Instructions: Write your solutions to the following problems and submit them on Crowdmark by the deadline. You are encouraged to work in groups or consult with each other on the problems, but the work submitted must be your own and must be written up by you.

(1) Solve the equation
\[ x'' + 2x' + 26x = \begin{cases} t & 0 \leq t \leq \pi \\ 0 & t > \pi \end{cases} \]
with initial conditions \( x(0) = 0, x'(0) = 0 \).

(2) Using Duhamel’s principle, write an integral formula for the solution of
\[ x'' + 4x' + 8x = f(t); \quad x(0) = x'(0) = 0. \]

(3) Solve the equation
\[ x'' + 2x' + x = \delta(t) - \delta(t - 3) \]
with initial conditions \( x(0) = x'(0) = 2 \).

(4) A mass \( m = 1 \) is attached to a spring with constant \( k = 1 \). A hammer strikes it and delivers a unit impulse at time \( t = 0, 2\pi, 4\pi, 6\pi, \ldots \) so that the position \( x \) satisfies
\[ x'' + x = \sum_{n=0}^{\infty} \delta(t - 2n\pi); \quad x(0) = x'(0) = 0. \]

Find the solution \( x(t) \) and compute \( \lim_{t \to \infty} |x(t)| \). Briefly explain what this limit means physically.