
Which of the following is the definition of the Laplace transform on the function $\sin(t)$?

- A. $\int_0^{\infty} e^{-st} e^{7t} dt$
- B. $\int_0^{\infty} e^{-st} \sin(s) dt$
- C. $\int_0^{\infty} e^{-st} \sin(t) dt$
- D. $\int_0^{\infty} e^{-st} \cos(t) dt$

The expression $\lim_{a \rightarrow \infty} \int_0^a e^{-st} f(t) dt$ is a function of which variable?

- A. k
- B. t
- C. a
- D. s

We have $\mathcal{L}(\cos(8t))$ equals which of the following?

- A. $\frac{1}{s-8}$
- B. $\frac{8}{64+s}$
- C. $\frac{s}{8+s}$

- D. $\frac{s}{64+s^2}$

The expression $\mathcal{L}^{-1}\{F(s)\}$ is a function of which variable?

- A. a
- B. t
- C. k
- D. s

5. (1 point)

Use the theorem for the inverse Laplace transform to compute the inverse Laplace operator $\mathcal{L}^{-1}\left\{\frac{1}{s^2}\right\}$.

(Note: your answer should be a function of t .)

$$\mathcal{L}^{-1}\left\{\frac{1}{s^2}\right\} = \underline{\hspace{2cm}}$$

Recall that $\mathcal{L}\{e^{8t}\} = \frac{1}{s-8}$ and $\mathcal{L}\{t\} = \frac{1}{s^2}$. Using this and linearity, we find $\mathcal{L}\{7e^{8t} + 4t\}$ is which of the following?

- A. $\frac{8}{s-7} + \frac{4}{s^2}$
- B. $\frac{7}{s-8} + \frac{4}{s^2}$
- C. $\frac{7}{s-4} + \frac{8}{s^2}$
- D. $\frac{4}{s-8} + \frac{7}{s^2}$

Recall that $\mathcal{L}^{-1}\left\{\frac{1}{s^2}\right\} = t$ and $\mathcal{L}^{-1}\left\{\frac{1}{s-3}\right\} = e^{3t}$. Using this and linearity, we find $\mathcal{L}^{-1}\left\{\frac{7}{s^2} + \frac{6}{s-3}\right\}$ is which of the following?

- A. $3t + 6e^{7t}$
- B. $6t + 3e^{7t}$
- C. $6t + 7e^{3t}$
- D. $7t + 6e^{3t}$

8. (1 point) Select all of the Laplace transforms of derivatives that are CORRECT.

- A. $\mathcal{L}\{f^{(4)}(t)\} = s^4F(s) - s^3F(s) - s^2F(s) - sF(s) - f(0)$
- B. $\mathcal{L}\{f'(t)\} = sF(s) - f(0)$
- C. $\mathcal{L}\{f^{(3)}(t)\} = s^3F(s) - s^2f(0) - sf'(0) - f''(0)$
- D. $\mathcal{L}\{f''(t)\} = s^2F(s) - sf(0) - f'(0)$
- E. $\mathcal{L}\{f^{(6)}(t)\} = s^6f(0) - s^5f'(0) - s^4f''(0) - s^3f'''(0) - s^2f^{(4)}(0) - sf^{(5)}(0) - f^{(6)}(0)$
- F. $\mathcal{L}\{f'(t)\} = f'(0) - sF(s)$
- G. $\mathcal{L}\{f''(t)\} = f''(0) - sf'(0) - s^2F(s)$
- H. $\mathcal{L}\{f^{(5)}(t)\} = s^5F(s) - s^4f(0) - s^3f'(0) - s^2f''(0) - sf'''(0) - f^{(4)}(0)$
- I. None of the above

9. (1 point)

Which of the following is the correct form of the partial fraction decomposition of $\frac{2x}{(x+3)(3x+1)}$?

- A. $\frac{A}{x+3} + \frac{B}{3x+1}$
- B. $\frac{Ax+B}{x+3} + \frac{C}{3x+1}$
- C. $\frac{Ax+B}{x+3} + \frac{Cx+D}{3x+1}$
- D. $\frac{A}{x+3} + \frac{Bx+C}{3x+1}$

10. (1 point)

Consider the rational function

$$F(s) = \frac{s^3 - 3}{(s^2 + 6)^2(s + 10)^2}.$$

Select ALL terms below that occur in the general form of the complete partial fraction decomposition of $F(s)$. The capital letters A, B, C, . . . , L denote constants.

- A. $\frac{Hs+I}{s+10}$
- B. $\frac{Ks+L}{(s+10)^2}$
- C. $\frac{A}{s^2+6}$
- D. $\frac{G}{s+10}$
- E. $\frac{J}{(s+10)^2}$
- F. $\frac{Bs+C}{s^2+6}$
- G. $\frac{D}{(s^2+6)^2}$
- H. $\frac{Es+F}{(s^2+6)^2}$

11. (1 point) Find the constants needed in the partial fraction decomposition of the following rational function.

$$\frac{-(5x^2 + 2x + 51)}{(x+3)(x^2+9)} = \frac{A}{x+3} + \frac{Bx+C}{x^2+9}$$

$$A = \underline{\hspace{1cm}} \quad B = \underline{\hspace{1cm}} \quad C = \underline{\hspace{1cm}}$$

12. (1 point) Transform the differential equation

$$4y'' + 2y' - y = t^5$$

$$y(0) = -1$$

$$y'(0) = 5$$

into an algebraic equation by taking the Laplace transform of each side. (Be sure to plug in the initial conditions. Also, denote $Y(s)$ by just Y .)

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

Therefore,

$$Y(s) = \underline{\hspace{2cm}}$$

13. (1 point)

Consider the initial value problem

$$y' + 2y = 16t, \quad y(0) = 7.$$

- (1) Take the Laplace transform of both sides of the given differential equation to create the corresponding algebraic equation. Denote the Laplace transform of $y(t)$ by $Y(s)$. Do not move any terms from one side of the equation to the other (until you get to part (b) below).

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}} \quad \text{help}$$

(formulas)

- (2) Solve your equation for $Y(s)$.

$$Y(s) = \mathcal{L}\{y(t)\} = \underline{\hspace{2cm}}$$

- (3) Take the inverse Laplace transform of both sides of the previous equation to solve for $y(t)$.

$$y(t) = \underline{\hspace{2cm}}$$

Which of the following is $\mathcal{L}\{e^{7t} \sin(3t)\}$?

- A. $\frac{3}{s^2 - 40}$
- B. $\frac{s}{s^2 - 14s + 40}$
- C. $\frac{3}{s^2 - 14s + 40}$
- D. $\frac{7}{s^2 - 14s + 40}$

Which of the following is $\mathcal{L}^{-1}\left\{\frac{s}{s^2 - 18s + 65}\right\}$?

- A. $e^{9t} \sin(4t)$
- B. e^{9t-4t}
- C. $e^{4t} \cos(9t)$
- D. $e^{9t} \cos(4t)$