1. State The Fundamental Theorem of Calculus (both parts).

2. Suppose that $f(x)$ has the following definition:

$$f(x) = \int_0^x (1 + \sin^2 t)^{1/2} dt$$

   (a) What is $f'(x)$?

   (b) Express $g(x) = \int_2^{\cos x} (1 + \sin^2 t)^{1/2} dt$ in terms of f . Then find $g'(x)$.

3. We are given a differentiable, odd function $f(x)$ defined on $[-3, 3]$ which has zeros at $x = -2, 0,$ and 2 (nowhere else) and critical points at $x = -1$ and $x = 1$ (nowhere else). Also, we know that $f(-1) = 1$. Define a new function F on $[-3, 3]$ by the formula

$$F(x) = \int_{-2}^x f(t)\, dt$$

   (a) Sketch a rough graph of $f(x)$.

   (b) Find the value of $F(-2)$, $F(2)$, and an upper and lower bound on $F(0)$.

   (c) Find the critical points and inflection points of $F(x)$ on $[-3, 3]$.

   (d) Sketch a rough graph of $F(x)$ on $[-3, 3]$.

   (e) Interpret the points found in (c) in terms of the graphs of $f(x)$ and $F(x)$.

4. In each of the following sketch a graph(s) with the properties:

   (a) $f(x)$ is not constant 0 and $\int_{-a}^a f(x)\, dx = 0$.

   (b) $f(x) < 0$ for $x \in (-2, -1)$ and $\int_{-3}^0 f(x)\, dx > 0$.

   (c) $f(x),\ g(x) < 0\ \forall\ x$ and $\int_1^2 (f(x) - g(x))\, dx > 0$.

   (d) $\int_0^{2\pi} f(x)\, dx = 0,\ \int_0^{2\pi} |f(x)|\, dx = 2 \int_0^{\pi} f(x)\, dx$.