AP Calculus BC
Lesson 5.3 day 2 The Fundamental Theorem of Calculus

1. Find $\frac{dy}{dx}$ for each function given:

a) $y = \int_2^x \sin t \, dt$ b) $y = \int_x^{3x} \ln t \, dt$ c) $y = \int_{x^2}^{\sin x} \frac{1}{t^2} dt$

2. Evaluate each indefinite integral:

a) $\int (x^2 + 2x) dx$ b) $\int \sin x \, dx$ c) $\int \sqrt{x+2} \, dx$

d) $\int \sin x \cos x \, dx$ e) $\int \tan^3 x \, \sec^2 x \, dx$ f) $\int \frac{1}{2x} \, dx$

3. Evaluate each definite integral:

a) $\int_0^{\pi/2} \cos x \, dx$ b) $\int_1^3 (4 - x) dx$

c) $\int_{-2}^{2} \sqrt{4 - x^2}$ d) $\int_0^a x(1 + x^2)^3 dx$

4. Solve for a if $\int_a^{2a}(5-2x)dx = 15$

5. [1996AB2] Let R be the region in the first quadrant under the graph of $y = \frac{1}{\sqrt{x}}$ for $4 \le x \le 9$.

   a) Find the area of R.
   b) If the line $x = k$ divides the region R into two regions of equal area, what is the value of k?

6. [1997AB3] Let f be the function given by $y = \sqrt{x-3}$.

   a) Sketch the graph of f and shade the region R enclosed by the graph of f, the x-axis, and the vertical line $x = 6$.
   b) Find the area of the region R described in part a).
   c) Rather than using the line $x = 6$ as in part a), consider the line $x = w$, where w can be any number greater than 3. Let A(w) be the area of the region enclosed by the graph of f, the x-axis, and the vertical line $x = w$. Write an integral expression for A(w).
   d) Let A(w) be as described in part c). Find the rate of change of A with respect to w when $w = 6$.