6. **(10 points)** Please write down the Fundamental Theorem of Calculus.

7. **(20 points)** Suppose that g is differentiable with $g'(x) < 0$ for all $x < 1$, $g'(1) = 0$, and $g'(x) > 0$ for all $x > 1$. And Suppose that $g(1) = 0$. Set

$$G(x) = \int_0^x g(t)dt.$$

Which of the following statements are true? (You need to prove your answer.)
(a) G is twice-differentiable.
(b) $x = 1$ is a critical number of G.
(c) G is an increasing function.
(d) The graph of G is concave up for all x.

8. **(10 points)** Please determine whether the integral is convergent or not.

(a)

$$\int_0^\pi x^{-1/2}dx$$

(b)

$$\int_0^\pi \frac{\sin^2 x}{x^{1/2}}dx$$

9. **(10 points)** Prove that for all $x > 0$ and all positive integers n,

$$e^x > 1 + x + \frac{x^2}{2!} + \cdots + \frac{x^n}{n!}.$$

(Hint: $e^x = 1 + \int_0^x e^t dt$.)