

MATH 1080 — FIRST MIDTERM EXAM

September 24, 2014

NAME: _____

1. Do not open this exam until you are told to begin.
2. This exam has 7 pages including this cover. There are 5 problems.
3. Write your name on the top of EVERY sheet of the exam at the START of the exam!
4. Do not separate the pages of the exam.
5. Please read the instructions for each individual exercise carefully. One of the skills being tested on this exam is your ability to interpret questions, so I will not answer questions about exam problems during the exam.
6. Show an appropriate amount of work for each exercise so that I can see not only the answer but also how you obtained it. If you use slicing to calculate a value, you MUST draw and label a typical slice as well as give the Riemann sum used to obtain an integral.
7. You may use a non-graphing calculator. You are NOT allowed to use it to do anything significant such as integrating, taking derivatives, etc.
8. Turn **off** all cell phones.

PROBLEM	POINTS	SCORE
1	20	
2	20	
3	20	
4	20	
5	20	
TOTAL	100	

If you recognize the theme of the exam, impress me: _____

Name: _____

1. (20 points) Howard and Raj decide to cruise a bar near Caltech in order to meet women. They wait five minutes after they arrive to approach the first lucky lady. Assume they get turned down at a rate of $f(t) = \frac{1}{10} \left(5 + \frac{\cos(\sqrt{t})}{\sqrt{t}} \right)$ women/minute once they begin approaching women. How many women will they have been turned down by after the first hour of being in the bar?

Name: _____

2. (20 points) After throwing away the French toast that Penny foolishly tried to serve him on oatmeal day (though the french toast did smell good), Sheldon has been staring at his bowl of oatmeal so long that the heavier parts of the oatmeal have sunk to the bottom of the bowl. The density of the oatmeal, measured in grams per cubic inch, is given by the function $\rho(y) = 3 \left(1 + \frac{20}{3 + (y^2)^2} \right)$ where y is measured from the bottom of the bowl. The bowl has a height of 2 inches and is given by rotating the function $y = \frac{x^2}{8}$ around the y -axis. What is the mass of the oatmeal in the bowl? (Hint: At some point you might consider why I wrote $(y^2)^2$ instead of just y^4 .)

Name: _____

3. (10 points each) **(a)** As Leonard reads the roommate agreement his desire to strangle Sheldon grows. He has no desire to strangle Sheldon for the first two pages, but after 2 pages the function $f(p) = \frac{4.5}{(p+1)(p-1)^2}$ gives the percentage of Leonard that wants to strangle Sheldon per page read. After 10 pages of the roommate agreement what percentage of Leonard wants to strangle Sheldon?

Name: _____

(b) Concurrently, Sheldon is watching Leonard read the roommate agreement with anticipation of him signing it. The percentage of Sheldon filled with anticipation after Leonard has read p pages is given by

$\int_0^{p^2} \frac{2 + \cos(x)}{10} dx$. At what rate is the percentage of Sheldon filled with anticipation changing per page after 10 pages?

Name: _____

4. (20 points) Leonard is a bit sad that his physics students could not remember that work depends only on total displacement, so in calculating the work to remove a liquid from a container they incorrectly thought it mattered if the liquid was removed from the top or the bottom. When Leonard arrives home Sheldon offers him a warm beverage, as is the social protocol, to console him. The warm beverage is in a cup given by rotating the line $x = 2$ around the y -axis. The cup is 5 cm tall and 2 cm in radius. The density of liquid in the cup is given by $\rho(y) = y \tan^{-1}(y)$ where y is measured from the top of the cup and the density is measured in grams per cubic cm. Assuming the beverage is consumed using a straw that sticks 3 cm out of the top of the cup and the cup is completely full when presented to Leonard, how much work does Leonard do in consuming his beverage? (You may just write g for the gravitational constant in terms of grams and cm; you do not have to do any conversions.)

Name: _____

5. (20 points) Penny feels that Leonard is too smart for her and she needs to try and understand some of his work better. She tells Sheldon she has heard of this concept called “the definite integral of a function.” Pretend you are Sheldon and explain what an integral is to Penny by using sentences, pictures, examples, and anything else you think will help her. Be optimistic and assume she understands college algebra level material well.