

## Math 207 Quiz #5 Answers

1. Let  $T(t)$  = Internal temperature (in °C) of the potato  $t$  minutes after placing it in the oven

Using Newton's Law of Cooling, we have that  $\frac{dT}{dt} = k[200 - T]$ , whose general solution is  $T(t) = 200 + Ce^{-kt}$ .

Using the given conditions,  $T(0) = 20$  and  $T(20) = 60$ , we have the solution  $T(t) = 200 - 180e^{-kt}$  with  $k = -\frac{1}{20} \ln\left(\frac{7}{9}\right) \approx 0.01257$ .

Solving  $T(t) = 99 \Rightarrow \boxed{t \approx 45.9851 \text{ minutes}}$

2. (a) The distance the mass has fallen is given by  $x(t) = \frac{9.81}{20}t - \frac{1}{20}\left(0 - \frac{9.81}{20}\right)e^{-20t} + \frac{1}{20}\left(0 - \frac{9.81}{20}\right)$   
 $\Rightarrow x(t) = 0.4905t + 0.024525e^{-20t} - 0.024525$

Ignoring the exponential term (since it is relatively insignificant compared to the other terms when  $t$  is large), we need to solve  $160 = 0.4905t - 0.024545 \Rightarrow t = 326.2478$  seconds

So, it will take approximately  $\boxed{326.2478 \text{ seconds.}}$

- (b) The limiting velocity is  $\frac{mg}{b} = \frac{9.81}{20} = \boxed{0.4905 \text{ meters/sec.}}$