1. (50 points) Evaluate the following integrals. Show your work.

   (a) $\displaystyle\int \frac{x+x^3}{1+x^4}\,dx$ Hint: $x^4 = (x^2)^2$

   (b) $\displaystyle\int \frac{1}{(x^2-4)(x-2)}\,dx$

(c) $\int x \ln x \, dx$

(d) $\int \cos^3 x \, \sin^2 x \, dx$

(e) $\displaystyle\int \frac{1}{(1+x^2)^{3/2}}\,dx$

2. (14 points) Let R be the homogeneous lamina (with density 1) bounded by the graph of $y = x(x-2)$ and the graph of $y = 2x$. Compute the value of $\bar{x}$ for this lamina. Draw a sketch of the region. Show all of your work.

3. (12 points) Write out the form of the partial fraction decomposition of the following rational function. **Do not** determine the values of the coefficients.

$$\frac{3x^3 + 2x^2 + x}{x^2(x^2 + 2x + 1)(x^2 + x + 1)}$$

4. (12 points) For each limit, show which kind of indeterminant form it has, and then evaluate the limit. Show all of your work. (Hint: Use L'Hopital's rule twice.)

$$\lim_{x \to 0} \frac{x \sin x}{1 - \cos x}$$

5. (12 points) Use the reduction formulas on the formula sheet to find the following antiderivative. Show all of your steps.

$$\int x^3 \sin x \, dx$$