Name:

Math 216 Quiz 3

November 24, 2015

Directions: WRITE YOUR NAME ON THIS QUIZ! Except where indicated, merely finding the answer to a problem is not enough to receive full credit; you must show how you arrived at that answer. If you convert irrational numbers to decimal approximations, round to at least four decimal points.

1) A 5 kg mass is attached to a spring. The mass is released from rest 1 meter below equilibrium. There are no external damping forces acting on the system and the spring constant is $k = 4$. After $\pi/2$ seconds, the mass is struck by a hammer with a force of 3 N. Find a formula for the position $y(t)$ of the mass by

a) (7 points) writing down a formal initial value problem describing this physical scenario,

b) (8 points) taking the Laplace transform of both sides of the equation you found in a),

c) (10 points) solving for the position $y(t)$ by taking the inverse Laplace transform of the equation you found in b).

LaPlace Transforms and Properties

1. $\mathcal{L}(e^{at})(s) = \dfrac{1}{s-a},\ s > a$
2. $\mathcal{L}(t^n)(s) = \dfrac{n!}{s^{n+1}},\ s > 0$
3. $\mathcal{L}(\cos(at))(s) = \dfrac{s}{s^2+a^2},\ s > 0$
4. $\mathcal{L}(\sin(at))(s) = \dfrac{a}{s^2+a^2},\ s > 0$
5. $\mathcal{L}(\delta(t-a))(s) = e^{-as},\ s > 0$ where δ is the Dirac delta "function".
6. $\mathcal{L}(u(t-a)f(t-a))(s) = e^{-as}\mathcal{L}(f)(s)$ where u is the Heaviside function.
7. $\mathcal{L}(e^{at}f(t))(s) = \mathcal{L}(f)(s-a)$