Math 122 (Section 3)  

Fundamental Theorem of Calculus

1. Suppose that a town had a population of 5000 people in 1970. If the population was growing at a rate of $r(t) = 16t$ people per year, where $t$ represents the number of years since 1970, then what was the population of the town in 1980? You must show sufficient work to justify your answer.

2. The marginal cost of a product, in dollars per item, is $C'(q) = q^2 - 50q + 700$. If fixed costs are $500, find the total cost to produce 50 items. You must show sufficient work to justify your answer.

3. Evaluate the following definite integrals without the use of a calculator. Then check your answer with a calculator to make sure that your answers are the same.

   (a) $\int_{1}^{2} 4x^3 \, dx$

   (b) $\int_{0}^{2} (5x + 2) \, dx$

   (c) $\int_{1}^{5} 3 \, dx$

   (d) $\int_{0}^{2} e^x \, dx$

   (e) $\int_{1}^{3} \frac{1}{x} \, dx$

   (f) $\int_{0}^{1} e^{2x} \, dx$

   (g) $\int_{0}^{2} xe^{x^2} \, dx$
4. Which one of the following most clearly states the Fundamental Theorem of Calculus?

(a) Rate of change of a quantity from \( t = a \) to \( t = b \) equals \( \int_a^b \) (total change in that quantity) \( dt \)

(b) Rate of change of a quantity from \( t = a \) to \( t = b \) equals \( \int_a^b \) (total change in that quantity) \( dt \)

(c) Total change in a quantity from \( t = a \) to \( t = b \) equals \( \int_a^b \) (rate of change of that quantity) \( dt \)

(d) Total change in a quantity from \( t = a \) to \( t = b \) equals \( \int_a^b \) (rate of change of that quantity) \( dt \)

(e) Rate of change of a quantity from \( t = a \) to \( t = b \) equals \( \int_a^b \) (rate of change of that quantity) \( dt \)

(f) Rate of change of a quantity from \( t = a \) to \( t = b \) equals \( \int_a^b \) (rate of change of that quantity) \( dt \)

(g) Total change in a quantity from \( t = a \) to \( t = b \) equals \( \int_a^b \) (total change in that quantity) \( dt \)

(h) Total change in a quantity from \( t = a \) to \( t = b \) equals \( \int_a^b \) (total change in that quantity) \( dt \)

5. Which one of the following most clearly states the Fundamental Theorem of Calculus?

(a) \( \int_a^b F'(t) \, dt = F'(b) - F'(a) \)

(b) \( \int_a^b F'(t) \, dt = F'(a) - F'(b) \)

(c) \( \int_a^b F'(t) \, dt = F(b) - F(a) \)

(d) \( \int_a^b F'(t) \, dt = F(a) - F(b) \)

(e) \( \int_a^b F(t) \, dt = F'(b) - F'(a) \)

(f) \( \int_a^b F(t) \, dt = F'(a) - F'(b) \)

(g) \( \int_a^b F(t) \, dt = F(b) - F(a) \)

(h) \( \int_a^b F(t) \, dt = F(a) - F(b) \)