

Name: _____ Section: _____

You must show all your work to receive credit. Calculators are allowed.

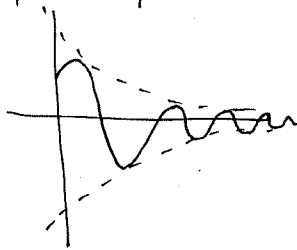
Problem 1: (3 points) A (horizontal) spring with a spring constant $k = 7$ N/m and a damping constant $c = 3$ kg/sec is attached to a mass of m kg and put into motion. The equation of motion is

$$mx'' + cx' + kx = 0.$$

Suppose the motion is such that there are infinitely many times t such that $x(t) = 0$.

What can be said about the mass m ?

displacement hits 0 infinitely many times \Rightarrow oscillates back and forth \Rightarrow underdamped



this happens when there are sin's and/or cos's in solution, so the char. eqn. has complex conjugate roots

char. eqn. is $mr^2 + cr + k = 0$

roots are
$$r = \frac{-c \pm \sqrt{c^2 - 4km}}{2m}$$

So
$$c^2 - 4km < 0$$

$c = 3, k = 7$, so
$$9 - 28m < 0$$

Thus

$$m > \frac{9}{28} \text{ kg}$$