Hwmk 1

Math 528 Summer Session 1

Due 5/21 (Friday at 11:59 pm)

1 French Gallagher

If dropping a watermelon off the Eiffel Tower, air resistance can be neglected for a modeling approximation. The equation to model the descent of the watermelon is a simplified equation:

$$m\frac{d^2H(t)}{dt^2} = -mg$$

where g is gravity (9.8 meters per second), t is time and H is the height of the watermelon. Assume that you drop the watermelon (with no initial velocity) from the top of the 984 meter Eiffel tower. Recall that $H(t)$ is position, its derivative is velocity, and its second derivative is acceleration.

(a) [4 points] What speed will the watermelon have in the instant before impact with the ground?

(b) [1 point] Why does it make sense that mass is not a part of the model solution?

(c) [1 point] Is this ODE linear?

(d) [1 point] Is the full ODE model below (with air Resistance) linear?

$$m\frac{d^2H(t)}{dt^2} = mg - b\frac{dH(t)}{dt}^2$$

(e) [2 points] What is the percent increase in impact speed if the height is doubled?

(f) [1 point] If kinetic energy is $\frac{1}{2}mv^2$, by what percent did the kinetic energy upon impact increase from the solutions to part (a) and part (f) ?