

1. Find the Laplace transform of $f(t) = t^3 e^{-4t}$.
2. Find the Laplace transform of $f(t) = 6e^t \sin(3t) + 3e^{-4t} \cos(4t)$.
3. Find the Laplace transform of $f(t) = \begin{cases} 0, & t < 2 \\ (t-2)^4, & t \geq 2 \end{cases}$.
4. Find the Laplace transform of $f(t) = \begin{cases} 0, & t < 3 \\ t^2 - 6t + 11, & t \geq 3 \end{cases}$.
5. Find the Laplace transform of $f(t) = -5\mathcal{U}(t-4) - 4\mathcal{U}(t-7) - 3\mathcal{U}(t-9)$.
6. Find the Laplace transform of $f(t) = \begin{cases} 0, & t < 2 \\ 4 \sin(\pi t), & 2 \leq t < 3 \\ 0, & t \geq 3 \end{cases}$.
7. Find the Laplace transform of $f(t) = e^{t-4} \mathcal{U}(t-4)$.
8. Find the Laplace transform of $f(t) = t \mathcal{U}(t-5)$.
9. Find the inverse Laplace transform of $F(s) = \frac{e^{-6s}}{s^2 + 1}$.
10. Find the inverse Laplace transform of $F(s) = \frac{5s - 2}{(s+2)^2 + 1}$.
11. Find the inverse Laplace transform of $F(s) = \frac{2s - 9}{s^2 - 6s + 10}$.
12. Find the inverse Laplace transform of $F(s) = \frac{e^{-3s}(6 - 5s)}{s^2 + 1}$.
13. Use the Laplace transform to solve the following initial value problem: $y' - y = \begin{cases} 1, & 0 \leq t < 1 \\ 0, & 1 \leq t \end{cases}$,
 $y(0) = -3$.
14. Use the Laplace transform to solve the following initial value problem: $y' + 3y = \begin{cases} 0, & 0 \leq t < 2 \\ 9, & 2 \leq t < 5 \\ 0, & 5 \leq t < \infty \end{cases}$, $y(0) = 9$.