## MATHEMATICS: ASSIGNMENT 10

Instructions: Submit using the assignment box in IBLC 361. Indicate subject (mathematics), assignment number, name and student ID\# at the top of the front page. Multiple pages should be stapled; no folded-corner tricks, no paper clips.
Due: Before 8:30 am, Thursday, Mar 25.

1. A sink can hold a maximum of 20 liters before it overflows. Suppose the sink is initially empty. The inflow rate from the tap is given by $T(t)=A\left(1+e^{-3 t}\right)$ and the outflow through the drain is $D(t)=A\left(1-e^{-4 t}\right) . T(t)$ and $D(t)$ are both measured in liters per minute and $t$ is measured in minutes.
(a) How many liters of water are in the sink at time $t$ ?
(b) What is the maximum value of $A$ for which the sink does not eventually overflow?
2. Suppose a bagel contains 1.5 calories per $\mathrm{cm}^{3}$. If slicing through the middle of the bagel (giving two U shaped pieces) reveals two circles of dough each of radius 1.5 cm and whose centers are 6 cm apart, how many calories are there in the bagel?

3. A cone-shaped coffee filter with a height of 10 cm and an opening radius of 10 cm is used to make coffee. While in use, the filter is full of water and the density of coffee grounds is given by $\rho(y)=-\frac{1}{10} y$ where $y=0$ corresponds to the top of the filter. $y$ is measured in cm and $\rho$ is measured in grams $/ \mathrm{cm}^{3}$.

(a) Use the method of disks to find the volume of water in the filter.
(b) Calculate the total mass of coffee grounds in the filter.
4. The goal of this problem is to estimate the moment of inertia of a skater with arms down and with arms outstretched. Assume the body consists of 6 parts (2 legs, 2 arms, torso and head). For each of these parts, choose a shape that is both anatomically reasonable and also simple enough that its contribution to the moment of inertia can be calculated by hand (e.g. a cylinder for the head, wedge shaped legs). For the density, treat the body as consisting entirely of water.
