1. A body with mass 1kg is attached to the end of a spring that is stretched 2m by a force of 8N. At time \( t = 0 \), the body is pulled 1m to the right, stretching the spring, and set in motion with an initial velocity of 5m/s to the left.
   (a) Build a model for the motion.
   (b) Find the displacement \( x(t) \) in the form \( C \cos(\omega_0 t + \alpha) \).
   (c) Find the amplitude and period of the motion of the body.

2. Consider the following reaction sequences with cooperative phenomena:

\[
S + E \xrightleftharpoons[\kappa_1]{\kappa_4} C_1 \xrightarrow{k_2} E + P, \quad S + C_1 \xrightleftharpoons[\kappa_3]{\kappa_4} C_2 \xrightarrow{k_4} P + C_1
\]

(i) Derive the relevant rate equations.
(ii) Simplify the ODE system and derive an ODE system for the concentrations of \( S, C_1, C_2 \) and \( P \).
(iii) Nondimensionalize the system in (ii) under the initial data

\[
\begin{align*}
    s(0) &= [S](0) = s_0, & e(0) &= [E](0) = e_0, \\
    c_1(0) &= [C_1](0) = 0, & c_2(0) &= [C_2](0) = 0, & p(0) &= [P](0) = 0.
\end{align*}
\]
(iv) Find the ODE system governing the pseudo-steady results by making suitable assumptions, e.g. \( E \) is in pseudo-steady state.