

# Math 1B: Quiz 6

GSI: Theo Johnson-Freyd

Name: \_\_\_\_\_

Monday, 20 July 2009

You must always justify your answers. This means: show your work, show it neatly, and when in doubt, use words (and pictures!) to explain your reasoning. No justification = no points.

1. (10 pts) A certain population has no carrying capacity, and has a relative growth rate  $k$ . Humans harvest the population at a rate of  $\ell(1 + \cos(2\pi t/\text{yr}))$ , where  $\ell$  is a constant and  $t$  is the time, measured in years. Let  $P(t)$  be the population at time  $t$ .
  - (a) Write a differential equation for  $P(t)$  modeling the above description. Hint: you should get a linear differential equation.
  - (b) Find the general solution to your differential equation.
2. (bonus) Is there necessarily a sustainable solution, in which the population never goes to 0 nor to  $\infty$ ? Discuss the limitations of the model above. For example, is it reasonable to say that a population “has no carrying capacity”? Conversely, can humans harvest a fixed amount in all circumstances?