

1. (6 points) A mass of  $m$  kilograms is attached to a spring with constant 10 newtons per meter and with no damping. Suppose the mass is at rest until it is kicked at time  $t = 0$  to a starting velocity of 5 meters per second. How small does  $m$  have to be so that the mass does not go further than 2 meters from the rest position? Defend your answer completely.

2. (7 points) Find a particular solution for  $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 3y = 26e^{2x} \sin(x)$ .

3. (6 points) Find the charge  $q(t)$  on the capacitor at any time  $t$  for the LRC circuit with  $L = 1$  henry,  $R = 6$  ohms, and  $C = \frac{1}{9}$  farad,  $E(t) = 18$  volts,  $q(0) = 1$  Coulomb, and  $i(0) = 5$  Amperes.

4. (6 points) Find a particular solution for  $4y'' - 4y' + y = \sqrt{te^t}$ . Hint: put the equation in standard form before finding  $v_1'$  and  $v_2'$ !