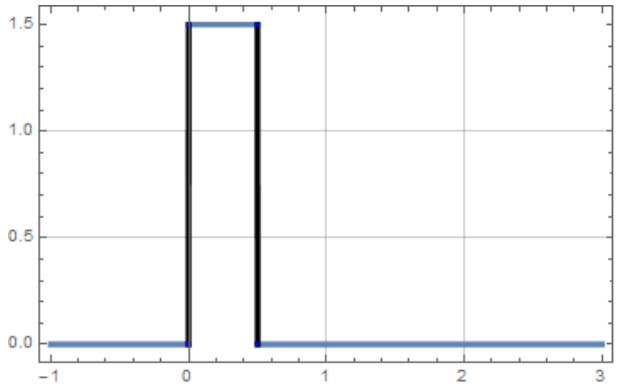


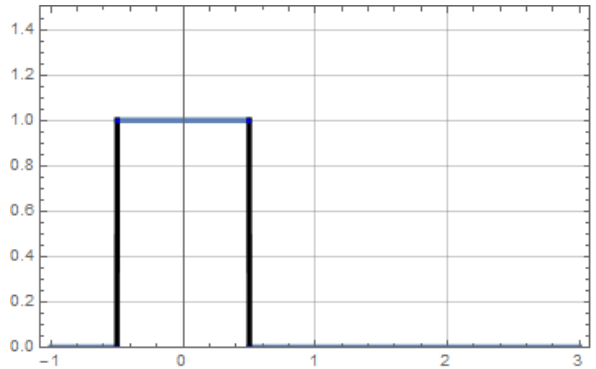

u(t-τ)=u(-0.25-τ)



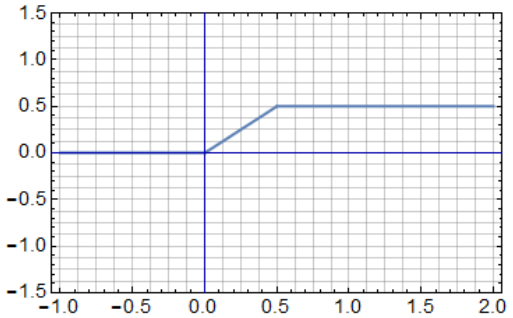


Convolve

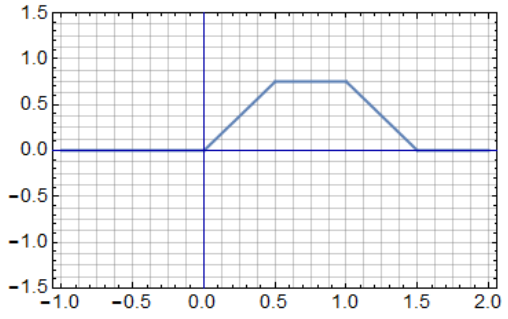




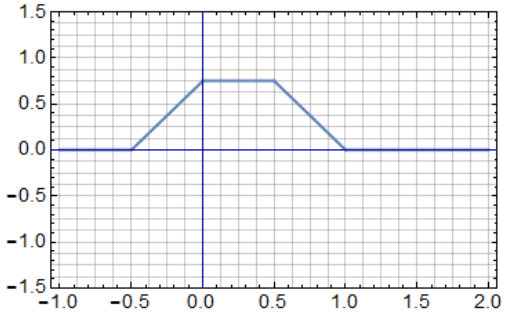
A.



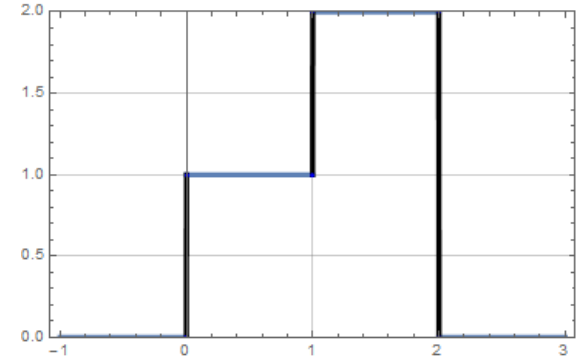
B.



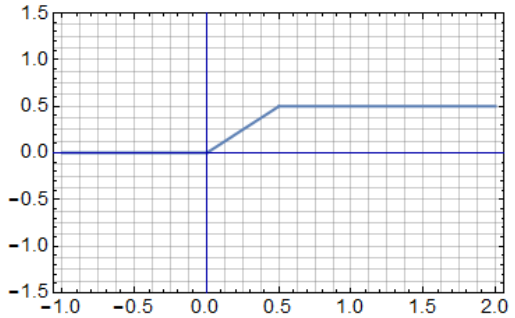
C.



