1. Calculate four of the following integrals:

\[
\int x \cos x^2 \, dx; \quad \int x^2 \cos x \, dx; \quad \int x^2 \cos x \, dx; \quad \int x^2 \cos^2 x \, dx; \quad \int x \cos^2 x \, dx.
\]

**Comment** Most people use *many* parentheses and rewrite the integrands to decrease possible confusion. So \(x^2 \cos x\) becomes \(x^2 (\cos x)\) and \(x^2 \cos^2 x\) becomes \(x^2 \cos(x^2)\).

2. a) Suppose that \(m\) and \(n\) are integers. Compute \(\int_0^{2\pi} (\cos(mx))(\cos(nx)) \, dx\). (Be careful: there will be two different results, one when \(m = n\) and one when \(m \neq n\).)

b) Suppose \(f(x) = A \cos(x) + B \cos(2x) + C \cos(3x),\) and that you also know

\[
\int_0^{2\pi} f(x) \cos(x) \, dx = 5; \quad \int_0^{2\pi} f(x) \cos(2x) \, dx = 6; \quad \int_0^{2\pi} f(x) \cos(3x) \, dx = 7.
\]

Find \(A\) and \(B\) and \(C\).

**Note** The ideas of this computation are used often with Fourier series, a standard method of analyzing periodic phenomena.

3. a) Find \(\int \frac{e^{2x}}{\sqrt{e^{2x} + 1}} \, dx\).

b) Find \(\int \frac{e^{x}}{\sqrt{e^{2x} + 1}} \, dx\).

**Comment** These antiderivatives may appear similar, but different methods are needed.

4. Compute these two definite integrals exactly:

a) \(\int_0^{1/3} 4x \sqrt{1 - 3x} \, dx\)

b) \(\int_\pi^{2\pi} x \arcsin \left( \frac{x}{\sqrt{x}} \right) \, dx\)

One problem will be selected for a writeup to be handed in at the next recitation meeting. Please see Professor Greenfield’s Math 152 webpage to learn which problem to hand in.