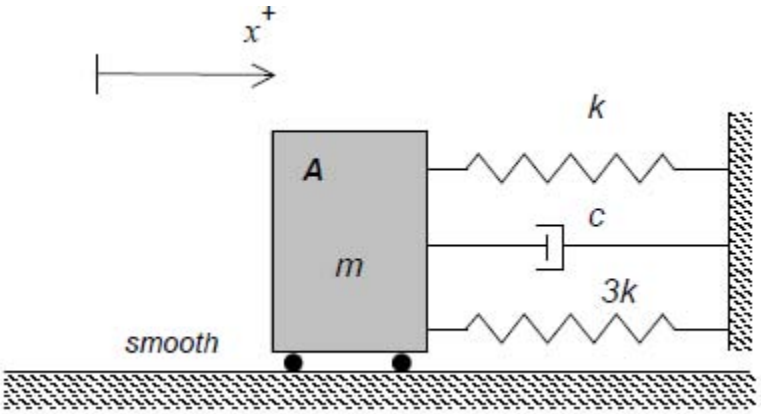
Homework H.6.E

Given: Block A, having a mass of m is able to slide along a smooth horizontal surface. Two springs, having stiffness of k and $3k$, are connected between block A and ground. A dashpot with damping constant c is also connected between A and ground, as shown in the figure below. Let x represent the motion of block A measured positively to the right. When $x = 0$ m, the springs are unstretched.

Find: For this problem:
(a) Draw a free body diagram of block A;
(b) Derive the single equation of motion for the system in terms of the coordinate x, its derivatives, and, at most, the parameters m, c, and k;
(c) Determine the numerical values for: the undamped natural frequency ω_n, the damping ratio ζ, and the damped natural frequency ω_d; and
(d) Determine the response of the system $x(t)$ for $t > 0$, assuming the system is released with $\dot{x}(0) = v_0$ when the springs are unstretched.



Use the following parameters in your analysis: $m = 24$ kg, $k = 600$ N/m, $c = 10$ Ns/m, and $v_0 = 4$ m/s.