Show all work in your solutions; turn in your solutions on the sheets provided. **No calculators allowed.** (Suggestion: Do preliminary work on scratch paper that you don’t turn in; write up final solutions neatly and in order; write your name on all pages turned in.)

1. Evaluate the integrals:

   \[(a) \int_0^1 \frac{x^3 - x^2}{x^2 - 3x + 2} \, dx \quad (b) \int_0^{\pi/6} \sin(3x) \sin(5x) \, dx\]

2. Find the integer part of \[\sum_{n=1}^{40000} \frac{1}{\sqrt{n}}.\] (That is, if the sum is evaluated numerically, what are the digits to the left of the decimal point?)

3. For \(t > 0\) let \(F(t) = \frac{1}{t} \int_0^{\frac{\pi t}{2}} |\cos(2x)| \, dx.\) Compute \(\lim_{t \to 0} F(t).\)

4. Find all the critical points of the function \(f(x, y) = x^2 + y^2(1 - x)^3,\) and classify them as local minima, absolute (global) maxima, saddle points, etc.

5. Points \(P\) and \(Q\) move together around the parabola \(y = x^2\) in such a way that the area cut off from the parabola by the line segment \(PQ\) always has area \(\frac{4}{3}\). Let \(M\) be the midpoint of \(PQ\). What curve does \(M\) trace out as \(P\) and \(Q\) vary around the parabola?

Answers will soon be posted to [http://www.math.utexas.edu/users/rusin/Bennett/](http://www.math.utexas.edu/users/rusin/Bennett/).