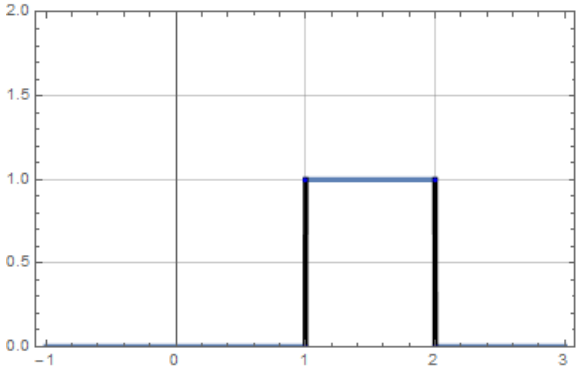
Convolve



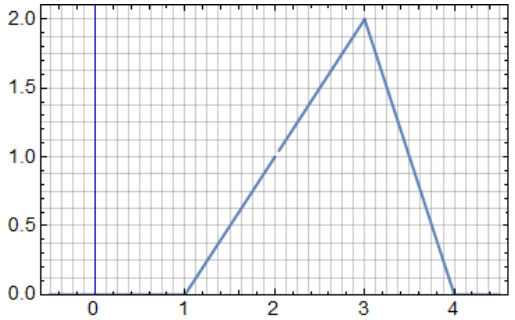
A.

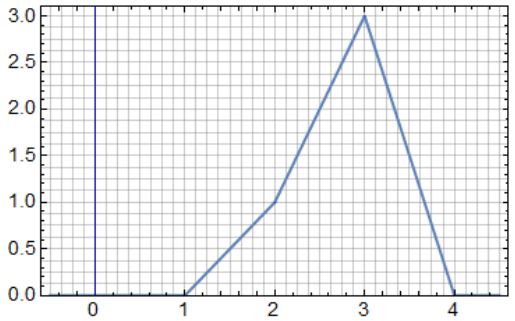


B.

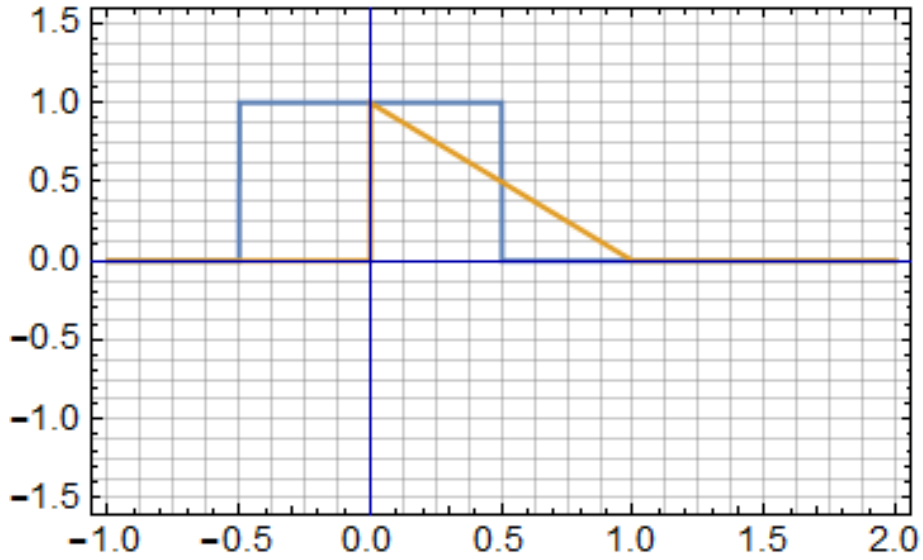


C.



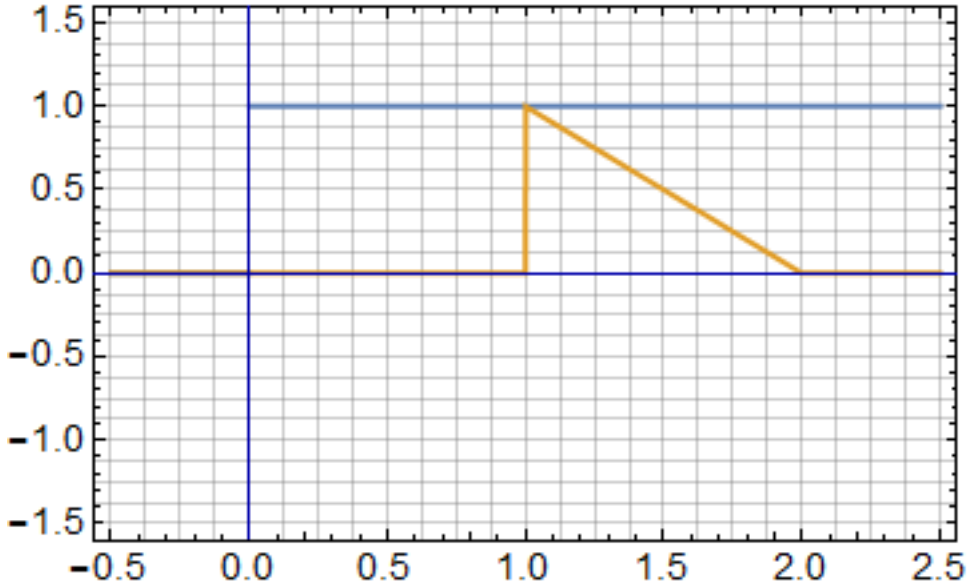


What is the extent in the time domain of the convolution?



A. 0.5
B. 1
C. 1.5
D. 2
E. 2.5
F. 3

f(t) is the convolution of the functions shown. What is the value of f(3)?



A. 0.5
B. 1
C. 1.5
D. 2
E. 2.5
F. 3