

Solving the following problems will show that you are in fine shape for the midterm. For the midterm you may bring in a single $8\frac{1}{2} \times 11$ sheet of paper with anything you wish hand written on it (both sides even.) I do not care if you copy your friend's cheat sheet, but you may not photocopy it.

1. Show that the derivative of an even function is an odd function.
2. Derive the differentiation formula for $y = \operatorname{arctanh} x$.
3. Define functions F, G by

$$F(n) = \int_0^\pi x^n \sin x \, dx \quad G(n) = \int_0^\infty x^n e^{-x} \, dx$$

Compute $F(4)$ and $G(5)$.

4. Find the following integrals

$$\int \sec^3 x \, dx \quad \int \sqrt{x^2 - 2} \, dx \quad \int e^x (\sin x + \cos x) \, dx$$

$$\int_0^1 \frac{\sqrt{x}}{1+x} \, dx \quad \int \frac{1}{x+x^3} \, dx \quad \int \frac{3}{1+x+x^2} \, dx$$

5. Decide whether the following integrals converge or diverge.

$$\int_0^\infty \frac{1}{\sqrt{3+x^2}} \, dx \quad \int_0^\infty \frac{x^2}{1+2x^4} \, dx$$

6. For what values of p does the integral

$$\int_0^\infty \frac{x^p}{1+x+x^2} \, dx$$

converge?

7. A solid with circular base of radius a has all sections of the solid perpendicular to a particular diameter of the base equilateral triangles. Sketch the solid and find its volume.
8. Let C be that piece of the parabola $y = x^2$, with $0 \leq x \leq 1$. What is the arclength of C ?
9. An equilateral triangle of side length a is rotated about an edge. What is the surface area of the resulting solid of revolution?